POLLUTION HAZARDS ON THE PEOPLE AND ECOSYSTEM OF SELECTED COIR RETTING YARDS IN THE BACKWATERS OF CALICUT DISTRICT

FINAL REPORT

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KUNNAMANGALAM, KOZHIKODE 673 571, KERALA

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APPENDIX V

TEST CHARACTERISTICS FOR DRINKING WATER

(Indian Standard - specification BIS-IS 10500:1991)

Sl.No	Substances or characteristics	Requirement (Desirable limit)
i	Colour, hazen units, max	5
ii	Odour	Unobjectionable
iii	Taste	Agreeable

iv	pH value	6.5-8.5
v	Total hardness, mg/l,max	300
vi	Iron mg/l, max	0.3
vii	Chlorides, mg/l, max	250
viii	Calcium mg/l, max	75
ix	Magnesium mg/l, max	30
x	Sulphide mg/l, max	2
xi	Nitrate, mg/l, max	45

BACTERIOLOGICAL QUALITY

WHO Standards

Fecal coliforms	0
Coliforms	10/100ml

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ABBREVIATIONS AND SAMPLE CODES USED

Abbreviations	
BOD - Biochemical Oxygen Demand	PHC - Primary Health Centre
MPN - Most Probable Number	WHO - World Health Organization
SPC - Standard Plate Count	ORS - Oral Rehydration Solution
PRA - Participatory Rural Appraisal	URI - Upper Respiratory Infection
NGO - Non Governmental Organization	APD - Acid Peptic Disease

Sample Codes	
R1 - Retting yard 1, Ward 11, Kizhukottil	K3 - Well in Pullichery area, Ward 10
R2 - Retting yard 2, Ward 10, Kizhakkumpadu	K4 - Well in Pullichery area, Ward 10
W1 - Well 0.5 Km away from R1, Ward 11	K5 - Well located in a Sand dune in Kadalundi River, near R2, Ward 11
W2 - Well 1 Km away from R1, Ward 11	K6 - Well in Ward 11
W3 - Well 0.5 Km away from R2, Ward 10	K7 - Well in Ward 7
W4 - Well 1 Km away from R2, Ward 10	K8 - Well in Ward 7
K1 - Community well near Kadalundi Railway Station, Ward 7	K9 - Well in Ward 9
K2 - Well near Kadalundi Railway Station, Ward 7	K10 - Well in Ward 9
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Chapter VIII

POLLUTION HAZARDS ON THE PEOPLE AND ECOSYSTEM OF SELECTED COIR RETTING YARDS IN THE BACKWATERS OF CALICUT DISTRICT

Nirmala. E , Jalaja T. K. & Remani. K. N.

ABSTRACT

The backwaters of Kerala provide water front for several major and small scale industries, amongst which coir retting industry ranks first. This industry provides employment to a large number of people, especially women folk, who find this work as the source of their principal income. Traditional conventional method of retting has adverse impacts on the ecosystem, including fauna, flora and human beings. Lack of dissolved oxygen, very high BOD, chloride, hardness, nutrients and low pH, with foul smell of hydrogen sulphide are the characteristic features of the retting yards. Socio-economic survey conducted in the coastal Panchayat of Kadalundi in Calicut District, through random sampling method, revealed the low financial, educational and health status of the target group. Only 52% of the retting community had protected water supply, 36% of them were illiterate and 16.5% of the house holders lack latrine facilities. Management and preventive measures were adopted by disseminating scientific and technical know-how through Awareness and Health Camp, to increase their health and life status. Treatment and therapies were provided to the patients to reduce their drudgery and improve their health status. Statistical analysis of the job oriented diseases show high prevalent rate for Low Back Ache, Peripheral Neuritis and Acute Respiratory Infection. Rooftop Rain Water Harvesting System using ferrocement Technology installed and demonstrated would serve as a model to solve acute drinking water scarcity problems in the target sites. To continue the Project activities in a sustainable way and to ensure the upliftment of the life status of the retting community, Local Level Committees were formulated in each Ward of Kadalundi, involving medical practitioners, ward members and care takers selected from among the local people. Retting community as a whole deserve consolation from the public and the Government through sustainable schemes and programmes for their welfare.

Key Words : *Coir Retting, Job Oriented diseases, Rainwater Harvesting, Health Camp & Awareness Camp*

INTRODUCTION

The quest of man to conquer nature has led to ever increasing degradation of the environment than envisaged. Scientists and environmentalists now appear to be strongly committed to collaborate in finding long term solutions to these vexing environmental and resource problems. The far reaching consequences of the problem can only be solved by making the people environmental conscious, thereby achieving a transition into a sustainable society.

Rapid rate of urbanisation has imposed great strain on man and ecosystem. Population explosion compounded with pollution from anthropogenic activities has affected aquatic and terrestrial ecosystem, threatening human life and generating massive economic loss. Thus, multifaceted activities like rapid industrialisation, expanding population and agricultural activities have severely effected the status of the coastal environmental zone of Kerala. Clustered along the coastal belt are major industries like Fertilizer and Chemical, Pulp and Paper Mills and an array of small scale industries such as coir retting, log setting, sugar mills, ice plants, clay, bricks and pottery making and food processing units. Among the smallscale industries, coir retting stands first.

Kerala being a major coconut producing State, the development of coir industry has been largely confined to the State and accounts for about 80% of the total production of coir fibre (**CWRDM Report, 1989**). A vast number of the rural population, especially women folk are engaged in coir retting. As such, they are at a high risk of developing occupational diseases. Hence,

this Project aims to study the impact of coir retting industry on the target group and ecosystem, thereby suggesting and implementing mitigative measures.

BACKGROUND

Kerala coast is strikingly bordered by a string of backwaters, generally running parallel to the shoreline (***Fig 1***) These water bodies locally known as Kayals, occupy extensive areas. The size of these water bodies are significantly varied. Out of the 29 backwaters of the Kerala coast, seven are characteristically river mouth estuaries. The backwaters of Kerala provide water front for several major and small scale industries, amongst which coir retting industry ranks first. This industry provides employment to a large number of people, especially women folk. The raw material for the industry is obtained by immersing the husk in water for 8-9 months. In Kozhikode district, retting yards are located along the three main rivers viz: Kallaipuzha, Korapuzha and Kadalundi river ***(Fig 2***) . Here, mainly conventional methods of retting are practised. Retting of husk presents unique and extremely serious problems along the coastal belt, changing the hydroecology of the water body. Besides the ecological degradation caused by the liberation of organic wastes during the retting process, the unhygienic conditions prevailing around the area results in health hazard problems to the people engaged in this cottage industry. A vast number of rural population of coastal Kerala is engaged in retting industry, irrespective of their age. They find this work as the source of their principle income. Male members are associated with coolie work connected with coir industry, agriculture and fishing. The most striking aspect of the retting industry is that the workers in the retting site spent almost the whole day in the unhygienic conditions prevailing in the yard and find hardly any time to spare for other educational and cultural activities. The wages given

to them are very low compared to their hard work. As a natural consequence their living conditions are never improved. Their financial and epidemiological conditions remain to be very low. The area around the retting yards are inhabited mainly by the community engaged in coir industry. Hence, job related diseases are likely to occur among these people. In the retting sites, aquatic pollution is caused due to organic wastes like lignin, tannin and polyphenols. Low pH and oxygen content, high BOD, chloride and alkalinity leads to anoxic condition, adversely affecting the flora and fauna. Air pollution also prevail in these areas due to the release of hydrogen sulphide, methane and carbondioxide. Common diseases likely to occur among the people are filariasis, eye diseases, skin diseases, oedema of lungs and headache due to the inhalation of poisonous gases. In the above circumstances, this Project mainly aims to study the impacts of coir industry on the ecosystem and the target group engaged in this trade. The Project also lays prime emphasis on recommending and implementing measures to enhance the socio - economic and health status of the local people in the retting site.

OBJECTIVES

(i) Primary Objectives

- To study the impact of coir retting on the socio-economic and health status of the local people, with special reference to those employed in this trade, especially women.

(ii) Secondary Objectives

- To study the type and extent of pollution caused by retting with reference to the following aspects and recommendation of mitigative measures.
  - (a) On the quality of drinking water sources of the target area (groundwater pollution of dug wells)
  - (b) On the ecology of the selected site with reference to fauna and flora
- To suggest mitigative measures for the reduction of cumulative impacts of pollution due to retting and to enhance the socio-economic and health status of the local target group.
- To conduct health camps in the target area to examine the presence of occupational diseases among the local people and to provide preventives and therapies.
- To conduct 'Awareness Campaign' in the selected target sites explaining the following aspects
  - (a) Sanitation and hygiene which will help to enhance their life status.
  - (b) Drinking water quality and safe drinking water.
  - (c) Low cost methodologies for water treatment.

For conducting awareness campaign necessary help from Local Level Agencies like Mahila samajams, Panchayats, Gramasabhas will be sought.

- To form a committee consisting of members from local bodies like Panchayats, Blocks and Health Centres and selected members from local people engaged in retting industry i.e. Local Level Committee (LLC) to entrust or carry on the measures suggested in the Project.

METHODOLOGY

- Preliminary survey of the retting yards in Kallai river, Korapuzha and Beypore river and final selection of highly problematic areas.

- Physicochemical and biological analysis of water and sediment samples from the selected sampling sites at seasonal intervals. Physicochemical analysis include, temperature, dissolved oxygen, pH, electrical conductivity, hydrogen sulphide concentration, phosphate and nitrate. Biological analysis include : (i) Plankton (ii) Nekton (iii) Benthos (iv) Productivity by chlorophyll analysis.

- Collection of water samples for physicochemical and microbiological analysis (coliforms, fecal coliforms, MPN, SPC) from the dug wells, to assess the quality of water.

- Socio-economic and health survey

Household details from local people residing in the target area will be collected to assess their social, cultural, economic, educational, health status and epidemiological aspects.

- Health camps will be conducted in the target area. Doctors from the Department of Community Medicine of Medical College or Health Centres will examine the groups to assess the presence of occupational diseases among the target groups and preventives and therapies will be provided to the patients.

- Awareness campaign will be conducted in the target site and the following aspects will be explained and demonstrated which will be highly useful especially to the womenfolk.

- Formation of a Local Level Committee (LLC)

  A Local Level Committee will be formed consisting of members from Panchayats/Blocks, Health Centres and selected people from local communities. They can meet at regular intervals and discuss the plans already entrusted in the Project for the welfare of the local people. The aim of this Local Level Committee is to put the programmes already evolved into sustainability.

REVIEW OF LITERATURE

Studies on the ecosystem of Cochin backwaters in the retting and non-retting areas were carried out by various authors. Organic matter showed enrichment in the retting ground sediments. Annual average of bacterial biomass was higher in the reference (control) station. Bacterial contribution to total organics was consistently higher at the reference station. (**Remani et al., 1981**).

Fluctuations in the abundance of Crustaceans, the important component of plankton community and a major food item of many fishes in the retting zone were studied. The existence of sulphide system in the retting zone and the seasonal variation in abundance of the Crustacean fauna, in comparison with the non- retting area were discussed by **Abdul Aziz et al., 1982**. Environmental pollution due to retting of coconut husk and preliminary studies on closed system retting has been studied by **Abbassi, et al., 1982**.

The retting of coconut husks in the backwaters is brought about by the pectinolytic activity of microorganisms, especially bacteria and fungi, degrading the fibre-binding material of the husk and liberating large quantities of organic substances including pectin, pentosan, fat and tannin into the ambient water. Microbiological studies of a few coconut retting areas were carried out by **Jayasankar & Menon, 1961**. Retting activities carried out in anaerobic system were studied by **Bhatt, 1969**. Effects of retting on water quality and ecosystem of the estuaries of Kerala has been studied in detail by various scientists. The impact of retting on the fishery wealth was studied by **Abdul Azis and Balakrishnan Nair, 1978**. Oxidation of organic matter liberates hydrogen sulphide, adversely affecting the fishery wealth of the area. The nature, significance and consequences of this man-made sulphide system were examined in detail and its effect on the fishery of the area was discussed. Fluctuation in the abundance of Crustaceans, has a direct bearing on fisheries. The Edava-Nadayara - Paravur backwater system with the exception of the retting areas supports a rich fishery. Seasonal variations in the Crustacean plankton population with reference to the non-retting areas were noticed by **Abdul Aziz, et al., 1982**. The existence of sulphide system in the retting zone and the seasonal variation in abundance of the Crustacean fauna in comparison with the non retting area are discussed in detail. **Remani, et al., 1981** studied the characteristics of a retting yard and a control station (reference station) in Cochin backwater. Effects of monsoon were found significant. Organic carbon and organic matter showed enrichment in the retting ground

sediments. The C/N ratios were constituently higher in the retting yard. Annual average of bacterial biomass was higher in the non retting yard (25.7mg/g) as against 22.8 mg/g in the retting yard. Ecology of the Akathumuri, Anjengo and Kadinamkulam lake and its physicochemical conditions were studied by **Balakrishnan Nair. N., 1983**. Meiofauna of Edava - Nadayara backwater system, south-west coast of India was studied. Ecology and distribution of benthic macrofauna in the Ashtamudi estuary of Kerala were attempted by **Balakrishnan Nair. N. et al., 1984**. Pollution in Cochin backwaters due to coconut husk retting with special reference to benthos, was studied by **Remani 1979**. Ecology of Vaduthala retting yards in cochin backwaters and its effect on water quality, sediments and estuarine communities, especially local fisheries were reported by **Remani et al., 1980**. Studies on the sediments of retting yards with reference to the nutrient contents in Cochin backwaters were attempted **(Remani et al.,1981).** Indicator organisms among benthic communities which dominated maintaining high population densities in retting yards of Cochin backwaters were studied **(Remani, et al., 1983).** Various species of Polychaetes which are pollution tolerant are abundantly seen in the retting yards. Studies on the variations of Polychaete fauna in areas affected by retting was attempted by **Antony et al., (1982).** Effect of retting on the reproductive potential of green mussel *Perna viridis* in the intertidal mussel beds of Elathur along the Malabar coast was studied **(Ajith Kumar et al.,1982). Remani & Nirmala (1989)** classified the retting yards based on hydrology, area and intensity of retting activities. The process of retting is found to cause pollution problems in the river mouths and backwaters. Detailed systematic studies were carried out in Kadalundi retting yards. Adverse effects of pollution are well marked on the local fishery of these areas. Assessment of pollution due to retting of coconut husk and development of Alternative Retting Technology was carried out by **Remani and Nirmala, 1989, (CWRDM Report).** Experiments on the development of alternative retting technology reveals that retting can be practised in fresh water. The periodicity of retting is prolonged in closed system in anaerobic conditions. Flushing of ret liquor reduces the periodicity of retting without affecting the quality of fibre. Impact of retting industry on the fauna and flora

of the backwater system was studied by **Remani and Nirmala, (1990).** Correlative assessment of benthic communities in the retting yards based on the taxa and ranges of Dissolved Oxygen content were carried out by **Remani and Nirmala, (1989)**. The high population density and species richness which are the structural parameters of the benthic community suggests a relationship between community composition and dissolved oxygen regime.

Acute drinking water scarcity problem is being experienced by the people living in Mannoor area, near Kadalundi. Eighty families requested the Panchayat President, Kadalundi to provide them with safe drinking water **(Malayala Manorama, 18th May 2000)**. People who earn their living from retting industry suffer much due to the very low wages they receive from the Coir Mill owners. Thus, low wages compounded with untiring labour and seasonal employment aggravates their poverty (**Mathrubhumi, 14th May 2000**). Coir workers of Malappuram district in Kerala, is of the opinion that mechanical defibering have lost the job opportunities of many workers who are engaged in this industry **(Mathrubhumi, 26th May 2000)**

Coirfed has taken the initiative to help the coir industry to achieve new standards of excellence in quality by setting up a Raw Material Bank. Its aim is to ensure uniform high quality of the raw materials required including dyes and chemicals. Today, Coirfed, the apex body of more than 600 co-operative Coir Societies has taken on the mantle of keeping alive this eco-friendly heritage in this land of coconuts. The prosperity of more than four lakhs coir workers in its vast family, is ensured directly by Coirfed, while 20 million is benefitted indirectly. **(The Hindu, Friday, August 4, 2000)**

In the traditional retting process, 9-11 months are required for retting the husk, which is a negative factor for the progress of this industry. Central Institute of Alleppy has designed a new methodology for retting the coconut husk within 3 months. A group of

bacteria named as "Coir Rett" when introduced @ 6 kg/one tonne coconut husk, can degrade the husk within 3 months. This methodology can be successfully applied for getting 'Golden Fibre' within short duration. This is also an easy way of reducing the pollution load in the retting yard **(Mathrubhumi, September 22nd, 1999)**

RESULTS AND DISCUSSIONS

Reconnaissance Survey

A detailed survey was conducted along the retting yards of Kozhikode district. Representative retting yards in and along the main rivers of Kozhikode, viz. Korapuzha, Kallai and Beypore rivers were surveyed. In Cheruvannoor, Ramanattukara and Kadalundi retting is practised in the tributaries of Beypore river. The retting yards of Kadalundi are a few kilometers away from the barmouth. On the eastern side of the retting yard, Kadalundi river continues as Beypore river and on the western side the river joins the sea. In Ramanattukara retting sites are in Pallipuzha, which is a branch of Kadalundi river on the western side. In Cheruvannoor and Perumugham, retting sites are in the branches of Beypore river itself. In Elathur, Eranhikkal, Thalakkulathur and Kuniyakkadavu in Korapuzha river, retting is practised in the river and canals connected to it. At Chettikulam in northern Kozhikode, retting is carried out near the seashore. Rocky pits on the sea shore serve as retting pits. Husks are dumped into these rocky pits in the surf beaten areas of the seashore yards in Kadalundi, Ramanattukara, Cheruvannoor and Thalakkulathur. The area extends from 1.0 - 1.5 acres and 5-6 lakhs of husks are ret each year. 1 to 2 lakhs of husks are ret in Eranikkal, Elathur, Iringalloor and Payyanakkal in an area less than one acre. In Olavanna, Palazhi, Kuniyakkadavu, Pokkunnu and Chettikulam the yards are not found to be extensive and here the number of husks ret depends upon the availability in each year. Along the coastal belt of Kozhikode, method of retting, defibering of coconut husk and processing of coir fibre is mainly carried out by two processes

a) Natural Process and
b) Mechanical Process.

a) Natural Process

Natural retting process involves, conventional method by immersing the husk in the backwaters, rivers and canals connected to it. ***Plate-1*** shows the figure of the husks heaped near the retting sites in the backwater. Wells of depth 4-5 feet are made and about 1000-2000 husks are dumped into these pits and covered with mud. Sometimes the husks are tied in coir nets called 'Mallis'. Stakes are built to prevent the husks from being carried away by the waves. In the first stage of this process, the husks swell up and carbohydrates, tannins and nitrogenous compounds get leached out. During the second stage i.e., the biological stage, the organisms act upon these compounds producing organic acids and gases. The fibres in the middle lamellae get loosened. The fibres are extracted from the decayed husk by malleting the husk by wooden hammer. The natural process of retting takes about 9 months to one year for the husk to ret and it is a slow and time consuming one. In the retting yards of Kozhikode, husks are ret by natural processes and this extracted fibre contribute to the white coir fibre. This natural process of retting, results in much pollution and ecodegradation of the backwaters of Kerala.

b) Mechanical Process

In the mechanical process of retting, coconut husk is soaked in fresh water for one week and crushed in the machine. The crushed husks are fed into defibering machine for the extraction of fibre. The screening machine removes the pith from the fibre. With the help of hydraulic press, the fibres are compressed into bales ***(Plate-2)***. The coir fibre obtained by mechanical process will be small in length and can be used for making matresses and brushes. Mannur Coir Co-operative Society located in

Kadalundi Panchayat is actively engaged in yarning coir fibre. Society purchase the fibre from the co-operative societies located at Ponnani, as suggested by Coir fed. Depending upon the quality of the fibre, Mannur Co-operative Society purchases the fibre and the cost is paid to Coirfed. The cost of the fibre usually vary from Rs.1200 to Rs.1600 per quintal. Usually ladies are actively engaged in yarning the coir fibre in the Ratt. At an average rate, a lady can yarn 4 kg fibre per day. For yarning 1kg fibre, she receives only Rs.10 (Rupees ten only). One day, a lady can yarn 3 kg coir fibre and she receives only Rs.30 (Rupees thirty only) for her untiring labour. While yarning, waste fibre occurs. If waste fibre is converted to yarn, labourers get only Rs.7 (Rupees seven only) per kg. At Mannur, steps have been initiated to implement mechanized defibering unit. Job will be assured to those who own shares in co-operative societies. The capital aimed is Rs.20,00,000/-. Compared to the hard work endured by the labourers engaged in retting activity, they gain very low wages. Thus the prime aim of the survey was to have an insight into the different methods of retting practices, extent of pollution due to retting and epidemiological and health aspects of the target group engaged in this industry, in Kozhikode.

STUDY AREA

The project envisages systematic study of the various aspects of this industry along the coastal Panchayat of Kadalundi, where sizeable retting practices are being carried out. Kadalundi Panchayat is located in Kozhikode district in Kerala State, which lies between 8^0 17' 30"and 12^0 47' 4" North latitude and 74^0 5 ' 51" and 77^0 24' 47" East longitude ***(Fig. 3).*** On the western part of this coastal panchayat is Arabian sea, Southern part, Kadalundi river and Vallikunnu Panchayat, Eastern part Cannoly canal and Vadakkummpattu river and Northern part Feroke Panchayat. Mannur and Chaliyam are the two Block Divisions in

this Panchayat. ***Fig.4*** shows the Ward Divisions of Kadalundi Panchayat. ***Plate-3*** shows the two retting yards (Retting yard-1 & Retting yard 2) selected for study.

IMPACT OF RETTING INDUSTRY ON ECOSYSTEM

The present chapter covers the gross pollution caused by retting industry on the ecosystem of Kadalundi backwater. The pollution caused by the retting of husk by the traditional conventional method is threatening and adversely affects the industry based on fisheries. Above all, since the area around the retting yards are inhabited mainly by the community of people engaged in the above industry, occupational hazards are reported among the target groups. In this background, to assess the impact of this small-scale industry on the ecotone and the target groups, detailed systematic studies of the Kadalundi retting yards and the suburb areas were carried out.

I) FISHERY WEALTH

Fishing is a means of livelihood for many people living along the coasts of Kadalundi backwater. Impact of retting on fishery wealth showed that these zones were adversely affected in terms of community diversity as well as zoomass productivity. The following methodology were used to assess the impact of coir retting on the fishery resources.

METHODOLOGY

Sampling points were fixed at the retting and non-retting (control) areas and samples were collected at seasonal interval viz: monsoon, premonsoon and post monsoon seasons. A castnet, having a diameter of 5 metre, length of 2 metre and mesh size of 0.5 mm was used for fishing. Average number of fishes in the retting and control stations were collected and identified as per Beaver (1982) and Jhingran (1982) and total number per hactare were calculated. Details of fishery were also gathered from local fishermen.

TABLE - 1

FISHERY RESOURCES IN RETTING AND NON-RETTING ZONES AT SEASONAL INTERVALS

Sl No	Name of species Numbers/ha	Postmonsoon		Premonsoon		Monsoon	
		Retting	Non-Retting	Retting	Non-retting	Retting	Non-Retting
	FISHES						
1.	Arius sp.	3200	2400	2400	1600	-	-
2.	Etroplus sp.	2000	2200	-	800	-	-
3.	Anchoviella sp	-	-	-	-	800	1600
4.	Leiognathus sp.	-	-	800	1600	-	-
5.	Ambassis sp.	-	1600	-	200	-	-

6.	Cynoglossus	-	200	-	1600	-	-
7.	Sillago sp.	-	80	-	100	-	-
8.	Triacanthus sp.	-	100	--	-	-	-
9.	Tilapia sp.	600	800	450	1200	100	600
10.	Scianids	-	200	-	150	-	-
11.	Mugil sp.	-	200	-	300	-	800
12.	Eel	-	-	-	60	-	200
	ARTHROPODS						
1.	Penaeus spp.	-	20000	-	1600	-	2400
2.	Scylla spp.	800	1600	200	800	-	2000
	MOLLUSCS						
1.	Vellorita sp.	-	1600	-	880	-	-
2.	Meretrix sp.	-	200	-	800	-	-

a) FISHES

Economically important fishes including migratory and resident species along with bivalves and crabs ensured a good fishery in the riverine system. Major groups forming the bulk of the fishery were, *Mugilidae, Siluridae, Cyprinidae* and *Sillangidae*. In the retting sites, tolerant species like *Arius, Etroplus* and *Tilapia* were abundant. The non-retting area supported good fish population such as, *Mugil sp, Sillago, Ambassis, Anchoviella, Cynoglossus* and *Leiognathus*. Tolerant species in the retting

areas showed numerical abundance, compared to the non-retting sites. The non-retting areas supported good fishery population with diverse community structure. Details are presented in **Table 1.** The fish biomass in the retting and non-retting yards were calculated to be 20 kg/hect/month and 60.6 kg/hect/month respectively.

b) ARTHROPODS

Arthropods were represented by *prawns* and *crabs* belonging to the class Crustacea. *Prawns* belonging to the family Penaeidae, which are commercially important were caught in abundance from non-retting, control areas. The edible *crabs, Scylla* species supported a regular fishery in the area **(Table.1)**

c) MOLLUSCS

Vellorita and *Meretrix* species supported the clam fishery in the backwater. The distribution of these two species is limited to retting free zone. The soft clay bottom and organic pollution of the retting sites were unfavourable for the survival of these filter feeders. Thus the continuous practice of retting was found to ruin the molluscan fishery which formed one of the source of income of the local people and also a raw material for some of the small-scale industries. Details are presented in **Table.1**

II) RETTING-IMPACT ON BACKWATER PRODUCTIVITY

The productivity of the backwater in terms of plankton, nekton and benthos were carried out.

a) PLANKTON

These are minute organisms which move at the mercy of the current and is considered to be an index of riverine fertility. The landings of fish are proportional to the quantity of plankton present in the water body. Samples were collected by using a plankton net and identification and enumeration carried out as per the Standard Methods **APHA 1995** and **Charles C Davis 1955.** Based on the size, plankton were divided into macroplankton and microplankton.

MACRO PLANKTON

Kadalundi backwater holds a combination of marine, brackish water and freshwater species. Among the macroplankton, zooplankton included *Calanus sp., Cyclops sp* and *Nauplius* larvae. Molluscs were represented by Gastropods and *Veliger* larvae. Distribution of *Calanoid Copepod* is found to be influenced by monsoon rain, temperature and salinity. Sparse distribution of species was noticed in the retting yards. In general macroplankton was limited in terms of abundance and diversity. Distribution of macroplankton in the retting and control stations are presented in the **Table.2**

TABLE - 2

MACROPLANKTON IN RETTING YARD AND CONTROL SITE

Name of the organisms No. of species /20L	Premonsoon		Monsoon		Postmonsoon	
	Retting	Control	Retting	Control	Retting	Control
Cyclops	10	50	20	32	15	22
Calanus	8	101	-	-	6	9
Cypris	6	2	-	8	-	6
Chironomus larvae	4	-	-	-	6	1
Nauplius	-	8	-	-	-	6
Veliger larvae	-	2	-	-	-	4
Gastropods	2	8	-	1	3	6

MICROPLANKTON

Microplankton of Kadalundi backwater includes zooplankton belonging to the phylum Protozoa and Rotifera, as well as Phytoplankton. The distribution and abundance of Phytoplankton possess great importance in the food chain and fertility of the

water bodies. Major groups of Phytoplankters belong to the class Chlorophyceae, Cyanophyceae and Bacillariophyceae **(Table.3)** Chlorophyceae included *Ankistrodesmus, Closterium, Scenedesmus* and *Ulothrix.* Cyanophyceae were represented by *Oscillatoria sp. Bacillariophyceae (Diatoms)* were composed of *Cyclotella, Stephanodiscus* and *Navicula.* Phytoplankton in the retting zone were comparatively higher than in non-retting zone. The abundance of phytoplankton in non-retting zone can be attributed to shallow nature of the backwater and availability of organic nutrients on a large scale due to the effect of retting.

Zooplankton which belonged to the Phylum *Protozoa* included *Amoeba, Arcella, Euglena, Euplotes, Euglypha* and *Paramecium*. Rotifers were represented by *Brachionus sp. and Philodina*. Percentage composition of phyto and zooplankton are given in ***Fig.5***

TABLE - 3

PHYTOPLANKTON COMPOSITION IN THE RETTING YARD AND CONTROL SITE OF KADALUNDI BACKWATER

Name of the organisms in 20 lit x 10^4	**Retting**	**Control**
Chlorophyceae		
Ankistrodesmus	11	13
Closterium	18	13
Scenedesmus	11	8
Ulothrix	47	14

Bacillariophyceae (Diatoms)		
Cyclotella	146	64
Stephanodiscus	24	22
Diatoma	6	3
Nitzschia	9	2
Navicula	32	20
Pinnularia	25	6
Surirella	95	3
Cyanophyceae (Blue-Green Algae)		
Oscillatoria	6	3

b) NEKTON

Impact of retting on nektons (fishes) has been explained in detail in **Table 1**. *Tilapia sps*. were present in the retting and non retting yards during the three seasons. *Arius sps*. were encountered only during pre monsoon and post monsoon. *Etroplus sps.*, *Tilapia sps*. and *Scylla sps.* were encountered in the retting yards

c) BENTHIC FAUNA

Benthic faunal studies are indispensable for a proper understanding and management of any aquatic ecosystem. Impact of pollutants on the environment is reflected by the species composition and population density of the bottom fauna. Benthic samples were collected using van Veen grab (0.048 m^2).

Diverse pattern of distribution of benthic fauna existed in the retting zone. Among benthic community Polychaetes dominated, followed by Molluscs in the retting yard. Generally in the near shore estuarine waters along Indian coasts Polychaetes are the dominant groups of benthic fauna. Polychaetes accounted for about 10% in the retting yards and was represented mainly by *Capitellids* and *Spionids*. Polychaete species in Kadalundi river mainly included *Diapatra neapoliatana, Nephthys polybranchiata, Paraheteromastus tenius, Perineries cavifrons and Prinospio polybranchiata.* Details are presented in **Table 4**

Considerable seasonal variations were noticed in the distribution of Polychaetes. During monsoon, the numerical abundance is low in both control and retting yards. The population abundance of Capitellids and Spionids in retting site is high, especially during premonsoon season. Appreciable variation is noticed in the two species of Polychaete, i.e., *Prinospio polybranchiata* and *Paraheteromastus tenius* in the retting zone. These two species are found to be benefitted by the polluted conditions in the retting zone and are indicators of pollution. *Prinospio polybranchiata* is omnivorous in feeding habit and is benefited by the high organic content in the retting zone. The low population density of the species in the control site may be due to the lack of sufficient food and competition with other benthic fauna.

TABLE-4

BENTHIC FAUNA IN RETTING AND CONTROL STATION

Name of the organism Number/m^2	Premonsoon		Postmonsoon		Monsoon	
	Retting	Control	Retting	Control	Retting	Control
Polychaetes						
Diapatra neapoliatana	--	100	--	--	--	5
Nephthys polybranchiata	--	25	--	--	--	20
Paraheteromastus tenius	586	40	240	3	155	3
Perinereis cavifrons	25	--	20	220	45	80
Prinospio polybranchiata	155	20	105	3	108	3
Crustaceans						
Tanidaceae	--	60	--	45	--	--
Amphipod	--	5	--	3	--	--
Molluscs						
Meritrix casta	--	10	--	40	--	--

POLYCHAETA FAUNA AS AN INDICATOR OF POLLUTION

Indicators are primarily to identify pollution, rather than to measure environmental changes. Among Polycheates, *Paraheteromastus tenius*, found in abundance in the retting site is an indicator of organic pollution.

Crustaceans

Among other benthic organisms, crustaceans which belong to the phylum Arthropoda survive in the retting yards. Their population was limited since they are found to be sensitive to the effect of pollution than Polychaete worms. Crustaceans were mainly represented by *Amphipods* and *Tanidaceans*. *Chironomus larvae* and *Dipteran larvae* were distributed in the retting yard, which indicate characteristic stagnancy and pollution of water.

ESTIMATION OF PRODUCTIVITY AND ALGAL BIOMASS

Chlorophyll Method

Productivity was recorded by analysing chlorophyll content at seasonal interval. Maximum productivity observed during premonsoon period in the retting yard, R2 - 0.02 µg/l. During monsoon and postmonsoon seasons, in the Retting yard 1 (R1) productivity rate was less. **Table-5 a, b & c** gives the seasonal variations of the productivity in the retting yard.

TABLE - 5(a)

CHLOROPHYLL CONTENT IN RETTING YARDS (PREMONSOON)

Sampling Site	Chlorophyll a mg/l	Chlorophyll b mg/l	Chlorophyll c mg/l	Total Chlorophyll mg/l
Yard 1 (R1)	0.0063	0.000056	0.00054	0.00689
Yard 2 (R2)	0.0034	0.0053	0.01082	0.0195

TABLE - 5(b)

CHLOROPHYLL CONTENT IN RETTING YARDS (MONSOON)

Sampling Site	Chlorophyll a mg/l	Chlorophyll b mg/l	Chlorophyll c mg/l	Total Chlorophyll mg/l

Yard 1 (R1)	0.0008976	-0.0043516	0.0027408	-0.0007132
Yard 2 (R2)	0.001864	-0.0007036	0.0001996	0.00136

TABLE - 5(c)

CHLOROPHYLL CONTENT IN RETTING YARDS (POSTMONSOON)

Sampling Site	**Chlorophyll a mg/l**	**Chlorophyll b mg/l**	**Chlorophyll c mg/l**	**Total Chlorophyll mg/l**
Yard 1 (R1)	0.0022668	-0.0090804	0.0085136	0.0017
Yard 2 (R2)	0.0048216	-0.0097276	0.0040438	-0.0008622

Algal Biomass

Algal biomass was calculated from the chlorophyll content. High algal biomass was observed during premonsoon season in the retting yard, R1- 0.4221µg/l **Table-6** shows the algal biomass content in the retting yard during different seasons.

TABLE-6

ALGAL BIOMASS IN RETTING YARDS

Sampling sites	Algal Biomass (mg/l)		
	Premonsoon	**Monsoon**	**Postmonsoon**
Yard 1	0.4221	0.0601392	0.1518756
Yard 2	0.2278	0.124888	0.3230472

SALIENT FINDINGS

- Traditional conventional method of retting has adverse impact on the ecosystem
- The ambient backwater loses its aesthetic value and changes into grayish black in colour, with foul smell of Hydrogen sulphide
- Physicochemical quality of the water in the retting yard shows the prevalence of nil dissolved oxygen, very high BOD, electrical conductivity, hydrogen sulphide and nutrients.
- Phytoplankton composition in the retting yard was slightly high when compared to non retting zones, due to rich nutrient content. Macroplankton of Kadalundi backwater is a combination of marine, brackish water and freshwater species. Diverse species of benthic organisms existed in the retting yard.
- Fishery wealth- fishes, prawns, clams and crab fishery were adversely affected in terms of community diversity and zoomass productivity.

- Depleted fishery wealth was observed in retting yards compared to non retting sites. Oxygen concentration was low due to the continuous release of organic materials.
- Commercially important fishes *like Mugil cephalus, Anchoviella, Penaeid prawns* and *crabs* were seen sparsely distributed in the retting sites and premises. Tolerant fish varieties like *Tilapia sp.* and *Arius sp.* were dominant in the retting yards.
- Molluscan fishery has dwindled in the area, since retting yard with soft substratum could not provide better grounds for the mussels and clams which need hard surface for attachment. The related lime shell industry has also been found to be affected in the nearby areas.
- The bottom fauna of the retting sites was represented by tolerant varieties of polychaete species, favoured by the organic enrichment in the area.
- In the retting yards less abundance and diversity of zooplanktonic organisms were noted. Phytoplankton density was high due to the nutrient rich conditions created by retting process.
- High organic content, depleted oxygen conditions and presence of hydrogen sulphide has affected the ecology of the retting sites. Low productivity in terms of planktonic and nektonic organism and depleted fishery wealth were observed to be characteristic nature of the retting yards

WATER SOURCES AND DRINKING WATER PROBLEMS IN KADALUNDI PANCHAYAT

Survey conducted in Kadalundi Panchayat revealed that one of the major problems faced by the target group was lack of safe drinking water . Acute water scarcity is experienced both for domestic as well as agricultural purposes. To overcome the drinking water scarcity problem, Government has implemented many schemes. 371 household water connections and 104 public taps have been provided by Kerala Government. Apart from this scheme, Mannur Ganga Drinking Water Scheme implemented by the Kadalundi Panchayat, supply water to the people through 21 public taps. It has been reported that during summer months almost 40 public wells become dry and people depend upon rivers, ponds and stream. This water is contaminated with pathogenic organisms. In some Wards, to overcome the water scarcity problems, people joined together and implemented 17 Drinking Water Schemes. People's Plan Campaign is promoting need based and resource-based perspective plans to solve acute drinking water scarcity. A few such schemes implemented in Kadalundi Panchayat is a blessing to the people. But people suffer much for want of safe drinking water.

I) WATER QUALITY MONITORING STUDIES

a) SOURCES OF POLLUTION

Drinking water sources are getting polluted due to industrial, domestic and agricultural wastes. Smallscale industries like coir retting, log setting, food processing and clay making pollute the riverine system. Coir retting industry discharge effluents like lignin, tannin, and polyphenols into the backwater system. Poisonous gases hydrogen sulphide and methane pollute the air.

Community wastes, hospital wastes and hotel wastes contain pathogenic micro organism which spread water-borne and water related diseases. Apart from this salinity intrusion into dug and bore wells aggravate pollution problem. Hence, to study the impact of pollution due to coir industry, systematic water quality monitoring studies were carried out ***(Plate 4)***.

b) METHODOLOGY

Water samples for physicochemical analysis were collected using Mayer type bottom samplers.

c) SAMPLING SITES

Sampling points were fixed for collecting samples from the river and the nearby wells**.** Map showing the location of the retting yards and wells studied in Kadalundi Panchayat are furnished in ***Fig.6***.

d) PHYSICOCHEMICAL QUALITY

Variation of water temperature, pH, dissolved oxygen, electrical conductivity, alkalinity, hydrogen sulphide, nitrate, phosphate, calcium and magnesium were studied. **TABLE 7a,b&c** shows the quality of water from retting yards and nearby groundwater sources. Sampling and analysis were carried out seasonally i.e. Premonsoon (Feb-May), Monsoon (June-Sept) and Postmonsoon (Oct-Jan). Appendix gives the Drinking Water Standards.

Temperature

Well pronounced seasonal variations in temperature could not be observed in the retting yards and nearby wells ***(Fig.7a & b)***

Hydrogen Ion Concentration (pH)

Almost uniform pH values were observed in the retting yards and also wells situated 0.5 km and 1 Km away from the yards. The well K - 2 located near Kadalundi Railway Station showed acidic condition (pH-2.77) during premonsoon season. This may be attributed to the large scale retting practise encountered in this area. ***Fig.8a & b*** shows the variation in pH values in the retting yards and wells.

Dissolved oxygen

Low Dissolved Oxygen level prevailed in the retting yards and certain selected wells during premonsoon season ***(Fig. 9a & b)***.

Electrical Conductivity

Retting yards showed very high electrical conductivity which ranged from 170.6 µS during monsoon to 58,900 µS during premonsoon Certain wells located along the coastal areas also had high electrical conductivity values due to salinity intrusion from the backwater. ***Fig.10 a & b*** showed the EC values in the retting yards and wells.

Alkalinity

Certain wells under study showed very low alkalinity values. ***Fig.11 a & b*** gives the alkalinity in retting yards and wells

Total Hardness

Hardness in the retting yards of Kadalundi backwater was found to be high (7580 mg/l during Premonsoon season). Well K-2, near Kadalundi Railway Station also showed very high total hardness. ***Fig.12 a & b*** showed variations of total hardness in wells and retting yards.

Calcium

Retting yards and wells (K-2, well near Kadalundi Railway Station and B1-Borewell at Poocherikkunnu) showed high values of calcium during premonsoon period. In the retting yards, the calciun content ranged from 8.0 to 464 mg/l. ***Fig.13 a & b***.

Magnesium

Retting yards and wells (K-2, well near Kadalundi Railway Station and B1-Borewell at Poocherikkunnu) showed high magnesium content during premonsoon period. ***Fig.14 a & b*** gives the seasonal variations of magnesium content in wells and retting yards.

Chloride

Retting yards showed very high chloride content during premonsoon period (Retting yard 1 = 20,582.32 mg/l and Retting yard 2 = 21,173.2 mg/l). Water samples collected from the borewell also showed very high chloride value (3446.8 mg/l). Details are presented in ***Fig.15 a & b***.

Nitrate

Low nitrate values were observed in the wells under study. In the retting yards nitrate concentration varied from 0.23 mg/l to 1.8 mg/l ***(Fig.16 a & b)***

Phosphate

Retting yards, dugwells and borewell samples showed very low phosphate values during the three seasons. During postmonsoon phosphate was absent in the retting yards . ***Fig.17*** shows the seasonal variation of phosphate in the random selected wells of Kadalundi.

Hydrogen Sulphide

Sulphide content was high in the retting yards during premonsoon period. (R1=1.77 mg/l, R2 = 1.93 mg/l). Wells located nearby the retting yards showed sulphide content which can be attributed to the infiltration through soil. Well water samples studied showed high sulphide values which ranged from 1.29 mg/l to 0.14 mg/l. Many wells showed higher sulphide values during monsoon season. Sulphide concentration present in the retting yards and wells are shown in ***Fig.18 a & b***.

Salinity

Apart from other sources of pollution, salinity intrusion in to the dugwells deteriorates the quality of water. During peak summer months high range of salinity was observed in wells. Maximum salinity recorded in well was 2.8 ppt. and borewell 5.1 ppt. Seasonal variation of salinity is recorded in ***Fig.19 a & b***

e) BIOLOGICAL QUALITY

Microbiological Analysis

Seasonal monitoring of the drinking water samples is of particular importance in the water quality monitoring programmes, since continued monitoring for the low levels of coliform bacteria is the signal for the occurrence of possible contamination by pathogenic microorganisms. Sampling and analysis of the bacterial population viz: coliform density, fecal coliforms and total bacterial population were carried out by MPN (Most Probable Number) and SPC (Standard Plate Count)method. **(APHA 1995, Geldreich, 1975)**. Retting yards and many of the wells were found to be biologically contaminated. **Table.8 a, b & c** gives the bacterial contamination of wells and retting yards during different seasons. During monsoon period the retting yard and the nearby wells were found to be fecally contaminated.

SALIENT FINDINGS

- Survey reveals that only 52% of retting community is supplied with protected water supply. Rest of the people rely on dug wells.
- Only 25.6% of the people used boiled water for drinking. Methods of disinfecting wells / purification of water remain unknown to the people.
- 34.29% of the retting community being illiterate, is not aware of the importance of safe water for controlling diseases.
- Lack of sufficient sanitary facilities and hygienic practices have affected the water quality status of the wells, and during monsoon season all the wells , studied were biologically contaminated.

- Colour, taste and odour of the drinking water sources were found to be disagreeable.
- Black colour and foul smell of hydrogen sulphide are the characteristics of the water sources of the area. Sulphide values of the dug wells ranged from 0.14 to 1.29 mg/l. .
- Electrical Conductivity, Total Hardness, Calcium, Magnesium and Chloride were high in the wells studied.
- Nitrate and Phosphate content in the groundwater sources and retting yards were reported to be low.
- Salinity intrusion and leaching of organic wastes from retting yards have affected the drinking water quality in the target site. In peak summer salinity in the dug wells were noted to be as high as 2.8 mg/l and 5.1 mg/l in the borewell.
- Government through peoples participation is encouraging the construction of Mini Water Supply Schemes to solve the drinking water problems in the Panchayat.

SOCIO ECONOMIC STUDIES

A) SCOPE OF THE STUDY

Socio economic conditions are the main factors which bring about changes in the vital events of life. Hence, data collected through survey is of utmost importance, as survey research is probably the most visible and influential variety of research in social and behavioural sciences. The information collected, aids in describing, comparing and explaining the various aspects pertaining to education, occupation, availability of potable water, hygiene, epidemiology, economic and social status of the target group

B) METHODOLOGY

Random sampling method was used for collecting information on socio-economic aspects of the target group. A key informative schedule/questionnaire was framed for household surveys (Appendix-1) Information required for the study was also collected from secondary sources.

C) SECONDARY DATA COLLECTION

Socio-economic survey was initiated by collecting secondary data from Panchayat Office, Kadalundi and also from personal interviews with Vanitha Councillor/Ward Member. A detailed list of the number of people engaged in coir related activities in Kadalundi area was prepared based on the information collected from Panchayat Office, Project Office-Coir, Coir Welfare Office, Kozhikode and other available sources through field visits.

D) PRIMARY DATA COLLECTION - Random Sampling Method / Key Information Schedule

Socio-economic status of the people engaged in coir retting activities were collected by adopting Random Sampling Method. A questionnaire was prepared covering aspects related to educational, occupational, health, economic and social status of the target group. Information collected from door to door household interview are summarised below.

i) Residential Aspects

The present study covers 207 households. Among them 331 members were engaged in coir related works who belonged to Hindu and Muslim community. Their residential status reveal that they belong to lower middle class families. About 2.8% of people lack houses. 64.25% of the respondents have tile-roofed houses and 14.49% have terraced buildings. Lack of safe excreta disposal facilities and open defecation paves the way for the spread of water-borne and water related diseases in the area. Details are furnished in **Table. 9 a & b.**

ii) Health Aspects

One of the main objectives of the Project was to evaluate the health hazards caused by retting activity. Studies revealed that 66.67% of the respondents suffer from job related diseases. Main health problems encountered were backpain, respiratory diseases, skin diseases and eye diseases. Details are presented in ***Fig.20.*** Survey revealed that majority of the respondents were females. The low wages paid to the male workers have forced them to shift to other works like building construction and plastic industry. Statistical interpretation of the prevalent rate of the study of the job oriented diseases showed that about 50% of the coir workers suffered from back pain. Eye diseases, respiratory problems and skin diseases were also encountered among them. Details are given in ***Fig.21***

Agewise and genderwise analysis of the health aspects were studied **(Table 10)**. Sex-wise analysis of the health aspects showed that most of the male and female respondents experienced back pain. The respondents who suffered back pain among males

belonged to the age group of 50-60 and among females the ailing belonged to the age group of 40-50. Prevalence of back pain was less among the age group 20-30. Female respondents between the age group of 40-50 suffered from back pain and head ache. The unhealthy posture maintained by the workers is the cause for back pain. The unhygienic working environment, menial strain of beating the husk, atmospheric pollution from the release of hydrogen sulphide and other noxious gases, all these compounded factors have impaired the health of the workers. Respiratory disease prevailed more among the age group of 50-60. Respiratory disease may be attributed to the exposure of the coir workers to the dust of coconut fibres and the noxious gases. Among the females, prevalent rate of eye disease is high among the age group of 50-60. While skin disease, stomach problem and rheumatism were high among the age group of 40-50. In short retting of husk along the coastal belt caused ecological degradation due to the liberation of organic wastes which aggravates the unhygienic condition of the area. Frustration, lack of job satisfaction, insecurity, poor human relationships and mental tension, undermined the physical and mental health of the workers.

iii) Education

Majority of the people engaged in retting industry were illiterate. Only 1% of them received college education. Details are presented in ***Fig 22***.

iv) Family and Occupation

Among the target group 40.57% belonged to nuclear families, 18.84% joint families, 35.74% extended families and 4.83% single families. **Table. 11** shows the type of families. Occupational details collected from the household survey shows that

majority of the respondent engaged in retting were females, who fall under the age group 50-60 and above 60 years. Irrespective of their age they find this work as the means of livelihood unlike men and younger generation. Low wages in return for the hard work may be the reason for the reduction in percentage of the people engaged in retting activity. In addition to this, exhaustive import of coir goods from other States have adversely affected this traditional occupation.

v) Economic Status

Majority of the families residing in the coastal areas hardly possess any landed property. Hence, their income from agricultural products are meagre. In the coastal areas of Kadalundi coconuts palms are the life supporting cash tree. Apart from the nuts, rich and poor people engage themselves in coir retting industry. Presently, Co-operative Societies have taken up the major role in this industry. Husk is pruchased from private parties. Depending upon the quality of fibre, the society purchases fibre for Rs.1200-1600/- per quintal. For drying the fibres extracted from 1000 coconuts, a worker is paid Rs.40/-. In Co-operative Societies, female workers yarn the fibre mechanically. For yarning 1kg fibre, they are paid Rs10/- Usually a lady yarns 3-4 kg/day. Details regarding the wages given to a female worker from the Coir Co-operative Society, Mannur are given below.

	Nature of work	**Wages (Rs.)**
i)	For drying the coconut fibre of 1000 coconuts	40.00
ii)	For yarning 1kg fibre (Present rate)	10.00

iii) For yarning 1 kg fibre (Rate before 10 years) 4.00

Thus, the wages given to them are very low compared to their hard work, which makes the families remain poor.

vi) Income, Expenditure and Debt

To have an in-depth study of the economic conditions of the target group, details regarding their income, expenditure and debt were collected. Among the 207 families majority of them belonged to Rs.500-1000 monthly income group (66 families - 31.88%) 6.76% belonged to very low income group, i.e Rs 0-500 and only 47 families (22.7%) gained above Rs. 2000/- per month **(Table 12).** Considering the monthly expenses, 61 families (30%) spent above Rs.2000/- per month **(Table 13).** Their poor economic condition is revealed from the loans that are outstanding.

COMPARATIVE STUDY OF THE COIR AND NON-COIR FAMILIES

For comparing the socio-economic status of the coir families with that of non-coir families, 43 numbers of latter families were surveyed covering aspects pertaining to education, occupation, hygiene and socio-economic details. In aspects relating to education, occupation and economic status, non retting families stand above the target group. Many of the family members who gained higher education gained employment in Government Service and some were working in foreign companies. Hence, they had well furnished houses and sound earnings, unlike the target families. Considering the health aspects, job oriented diseases

have not been recorded among the non-coir families. Details are furnished in **Table 14.** On analysis and comparison of the health aspects it was seen that majority of the target group experienced back pain, owing to the countless hours spent in an unhealthy posture. In the case of non-coir workers respiratory problem is higher than other diseases ***(Fig.23)*** probably due to their stay in the vicinity of the Kadalundi River, where coir retting is progressing and the immediate environment is polluted by the release of Hydrogen Sulphide.

SALIENT FINDINGS

- Majority of the families who are solely engaged in retting activities are financially backward.
- None of them were satisfied with the present wages. Eg. For drying the fibres of 1000 coconuts, a female worker receives only Rs.40/- (forty rupees only) per day for their untiring labour.
- Illiteracy of the target groups force them to continue this strenuous labour for low wages. Survey reveals that 36% of them were totally illiterate.
- Majority of the target families have their own houses.
- Sanitation facilities are poor. 16.5% of the households lack latrine.
- Survey revealed the occurrence of job oriented diseases among the coir workers.
- Acute drinking water scarcity problems are being experienced by the people along the coastal areas of Kadalundi Panchayat.

- Introduction of mechanisation has tremendous impact on the retting industry. It has reduced job opportunities among the target group especially women. Hence, while introducing mechanisation, Government should take necessary steps to provide job to the target group.
- The new technologies have helped in reducing the pollution load and physical strain to some extent. But, the low efficiency of the machine prevents the achievement of intended output, thereby resulting in financial loss.
- Training programmes have to be introduced by the Government among the target groups and make them well equipped in their traditional industry.
- Government of Kerala should take initiative to provide subsidies to the target groups, thereby increase their financial and life status.
- Coirfed, the apex body of 600 Co-operative Coir Societies have captured the markets at home and the hearts of customers in the Middle East, Europe and USA. Hence, Coirfed should take initiative to encourage the production and marketing of coir products in Kerala.
- The fear that introduction of mechanisation will result in unemployment, has prevented the younger generation in entering this field. Thus lack of competition in this field, is tending towards decrease in the flourish of this industry.
- Immediate measures should be taken to save this industry or else, coir will be totally wiped out from the face of Kerala which was reported to be 'the land of coir'.

MANAGEMENT AND PREVENTIVE MEASURES

The Project envisages to suggest necessary mitigative measures for the reduction of cumulative impacts of pollution due to retting and to enhance the socio-economic and health status of the target group. As a key part, for sustainable development the following environmentally sound management aspects were implemented in the target sites of Kadalundi Panchayat.

i) **Dissemination of Scientific aspects through Mass Communication**

ii) **Health Camps**

iii) **Water Conservation**

DISSEMINATION OF SCIENTIFIC ASPECTS THROUGH MASS COMMUNICATION - AWARENESS CAMPS

METHODOLOGY : ***PARTICIPATORY RURAL APPRAISAL (PRA)***

PRA methodology is used for interactin g with the target group, while conducting 'Awareness Camps'. Involvement of this technique makes the Project more adaptable to local needs, increasing the chances of sustainability through people's participation. **(Neela Mukherjee, 1997 & Amitava Mukherjee 1995).** Through 'Awareness Camps' scientific aspects dealing with 1. 'Sanitation and Hygiene', 2. 'Water Quality/ Treatment', 3. 'Water- borne and Water related diseases and their Control' were spread among the target group.

Monitoring PRA

PRA can form a basis for monitoring and evaluating problems faced by the coir workers community in Kadalundi Panchayat. Hence, while conducting 'Awareness Camps' Focus Group Discussions' were applied , which is a PRA tool helpful to "Give and Receive Information" on the topics to be discussed.

AWARENESS CAMPAIGNS

Awareness campaign is an effective way of communication to the mass, since such programmes are highly relevant in transferring research / extension / management aspects to the public. 5 Awareness camps were conducted in various Wards of Kadalundi Panchayat. **(Table 15)**. Views from Awareness Camps are shown in ***Plate 5*** .

HEALTH EDUCATION IN THE TARGET SITES

"Health education is a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles through training and research" **(J.E.Park and K.Park, 1986).** Many problems of community health require changes in the health practices, which are detrimental to health, viz. pollution of water / out-door defecation. Hence through awareness classes target groups were informed and disseminated scientific knowledge about prevention of diseases transmitted through water and also aspects related to environmental and personal hygiene. The following were the main topics highlighted during the camp.

1. Sanitation and Hygiene

The major segment of the rural community, who assembled in the awareness camps conducted in the various Wards of the target sites were women. Through discussions and demonstration classes, they were educated on the various components related to sanitation and hygiene, which are helpful in developing a

healthy society. Since dug wells are one of most common sources of water supply, they were explained the need to keep them clean, safeguarding water from contamination.

2. Water quality / Water Treatment

Drinking water sources are likely to contain harmful bacteria, virus, protozoans and also certain harmful chemicals, which may spread water-borne and water related diseases. Apart from pollution, water scarcity adds to the ill health and drudgery of the

people. Hence, women groups were educated on the simple and low-cost methods of water treatment through demonstration and mass communication activities.

a) Disinfection of wells with Bleaching Powder

Pathogenic microorganisms can be effectively removed by treating domestic wells with bleaching powder at the rate of 2.5 grams per 1000 litres of water. The bleaching powder mixed in water should be allowed to settle for 1-2 hrs. The supernatant water in the bucket is poured into
the well and mixed thoroughly. The volume of water in the well is calculated using the formula,

$$\frac{3.14 \times d^2 \times h \times 1000}{4}$$

where, h = height of water in the well
d = diameter of the well

b) Chlorination Pot

A clay pot of 7.8 litres capacity with 6 to 8 holes of half a centimetre diameter at the bottom is made. At the base, the holes are covered with pea gravel, of smaller size. A dry mixture of 1.5 kg of bleaching powder and 3 kg of coarse

sand is spread over the pea gravel. Above this mixture the pot should be filled with pebbles up to the neck. A rope is tied at the neck of the pot and lowered in the well, approximately 1 meter below the water level ***(Plate 6)***. A pot of this size provides

adequate Chlorination for about 15 days for a community well (9000-13000 litres capacity), where 900-1300 litres per day are drawn.

c) Household Water Filters

Charcoal Water Filter

For the removal of solids, suspended materials and harmful bacteria from the water, charcoal filter can be used successfully. A clay pot (42 cm diameter and 100 cm height) is fitted with a tap at the bottom. Gravel, sand and charcoal are first washed thoroughly. Then gravel is put into the pot upto a height of 25 cm. This layer removes the dust and dirt. Above this, coarse sand is piled for a height of 25 cms. This layer is covered with a 15 cms bed of charcoal which is again covered with 5-10 cms of gravel. This bottom layer prevents the charcoal pieces from floating and keeps them stationery. Filter is placed on an empty domestic container, which collects the filtered water.

3. Water-borne and Water-related diseases and their Control

Drinking water scarcity problem and lack of hygiene results in the outbreak of various water-borne and water-related diseases like cholera, typhoid, diarrhoea, amoebiasis, scabies and elephantiasis . During the outbreak of epidemics like cholera, dysentery and diarrhoea, first aid measures to be adopted immediately, like giving the patients ORS (Oral Rehydration Solution) were explained. The target groups were informed of the need for opting safe excreta disposal measures, as it is the easiest method to control water-borne diseases.

DISTRIBUTION OF AWARENESS MATERIALS

The leaflets consist of text information ideally supported by graphics which is preferably presented to provide information in an appealing and easily understood manner.
Leaflets on the following topics were prepared and distributed among the target groups who attended the 'Awareness Camps'. (Appendix.2 & 3)

- Water treatment - Domestic level
- Water and Diseases

HEALTH CAMP

Occupational Hazards

In many industrial sectors, workers face sharply defined hazards due to obsolete technology and lack of pollution control. Among the traditional small scale industries, coir retting activities along the backwaters poses serious dangers from toxic sulphides, polyphenolic acids and hydrogen sulphide. Survey revealed that, along the coastal areas of Kadalundi Panchayat, women are the ones who suffer most, due to occupational health hazards due to coir industry. As a preventive measure, a Medical Camp was conducted for the target group.

Medical Camp

Medical camp was conducted at Sreedevi AUP School, Kadalundi with the help of the Doctor and paramedical staff of the Primary Health Centre Chaliyam, Govt. of Kerala and Ward member of Kadalundi Panchayat ***(Plate 7).*** 89 patients attended the camp. Job related diseases diagnosed were Peripheral Neuritis, Acute Respiratory Infection, Chronic Bronchitis, Eye diseases, Scabies and Tennis Elbow. Details regarding job-oriented diseases are presented in ***Fig.24***. Prevalent rate of diseases found among the patients who attended the camp were statistically analysed (**Table - 16)**, using the following equation

$$\text{Prevalent Rate} = \frac{\text{Number of cases x 1000}}{\text{No. of patients who attended the camp}}$$

The prevalence of peripheral neuritis and back pain was high among the patients. Medicines and treatment were provided to all the patients who attended the Medical Camp. Appendix 4 shows the Proforma used at the Medical Camp.

WATER CONSERVATION

Construction of a Rainwater Harvesting Unit

Drought and drinking water problems have become a recurring phenomena in the coastal panchayat of Kadalundi. Pollution and salinity intrusion adds to the water scarcity problem. Among the Water Conservation Technology, Rainwater Harvesting through roof catchment system is simple and economical. Hence, this method was adopted and implemented ***(Plate 8).***

Significance of Rainwater Harvesting

Rainwater harvesting involves the collection and storage of rainwater from surfaces on which it has directly fallen. In roof top rainwater harvesting, the roof of a suitable building is used as catchment area for rainwater and the collected water is stored in storage tanks. This method is simple, economical and rainwater being the purest form of water provides water of high quality. **(Remani, et al, 1993, Jayakumar, et al, 2002)**. Hence, in areas where surface water sources are inadequate, utilisation of rainwater is a viable option to meet the drinking water needs of the people. As surface water resources are of poor quality in Kadalundi Panchayat, adoption of Rainwater Harvesting techniques
will help to mitigate drinking water shortage to a great extent.

A roof top Rainwater Harvesting system adopting low cost ferrocement technology was fabricated at AMLP School Kadalundi. This unit was established as a demonstration site, so as to serve as a model that can be replicated by the local people.

Techno Economic Aspects

In the Rainwater Harvesting unit established at Kadalundi, the rainwater collected from the roof is stored in a ground level, cylindrical, ferrocement storage tank of capacity 7500 litres having 2.05 m diameter and 2.2 m depth. The total cost of fabrication of the unit was Rs.19000/-. Analysis of the cost for fabrication of this unit indicates that the expenditure per litre of storage capacity is about Rs.25/- which is about 50% of the cost of fabrication using conventional methods. Thus, this method of fabrication is highly cost effective and appropriate for adoption in rural areas.

SUSTAINABILITY OF THE PROJECT

FORMATION OF LOCAL LEVEL COMMITTEE (LLC)

For attaining the various objectives of the project, phase-wise activities were implemented among the target group. In each Ward of Kadalundi Panchayat, a Local Level Committee comprising three persons (one Ward Member, an Official from Health Department and a local public) were formed. They were entrusted to continue the future activities of the, Project in a sustainable way.

SALIENT FINDINGS

- Disseminated scientific and technological know-how through Awareness camps, Health camp and by constructing Rainwater Harvesting Structure.

- Awareness camps and group discussions benefited the target groups, especially women to increase their life and health status.

- Techno economic aspects of roof top Rainwater Harvesting System through ferrocement technology installed will serve as a model to solve acute drinking water scarcity problems in the target site.

- Medicines and treatment provided to the patients through Health camp is a blessing to the economically backward target group. Panchayat / NGO's should take necessary steps to conduct such camps periodically.

- Local level Committees formed in each Ward is responsible for the sustainability of the Project activities so far implemented.

REVIEW AND RECOMMENDATIONS

- Coir retting industry, is presently passing through difficult times, mainly due to the scarcity of raw materials, increased price of yarn and products and reduced inflow of orders from abroad. Coir Board in collaboration with the State Government may initiate proper steps for improving the status of this industry.

- The premises of the retting yard situated in the Coastal areas of Kadalundi, are inhabited mainly by the community of people engaged in coir industry. Retting practises cause air and water pollution which adversely affect the community and ecosystem.

- In Kadalundi Panchayath one of the major problems faced by the people engaged in retting activity is lack of safe drinking water. A Rainwater Harvesting unit, having a capacity of 7,500 litres was constructed at AMLP School, Kadalundi with the financial aid from KRPLLD. Local people can take initiative for constructing such new and low-cost ferrocement tank, seeking aid from NGO's / Panchayats.

- Awareness programmes conducted in the various Wards of Kadalundi Panchayath demonstrated simple low-cost water treatment technologies among the target group. Chlorination pot was introduced in each Ward for treating Panchayath wells.

- Local Level Committee (LLC) formed in each Ward could take up the responsibility of renewing and cleaning the bleaching powder-sand mixture at monthly interval. Community well purification using Chlorination Pot will aid to supply safe water to the public.

- Medical camp conducted in the target area showed the presence of job-related diseases among the coir workers. Panchayat, with the help of PHC, Government of Kerala should take initiative for conducting free Medical Camp once in a month.

- Coir labourers receive very low wages from co-operative societies. It is most striking that workers especially women spent the whole day in the unhygienic conditions of the yard and find hardly any time to spare for other educational and cultural activities. Low financial conditions compounded with illiteracy make their life miserable. Retting community deserves much support from the Government for the upliftment of their life status.

SUMMARY AND CONCLUSIONS

Many families dwelling in the coastal stretches of Kerala, depend upon coir industry for their livelihood. At the same time retting of husk presents unique problems affecting the hydro-ecology of the water body as well as health hazard problems to the people engaged in this industry. The Project examines the impact of this smallscale industry on the ecosystem. Through action programmes like Awareness Camps and Health Camps, enhancement of the socio-economic and health status of the target groups were attempted. To sum up, the activities carried out in a nut shell are:

- Reconnaissance survey along the backwaters of Calicut district to study the systematics of retting practices

- Systematic studies were envisaged along the coastal Panchayat of Kadalundi, where sizeable retting activities are being carried out.

- Carried out Socio-Economic survey by Random Sampling Method. Survey was initiated by collecting secondary data from Kadalundi Panchayat, Coir Welfare Office and Project Office, Coir.

- Water Quality Monitoring of the water samples of the retting yards and wells at seasonal intervals.

- Impact of retting industry on ecosystem - Viz: fauna and flora, benthos and fishes were assessed.

- Awareness Camps were conducted in various Wards of Kadalundi where retting is practised, which is an efficient way of communication of research/extension/management aspects to the public.

- A Health Camp was conducted for the target group. Job oriented diseases relating to eye, skin and lungs were observed. Medicines and treatment were provided to the patients.

- A Rainwater Harvesting Unit-Roof top catchment system was constructed in AMLP School, Kadalundi. Such water conservation units will help a great extent in solving water scarcity problem.

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TABLE 7(a)

PHYSICOCHEMICAL ANALYSIS OF WELLS AND RETTING YARDS OF KADALUNDI (PREMONSOON)

Sl. No	Sample code	Tempe-rature ^{0}C	pH	E.C mS	Salinity ppt	Dissolved Oxygen mg/l	Phosphate mg/l	Nitrate mg/l	Chloride mg/l	Alkalinity mg/l	Total Hardness mg/l	Calcium mg/l	Magnisium mg/l	Sulphide mg/l
1	K1	28.5	8.56	456	0.2	4.73	ND	ND	13.79	140	160	51.2	0.1944	1.296
2	K2	27	2.77	5830	2.8	Nil	ND	ND	541.64	NIL	2428	472	303.264	0
3	K3	28	6.53	652	0.3	4.87	ND	0.11	344.68	16	72	14.4	0.2187	0.656
4	K4	28	6.27	128.3	0.1	7.6	ND	0.67	19.7	12	20	3.2	0.0729	1.136
5	K5	28.5	7.8	1211	0.5	7.47	ND	ND	393.92	52	176	28.8	0.6318	0.416
6	K6	27.5	7.5	293	0.1	7.13	ND	0.86	27.58	70	78	16	0.0486	1.216
7	K7	27.5	7.12	351.4	0.1	5.43	ND	0.58	17.73	56	104	17.6	0.3645	0.416
8	K8	28.5	6.62	350	0.1	5.93	ND	0.38	15.76	82	36	14.4	0	0.256
9	K9	27	7.72	260	0.1	5.4	ND	0.33	7.88	48	88	27.2	0.1215	0.146
10	K10	28	5.86	125.1	0.1	5.4	ND	0.10	13.79	12	28	6.4	0.0729	0.576
11	K11	28	7.13	49.3	0	4.33	0.012	0.51	5.91	10	12	4.8	0	0.416
12	K12	27	6.7	180.1	0.1	2.27	0.043	2.58	25.61	18	36	8	0.0972	0.416
13	K13	30	7.7	169.3	0.1	6.67	ND	1.19	19.7	110	124	43.2	0.0972	0.816
14	B1	27	7.8	10520	5.1	5.47	0.014	0.61	3446.8	62	2412	456	309.096	0
15	R1	28	7.32	58900	33.9	0.8	0.009	1.80	20582.32	106	7580	464	1560.06	1.776
16	R2	29	7.11	28020	14.8	3.47	0.012	0.71	21173.2	112	7580	464	1560.06	1.936
17	W1	27.5	7.1	90.3	0	6.27	ND	2.24	21.67	12	16	1.6	0.0729	0.496
18	W2	27.5	5.46	84.3	0	7.27	ND	2.41	7.88	8	12	4.8	0	0.336
19	W3	28	7.3	1026	0.4	4.87	ND	1.33	443.16	42	176	30.4	0.6075	0.336
20	W4	28.5	5.58	68.8	0	5.53	ND	2.18	7.88	8	8	3.2	0	0.46

TABLE 7 (b)

PHYSICOCHEMICAL ANALYSIS OF WELLS AND RETTING YARDS OF KADALUNDI (MONSOON)

Sl. No	Sample Code	Tempe -rature ℃	pH	E.C mS	Salinity ppt	Dissolved Oxygen mg/l	Phosphate mg/l	Nitrate mg/l	Chloride mg/l	Alkalinity mg/l	Total Hardness mg/l	Calcium mg/l	Magnisium mg/l	Sulphide mg/l
1	K1	23	7.35	409	0.26	6.33	0.046	0.076	160	348	196	65.6	7.776	0.24
2	K2	23	7.63	620	0.396	5.93	0.028	2.5	200	24	300	88	19.44	0.24
3	K3	26.5	6.35	111.6	0.07	3.73	0.025	0.11	120	296	20	6.4	0.972	0.08
4	K4	26.5	5.61	112.1	0.07	5.13	0.017	1.04	140	20	14	4.8	0.486	1.28
5	K5	-	-	-	-	-	-	-	-	-	-	-	-	-
6	K6	26	7.08	217	0.14	6.73	0.023	3.8	160	104	64	17.6	4.86	1.12
7	K7	25	7.44	236	0.15	5.86	0.063	0.71	120	244	116	24.8	13.122	1.36
8	K8	24	6.63	263	0.168	5.53	0.021	0.1	140	122	102	28.8	7.29	1.12
9	K9	27	7.21	289	0.18	6.53	ND	0.59	36	130	118	40	4.374	1.44
10	K10	28	7.78	140	0.09	4.93	ND	3.3	140	34	28	10.4	0.486	1.28
11	K11	28	6.76	51	0.03	6.53	0.015	0.55	24	38	12	2.4	1.458	1.52
12	K12	26.5	5.45	99.4	0.06	4.0	0.037	2.2	140	24	22	4	2.916	1.44
13	K13	22	7.21	314	0.2	4.8	0.023	0.7	160	270	142	52	2.916	0.96
14	W1	27	5.86	101.3	0.06	5.8	0.014	0.95	220	18	16	3.2	1.944	0.24
15	W2	25.5	7.61	108.1	0.07	6.6	0.052	0.8	54	60	42	40.4	1.458	1.04
16	W3	26	6.63	257	0.16	5.8	0.025	0.079	280	96	74	13.6	9.72	0.24
17	W4	26	6.34	86.9	0.06	6.6	0.109	0.75	38	80	48	18.4	0.486	0.16
18	R1	26	6.83	170.6	0.109	7.6	0.06	0.9	240	28	40	8	4.86	0.08
19	R2	25.5	6.51	349	0.22	7.0	0.048	0.23	300	30	60	8	9.72	0.08
20	B1	28.5	7.51	1160	0.74	8.13	0.044	0.2	880	200	360	64	48.6	0

TABLE 7 (c)

PHYSICOCHEMICAL ANALYSIS OF WELLS AND RETTING YARDS OF KADALUNDI (POSTMONSOON)

Sl. No	Sample Code	Tempe -rature ºC	pH	E.C mS	Salinity ppt	Dissolve d Oxygen mg/l	Phosphate mg/l	Nitrate mg/l	Chloride mg/l	Alkalinity mg/l	Total Hardness mg/l	Calcium mg/l	Magnesium mg/l	Sulphide mg/l
1	K1	27	7.22	539	0.34	4.13	0.035	0.017	60	18.6	260	76	17.01	0.72
2	K2	25	4.19	2390	1.53	4.07	0.003	0.9	320	Nil	1700	344	204.12	0.00
3	K3	26.5	6.17	196	0.13	5.13	0.009	0.224	100	22	28	5.6	3.402	0.72
4	K4	26	6.12	95	0.06	6.47	0.001	0.29	80	16	14	3.2	1.458	1.12
5	K5	-	-	-	-	-	-	-	-	-	-	-	-	-
6	K6	26.5	6.83	318	0.2	5.93	ND	1.07	80	70	46	17.6	0.486	1.12
7	K7	25.5	7.32	272	0.17	6.4	0.125	0.1	60	84	100	28	7.29	0.88
8	K8	26	7.14	471	0.3	4.73	0.008	0.1	100	116	200	5.6	45.198	0.72
9	K9	27	8.41	325	0.2	5.67	0.013	1.0	32	86	100	33.6	3.888	0.64
10	K10	27	6.10	109	0.07	6.53	0.003	2.32	80	18	28	7.2	2.43	0.4
11	K11	28	5.76	60.1	0.04	5.53	ND	0.78	14	10	14	2.4	1.944	0.92
12	K12	26	5.88	129.2	0.08	4.27	0.016	1.92	80	16	28	4.8	3.888	0.32
13	K13	26	7.22	409	0.26	2.87	0.003	0.015	80	128	150	50.4	5.832	0.88
14	W1	26	6.35	104.5	0.066	5.87	ND	1.03	60	10	12	2.4	1.458	0.4
15	W2	26.5	6.42	102.7	0.065	6.53	ND	1.38	18	12	10	4	Nil	0.48
16	W3	27	7.16	403	0.257	5.53	ND	0.135	120	48	84	17.6	9.72	0.8
17	W4	28	6.16	78.2	0.05	6.53	ND	1.79	18	10	6	2.4	Nil	0.72
18	R1	30	7.91	32600	20.86	5.53	ND	0.94	16500	96	5160	344	1044.9	0.816
19	R2	28	8.07	31300	20.032	4.67	0.001	0.84	16700	108	6000	336	1253.88	0.8
20	B1	27	7.47	4210	2.69	7.2	0.02	0.174	1480	98	1180	184	174.96	0.00

TABLE - 10

PREVALENT RATE - AGE WISE & SEX WISE

Name of diseases	Age Group of Male					Age Group of Female				
	20-30	30-40	40-50	50-60	Above 60	20-30	30-40	40-50	50-60	Above 60
	No. of cases / Prevalent rate					No. of cases / prevalent rate				
Rheumatism							(1) 1.6863	(3)5.05902	(2) 3.37268	(3) 3.37268
Stomach problem	-	-	-	-	-	-	(3) 5.05902	(2) 3.37268	-	(1) 1.6863
Respiratory disease	-	-	(1) 2	-	-	-	(2) 3.37268	(4)6.7453	8(13.4907)	(7)11.19
Skin disease	-	-	(1)2	-	-	(1) 1.6863	(2) 3.37268	(3)5.05902	(1) 1.6863	(2)3.37268
Eye disease	-	-	-	(1)2	-	-	(2) 3.37268	(2) 3. 37268	(5)8.4317	(2) 3.3726
Head ache & back pain	-	-	-	-	-	-	(2) 3.37268	(10)16.864	(5)8.4317	-
Back pain	-	(1)2	(1)2	(3) 6	-	(3) 5.05902	(11)18.5497	(13)21.9224	(12)20.236	(10)16.864
Other Diseases	-	-	-	-	(1) 2	-	(1)1.6863	(2)3.37268	(2)3.37268	(2)3.37268

TABLE 8 (a)

BACTERIOLOGICAL QUALITY OF THE WELLS AND RETTING YARDS OF KADALUNDI (PREMONSOON)

Sl. No	Sample code	SPC Colonies/ ml	MPN Index/100ml	Test for E. Coli
1	K1	TNC	11,000	Negative
2	K2	Nil	<3	Negative
3	K3	87	93	Negative
4	K4	TNC	460	Negative
5	K5	262	24,000	Negative
6	K6	75	15,000	Positive
7	K7	TNC	1,50,000	Positive
8	K8	TNC	24,000	Positive
9	K9	TNC	24,000	Positive
10	K10	43	24,000	Negative
11	K11	TNC	24,000	Positive
12	K12	TNC	24,000	Negative
13	K13	TNC	24,000	Negative
14	R1	91	75	Negative
15	R2	42	210	Positive
16	B1	61	460	Positive
17	W1	Nil	24,000	Negative
18	W2	80	6,400	Negative
19	W3	176	37	Negative
20	W4	208	1,100	Negative

TABLE 8 (b)

BACTERIOLOGICAL QUALITY OF WELLS AND RETTING YARDS OF KADALUNDI (MONSOON)

Sl.No.	Sample Code	SPC Colonies/ml	MPN Index/100ml	Test for E. coli
1	K1	184	≥2400	Positive
2	K2	78	240	Positive
3	K3	47	210	Positive
4	K4	26	93	Positive
5	K5	-	-	-
6	K6	33	1100	Positive
7	K7	168	240	Positive
8	K8	142	460	Positive
9	K9	68	≥2400	Positive
10	K10	224	≥2400	Positive
11	K11	312	≥2400	Positive
12	K12	82	≥2400	Positive
13	K13	264	≥2400	Positive
14	W1	368	≥2400	Positive
15	W2	15	75	Positive
16	W3	11	93	Positive
17	W4	206	93	Positive
18	R1	240	≥2400	Positive
19	R2	568	≥2400	Positive
20	B1	134	64	Positive

TABLE 8 (C)

BACTERIOLOGICAL QUALITY OF WELLS AND RETTING YARDS OF KADALUNDI (POST MONSOON)

Sl.No.	Sample Code	SPC Colonies/ml	MPN Index/100ml	Test for E. coli
1	K1	10	300	Positive
2	K2	10	11000	Positive
3	K3	58	700	Positive
4	K4	51	30	Positive
5	K5	--	-	-
6	K6	2	390	Positive
7	K7	17	2300	Positive
8	K8	156	300	Negative
9	K9	9	300	Negative
10	K10	224	46000	Negative
11	K11	13	15000	Positive
12	K12	118	230	Negative
13	K13	37	9300	Positive
14	W1	51	930	Positive
15	W2	172	24000	Positive
16	W3	34	400	Negative
17	W4	16	23	Negative
18	R1	392	30	Positive
19	R2	39	2300	Positive
20	B1	38	700	Positive

TABLE - 9(a)

TYPE OF HOUSE

Type	No. of families	Percentage
Roofed	133	64.25
Terraced	30	14.49
Incomplete house	11	5.31
Thatched	25	12.07
Asbestos	2	0.966
No house	6	2.89
Total	207	100

TABLE - 9(b)

TYPE OF LATRINES

Type	No. of family	Percentage
Separate	160	77.29
Attached	9	4.34
River/Open	34	16.42
Common toilets	4	1.93
Total	207	100

TABLE - 11

TYPE OF FAMILY

Type of family	No. of houses	Percentage
Extended	74	35.74
Joint	39	18.84
Nuclear	84	40.57
Single	10	4.83
Total	207	100

TABLE - 12

MONTHLY INCOME OF THE FAMILIES

Monthly income	No. of families	Percentage
0-500	14	6.76
500-1000	66	31.88
1000-1500	57	27.53
1500-2000	23	11.11
Above 2000	47	22.70
Total	207	100

TABLE - 13

MONTHLY EXPENSE OF THE FAMILIES

Monthly expense	No. of workers	Percentage
0-500	9	4.34
500-1000	43	20.77
1000-1500	58	28.01
1500-2000	36	16.9
2000 above	61	29.95
Total	207	100

TABLE - 14

HEALTH ASPECTS OF COIR & NON COIR WORKERS

Health aspects of Coir workers			**Health aspects of Non-coir workers**		
Name of diseases	No. of persons	Percentage	Name of diseases	No. of persons	Percentage
Head ache & Back pain	17	12.32	Back pain	1	7.6
			Respiratory disease	4	30.76
Back pain	54	39.13			
Rheumatism	9	6.52	Skin disease	3	23.07
Respiratory disease	22	15.94	Blood Pressure	2	15.38
Skin disease	10	7.25	Eye disease	2	15.38
Stomach ache	6	4.35			
Eye disease	12	8.69	Dental disease	1	7.6
Others	8	5.795			
Total	138	100	Total	13	100

TABLE - 15

DETAILS OF AWARENESS CAMPS CONDUCTED IN KADALUNDI PANCHAYAT

Sl. No.	Date	Ward /Number of participants	Problems encountered by the people	Solution/Mitigative measures suggested
1.	17. 11. 2000	Ward 6 , 23 participants	Drinking water scarcity	Installation of Rain water harvesting Unit / other water conservation measures
2.	20. 12. 2000	Ward 8 55 Participants	Same as above	Same as above
3.	6. 2. 2001	Ward 5 46 participants	Same as above	Same as above
4.	7.4.2001	Ward 1 58 participants	Same as above	Same as above
5.	25.5.2001	Ward 3 67 participants	Same as above	Same as above

TABLE - 16

PREVALENT RATE OF DISEASES AMONG PATIENTS WHO ATTENDED THE MEDICAL CAMP

Sl. No	Name of diseases	Number of cases	Prevalent rate $\frac{\text{No. of cases x 1000}}{89}$
1	Low Back Ache	21	235.96
2	Peripheral Neuritis	14	157.3
3	Defective iris	4	44.94
4	Hypertension	5	56.17
5	Scabies	4	44.94
6	Acid Peptic Disease	5	56.18
7	Helmintharis	3	33.7
8	Diabetes Mellitus	2	22.47
9	Tennis elbow	5	56.18
10	APD	7	78.65
11	URI	7	56.18
12	Acute Respiratory Infection	6	67.42
13	Chronic Infection	6	67.42
14	Sinusitis	2	22.47
	Total	89	1000