

Risk Analysis of Dam Failure, Floods and Growing Water Crisis in Kerala.

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Date: 22September,2018

ABSTRACT: People have exploited water resource to a level where controlling of water and environmental pollution has become an exhausting exasperating task. Environmental degradation is caused by predominantly by the human activities that contributes significantly to changes in climatic conditions and hydrological disasters in Kerala. Water scarcity has become a major constraint to socio-economic development and a threat to livelihood in increasing parts of Kerala State. Water pollution was negatively associated with health outcomes, and the common pollutants in Industrial wastewater had differential impacts on health outcomes. Environmental changes are based on factors like urbanization, population and economic growth, increase in energy consumption and agricultural intensification. The environmental and water degradation has adverse impacts on humans, plants, animals and micro-organisms.

Kerala State in India is considered to be having a developed modern society. Public ignorance, all types of waste including solid, hazardous and biomedical waste generation in the Kerala state are more compared to other states in the country.

The overall aim of this paper is to provide the insight view how population increase with rapid urbanization, industrialization and consumerism, without due regard to environmental considerations, have led to extensive pollution of water and environment. The use of hazardous chemicals in manufacturing industries and agriculture cause severe water pollution. These harmful toxins and compounds which not only affects the quality of water but also pose danger to several endangered aquatic species and marine life and their habitats. The concentrations of heavy toxic chemicals that are deposited in bank soils, bed sediments and river waters upstream and downstream of the industrial effluent discharge point were examined with the aim of determining the effect of the effluent on the river water quality. We also focus on dangers of emerging deteriorating Dams that are old in Kerala and solutions for Water Crisis where contaminated water can be treated by a water treatment technology method and provide adequate drinking water for the people.

The most common is the perennial flooding that causes massive destruction of property, disease outbreaks, loss of lives, large losses to the economy and many socio-cultural impacts. The main cause of this menace is the perennial rainfall and resulting runoff. The severe impacts associated with extreme flooding events can be reduced through understanding of previous climate events and their impact and vulnerability, enhanced climate monitoring and timely early warning, Improved awareness of the usefulness of climate information and prediction products in decision making, as well as the existence of availability of good disaster management policies that effectively addresses the vulnerability. This research investigates the relationship between Rainfall and Runoff in the upper River Basin In order to understand the hydrological regime of the catchment. many other rivers are frequently flooded due to heavy rains. This research results and findings will assist the relevant bodies and stakeholders in dangers and threats in future which will affect their departments. The paper discusses major physical, hydrological, chemical and biological constraints relating to soil and water resources for ecosystem

sustainability. Better infrastructure, conservation and education along with innovative technology will provide a sustainable future for water resources.

Keywords: Water degradation, Environmental degradation, Health and sanitation, Kerala flooding, Dam Dangers, water crisis, Heavy Rainfall, contaminated water, deteriorating Dams, hydrological disasters, Water reservoirs, Catchment Areas, water treatment and Reverse Osmosis

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1.INTRODUCTION: Kerala is rapidly moving towards the scarcity for water at an alarming level. Water scarcity is caused by a lack of investment in infrastructure and technology to draw water from rivers and other water sources. The concerned authorities remain negligent about the crisis that's posing a serious threat to the state's stability because of politics. There are many reasons for the water crisis. Indians pump the water from the underground for irrigation and now they almost run out of water and the Government even though tried to solve the water issues. TI India's 'India Corruption Study 2005', which sampled 14,405 respondents from 151 cities and 360 villages, found that water was one of the public services most clearly identified with corrupt practices [1]. And this also has to be noted that India is not the only country where the natural resources face the corruption from bureaucracy of the government. In America a Water Law, passed on 10th July 2007, declared the public ownership of all surface and underground water, regardless of whether it is located on private or public land. Landowners will henceforth have to pay the government to use their own wells, signaling an increase in bureaucracy that is likely to usher in a lucrative new arena for corruption [2].

Kerala is suffering from water shortage for cultivation and drinking even though it has many big rivers, some of them perennial rivers, flow through some parts of India. Some of these Rivers are contaminated. The report states that an average of 200,000 Indian lives are lost every year due to inadequate supply or contamination of water. Every river in India is polluted to some degree. Combination of sewage disposal, industrial effluents, and chemicals from farm runoffs, arsenic, and fluoride has rendered India's rivers unfit for drinking, irrigation, and even industrial purposes [3]. The water quality in underground wells violates the desired levels of dissolved oxygen (DO), having high concentrations of toxic metals, fluoride, and nitrates [4] and coliform, the presence of which is one measure of filth.

There are many different types of research studies are done in the Environmental and water degradation and its serious consequences to capture the health benefits from improved environmental quality measures, and Significant progress in reducing the exposure to environmental risk factors by enhancing

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air quality, accessing safe drinking water, sanitation and hygiene to ensure environmental sustainability to eradicate water crisis.

2.SYSTEMATIC DETERIORATION OF WATER AND ENVIRONMENT: River water pollution in recent years is a result of Industrial waste, sewage outfall from townships, pilgrimage centers etc. The water contaminants are caused by human activities that cause extreme health problems by contaminated water that has high bacteria, viruses, protozoa, and parasites. Human Waste, paper, pulp plants and tanneries are discharged and deposited into a streams, rivers, lakes and the organic materials are decomposed by using large quantities of oxygen from water harming humans, animals, and plants if they encounter these toxins buried in the ground, in stream runoff, in groundwater that supplies drinking water, or in floodwaters, as happened after recent Floods in Kerala. Toxic waste like DDT, pesticides and Mercury are poisonous when consumed or contacted by plants and animals poses serious health problems, deaths, reduction of agriculture and aquatic animals' output.

In the past human wastes were deposited in natural systems, but with increasing population, the load of human waste has far exceeded the natural systems absorption and cleaning rate. Rapid rural urban migration is also contributing to pollution (Deshpande, 1971). Water quality has been steadily degraded by a combination of factors including saline, intrusion; sewage and industrial effluents and agricultural runoff. Bio Chemical Oxygen Demand (BOD) in Asian rivers is 1.4 times the world average and 1.5 times OECD levels. Kerala is having both abundance and scarcity from the point of view of water resources. The average annual rainfall of the state is 3000 mm. About 60 % of the annual rainfall in the state is received, during the South-West Monsoon (June-August) 25% during North-East monsoon (September-November) and remaining during the summer months. Though it has 44 rivers, most of these monsoon-fed, short rivers dry up during summer (State of Environment Report: 2005).

Kerala is densely populated region and as a result proper measures to be taken and the rivers of Kerala have been increasingly polluted from the industrial and domestic wastes and from pesticides and fertilizers in agriculture. Industries discharge hazardous pollutants like Phosphates, Sulphides, Amonia N, Fluorides, heavy metals and insecticides into the downstream which reaches the river. The river Periyar and Chaliyar are very few examples for the pollution due to industrial effluents. The assessment of rivers such as Chalakkudy, Periyar, Muvattupuzha, Meenachil, Pampa and Achenkovil indicate bacteriological pollution.

Most rivers in Kerala are associated with bacteriological contamination due to dumping of solid waste, bathing and discharge of Industrial effluents. The presence of fluoride in ground water above permissible limits is reported in Palakkad and Alapuzha districts. Studies have shown that faecal contamination is present in 90 % of drinking water wells.

Even though Kerala State has many rivers, numerous lakes and ponds, estuaries and back water system. Unfortunately, there is a severe deterioration due to over exploitation of natural resources from active channels and flood plain areas. The river Periyar and Chaliyar are very examples for the pollution due to industrial effluents. (State of Environment Report 2005).

River around the downstream municipalities and in parts of Kuttanadu is known for poor quality of water. The conventions held on the river bed, and the direct discharge of untreated hospital and municipal wastes and agricultural runoff are causing high damage to the river and seriously affecting the quality of life of the people who depend on Pampa river. Indiscriminate mining of sand from the river are also one of the main causes of water deterioration of the aquatic system. Large numbers of pumping stations that are

operating in the pampa river and the polluted water flows to surrounding communities without proper and effective treatment.

3.FLOODING AND GROWING RISK OF DAM DANGERS

The abnormally high rainfall that Kerala has received this year has led to over two dozen deaths in landslides and flash floods as well as the opening of sluice gates of 24 dams which is a wakeup call on the dangers posed by extreme weather.

There are many dangers emerging over deteriorating Dams that are old in Kerala. The three dams of the Idukki project would fail if the Mullaperiyar dam fails. The expert said that 216.5 million cubic meters of water would flow over the Idukki, Cheruthoni and Kulamavu dams in the event of a collapse of the Mullaperiyar dam. The Mullaperiyar reservoir holds 316.5 million cubic meters of water and the Idukki reservoir could hold only an additional 100 million cubic meters of water.

The rising water levels at the 123-year-old Mullaperiyar Dam in Idukki district, Kerala, fears the devastation by residents living downstream areas which is the earthquake-prone district of Idukki. Scientists have argued that if there is an earthquake in the region measuring above six on the Richter scale, the lives of over three million people will come under grave danger. The committee has noticed more seepage openings, which will cause more severe safety problems when the water level goes up.

4.WATER RESOURCES DEPLETION AND ITS REPERCUSSIONS: Many parts of Kerala are experiencing annual population growth rates between 2 and 4 %, degradation of the natural resource base, recurrent droughts and a growing dependence on water. The unscrupulous exploitation of earth's natural resources has posed a threat to sustainability. This water scarcity could be devastating socially, economically, ecologically, energetically and politically. In order to assess these problems, the following possible solutions are to be proposed such as planning of crops, intelligent agriculture, agricultural reforms, water related and industrial policies, governmental campaigns promoting awareness about water use for the population, and preservation of underground water reserves.

The protection, enhancement, and restoration of water quality of water pollution are an issue. The climate of the state plays a significant role in the water resources availability. For example, Rainfall is the main source of recharge for different water resources such as surface water and groundwater. Water vapor from desalination plants is cooled down by sea water for condensation and is then passed through processes to add useful minerals and carbonates. Evaporation, which reduces the amount of surface water, is high. Heavy pumping of groundwater has made groundwater levels grave.

However, despite of this pumping is not only the reason for water depletion. Daily usage of consumption of water for personal hygiene etc. are also a problem. Some of the negative effects of ground-water depletion include increased pumping costs, deterioration of water quality, reduction of water in streams and lakes, or land subsidence. Such effects, while variable, happen to some degree with any ground-water use.

The destruction of vegetation and natural habitats, erosion of uplands and watersheds, over-exploited and damaged aquifers, salinization of streams and groundwater, desertification of semiarid areas, and in particular, depletion and pollution of limited water resources have caused environmental pollution.

The water shortage and contamination has already reached dangerous level. Proper plan and actions should be implemented to sustain and preserve this limited resource. The continued reduction of water storage will hinder the development. "Depletion of availability of reliable water sources is gaining ground

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throughout the state through a number of activities which include drying up of water bodies through excessive exposure brought about by cutting of trees along river banks either through the "chitemene" system or clearing of river banks to facilitate development where local authorities have allocated plots along river banks as is the trend now. The cutting of trees along river banks which causes loss in water and pollution in many regions is big concern on the depleting water resource. Deforestation in the Western Ghats, the mountains above the Thrissur district, has also reduced the amount of water retained and increased erosion. The water source are heavily abused by unsustainable and unscientific approach, entirely due to the lack of vision of the local government, as there are absolutely no plans and actions to solve the approaching disaster.

5.WATER CONSERVATION AND ITS TYPES: The suitability of a soil conservation treatment depends on slope, rainfall amount, soil type and depth, Water holding capacity, location of impervious layer, agricultural practices, land cover, and economics.

The Government has been implementing various soil and water conservation measures in arable land like earthen bunds, stone pitched contour bunds, vegetative hedges, staggered trenches, moisture conservation pits, etc. to intercept rainfall where it falls and to obviate the chances of the runoff water from acquiring erosive velocities in arable land.

Some of the steps to conserve water are to Avoid leakage of water from the taps, Rainwater Harvesting, water supply should be limited in the areas of unlimited water supplies, by Educating people in the rural areas to save the water, by Promoting the conservation of water through media and wall posters, by Avoiding unnecessary water wastage, implementing Water Waste restrictions, by Improving the water distribution system, Reducing the interior water use cuts waste water flows, especially overflowing of gutters which contaminates the environment, by protecting ecosystem and habitat, reuse and recharge points of Historical Water Bodies, avoiding dumping sewage and garbage into Rivers and ponds. Further, water recharge through construction of pits near the vicinity of wells to be increased.

6.RAINWATER HARVESTING AND WATER SUPPLY RESERVOIRS: A Program called Jalanidhi, created by the Kerala government and World Bank has helped people to bring piped water to many households since 2000. People interested in digging new wells, drilling bore-wells, or building mechanisms to draw water from streams and rivers should be encouraged. Large reservoirs made of mud were traditionally built to catch surface runoff, and collection of water for irrigation should be allowed.

Since the mid-2000s, NGOs and the Kerala government have been trying to popularize roof-water harvesting as a viable solution, one that allows people to use their dry or discarded wells for conservation and groundwater recharge. The Government of Kerala proposes to provide piped water supply to all the inhabitants of the State by 2020. With the view to achieve various schemes aimed at creation of sources of water, its treatment and distribution have been launched by the Water Resources Department, primarily by the Kerala Water Authority, using both surface and ground water sources.

7.IMPORTANTANCE OF PROTECTING WATER SHED CATCHMENT AREAS.

A watershed is an area of land that drains down slope until it reaches a common point. All precipitation that falls within a watershed, will ultimately flow to the lowest points of bodies of water such as rivers, lakes, and the ocean. Every stream, brook, tributary, and river will eventually reach a larger body of water within its associated watershed. Watershed can be compared to a giant funnel that catches and directs all of the water that falls into it towards the bottom.

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Pollution within the watershed has the potential affect on all waterbodies located downstream. Watersheds are extremely important providing us with our drinking water supply, plus recreational opportunities and aesthetic beauty. the replacement of vegetation by impervious surfaces increases amount of runoff flowing into surface waters and causes erosion, turbidity, and degraded wildlife habitats. This runoff carries pollutants such as oil, bacteria, nutrients, sediment and metals into surface waters along with it.

Forested areas are very important for the health of a watershed. The plant cover and leaf litter absorb moisture and help maintain soil structure, while root masses keep soil permeable and stable so moisture can move into it for storage and allows water to be filtered and released slowly into the stream system rather than rapidly running overland. Conversion of watershed area has altered the hydrological regime while enhancing the silt movement – lowering water yield in the catchment affecting the groundwater recharge. Large-scale deforestation in the Western Ghats and introduction of plantation crops in highlands replacing the natural vegetation reduced the storage capacity of soil and resulted in surface soil erosion in watersheds and sedimentation in rivers which has affected summer flow in rivers and some perennial rivers and rivulets have become seasonal in the last few decades due to large scale land cover changes. Sand Quarrying and River Bank Agriculture are killing the rivers which is leading to bank erosion, lowering of water table and creating many environmental problems.

Scientific investigations involving aquifer monitoring, coastal marine environment stud principal components of water management system should include Supply of optimization, including assessments of surface and groundwater supplies, water balances, wastewater reuse, and environmental impacts of distribution etc can be planned and put into actions. Demand management, including cost-recovery policies, water use efficiency technologies, and decentralized water management authority should be implemented.

8.HEALTH AND SANITATION: Water is an integral part of all creatures in the world. We use it every day for different purposes such as domestic, agricultural and industrial. WHO defines “sanitation as the provision of facilities and services for the safe disposal of human urine and feces” (WHO homepage). The United Nations-World Health Organization Joint Monitoring Program for Water Supply and Sanitation defines “improved” sanitation as: “the means that hygienically separate human excreta from human contact and hence reduces health risks to humans”. A Sanitation handbook defines the term “sanitation as a process whereby people demand, effect, and sustain a hygienic and healthy environment for themselves by erecting barriers to prevent the transmission of disease agents”⁶.

Even though the water is polluted, Indians still use the water for drinking, and taking a shower. “The river is making people sick.” (Thompson,2005, para14)⁷.

India stands out amongst the densest populated nations on the planet with least sanitation scope and have indicated moderate advancement for the marker of sanitation. Different diseases associated with fecal transmission are polio, hepatitis A and E, intestinal worms, skin diseases like scabies, and eye contaminations like trachoma that can result in visual impairment. According to WHO and UNICEF-'s Joint Monitoring Program for Water Supply and Sanitation (JMPWSS) when looked at comprehensively on the targets set under MDG, states for example, Madhya Pradesh and Orissa will attain MDG target in the one century from now. Adults and children get diarrhea and different diseases from ingesting the disease-causing germs in human excreta, these results in dehydration, malnutrition, fever, and even death, particularly of children, elderly and with weak immune system. Further, 17 States, including Kerala, Haryana, Meghalaya, Himachal Pradesh, Punjab and most Union domains effectively arrived at the MDG and TSC target.

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In spite of rich water resources, it is ironic that parts of the Kerala State are facing acute water scarcity, especially during summer months, with increasing regularity. Studies taken up by various organizations indicate that the water scarcity in the State is mainly due to Inability to conserve the surplus run-off available during the monsoons, due to topographic characteristics and destruction of traditional water storage structures such as ponds, tanks and wet lands and Rapid urbanization resulting in increased water consumption and reduced water conservation and ground water recharge. Recent changes in land use and cropping pattern resulting in conversion of land from agricultural to non-agricultural uses has caused consequent reduction in water conservation and ground water recharge. Deterioration of water quality is due to salinity, fluoride, iron and anthropogenic causes.

9.WATER TREATMENT METHODS: Some of the water Treatment methods are Membrane filtration, ultraviolet irradiation, advanced oxidation, ion-exchange & biological filtration. Many of these technologies can be used for water treatment in water industry. The raw sewage can be treated through sewage water treatment plant before it can be safely released into the environment. To reduce the amount and toxicity of waste, it is passed through a number of chambers and chemical processes in water treatment plant.

Another method is Conversion of nitrates in gas is called Denitrification. It is an ecological approach to prevent leaching of nitrates in soil which helps stopping ground water from getting contaminated. Ozone waste water treatment method is becoming very popular where the pollutants in water are broken down by an ozone generator. In this Process, Ozone oxidizes bacteria, molds, organic material and other pollutants in water.

Due to the increased amount of minerals found in water, various societies in many places have come up with domestic water purification systems which has led to the demand of industrial RO systems all over which gives a better quality of water and eliminates all the chemical and biological contaminants by improving the taste, odour and appearance of water.

10.CONCLUSION: Necessary laws and regulation to be made strictly to protect environment and a Proposal Design Plan for Water Security in Kerala to be implemented for the positive outcomes, series of measures at the basin and catchment levels to conserve, protect, enhance and manage surface & ground water resources including both quantity and quality in a sustainable manner. Steps to be taken to Assure supply of safe drinking by using various methods of water treatment methods and domestic water supplies during droughts and other emergency situations. Conservation of surface water resources and replenishment of ground water which will act as a buffer against water scarcity in the state during low rainfall years can contribute toward the water security as well as resilience to climate change impact. Dam Managers should monitor conditions on rivers and inform the public of any potentially dangerous situation and also maintain proper water levels in the dam, and inform publics about evacuation areas to stay temporarily. Safety Precautions rules to be followed and informed in the event of a dam failure and flood hazards. Toxic waste from industrial, chemical, and biological should be processed and treated.

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