Chapter 6

SUMMARY AND CONCLUSION

6.1 Water in the tribal stations
6.2 Water in the rural stations
6.3 River waters
6.4 Water in the distribution system
6.5 Sanitation
6.6 Water borne diseases

The present study entitled ‘Studies on the status of drinking water quality of Pathanamthitta district (Kerala State, India) with special reference to tribal settlements’ was carried out to examine the quality of potable water sources. Identification of the drinking water sources in the study area was carried out through survey, using random sampling method and interview of target groups. On the basis of survey stations were identified, water samples collected from different stations for two years (January 2006 to December 2007) and analysed for physico-chemical and bacteriological parameters. It was observed in the study that mostly there was significant variations in all parameters considered and between stations and seasons.

6.1 WATER IN THE TRIBAL STATIONS

Water in the tribal stations (TS) was acidic and loaded with faecal coliforms. The water at TS-4 (Paruva) was not found potable based on WQI. Magnesium hardness and electrical conductivity were found above the prescribed standards at TS-4 (Paruva) in the pre-monsoon season. At all tribal stations (TS) the factors such as pH, total hardness, calcium hardness, magnesium hardness, acidity, dissolved oxygen, silicate, chloride, salinity, Biochemical Oxygen Demand, faecal coliforms and faecal streptococci were found high in pre-monsoon season. FC/FS ratio indicated warm blooded origin of coliforms. Presence of Lead was observed at certain tribal stations. Fluoride was below the
desirable limit at all tribal stations. Therefore it is realized that polluted ground water was the major cause for the spread of epidemics and chronic diseases in humans during the summer season. In tribal stations during the pre monsoon season the water level is decreases and form breeding ground for musquitos.

6.2 WATER IN THE RURAL STATIONS

Water samples at rural stations, RS-5 (Kaipattoor), RS-7 (Kozhencherry) and RS-9 (Kadapra) were not suitable for drinking based on WQI. The bacterial load was lesser in rural stations than tribal stations. The pH showed slight variations compared to tribal stations. The study revealed that turbidity, pH, total hardness, calcium hardness, magnesium hardness, dissolved oxygen and silicate, Biological Oxygen Demand (BOD), faecal coliforms and faecal streptococci counts showed higher values in pre-monsoon season, but the EC, TDS, chloride, salinity, CO2, alkalinity, acidity and nitrate values were found higher in the monsoon season. Occurrence of Lead was noted in some rural stations. Fluoride was found below the desirable limit at all rural stations except at RS-3.

Water samples from other drinking water sources in tribal areas (OS) exhibited higher coliform counts during the post-monsoon and BOD in pre-monsoon season. The EC was found high in the monsoon season. The presence of heavy metals was within the permissible limits. The WQI showed that the water at OS-1 was polluted and not fit for drinking. Natural waters from ponds, streams, and “olis” were not safe for drinking.

The pH of all ground water samples were acidic. Seasonal average showed that the pH was below 7 in the study area during the three seasons. The acidity of water might be due to the acidic nature of soil. Electrical conductivity (EC), magnesium hardness, alkalinity and silicate were found high in bore well samples. The total dissolved solids (TDS), electrical conductivity (EC), chloride, salinity and hardness were found high at rural stations. Very low fluoride was observed in the bore-well water. Among heavy metals lead was found above the permissible limits at certain tribal and rural stations while others like Zinc.Cadmim and Copper were present within the permissible limits.
All the water sources were heavily loaded with faecal coliforms, and the source of pollution was from fecal output. The parameters such as Biological Oxygen Demand (BOD), faecal coliforms, faecal streptococci and FC/FS ratio were found high at tribal stations. The high level of these factors might be due to the lack of sanitation facilities. The ground water in the rural stations was also loaded with coliforms even though well defined septic system is present. The FC/FS ratio was above four at all stations. The contamination was of warm blooded origin. The other drinking water sources were also not fit for consumption considering the bacteriological factors which are responsible for water borne diseases.

6.3 RIVER WATERS

All the physico-chemical and bacteriological factors of river water samples were found comparatively higher at Achencovil river. Highest coliform count was noticed in river waters. The coliform count was also high at Kallar, a tributary of Pamba. The heavy metals like cadmium and Lead were found above the permissible limit in the Achencovil river water.

Achencovil, Pamba and Manimala rivers and three tributaries of Pamba are also used as drinking water source of this district. These lotic habitats were also loaded with coliforms. The coliform load was found high during pilgrimage season (post monsoon season) of Sabarimala. The contamination of surface waters affects the ground water quality as well as the water in the distribution system. The coliform count was high at Achencovil, but the faecal streptococci and the FC/FS ratio were higher at Pamba river. Among tributaries high coliform load was found at Kallad Ar. All the other observed physico-chemical factors were found within the permissible limits but bacteriological factors were above the accepted standards. The coliform count showed higher range than ground water, but other factors like EC, TDS and sulphate were comparatively lower than ground water of rural stations. Seasonal variations were found significant.

6.4 WATER IN THE DISTRIBUTION SYSTEM

Total dissolved solids (TDS), electrical conductivity (EC), total hardness, calcium hardness, magnesium hardness, sulphate, chloride and salinity and BOD
were found high at Adoor municipal water supply (AD) and the phosphate was found high only during October/November. Presence of Lead was noted at Adoor municipal water supply. Eventhough the water was chlorinated the presence of coliforms was noticeable and the count was higher at Thiruvalla municipal water supply (TV). The microbial pollution may be due to the poor maintenance of the water supply system. The occurrence of Cadmium was also above the permissible limit there.

The river water sources are utilized by the Kerala Water Authority for water supply to the district. From Perunthenaruvi pumping station water is supplied to Naranamoozhy and Vechoochira panchayats. Water from Achencovil, Pamba and Manimala rivers are used in Adoor, Pathanamthitta and Thiruvalla municipalities and other parts of the district. The treated water is supplied through the distribution system. The treated water flowing through the supply system showed variations from the natural river water. Total dissolved solids (TDS) and electrical conductivity (EC) were high at Adoor municipality and at Achencovil river. Coliforms counts were less in treated water than in natural source. Public water system was generally disinfected with chlorine and hence the lower coliform load. So water in the distribution system is safer for drinking purpose than other water sources. Incorporating appropriate bacteriological filtration at the pumping point would greatly reduce the bacterial load further. The chemical pollution in the ground water sources was very minimal and dependent on the geological formations. On the other hand surface water sources exhibited seasonal variations with an increase in the concentration during the wet season.

6.5 SANITATION

Sanitation and human health are closely connected to each other. Sanitation facilities in the tribal areas were very poor. People use pit latrines which were very near to the well. Open defecation is common. In the tribal colony people used panchayat wells, streams, ponds, rivers and ‘olis’ for water. These water sources were not properly maintained. The current major obstacles to human health are related to unsafe water, poor sanitation and inappropriate hygiene.
It may be noted that Chickenpox was reported from hilly areas of this district in 2007 at Seethathode panchayat of Pathanamthitta district.

Toilet facilities of the tribal areas were very poor when compared to rural settlements. Most of the people use pit latrines, or resort to open defecation. Water closets were less in number in tribal settlements. The distance from the toilet to the well was mostly less than 10m. The correlation study revealed that the distance from toilet to well is related with the coliform count. Low education status, socio-economic status and lack of transportation facilities etc. affect the living standard of people in the forest region.

Inadequate quantity and quality of drinking water and lack of proper sanitation cause millions of world’s poorest people to die of prevalent diseases each year. The main victims are children and women. Improving the sanitary and drainage system and adopting safe domestic and industrial waste disposal system can control the degradation of the quality of ground water. Improving water quality at source may not ensure a reduction in the transmission of water related diseases. There is significant deterioration in water quality between the source and the point of use. Contamination of drinking water during collection and storage appears to be more severe where the water source is outside the home (i.e., private outdoor and communal taps). Contamination of drinking water after collection may thus pose a greater risk for diseases than any contamination of the water at source. Unhygienic water sources were used by people at tribal area during summer. Water scarcity problem is severe during summer in this district.

### 6.6 WATER BORNE DISEASES

Microbial contamination of wells in this area were extremely high. This indicated that a high probability exists for human pathogenic infections for diarrhoea, dysentery, hepatitis and cholera. Most of the deaths related to water borne diseases occur in tribal and rural area. There is positive relationship between income level and household environmental conditions.

The analysis of physico-chemical and bacteriological characteristics of water samples suggested the need for evaluation of water characteristics as
well as adoption of proper water quality management practices with a view to protect riverine ecosystem from the influence of allochthonous and autochthonous materials.

Several studies have indicated that drinking water is a major risk factor for the high morbidity rate in Kerala. The ground water quality varies from place to place and with the depth of water table. The water drawn for domestic applications should be tested and analysed to ensure the suitability of ground water for human consumption. Lack of accessibility and awareness on clean drinking water and sanitation among lower socio-economic groups of people create more complex health problems.

Incidence of water borne diseases was periodically reported from thickly populated areas, particularly during rainy seasons whereas in Pathanamthitta district water borne diseases were reported during the summer season. Outbreaks of waterborne diseases and vector transmitted diseases were common in hilly areas especially in tribal areas irrespective of season. Viral epidemics were reported like Dengu fever, Leptospirosis and most recently Chickunguinea. Several water borne diseases were frequently encountered from the people inhabiting hilly areas, who continuously consume uncleared well water and other drinking water sources.

Once beautiful and plentiful river in the district has been reduced to a trickle, in the case of sacred Pamba; the drainage and sewage water flowing into it has become a stinking drain. The three rivers (Achencovil, Pamba and Manimala) flowing through Pathanamthitta district are polluted by dumping of sewage wastes from chicken corners and slaughter houses. These three rivers are also victims of sand mining. Water is supplied to Pathanamthitta and Alleppy districts from the above three rivers by Water Authority. Pamba river gets highly polluted during the pilgrimage season of Sabarimala. The surface water quality will also affect the ground water quality. Improper sanitation practices during pilgrimage season deteriorate the surface water quality in this district and ultimately the ground water sources also.
Suggestions

Strategies for providing safe water and sanitation system are to be developed. It must include public health education in hygiene and water source protection, practical methods and standards for water quality monitoring. Disinfection of community wells, proper sewage drainage system, and periodical water quality monitoring are some of the necessary measures to be implemented. People should be made aware of the water quality and related health outputs especially in tribal area. Monitoring should be done both spatially and temporally.

Public awareness programmes on sanitation, its importance, simple and economical water treatment methods like filtration and boiling would provide beneficial to avoid waterborne diseases. Special attention to be given to drink always hot water after thoroughly boiled thereby mitigates the harmful effects microbial pollution.

The current practice of using chlorine for the disinfection and treatment of water especially when it contains high ‘total organic carbon’ is likely to be severely restricted in future, due to the possible formation of unacceptable level of trihalomethanes and other carcinogenic byproducts. Alternative technologies to chlorination include ozonisation, UV radiation and advance filtration process.

The sludge produced from water treatment plant need its disposal. Once sludge is added to the soil, it leaches indirectly into ground and directly into surface water.

Municipal water supply also needs proper filtration and treatment particularly during monsoon months as heavy rain leads to the overflow of drain and ditches in the river bed, which is the source of supply water.

Steps are to be taken to purify the well water in every three months using bleaching powder, alum or potassium permanganate. Household wells are to be sufficiently away (25-35m) from the toilet to avoid microbial contamination.
Training may be given in waste management. Solid waste management involving the production of biogas and vermicompost may be practiced in tribal and rural areas.

Proper guidance to be given to women to keep water hygienic. Copper is the best material to store water because the rate of decay of microorganisms was highest in copper. Women can play an important role in the management of water resources especially in the domestic sector in tribal and rural areas. Women should be trained in water resource planning and technology in order to improve water use efficiency and help to protect the environment.

Hygiene awareness, water quality monitoring, waste management and sanitation must be an integral component of education from primary to graduation and a routine action plan for the local government bodies. Promote water literacy and solve water scarcity problem during the summer season.

Again, proper environmental friendly landuse management pattern are to be evolved for the conservation of water resources in the study area facilitating the recharge of ground water that would help to solve the prevailing water scarcity to a great extent.

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