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Route of Exposure and Impact of Pesticides Pollution on Human Health and Aquatic Ecosystem

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Abstract: Pesticides have been found in aquatic ecosystems such as groundwater, lakes, rivers and oceans through clogged storm drains, improper disposal, unplanned discharges and accidental spills. Pesticide exposure results in a variety of abnormalities in the human body, including mutagenic or genotoxic impacts. Pesticide-exposed organisms exhibit a wide range of developmental abnormalities, including genital deformities. Herbicides have a direct negative impact on the population size of primary producer. Pesticides accumulate in rivers and fresh water because of the high concentration of pesticides in the agricultural environment. Toxicants produced by humans have been identified as a severe threat to freshwater ecosystems. Pesticide use has led to the drastic decline of the populations of certain fish species. Insecticides, herbicides and fungicides have all been associated with a decrease in several animal species. Pesticides accumulate in the bodies of fish and have an impact on human health as a result of biological cycling and bio-magnification. Not only can pesticides affect fish, but they can also affect the food webs that support them. Pesticides enter the human body through a variety of ways, including the food chain, air, soil, water, flora and fauna and the environment. In pesticide applicators, farmers and farm workers in general, abnormalities and illnesses of the skin have been documented.

Keywords: Pesticides, Herbivore, Ecosystem, Human, Fish, Decline, Abnormalities

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Introduction

There were a lot of various reasons for pesticides to be used after the Second World War, but now that they are used more and more and they pose a big risk to humans and the environment (Chambers *et al.,* 2001). Organochlorine pesticides are part of a large group of persistent organic pollutants (POPs), which are possibly considered mutagens, endocrine disruptors and carcinogens (Thomas *et al.,* 1998; Peter *et al.,* 2002). The United Nations Environmental Program (UNEP) has launched a global level campaign to eliminate or reduce POPs, which are known to be harmful to human and ecosystem health. The United Nations Environment Programme (UNEP) has identified 12 organic compounds with chlorine content, of which nine compounds have a pesticide nature (Peter *et al.,* 2002). Organophosphate pesticides are often far more harmful to vertebrates than other insecticides or pesticides (Chambers *et al.,* 2001). The use of pesticides has sparked widespread worry among scientists about the potential hazardous effects of pesticide pollution on aquatic flora and wildlife as well as on human beings (Jorgenson, 2001). In Honduras, Belize, Guatemala and Australia, pesticides have been found in marine water and are classified as one of the primary causes and responsible for coral reef damage and degradation (King *et al.,* 2013). Pesticides have been found in groundwater, lakes, rivers and oceans (Malaj *et al.,* 2014; Hull *et al.,* 2015). The number of species within a trophic level is described in two ways; first, vertical composition and second, horizontal composition in a natural system. Chemical effects on aquatic communities could be influenced by both dimensions, including vertical and horizontal composition (De Laender *et al.,* 2016; Baert *et al.,* 2016; Zhao *et al.,* 2019). A recent study found that the two dimensions (horizontal and vertical) have an inverse effect on the short-term stability of complete food webs after pesticide exposure (Zhao *et al.,* 2019). Pesticides have more lethal and harmful impacts on human health than other chemicals, depending on the toxicity of the chemical, amount and time of exposure (Lorenz, 2009). Pesticides can have a wide range of effects on human health, from minor skin irritation to cancer, birth defects, haematological and neural disease, endocrine malfunctioning and even death (Miller, 2004). Several studies have provided evidence of various cancers in human tissue due to pesticide toxicity (Mathur, 1999; Abdo *et al.*, 2013; Ennour-Idrissi *et al.,* 2019) and have caused various abnormalities in the human body, including mutagenic or genotoxicity (Ramirez and Cuenca, 2002; Ennaceur *et al.,* 2008), neural impairment (Sharma *et al.,* 2010; Heusinkveld and Westerink, 2012), endocrinal abnormalities (Fowler *et al.,* 2007; Frye *et al.,* 2012), carcinogenicity and teratogenicity (Kalra *et al.,* 2016; Ramakrishnan *et al.,* 2019). Similarly, wild organisms are also exposed to pesticide exposure and show various developmental defects, including deformities in genitalia, alteration in breeding behaviour, egg shell thinning, sterility, cancer and abnormalities in the immune system (Colborn and Smolen, 1996; Sonne *et al.,* 2006; Briz *et al.,* 2011; Newton, 2013). Surface, subsurface and groundwater fluxes, as well as downstream river transport can transfer pesticides from agricultural fields into the water system or aquatic ecosystem (Pereira and Hosteller, 1993; Schulz, 2001; Battaglin *et al.,* 2003). Pesticide concentrations in surface waters can increase significantly over weeks and months due to regular application and strong persistence (Dores and Lamonica-Freire, 2001; Beketov *et al.,* 2008). Human activities are causing fast changes in biodiversity in freshwater communities. According to several investigations; the extinction rate of aquatic faunal species are five times faster than terrestrial faunal species (Ricciardi and Rasmussen, 1999; Abell *et al.,* 2000). Agricultural practices, such as eutrophication, habitat degradation, sedimentation and pesticide and herbicide run-off, anthropogenic activities also responsible for vanishing of freshwater ecosystem.

In this review the impacts of pesticide pollution on human health and aquatic ecosystems have been discussed. The present study also demonstrated the route of exposure and impacts in various animals, including humans due to pesticide exposure.

Impact of Herbicides on Primary Producers/ Herbivores:

Herbicides cause a negative and direct detrimental impact on the population size of primary producers (Baert *et al.,* 2016). Both sensitive and tolerant producers can be found in a more varied producer group (Baert *et al.,* 2016). Negative interactions among producers result in competitive release when environmental stressors reduce the population of susceptible producers, allowing declines in sensitive species populations to be compensated for by increases in tolerant species populations (Gonzalez and Loreau, 2009; Baert *et al.,* 2016; De Laender *et al.,* 2016). Herbicides, on the other hand, can have a greater direct negative impact on producer populations when additional herbivore species are introduced, because herbivore grazing and herbicides may interact to enhance herbicide effects (Rohr *et al.,* 2006; Rohr and Crumrine, 2005; Halstead *et al.,* 2014). In contrast, the presence of a predator may lower the herbivore population and the ensuing reduction in grazing pressure may mitigate the herbicides' direct harmful impacts on producers (Anderson *et al.,* 1996; Pace *et al.,* 1999). Because more herbivore species are added, the direct harmful impacts of pesticides on the population size of herbivores can be reduced. Both sensitive and tolerant herbivores can be found in a more diversified herbivore group, whereas more intolerant herbivores are more likely to be found (Becker and Liess, 2017). Several studies also found, when there is a predator present around herbivore, the insecticide and predation work together to have a greater impact on the growth of herbivores (Beketov and Liess, 2006; Trekels *et al.,* 2013).According to Relyea (2005), when a predator (*Ambystoma maculatum*) was present, the insecticide carbaryl was 4 times more harmful to the prey (tadpoles). However, some studies have found that insecticides and the presence of a predator on herbivores might work together or against each other (Campero *et al.,* 2007; Janssens and Stoks, 2013 and 2017; Trekels *et al.,* 2011). Pesticides also influence the composition of an aquatic ecosystem's horizontal and vertical communities. Herbicides may reduce herbivore population numbers indirectly by reducing the biomass of edible producers (Preston, 2002; Fleeger *et al.,* 2003; Bracewell *et al.,* 2019).

Impact of Pesticide Contamination on Aquatic Ecosystem:

The excessive concentration of pesticides in the agricultural landscape leads to bioaccumulation of these pesticides along rivers and fresh water in a variety of ways (Gavrilescu, 2005; Holvoet *et al.,* 2007; Takatori *et al.,* 2008). The accumulation and presence of these pesticide concentrations cause a negative impact on natural environmental conditions as well as non-targeted species or organisms (Takatori *et al.,* 2008; Carriquiriborde *et al.,* 2014). The use of pesticides like organophosphate, organochlorines, carbamates and pyrethroids has a significant negative environmental impact on non-target organisms due to their properties like toxicity, long range transmission and bioaccumulation in favourable conditions (Contreras Lopez, 2003; Briz *et al.,* 2011; Gao *et al.,* 2013). In any event, pesticides reach the ground level through impaired surface water drainage, improper disposal and unanticipated spills and spillages (Pesticides in Groundwater, 2014). Pesticides that enter into lakes, rivers and streams are causing substantial damage to aquatic environments. Atrazine also has a toxic nature and is potentially toxic to several fish species and also causing an indirect effect on the immune systems of some amphibians (Forson and Storfer, 2006; Rohr *et al.,* 2008). Anthropogenic toxicants were identified as a serious threat to freshwater ecosystems in the Millennium Ecosystem Assessment (MEA, 2005), with pesticides and heavy metals being the most relevant. Several studies have found that both enter aquatic ecosystems via a variety of routes, including mine waste water, drainage, industrial discharge, spray drift, or runoff and can have an impact on aquatic communities (Gjessing *et al.,* 1984; Clements *et al.,* 2000; Niyogi *et al.,* 2002; Beasley and Kneale, 2003; Arts *et al.,* 2006; Sierra and Gomez, 2010; Schafer *et al,*.2011 a, b, 2012 a, b). Several studies conducted on pesticide effects in freshwater ecosystems focus on small groups of species and some studies have been targeted at single species (Hardersen and Frampton, 1999; Mora *et al.,* 2000). Carbamates are widely used in the agricultural field as insecticides that can reach aquatic systems via runoff and are particularly hazardous to non-target aquatic organisms (Weber and Rosenberg, 1984; Beyers *et al.,* 1995; Braman *et al.,* 1997; Brewer and Atchison, 1999; Peterson *et al.,* 2001a). Carbaryl is also toxic to planktonic and bacterial communities. Carbaryl is lethal to zooplankton, especially cladoceran, reduce the diversity of estuarine bacteria (Havens, 1995; Chang *et al.*, 2005). Carbaryl is commonly found in nature at low concentrations because it degrades quickly (Beyers *et al.,* 1995). Carbaryl has been demonstrated to have a half-life of 2.2 days, which is 4–8.5 times faster than chloropyrifos and diazinon (Bondarenko *et al.,* 2004). The degradation rate of carbaryl is slow as compared to other pesticides, which are influenced by several abiotic factors like temperature, light and pH (Bondarenko *et al.,* 2004). Pesticides enter aquatic bodies through a variety of routes (Schulz, 2004; Hageman *et al.,* 2006). During heavy rain fall, the water that washes off the earth's surface enters into water bodies with the help of drainage and irrigation canal systems. These are the main routes or pathways for pesticides to reach non-irrigating surface water bodies (Rabiet *et al.,* 2010; Taghavi *et al.,* 2010; Bereswill *et al.,* 2012; Stehle and Schulz, 2015). The exposure of pesticides in aquatic ecosystems is also influenced by climatic and geological factors, the position of cultivated land, hydrology, the amount of rainfall and types of soil (Schulz, 2004). Improvements in crop production appear to be an essential component of the modern agricultural industry, given the rising needs of a growing population (Omer *et al.,* 2010; Sabir *et al.,* 2013; Hakeem, 2015; Pierart *et al.,* 2015). Water pollution has become a worldwide issue. Organophosphate, pyrethroids, carbamates, nicotinoids and chlorinated hydrocarbons are the most commonly used insecticides. Bionetworks that are important to the long-term survival of organisms can be damaged by the use of insecticides (Banaee, 2013). Ecological interactions between living organisms are also disrupted and biological diversity is declined due to pesticide contamination in ecosystem.

Pesticides Exposure to Fish:

Pesticides that are used on land enter into aquatic systems, where they affect fish and other non-target animals. Pesticide usage has resulted in a decline in the populations of several fish species (Scholz *et al.,* 2012). There are three ways in which aquatic organisms are exposed to pesticides that are detrimental to them (Helfrich *et al.,* 2009)-- direct absorption through the skin; oral absorption through contaminated water; and absorption through the gills. It is critical to evaluate the effects of pesticides on populations of aquatic organisms including fresh water and marine animals, terrestrial plants and animals. Pesticide accumulation in food chains is a major source of concern since it directly affects the predator's level and the top consumer of the food chain. On the other hand, pesticides can reduce the number of weeds, bushes and insects which animals eat. The use of insecticides, herbicides and fungicides has also been linked to a drop in the number of several animal species and populations. Furthermore, long-term exposure has a negative impact on organisms' lives and leads to bioaccumulation in the food chain (Pesticides Reduce Biodiversity, 2010). Aquatic plants provide about 80% of the dissolved oxygen, which is critical for aquatic life's survival. Because herbicides kill aquatic vegetation, oxygen levels declined dramatically, resulting in a lack of oxygen for fish and a reduction in fish productivity and enhancing the morality of aquatic organisms, including fish (Helfrich *et al.,* 2009). Direct mortality of organisms, functional impairments and reproductive abnormalities and negative effects on prey species are all examples of pesticides' effect on aquatic animals (Pimentel, 2005; Erdogan *et al.,* 2007; Moore *et al.,* 2007; Perschbacher *et al.,* 2008; Boone, 2008; Kim *et al.,* 2008; Couillard *et al.,* 2008; Henny *et al.,* 2008; Hontela *et al.,* 2008). When a keystone species is lost, it triggers a series of severe cascading effects that disrupt trophic status or level, other food-web links and can even result in the population decline of several species in a community or ecosystem. Most aquatic organisms are particularly sensitive to some pesticides, such as pyrethroid insecticides. Pesticides clearly have a significant impact on the global production of fish. Furthermore, studies on fenitrothion and endosulfan toxicity in tilapia species from Tanzania's Lake Victoria revealed that the species has a high capacity to absorb these pesticides (fenitrothion and endosulfan) from water, with bioaccumulation factors of 33 and 346 L/ kg fresh weight, with the help of rapid uptake and distribution in organs (Henry, 2003).

The majority of fish species are sensitive and vulnerable to contamination and pollution of water (Banaee *et al.,* 2013). Dichlorvos and other organophosphate insecticides are particularly toxic to fish and other non-target aquatic species. These pesticides are effective neuro-toxic because they inhibit acetyl cholinesterase (AChE) activity in the nervous system by disputing nerve impulse communication at cholinergic synapses. The disruption of nerve function causes problems with the parasympathetic nervous system, which leads to death of organisms (Nguyen *et al.,* 2008). Fish are the major aquatic dwellers that are regularly exposed to and come into contact with these harmful chemicals (Scott and Sloman, 2004; Firat *et al.,* 2011). Pesticides may accumulate in the bodies of fish and through ecological cycling and bio-magnification, have an impact on human health (Chebbi and David, 2011). Pesticide poisoning in fish causes biochemical changes that cause metabolic abnormalities, development retardation, enzyme activity suppression and decreased fertility. When fish are exposed to toxins-polluted water, the organs most affected are the gills, liver, brain and kidneys (Malik and Maurya, 2015). Excessive use of these insecticides has caused the populations of many fish species to decline (Scholz *et al.,* 2012).

Pesticides diminish the population of organisms on which fish eat in aquatic ecosystems, which leads to an interruption in fish food availability and changes the hydrobiology of aquatic bodies (Maskaoui *et al.,* 2005; Helfrich *et al.,* 2009). Furthermore, pesticides alter fish behaviour and impair the suitability of fish habitat, increasing the risk of fish predation (Gill and Raine, 2014). Variety of pesticides affect the fish directly and also induce various forms of toxicity in fish that leads to modifications and changes in the behaviour of fish (Rao and Pillala, 2001; Satyavardhan, 2013; Ullah *et al.,* 2014a; Rani and Kumaraguru, 2014), histology (Saeedi *et al.,* 2012; Ullah *et al.,* 2014b), enzymatic changes among biochemical pathways of fishes (Gartiser *et al.,* 2001; Vargas *et al.,* 2001; Çavas and Konen, 2007), biochemical changes and modification in hormone level (Murthy *et al.,* 2013; Dey and Saha, 2014), liver related disorder (Rani and Venkataramana, 2012; Deka and Mahanta, 2012; David and Kartheek, 2014), alteration and variation in nutrient profiling of fishes (Bhandare *et al.,* 2011; Ravindran *et al.,* 2012; Muthukumaravel *et al.,* 2013; Bibi *et al.,* 2014) and modification and alteration in antioxidant defence system and changes in acetycholinesterase action level (Nwani *et al.,* 2010; Muthukumaravel *et al.,* 2013; Joseph and Raj, 2011; Bibi *et al.,* 2014). Pesticides have been thoroughly studied in order to establish their impact on the declining fish population (Scholz *et al.,* 2012). Pesticide contamination of aquatic ecosystems has been linked to fish deaths all around the world. In Europe, for example, plant protection products (PPP) have been reported for negative impact on 27 species of freshwater fish (Ibrahim *et al.,* 2013). Another insecticide, pentachlorophenol pesticides-toxic aspects (NaPCP), has been linked to large-scale fish deaths in Surinam's rice fields (Vermeer *et al.,* 1970). Pesticides have an influence not only on fish, but also on the food webs that support them. Persistent pesticides (organochlorine pesticides and polychlorinated diphenyls) have been previously found in the primary food webs of the Arctic Ocean (Hargrave *et al.,* 1992). Pesticides severely destroy tissues in fish, including the alimentary canal, liver, gills and brain of catfish and carps. Pesticide levels in fish could damage fish eaters as well (Konar, 2011). There are several examples of pesticides affecting key fish organs and behaviour. The organophosphate insecticide "Abate" has the potential to disrupt vitellogenesis in catfish (*Heteropneustes fossilis* (Bloch.)), which can adversely affect catfish farming and production (Kumari, 2012). Another prominent consequence of toxic pollutants on fish is olfaction, which can influence activities such as food location, predator avoidance, mating, kin identification and homing (Tierney *et al.,* 2014). Glyphosate exposure influenced and limited the growth of freshwater fish (*Galaxias anomalus*), treamatode parasites (*Telogaster opisthorchis*), and snails, with higher concentrations of glyphosate causing mortality of these orgamisms (Kelly *et al.,* 2010). Pesticides impact in an aquatic environment is impacted by their water solubility and ability to be absorbed by organisms (Pereira *et al.,* 2013). Clomazone, for example, is a common herbicide that is highly water soluble, making it more likely to contaminate ground and surface water. Clomazone pesticide's hydrophilic or lipophobic properties make it less available in an organism's fatty tissues (Pereira *et al.,* 2013). Furthermore, physicochemical parameters of water and fish size are also influenced by the toxicity of pesticides, including endosulfan (Capkin *et al.,* 2006)

Route and Impact of Pesticides Exposure on Human:

Pesticides can enter the human body via four different routes: the eye, the oral cavity, the skin and the respiratory tract. Toxicity varies and depends on the type of contact with human body organs, such as oral, skin and inhalation through respiration. Humans are exposed to pesticides in a variety of ways, including the food chain, air, soil, water, flora and fauna, and the surroundings (Anderson and Meade, 2014). Pesticides are carried throughout the human body by the circulatory system, but they can also be released through the skin, exhaled air and urine (Damalas and Eleftherohorinos, 2011). Pesticides can enter the human body through inhalation of pesticide-containing aerosols, dust and vapor, cutaneous exposure from pesticides coming into direct contact with the skin and oral exposure from contaminated food and water (Sacramento, 2008). One of the most well-known and convincing ways for pesticide applicators to be exposed to pesticides is through dermal exposure (Anderson and Meade, 2014). When stacking, arranging, carrying, combining and cleaning pesticides, dermal absorption usually occurs as a result of spray drift, spill and sprinkle (Salvatore *et al.,* 2008). Oral ingestion refers to the process of ingesting a substance through the mouth and into the digestive tract. During spraying, a small amount of spray vapor enters the nose and mouth and is inhaled. This occurs as a result of occupational, purposeful or unintentional pesticide application (Thundiyil *et al.,* 2008). Oral pesticide exposure is usually increased by chance owing to inattention or for specific causes (Damalas and Eleftherohorinos, 2011). The most common examples of unintentional oral exposure were accounted for when pesticides were changed from their unique designated containers to unlabelled bottles or food containers (Gilden *et al.,* 2010). Pesticides have a high potential for respiratory introduction due to the presence of unstable ingredients (Amaral, 2014). Inhaling enough pesticides can cause serious damage to the tissues of the respiratory tract, including the throat, nose and lungs (Damalas and Eleftherohorinos, 2011). When pesticides are sprayed in large droplets with typical equipment, the danger of pesticide exposure is relatively low. In any case, spraying a concentrated chemical using low-volume equipment increases the danger of respiratory exposure due to the creation of small drops (Amaral, 2014). A few pesticides have been found to be absorbed by the eyes in enough concentrations to produce real or even deadly disorder of eyes (Gilden *et al.,* 2010). Because of the density and weight of individual particles, granular insecticides pose a special risk to the eyes (Jaga and Dharmani, 2006). Pesticide pellets may spray off vegetation or other surfaces at high speeds when applied with power equipment, causing serious eye damage (Fareed *et al.,* 2012). Pesticides' long-term effects include Leukaemia, lymphoma, soft tissue sarcomas, cancerous growths of the bone, brain and stomach, peripheral and central nervous system damage, birth defects, reproductive complications, immune system disruption and mortality (Michael *et al.,* 2013). Lymphoma, Wilm's tumour, leukaemia, Burkitt lymphoma, neuro-blastoma, soft tissue sarcoma, tumours of the lung, rectum, stomach, colon, bladder and ovarian disease have all been found to be more serious in those who are closely linked to pesticide exposure (Schinasi and Leon, 2014; Bonner *et al.,* 2016). Hormone disrupters have been linked to an increase in the rate of hormone-related disorders such as prostate, testis and male reproductive system (Skakkebaek, 2002). Chlorpyrifos (CPF) is a widely used organophosphate pesticide in agriculture. Organophosphates are neurotoxins that are metabolically activated and function as irreversible inhibitors of cholinesterases (Amitai *et al.,* 1998). In a meta-analysis, exposure to pesticides also enhanced the risk of prostate cancer in farmers when evaluated in relation to a contaminated pesticide containing the extremely harmful 2, 3, 7, 8-tetrachlorodibenzop-dioxin (TCDD). Until 2006, five studies looked at 26706 people who had been exposed to the pesticide, and they found a link between pesticide exposure and prostate cancer (Kabir *et al.,* 2018). Also, when women were exposed to pesticides in the early stages of life and during puberty, they were more likely to get breast cancer (Niehoff *et al.,*2016). In the United States, colorectal cancer is the second-highest cause of cancer-related mortality in both men and women (Raina *et al.,* 2016). Non-Hodgkin's lymphoma (NHL) is a group of cancers that affect the lymphatic and immune systems. It includes more than 20 different cancers. This type of threat has spread around the world in recent decades (Alavanja and Bonner, 2012). Exposure to organochlorine pesticides (OCPs) enhances the risk of getting NHL. The risk of pesticide exposure for NHL was examined in a meta-analysis, and positive relationships for hexachlorocyclohexane, chlordane, dichlorodiphenyldichloroethylene and hexachlorobenzene were found by Luo *et al.* (2016). Malathion targeted immune cells specifically, but diazinon disrupted a neuro-immune system that involves a cholinergic lymphocyte arrangement (Hu *et al.,* 2017). The presence of extracellular amyloid–beta (A) plaques, demise of neurons and lack of neurotransmitter are all characteristic features of the Alzheimer's disease (chronic neuro-degenerative disease). Environmental contaminants have been found to be strongly linked to the etiology of Alzheimer's disease. Organophosphate pesticides, like the drugs used to treat Alzheimer's disease, have been found to suppress acetyl cholinesterase. They've also been linked to microtubule aberrations and tau hyper phosphorylation (Zaganas *et al.,* 2013). Bernardino Ramazzini was one of the first scientists to warn about the dangers of respiratory diseases in farmer throughout the 1700s (Hoppin *et al.,* 2006). Several epidemiological and clinical investigation have found connection between pesticides exposure, asthma and bronchial hyper-reactivity. Inflammation, disturbance, endocrine disruption and immunosuppression may all contribute to the increasing of asthma (Hernández *et al.,* 2011). In the human body, the kidney and liver are the major organs for excretion and detoxification. Every toxic substance in the body is stored here for elimination and conversion into non-toxic forms (Tomer *et al.,* 2015). As a result, these organs have a proclivity for accumulating large amounts of chemicals and toxins, leading to structural and functional problems. With reference to tissue susceptibility to free radicals, the effectiveness of pesticide activity can be clarified. Pesticides that target lipoidal films, such as chlorpyrifos, produce reactive oxygen species (ROS) and cause alteration in the lipid layer (Kumar *et al.,* 2011). In chronic kidney disease (CKD) patients, a major positive connection between plasma levels of oxidative stress parameters (propelled oxidation protein molecules and malonaldehyde) and absolute pesticide levels demonstrated oxidative stress amplification with elevated pesticide accumulation (Fetouiet *et al.,* 2010). An increased pesticide load forces the liver to work harder to purify the blood. Digestive enzymes are produced in greater quantities as a result of this. Glutamate pyruvate transaminase, glutamate oxaloacetate transaminase, and alkaline phosphatase levels were higher in the livers of 86 pesticide sprayers from northwest Ethiopia (Ejigu and Mekonnen, 2005). Abnormalities and diseases of the skin have been observed in pesticide applicators, farmers and farm workers in general. When organochlorine insecticides are applied to the skin, they cause chloracne, rashes and pain and stimulating sensations on the skin (Longnecker *et al.,* 2005; Dasgupta *et al.,* 2007; Fukuyama *et al.,* 2009). Zhang *et al.* (2011) observed that 106 (11.6 percentage) of 910 applicators had severe dermal poising, with symptoms like hyperhidrosis and dermatitis in China. Blisters, edema, itching and urticaria were all found in those who had it. Contact dermatitis, both irritating and allergic is the most common pesticide-related dermatitis. Ashydermatosis, parakeratosis, chloracne, erythema multiformeand pesticides also cause skin hypopigmentation due to porphyria cutanea tarda, hair and nail problems are all prevalent clinical features (Spiewak, 2001).

Conclusion

Organochlorine pesticides are part of a wide category of POPs that may be mutagens, endocrine disruptors or carcinogens. Detection of pesticides in aquatic ecosystems has been found in a variety of habitats, including groundwater, lakes, rivers and seas. Pesticide exposure induces mutagenic or genotoxic effects in humans. Wild animals exposed to pesticides exhibit developmental abnormalities, including genital malformations. Pesticide bioaccumulation occurs in rivers and freshwater due to overuse in agriculture. Chemicals reach the ground through surface water drainage, improper disposal and unplanned spills. Anthropogenic pollutants pose a severe threat to freshwater ecosystems. Use of pesticides has led to a decrease in the number of fishes and other organisms including aquatic and terrestrial. Insecticides, herbicides and fungicides have been linked to a decrease in the numbers of different species. Pesticides build up in the food chain and have an effect on human health through the ecosystem and bio-magnification. There are several ways through which pesticides get into the body, including the food chain, air, soil, water, plants and animals in the environment.

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