ECONOMIC ANALYSIS OF WATERSHED DEVELOPMENT PROGRAMME IN PALAKKAD DISTRICT

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "**Economic analysis of Watershed Development Programme in Palakkad district**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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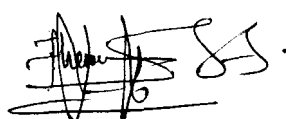

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THOMAS, T.T.

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INTRODUCTION

INTRODUCTION

Water is a prime natural resource, a basic human need and a precious natural asset. 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. The total water resource of the country is approximately four per cent of the world's fresh water resources, where as the country's population is slightly more than 16 per cent of the global population. The availability of water is very unevenly distributed over the country. The economic survey of 1999-2000 stated that only 90 per cent of urban area and 92.50 per cent of rural areas have access to drinking water.

India's food grain production of 50.8 million tonnes in the early post independent era (1950-51) has risen to the all time higher level of more than 200 million tonnes by the turn of the new millennium (Fertilizer statistics 1998-99). But this is closely followed by challenges of resource management of a magnitude never faced before. The challenges include high population, pressure on land and high eco degradation. Soil erosion has reached crisis proportion and about 50 per cent of 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 of 1000 years to produce an inch of soil. The only practical solution for its conservation and sustainable development is through watershed development, which includes the integrated use of the total water available according to the best possible co-ordinate programme taking in to consideration all the present and future likely uses of water in that water shed.

Technically watershed is a hydrological entity. It is an area of land from which the run off flows through a natural drain as gullies or streams or rivers. Therefore, area of land falling on a watershed is hydrologically interrelated in that; it has its own natural drainage system. Watershed management is an integrated

approach of conservation of land, soil, water and biomass for ultimate benefit of mankind. On the contrary, if the watershed is not managed through effective conservation measures, the land degradation starts leading to severe devastation of agricultural land. Out of the 304 million hectares of land area in India 178.6 million hectares is estimated to be problem land areas, which include, 144.44 million hectares affected by wind and water erosions. The rest of the land area is inflicted with salinity, sodicity, acidity, water logged conditions, ravines, gullies etc.

Watershed development programme aims to generate such activities which would conserve as much precipitation as possible *in situ* in soil profile or through controlled run off, collection, storage and reuse according to land capabilities. The ultimate purpose of the development of watershed is to increase the economic and social well being of the people of the basin in particular and of the nation as a whole. The development of a watershed usually starts with the need felt for power, industrial or municipal water supply, flood control or irrigation in the lower or middle reaches of a large river.

Approach to the development of a watershed would seem to be in the integrated use of the total water available according to the best possible co-ordinated programme, taking in to consideration all the present and future likely uses of water in that watershed. The development of a watershed as a whole requires knowledge of its working as it is and its resources in water and land besides the human resources.

Agricultural problem in relation to a watershed are many. The basic objective is to secure a higher level of agriculture, which would provide not merely larger and more economic return from the use of land that will utilize the moisture more efficiently, but serve as an effective agent of soil and water conservation. The preliminary requisites for effective watershed development are external peace and internal order, an accepted national policy of development of watersheds, adequate

staff of technicians and extension service men, enlightened leadership of the people and the willing participation of the people.

Social, economic and political problems arise with respect to a watershed, also the problem of the education of the people of an entire watershed on their inter dependence in the use of the two basic assets of nature viz. land and water. With increasing population, industrialization and higher consumption, the shortage of total assets in land is already obvious in many countries and the shortage of water is becoming more apparent. The challenge of our watersheds is a challenge of our fundamental problems of food and drink and evolution of satisfactory social and economic patterns of our living. To the extent this challenge is understood and met effectively, better living is secured for men, women and children not only in the present but also in the future.

Watershed management started in India in 1962-63 with the launching of government scheme "Soil conservation works in the catchments of river Valley Projects". The main purpose of the scheme was building of reservoirs with huge government funds. Thus watershed management started primarily due to the felt need of the government to maintain the life of reservoirs, which benefited down stream people. The concern for the production and productivity of the up stream catchment areas was marginal. The ownership of the scheme was with the central and state governments, which funded the scheme. The consequence is that people do not own soil conservation works. Watershed community is now being encouraged to participate in the government projects and contribute labour or cash. If watershed management has to succeed and sustain, land and water conservation should emerge from the felt need of the landholders and village community. Governments, donors and NGO'S should provide technical and financial support. Thus watershed management should become individual farmers and village community's endeavor and government, donors and NGO'S should participate in people's efforts to upgrade and consume their natural resources.

A holistic approach for integrated farming system development on watershed basis in rainfed areas has been the main pursuit of the development activities, under the National Watershed Development programme for Rainfed Areas (NWDPRA) in the eighth five year plan. If watershed management has to become a people's movement, technologies would have to be simple so that farmers and villagers can understand and internalise it. The cost incurred should be low so that resource poor farmers in rain fed areas can adopt and replicate with minimal external support and it should be based on vegetative measures, which are self-regenerative. Demonstrations and field days should be organized periodically for the transfer of technology.

In Kerala the soil and water conservation works being undertaken in the state evolved a more effective approach in the year 1990 and watershed based projects were formulated and need based technical know how was developed with emphasis on people's participation. These changes have made the farmers more energetic and enthusiastic towards the implementation of the project. The projects undertaken in the state are watershed-based soil and water conservation projects, special component projects, scheduled tribes sub project etc. The watershed based soil and water conservation projects envisage conservation of soil and water in the agricultural land benefiting the farmer to the maximum extent. The project is being implemented under the guidance and supervision of soil conservation officers.

In the eighth five-year plan a number of Watershed Development Projects have been implemented in Kerala sponsored by different agencies. Even after implementation of these programmes, problems exist in these areas and an economic evaluation of these programmes has not been under taken till now. Economic analysis of these programmes helps us to understand the efficiency, social and economic changes, extent of employment generated by the project and to assess the land use pattern and cropping pattern in the area. In the above context, an analysis of the impact of Watershed Development Programme on various aspects of agricultural sector seems to be highly relevant. Hence the present study

on the "Economic Analysis of Watershed Development Programme in Palakkad District" is undertaken with the following objectives.

1. To assess the changes in the land use pattern and cropping pattern in the area.
2. To examine the income and employment generation from agriculture and allied activities.
3. To analyse the problems and weakness of the programme as perceived by beneficiaries.
4. To study the awareness among the beneficiaries about rationality behind the watershed development programme.

Limitations of the study

The study is based on farm level data generated through sample survey. The main limitation of the study is that farmers do not maintain any basic farm records, as a result of which reliance has to be made on their memory, which might have resulted in recall bias. More over people are usually reluctant in giving correct information on costs and income. In spite of all these every effort has been made to generate as reliable information as possible. The study involves a few concepts and definitions for which working definition have been used wherever required. The comparison of expenses and income have been made between two periods viz. 1991-92 and 1997-98 (pre project and post project periods), and the prices of inputs and out puts of the latter period have been used for computation purpose to avoid the influence of price changes over this period.

Plan of work

The thesis consists of seven chapters including the present one. A review of the relevant literature is given in chapter two. A brief description of the area of study is given in chapter three. Chapter four deals with the materials and methods used in the study. The results of the study are given in chapter five, while chapter six deals with discussion. The summary of major findings of the study is given in the final chapter.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

A comprehensive review of the past studies is useful to formulate concepts methodology and tools of analysis to be used for any research. An attempt is made in this chapter to review the past studies related to watershed development and its impact on the farming community.

A study on the optimal cropping systems for Ramganga watershed of Uttar Pradesh, based on information collected by an agro-economic survey of all the farm house holds in the watershed by Singh and Rahim (1978) revealed that the returns over variable cost was increased by 89 per cent with improved farming system and availability of credit in required quantities. The soil erosion losses were also reduced. Adopting improved farming system along with appropriate package of practices and inputs substantially increased farm income and employment.

Sharma and Garg (1978) in an ex-ante appraisal of the forestry component in the Kandi watershed area of Punjab using secondary data collected from the forest department of Punjab government and the publications brought out by the world bank, concluded that 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 and the project provides employment to 4000 persons annually, besides increasing the productivity of its land resources. Thus the forestry component was found to be economically viable in the watershed development programme.

The study on problems and prospects of wasteland development in India, by Sen and Das (1988) observed that watershed approach in waste land development will effectively supplement centralised planning in meeting basic human needs.

An attempt was made by Arputharaj and Rajayan (1989) to evaluate the water conservation and harvesting scheme in dry farming areas of three watersheds

in Vadakarpatty panchayath in Kerala, using sample selected on the basis of probability proportional to the total number of beneficiaries. The study showed that the incremental income generated by the project worked out to be Rs.306 per farm, which resulted in increased employment and a positive impact on the standard of living.

Atheeq and Venkataram (1989) assessed the optimum land use pattern based on data collected from the farmers in the Kabbalanala watershed of Karnataka and found that the land use pattern of the farmers in the watershed was closer to the optimum and hence a reorganisation of the existing resource use pattern would yield only 17 to 18 per cent increase in net returns. The pattern of land use of both small and large farmers was found to be subsistence oriented.

A comparative study of pre and post watershed period in Chinnatekur watershed of Andhra Pradesh by Hanumanthaiah and Nataraj (1989) based on data collected from the records of the local office of the state department of agriculture, observed that the cropping pattern showed considerable variations and mixed cropping with new crops like red gram was also introduced during the watershed programme. The production of pulses and oil seeds showed tremendous increase after the project. The employment opportunities have also been increased.

In an analysis of the impact of watershed management programme on crop pattern and resource use in the Maili watershed in Punjab, Kumar *et al.* (1989) found that there was a shift in crop pattern in favour of high yielding varieties of wheat and commercial crops such as sugrcane, oil seeds, vegetable and pulses. The net income increased from Rs.2007 per hectare to Rs.3054 after the execution of the programme.

Kulkarni *et al.* (1989) in their study in Asundinala watershed of Karnataka, found that productivity and profitability of the crops as well as the cropping intensity were invariably much higher in the watershed area compared to

non-watershed area. The poor performance of the farmers in non-watershed area was mainly attributed to the non-adoption of the soil and water conservation techniques.

A comparative study of cost and return of the watershed unit in Ahmed Nagar district of Maharashtra by Mahandule *et al.* (1989) based on the primary data collected from all the farmers in the watershed area for pre and post project periods indicated that the proportion of irrigated area increased from 19 per cent to 23 per cent after the implementation of the programme. Cropping intensity was found to be increased by 15 per cent. There was also an increase in per hectare production costs and returns. The benefit cost ratio for the programme was 1.28 with an internal rate of return of 12.33 per cent at 11 per cent discount rate. The watershed development programme was found to be economically viable.

Prasad *et al.* (1989) in their study on the impact of watershed management project on productivity of crops in Jalam district of Uttar Pradesh concluded that the productivity of different crops increased by three to five times as compared to the pre project period and by two to four times as compared to the non project area. The cropping intensity was also increased by 56 per cent. In jowar, bajra, wheat and mustard the net returns were two times higher while in gram and barley four times higher than non-project area. The study indicated that an integrated approach to the watershed management may prove the best way to minimise the hazards associated with dry land agriculture.

A study on the impact of watershed development programmes on crop productivity and agricultural income in Kolhewadi village in Ahmed Nagar district of Maharashtra by Pagire (1989) showed that there was an increase in the area under the khariff and rabi crops and diversification of cropping pattern. The gross cropped area increased by 7.5 to 15 per cent. In the case of sorghum and wheat the increase in yield was 85 per cent to 134 per cent and 12 per cent to 72 per cent.

Rajagopalan and Anuradha (1989) studied the farmer's participation in a water conservation project in Kerala based on data collected by the Agricultural Economics Research Centre, Madras and suggested that financial and technical assistance for maintenance of wells, more extension work, financial help for purchase of fertilizers and prompt payment of subsidy to the farmers will go a long way in enlisting their participation and better involvement in the project works. Land leveling and deepening of wells facilitated adequate irrigation and has resulted in increased yield of crops.

An analysis of soil conservation measures adopted in Maheswaram watershed project of Andhra Pradesh by Rao (1989) based on the data collected from beneficiary farmers, showed that the productivity of jowar, red gram and castor crops were higher than that of non watershed area.

Singh and Panday (1989) assessed the economic feasibility of model water harvest tank at Palaman of Bihar and observed that gross income, net income and return from per rupee investment significantly increased after water harvest tank management programme. This happened due to rise in productivity, increase in cropping intensity and shift in cropping pattern.

A comparative study of socio-economic impact of Kandi watershed development programme in Punjab by Singh *et al.* (1989) revealed that there was significant shift in land use pattern. Investment of inputs showed 21 per cent increase after the project and the crop yield of maize, wheat and oil seeds increased by 2.7, 2.8 and 6.2 per cent respectively. The project yielded a benefit cost ratio of 1.7 at 12 per cent discount rate.

Singh (1989) in his study on Mittermari watershed development programme in Kolar district of Karnataka found that the project had a positive impact on crop yields, net benefit from crops and availability of water in the project area and was financially viable even when benefits from crops alone were

taken in to account. The study also pointed to the need for involving farmers more actively in the process of project planning and management from the very beginning.

Alagumani (1991) in her study in Avanashi watershed of Tamilnadu observed that there was no significant difference in cropping pattern, while the total cropped area was increased by 5.56 per cent during the post implementation period. The productivity of cotton and gingelly increased by 23.37 per cent and 19.76 per cent respectively. The increase in the cropped area and productivity resulted in increased employment and income by three man-days and Rs.573 per hectare.

In an analysis of the Gunj watershed development project in Akola district of Maharashtra, Alshi *et al.* (1991) concluded that the cropping intensity in the project area increased from 104.97 per cent to 125.84 per cent. Yield of important crops in the area also increased substantially due to the adoption of recommended package of practices. Crops like cotton and pigeon pea were introduced after reclamation of soil.

Arya *et al.* (1991) in their study on economic efficiency of watershed management system in Shivalik foot hill villages of Haryana found that cropping intensity was 227 per cent on supplemental irrigated farms as against 100 per cent on rainfed farms. A significant change in input structure was observed on irrigated farms as compared to rainfed farms.

In an attempt to analyse the strategy for sustainable watershed development in hilly areas in Gharyana watershed of Himachal Pradesh, Bhati *et al.* (1991) showed that animal husbandry and farm forestry activities were prominent contributors to the total house hold income. The study suggested the inclusion of activities such as soil conservation, restoration of tree cover, measures to improve soil moisture and other minor irrigation structures for water harvesting.

Biradar (1991) In his study on the techno-economic issues of watershed development in Gulbarga district of Karnataka, concluded that soil erosion of the fields in the watershed was reduced considerably and the ground water recharge had increased and uniform soil moisture was noticed in the fields which helps to grow the crops uniformly by maintaining the crop population. The crop yields were also increased by 80 to 100 per cent.

Chaurasia *et al.* (1991) assessed the optimum-cropping pattern for minimising soil loss in Naurar watershed of Uttar Pradesh. The study revealed that farmers grew a number of crops and diversification of crop was a common feature to minimise the risk of crop failure on account of drought. The optimal cropping pattern indicated that the existing level of soil loss could be reduced by specialization in crop production.

Ghosh (1991) in a comparative study of the National Watershed Development Programme in Bankura district of West Bengal showed that there has been significant increase in the net sown area after the programme. The cropping intensity increased from 109 to 118 per cent. The per acre value of productivity to the command area increased from Rs.1788 to Rs.2776.

Guleria (1991) in his study on watershed approach for sustainable development in hilly region of Kotgarh watershed observed that the optimum carrying capacity, as indicated by the number of persons that a watershed can support without causing environmental and ecological degradation, was 16,000 persons.

The crop diversification and its economics in Chitravati watershed of Karnataka was analysed by Hafeez *et al.* (1991) and it was found that the crop diversification constantly increased in the villages at Chitravati watershed. Benefit cost ratio worked out to be 1.48 indicating higher return on each rupee invested in the cultivation of these crops.

Jahagirdar (1991) analysed the growth parameters of Mandi watershed development project in Maharashtra. The study indicated that there was an increase in cultivated area and per hectare crop yield. The area under well irrigation increased by 206 hectare. Adoption of *in situ* moisture conservation technologies and vegetative barriers helped in increasing the yield.

A study on socio-economic impact of Muchkullanala watershed development project in Karnataka by Kallur (1991) revealed that crops like red gram registered more than 100 per cent increase in yield. It has led to complimentary land use pattern where in dry land horticulture crops like mango, lime etc. have been raised for the first time. Farmers become progressive in their approach, which is reflected in their adoption and use of high yielding variety seeds, chemical fertilizers and plant protection measures.

Mahandule *et al.* (1991) in a study in the drought prone area of western Maharashtra found that as a result of watershed development programme the proportion of irrigated area and the cropping intensity increased by 30 and 53 per cent respectively. The substitution of high value crops for the low value crops was pronounced in the watershed area and has resulted in an increase in gross returns and returns to different factors of production in a positive direction.

Misra (1991) in his study on performance of a watershed project in West Bengal found that the availability of water from watershed works has resulted in diversification of cropping pattern. It also emerges that the provision of water led to substitution of less profitable crops by more profitable crops. Afforestation programmes also improved the fuel resources of the area.

An analysis of the impact of watershed programme in Mitternari watershed of Karnataka by Narasamma *et al.* (1991) indicated that the productivity levels were high in watershed area compared to non-watershed area. Benefit-cost

ratios were also higher for all crops in watershed programme villages compared to non-watershed villages.

Nema *et al.* (1991) in their study on impact of Barkheda-Hat watershed development programme of Madhya Pradesh, found that the intensity of cropping in watershed development programme area was higher by 13 to 20 per cent than in non-watershed area. Employment of human labour and bullock labour was also increased by 28 per cent and 14 per cent respectively in watershed area.

In a study on the impact of national watershed development programme in Palakkad district of Kerala, Norman *et al.* (1991) showed that about 25 per cent of the beneficiaries have benefited by the land development works by way of increased yields, irrigation potentials and subsequent change in cropping pattern. The net irrigated area was increased by about five per cent.

Raju *et al.* (1991) in their study on the economic evaluation of watershed based technology in Chevella watershed of Andhra Pradesh concluded that the productivity of crops were higher in watershed area compared to non watershed area. Benefit cost ratio for crops were more than one in the watershed villages.

In an attempt to study output-input energy relationship in Maheswaram watershed programme of Andhra Pradesh, Rao *et al.* (1991) observed that the output-input energy ratio varied across crops and size groups and it showed greater than unity in all cases. It also indicated that farmyard manure and fertilizer were the major items of energy input factor out of total input energy, which had substantially increased in watershed area.

Randhir and Chandran (1991) conducted a study on watershed management in Anakkatti region of Tamilnadu. The study showed that the ground water level rose by 10 feet and the duration of stagnation of water after rainfall increased by 20 to 26 hours. There was an increase in cropping intensity by 12.68

per cent due to the programme. New crops like cotton and cowpea entered in to the cropping system during the period.

A study in the Uppalur watershed area of Andhra Pradesh by Reddy and Naidu (1991) revealed that the minor irrigation facilities created by the project resulted in the increase in asset value of beneficiaries. The impact of the programme was significantly high on marginal beneficiary farms growing groundnut and jowar crops.

Sandhu *et al.* (1991) analysed the watershed development approach for Shivalik hills in Punjab and found that the rate of return was 15.20 per cent for forestry, 13.10 per cent for livestock and 12.60 per cent for soil conservation with an over all benefit-cost ratio of more than unity at 12 per cent discount rate. The aggregate rate of return was found to be 14.50 per cent.

In a study in Mandsaur watershed of Madhya Pradesh, Shrivastava *et al.* (1991) concluded that the change in cropping pattern was quite substantial and the change in area under different crops showed a shift for more remunerative crops. The maximum yield increase was recorded in opium (93 per cent) followed by gram (84.2 per cent). Among kharif crops maize, groundnut and jowar benefited most.

An attempt to study the economic implications of the Rendhar watershed project in Uttar Pradesh by Singh and Singh (1991) indicated that there has been an increase in the cropping intensity and crop productivity. Productivity of crops increased by 300 to 600 per cent. The irrigated area increased from 56.2 hectares to 610 hectares. The project had provided tremendous employment opportunities to the local people.

Singh and Gupta (1991) assessed the impact of watershed based farming system on crop productivity and socio-economic status in Bunga watershed project area of Haryana. The study revealed that the availability of assured water supply

for irrigation helped in increasing the yield of all crops ranging from 100 to 300 per cent. The benefit-cost ratio was more than one.

A study on the impact of National Watershed Development Programme, Bilaspur in Himachal Pradesh by Sikka *et al.* (1991) revealed that the impact of the programme on labour utilisation was marginal, while no impact was observed on the application of seed rates and fertilizer consumption. A very slight change has been observed on the productivity of important crops. It was also found that the project lacked proper infrastructure facilities and this hindered its working.

An analysis of the impact of national watershed development projects in Bundelkhand region of Uttar Pradesh, by Singh and Thapaliyal (1991) indicated that watershed projects have helped significantly in raising the underground water table in the area. A shift in area under pulses from cereals and oil seeds during the kharif season was also observed. During kharif season the yield of paddy, jowar and bajra had increased tremendously.

An analysis of the watershed development projects in Kandi area of Punjab by Sindhu *et al.* (1991) revealed that out of the three projects only two of them was economically viable and contributed significantly in enhancing the productivity and income of the beneficiaries in the watershed area through increased cropping intensity.

Suryawanshi *et al.* (1991) made a comparative study on economic impact of Kolhewadi watershed development programme in Maharashtra and observed that the soil and water conservation structures were beneficial in increasing ground water table. The number of effective wells increased from 34 to 74. The ground water levels increased and the water level depth decreased from 6.85 to 3.15 m. The area under pulses, oil seeds, cash crops and horticultural crops increased after the implementation of the project.

Undirwade *et al.* (1991) in their study on impact of watershed development programme on resource use and returns in Gunj watershed area found that the project helped in increasing the double cropped area by 577.38 per cent and cropping intensity from 104.97 to 134.06 per cent. The introduction of high productivity crops in the place of low productivity crops was highly pronounced in the watershed area. The production cost, structure, gross return and net return also increased in the watershed area.

An attempt to study the impact of watershed development programme in Kolhapur district of Maharashtra by Yadav *et al.* (1991) indicated that the soil and nutrient losses have been substantially checked. The losses through run off were diverted towards moisture storage, ground water recharge and deep percolation. The agriculture in the area witnessed positive changes with vision for ecosystem balance.

Anuradha (1993) in an evaluation of soil conservation programme in the watersheds of kundah catchment, Tamil Nadu using secondary data collected from Agricultural economics research centre, university of Madras, concluded that there was increase in employment opportunities and income after the implementation of the project.

Dhyani *et al.* (1993) analysed the watershed management programme in Fakot, Himachal Pradesh and concluded that adoption of soil and water conservation technologies in farmer's fields on watershed basis was highly economical. The benefit cost ratio found to be 1.93. It also indicated 25 per cent increase in employment and 76 per cent increase in irrigated area.

In an analysis of the economic potential of watershed development in dryland agriculture, Shah (1993) found that the expected benefits in terms of employment were quite low. The availability of fodder per house hold is also not

showed a substantial increase, while income from horticulture was increased after the project.

Singh (1993) in his study on dry land agriculture and approaches for watershed development in India found that the completed watersheds have demonstrated higher monetary returns and overall improvement of the regions. Watershed project was quite helpful in improving soil moisture and also increased income and employment opportunities. Major shifts in cropping systems in favour of high value crops and overall improvement was also observed. The study also indicated that despite good performance these projects have some problems such as lack of adequate information about the local resource and co-operation of the people in the area for proper planning of the project.

Arya *et al.* (1994) conducted a study on economic viability of watershed management project selected to rehabilitate degraded Aravali foot hills of Haryana. The study revealed that as a result of the project the area under irrigation increased from 125 to 601 hectares. The increase in yield varies from 20 to 44 per cent in the case of rainfed crops. The benefit-cost ratio of the project worked out to be 1.68.

Arya and Samra (1994) assessed the determinants of people's participation in watershed development and management in Shivalik foothill villages in Haryana. The study observed that the co-operation and participation of people couldn't be ensured unless they were benefited directly and immediately. The local leadership also played an important role in enlisting people's participation by mobilising their resources, energy and by assuring them that they would have access to the benefits from their participation.

Singh *et al.* (1995) in their study on watershed approach in improving the socio-economic status of tribal area in Udaipur district concluded that the watershed programme not only increased the crop yield but also developed fodder resources in the area. Per capita income has gone up from Rs.598 to Rs.1739 and

benefit cost ratio worked out to be 1.76, which indicated the economic feasibility of watershed management programme for improving the socio-economic status of farmers residing in the tribal area.

A study in Chitravati watershed project in Kolar district of Karnataka, by Gowda and Jayaramaiah (1996) found that the adoption level of participants of soil and moisture conservation practices in respect of ragi was significantly higher than the non-participants. It showed that the watershed development programme was able to bring about significant changes among its beneficiaries. Incentives given to beneficiaries have played prime role in influencing technological changes among beneficiaries.

Kapase and Patil (1996) assessed the building up of the capital assets in National Watershed Development Programme in Nanaj village of Maharashtra. The study indicated that the capital investment on public sector was not fully utilized due to unawareness of watershed concept, disintegration among agencies, less involvement of beneficiaries and non-acceptance of proposed measures due to fear of success. The benefit-cost ratio was 1.6 indicating that public and private investment was economically viable.

An attempt to study the impact of watershed on capital formation in agriculture in Madhavanti watershed of Saurshtra region by Shiyani and Vekariya (1996) revealed that the beneficiary farmers enjoyed relatively better position in respect of net income, family labour income and input out put ratios. This suggests that investment made by the beneficiary group was more remunerative as compared to non-beneficiary group.

Nalatwadmath *et al.* (1997) studied the model watershed development programme in Bellary district of Karnataka to assess the improvement in socio-economic status through watershed development programme. The study showed that there was 54.08 to 95.83 per cent increase in net returns from agriculture crops

due to increased cropped area. The cropping intensity of the watershed area had increased from 93.55 per cent to 108.40 per cent while the productivity of crops increased by 1.36 to 1.70 times. The average benefit-cost ratio worked out to be 1.45, which shows that the project was economically feasible.

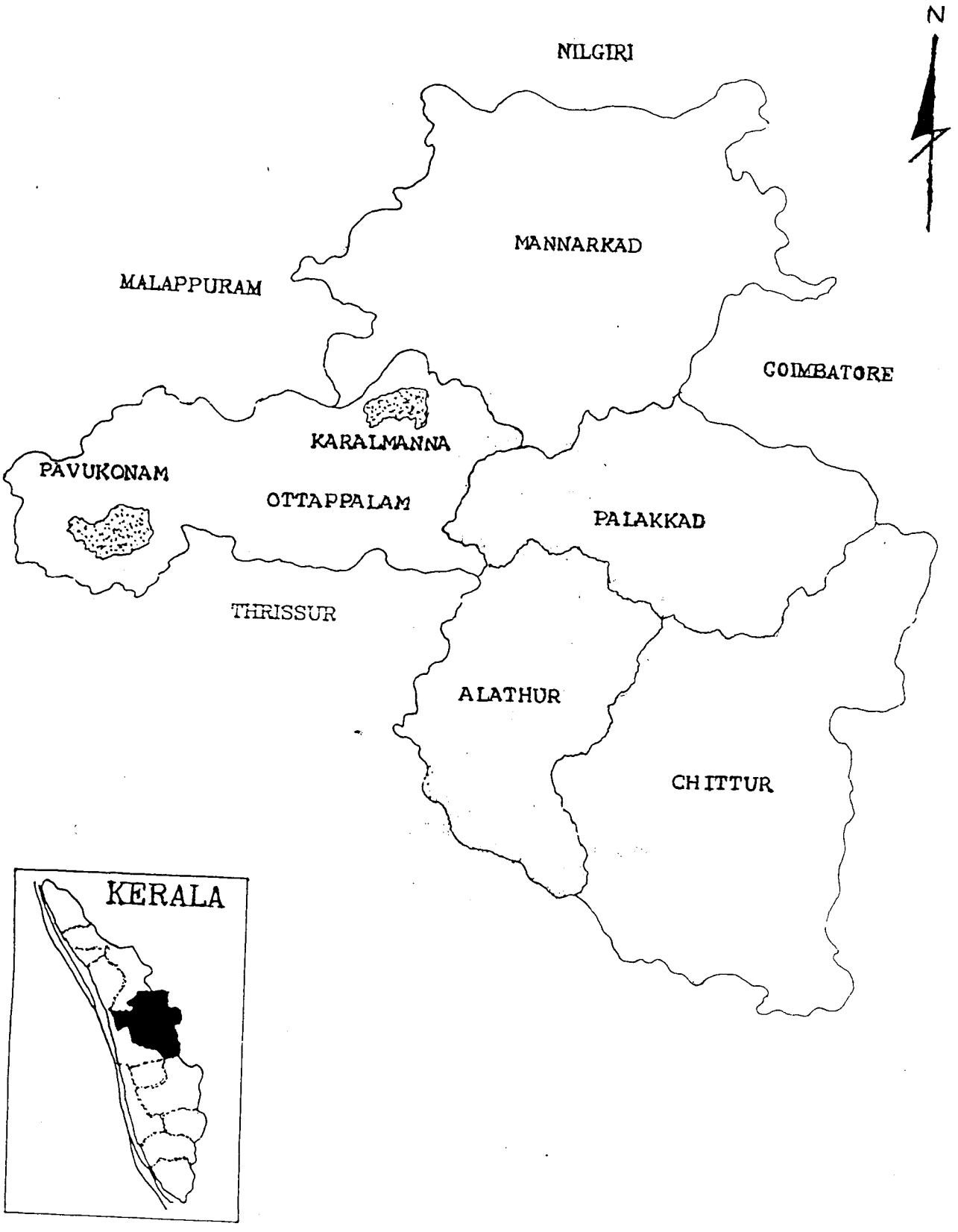
Samuel (1999) analysed the Indo-German watershed development programme in three villages of Ahmed Nagar district and concluded that the watershed management programme led to a remarkable socio economic improvement as compared to the pre watershed period. The irrigated area showed an increase of 300 per cent. Grain production was almost doubled in all three villages. Fuel production and fodder production also improved by the project. A 100 per cent increase is observed in the number of perennial wells as compared to the pre-watershed phase.

A study on comphrensive watershed development programme in Ralegan Siddhi of Maharashtra by Narayana and Prahalladiah (1999) indicated that the irrigated land area increased from 56.43 hectares to 464.73 hectares. Contour cultivation increased from 40 to 186 hectares and values of crops increased from Rs.6.72 lakhs to Rs.128.15 lakhs. The message of ecological sustainability, economic self-reliance and social development of villages through mutually helpful co-operative efforts has been clearly spelt out as a result of the programme.

Singhal (1999) based on the information collected from twenty three watershed projects located in Shivalik foot-hills of Haryana tried to find out the factors affecting people's participation in watershed development projects. The study showed 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 government and thereby making the programme self sustaining.

AREA OF STUDY

FIG.1. MAP OF PALAKKAD DISTRICT
SHOWING THE STUDY AREA



constitute 2.79 per cent of the working population. All this highlights the fact that economy is basically an agrarian based.

Table 3.1. Occupational pattern of working population of Palakkad district (1991 census)

Categories	Number	Percentage
Cultivators	97289	12.37
Agricultural labourers	348299	44.29
Household industry workers	21904	2.79
Other workers	318871	40.55
Total	786363	100.00

Source: Farm Guide 2000, Farm Information Bureau, Government of Kerala

3.4 Climatic conditions

The Sahya ranges bordering the region influences the climate of the district. During summer months oppressive heat and drought is particularly experienced in Palakkad district. The temperature of the district varies between 22°C to 42°C. The four main seasons are:

1. Dry weather - December to February
2. Hot weather - March to May
3. South west monsoon - June to September
4. North east monsoon - October to November.

3.5 Rainfall

The normal rainfall of the district is 2329 mm, mostly from south west monsoon. Average rainfall is 1878 mm. Velocity of wind recorded in Palakkad district is highest in Kerala, i.e. 12.7 km per hour, compared to state average of 7.9 km per hour.

3.6 Soil type

There are three main types of soils in the district, viz. laterite soil, virgin forest soil and black soil. Laterite soil is prominent soil type and found in the major

parts of Ottappalam, Alathur, Palakkad and Chittur taluks. Virgin forest soil is found mainly in Mannarkad taluk and in the northern region of Ottappalam taluk. Black soil which is an extension of black soils of Deccan plateau is found in Chittur taluk.

3.7 Land utilisation pattern

The land utilisation pattern is presented in Table 3.2. The total geographical area of the district is 438980 hectares out of which forests occupy 31.04 per cent. Cultivable waste land alone comes to 4.15 per cent and current fallows comes to 3.04 per cent while net area sown contributes to 47.73 per cent of the total geographical area.

Table 3.2. Land utilization pattern of Palakkad district (1996-97)

Category	In hectares	Percentage to total geographic area
Forest	136257	31.04
Land put to non agricultural uses	41514	9.46
Barren and uncultivable land	6223	1.42
Permanent pastural and other grazing places	62	0.01
Land under tree crops	4810	1.10
Cultivable waste	18239	4.15
Fallow other than current fallow	8990	2.05
Current fallow	13358	3.04
Net area sown	209527	47.73
Total geographical area	438980	100.00

Source: Farm Guide 2000, Farm Information Bureau, Government of Kerala

3.8 Cropping pattern

The cropping pattern of Palakkad district as presented in Table 3.3 revealed that the total cropped area was 331713 hectares. Paddy was the most important crop occupying 36.42 per cent of the total cropped area (120809 hectares). Coconut was also found to occupy a prominent position with 14.75 per cent of the total cropped area (48929 hectares). The other crops cultivated in the

district consists of rubber (8.48 per cent) followed by fruits (7.37 per cent) and vegetables (7.31 per cent).

Table 3.3. Cropping pattern of Palakkad district (1997-98)

Crops	Area in hectares	Percentage to total cropped area
Paddy	120809	36.42
Pulses	4660	1.40
Sugarcane	6434	1.94
Spices and condiments	19073	5.75
Fruits	24452	7.37
Vegetables	24256	7.33
Cashew	5750	1.73
Coconut	48929	14.75
Groundnut	10031	3.02
Other oil seeds	1161	0.35
Cotton	14551	4.39
Coffee	4660	1.40
Rubber	28125	8.48
Tea	829	0.25
Fodder grass	210	0.06
Green manure crops	1964	0.59
Others	15819	4.77
Total cropped area	331713	100.00

Source: Farm Guide 2000, Farm Information Bureau, Government of Kerala

Watershed Development Programme (NWDPRA)

The National Watershed Development Programme for Rainfed Agriculture occupies a very prominent position in the development activities of the Palakkad district. This is a centrally sponsored scheme providing 75 per cent grant and 25 per cent loan to the state government for implementation of Integrated Watershed Development Programmes in the watersheds, selected in identified blocks. The most important criteria for a block to get qualified for inclusion in the programme is that it should have only less than 30 per cent of the land under irrigated agriculture. The project was implemented in the state from 1990-91 onwards. Out of 151 blocks in the state, 114 blocks have been found as qualified for inclusion and hence 114 watersheds have been selected.

The objectives of the programme

1) Conservation, upgradation and utilisation of natural endowments like land, water and plant, animal and human resources in a harmonious and integrated manner.
2) Generation of massive employment during the project period and regular employment after the project period.
3) Improvement of production environment and restoration of ecological balance through scientific management of land and rainwater.
4) Reduction of inequalities between irrigated and rainfed areas. Ultimately stable production and processing of biomass would contribute towards better life in rural area.
5) To enhance cash flow to the rainfed farmers and landless agricultural labourers through increased casual employment, enhanced marketable surplus of agricultural produce and by growing cash crops etc.

Basic activities

The basic activities of the programme include training to Mitra Kisans and Project Staff, conduct of Kissan Mela, award to farmers, award to PG apprentice trainees, purchase of drawing and survey equipments construction of low cost building for Bharani Chetna Kendras and composite nurseries. Under the research activities the items included are on farm research by farmers with the guidance of project staff and collaboration of research with research institutions.

Project activities

The following are the different activities under the programme.

1. Land development works for arable land

Efficient use of rain water will be ensured by adoption of low cost technologies like tillage, organic mulches, burial of coconut husk, contour trenches etc. For effective soil and moisture conservation, the soil conservation wing of the

Department of Agriculture providing assistance to the farmers in the watershed areas.

2. Establishment of composite nurseries

The scion/nucleus materials of fruit plants produced in the government farms will be supplied at 25 per cent cost to the nursery men, who are willing to take up the decentralised nurseries under departmental supervision.

3. Crop demonstration

Under this activity input materials like fertilizer, pesticides, seeds etc. are supplied to the selected progressive farmers at free of cost and departmental staff will assist them in achieving higher yields.

4. Establishment of homestead garden

Minikits of high yielding varieties of vegetables and chemical fertilizer, worth Rs.100 per kit will be supplied at free of cost to the farmers who have attended the five days training camp organised by the farmers training centres.

Programmes for service sector

It includes assistance for activities such as mat making, umbrella making, small livestock rearing, etc. These activities are exclusively meant for up gradation of SC/ST and marginal farmers in the watershed area. For all those activities a maximum amount of Rs.1000 per farm/person is given in two installments. The project is implemented under the technical supervision of the Agricultural Officer in charge of the watershed. He will co-ordinate the supply of inputs in the area. The project envisages to provide a sum of Rs.3500-5000 per hectare for various activities related to the implementation of the project. Soil conservation measures have to be undertaken under the supervision of soil conservation officer, and they will provide assistance to the farmers through Krishi Bhavans.

Control of the programme

The control of the programme includes constitution of committees at different levels.

i. State Policy Committee (Chairman - Chief Minister)

ii. State Implementation Committee (Chairman - Agricultural Production Commissioner)

iii. Committee of the State Co-ordinator (Chairman - Co-ordinator of NWDPRA)

iv. District Committee (Chairman - Principal Agrl. Officer)

v. Block Committee

vi. Watershed Development Team (Leader - The team level officer of the predominant activity)

MATERIALS AND METHODS

4. MATERIALS AND METHODS

In this chapter, the design of the study, the methods employed for data collection and data analysis techniques have been presented under the following heads.

4.1 Location of study and sampling design

4.2 Operationalisation and measurement of variables

4.3 Techniques employed in data collection

4.4 Analysis of data

4.1 Location of study and sampling design

The study was undertaken in Palakkad district. Out of the four completed watershed development projects in the district two watersheds viz. Pavukonam and Karalmanna were randomly selected as the location for the study. Two other watersheds where in the project was not implemented, but areas which are similar in agroclimatic conditions, soil type and topography and approximately 5-10 km away from the two selected watershed project areas were also identified for comparison with the study area. Based on discussion with the implementing agencies and Mitrakisans of the selected watershed areas, all the major activities of watershed projects were identified.

For collecting data the respondents of the study were categorized as beneficiaries and non-beneficiaries (control group). 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, where in the watershed project was not implemented.

The list of beneficiaries and non-beneficiaries were collected from the Krishi Bhavans. The beneficiaries and non-beneficiaries were stratified in to four groups viz. large farmers with an area above two hectares of land (referred to as class-I), small farmers having area between one to two hectares (class-II), marginal

and marginal farmers with an area below one hectare (class-III). As SC/ST category is a special component of watershed development programme this group have been included as class-IV. From the two watershed areas selected 60 beneficiaries each and 60 non- beneficiaries belonging to the different classes were randomly selected. Thus altogether 120 beneficiaries and 60 non-beneficiaries formed the respondents of the study. Class wise details of selected respondents are given in Table.4.1.

Table 4.1 Class wise details of selected respondents

Category	Project area		Non project area
	Karalmanna	Pavukonam	
Class-I (Large)	15	15	15
Class-II (Small)	15	15	15
Class-III (Marginal)	15	15	15
Class-IV (SC/ST)	15	15	15
Total	60	60	60

4.2 Operationalisation and measurement of variables

4.2.1. Watershed

Watershed can be defined as a hydrological entity, where rainwater is collected and stored. It is a drainage basin of a stream.

4.2.2. Watershed development

It is defined as an integrated approach of conservation of land, soil, water and biomass for the ultimate benefit of mankind. Watershed development programme aims to generate such activities, which would conserve as much precipitation as possible *in situ* in soil profile or through controlled run off, collection, storage and reuse according to land capabilities.

4.2.3 Benefits under watershed development project

Benefits have been defined as the subsidies in the form of cash or kind availed by the farmers as a part of watershed project. These were divided in to three main categories viz. subsidies for soil conservation, farm development and animal husbandry development activities.

a) Soil conservation measures

The subsidies availed by the farmers for soil conservation measures such as contour bunding, trenching, rain pit, hush burial etc. were included in this category.

b) Farm development

The subsidies to the farmers for undertaking activities such as multi-tier cropping, intercropping etc. were considered in this category.

c) Animal husbandry development

Animal husbandry development activities were exclusively for marginal and SC/ST farmers. The different benefits under this activity included subsidies for goat rearing and poultry rearing.

4.2.4 Operating area

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

4.2.5 Net cropped area

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

4.2.6 Gross cropped area

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

4.2.7 Cropping pattern

The cropping pattern is expressed as the percentage share of each crop in the gross cropped area. The major crops in the area were paddy, coconut, arecanut, pepper and rubber. In the case of coconut, arecanut, pepper and rubber the number of plants were collected and area under these crops were estimated based on recommended spacing for respective crops suggested by Kerala Agricultural University (Package of Practices, KAU, 1996).

4.2.8 Cropping intensity

Cropping intensity measures the extent of land for cropping purpose during a particular year. Cropping intensity has been defined as the ratio of gross cropped area to the net-cropped area, which is expressed in percentage.

4.2.9 Labour use pattern

The labour use pattern for various classes with respect to the major crops grown by the respondents were collected. The concept of man-day used here relates to 8 hours work per day and the wage rate prevailing was Rs.110 per day. In the case of coconut and arecanut the per palm harvesting expenses were converted to man days and for paddy also the kind payment made for harvesting have been converted to man days.

4.2.10 Production and productivity of crops

The productivity of major crops were expressed as the number of nuts produced per palm in the case of coconut and arecanut, while production in kilograms per hectare was taken for paddy crop.

4.2.11 Cost of cultivation

Farm expenses incurred by different classes were studied. For calculating cost of cultivation, major operations in the cultivation of crops were identified. The major items of costs were land preparation, manures, fertilizers, harvesting, raking the field and other field works, and the cost incurred for each operation was collected.

4.2.12 Income generation

Gross farm income was defined as the total income realised from different crops in the farm such as paddy, coconut, arecanut, pepper and rubber. Data on quantity of product from each crop was collected and multiplied with the average market price as realised by each farmer to get gross farm income.

4.2.13 Incremental benefit-cost ratio

It is defined as the ratio of additional income generated from the improved cultivation practices adopted as a part of watershed development programme to the additional expenses for implementing it.

4.2.14 Constraints as perceived by beneficiaries

A constraint in this context is defined as any condition experienced by respondents which limits or acts as a barrier in their farming activities. The major constraints experienced by the sample respondents were collected during pilot survey. Seven important constraints that are faced by the respondents were included in the interview schedule for the main study. The constraints were non availability of irrigation water, lack of technical guidance, lack of awareness on rationality of the watershed programme, difficulty in produce marketing, non availability of subsidies in time, insufficient credit and high cost of labour.

4.2.15 Strengths/weaknesses of the programme

The strengths/weakness of the programme were identified in relation to the major components of the programme. The beneficiary respondents were asked to rate the components from their experience as either positive or negative.

4.3 Techniques employed in data collection

The data were collected from the respondents using a well structured interview schedule prepared for the purpose. The prepared schedule was pretested through a pilot study conducted among 20 beneficiaries in the project area. Based on the pilot study necessary modifications were made in the schedule and the final interview schedule was prepared. The data were collected from the sample respondents through personal interview, which formed the major source of information for the study. Data on aspects such as land use pattern, labour use, cost of cultivation and income generation were collected for two periods, viz. pre project period (1991-92) and post project period (1997-98). The study was carried out during 1999-2000.

4.4 Analysis of data

The collected data was tabulated and analysed in accordance with the objectives of the research problem. The socio-economic characteristics of the sample and changes in the selected variables due to watershed development programme were analysed for the different classes using averages and percentages.

The labour utilization pattern of the various classes with respect to the major crops were estimated for pre project and post project periods and for control and changes in the variable analysed. The input wise cost of cultivation of major crops were estimated on per farm and per hectare basis and the percentage share of each input to the total expenses were worked out in both pre project and post project period as well as for control and have been compared to analyse the changes.

The income generation of the different classes from the watershed project was examined by estimating the crop wise income on per farm and per hectare basis during pre project and post project period as well as for control.

The incremental benefit cost ratio for the project was estimated by taking the difference between the per hectare expenses of each crop in the various classes before and after the watershed development programme and change in income per hectare due to application of increased inputs and soil conservation measures and working out the ratio of benefit to cost.

Regarding allied activities, goat rearing and poultry rearing was taken up by the respondents in the project area. Data on labour use, costs and returns were collected and analysed. In the case of poultry rearing the available information was too scanty and was excluded from the analysis.

For the analysis of constraints the response of each constraint was obtained on a five point continuum as most important, important, some what important, less important and least important with scores 5, 4, 3, 2 and 1. 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 constraints were ranked based on this cumulative score.

RESULTS

5. RESULTS

This chapter deals with the results of the study. The results are presented in four sections. The first section deals with the general socio-economic characteristics of the sample households. The second section covers the watershed development Programme undertaken in the area. The land use pattern and cropping pattern and the change in them as a result of watershed development programme, the employment generation, cost of cultivation, income generation, incremental benefit cost ratio and costs and returns of animal husbandry development activities have been dealt in section three. The last section deals with the constraints experienced by beneficiaries and strengths/weakness of the watershed development programme as perceived by beneficiaries.

5.1 General socio-economic condition of respondents

The sample respondents have been divided in to four categories viz. large farmers with an area of above two hectares of land (referred to as class – I) small farmers having area between one to two hectares (class – II), marginal farmers with area below one hectare (class – III) and SC/ST farmers (class-IV). The results are presented class wise with respect to the different socio-economic characteristics.

5.1.1 Family size

The distribution of respondents on the basis of family size in the various classes is presented in Table 5.1. It was found that 61.11 per cent of the total respondents had a family size of 1-5 members, where as 23.33 per cent had 6-7 members and 15.56 per cent above 7 members in the family. Class wise analysis revealed that 55.56 per cent in class I, 48.89 per cent in class-II, 72.11 per cent in class-III and 68.89 per cent in class-IV had 1-5 members in the family.

Table 5.1. Distribution of sample holdings on the basis of family size

Size of family	Class I	Class II	Class III	Class IV	Total
1-5	25 (55.56)	22 (48.89)	32 (72.11)	31 (68.89)	110 (61.11)
6-7	11 (24.44)	11 (24.44)	7 (15.56)	13 (28.89)	42 (23.33)
Above-7	9 (20.00)	12 (26.67)	6 (13.33)	1 (2.22)	28 (15.56)
Total	45 (100.00)	45 (100.00)	45 (100.00)	45 (100.00)	180 (100.00)

Figures in parentheses indicate percentage to total

5.1.2 Age

The classification of respondents on the basis of age is given in Table 5.2. There were 32 respondents (17.78 per cent) below 35 years. But majority of the respondents were in the age group of 35 to 55 years consisting of 64.44 per cent of the total sample. There were 32 farmers above the age of 55 years comprising 17.78 per cent of the total sample. The class wise analysis also revealed the same trend with 55.56 per cent, 62.23 per cent, 73.33 per cent and 66.67 per cent of the respondents in class I, II, III and IV respectively belonging to the age group of 35 to 55 years.

Table 5.2. Classification of respondents on the basis of age

Age group	Class I	Class II	Class III	Class IV	Total
Below 35 years	10 (22.22)	11 (24.44)	3 (6.67)	8 (17.78)	32 (17.78)
35-55 years	25 (55.56)	28 (62.23)	33 (73.33)	30 (66.67)	116 (64.44)
Above 55 years	10 (22.22)	6 (13.33)	9 (20.00)	7 (15.55)	32 (17.78)
Total	45 (100.00)	45 (100.00)	45 (100.00)	45 (100.00)	180 (100.00)

Figures in parentheses indicate percentage to total

5.1.3 Educational level

The classification of respondents based on educational level as given in Table 5.3 showed that around 86.67 per cent of the respondents had formal schooling and have studied up to high school level while only 10 per cent had studied up to graduation and 3.33 per cent were having post-graduation or professional degree. Class wise analysis revealed that 64.44 per cent in class I, 86.67 per cent in class II, 95.56 per cent in class III and 100 per cent in class IV had only formal schooling. While around 24.44 per cent of respondents in class I had education above graduation, it was 11.12 per cent in class II and negligible in class III and IV. It may be noted that educational status of the respondents was directly related with their economic status.

Table 5.3. Classification of respondents according to educational level

Level of education	Class I	Class II	Class III	Class IV	Total
Formal schooling	29 (64.44)	39 (86.67)	43 (95.56)	45 (100.00)	156 (86.67)
Graduation	11 (24.44)	5 (11.12)	2 (4.44)	-	18 (10.00)
PG/ Professional	5 (11.12)	1 (2.21)	-	-	6 (3.33)
Total	45 (100.00)	45 (100.00)	45 (100.00)	45 (100.00)	180 (100.00)

Figures in parentheses indicate percentage to total

5.1.4 Occupation

Classification of respondents according to the main occupation is shown in Table 5.4. It was found that only 31.11 per cent of the respondents had agriculture as their main occupation while business, service and others constitute the rest. Among the classes 60 per cent in class I and 51.11 per cent in class II had agriculture as the main source of income while for class III and IV other workers including agricultural labourers constituted 57.77 per cent and 100 per cent respectively.

Table 5.4. Classification of respondents on the basis of main occupation

Main occupation	Class I	Class II	Class III	Class IV	Total
Agriculture	27 (60.00)	23 (51.11)	6 (13.33)	-	56 (31.11)
Business	7 (15.56)	5 (11.11)	7 (15.57)	-	19 (10.56)
Service	7 (15.56)	6 (13.33)	1 (2.22)	-	14 (7.78)
NRI	4 (8.88)	4 (8.88)	5 (11.11)	-	13 (7.22)
Other workers	-	7 (15.57)	26 (57.77)	45 (100.00)	78 (43.33)
Total	45 (100.00)	45 (100.00)	45 (100.00)	45 (100.00)	180 (100.00)

Figures in parentheses indicate percentage to total

5.2 Benefits received by the sample farms in the watershed area

The benefits received by the farmers can be divided into three main categories Viz. soil conservation, farm development activities and animal husbandry development activities. As given in Table 5.5, on an average, the total benefits received was Rs. 2626, with an amount of Rs. 1587 for soil conservation activities accounting for 60.43 per cent of the total. The amount received for farm development activities was Rs.848 which was 32.26 per cent of the total benefits. For animal husbandry development and related activities the amount spent was Rs.192 which constituted 7.31 per cent of total benefits. Class wise analysis revealed that for class I, the total benefits received was Rs.5767 out of which Rs.3684 (63.88 per cent) was for soil conservation works followed by Rs.1973 (34.21 per cent) for farm development activities and Rs.110 (1.91 per cent) for animal husbandry development activities. In the case of class II, the total benefits received was Rs. 3122 with 68.48 per cent for soil conservation works and 27.99 per cent for farm development activities. Regarding class III, Rs.1017 was received

as total benefits, with soil conservation works contributing 39.13 per cent and farm development activities 37.17 per cent, followed by animal husbandry activities with a share of 23.70 per cent. For class IV the total benefits received was Rs.599, with 51.25 per cent for animal husbandry development activities followed by 27.38 per cent for farm development activities and 21.37 per cent for soil conservation works.

Table 5.5. Benefits received by respondents for various watershed development activities in the project area (rupees per farm)

Category	Class I	Class II	Class III	Class IV	Aggregate
Soil conservation	3684 (63.88)	2138 (68.48)	398 (39.13)	128 (21.37)	1587 (60.43)
Farm development	1973 (34.21)	874 (27.99)	378 (37.17)	164 (27.38)	848 (32.26)
Animal husbandry development	110 (1.91)	110 (3.52)	241 (23.70)	307 (51.25)	192 (7.31)
Total	5767 (100.00)	3122 (100.00)	1017 (100.00)	599 (100.00)	2626 (100.00)

Figures in parentheses indicate percentage to total

5.2.1 Soil conservation measures

Soil conservation measures adopted by sample respondents in the watershed area before and after the project are shown in Table 5.6. It indicated that for soil conservation measures adopted by the respondents in the watershed area such as contour bunding, trenching, rain pit and husk burial the number of respondents who had adopted increased from 48 to 72 for contour bunding, 3 to 20 for trenching, 4 to 25 for rain pit and 3 to 15 for husk burial after the implementation of the programme.

Table 5.6. Soil conservation measures adopted in the project area (number of respondents)

Category	Class I		Class II		Class III		Class IV		Aggregate	
	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP
Contour bunding	17	23	16	21	12	23	3	5	48	72
Trenching	1	7	2	8	-	4	-	1	3	20
Rain pit	3	11	1	9	-	4	-	1	4	25
Husk burial	2	8	-	4	-	2	1	1	3	15

5.2.2 Agronomic interventions

Agronomic interventions adopted by the respondents in the watershed area before and after the project are given in Table 5.7. Agronomic interventions such as multi-tier cropping and inter cropping was prevalent among farmers, and the number of adopters increased from one to 31 for multi-tier cropping and 8 to 66 for inter cropping after the implementation of the programme.

Table 5.7. Agronomic interventions adopted in the project area (number of respondents)

Category	Class-I		Class-II		Class-III		Class-IV		Aggregate	
	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP	Before WDP	After WDP
Multi-tier cropping	1	10	-	9	-	10	-	2	1	31
Inter cropping	3	26	2	25	3	22	-	3	8	76
Contour cropping	-	5	-	4	-	-	-	-	-	9

5.2.3 Animal husbandry development activities

Animal husbandry development activities allotted to the respondents in the watershed area were goat rearing and poultry rearing. Poultry rearing was taken up by all the classes of farmers as two birds per

household were given free of cost. Regarding live stock, only class III and class IV farmers have been included in the scheme and they have taken up goat rearing as part of the project.

5.2.4 Land use pattern

The operating area has been defined as the total land possessed excluding land used for non-agricultural purposes. Operating area for each class consisting of both project area and control were worked out, and is shown in Table 5.8. The average operating area was 2.46 hectares and 2.82 hectares respectively for beneficiary and control in class I. In class II both the groups were having an average operating area of 1.10 hectares. With respect to class III the average operating area was 0.35 hectares for beneficiary and 0.22 hectares for control. For class IV, it was 0.08 hectares and 0.06 hectares respectively for beneficiary and control group.

Table 5.8. Class wise operating area of respondents (in hectares)

Category	Average operating area	
	Project area	Control
Class I	2.46	2.82
Class II	1.10	1.10
Class III	0.35	0.22
Class IV	0.08	0.06
Aggregate	0.99	1.048

5.2.5 Cropping pattern

Cropping pattern can be expressed as the percentage share of each crop in the gross cropped area. The area under crops like coconut, arecanut, pepper and rubber were estimated by converting the existing number of plants based on recommended spacing for respective crops suggested by Kerala Agricultural University (Package of practices, KAU, 1996). The area estimated in this manner showed a wide gap between the operating area and cropped area due to the wide spacing and non uniform planting adopted by the respondents and the same has

Table 5.9. Cropping pattern of Class-1 farmers (in cents per farm)

Crops	Before WDP	After WDP	Control
Coconut	179.75 (35.02)	201.00 (31.75)	325.25 (50.00)
Arecanut	2.50 (0.49)	19.00 (3.00)	2.00 (0.30)
Pepper	3.25 (0.63)	13.75 (2.17)	-
Rubber	-	69.25 (10.94)	115 (17.68)
Paddy Ist	150 (29.23)	150 (23.70)	97.75 (15.03)
Paddy – IInd	165 (32.15)	165 (26.07)	97.75 (15.03)
Other crops	12.75 (2.48)	15.00 (2.37)	12.75 (1.96)
Total cropped area	513.25 (100.00)	633 (100.00)	650.50 (100.00)

Figures in parentheses indicate percentage to total

Table 5.10. Cropping pattern of Class-II farmers (in cents per farm)

Crops	Before WDP	After WDP	Control
Coconut	83.5 (35.76)	91.75 (33.30)	156 (59.32)
Arecanut	1.25 (0.54)	11.75 (4.26)	8.75 (3.33)
Pepper	0.75 (0.32)	4.25 (1.54)	-
Rubber	-	19.25 (6.99)	-
Paddy Ist	69.5 (29.76)	69.50 (25.23)	48.25 (18.35)
Paddy – IInd	70.25 (30.09)	70.25 (25.50)	48.25 (18.35)
Other crops	8.25 (3.53)	8.75 (3.18)	1.75 (0.65)
Total cropped area	233.5 (100.00)	275.50 (100.00)	263 (100.00)

Figures in parentheses indicate percentage to total

been accounted as unutilised land. The percentage share of each crop in gross cropped area before and after the project was calculated to find out the change in cropping pattern. The major crops in the sample households consisted of paddy, coconut, arecanut and rubber. In addition some multipurpose tree crops like mango, jack and miscellaneous tree crops like palm, neem, glyricidia etc, were a common feature in all homesteads. Rubber was seen to be introduced in the area during the watershed development programme.

The cropping pattern of beneficiary farmers and control for class I is presented in Table 5.9. The results revealed that the proportion of area under coconut decreased from 35.02 per cent to 31.75 per cent in the project area while it was 50 per cent in the non-project area. In the case of arecanut proportion of area increased from 0.48 per cent to 3 per cent while it was 0.30 per cent for the control group. Rubber was introduced as a consequence of the programme contributing to 10.94 percent of cropped area. Paddy area was found to be unchanged during both periods.

The cropping pattern of beneficiary farmers and control for class II is presented in Table 5.10. The results indicated that the proportion of area under coconut decreased from 35.76 per cent to 33.30 per cent in the watershed area and it was 59.32 per cent in the non-project area. In the case of arecanut, there was an increase from 0.54 per cent, to 4.26 per cent in the project area while for control it was 3.33 per cent. Rubber was introduced as in the case of large farmers contributing to 6.99 per cent of the cropped area. Paddy area was found to be unchanged during both periods.

In the case of class III the cropping pattern as presented in Table 5.11. revealed that the proportion of area under coconut increased from 38.66 to 48.48 per cent in the project area, while it was 64.73 per cent for the control group. The proportion of area under arecanut increased from 1.13 per cent to 1.88 per cent in

Table 5.11. Cropping pattern of Class-III farmers (in cents per farm)

Crops	Before WDP	After WDP	Control
Coconut	28.28 (38.66)	47.83 (48.48)	34.50 (64.73)
Arecanut	0.83 (1.13)	1.85 (1.88)	0.50 (0.94)
Pepper	0.66 (0.90)	5.33 (5.40)	-
Paddy Ist	18.53 (25.33)	18.53 (18.78)	3.75 (7.04)
Paddy – IInd	21.83 (29.84)	21.83 (22.13)	3.75 (7.04)
Other crops	3.03 (4.14)	3.28 (3.33)	10.80 (20.25)
Total cropped area	73.16 (100.00)	98.65 (100.00)	53.30 (100.0)

Figures in parentheses indicate percentage to total

Table 5.12. Cropping pattern of Class-IV farmers (in cents per farm)

Crops	Before WDP	After WDP	Control
Coconut	7.78 (70.47)	12.09 (73.54)	6.50 (66.67)
Arecanut	-	0.80 (4.87)	-
Pepper	0.15 (1.36)	0.40 (2.43)	-
Paddy – IInd	2.53 (22.92)	2.60 (15.82)	-
Other crops	0.58 (5.25)	0.55 (3.34)	3.25 (33.33)
Total cropped area	11.04 (100.00)	16.44 (100.00)	9.75 (100.00)

Figures in parentheses indicate percentage to total

the project area where as it was 0.94 per cent in the non-project area. In the case of paddy, area was found to be unchanged during both periods.

For class IV farmers cropping pattern in the project area and control area presented in Table 5.12 indicated that the proportion of area under coconut increased from 70.47 per cent to 73.54 per cent and it was 66.67 per cent for the control group. Paddy area was found to be unchanged as in the case of other categories.

5.2.6 Cropping intensity.

Cropping intensity measures the extent of use of land for cropping purpose during a particular year. In the present study cropping intensity was expressed as the percentage share of gross cropped area to the net cropped area under cultivation.

Cropping intensity of the different categories of farmers are presented in Table 5.13. It revealed that the cropping intensity of class I before and after the project were 141 and 131 per cent respectively while it was 117 per cent in the control area. In the case of class II farmers the cropping intensity was 143 and 134 per cent respectively before and after the project where as it was 122 per cent in the control area. For class III cropping intensity was 134 and 123 per cent respectively during pre project and post project periods and it was 108 per cent in the control area. In the case of class IV farmers the cropping intensity was 100 per cent in all the cases.

Table 5.13. Class wise cropping intensity of the respondents (in percentage)

Category	Before WDP	After WDP	Control
Class I	141	131	117
Class II	143	134	122
Class III	134	123	108
Class IV	100	100	100

5.3.1 Labour use pattern

The labour use pattern for the various classes with respect to the major crops grown by the respondents on per farm and per hectare basis are presented in the following section.

The concept of man day used here relate to 8 hours work per day and the wage rate prevailing was Rs.110 per day. It maybe noted that harvesting was one of the major component of labour use in crops like paddy, coconut and arecanut. In the case of coconut and arecanut, the per palm harvesting expenses were converted in to man days. For paddy the kind payment made have been converted to man days.

The labour use pattern of class I during the pre-project and post project period as well as that of control are presented in Table 5.14. It was found that the total labour use increased from 139 man days of hired labour and 15 man days of family labour to 196 man days and 30 man days respectively as a result of watershed development programme, while for control it was 198 and 41 man days of hired and family labour. Among crops the employment generation as a result of the project was substantial for arecanut and coconut, as compared to paddy. Per hectare labour use pattern for class I as presented in Table 5.15. revealed that the per hectare labour use increased from 57 man days of hired labour to 80 man days and 6 man days of family labour to 12 man days as a result of watershed development programme. For non-project area, the labour use was 70 and 15 man days of hired and family labour.

Table 5.14. Labour use pattern of Class – I (man days per farm)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	39	4	41	4	24	6
Paddy II	65	4	67	5	38	7
Coconut	34	6	53	11	86	16
Arecanut	1	1	7	5	1	1
Rubber	-	-	28	5	49	11
Total	139	15	196	30	198	41

Table 5.15. Per hectare labour use pattern – Class I (man days)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	65	7	68	7	62	16
Paddy II	98	6	102	7	98	9
Coconut	47	8	67	14	66	12
Arecanut	37	57	96	62	58	67
Rubber	-	-	101	18	107	23
Average	57	6	80	12	70	15

The labour use pattern of class II as shown in Table 5.16 showed an increase in labour use with respect to hired labour from 54 to 66 man days and that of family labour from 16 to 23 man days. For control, it was 67 man days for hired labour and 17 for family labour. The per hectare labour use as presented in Table 5.17 revealed an increase in labour use from 49 to 60 man days in the case of hired labour and 15 to 21 man days for family labour, where as in the non project area, it was 61 man days of hired labour and 15 man days of family labour per hectare. Crop wise analysis revealed the same trend as in the case of class I.

Table 5.16. Labour use pattern of Class II (man days per farm)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	16	3	17	5	11	5
Paddy II	25	6	26	6	17	3
Coconut	12	6	20	8	37	7
Arecanut	1	1	3	4	2	2
Total	54	16	66	23	67	17

Table 5.17. Per hectare labour use pattern – Class II (man days)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	58	11	61	18	57	26
Paddy II	89	23	93	21	88	16
Coconut	36	18	54	22	59	11
Arecanut	32	47	64	85	68	56
Average	49	15	60	21	61	15

The labour use pattern of class III is presented in Table 5.18 showed an increase from 10 man days to 17 man days for hired labour and 12 man days to 15 man days for family labour. For control, labour use was 6 and 7 man days of hired and family labour. Per hectare labour use pattern as given in Table 5.19 revealed that labour use was increased from 29 man days to 49 man days for hired labour and 34 man days to 43 man days for family labour. In the non project area, the labour use per hectare was 27 man days of hired labour and 32 man days of family labour. Among crops coconut reported substantial increase in labour use.

Table 5.18. Labour use pattern of Class III (man days per farm)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	2	4	3	4	1	1
Paddy II	5	6	5	7	1	1
Coconut	3	2	9	4	4	5
Total	10	12	17	15	6	7

Table 5.19. Per hectare labour use pattern – Class III (man days)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy I	32	57	34	58	42	51
Paddy II	52	71	54	75	58	64
Coconut	26	19	46	21	28	34
Average	29	34	49	43	27	32

For class IV farmers the average size of farm being small only family labour was employed and only a marginal increase in labour use (2 to 3 man days) was observed as shown in Table 5.20. Regarding per hectare labour use, as given in Table 5.21 the increase in labour use in the project area was from 25 man days to 38 man days of family labour while in the non project area, 17 man days of family labour was used.

Table 5.20. Labour use pattern of Class IV (man days per farm)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy II	-	1	-	1	-	-
Coconut	-	1	-	2	-	1
Total	-	2	-	3	-	1

Table 5.21. Per hectare labour use pattern – Class IV (man days)

Crops	Before W.D.P		After W.D.P		Control	
	H.L	F.L	H.L	F.L	H.L	F.L
Paddy II	-	71	-	78	-	-
Coconut	-	38	-	43	-	37
Average	-	25	-	38	-	17

5.3.2 Production and productivity of crops

The objective of the farmer while adopting soil and water conservation measures is an increase in production of the crops. Improvement in moisture retention in soil and better water availability facilitated increased and efficient use of fertilizers consequently leading to an increase in productivity. The productivity of major crops in the project area before and after investment and in the control group is presented in the following section.

The productivity of major crops of class I in the watershed area and non watershed area are shown in Table 5.22 The results revealed that the productivity of coconut increased from 41 nuts to 44 nuts per palm in the watershed area and it was 39 nuts per palm in the control area. In the case of arecanut the productivity increased from 162 nuts to 176 nuts per palm in the project area while it was 158 nuts in the non-project area. Yield of second crop paddy increased from 3004 kg to 3082 kg per hectare in the watershed area, which was 3039 kg in the non watershed area.

Table 5.22. Productivity of major crops – Class I

Crop	Before W.D.P	After W.D.P.	Control
Coconut (Nuts/palm)	41	44	39
Arecanut (Nuts/palm)	162	176	158
Paddy I (kg/ha)	3128	3149	3131
Paddy II (kg/ha)	3004	3082	3039

The productivity of major crops of class II is given in Table 5.23. The results indicated that the productivity of coconut increased from 36 to 38 nuts per palm, in the project area while it was 29 nuts per palm in the non project area. In the case of arecanut productivity per palm increased from 146 to 161 nuts in the project area. Yield of second crop paddy increased from 3268 kg per hectare to 3316 kg, while it was 3206 kg in the non-project area.

Table 5.23. Productivity of major crops – Class II

Crop	Before W.D.P	After W.D.P.	Control
Coconut (Nuts/palm)	36	38	29
Arecanut (Nuts/palm)	146	161	-
Paddy I (kg/ha)	3252	3269	3241
Paddy II (kg/ha)	3268	3316	3206

For class III productivity of crops are presented in Table 5.24. It was found that the productivity of coconut increased from 34 nuts to 39 nuts in the project area while it was 31 nuts in the non-project area. In the case of paddy (2^{nd} crop) the yield increased from 3281 kg per hectare to 3296 kg in the project area where as it was 3163 kg in the non-project area.

Table 5.24. Productivity of major crops – Class III

Crop	Before W.D.P.	After W.D.P.	Control
Coconut (Nuts/palm)	34	39	31
Paddy I (kg/ha)	3261	3268	3012
Paddy II (kg/ha)	3281	3296	3163

The productivity of major crops of class IV farmers in the project area and non-project area are given in Table 5.25. The results indicated that the

productivity of coconut increased from 24 nuts to 25 nuts per palm in the project area and it was 18 nuts in the non-project area. In the case of paddy (2nd crop) the yield increased from 2753 kg to 2801 kg per hectare in the project area. In the non-project area paddy was not taken up as already indicated in the cropping pattern.

Table 5.25. Productivity of major crops – Class IV

Crop	Before W.D.P.	After W.D.P.	Control
Coconut (Nuts/palm)	24	25	18
Paddy II (kg/ha)	2753	2801	-

5.3.3 Cost of cultivation of major crops

Farm expenses incurred by different categories of farms were studied for both pre- project period and post-project period. For calculation of farm expenses major operations in the cultivation of crops were first identified. The major items of costs were land preparation, manures, fertilizers, harvesting, raking the field and other field works. For coconut and arecanut only maintenance costs have been considered. The cost incurred per farm for each category of farm was calculated and compared with that of non watershed area.

The total farm expense incurred for class I as given in Table 5.26 showed that a total of Rs.21547 per farm was incurred during pre-project period, which increased to Rs.29642 in the post-project period and for control it was Rs.30367. It may be noted that the average operating area of large farmers in the project area and control were 2.46 and 2.82 hectare respectively. A crop wise analysis of the cost of cultivation per hectare showed that coconut and arecanut reported substantial increase in expenses. For coconut increase was from Rs.7605 to Rs.10786 per hectare while it was Rs.9978 for control. In the case of arecanut the cost increase was from Rs.14953 to Rs.22143 where as it was Rs.16876 for control. In the case of paddy increase was from Rs.11106 to Rs.12095 and Rs.14269 to Rs.15371 respectively for first and second crop.

Table 5.26. Crop wise farm expenses for Class – I (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy – I	6663	11106	7257	12095	5018	11836
Paddy – II	9268	14269	10144	15371	5759	14730
Coconut	5467	7605	7755	10786	1302	9978
Arecanut	149	14953	221	22143	135	16876
Rubber	-	-	4265	15398	6791	14764
Total	21547	8748	29642	12049	19005	10768

Table 5. 27. Input wise farm expenses for Class - I (rupees per hectare)

Item	Paddy - Ist crop			Paddy – IInd crop		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	7920 (71.31)	8580 (70.94)	8580 (72.49)	11440 (80.17)	11990 (78.00)	11770 (79.90)
Machine labour	923 (8.31)	932 (7.71)	962 (8.13)	985 (6.90)	1011 (6.58)	1048 (7.11)
Seeds	988 (8.90)	996 (8.23)	864 (7.30)	816 (5.73)	833 (5.43)	704 (4.78)
Manures	491 (4.42)	533 (4.40)	472 (3.99)	281 (1.97)	328 (2.13)	264 (1.79)
Fertilizer	507 (4.57)	688 (5.69)	566 (4.78)	524 (3.67)	781 (5.08)	612 (4.15)
Plant protection	277 (2.49)	366 (3.03)	392 (3.31)	223 (1.56)	428 (2.78)	332 (2.27)
Total	11106 (100.00)	12095 (100.00)	11836 (100.00)	14269 (100.00)	15371 (100.00)	14730 (100.00)

Item	Coconut			Arecanut		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	6050 (79.55)	8910 (82.60)	8580 (85.99)	10340 (69.15)	17380 (78.49)	13750 (81.48)
Manures	781 (10.27)	769 (7.13)	654 (6.55)	3520 (23.54)	2436 (11.45)	2326 (13.78)
Fertilizer	629 (8.29)	881 (8.17)	560 (5.61)	873 (5.84)	1444 (6.52)	652 (3.86)
Plant protection	145 (1.91)	226 (2.10)	184 (1.85)	220 (1.47)	783 (3.54)	148 (0.88)
Total	7605 (100.00)	10786 (100.00)	9978 (100.00)	14953 (100.00)	22143 (100.00)	16876 (100.00)

Figures in parentheses indicate percentage to total

Input wise analysis of cost of cultivation for class I as presented in Table 5.27 indicated that human labour was the most important item of farm expense. In the case of paddy Ist crop, human labour constituted 71.31, 70.94 and 72.49 per cent respectively of the total cost of cultivation in the pre-project period, post-project period and for control. For coconut and arecanut there was considerable change in labour component and it increased from 79.55 to 82.60 per cent for coconut and 69.15 to 78.49 per cent for arecanut.

The total farm expense incurred for class II as given in Table 5.28 showed that a total of Rs.9763 per farm during pre-project period increased to Rs.11399 in the post-project period and for control it was Rs.10697. A crop wise analysis of the cost of cultivation per hectare showed that coconut and arecanut reported substantial change in expenses. For coconut increase was from Rs.6994 to Rs.9850 per hectare over the project period while it was Rs.9110 for control. In the case of arecanut the cost increase was from Rs.10867 to Rs.18985 while it was Rs.16243 for control. For paddy total cost increased from Rs.10759 to 12297 and Rs.15594 to Rs.16356 respectively for first crop and the second crop, while for non-project area, the total cost was Rs.12256 for first crop paddy and Rs.15100 for second crop paddy.

Input wise analysis of farm expenses of class II revealed human labour to be the major cost item (Table 5.29). For paddy it contributed more than 70 per cent in both the seasons in the project area and control. Fertilizer consumption in paddy was increased from 3.84 to 6.97 per cent and 2.85 to 4.66 per cent respectively for first crop and second crop. For arecanut, the labour cost increased from 79.97 per cent to 86.33 per cent in the project area, while it was 83.97 percent for control.

The total farm expense incurred for class III as given in Table 5.30 revealed that a total of Rs.3667 per farm during pre project period increased to Rs.3579 in the post project period and it was Rs.1509 for the control. A crop wise

Table. 5.28. Crop wise farm expenses for Class – II (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy - I	2991	10759	3418	12297	2365	12256
Paddy - II	4382	15594	4596	16356	2914	15100
Coconut	2336	6994	3290	9850	5684	9110
Arecanut	54	10867	892	18985	575	16243
Total	9763	8875	11399	10363	10697	9725

Table 5. 29. Input wise farm expenses for Class - II (rupees per hectare)

Item	Paddy - Ist crop			Paddy - IInd crop		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	7590 (70.55)	8690 (70.67)	9130 (74.49)	12320 (79.00)	12540 (76.67)	11440 (75.76)
Machine labour	880 (8.18)	880 (7.16)	982 (8.01)	1188 (7.62)	1212 (7.41)	1168 (7.74)
Seeds	913 (8.49)	913 (7.42)	898 (7.33)	789 (5.06)	769 (4.71)	820 (5.43)
Manures	527 (4.90)	347 (2.82)	412 (3.36)	421 (2.70)	570 (3.48)	564 (3.74)
Fertilizer	414 (3.84)	857 (6.97)	516 (4.21)	444 (2.85)	763 (4.66)	726 (4.80)
Plant protection	435 (4.04)	610 (4.96)	318 (2.60)	432 (2.77)	502 (3.07)	382 (2.53)
Total	10759 (100.00)	12297 (100.00)	12256 (100.00)	15594 (100.00)	16356 (100.00)	15100 (100.00)

Item	Coconut			Arecanut		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	5940 (84.93)	8360 (84.87)	7700 (84.52)	8690 (79.97)	16390 (86.33)	13640 (83.97)
Manures	616 (8.80)	836 (8.49)	724 (7.95)	1269 (11.68)	1536 (8.09)	1609 (9.91)
Fertilizer	304 (4.35)	470 (4.77)	452 (4.96)	723 (6.65)	862 (4.54)	768 (4.73)
Plant protection	134 (1.92)	184 (1.87)	234 (2.57)	185 (1.70)	197 (1.04)	226 (1.39)
Total	6994 (100.00)	9850 (100.00)	9110 (100.00)	10867 (100.00)	18985 (100.00)	16243 (100.00)

Figures in parentheses indicate percentage to total

analysis of the cost of cultivation per hectare showed the same trend as in class-II. For coconut increase was from Rs.6638 to Rs.8645 while it was Rs.8028 for the control. In the case of paddy total cost increased from Rs.12860 to Rs.13325 for the first crop, in the project and it was Rs.13298 in the non-project area. For second crop paddy, the total costs per hectare increased in the project area from Rs.18628 to Rs.19498, while for control, it was Rs.15988.

Input wise analysis of farm expense of class III as depicted in Table 5.31 revealed the same trend as in class II. For paddy, the percentage share of labour to total cost remained around 76 percent in the project area and non-project area. In coconut human labour component was increased from 74.57 per cent to 85.25 per cent while manure component decreased from 13.38 per cent to 5.30 per cent.

The total farm expense incurred for class IV farmers as presented in Table 5.32 indicated that a total of Rs.292 per farm during pre project period increased to Rs.334 in the post-project period and it was Rs.124 in the control area. A crop wise analysis of the cost of cultivation per hectare showed that for paddy 2nd crop total cost increased from Rs.12669 to Rs.14979 per hectare in the project area. In the case of coconut cost increased from Rs.5291 to Rs.5924 per hectare in the project area and for control it was Rs.4769. Input wise analysis also showed the same trend as observed in other classes, with labour component contributing the highest share for both paddy and coconut (Table 5.33).

5.3.4 Income generation

Farm income for different classes of farms were studied for both pre and post project periods. The total farm income for class I as given in Table 5.34 revealed that farm income increased from Rs.39350 to Rs.54965 in the project area while it was Rs.53233 in the non-project area. A crop wise analysis of the farm

Table. 5.30. Crop wise farm expenses for Class – III (rupees)

Crops	Before W.D.P		After W.D.P		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy - I	952	12860	986	13325	198	13298
Paddy - II	1626	18628	1703	19498	240	15988
Coconut	751	6638	978	8645	1108	8028
Total	3329	9511	3667	10226	1509	6859

Table 5. 31. Input wise farm expenses for Class - III (rupees per hectare)

Item	Paddy - Ist crop			Paddy - IInd crop		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	9790 (76.13)	10120 (75.95)	10230 (76.93)	13530 (72.63)	14190 (72.78)	13420 (76.25)
Machine labour	1004 (7.81)	955 (7.17)	1012 (7.61)	1763 (9.46)	1115 (5.72)	1286 (7.30)
Seeds	954 (7.42)	977 (7.33)	890 (6.70)	1049 (5.63)	1167 (5.99)	1089 (6.18)
Manures	541 (4.20)	556 (4.17)	461 (3.47)	1233 (6.62)	1766 (9.06)	838 (4.76)
Fertilizer	328 (2.55)	384 (2.88)	338 (2.54)	534 (2.87)	713 (3.66)	578 (3.28)
Plant protection	243 (1.89)	333 (2.50)	367 (2.75)	519 (2.79)	547 (2.79)	412 (2.33)
Total	12860 (100.00)	13325 (100.00)	13298 (100.00)	18628 (100.00)	19498 (100.00)	17623 (100.00)

Item	Coconut		
	Before W.D.P.	After W.D.P.	control
Human labour	4950 (74.57)	7370 (85.25)	6820 (84.95)
Manure	888 (13.38)	458 (5.30)	674 (8.40)
Fertilizer	683 (10.29)	574 (5.49)	236 (2.94)
Plant protection	117 (1.76)	342 (3.96)	298 (3.71)
Total	6638 (100.00)	8654 (100.00)	8028 (100.00)

Figures in parentheses indicate percentage to total

Table. 5.32. Crop wise farm expenses for Class – IV (rupees)

Crops	Before W.D.P		After W.D.P		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy – II	127	12669	150	14979	-	-
Coconut	165	5291	184	5924	124	4769
Total	292	3650	334	4175	124	2067

Table 5. 33. Input wise farm expenses for Class - IV (rupees per hectare)

Item	Paddy – II nd crop			Coconut		
	Before W.D.P.	After W.D.P.	Control	Before W.D.P	After W.D.P.	Control
Human labour	8690 (68.59)	9570 (63.89)	–	4180 (79.00)	4730 (79.85)	4070 (85.34)
Machine labour	1703 (13.44)	1703 (11.37)	–	–	–	–
Seeds	1125 (8.88)	1125 (7.51)	–	–	–	–
Manures	438 (3.46)	1531 (10.22)	–	947 (17.90)	993 (16.76)	612 (12.83)
Fertilizer	525 (4.15)	862 (5.75)	–	164 (3.10)	201 (3.39)	87 (1.83)
Plant protection	188 (1.48)	188 (1.26)	–	–	–	–
Total	12669 (100.00)	14979 (100.00)	–	5291 (100.00)	5294 (100.00)	4769 (100.00)

Figures in parentheses indicate percentage to total

income per hectare showed that coconut and arecanut showed substantial increase in income. For coconut increase was from Rs.15714 to Rs.19262 per hectare while it was Rs.17516 for control. In the case of arecanut the income increase was from Rs.24200 to Rs.31864 per hectare where as it was Rs.27684 for control. In the case of paddy increase was from Rs.22343 to Rs.23418 and Rs.24085 to Rs.25310 respectively for first and second crop. For non-project area, the income was Rs.22648 per hectare for 1st crop of paddy and Rs.24672 for 2nd crop paddy.

Table 5.34 Income pattern of Class I (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy I	13406	22343	14051	23418	8855	22648
Paddy II	14451	24085	15186	25310	9647	24672
Coconut	11251	15714	15487	19262	22788	17516
Arecanut	242	24206	2422	31864	221	27684
Rubber	-	-	7819	28226	11722	25483
Total	39350	21586	54965	25616	53233	23601

The gross farm income of class II farmers in the project area and non project area as depicted in Table 5.35 revealed that a total of Rs.19466 per farm during pre-project period increased to Rs.23181 in the project area while it was Rs.22323 in the non project area. A crop wise analysis of the farm income per hectare revealed that coconut and arecanut showed substantial increase in income for coconut the increase was from Rs.16015 to Rs.19479 in the project area while it was Rs.18273 for control. In the case of arecanut the income increase was from Rs.23186 to Rs.31681 in the project area and it was Rs.25841 for non-project area, for paddy first crop the increase was from Rs.20687 to Rs.22316 in the project area and for control it was Rs.22031. The income increase for paddy second crop was from Rs.29359 to Rs.30345 in the project area, while it was Rs.29868 in the non-project area.

Table 5.35 Income pattern of Class II (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy I	5751	20687	6204	22316	4252	22031
Paddy II	8250	29359	8527	30345	5765	29868
Coconut	5349	16015	7149	19479	11402	18273
Arecanut	116	23186	1301	31681	904	25841
Total	19466	22312	23181	25956	22323	24003

The total farm income for class III in the project area and non project area as shown in Table 5.36 revealed that a total of Rs.5677 per farm during pre-project period increased to Rs.7467 in the post project period while it was Rs.3005 in the non project area. A crop wise analysis showed the same trend as in the case of other classes and for coconut income increase was from Rs.15364 to Rs.17866 per hectare while it was Rs.16532 in the non-project area. For first crop paddy, there was an income increase in the project area from Rs.18915 to Rs.19454, while for non-project area it was Rs.19126 .For second crop paddy, the income increase was from Rs.29054 to Rs.30228 in the project area.

Table 5.36 Income pattern of Class III (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy I	1402	18915	1442	19454	287	19126
Paddy II	2537	29054	2639	30228	437	29133
Coconut	1738	15364	3386	17866	2281	16532
Total	5677	21111	7467	22247	3005	21597

The gross farm income for class IV in the project area and non-project area as given in Table 5.37 revealed that a total income of Rs.577 per farm during pre project period increased to Rs.832 after the project and it was Rs.293 in the control area. A crop wise analysis of farm income per hectare revealed that for coconut per hectare income increased from Rs.10989 to Rs.11794 after the project

while it was Rs.11263 in the non-project area. In the case of paddy, the income increase was from Rs.23221 to Rs.26284.

Table 5.37 Income pattern of Class IV (rupees)

Crops	Before W.D.P.		After W.D.P.		Control	
	Per farm	Per hectare	Per farm	Per hectare	Per farm	Per hectare
Paddy II	235	23221	266	26284	-	-
Coconut	342	10989	566	11704	293	11263
Total	577	17105	832	18994	293	11263

5.3.5 Incremental benefit-cost ratio

The ratio of change in income to the change in expenses due to the application of increased inputs and soil conservation measures was taken as the incremental benefit cost ratio. The incremental benefit cost ratio for different classes of farmers as depicted in Table 5.38, revealed that for paddy first crop class I farmers exhibited an incremental benefit cost ratio of 1.09, class II farmers 1.06 and class III farmers 1.16. In the case of paddy second crop, class I had an incremental benefit cost ratio of 1.11, class II 1.29 and class III farmers 1.35, while for class IV it was 1.33. The increment benefit cost ratio of coconut was 1.12 for class I, 1.21 for class II, 1.25 for class III while it was 1.13 among class IV farmers. For arecanut the incremental benefit cost ratio could be worked out only for class I and class II farmers, and it was 1.07 and 1.05 respectively for class I and class II.

Table 5.38 Incremental benefit- cost ratio

Category	Paddy - I	Paddy - II	Coconut	Arecanut
Class I	1.09	1.11	1.12	1.07
Class II	1.06	1.29	1.21	1.05
Class III	1.16	1.35	1.25	-
Class IV	-	1.33	1.13	-

5.3.6 Labour use, costs and returns of goat rearing.

Labour use, costs and returns of goat rearing in the project area as presented in Table. 5.39 revealed that the labour use per animal for class III was 28 man days where as it was 26 man days in class IV. The labour cost was the main item of expense which was incurred for collecting feeding material, shed cleaning, milking etc. The cost incurred per animal was Rs.3682 for class III and Rs.3513 for class IV. The main source of income was from the sale of kids, milk and goat manure. The income per animal was Rs.3827 and Rs.3763 respectively for class III and class IV. Regarding the non-project area, only very few respondents had taken up goat rearing and hence the same was excluded from the analysis.

Table 5.39 Labour use, costs and returns of goat rearing

Category	Labour use (man days)	Cost	Return
Class III	28	3682	3827
Class IV	26	3513	3763

5.4.1 Major constraints as perceived by beneficiaries

The major constraints experienced by the sample respondents were identified while conducting pilot survey. The constraints were non-availability of irrigation water, lack of technical guidance, lack of awareness of watershed programme, difficulty in produce marketing, non availability of subsidies in time, insufficient credit and high cost of labour. The response of the farmers regarding these problems were gathered in order of their importance, classified as most important, important, somewhat important, less important and least important. The score assigned to these classes were 5, 4, 3, 2, 1 in the order of their rank. The cumulative rank for each constraint was estimated and the results are presented in Table 5.40.

It was found that non availability of irrigation water was the most important constraint in the project area with a total score of 465 followed by lack of technical guidance scoring a total of 413. Lack of awareness of beneficial programme also found to be an important problem with a score of 343, while the problem of high cost of labour was the least important one with a score of 114.

Table 5.40 Major constraints as perceived by respondents in the project area

Constraints	5 Most important	4 Important	3 Some what import-ant	2 Less important	1 Least important	Cumulat ive score
Non availability of irrigation water	58	24	21	8	-	465
Lack of technical guidance	20	37	47	11	2	413
Unaware of beneficial programme	15	40	20	24	-	342
Difficulty in produce marketing	25	7	4	11	8	195
Untimely availability of subsidy	-	3	14	33	29	149
Insufficient credit	2	5	9	23	18	121
High cost of labour	-	4	5	10	63	114

5.4.2. Strengths/weaknesses of the programme as perceived by beneficiaries

The strengths/weaknesses of the programme as perceived by beneficiaries were also analysed. The responses were arranged in positive and negative perception categories and are presented in Table 5.41. The results revealed that the most prominent strength of the programme was the co-operation of farmers as perceived by 89.17 per cent of the sample respondents, followed by local feel of the project adding to the strength of the programme according to 80.83 per cent of the respondents. Selection of beneficiaries was also perceived as the strength of the project by 56.67 per cent of the respondents.

The analysis of negative perceptions about the programme by the beneficiaries showed that timely distribution of inputs was perceived as the most important weakness of the programme as per the assessment by 84.17 per cent of the respondents. It was also found that 77.50 per cent of the respondents were unaware of the rationale behind the project components. Lack of technical support was reported as another weakness of the programme as perceived by 76.67 per cent of the respondents.

Table 5.41. Strengths/weaknesses of the programme as perceived by beneficiaries

Strength/Weakness	Positive perception		Negative perception	
	Frequency	Percentage	Frequency	Percentage
1. Timely distribution on inputs	19	15.83	101	84.17
2. Technical support	28	23.33	92	76.67
3. Target achievement	34	28.33	86	71.67
4. Local feel of the project	97	80.83	23	19.17
5. Co-operation of farmers	107	89.17	13	10.83
6. Improvement in water availability	42	35.00	78	65.00
7. Selection of beneficiaries	68	56.67	52	43.33
8. Improvement in socioeconomic condition	49	40.83	71	59.17
9. Awareness about the rationale behind the project components	27	22.50	93	77.50

DISCUSSION

6. DISCUSSION

The present study envisages an analysis of the impact of watershed development in terms of changes in cropping pattern, labour utilization pattern, productivity of crops and farm income of the beneficiaries as also to identify the constraints experienced by them.

The results in terms of the various parameters mentioned are discussed in this chapter, under the following headings

6.1 Cropping pattern
6.2 Cropping intensity
6.3 Labour utilization pattern
6.4 Production and productivity of crops
6.5 Cost of cultivation of major crops
6.6 Income generation
6.7 Incremental benefit cost ratio
6.8 Major constraints
6.9 Strengths/ weaknesses of the programme
6.10 Suggestions/ recommendations

6.1 Cropping pattern

The analysis of cropping pattern of the different categories of farmers indicated that the major crops in the area were rice, coconut, arecanut and rubber. A comparison of the total cropped area of the respondents before and after the project has revealed an increase in the total cropped area. The increase in area was mainly contributed by the cultivation of unutilized land. The interventions undertaken in the area have resulted in an increase in soil moisture availability, which in turn have resulted in the increase in cultivated area. The above results are in conformity with the findings of Pagire (1989), Alagumani (1991), Misra (1991)

and Norman *et al.* (1991) where an increase in total cropped area and diversification of cropping pattern was noticed.

The changes in cropping pattern as indicated by the proportion of area under different crops showed a shift towards crops like arecanut, pepper etc. For class-I and class-II farmers rubber was found to be introduced in view of the relative profitability. Similar results were reported by Natraj (1989) where new crops were introduced as a result of Watershed Development Programme and a shift in cropping pattern for more remunerative crops was reported by Shrivastava (1991). All the above studies confirm the results obtained in the present study.

6.2 Cropping intensity

Cropping intensity was found to decrease from 141 to 131 per cent after the project in the case of class-I and the same trend was observed among other categories. It is due to the fact that even though cropped area showed an increasing trend, it was mostly contributed by the utilization of uncultivated land. Thus the net cropped area was also increased along with the gross cropped area leading to decrease in cropping intensity. The possibility for taking up more number of crops from the same area was limited as indicated in the changes in paddy area. These results are contrary to the reports by Prasad *et al.* (1989), Ghosh (1991) and Alshi *et al.* (1989), where in an increase in cropping intensity was observed. The reason for the contradiction may be the limitation of taking up seasonal crops other than paddy in the area.

6.3 Labour utilization pattern

A comparison of labour utilization pattern in the different classes of respondents before and after the watershed development programme revealed a substantial increase in labour use. The labour use shared an increase in respect of crops like coconut, arecanut and rubber for both hired and family labour. These could be attributed to the adoption of soil conservation measures as well as the

requirement of labour for planting of seedlings of introduced crops like rubber and existing crops like coconut and arecanut. More over the increased availability of green manure facilitated an increase in application of green manure contributing towards an enhanced labour use.

It may be noted that hired labour use was prominent among large farmers while for class III and class IV family labour use was predominant. In the case of class I and class II family members do not usually undertake farming operations and having larger area under cultivation they were more depended on hired labour compared to other groups and the same was found to be the reason for the above differentiation in labour use pattern. The above results can favourably be compared with the previous studies conducted by Nema *et al.* (1991) Singh (1991) and Dhyani *et al.* (1993) where in tremendous increase in employment opportunities through increased use of human and bullock labour were reported as a result of watershed development programme.

6.4 Production and productivity of crops

As envisaged in the watershed development programme, productivity of crops like coconut and arecanut showed substantial increase. The increased availability of soil moisture as a result of interventions adopted in the area facilitated an increase in fertilizer application along with an improvement in fertilizer use efficiency. The productivity of paddy crop was found to be moderate both for first and second crop. As paddy is cultivated in wet lands, where in the direct impact of interventions may not be felt, these moderate productivity changes could be substantiated. However in the case of second crop, increased moisture retention in the field as a result of the programme has contributed towards an enhancement in productivity.

The studies by Singh and Gupta (1991) Singh and Singh (1991) and Sandhu *et. al.* (1991) confirms the above findings, where in significant increase in productivity of crops was reported after the watershed development programme.

The above results can favourably be compared with the study by Norman *et al.* (1991) in Palakkad district of Kerala, in which significant increase in yield of crops were reported as a result of watershed development programme.

6.5 Cost of cultivation of major crops

The cost of cultivation of major crops in the area was estimated and the contribution of various inputs towards the total cost was analysed. As already indicated an increase in total farm expense for the different classes were observed as a result of the programme. This has been contributed on account of the increased labour use as already explained in the previous section and enhanced use of green manure, fertilizers and plant protection measures.

The crop wise analysis revealed that the increase in cost was observed for all crops in the study area. In the case of paddy, labour use was found to be more in second crop due to the fact that second crop paddy is transplanted. Among the classes, class III incurred higher cost for paddy due to the diseconomies of scale. Human labour was found to occupy about 70 per cent of the total cost of cultivation of paddy. For coconut and arecanut an increase in cost of cultivation for all the classes was observed. This could be attributed to the increased human labour use, fertilizers, plant protection measures etc. The increased moisture availability facilitated an increase in fertilizer application and consequent increase in yield. This in turn contributed towards an increase in harvesting expenses and the management practices, there by leading to an increase in cost of cultivation.

The above results are in conformity with the studies of Undirwade *et al.* (1991) and Kallur (1991). An increase in production cost and enhanced use of chemical fertilizers and plant protection chemicals were reported in these studies.

6.6 Income generation

The watershed development programme was able to bring about a remarkable increase in income for the respondents. The interventions undertaken in

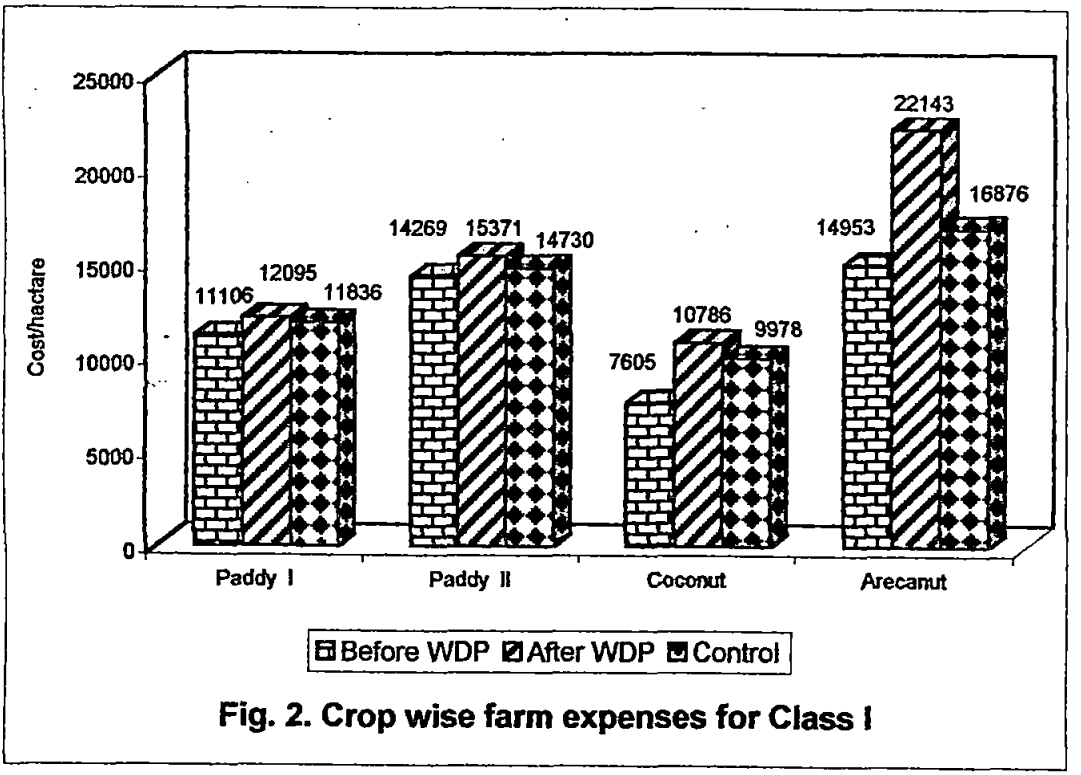


Fig. 2. Crop wise farm expenses for Class I

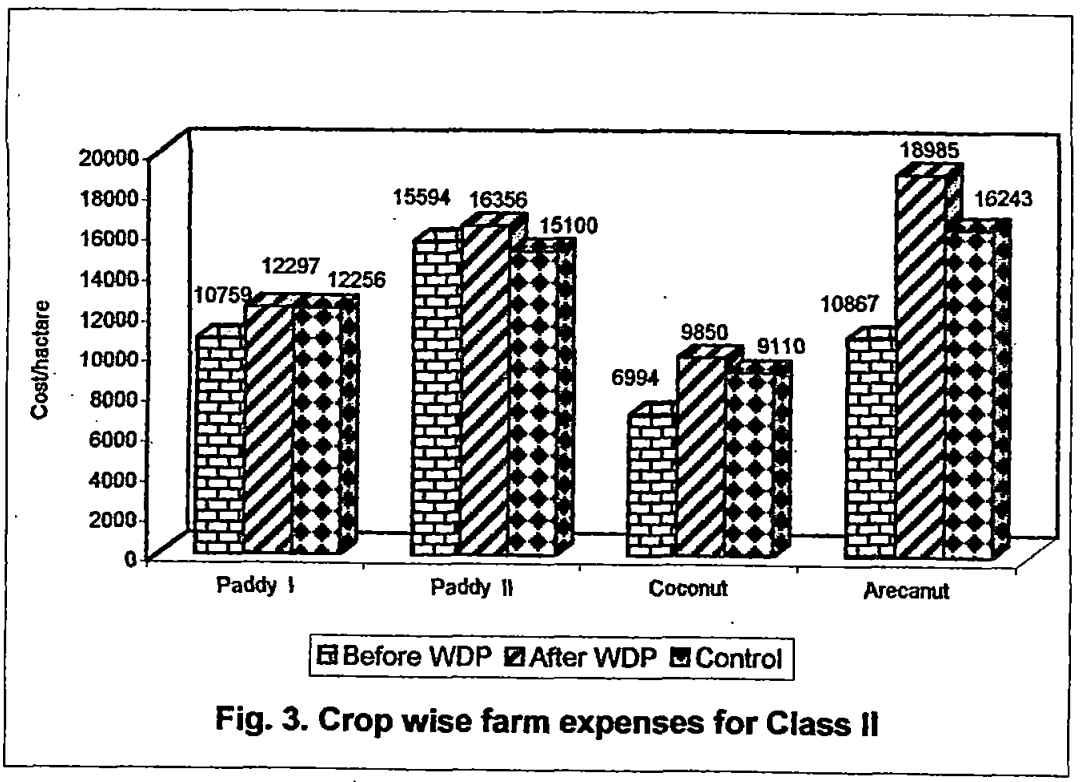


Fig. 3. Crop wise farm expenses for Class II

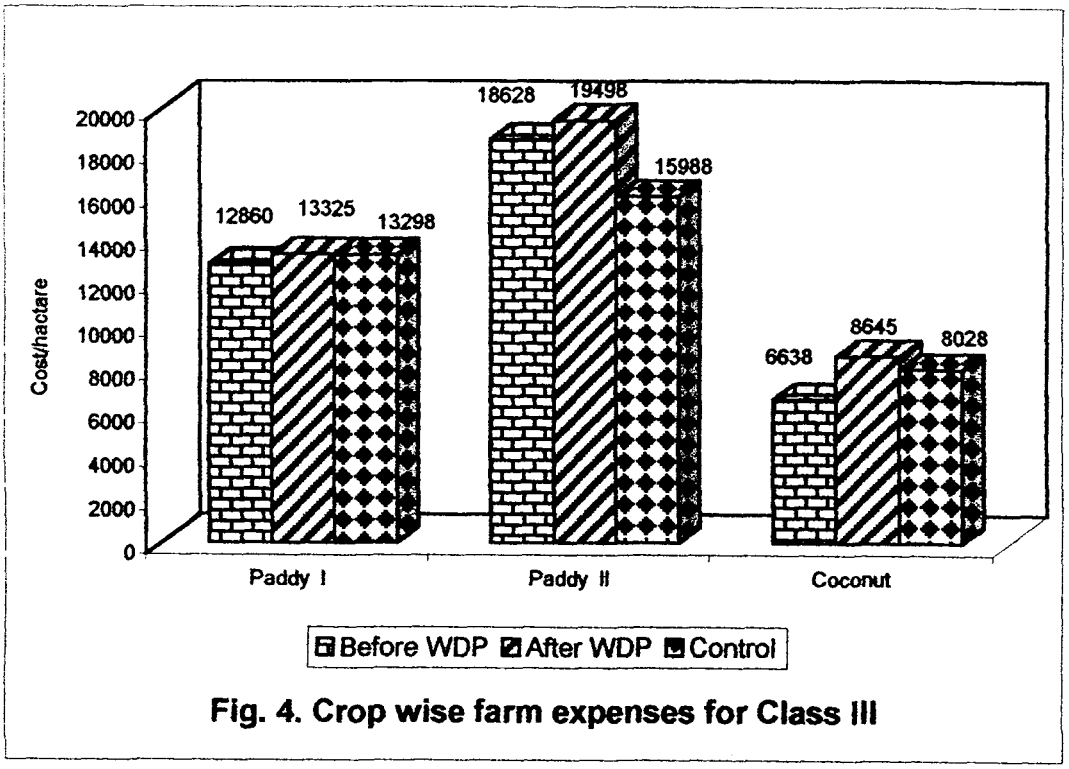


Fig. 4. Crop wise farm expenses for Class III

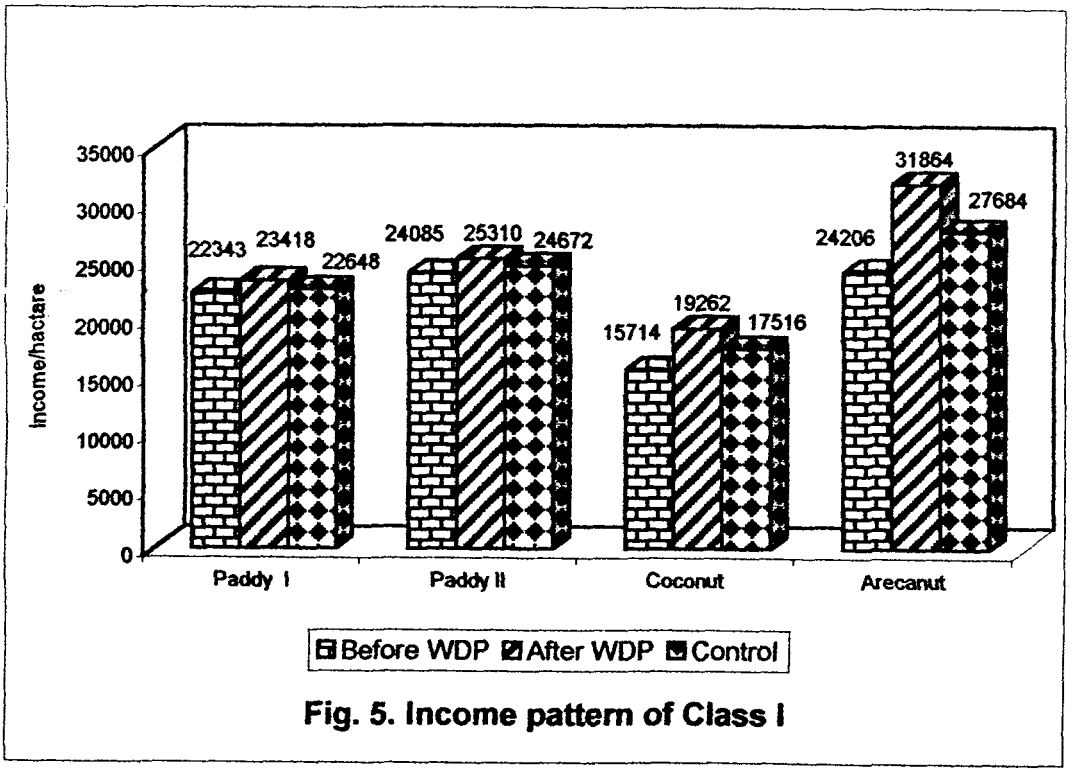


Fig. 5. Income pattern of Class I

the area like soil conservation measures have led to an improvement in soil fertility and moisture availability. As already explained in the previous sections, an increased input use especially the labour use and fertilizer use have resulted in substantial increase in yield of all the crops in the area. Consequently as envisaged in the programme, the farm income showed substantial increase. Introduction of remunerative crops like rubber had also contributed towards an enhancement of income particularly among class I and class II, who have opted for rubber during the programme. The results of the studies by Narayana and Prahalladiah (1999) and Manhandule (1991) have reported an increase in farm income of the beneficiaries of watershed development programme which confirms the results of the present study.

6.7 Incremental benefit-cost ratio

The results of the incremental benefit cost ratio worked out for the watershed development programme revealed that among the various classes, class III (marginal farmers) reported highest incremental benefit cost ratio. It could be due to the increased use of fertilizers, manures and soil conservation works, which was not practiced prior to the project, there by contributing towards a higher income. Among the crops the ratio was highest for second crop paddy in all the classes, as compared to first crop of paddy and coconut. This might be due to the increased moisture availability throughout the crop season as a result of the project, there by improving crop yields and income of farmers. These results are in conformity with the findings of Arputharaj and Rajayan (1989), where an increase in income over costs was reported after the watershed development programme.

6.8 Major constraints

The results on the constraints experienced by the beneficiaries revealed that the non availability of irrigation water was the most important constraint in the area. It may be noted that the topography of the area being sloppy most of the rain water was lost through run off within a short time which resulted in low water

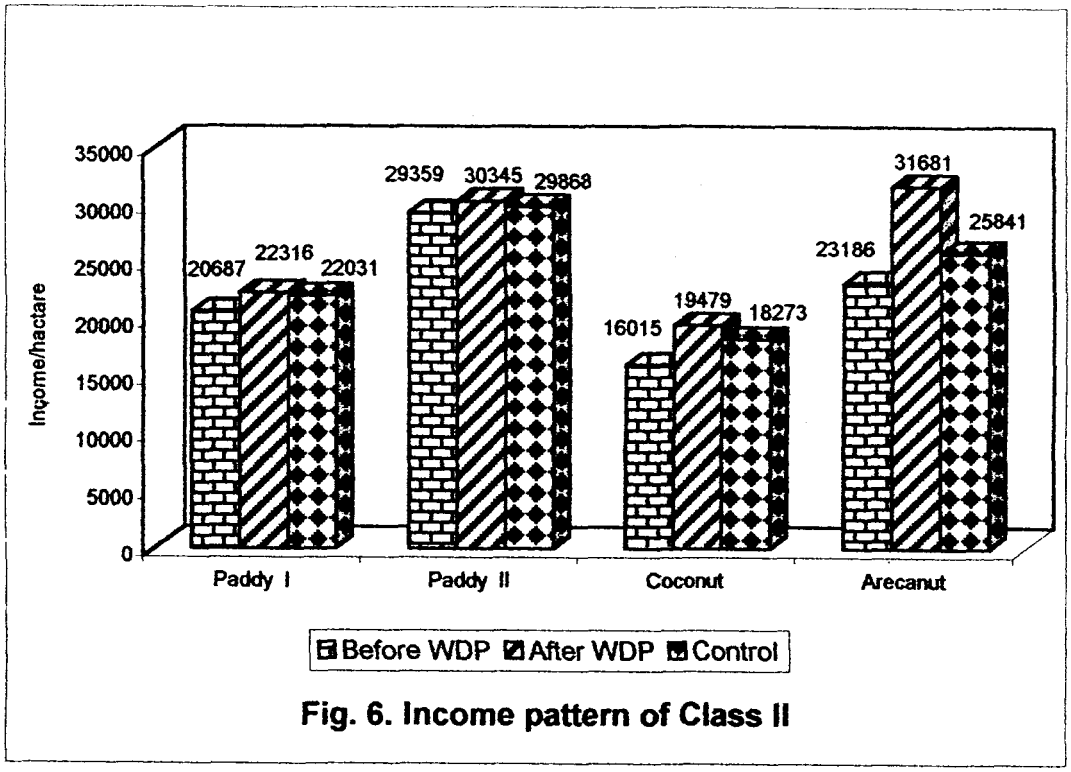


Fig. 6. Income pattern of Class II

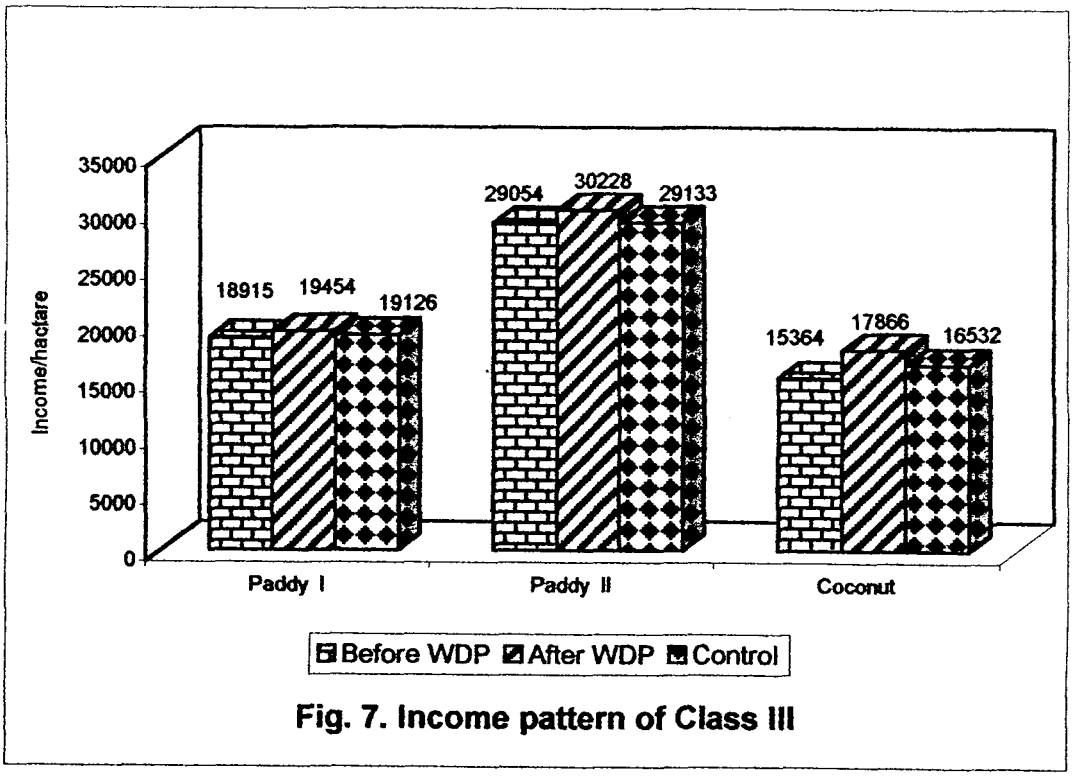


Fig. 7. Income pattern of Class III

availability. The soil conservation measures adopted by the farmer as a component of the watershed development programme would be able to improve the situation, but lack of effective implementation of the measures by the beneficiaries have made the problem severe and have led to non availability of water in the area. In certain areas the soil depth is low and rocky strata begins from two metre depth so that only tube wells are possible in these regions, which causes depletion of ground water table.

Lack of technical guidance was a major constraint in this area, which was mainly due to lack of adequate staff in the Krishi Bhavan, which is the implementing agency for the programme. As the agricultural officer has to undertake the project work in addition to the other programmes in the Krishi Bhavan, it is not possible for him to go frequently for field visits and provide technical guidance. Lack of awareness of the beneficial programme was another problem mainly due to lack of efficient personnel. The details of the programmes were not conveyed to each and every person in the area as there was no proper arrangement for communication of the benefits of the programme to the people. The above results are in conformity with the findings of Rajagopalan and Anuradha (1989) where lack of technical guidance and extension work were reported as the major constraints.

6.9 Strengths/weaknesses of the programme

As already indicated the co-operation of farmers was found to be a major strength of the programme. As the programme envisaged improvement in the living condition of the farmers, they were whole-heartedly coming forward for implementation of the project. As it was expected to improve the water availability in the area there by improving their farming system and income, the local feeling regarding the project was also highly favourable. The problem in timely distribution of inputs was found to be an important weakness of the programme. The inputs were made available at the end of the season or at the off season. So the

farmers were not able to make use of the benefits, thereby leading to wastage of inputs. It was also found that majority of the farmers were unaware of the rationale behind the project components. This has led to the situation of most of them becoming non-adopters of soil and water conservation measures. This might be due to lack of orientation of farmers towards the need of soil and water conservation measures. Lack of technical support was another weakness of this project, mainly due to lack of adequate staff for the implementation of Watershed Development Programme. In most of the cases the Agricultural Officer in charge of the Krishibhavan has to carry out the project implementation, making it difficult for him to concentrate in providing technical support to the farmers.

6.10. Suggestions/Recommendations

1. NWDPRA is a programme spread well over all the districts of the state. However, it is felt that treatment of highly eroded regions as well as drought prone regions should get priority. It would be better if NWDPRA is taken up in the entire drought prone areas of the state on priority basis.

2. While planning for watershed preference should be given for locally available technologies, which is substantial in the long run.

3. The adoption of technologies having high cost and long gestation like bunding, improved implements etc., mainly depends upon the incentives to adopt such technologies. So more incentives are to be provided for such technologies especially for the small and marginal farmers.

4. The flexibility in planning of the components and time frame of implementation at local watershed level will help in effective implementation of the programme. Savings available in one component should be utilized in another component and such flexibility helps to achieve the objectives within the specified time.

5. There should be enough orientation programmes for the farmers and the project staff, before the implementation of the project. This will help to achieve a higher efficiency from initial period onwards.

6. It is essential to improve the inter-departmental co-operation for the effective implementation of various components at the watershed level.

7. The guidelines of National Watershed Development Programme for Rainfed Areas recommended internal as well as external monitoring of the project. The internal monitoring is carried out by the departmental staff but external monitoring is not taken up in the state. External monitoring should be carried out, which helps in effective implementation.

8. The structures constructed as a part of watershed project must be low cost and self sustaining one so that more preference will be given to live structures than engineering structures.

9. The number of 'Mitra kisans' has to be increased so as to derive better and wide spread participation.

10. For a successful watershed development programme, it is essential that the beneficiaries contribute either in terms of labour or share the expenses of the treatments such participation can be achieved by initiating what we can call as 'watershed samithis'. This organization will be helpful in effective implementation.

11. There should be a separate agricultural officer in charge of watershed project, so that it helps him in better implementation and giving technical guidance to the farmers.

12. Proper arrangements for timely distribution of inputs should be made to make the programme highly beneficial to the farmers.

SUMMARY

7. SUMMARY

The present study on the Economic analysis of watershed development programme in Palakkad district was undertaken during the year 1999-2000. The objectives of the study were to assess the changes in the land use pattern, cropping pattern, income and employment generated in the area and to analyse the problems and weaknesses of the programme as perceived by beneficiaries.

Stratified random sampling technique was adopted for the selection of sample farmers. Out of the four completed watershed projects in the district, two watersheds Viz. Pavukonam and Karalmanna were randomly selected. The beneficiaries of the project include large, small, marginal and SC/ST farmers. From each watershed a total of 60 beneficiaries belonging to the different categories have been randomly selected. In addition to this 60 non-beneficiaries were also selected from the non-watershed area as control group, making a total sample of 180.

Tabular analysis was used to study the socio-economic features and the impact of watershed development programme was measured on the basis of changes reflected in certain parameters like cropping pattern, cropping intensity, employment generation, cost of cultivation and farm income over the project period. The results of the study indicated that major crops in the area were rice, coconut, arecanut and rubber. The cropping intensity showed a decrease from 141 to 131 per cent after the project in the case of class 1 and the same trend was observed among other categories.

The labour use in the case of crops like coconut, arecanut, and rubber for both hired and family labour showed an increase. Hired labour use was prominent among class I while family labour use was predominant in other categories.

The total farm expense incurred for class I was increased from Rs.21547 to Rs.29642 per farm after the project. Crop wise analysis of cost of cultivation showed substantial increase. For coconut increase was from Rs.7605 to Rs.10786 per hectare and in the case of arecanut the cost increase was from Rs.14953 to Rs.22143. Input wise analysis indicated human labour to be the most important item of farm expenses. For paddy human labour constituted 71.31 per cent of the total cost of cultivation. The share of labour in the total cost for coconut increased from 79.55 to 82.60 per cent of the total cost over the project period, while the increase was from 69.15 to 78.49 per cent for arecanut.

In the case of class II farm expenses increased from Rs.9763 to Rs.11399 per farm after the project. Crop wise analysis of cost of cultivation showed that for coconut increase was from Rs.6994 to Rs.9850 per hectare after the project and in the case of arecanut the increase was from Rs.10867 to Rs.18985. Input wise analysis of farm expenses revealed human labour as the major cost item. Increased use of human labour was observed in arecanut from 79.97 per cent to 86.33 per cent of the total cost over the project period along with an increase in fertilizer consumption.

Input wise analysis of farm expenses of other classes also showed the same trend as that of class I and class II. The increasing trend could be attributed to the increased human labour use, fertilizers, plant protection measures etc. The increased moisture availability facilitated an increase in fertilizer application and consequent increase in yield. This in turn contributed towards an increase in harvesting expenses and management expenses there by leading to an increased cost of cultivation.

The watershed development programme was able to bring about a remarkable increase in income for the respondents. The interventions undertaken in the area such as soil conservation measures have led to an improvement in soil fertility and moisture availability. Among class I the total farm income increased

from Rs.39350 to Rs.54965 after the project. The per hectare income from coconut increased from Rs.15714 to Rs.19262 for class I. Similar trend was observed in the case of other categories. Introduction of remunerative crops like rubber might have contributed towards an enhancement of income particularly for small and large farmers, who have opted for rubber during the programme.

The incremental benefit cost ratio for different classes revealed that among various classes class III reported highest ratio and among different crops the ratio was highest for second crop paddy in all the classes, with a value of 1.35, in class III.

Analysis of major constraints revealed that nonavailability of irrigation water was the most important constraint in the project area, followed by lack of technical guidance. Lack of awareness of beneficial programme was also found to be an important problem. The analysis on strengths/weaknesses of the programme indicated that co-operation of farmers was the major strength of the programme. It was expected that the project would improve the water availability in the area there by improving their farming system and income and hence there was favourable local feeling regarding the project. The problem in timely distribution of inputs was found to be an important weakness of the programme. Lack of technical support was another weakness of this project, mainly due to lack of adequate staff for the implementation of watershed development programme.

The following suggestions are put forward regarding the implementation of the project on the basis of the above study.

1. Priority in watershed projects should be given for treatment of highly eroded regions as well as drought prone regions. It would be better if NWDPRA is taken up in the drought prone areas of the state on priority basis.

2. Preference should be given for locally available technologies.

3. Flexibility in planning is essential which will helps in effective implementation of the programme.

4. It is essential to improve the inter departmental co-operation for the effective implementation of various components at the watershed level.

5. There should be a separate agricultural officer in charge of watershed project, so that it leads to better implementation of the programme.

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ECONOMIC ANALYSIS OF WATERSHED DEVELOPMENT PROGRAMME IN PALAKKAD DISTRICT

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ABSTRACT OF THE THESIS

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ABSTRACT

The present study on "Economic analysis of watershed development programme in Palakkad district was undertaken during the year 1999-2000. The study was focused on the estimation of nature and extent of benefits realised by farmers after the watershed development programme.

Data for investigation was generated through a sample survey of the project beneficiaries and non-beneficiaries. Stratified random sampling was adopted for the selection of sample farmers. Out of the four completed watershed projects, two watersheds were randomly selected. From each watershed a total of 60 beneficiaries belonging to the different categories were selected. In addition to this 60 non-beneficiaries were also selected from the non-watershed area as control group, making a total sample of 180.

The results of the study showed an increase in area under horticultural crops. An over all higher productivity and income generated through agriculture was observed in watershed area as compared to the non-watershed area. This cannot be attributed totally to the watershed project but can also be due to the better adoption of new technology in the area.

Among the constraints faced by the beneficiaries, three assume great importance, namely, (a) non-availability of irrigation water (b) lack of technical guidance and (c) lack of awareness of beneficial programme. The analysis on strengths/weaknesses of the programme indicated that co-operation of farmers was the major strength of the programme. The problem in timely distribution of inputs was found to be an important weakness of the programme.

Thus it is evident that the Watershed Development Programme was able to bring about improvement in living condition among its beneficiaries and also among different categories of farmers. Incentives given to beneficiaries have played prime role in influencing technological changes among beneficiaries,

besides management orientation. There is need to give due importance for the above factors with suitable changes by the watershed staff to promote successful implementation of watershed development programme.