2. LITERATURE REVIEW

Adeyemo et al. (2008) performed Geographical Information System Mapping of Spatio-Temporal Pollution status of the rivers of Ibadan, Nigeria. The water samples were collected from upstream and downstream of the rivers in the major eleven areas in Ibadan between October 2003 to March 2004 and again from August 2004 to September 2004. The parameters that were assessed were DO, BOD, pH, chlorides, nitrates and phosphates. Varying levels of pollution from unpolluted to exceptionally-polluted were found during the different seasons, posing a threat to the fish health and biodiversity.

Aggarwal et al. (2012) analysed the physicochemical and bacteriological parameters of the Kaushalya River in Parwanoo. The water quality was studied at two sites upstream and two sites downstream in the months of January, April, July and October in 2011. Most of the parameters were in the acceptable range except COD, alkalinity, hardness, total coliform and faecal coliform due to which the water is unsuitable for drinking unless purified. Due to the presence of a water treatment plant at Kamli, the water becomes suitable for drinking and other domestic purposes.

Alam et al. (2007) studied the deterioration of water quality of Surma River, Bangladesh. Water samples (number 167) were collected from the Surma River during two seasons—dry and monsoon and tested for physical qualities, chemical contents, and microbiological counts. Ten sampling points, each 250 m apart were randomly selected. The effluents of paper mills and cement factory have deteriorated the water quality which is shown by high value of BOD and coliform count in dry season. The results from data analysis show that, the water is certainly unfit for drinking purposes without any form of treatment, but for various other surface water usage purposes, it still could be considered quite acceptable.

Charkhabi et al. (2005) studied the seasonal fluctuation in heavy metal pollution in Siahroud River, Iran. The study focused on seven heavy metals including Zn, Cu, Pb, Cd, Mn, Fe and Ni were measured for five consecutive seasons. The results stated that four heavy metals Pb, Fe, Cd and Mn exceeded permissible safe limits given by the United States Environmental Protection Agency. It was found out that industrial land-use, agricultural activities in the watershed and other anthropogenic sources were the major causes for the high concentrations of the metals.

Chopra et al. (2012) studied the Limnochemical characteristics of the Yamuna River at upstream, downstream and at the point of influx of industrial effluent and domestic waste. Their research revealed that the intensity of pollution increased at the point of effluent/sewage disposal causing severe pollution. Thus, indicating the need to treat effluent/sewage before disposal into the river.
Gupta et al. (2011) performed the physicochemical analysis of the Chambal River water in Kota city, Rajasthan during the pre-monsoon season of the years 2007 to 2009. The pH values, total hardness, alkalinity, chlorides, sulphates and total dissolved solids were found to be in permissible limits. The presence of iron, ammonia and comparatively lower value of dissolved oxygen indicate the river is polluted to some extent. Overall the river was moderately polluted and only highly polluted at the points of influx of sewage and domestic wastes.

Hema et al. (2012) performed evaluation of surface water quality using multivariate statistical studies of the Cauvery River in Erode district, Tamil Nadu. The river carries the effluents of a large number of tanneries and textile industries established in this region. Water samples were collected from fifty sampling points along the river and were tested for thirteen parameters including trace elements like Cd, As, Cu, Cr, Zn and Pb. Multivariate statistical methods like FA, CA, PCA and data interpretation were used to identify low, moderate and high pollutant groups.

Jaji et al. (2007) performed Water quality assessment of Ogun River, South West Nigeria. The water samples were obtained from thirteen different sites and analysed for physicochemical parameters, bacteriological parameters and heavy metals for a period of one year. The values obtained for turbidity, phosphate, oil and grease, iron and faecal coliform from all the sites were above the maximum acceptable limit set by the World Health Organization (WHO) for drinking water. The Mn and Cd concentrations from were above the WHO limit. It was reported that the river water is highly polluted and unfit for drinking or domestic use.

Jayalakshmi et al. (2011) assessed the physicochemical analysis of the Krishna River water around Vijayawada, Andhra Pradesh. The water samples were taken during January to December 2007 from seven different sites. Several physical like pH, turbidity, temperature and chemical parameters like DO, BOD, sulphates, chlorides etc. were determined and compared with standards given by the WHO. The sites around agricultural fields, factories, railway sewage entry and bus station drain water entry were found to be highly polluted.

Jeena et al. (2012) studied the impact of municipal sewage oh the Cauvery River in Tiruchirapalli city, Tamil Nadu. Various parameters like PH, electrical conductivity, COD, BOD etc. were considered and it was observed that the Uyyakodan canal, which is a tributary of the Cauvery River, was more polluted than the river itself. The reason for this was stated as the dumping of domestic waste and municipal sewage into the canal as it passes through the city.
Khare et al. (2011) conducted the physicochemical analysis of Ganga River water at Kanpur. The analysis involved the water taken from six different stations during pre-monsoon season (April-May) of 2010. Most of the considered parameters were found to be within the highest desirable or maximum permissible limits set by the WHO except turbidity. They concluded by saying that the Ganga river water is most probably unfit for drinking and needs to be treated.

Kori et al. (2011) studied the Water Quality Index of Karanja River at Bidar District, Karnataka. The water samples were collected from five sampling points along the river during December 2007 to November 2009. The physicochemical parameters of the samples were determined and a weighted arithmetic method was used to calculate the water quality index. The Water quality index of the samples season wise varies 66.16 to 81.88. Thus, the quality of water is poor and water quality management is essential to prevent further degradation.

Kumar et al. (2006) assessed the quality of water of the Tunga River, Karnataka. They conducted hydro-chemical analysis to measure the seasonal variation in different variables of surface water of Tunga River by sampling at different stations during March to February 2005. It was found that the DO levels were 100% of saturation concentration. The nitrite, nitrate phosphate, sodium and potassium concentrations were low as compared to that of groundwater in the region. However, values of all the parameters are observed within the range of BIS specification. Hence, the surface water of Tunga river water is fit for domestic use but a check needs to be maintained to prevent contamination in future.

Mahadev et al. (2010) assessed the environmental variables in Cauvery River and its tributaries in Mysore, Mandya and Chamaraja Nagar districts. The physicochemical and biological parameters of the water samples were evaluated over a period of 1 year at four different stations. Significant spatial variations were observed in water level, transparency, turbidity, colour, DO, BOD, NO3, NO2 and total hardness among the physicochemical parameters at the study locations. The number of algal species were recorded at various sampling points ranged between 13 -20.

Murugesan et al. (2007) studied the Physicochemical and biological properties of the Chittar River at Courtallam, Tamil Nadu. Courtallam Falls of the Chittar River is a place of tourist attraction during the southwest monsoon season. In this season high input of detergents and other anthropogenic activities is observed to contaminate the water. This study was performed during peak tourist season to assess physicochemical and biological properties of the river. All
physicochemical parameters except sulphate were found within the permissible limits. However, the total and faecal coliforms exceeded the permissible limits, indicating a poor quality of the river water.

Nhapi et al. (2004) assessed the sewage discharges and nutrient levels in the Marimba River, Zimbabwe. Marimba River is one of the major inflow rivers into the Lake Chivero which is Harare city’s main water supply source. The study was conducted across 14 river sampling points on the Marimba and Little Marimba Rivers. The samples were taken monthly from June 2000 to December 2001 to capture seasonal variations in water quality. The results indicated high pollution levels, especially nutrients like Nitrogen and phosphorus. The high nutrient values, exceeding acceptable limits indicate industrial, agricultural, and sewage discharges upstream which become detrimental downstream.

Offiong et al. (1998) assessed the water quality of Cross River basin in Akpabuyo, South-Eastern Nigeria. The samples were collected from 21 different locations and for each sample all the organoleptic, physicochemical and the biological parameters were determined. The study results showed that the waters are acidic, soft, fresh and characterised by low sodium adsorption ratio (SAR). The major cation and anion concentrations are all within the World Health Organisation (WHO) standards. Hence considering all parameters except PH, it was stated that the water is fit for drinking, domestic and agricultural purposes.

Ombaka et al. (2012) investigated the physicochemical and bacteriological characteristics of the water of the Irigu River Meru South, Kenya during the wet and dry seasons. Certain parameters like pH, turbidity, NH3 were high during the dry seasons due to anaerobic decomposition of organic matter. The phosphorous levels were beyond the limit which was likely to trigger periodic bloom and eutrophication. Metals like Fe, Mn, Pb and Al were beyond permissible limit, hence not suitable for human consumption.

Patel et al. (2003) studied of physicochemical properties of the water in Amirgadhtaluka in North Gujarat. They considered various parameters such as PH, electrical conductivity, total dissolved solids, Total hardness, chlorine and metal concentrations. Their study revealed that the values of certain parameters exceeded the permissible irrigation limit.

Pathak et al. (2011) studied the interdependency between the physicochemical water pollution indicators. The research was conducted during the pre-monsoon, monsoon and post-monsoon periods from 2008 to 2010 on water samples collected from ten different points on the Bebas
River at Sagar, Madhya Pradesh. They analysed the samples for 21 different parameters and established an equation which can be used to predict the levels of pollution indicators when one variable is known.

Prabu et al. (2008) assessed the downstream pollution of the Huluka River of Ambo, Ethiopia. They collected water samples from five different sites distributed along the course of the river during February to July 2007. Various parameters like pH, hardness, magnesium, chloride etc. were considered and the obtained values were compared with the limits set by the Canadian Council of Ministers for Environment. It was found that most parameters exceed the limits and the quality was found to deteriorate steadily due to the direct discharge of domestic and municipal sewage. It was also found that the water quality worsens as one goes further downstream.

Rahimibashar et al. (2012) studied the effects of fish Culture pond on the water quality of the Shenrod River, Iran. They had six sampling sites before and after each fish ponds which were sampled weekly from April to September 2008. The results showed certain physicochemical parameters had crossed the permissible limit at study point after the fish ponds. The high values of NH3, Nitrate, Sulphates and high value of hardness indicate that domestic and industrial waste is discharged into the river.

Rai et al. (2011) performed a study on the effects of disposal of sewage on the water quality of the Harmu River at Ranchi. The water samples were collected from three different sites and tested for various physicochemical parameters like pH, electrical conductivity, alkalinity, chloride etc. The results obtained were compared with permissible limits given by the WHO. The obtained values exceeded the standard limit making it unfit for drinking purposes.

Rai et al. (2012) performed a study of the water quality of the Ganga River at Patna, Bihar. They carried it out for two seasons, pre-monsoon and post-monsoon at two different stations. Most of the parameters were found to exceed the safe limits for drinking water given by the WHO. It was concluded that the water is unfit for drinking and it needs to be purified before it can be used for domestic consumption.

Samanta et al. (2005) assessed the heavy metals concentration in water of the rivers Hooghly and Haldi at Haldia and studied their impact on fish. The water samples were collected from multiple sites including the industrial effluent out fall at Patikhali from June 1999 to October 2002. The concentration of five heavy metals Cd, Cu, Mn, Pb and Zn were measured. It was observed that
the concentration of the metals was least at the sampling site above the Haldia industrial area. The data obtained was compared with the Criterion Continuous Concentration (CCC) of USA. It was revealed that Cd, Cu and Pb were present at alarming level to disturb the aquatic life process in the zone. The effect was found to reflect on the tissue level aberrations in the residential fishes.

Sharma et al. (2011) evaluated the quality of Narmada River water with respect to physicochemical parameters at Hoshangabad, Madhya Pradesh. The study showed that the values of the parameters at few locations exceeded the maximum permissible limit due to heavy mixing of effluent waste and domestic sewage. Thus, the potable nature of the water is lost.

Sharma et al. (2012) performed an evaluation of the physicochemical parameters of the Narmada River, Madhya Pradesh. The water samples were collected monthly from three different sites along the river for a period of one year from August 2009 to July 2010. The various parameters considered were pH, temperature, transparency, DO, BOD, chlorides, phosphates, nitrate, alkalinity, sulphates and total hardness. Phosphates, nitrate, alkalinity, sulphates were found to be high in September and October whereas pH, temperature, chlorides and total hardness were high in summer. The overall values of the parameters were within the WHO limits.

Shinde et al. (2011) studied the physicochemical parameters and the correlation coefficient of Harsool-Savangi Dam, Aurangabad. The water samples were collected from four different sampling sites during January to December 2009. The values of the parameters indicated that the water was rich in nutrients and fit for irrigation and fish culture. Only in the monsoon, the total hardness increases making it unfit for drinking. The correlation coefficient indicated positive and negative significant correlation of physicochemical parameters with each other.

Shrivastava et al. (2012) performed the study on the sewage disposal into the Mancha River in Betul City, Madhya Pradesh. The water samples were collected from nine different sewage inlets during pre-monsoon (March), monsoon (July) and post-monsoon (November) 2009. They studied water quality for physicochemical parameters like DO, COD, BOD, chlorides, nitrates etc. On comparing the data obtained with the amounts prescribed by the WHO, it was found that all the parameters exceeded the prescribed limits.

Sreeja et al. (2012) assessed the physicochemical parameters of the Kodayar River, Tamil Nadu at seven sampling stations from June 2010 to June 2011. Various parameters like the temperature, electrical conductivity, total dissolved solids etc. were determined and the results
were compared with the standards prescribed by the WHO and ISI. It was found that water at most stations was not contaminated and fit for domestic use. At some stations where the contamination was higher, preventive measures need to be adopted to avoid further contamination.

Thakare et al. (2012) performed a study of the metal pollutants of the water of Wardha and Dham Rivers at Wardha, Maharashtra. The water was collected from 10 different points on the Dham River and 9 different points on the Dham River. It was tested for seven metals – Cu, Mn, Fe, Zn, Ni, Na and K and 9 other physicochemical parameters. The results obtained showed that the values of all the parameters were within the permissible limit as per the Indian Standard Specification. Hence the water of these rivers was completely harmless for human beings and fit for irrigation and domestic use.

Ugwu et al. (2012) analysed the impact of growing population in the city of Abuja in Nigeria by studying the seasonal physiochemical characteristics of the Usma River. The study revealed that all parameters measured were within the permissible level except Total Suspended Solid, which exceeded for all seasons. The values for electrical conductivity and total dissolved solids showed that the anthropogenic activities are on the increase in the area of study indicating the increasing pollution.

Venkatesharaju et al. (2010) conducted a physicochemical and bacteriological investigation on Cauvery River, Karnataka. They studied 19 prime physicochemical and 2 bacteriological parameters at six locations of the Kollegal stretch for a period from 2006 to 2008. It was found based on the physicochemical parameters that the river is not polluted and all the parameters are within the permissible limits of the Bureau of Indian Standards and National River water quality standards. The bacteriological parameter values indicated that the water is unfit for drinking.

Verma et al. (2010) assessed the pollution status of the Kalpi River at Gwalior, Madhya Pradesh. They reported the values of various pollution parameters such as transparency, electrical conductivity, BOD, COD etc. at six different locations and also proposed a conservation and management plan to reduce the pollution.

Yang et al. (2007) evaluated the water quality of the Huangpu River, China. The water samples were collected on a bimonthly basis in 2004 at five different sampling points along the river. Various physicochemical parameters like pH, SS, DO, BOD etc. along with the total bacteria and E. coli content were calculated. From the values and correlation parameters it was observed that
the high nutrient content of the water had led to the growth of microorganisms, which in turn increased the BOD of the water. Due to the high demand for oxygen, there is a decrease in the nitrification rate. This blocks the self-purification of the surface water due to the low nitrification and de-nitrification process.