Chapter 23
Global Warming and Pesticides in Water Bodies

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ABSTRACT

Over the last few decades, significant effort has been undertaken to record the effect, fate, and transport of pesticides into surface water and groundwater. The functional aspect of climate change and pollutant interactions induces vulnerability on species and populations and reveals the onset of adverse events by triggering the nature's threshold. Erstwhile climate change by itself will affect the environmental distribution and induces prominent toxicity of various chemical toxicants like pesticides. Despite of their potential toxicity towards the beneficial organisms and even to human beings, their use is mandatory to improve the productivity and high-quality life standards. In general, climate change alters the efficiency of pesticide use and can also be expected. But their leaching pollutes ground water. Research on the effects of climate change, on the environmental fate and behavior of pesticides and their mechanisms of action between the environmental compartments has been reviewed in this chapter.

INTRODUCTION

In the recent past the rise in global temperature is impacted due to rapid climatic change generated through global warming. Anthropogenic sources, emitting green house gases (GHG) remarkably raised the global temperature (Keer, 2007; Weare, 2009). These raising extreme events which are a real and daunting problem might lead to global average temperature of 2–3ºC by 2050 and by the end of the century reaching 6.5°C (Solomon *et al*., 2007; Anuradha *et al*., 2017; Sanjeevi *et al*., 2017). In general '*Climate change'* is defined as a variation in the statistical properties of climatic systems, on considered it over long period, regardless of its cause (ENSAA, 2011). According to the U.N. Intergovernmental Panel on Climate Change (IPCC) has reckoned its four assessments comprising evidence, impacts, and mitigation of climate change (IPCC, 2007). According to their report unequivocal global warming with

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the evidence of increases in global mean air and ocean temperature, with consequent effect of widespread melting of snow and ice, and rise in global sea level. The projected raise in temperature of 1.8–4.0 ºC by end of this century under a range of probable GHG emission scenarios with greater warming is expected at higher latitudes. These extensive difference pose impact on nature, human health and even the economy, implies that climate change is both spatially and temporally heterogeneous (EEA, 2012).

The functional aspects of climate change and pollutant interactions further induces vulnerability on species and populations and reveals the onset of adverse events by triggering the nature's threshold. Erstwhile climate change by itself will affect the environmental distribution and induces prominent toxicity of various chemical toxicants. Most significantly here we focus on the classes of chemicals with global significance, including persistent organic pollutants (POPs) and other pesticides. As of now, twelve chlorinated organic chemicals (COCs) were listed as POPs as per the U.N. Stockholm Convention, which comprises organochlorine pesticides (e.g. DDT (dichlorodiphenyltrichloroethane) and toxaphene), polychlorinated biphenyls (PCBs), dioxins and furans (UNEP, 2009). Other pesticides, includes aldicarb, atrazine, and chlorpyrifos with special interest due to their wider application in large quantities over a broad spectral area and possessing higher range of toxicological effects.

For several years, pesticides were widely utilized so as to prevent, mitigate and/or to destroy pests and to improve the economy of yield and crop quality. Pesticides provided significant advantage for agricultural crops, than that of weeds and protected the crops from the damage influenced by disease causing agents and pests. Despite of their potential toxicity towards the beneficial organisms and even to the human beings, their use is mandatory to improve the productivity and high quality life standards. In general climate change alters the efficiency of pesticide use and can also be expected. The direction of this action, is however uncertain and has not yet been detailed thoroughly (Noyes *et al*., 2009). Research on the effects of climate change, on the environmental fate and behavior of pesticides and their mechanisms of action between the environmental compartments has been reviewed in this chapter.

Some of the significant environmental factors posing challenges for sustainability include flooding, drought, temperature extremes, nutrient deficiency, and higher level of pollutants. Presence of lower pesticide residue on crops, induced by climatic effect results in increased pests and diseases attach. This indirectly induces the farmers to spray the pesticides more often in future for better crop yield. Similarly higher pest attach and disease will also enhance the pesticide application frequencies and dosage. As a consequence, the detected residual concentrations will be higher in the products, there by consumer exposure to pesticide residues remains still at the end of food chain. In this respect, the food safety issues related to an increased exposure to pesticide residues, as a consequence of climate change, might occur. On the other hand pesticides and global warming have potentiality to interact, thereby challenges ecological risk assessment (ERA) of pesticides in the warming world (Noyes & Lema, 2015). The toxicity of several pesticides either increases under warming conditions causing "*climate–induce–toxicant–sensitivity*" or the ability to cope up with high temperatures declines efficacy of pesticides causing "*toxicant–induced–climate–change–sensitivity*" (Moe *et al*., 2013; Noyes & Lema, 2015). The present chapter brings the nut shell on *state–of–the–art* climate change impact on pesticides and their environmental fate. With special reference to surface water quality (from *source to sink*) is that there is a degradation trend of surface and underground water quality leading to an increase of at risk situations with regard to potential health impact, mainly due to climate change.