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Assessment and Impact Study of Pesticides Residue Pollution in River Water: A Review

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Abstract- River Water quality has become global issue due to population growth, rapid industrialization and agricultural practices. Water bodies are used for irrigation and significantly acts for environmental, social and economic functions. The present study focus on the pesticides residue pollution in Indian rivers. Globally, 80 percent of municipal wastewater is discharged into water bodies untreated, and millions of tones of heavy metals, solvents, toxic sludge and other wastes into water bodies each year (WWAP, 2017) as a industrial effluent. Agriculture, which accounts for 70 percent of water abstractions worldwide, plays a major role in water pollution. Presence of pesticide residues like organochlorine and organophasphorus are potentially toxic. Pesticides are entering natural water and their distribution processes are controlled by a dynamic set of physical-chemical equilibrium. The input of pesticides residue in surface waters has particular concern due to their toxic nature. After entering to water bodies, pesticides accumulate in water, sediments, and biota. These concentrations determined were more than the maximum admissible and desirable limit when compared with the National and International organizations like WHO, USEPA. Therefore Pesticides can affect human health and Create acute and chronic risks in children and adults, may also affect biodiversity by killing weeds and insects, with negative impacts up the food chain, fauna and flora. This review is mainly focus on the assessment and impact on human health and vegetables by different pesticides present in the water bodies.

Keywords- Pesticides, MCL, Organochlorine & Organophasphorus, WHO, Agriculture

I. INTRODUCTION

Studied that the modern agriculture pattern increases the chemicals and pesticide poisoning is recorded each year in millions in our nature (Richter ED. 2002). 26% river length impacted by pesticides (USEPA 1994a). Pesticides are used to control the organism like insecticides, herbicides, fungicides, or fumigants. And further classification based on their active agents, while insecticides are classified as organophosphates (OPs), organ chlorines, carbonates etc. pyr (Kamel F et al. 2004). Due to run off, nearby agriculture fields increases the concentration of pesticides. Primary entry of pesticides into surface water and then ground water. Most of used pesticides toxic to human health (Jacobs M. et.al. 2001, Henrik Andersson 2014).

Most of the researchers observed in water bodies, the pesticides residues are frequently crossing US EPA standards permissible limits , showing the various levels of risk in human being like causes of cancer, obesity, endocrine disruption, and other diseases.(J.M. Gorell et.al.1998, Bassil KL et.al.2007, George J et.al. 2011, Mrema EJ et.al. 2013). Exposure of pesticides can be through contact with the skin, ingestion, or inhalation. The type of pesticide, the duration and route of exposure, and the individual health status are determining factors in the possible health outcome (World Health Assembly 1990, Alewu B.et.al. 2010). The primary "sink" for some of the pesticides is fatty tissue ("lipids"). In, fatty tissue such as edible fish tissue and human fatty tissue. Other pesticides such as glyphosate are metabolized and excreted. As smaller organisms are eaten by larger organisms, the concentration of pesticides and other chemicals are increasingly magnified in tissue and other organs. Very high concentrations of pesticides found in top predators, including man. The effects of pesticides to "the level of oncological (cancer), pulmonary and hematological morbidity, as well as on inborn deformities and immune system deficiencies"(FAO 1996).

Fourth Assessment of the Intergovernmental Panel on Climate Change, India is designated a 'water stressed region' with current utilizable freshwater standing at 1122 cubic meter (cu m) per year and per capita compared to international limiting standards of 1700 cu m. In future, at the current rate it is expected that India with high demands will be termed a ‘water scarce region’ as utilizable freshwater falls below the international standard of 1000 cu m per year and per capita (Das B. 2009).

In India, the general awareness among farmers about chemicals risks, safety, and chronic diseases was less. Environmental awareness and safety of pesticides should be initiated by the agrochemical firms and government (Deborah Atieno Abong’o et.al.2014).The compounds analyzed and reported in the studies represent a serious bias because a great deal of attention is given to DDT and HCH, whereas the organophosphate insecticides dominating current use are less frequently analyze. A few studies have been conducted, therefore further study is required on the level of pesticides in this region .The review reveals a major knowledge gap for understanding the status of pesticide contamination and related risk in the river. It is point to the need for an organized monitoring plan designed according to the knowledge gaps (Merete Grung et.al. 2015).
The objective of study that the assessments of pesticides residue in the river water and related risk to human health .And focuses on mostly used pesticides in agriculture, causes of various human diseases. And also highlighted the concentrations of various pesticides residue in different river water and discussed the human health impacts that have been associated with exposure of some banned pesticides (DDT,BHC etc) mostly used in developing countries and some other common pesticides like herbicides, insecticides (OCPs, and OPPs). The important health impacts are discussed in this review.

II. SCENARIO OF PESTICIDES RESIDUE IN SURFACE WATER

Global Scenario:
Agrochemicals have enabled to more than duplicate food production during the last century, and the current need to increase food production to feed a rapid growing human population maintains pressure on the intensive use of pesticides and fertilizers. However, worldwide surveys assess and predict the impact of agrochemical residues in soils, terrestrial and aquatic ecosystems including coastal marine systems, and their toxic effects on humans and nonhuman biota (Fernando P.2017). The historic scenario of pesticides can be divided into three phases. In the early phases (before 1870s) natural pesticides, for instance sulfur in ancient Greece, were used to control pests; while the second phase (the period 1870s-1945).are the era of inorganic synthetic pesticides .

Since 1945 is the phase of organic synthetic pesticides. However the man-made organic pesticides, e.g., DDT, 2, 4-D, and later HCH, dihedron, have terminated the era of inorganic and natural pesticides. Most of the pesticides have been synthesized by human being, and they were known as chemical pesticides (WenJun Zhang et.al. 2011).

Consumption of synthetic pesticides increased substantially over time since from 1940, for example, in the USA, the use of pesticides doubled from 1960 to 1980, but now the total use has remained stable or fallen. Pesticides are mainly used in the agricultural sector, but from 1999 about 74% of households in USA were reported to use at least one pesticide for domestic purpose. Use has risen in developing countries and the fastest growing markets in Africa, Asia, South and Central America, Eastern Mediterranean. There is a high pesticide use on crops grown for export (Dr. N. Besbelli, WHO, personal communication). Although developing countries use only 25% of the pesticides produced worldwide, they experience 99% of the deaths. This is because use of pesticides tends to be more intense and unsafe, and regulatory, health and education systems are weaker in developing countries (WHO Training Package for the Health Sector 2008). It was found that worldwide consumption structure of pesticides has undergone significant changes since 1960s. The proportion of herbicides in pesticide consumption increased rapidly and the consumption of insecticides and fungicides/bactericides simultaneously decreases. China has become the largest pesticide producer and exporter in the world. Pesticide pollution of air, water bodies and soils, and pesticide-induced deaths in China has been serious in past years. Application of bio-pesticides should be developed in the future (WenJun Zhang et.al2011). (Arnab De, Rituparna Ajeet Kumar Bose 2014) .The World wide consumption of pesticides are shown by figure-1

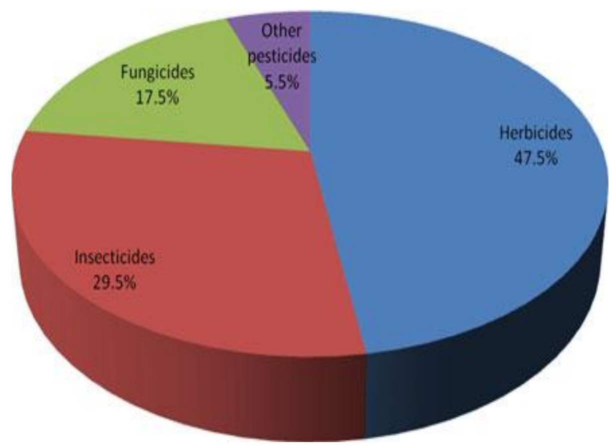

Figure: 1Worldwide consumption of pesticides

Indian Scenario:
The production and use of pesticides started in India since 1952 with the establishment of a plant for the production of *BHC* near Calcutta, and now it is the second largest manufacturer of pesticides in Asia (Mathur, S.C. 1999) . High levels of POPs in the environment are due to weak management of e-waste, municipal and industrial wastes. About 80% of Indian population lives in malaria-prone areas and India’s has been exempted from the ban of DDT as a

result of the Stockholm Convention (SC) and is allowed to produce and use DDT—but mainly for the control of vector-borne diseases. India was also allowed to use DDT for termite control until March 2013, although DDT was banned for agricultural use (Girija K Bharat 2018). 51% of food commodities are contaminated with pesticide residues and out of these, 20% have pesticide residues above the maximum residue level on a worldwide basis (Gupta SK et.al.2004). India, being a tropical country, the consumption pattern of pesticides is skewed towards insecticides, which account for 52% of total chemical pesticide consumption, herbicides 33% and fungicides 15% (Singhal, V. 2003). Almost 67% of the pesticides manufactured in India and applied for rice and cotton crops, which are grown from July to November (Anonymous, 1996). For agricultural and public health purposes, about 9,000 tons of pesticides are applied annually in the Ganga River basin (Naresh C.et.al. 2009). Recent literature revealed the level increases (NGRBA, 2011),

(Cheepi, P. 2013) , Agricultural drained water is another source of pesticides pollution, Musi river water (Telangana, India) is enriched with heavy metals, pesticide residues, phenols, oils, grease, alkalis and acids etc.

Main pesticides used in Indian Agriculture: Agriculture sector play a prime role in the socio-economic fabric of India. The sector has remained backbone of the Indian economy and presently accounts for ~15% of the country's GDP. Nearly 58% of the rural households rely on agriculture as their principal means of livelihood (Indian Agrochemical Industry, 2016).The demand and availability status of different pesticides is reviewed regularly during the Zonal Conferences on inputs for Kharif and Rabi with the state representatives of the Departments of Agriculture (P. Indira Devi et.al. 2017).On the basis of chemical nature, pesticides are classified in the table-1.

Pesticides are classified in different types like insecticides, herbicides, fungicides etc. but some pesticides are commonly used for crop protection. Commonly used crop protection chemical molecules classified are in the table -2.

(Vijesh V. et.al. 2000) Andhra Pradesh (including Telangana & Seemandhra), Maharashtra and Punjab are top three states contributing to 45% of pesticide consumption in India. Andhra Pradesh is the leading consumer with 24% share. The top seven states together account for more than 70% of crop protection chemicals usage in India. In India, state wise consumption of pesticides are listed in table-3 and their graphical presentation is given in figure 2.

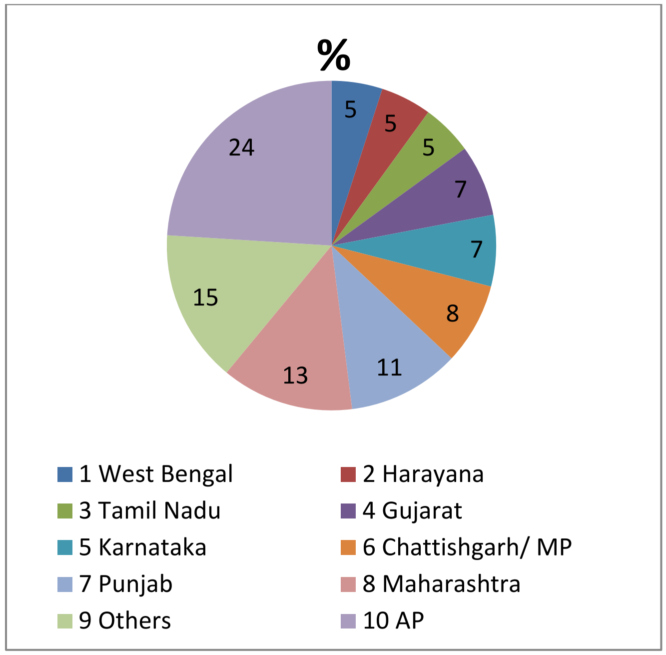

Figure 2 : State wise consumption of pesticides in India

After considering all the objections and suggestions submitted its report to the Central Government on the 16th July, 2018 studied by in exercise of the powers conferred by section 27 read with section 28 of the Insecticides Act, 1968 (46 of 1968). The Central Government after considering the recommendations of the Expert Committee has banned the following pesticides in the country (Report to the Central Government, 2016).: Benomy , Diazinon , Fenarimol , Fenthion , Linuron , Methoxy , Ethyl , Mercury Chloride , Methyl , Parathion , Thiometon , Tridemorph , Alachlor , Dichlorvos , Phorate , Phosphamidon , Triazophos , Trichlorfon.(18 pesticides banned by Govt. of India,13 Aug 2018, Monika Mondal, Industry news , Krishijagran.com)

Assessment of Pesticides Residue in River Water & Sediments:

Water

Total phosphorus and fecal Coliform of Youshui River exceed the standard value, which is mainly due to the excusing emissions of living and livestock sewage and the non-point source pollution of agriculture (Xue-qin Wangi, Juan Wen 1, Ping-hua Chen 2, Na-na Liui Icaesee 2017). Out of 16 detected pesticides in river water samples, the levels of a-, b- and d-HCH and 4,40-DDT exceeded the EC limit in drinking water (0.10 ng mL_1 for single pesticide) in 56.2e100% of samples whereas only 6.2e12.5% of samples crossed the EC limit for the remaining detected pesticides. Occurrence of these pesticides exceeding the EC limit has also been reported in the old channel of River Hooghly i.e. Ganga (Raghuvanshi T.K. et.al. 2014) and Yamuna (Kaushik A. et.al.2001). The most important agricultural provinces are (e.g., Henan, Hubei and Hunan) with the largest pesticide use has been the subject of few studies on the environmental levels of pesticides. Consider this to be a major knowledge gap for understanding the status of pesticide contamination and related risk in China. Furthermore, there is also a lack of studies in remote Chinese environments, which is also an important knowledge gap. The compounds analyzed and reported in the studies represent a serious bias because a great deal of attention is given to DDT and HCH, whereas the organophosphate insecticides dominating current use are less frequently investigated (Merete Grung et.al.2015). Performance characteristics for the selected pesticides were acceptable according to European Commission's (EC) guidelines for method validation (recovery 70e120%, RSD <20% and R2 value _ 0.99). River, pond and tube well water and river sediment basin in West Bengal, India during 2014-2016. About 42% of the samples showed the presence of 19 pesticides with the highest loading of total pesticides (T-pesticides) in river water (3.01 ngmL_1) followed by sediment (1.25 ng g_1), pond (0.40 ngmL_1) and tubewell (0.02 ngmL_1) water. The nonagricultural OC (organochlorine) insecticides were detected in all river water and sediment samples mainly due to HCHs (hexachlorocyclohexane) from old source and fresh use of DDTs (dichlorodiphenyltrichloroethane) in local areas (Rahul Mondal et.al. 2018). Pesticides residue studied in some Indian rivers are given in table -4

As compared to ground water, higher concentrations of OClPs and OPPs were found in surface water. Throughout the monitoring study, α − HCH (0.39 μg/L in Amravati region),α endosulphan (0.78 μg/L in Yavatmal region), chlorpyrifos (0.25 μg/L in Bhandara region) and parathion-methyl (0.09 μg/L in Amravati region) are frequently found pesticide in ground water, whereas α,β,γ-HCH (0.39 μg/L in Amravati region), α,β − endosulphan (0.42 μg/L in Amravati region), dichlorovos (0.25 μg/L in Yavatmal region), parathion- phorate (0.33 μg/L in Yavatmal region) were found in surface water (Summaiya Z Lari et al.,2014). Water samples are being analyzed for 28 parameters consisting of physicochemical and bacteriological parameters for ambient water samples apart from the field observations. Besides this 15 pesticides (a, b, g-HCH, o,p- and p,p'-DDT, a,b-endosulphan, aldrin, dieldrin, carbamat, 2-4 D, Malathion, methyl parathion, anilophos and choropyriphos are analyzed from the selected samples The monitoring results obtained under the program indicate that organic pollution continues to be the predominant pollution of aquatic resources (Bhardwaj RM 2005 , Kumar B et.al. 2010). Organochlorine pesticide (OCP) residues were determined in water and bottom sediments from four rivers running through sugarcane plantations in Kilimanjaro Tanzania.The OCP concentrations ranged from trace (endrin) to 120 ng/l (*p,p'*-DDD) in water (Er Hunmwunse et.al.2012).

Sediments: During 2014-2016sediments were studied in river, ponds, tubewell of West Bengal region of India and observed about 42% of the samples showed the presence of 19 pesticides with the highest loading of total pesticides (T-pesticides) in river water (3.01 ngmL_1) followed by sediment (1.25 ng g_1), pond (0.40 ngmL_1) and tubewell (0.02 ngmL_1) water. Pesticide residues of Chlorpyriphos, dicofol and ethion in in sediments 0.0513 ±0.0085ppm, 0.0414 ± 0.0045 ppm and 0.1271 ± 0.0122ppm (Swati Singh et al.2015).

In this section, The Author summarize data of the published studies for the different compartments/matrices (river water &sediment) of aquatic environments. This way of presenting data is more convenient than just reporting levels of concentrations, because the assessment is effect based. DDT, DDE and HCH pesticides are found in every river basin and OCPs and OPPs with higher toxic effects. Most of the studies were based on DDT and HCH.

The table 5 described the different types of pesticides residue studied in the various river bodies of India and their MRL value (The Japan Food Chemical Research Foundation) are compare by the researchers.

III. IMPACT OF RIVER WATER PESTICIDES RESIDUE

Impact On Human Health From Water: World Health Organization (WHO, 2006) reported that pesticide exposure depends on dosage, the route of exposure, how readily the pesticide absorbed, the type of effects of pesticides and its metabolites, accumulation and persistence in the body and the health status of the individual (Deborah Atieno Abong'o et.al. 2014).

A list of agro-chemicals used along the River Nyando drainage basin, their recommended rates of applications, environmental and human health impacts and toxicity to birds and bees. Most of the pesticides used in Nyando catchment area are organophosphate and are moderately hazardous most farmers are ignorant of the safe use and handling of the pesticides, which results in some injuries and chronic illnesses (Nitika Singh et.al. 2017). These Studies demonstrated that a variety of chemicals may contribute to behavioral disabilities, developmental, and learning impairment. Humans are generally exposed by not only the oral route but also by dermal contact, inhalation, as well as ingestion. Secondly, the delectability of the toxic effects (including immunologic) of a single compound can be changed by the interactions with one or more with other heavy metals or other xenobiotics (Zvonko Brnjaš et.al. 2015). Toxic chemicals and within them particularly persistent organic pollutants (ie. POPs chemicals), are representing a special danger for the environment. In this context, one of the key dilemmas of modern societies is not whether these substances should be used in everyday life, but how to find an optimal balance between the costs they generate in terms of its impacts on human health, economic development and ecosystems (Katja Knauer et.al.2016). A few pesticides in use might account for most of the concern for aquatic life. These pesticides with exceedances of the ecotoxicological thresholds are checked for a possible regulatory action. Implementing further risk mitigation measures might be advisable to reduce the exposure in aquatic systems. This evaluation is an ongoing process. When further RAC values are available, currently Switzerland is re-evaluating authorized pesticides, monitoring data can be evaluated accordingly (Karunakaran CO, 1958). In India, the first report of poisoning due to pesticides was from Kerala in 1958, where over 100 people died after consuming wheat flour contaminated with parathion (Mahipal Singh Sankhla et.al.2018). The use of pesticides and nitrogen fertilizers in agriculture has grown dramatically over the past many years to contaminated water. Environmental exposure of humans to pesticide is common effects in acute and chronic health effects, including acute and chronic neurotoxicity (insecticides, fungicides, fumigants), lung damage (paraquat), chemical burns (anhydrous ammonia), and infant methaemoglobinemia (nitrate in groundwater). A variety of cancers also have been linked to exposure to various pesticides, particularly hematopoietic cancers. Immunologic abnormalities and adverse reproductive and developmental effects due to pesticides also have been reported (Polyxeni Nicolopoulou-Stamati1et.al.2016).The industrialization of the agricultural sector has increased the chemical burden on natural ecosystems. Pesticides are agrochemicals used in agricultural lands, public health programs, and urban green areas in order to protect plants and humans from various diseases. However, due to their known ability to cause a large number of negative health and environmental effects, their side effects can be an important environmental health risk factor (Asghar U et.al. 2016). Increasing cases of Alzheimer and Parkinson disease and other neural defects like memory loss, disruption of neural coordination in the body and due to that disruption, paralysis of other system of body like digestive and respiratory system, inhibition of production or over production of neurotransmitter, high response or no response of receptor site to these neurotransmitter is due to pesticide exposure or its exposure is increase that defects incidence. Pesticide exposure is not only harmful for adults, but young children and fetus during their developmental period are more vulnerable to these pesticides due to their weak and inactive immune system. Exposure of fetus in mother womb case congenital anomalies, genetic diseases onset due to disruption of their DNA during development. Endocrine disruption side effect seen both during and after birth (Norida Mazlan1et.al.2018).

(Alexander Ccanccapa et.al. 2016) The survey carried out in 2010 and 2011 in the Ebro River and its tributaries regarding determination, distribution and ecotoxicological effects of 50 pesticides showed a dispersed pattern of concentration and risk on the different tropic levels (algae, daphnia and fish) along the basin. Water samples were the most frequently contaminated in both campaigns and in lesser extent sediment and biota samples. The most ubiquitous pesticides were azoles, organophasphorus and triazines in both years (Md. Wasim Aktar et.al. 2009).The data on environmental-cum-health risk assessment studies may be regarded as an aid towards a better understanding of the problem. Data on the occurrence of pesticide-related illnesses among defined populations in developing countries are scanty. Generation of base-line descriptive epidemiological data based on area profiles, development of intervention strategies designed to lower the incidence of acute poisoning and periodic surveillance studies on high risk groups are needed. Our efforts should include investigations of outbreaks and accidental exposure to pesticides, correlation studies, cohort analyses, prospective studies and randomized trials of intervention procedures. Valuable information can be collected by monitoring the end product of human exposure in the form of residue levels in body fluids and tissues of the general population (https://www.researchgate.net/publication/322065517).

Pesticides can enter the human body through inhalation, oral or dermal exposure, and well documented to be the main cause of several diseases such as cancer, respiratory diseases, skin diseases, endocrine disruption, and reproduction disorders (GU XJ, Tian SF. 2005). Pesticides can not only cause death but also induce various diseases. It is estimated that cancer patients resulted from pesticide poisoning account for nearly 10% of the total cancer patients (World Health Organization. 1990).

The most common pesticides used in agricultural production is indicated that are dangerous to human health, some are carcinogenic in nature, and others with permanent and temporal damages on either tissues, organs or the entire systems of human pathology as shown in Table 6.

Human Diseases: The way of pesticide exposure and their health outcomes, including the neurological, fetal growth, birth and cancerous outcome. Several pesticides are effect as neurotoxins and cause neuronal disorder and degenerative diseases, some effect fetal growth and cause congenital anomalies and other are carcinogenic for human. The data analysis of international researcher revealed that due to extensive use of pesticide increase their exposure to human which result greatly increase the risk of cancer, neural and birth defects, skin and respiratory diseases. Some dangerous human diseases are as follows.

Cancer: Application of pesticide on commercial level and in houses will highly increase the risk of leukemia, clone thyroid, brain and several other type of cancer. Collaborated efforts at molecular biology, pesticide toxicology and epidemiological studies help us to understand the pesticide carcinogenicity (Alavanja MC et.al. 2004). Prenatal exposure has been associated with leukemia in a newborn after intensive use of Permethrin at home by the pregnant mother. Children with certain metabolic enzyme polymorphisms have an increased risk of acute lymphocytic leukaemia when exposed to pesticides in utero or during pregnancy (particularly 2,4-D herbicide) (WHO Training Package for the Health Sector World Health Organization, 2008). Leukemia is a cancer which causes abnormal production of white blood cells,. According to Children's Cancer Study Group the basic reason of acute no lymphoblastic leukemia is parental exposure to pesticides and those children which are regularly exposed to household pesticide have 3.5 times great chance of leukemi(Lawrie M et.al. 1997). A research conducted for incidence of brain cancer on 767 patients, elaborate that 462 patients have glioma and 195 have meningioma both are different types of brain tumor (Claudine M et.al. 2008). Occupational exposure to pesticides and risk of adult brain tumor (Am J Epidemiol. 2008).

Fetal Growth Risk: OPs are specifically associated with increased risks of reproductive problems, childhood abnormalities, and developmental changes that can last multiple generations (Greene A. 2006).The estimation of pesticide exposure in fetus is estimated by the analysis of blood from umbilical cord and placenta, but it only shows the recently exposed and persistent pesticides (Rojas A et.al. 2000). All potential pesticide to which pregnant female exposed during their gestation period and majority of detected pesticide are used in houses include propoxur, pretilachlor, DDT, Cyfluthrin and Cypermethrin, blood and hairs not contain all pesticide to which mother exposed during pregnancy so it reviled that meconium is most sensitive part for pesticide exposure in infant (Enrique MO et.al. 2008).

Alzheimer disease: Dementia decreases the thinking ability of brain capacity; in recent year's dementia disease is increased day by day due to increase in pesticide exposure.

Skin and Respiratory diseases: It leads to alterations in behavioral pattern and several diseases syndromes such as encephalopathy, ataxia, seizures, muscle cramps, frequent urination and coma (J. Wang et.al.1995). Asthma, bronchitis, farmer's lung, and wheeze (Hoppin JA et.al. 2002). There is an increased risk for asthma when there is exposure to farm animals, crops, or dust (Salam M et.al. 2004).

Impact on human health from vegetables and fruits: Long term accumulation of pesticide residues in the human body through dietary intake of vegetables and other food commodities is a severe problem as indiscriminate amounts of such pesticides are used in many countries. Moreover, controlling the pesticide levels seems to be a substantial contemporary public health problem to guarantee food quality and to evaluate the health risk. The organophosphate, organochlorine and related pesticides act by binding to the enzyme acetylcholinesterase, disrupting nerve function, resulting in paralysis and may cause death (Boon P.E et.al. 2008). The excess consumption of pesticides contributes in the accumulation of pesticide residues in food grains and vegetables associated with variety of human health hazards, including damage to central and peripheral nervous systems, cancer, allergies and hypersensitivities, reproductive disorders, and disruption of the immune system (Ajmer Singh Grewal et.al. 2017). Pesticide residue concentration in vegetables and finds that the risk posed to consumers varies with the season (European Union Report,2009).The winter season has the highest pesticide concentrations in vegetables that might accumulate in the person's body and lead to fatal consequences in the long run. Exposure to very high levels of methyl parathion for a short period in air or water may cause death, loss of consciousness, dizziness, confusion, headaches, difficult breathing, chest tightness, wheezing, vomiting, diarrhea, cramps, tremors, blurred vision, and sweating (ATSDR, Public Health Statement Methyl Parathion, 2001). Consumption of high pesticide residue fruits and vegetables was associated with lower total sperm count, ejaculate volume and percentage of morphologically normal sperm among men attending a fertility clinic (Moon H.B et al., 2009). They may produce acute effects manifesting as meiosis, urination, diarrhea, diaphoreses, lacrimation, excitation of central nervous system and salivation. The chronic exposure involves neurotic and behavioral effects. Specific effects of pesticides can include cancer, allergies and hypersensitivities, damage to the central and peripheral nervous system (Gilden R. C. et al. 2010).Chronic poisoning also exhibits characteristic symptoms for each substance, including delayed neurotoxin effects, chromosomal changes, contact dermatitis, liver damage, cardiac arrhythmias, kidney damage, peripheral neuropathies, allergies, asthma, Parkinson's disease, cancers, teratogenic effects, and hearing loss, among others (Avaliacao Intoxicacao Agrotoxicos.pdf. Accessed, 2016.). In the general population, the food supply represents the most important source of exposure for organochlorines and Ops (AM, Bartell SM, Barr DB, Ryan PB,2008). Only fruit and vegetables had residues above the legal tolerance (approximately 2% each). Overall, the detection of residues in the samples from imported fruits and vegetables tested were less, but the exceedances of legal tolerances were greater (5%–7% of imported fruits/ vegetables sampled) (US Food and Drug Administration, 2011). DDT (and its major metabolite DDE) is the organochlorine that has been most extensively examined in relation to birth defects, fetal death, and fetal growth, with mixed findings exposures, as determined by maternal serum or umbilical cord blood levels, have been associated with preterm birth, decreased birth weight, and intrauterine growth retardation ((Longnecker MP et al. 2001, Ribas-Fitó N et al.2002, Weisskopf MG et al.2005, Wolff MS et al. 2007, Siddiqui MK et.al. 2003). However, for DDT, there is some emerging evidence for a link between metabolites of DDT and asthma risk (Karmaus W et al. 2001, Sunyer J et al. 2005). Organochlorine pesticides, such as DDT, endosulfan, Methoxychlor, Chlordecone, chlordane, and dieldrin and Other herbicides (atrazine , 2,4-D, and glyphosate) and fungicides (vinclozolin) also have some endocrine activity (Reigart JR et al. 2001 Gasnier C et al. 2009 , Silva MH et al. 2009 , Molina-Molina JM et al.2006).

An adverse effect on neurodevelopment from 2 classes of insecticides, the organochlorines (specifically DDT and its metabolite p,p′-dichlorodiphenyldichloroethylene [DDE]) and, most recently, Ops (Rosas LG et al .2008, Eskenazi B et al.2008, Jurewicz J et al. 2008). Although chronic neurologic sequelae after acute OP poisoning have been observed in multiple adult studies, the epidemiological data on children are limited (Keifer MC et al. 1997, Eskenazi B et al. 1999).

IV. PESTICIDE TOXICITY

The LD_{50} and LC_{50} values for each route of exposure for the four toxicity categories and their associated signal word are given in table-7

V. CONCLUSION

The contaminations of river water by pesticide residues from runoffs have greater impact on human health dependent on the water supply from the river. The farmers use the contaminated river water for the irrigation purpose which leads to accumulation of pesticides in food chain. The higher concentrations of these chemicals result in death of human beings. It can be safely con-clouded that Endosulfan sulfate, DDT, Endrin, DDE, Aldrin, HCH and Methoxychlor were found in signifi-cant concentrations at all the river basins in different concentrations. OCPs and OPPs pesticides residue are highly toxic in nature and present in river water. In many cases, the reported status of pesticides residue show lower risks in river water and also, to some extent, sediment. In some cases the concentration is in very low quantity or no detectable ratio.

According to this research review we come to know that, human health risk is great level because of causes of various types of cancers in children and adults like brain cancer, thyroid cancer, stomach cancer, bladder and colon cancer, leukemia etc and Alzheimer is a neuro disease and Parkinson diseases and other neural toxicity, Allergy, Immune system diseases, some genetic diseases**.** The most harmful effect of pesticides for both adults and children are due to their carcinogenic effects.

Our Current agriculture system has to deal with important factors, such as population growth, food security, health risks from chemical pesticides. In agriculture system for the crop protection, need a new advance system which should be ecofriendly and safer for man and the environment. This new concept must be based on an awareness of harmful impacts of pesticides and about the chemical nature and formula of used pesticides, and also requires the strict rule for use of banned pesticides in developing countries. Developing countries should be start awareness programs for farmers and public health programs. The urgent need for a education and training of workers as a major vehicle to ensure a safe use of pesticides is being increasingly recognized. Farmers and every applicator should be known about toxicity level of pesticide, a user can minimize the potential hazards. And also follow the label instructions before using the pesticides. Our approach to the use of pesticides should be based on scientific judgment and not on commercial considerations. There are some inherent difficulties in fully evaluating the risks to human health due to pesticides.

Therefore urgent need toward cleaner and safer agriculture practices for the crop protection. Future studied should be targeted to all biota, not single matrices like water or sediments.

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Table no. 1: Classification of pesticides based on chemical nature

S. no.	Chemical Nature	Pesticides
1.	Inorganic	salts of arsenic, mercury, copper, etc
2.	Natural organic	Neem oil, nicotine, rotenone, etc
3.	Organic chlorinated	DDT, DDD, Lindane, etc.
4.	Organic phosphorus	Dimethosate, phosphamidon, Malathion, etc.
5.	Organic sulphur	Tetradifon, granite, etc.
6.	S – Traiazines	Atrazine, cyanazine, etc.

(Source: Indian Agrochemical Industry, 2016)

Table no.2: Commonly used crop protection chemical molecules

S.No.	Molecule	Type	Application	Crop
1.	Acephate	Insecticide	Control of severe infestations of sucking & chewing insects	Chilies, vegetables, fruits & cereals, tobacco
2.	Chlorpyrifos	Insecticide	Control of fruit borers, stem borers & leaf eating caterpillars	Cotton, pulses, oilseeds, rice. Etc
3.	Dinotefuran	Insecticide	Control of Brown plat hoppers in rice	Rice
4.	Fipronil	Insecticide	Control of rice stem borer, diamond moth	Cole crops, sugarcane, Chilli
5.	Flonicamid	Insecticide	Control of all aphid species	Apples, peaches, wheat, potato, vegetables
6.	Imidacloprid	Insecticide	Control of sucking pests-aphids, jassids, whitefly, brown planthopper	Cotton, rice & vegetale crops
7.	Glyphosate	Herbicide	Control of weeds and grasses	Variety of crops
8.	Quizalofop	Herbicide	Control of narrow leaf weeds	Broad leaf crops
9.	Hexaconazole	Fungicide	Control of powdery mild leaf spots ews, rusts &	Cereals, Oil seeds, horticultural & plantation crops
10.	Tricyclazole	Fungicide	Control of leaf blast, node blast & neck blast	Rice

(Source: Industry reports, Analysis by Tata Strategic, 2016)

Table no. 3: State-wise consumption of pesticides in India

S. no.	State	%
1.	West Bengal	5
2.	Harayana	5
3.	Tamil Nadu	5
4.	Gujarat	7
5.	Karnataka	7
6.	Chattishgarh/ MP	8
7.	Punjab	11
8.	Maharashtra	13
9.	Others	15
10.	AP	24

(Source: A report on Indian Agrochemical Industry July 2016)

Table 4: Pesticides residue studied in surface water body in Indian Rivers:

S.no.	Surface water body	Type of pesticides residue	Concentration	Used method	Reference
1.	River Betwa	Heptachlor bm, Endosulphansulphate, DDT,DDE , α –HCH, β –HCH,	0.118 µ g/l, 0.078 µ g/l, ND,ND, 0.245 , 0.329,0.207	Nucon- Amil 5700 Gas chromatograph	(Daisy Bhat et.al. 2014)
2.	River Ganga	HCH, DDT, Endosulfan	1–971(ng l−1), 0–1240 (ng l−1), 0—2890 (ng l−1)	conventional liquid–liquid extraction method	(Ray et.al.1992)
3.	River Ghaghara	ΣHCH, ΣDDT	119.74 ± 76.54 (ng/L), 587.30 ± 201.18 ng/L	conventional liquid–liquid extraction method & Chemito series 2865 microprocessorcontrolled gas chromatograph equipped with electron-capture detector having 63Ni foil	(Anubha Kaushik et al 2009)
4.	River Yamuna & its canals	ΣHCH, ΣDDT	12.38–571.98 ng/l, 109.12–1572.22 ng/l	conventional liquid–liquid extraction (LLE)	(C. P. Kaushik et.al. 2008)
5.	River Deomoni	Cchlorpyriphos, Dicofol, Ethion	0.0091 ± 0.0020ppm, 0.0180 ± 0.0071ppm, 0.0892 ± 0.0375 ppm	On,e way ANOVA	(Swati Singh et.al.2015)
6.	River Ganga	Lindane, Me. Parathion, _-Endosulfan and _-Endosulfan , o, p'-DDT and p, p'-DDT	1.00 ng g-1, 10.00 ng g-1, 10.00 ng g-1, 1.00 ng g-1	Gas Chromatography (GC) supported by electron capture detector (ECD)	(Singh Leena et.al.2012 **)**
7.	River Kaveri	HCHs, DDTs, endosulfan	2,300 ng/L, 3,600 ng/L, 15,400 ng/L	-	(Nikhil et.al.2015)
8.	River	ΣHCH, endosulfan, dicofol,	ND - 0.024	GC-ECD &	(Purushottam

	Gomati	Alachlor, Heptachlor	µg/ml, ND - 0.127, ND - 0.041 µg/ml, ND - 0.035 µg/ml, ND - 0.107 µg/ml	GC-MS/MS	Trivedi et al.2016)
9.	River Yamuna, Delhi	α-BHC, β-BHC, γ-BHC, DDE, Ald	6.87 ± 1.31, 1.6 ± 0.23, 5.91 ± 1.1, 10.17 ± 2.31, 1.05 ± 0.21	Gas Chromatograph (Perkin Elmer Instruments, AutoSystem XL GC)	(Puneeta Pandey et.al.2011)

Table 5: Type of pesticides concentration in the different Indian river bodies

S.no.	Surface water body	Type of pesticides residue	Concentration	MRL Value (ppm)	References
1.	River Betwa	Heptachlor	0.118 µ g/l	0.01	(Daisy Bhat et.al. 2014)
		Endosulphansulphate	0.078 µ g/l	0.5	
		DDT	ND	0.5	
		α -HCH ,	0.245	0.01	
		β –HCH	0.329	0.01	
		Y-HCH	0.207	0.01	
2.	River Ganga	HCH	1–971(ng l−1)	0.01	(Ray et.al. 1992)
		DDT	0–1240 (ng l−1)	0.5	
		Endosulfan	0—2890 (ng l−1)	0.5	
3.	River Ghaghara	ΣHCH	119.74 ± 76.54 (ng/L	0.01	Anubha Kaushik et al 2009)
		ΣDDT	587.30 ± 201.18 ng/L	0.5	
4.	Yamuna river ,its canals	ΣHCH	12.38–571.98 ng/l	0.01	(C. P. Kaushik et.al. 2008)
		ΣDDT	109.12–1572.22 ng/l	0.5	
5.	River Deomoni	Cchlorpyriphos	0.0091 ± 0.0020ppm,	0.05	(Swati Singh et.al.2015)
		Dicofol	0.0180 ± 0.0071ppm	3.0	
		Ethion	0.0892 ± 0.0375 ppm	0.3	
6.	River Ganga	Lindane	1.00 ng g-1	1.0	Singh Leena et.al.2012 **)**
		Me. Parathion	10.00 ng g-1	0.05	
		_-Endosulfan and _-Endosulfan	10.00 ng g-1	0.5	
		o, p'-DDT and p, p'-DDT	1.00 ng g-1	0.5	
7.	River Kaveri	HCHs	2,300 ng/L	0.01	(Nikhil Nishikant Patil et.al. 2015)
		DDTs	3,600 ng/L	0.5	
		Endosulfan	15,400 ng/L	0.5	

8.	River Gomati	ΣHCH	ND - 0.024 μg/ml	0.01	(Purushottam Trivedi et.al. ,2016)
		Endosulfan	ND - 0.127 μg/ml	0.5	
		Dicofol	ND - 0.041 μg/ml	3.0	
		Alachlor	ND - 0.035 μg/ml	0.01	
		Heptachlor	ND - 0.107 μg/ml	0.01	
9.	River Yamuna, Delhi	α-BHC	6.87 ± 1.31		Puneeta Pandey et.al.2011)
		β-BHC	1.6 ± 0.23		
		γ-BHC	5.91 ± 1.1		
		DDE	10.17 ± 2.31		
		Ald	1.05 ± 0.21	0.05	

This comparison study showed the presence of pesticides residue in water of different rivers of India, Maximum studied values were below the MRLs.

Table 6: Impact of pesticides on human health

S.no.	Pesticide	Effect/ Impact	Reference
1.	DDT	Skin sensitization, alhlergic reaction and rash, carcinogenic	(Adams et. al. 1983)
2.	Organophosphate and organochlorine	Alzheimer disease (decrease in brain capacity)	(Norida Mazlan et.al.2017)
3.	Pesticide which is used to control the termites	Brain cancer	(Kathryn R et.al.2013)
4.	Herbicides	Carcinogenic effects on fetus	(Gwynne Lyons et.al. 2010)
	Herbicides(heterocyclic aromatic amine)	Bladder and colon cancer	
5.	Dioxins, phthalates, polybrominated diphenyl ethers (PBDEs), and other halogenated organochlorines	Thyroid cancer	(Thuy VO et.al.2013)
6.	Organophosphate and Carbamate	Respiratory problems (asthma in Children)	(Marg Sanborn et.al. 2012)
7.	Atrazine; carbaryl; endosulfan; metolachlor; simazine; Malathion 2,4-D	Cancer (bone cancer, leukaemia; brain; prostate cancer; breast cancer; breast cancer; non-Hodgkin's lymphoma; mesothelioma)	(Lucia Miligi et.al.2006)
8.	Organochlorine insecticides, such as DDT	Metabolic disorders (obesity, diabetes, metabolic disease)	(Valvi D et al. 2012)
9.	POPs pesticides	Allergies , Hypersensitivity , Damage to the central and peripheral nervous systems, Cancers etc.	(Zvonko Brnjaš et.al. 2015)
10.	2,4-D	Sperm abnormalities , increased miscarriage rates	(Lerda D et.al. 1991)
11.	Dipyridyl derivatives-herbicides	tissue damage in the lungs, kidney, and liver	(Mariana Furio et.al.2015)
12.	Heptachlor and heptachlor epoxide	Kidney tumour	(Norida Mazlan

			et.al.2018)
13.	Molinate	Impairment of the reproductive performance	(Norida Mazlan et. al. 2018)
14.	Isoproturon	Marked enzyme induction and liver enlargement	(Norida Mazlanet.al. 2018)

Table-7 Toxicity categories for active ingredients:

S.no.	Routes of Exposure	Toxicity Category			
		I	II	III	IV
1.	Oral LD50	Up to and including 50 mg/kg	50-500 mg/kg	500-5,000 mg/kg	>5,000 mg/kg
2.	Inhalation LC_{50}	Up to and including 0.2 mg/l	0.2-2 mg/l	2-20 mg/l	>20 mg/l
3.	Dermal LD_{50}	Up to and including 200 mg/kg	200-2,000 mg/kg	2,000-20,000 mg/kg	>20,000 mg/kg
4.	Eye Effects	Corrosive corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
5.	Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours
6.	Signal Word	DANGER POISON	WARNING	CAUTION	CAUTION
Adapted from 40 CFR Part 156.					

(Source: Potential Health Effects of Pesticides, 2017).

