Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 11	No. 4	pp. 585-590	2012

Original Research Paper

Ecological Effects and Occupational Health Hazards Due to Coir Retting: A Case Study from West Coast of Kerala, India

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Nat. Env. & Poll. Tech.
Website: www.neptjournal.com
Received: 18-4-2012
Accepted: 15-5-2012

Key Words:
Kayamkulam backwaters
Coir Retting
Biodiversity
Health hazards

ABSTRACT

The backwater of Kerala is becoming polluted due to persistent retting of coconut husk for the manufacture of coir. This paper assesses the ecological status of the retting ground and brings out the occupational health hazards due to coir retting. It is observed that the quality of water becomes deteriorated due to retting, and plankton and benthic fauna show low community diversity. The paper also highlights the occupational health hazards observed among the coir workers.

INTRODUCTION

The vast stretch of brackish water lakes and long chain of lagoons that exist all along the west coast of Kerala consist of thirty identifiable backwater bodies. They receive water from the numerous rivers and streams. The backwaters are considered as a life support system for about 2 lakh population belonging to more than 32,000 fisherman families.

Aquatic pollution has emerged as the major hazard to the development of backwater fisheries as well as aquaculture practices. Heavy pollution load due to factory effluents, pesticides, hydrocarbons, sewage and domestic discharges, retting of coconut husks, use of organic bio manure (OBMS) etc. has already hampered the ecosystem irrecoverably. This has happened on account of the unawareness of the fishery needs and the general ignorance about the significance and consequences of large scale and indiscriminate discharge of obnoxious substances into the aquatic medium. Incidence of large-scale fish mortality due to pollution in the backwater has become quite common.

Retting of coconut husk is the main source of organic pollution in the backwaters of Kerala. The process for manufacture of coir causes serious anoxic problem through oxidation of organic matter and production of poisonous hydrogen sulphide.

MATERIALS AND METHODS

Study area: The location of the Kayamkulam backwater falls is shown in Fig. 1. The samples were collected from a retting and a non-retting ground of the area. *In situ* analysis was carried out using a mobile lab set up in the boat. This backwater is located between two Ramsar Sites of Kerala, i.e., Vembanad Kol and Ashtamudi Wetland systems. The main objectives of the study include, impact assessment of retting activity on the ecology of the area. This involves quantitative and qualitative analysis of plankton and benthos in retting and non-retting ground. The correlation between water quality and biodiversity of plankton and benthos was examined. A survey was carried out to understand the occupational health hazards consequence to coir retting.

Water samples were analysed for the pH, H_2S, hardness and carbon dioxide. Water collected from the lake floor (depth 1m) was analysed to obtain biomass count of plankton and benthos (APHA 1990, Bijoy Nandan 1991).

Details of occupational health hazard were collected from Vector Control Research Institute and Primary Health Centre, Cherthala. Personal interviews with fishermen, coir workers and Panchayath officials were also carried out.

RESULTS AND DISCUSSION

Chemical parameters of water such as pH, H_2S, hardness, DO and CO_2 were determined. The pH in the water at the retting zone ranged from 7.40 to 7.91 and that at the non-retting zone from 7.91 to 8.26. The water at the retting zone was acidic during the monsoon and pre-monsoon periods. The pH was minimum during the monsoon and maximum during the pre-monsoon period. Abdul Azis & Nair (1986) recorded wide fluctuation in pH in the retting yard (4.2 to 8.9).

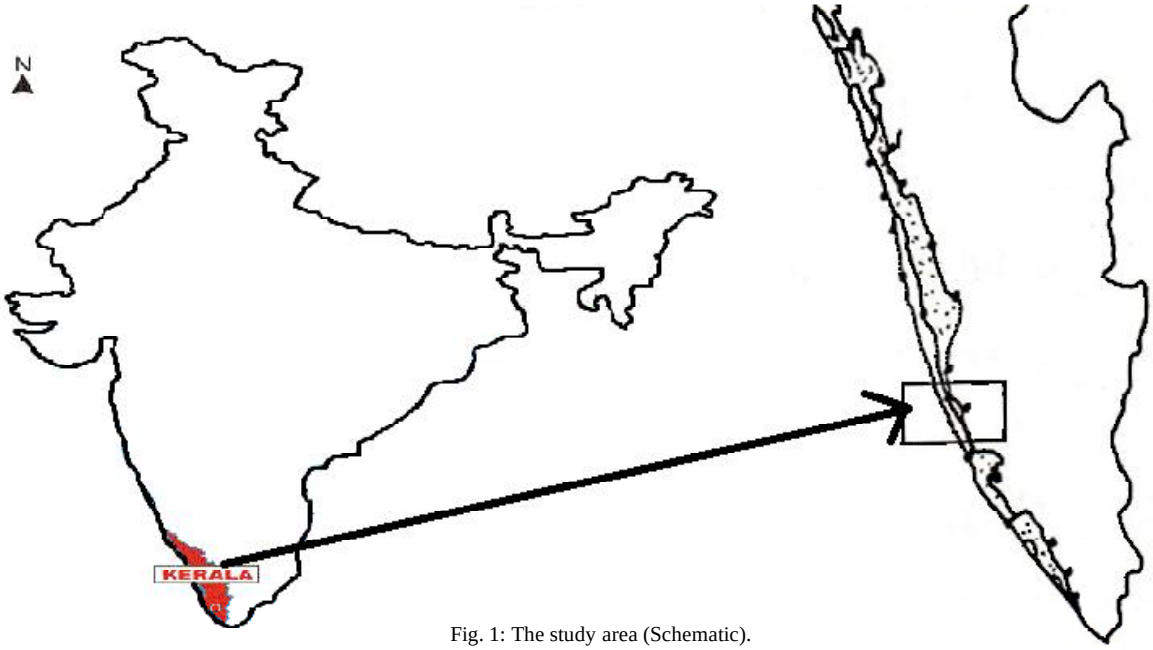

Fig. 1: The study area (Schematic).

A high hydrogen sulphide concentration was the characteristic feature of water at the retting zone. Hydrogen sulphide concentrations at the retting zone ranged from 10.40 to 41.10mg/L, and in non-retting zone from 1.43 to 4.00 mg/L. Hydrogen sulphide showed higher concentration during pre-monsoon period. Depletion of dissolved oxygen and production of hydrogen sulphide accompanied with the retting of coconut husk has been reported earlier from the Edava-Nadayara estuary by Abdul Aziz (1978) and Abdul Aziz and Nair (1986). The decomposition of the organic matter in the retting zones by bacteria results in the utilization of dissolved oxygen and production hydrogen sulphide. The organic load at the retting zones is always high resulting in generation of microbial decomposition leading to depletion of oxygen, which eventually led to a state of anoxia.

Dissolved oxygen ranged from 0.36 to 0.28mg/L at the retting zone, and in the non-retting zone, it ranged from 5.30 to 6.21mg/L. Dissolved oxygen showed lower values during pre-monsoon period. Highly restricted circulatory process and the higher consumption can be attributed to the very low levels of oxygen in the water. Such anoxic conditions coupled with depletion of oxygen have been reported from the Edava-Nadayara backwater during February to late July (Abdul Azis 1978).

Carbon dioxide concentration in the retting zone ranged from 12.7 to 7.79 mg/L, and in the non retting zone from 4.7 to 4.8 mg/L. The higher concentration was noticed during both pre-monsoon and monsoon periods. The higher concentration of free CO_2 in the retting zones could be attributed to the process of decomposition of organic matter like pectin, phenol, tannin etc. leading to a rise in temperature of the medium thereby favouring production of the gas. The retting zones showed tremendous increase in the concentration of sulphide accompanied with the production of CO_2 thereby establishing a positive direct relationship between CO_2 and sulphide values, particularly in the retting zones.

Hardness ranges from 370 mg/L (monsoon) to 823 mg/L (pre monsoon) in the retting zone, whereas in the non-retting zone the hardness ranges from 3.48 mg/L (pre monsoon) to 260 mg/L (monsoon).

Certain correlation has been established between some important parameters. A sympathetic relationship exists between H_2S, hardness and carbon dioxide. When H_2S reduces CO_2 and hardness get depleted (Figs. 2, 3, 4). However, dissolved oxygen has an antipathetic relationship with H_2S.

The main reason for the depletion of dissolved oxygen in the retting zone can be attributed to the very high demand for this vital gas to carry out the decomposition of the ever increasing daily load of coconut husk in the retting zones. The decrease in the organic load is represented by huge quantities of husk in the retting zones. Under this condition, all the bacteria utilize the dissolved oxygen in the receiving water.

Plankton biodiversity of the retting zones: The biomass values of the plankton in the retting zone were greatly reduced, and the incidence, abundance and diversity of the

Table 1: Plankton distribution in the non retting zone.

Name of the Species	Count No./mL	No./m³	%
Phytoplankton			
Melosira	893	267900	78.82
Closterium	8	2400	0.7
Trichodesmium	38	11400	3.35
Pinnularia	3	900	0.26
Navicula	10	3000	0.88
Tabellaria	3	900	0.26
Pleurosigma	20	6000	1.77
Microspora	8	2400	0.71
Desmidium	5	1500	0.44
Nitzschia	5	1500	0.44
Synedra	15	4500	1.32
Coscinodiscus	8	2400	0.71
Stephanodiscus	13	3900	1.147
Other Unidentified algae	8	5400	1.59
Zooplankton			
Testudinella sp.	23	7400	2.47
Copepod nauoplei	13	3900	1.14
Cyclopoid copepoda	13	3900	1.14
Keratella sp.	8	2400	0.71
Total	**1133**	**339750**	**100**

Table 2: Plankton distribution in the retting zone.

Name of the Species	Count No/mL	Number/m³	%
Phytoplankton			
Spirulina	8	2400	1.67
Oedogonium	8	2400	1.67
Navicula	45	13500	9.5
Closterium	18	5400	3.8
Oscillatoria	35	10500	7.4
Phacus	48	14400	10
Stichococcus	8	2400	1.67
Pleurosigma	25	7500	5
Melosira	35	10500	7.4
Lyngbya	5	1500	1
Trichodesmium	20	6000	4
Coscinodiscus	33	9900	7
Synedra	20	6000	4
Anabaena	20	6000	4
Microspora	3	900	6
Stephanodiscus	5	1500	1
Other unidentified algae	30	900	6
Zooplankton			
Testudinella sp.	78	23400	18.5
Copoepod nauplei	8	2400	1.67
Cyclopoid copepoda	15	4500	3
Keratella sp.	8	2400	1.67
Total	**472**	**141600**	**100**

fauna were greatly depleted in the retting zones as compared to the non-retting zones (Tables 1, 2). This depletion was more prominent during the pre monsoon period when retting process attained its peak resulting in anoxic conditions coupled with the formation of high concentrations of sulphide in the medium. The population in retting zones showed signs of increase with the advent of the monsoon rains resulting in a raise in the concentration of dissolved oxygen in the retting zones and non-retting zones. The plankton as well as benthic population declined again during the pre-monsoon period. The observation follows the general trend of the plankton population in the retting zones of the other backwaters of Kerala. Variation in plankton and benthos distribution in the retting and non retting zones in pre-monsoon period is illustrated in Figs. 5, 6, 7 and 8. Among planktons, algae dominate over Nauplei, Copepoda and Rotifers. However, Rotifers declined and all other species increased in the monsoon period (Table 3). Among benthos Polychaeta showed a decline by monsoon period and Gastropods increased. By onset of monsoon bivalved mussels have appeared. The continued exploitation of Kayamkulam estuary for retting of coconut husk has created a unique ecosystem, unsuitable for the existence of aquatic flora and fauna. The zooplankton had suffered severe damage thereby upsetting the food chain of the fishes occupying higher level in the trophic pyramid. The benthic faunal components also showed a depleted condition in the retting zone. The benthos in the non-retting zone consisted of five groups of organisms that in the retting zone contained only three groups of organisms. The fauna at the non-retting zone was always richer. Ambika Devi (1988) has reported Polychaetes, the only benthic fauna of the retting zone of Cochin backwaters. It is revealed that the non retting zone constitute Polychaetes, Crustaceans and Molluscs.

In the Kozhikode backwaters, Remani et al. (1989) reported a diverse pattern of benthic faunal distribution in retting zone. Polychaetes dominate the fauna followed by Crustaceans and Molluscs in the retting zone.

Occupational health hazards: The study area includes two district Panchayths, Arattupuzha and Thrikkunnipuzha. Most of the people in the area are engaged in coir and fishing industry. Based on the Panchayath development appraisal report and survey, it was found that 8000 people engaged in the coir industry and 5000 people engaged in fishing at Arattupuzha Panchayaths. In Thrikunnypuzha Panchayath coir and fishing are practiced by 80 percent people. Most of the women in the area are engaged in the coir industry. Modern technology adopted in fishing industry by foreign agency has reduced the employment potential of Thrikkunnypuzha Panchayath.

Retting of coconut husk by the traditional methods and mechanical extraction process in the backwaters has been a major source of health problem to the workers engaged in various stages of production of coir in the coir industry. Based on the study reports of Bijoy Nandan (1991) and personal interviews and discussion with the workers aged be-

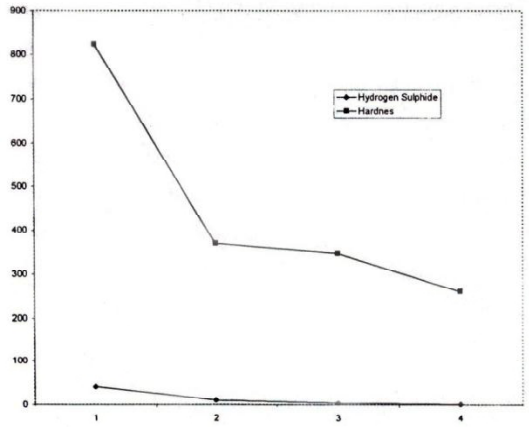

Fig. 2: Variation of H_2S and DO.

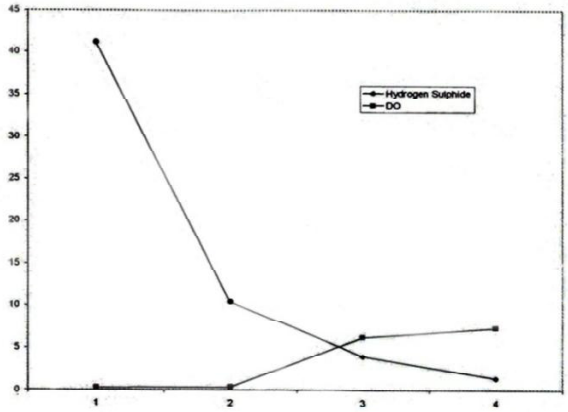

Fig. 3: Variation of H_2S and CO_2.

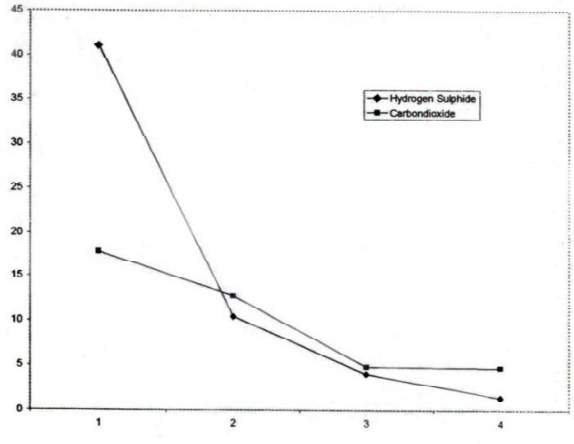

Fig. 4: Variation of H_2S and hardness.

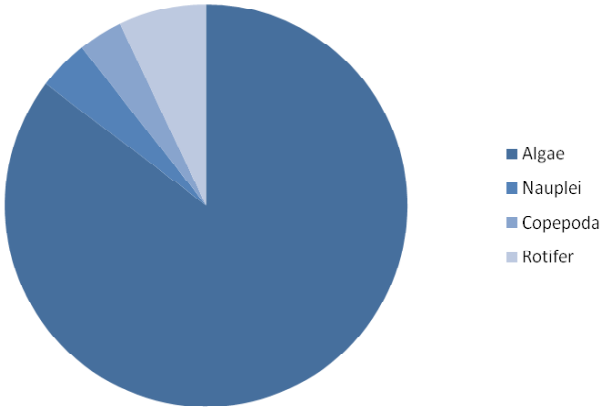

Fig. 5: Plankton distribution in retting zone (pre monsoon).

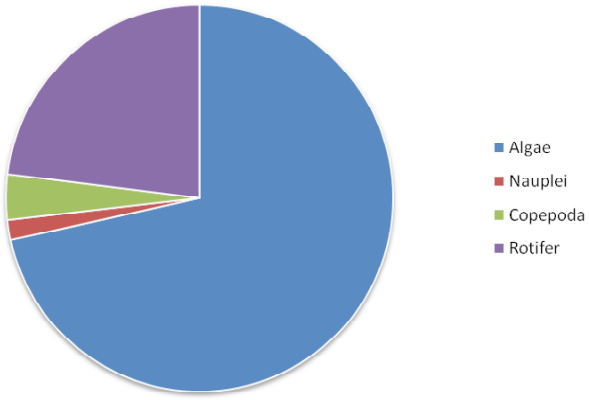

Fig. 6: Plankton distribution in non retting zone (pre monsoon).

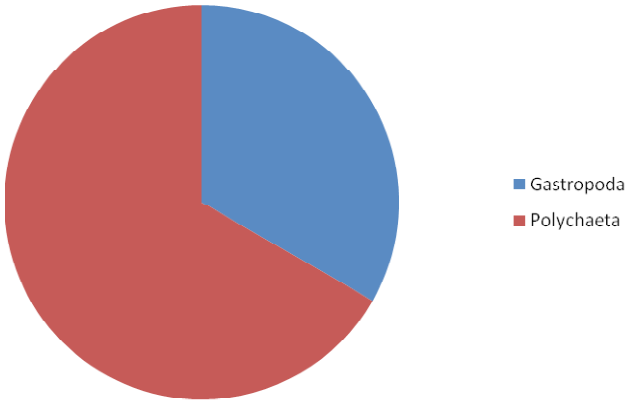

Fig. 7: Benthos distribution in retting zone (pre monsoon).

Table 3: Distribution of plankton and benthos in the retting zone during pre-monsoon and monsoon period.

Species	Non Retting zone		Retting zone	
	Pre-monsoon	Monsoon	Pre-monsoon	Monsoon
Plankton				
Algae	86.20	91.5	53.2	72.11
Nauplei	4.10	1.14	1.2	1.67
Copepoda	3.60	1.14	1.1	3.00
Rotifers	7.10	6.22	34.5	23.22
Benthos				
Gastropoda	26.30	-	33.33	67.00
Bivalved mussel	5.78	4.50	-	22.00
Polychaeta	62.36	64.70	66.66	-
Fish	-	0.75	-	-
Amphipoda	-	27.00	-	-
Oligochaeta	5.00	3.00	-	-

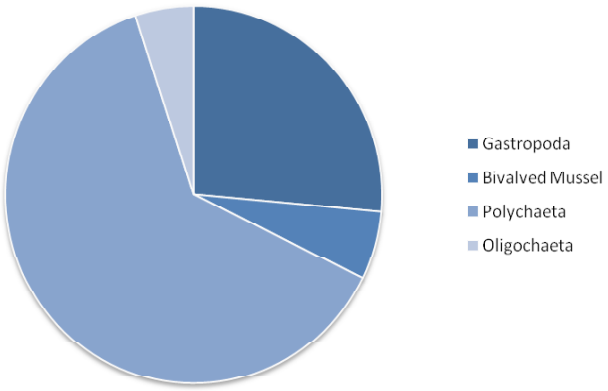

Fig. 8: Benthos distribution in non retting zone (pre monsoon).

tween 19-45 (male and female) engaged in retting activity has revealed that they are facing severe health ailments like skin, throat and eye irritation, knee swelling, red eyes, muscular weakness, sleeplessness and swelling in various parts of the body. The high amounts of carbon dioxide and hydrogen sulphide produced in the retting grounds justify the fact that these toxic gases act as simple chemical asphyxiant to the workers engaged in retting operations leading to discomfort, muscular weakness and other problems. The epidemiological survey of the retting yards of Kerala and surrounding areas conducted by the Vector Control Research Institute has shown that the inhabitants of these areas are endemic to filariasis. The organic rich liquor of the retting yards is associated with several water plants, which support the vectors of several waterbone diseases. The high organic content in the retting grounds serves as the breeding grounds of various species of mosquitoes. The species *Manosonia mansonia*, *Culex* sp. and *Brugia malayi* are found to be associated with the aquatic weeds along retting sites. *Bragia malayi* is specific to the retting areas especially in Kerala. Although malarial infection is common in many parts of Kerala, transmission is not reported through these vectors. But filariasis still exists to be a job associated disease among the communities engaged in the industry and inhabitants around the retting yards. Medicated salt distribution, anti larval measures like introduction of larvivorous fishes has been timed in several areas of Kerala to control filariasis, especially in the retting zones.

CONCLUSION

The heavy pollution caused by the pollutants from the retting yards is found to have adverse effect on the population and environment. The main conclusion drawn from the study is that the environmental and faunal characteristics of the backwater system show the intensity of impact of pollution from retting activity. The investigation revealed that due to retting of coconut husk, the water quality has deteriorated with the accumulation of toxic organic compounds, hydrogen sulphide and depletion of dissolved oxygen, concomitant with the creation of anoxic sulphide in the retting zone. This has led to severe depletion in the plankton and benthos. Above all, various occupational health hazards are also associated with workers engaged in the retting activities.

ACKNOWLEDGEMENT

The authors are grateful to Dr. S. Bijoy Nandan of Central Inland Fisheries Research Institute, Alappuzha for the generous help rendered during the period of study.

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