



COMBATING POLLUTION IN TRADITIONAL WATER SOURCES OF KERALA

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ABSTRACT

High density of population and enormous number of individual water sources like open dug wells are special features of Kerala state. It is estimated that there are about 60 lakhs of open wells in this state. Many of those wells are located in small area along with houses, excreta and other waste disposal system with a proximity for pollution. Many traditional water sources are polluted due to short circuiting from the polluting source. It is also prudent that depending upon the nature of different area the effect of water quality problems also differ. The typical quality problems in the state are enlisted and the state is divided in to seven different zones with different potential for water pollution. The approach for water pollution control to be adopted is slightly different in the different zones which are discussed with a view for adopting the same in their respective locations. General and specific water quality remediation measures that can be adopted in each zone is also discussed and illustrated

Keywords: *Assimilation, KWA, Water Quality, Well Maintenance, Zones*

I. INTRODUCTION

Kerala is one of the densely populated state in India. Due to urbanization a major portion of the Kerala people live in cities and this trend is going on increasing. The density of population in the state is about 819 per sq km as per census of 2011 and this necessitates accommodating the fundamental waste assimilation requirements of residences like excreta, waste water ,and solid waste in small areas with proximity to pollute the enormous number of traditional water sources like wells or bore wells which are located nearby . Various organizations have conducted studies in the various parts of the state and proposed the hypotheses that a good number of traditional water source of the state are polluted .Lot of water testing laboratories are functioning in the state, mostly under the Kerala Water Authority , with a clear cut focus on the remediation of domestic water quality issues .The first and second authors during their tenure in the Kerala Water Authority(KWA), had been

working in the quality control wing for a pretty long period and also as director CCDU and this article encompasses their encounter with this sphere for remediation of domestic water quality issues in this state

II. GENERAL WATER QUALITY ISSUES IN KERALA STATE AND REMEDIAL MEASURES

Generally observed water quality problems in Kerala state are listed with the basic causes and remedial measures [1], [2], [3]

Sl no	Water quality issues	Causes	Remedial measures
a	Excess Bacterial presence	Ubiquitous Presence of coliform bacteria	Disinfection, Proper maintenance of water sources
b	Excess iron	Dissolved from the earth	Aeration , sedimentation, filtration and other methods using Iron specific Resin etc[4], [5]
c	Low pH	Absorbing CO ₂ from the surface of the earth .pH below 6.5 and up to 4	Increasing the pH by adding lime
d	Very low pH	pH below 4 ,Natural processes which leads to formation of mineral acids	Increasing the pH by adding lime
e	High pH	Formation of calcium and magnesium bicarbonate when water is percolated through the earth	Weak acids can be used
f	Excess turbidity	Conditions in the surrounding soil , presence of Iron Etc	Filtration , coagulation and flocculation, sedimentation
g	Excess fluoride	Geogenic reasons, Generally dissolved from the crust of the earth	Domestic kit using activated alumina or domestic kit using reverse osmosis process or other conventional methods
h	Excess Chloride	Sea water intrusion , presence of saline soil	Proper maintenance of water source. reverse osmosis based kits
i	Excess conductivity/TDS	Presence of ions, mainly ,chloride	Do
j	Organic pollution measured as BOD/COD	Intrusion from nearby polluting source	Identification and Removal of waste source ,disinfection
k	Excess hardness	Formation of calcium and	Softeners

		magnesium bicarbonate when water is percolated through the earth	
l	Excess Nitrate	Natural processes , fertilizers	Conventional methods
m	Growth of Algae	Waste source , sunlight	Preventing Sunlight. Copper Sulphate, chlorine
n	Carbonate deposition	Removal of CO ₂ from water and subsequent deposition of CaCO ₃	Aeration , followed by filtration

III. WELL MAINTENANCE

In the state of Kerala we have enormous number of open dug wells and effective maintenance of all those wells are very much important for proper management of quality of water. Some fundamental principles of well maintenance are stated below [3]

- a. The premises of well should be hygienic and clean
- b. Unused wells being used for dumping of waste is highly dangerous. It will pollute the groundwater and should be filled
- c. Proper drainage around the well to avoid stagnation of water and intrusion in to the well
- d. Use motor with low discharge to limit speedy percolation of water in to the well
- e. Avoid polluting sources near the well especially upland
- f. Parapet wall and platform around the well is highly essential (see fig1 below)
- g. Provide impervious platform and sidewall to a reasonable depth about 3 meters (fig1)

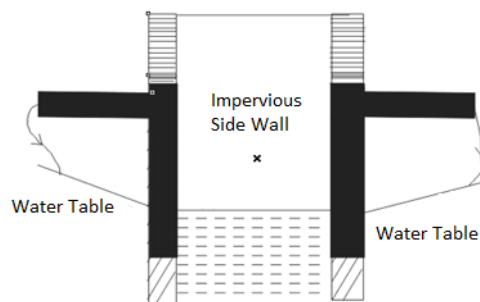


Figure 1. Impervious sidewall, platform and parapet wall attached to a well

- h. Avoid bath rooms attached to the wells
- i. Avoid usage of rope and bucket for withdrawing water from the well
- j. Use septic tank for disposal of human excreta especially in water logged area
- k. Avoid incidence of sunlight direct to the well as it can cause growth of algae
- l. Do not fix the foot valve to the bottom of the well, instead use flexible hose so that foot valve can be lowered or raised as per the fluctuation in water level . This is because bottom of the well contains excessive Iron
- m. Cover the well to avoid entry of other materials and algae growth
- n. Liquid waste to be disposed through soak pit so that there is no ingress of waste water in to the well
- o. Solid waste is to be disposed through separation, recycling or biodegradable processes

The above principles are to be followed everywhere which is fundamental for maintenance of open dug wells to control pollution

IV. DIVISION OF THE STATE IN TO SEVEN ZONES BASED ON WATER POLLUTION POTENTIAL

The total area in the state of Kerala is divided in to seven categories on the basis of water quality problems as detailed below. The classification is based on the fact that effects of water quality problems are different in different areas and the remedial measures are also slightly different which are discussed below

- a. Water logged area
- b. Coastal area
- c. Thickly Populated Urban area (towns, cities etc)
- d. Thickly Populated Rural Area
- e. Industrial area
- f. Geographically specific area
- g. Less populated rural area

Fig 2 below shows the division of the state in to seven zones based on water pollution potential

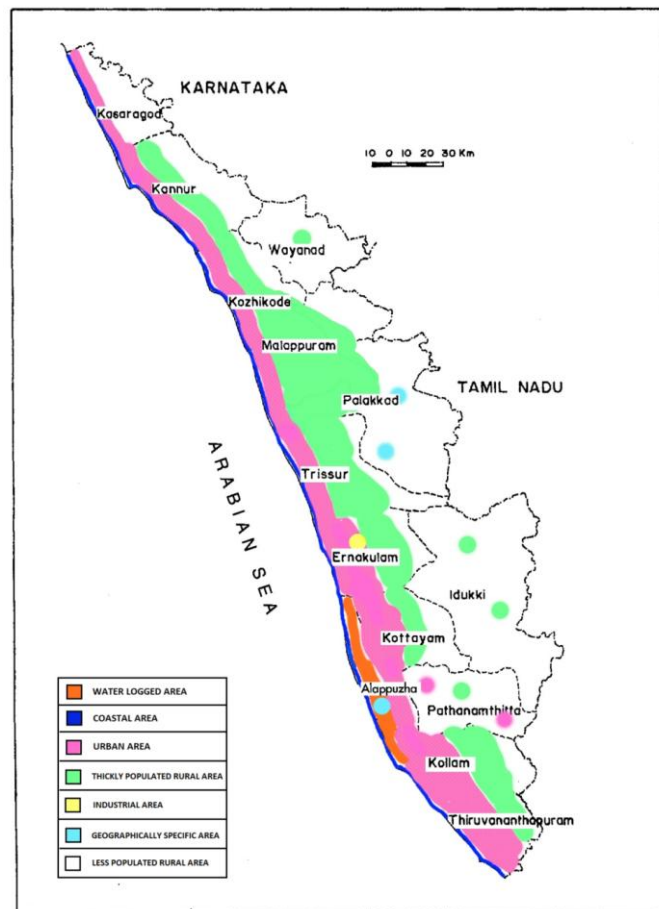


Figure 2. Map of Kerala state approximately illustrating the seven zones based on water quality

4.1 Water Logged Area

Typically good part of Alappuzha district and small parts in other districts are included in this category. In water logged area proximity for pollution is more since all the Surface contaminants are having direct access to water bodies. Disposal of human excreta and other wastes are problem. Water contains high organic matter, excessive bacterial presence, turbidity, color, odor and such contaminants. Rain water harvesting and artificial recharge are not very much appropriate

4.1.1 Remedial Measures

Construction of good quality septic tank with inlet and outlet above maximum water level for disposal of human excreta .Construction of septic tank or similar treatment options for waste water treatment is advantageous .Avoid dumping of solid waste in to the soil and instead of that separate the same and treat using biodegradability of the solid waste which can be performed in plastic drums or similar vessels .Community systems for disposal of human excreta ,solid and liquid waste etc are advantageous .Effective water supply system is invariably an effective solution. Effective water treatment even at the household level can be adopted to make water potable. Impervious side wall for a significant depth for the well to prevent ingress of contaminated water from the surface of earth is highly advantageous refer fig 1 above

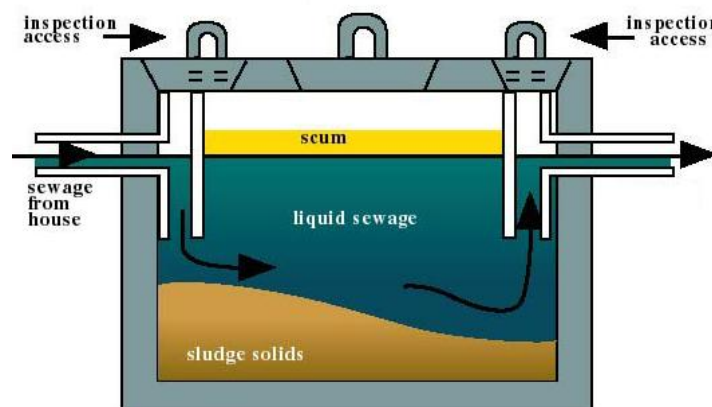


Figure 3. Septic tank

4.2 Water Quality Issues in the Coastal Area- Sea Water Intrusion

Excessive withdrawal of fresh water results in to intrusion of sea water in the wells of coastal area. Manifested as presence of excess Chloride (salty taste), Hardness and brackishness in the water which is predominant in most part of the coastal reaches of Kerala

The only theory is Ghyben – Hersberg equation [6] which states that in the coastal area sea water intrusion occurs and the depth of fresh water in the shore below the sea water level is 40 times the height of fresh water above sea level $h_s=40h_f$ (See figure below)

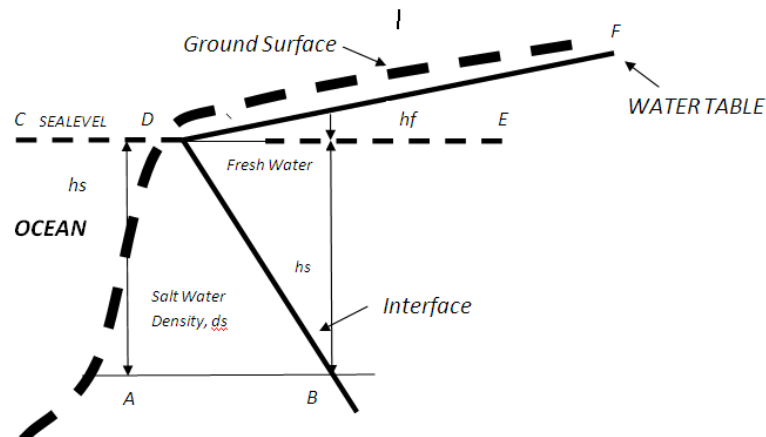


Figure 4. Ghyben – Herzberg Equation for sea water intrusion (fresh water will be on top and salt water bottom)

4.2.1 Remedial Measures

a. **Rain Water Harvesting** can reduce the ingress of sea water in to coastal aquifers. From the above figure it is evident that if the withdrawal of clear water from the various water sources in the coastal area is limited, sea water intrusion can be reduced

b. **Limited Depth of Well to Draw only Fresh Water**-while digging a well depth should be limited so that only clear water from the top only can be withdrawn . If depth is more there is possibility to reach the salty water .Treatment of sea water using reverse osmosis or other processes can also be used.

c. Domestic Level Water Treatment Kits Which can be used at Household Level

Lot of domestic water treatment kits are available in the market which can be used for treatment of water for removal of excess chloride, fluoride and other contaminants from water which function on the principle of reverse osmosis

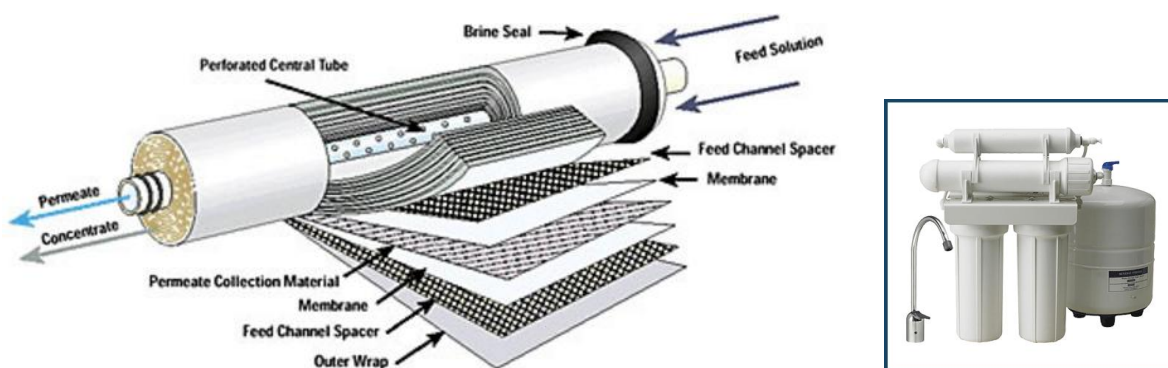


Figure 5. Process Description of Reverse Osmosis and Wall Mounted Domestic Kit Based on Reverse Osmosis process

4.3 Thickly Populated Urban Area

In addition to resident population floating population will also be enormous .If effective water supply is not available providing safe water to the people is challenging job .Waste problem both liquid and solid will be serious .Generally the traditional water sources are likely to be contaminated. In addition to high density of

population enormous number of other establishments like hotels, small industries etc will contribute more to the pollution potential

4.3.1 General Water Quality Issues

Presence of coliform bacteria

Presence of excess Iron in drinking water

Presence of organic matter

Low pH and in rare cases high pH

Growth of algae

In most cases the pollution can be considered as point sources but generally the surface water will be polluted. The general principles of preservation of water sources is to be followed and the fundamental treatment options for all the water quality issues as mentioned earlier is to be adopted

4.4 Thickly Populated Rural Area

Combined dependence on water supply and other water sources like wells, borewells, tube wells, filter point etc are special features of this area. Generally the area is covered with high density of population and the other establishments are comparatively less. Pollution potential will be less compared to urban area mentioned above. Effective maintenance of water supply system and other water sources are relevant. Roof top Rain water harvesting and artificial recharge is relevant to control pollution and for ensuring sustainability of source

4.4.1 Prominent Water Quality Problems

- a. Presence of coli form bacteria
- b. Presence of excess Iron in drinking water
- c. Presence of organic matter
- d. Low pH and in rare cases high pH
- e. Growth of algae
- f. Pollution due to organic matter

Effective water supply, proper maintenance of water sources like wells and various domestic water treatment objectives can be adopted

4.5 Industrial Area

Pollution from discharge of industrial pollutants. Situation aggravates if the industrial wastes are not properly treated. The pollution depends on the type of industry and its waste products. Public opposition against such industries are common everywhere. Artificial recharge reduces pollution. In the state of Kerala the Cochin area is only considered as industrial area. The issue is serious in the industrial belt of Kochi but there are various other locations where small or large industries discharge their wastewater without proper treatment and that ultimately results in to pollution of traditional water sources

4.5.1 Remedial Measures

Effective implementation and periodic updating of pollution control legislations. Role of pollution control board is relevant. Effective water supply system is an interim solution

4.6 Geographically Specific Area

In the state there are areas in which certain geographic characters create pollution of water sources. A few of such cases are listed below

Alappuzha and Palakkad districts are having high content of Fluoride in the ground water .Ground water in certain area in Palakkad district also contains high content of chloride which is due to the presence of saline soil .Certain area in Thrissur district contains high sulphur content in soil which forms sulphate and thereby mineral acidity is created which reduces the pH to below 4

In all these cases it requires treatment especially for removal of fluoride from water and also for removal of chloride from drinking water .For removal of fluoride from drinking water conventional method using activated alumina is useful .For fluoride and chloride removal filters working on the principle of reverse osmosis, can be used.(see figure 5).Rain water harvesting and artificial recharge are advantageous

4.7 Less Populated Rural Area

Generally refers to hilly terrain in the state .Generally the people living in this are agriculturist. Houses are located in more area .Comparatively less pollution and area is healthy. Generally open wells are the water sources. Well maintenance is more important and generally the water sources are deep .Rain water harvesting and artificial recharge improves availability of water and also improve agricultural products

Generally there is chance for sporadic Occurrence of point source pollution and its requirement is to adopt better well maintenance principles mentioned earlier

4.8 Government Initiatives Required

For implementing the programme in this state government involvement is highly essential

- a. Creating more awareness among the people on the preservation of water resources
- b. Creating more awareness among the people on the treatment of water
- c. Popularizing all types of water treatment equipment including low cost equipment's like terrafil technology among the people and to make them locally.
- d. Making the pollution control legislations more effective

V. CONCLUSION

Water quality issues are predominant in this state due to high density of population and the large number of traditional water sources. Water shortage is also predominant and the situation is becoming more and worse along with more development. Various measures are required to control water issues which require both governmental and public initiatives in which the people occupy a significant role. Now the water treatment equipment market is developing very fast and there is no agency for providing proper assistance to the people. There is no doubt that in future also there will be more demand for such services and we should have a proper system for guiding the people in the correct direction

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