Uses of Chemical Pesticides in Agricultural Fields in West Bengal and their Effects on Non-Target Species - A Review Study

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Abstract **- The meaning of Pest is described in Oxford Dictionary that a troublesome or destructive organism and the suffix 'cide' mean "slaughter of". From this we can define the Pesticide is a substance or mixture of substances intended for killing of a pest. By destroying the pests the Pesticide prevents some species of plants and animals that causes harm or interferes in the growth of plants/ crops. The pesticide may be biological agents or chemical substances. The chemical pesticides are very much toxic on environment after their uses in the agricultural field. However, it is estimated on a global report that the worlds crops yield is reduced by 10-15% due to presence of weeds. So it is very necessary to use of pesticides for better crop yield. Using of pesticide the target species as well as non-target species including human also effected. The indiscriminate use of pesticides in agricultural fields polluted the environment including soil, water and air through pesticide residues. Through bio-accumulation or biomagnification pesticides (e.g., chlorinated) enter into the food chain and multiplying its toxicity and hampered the life cycle of too many non-target organisms. Now it should be very essential to take some steps to use over the pesticide, otherwise the living organisms will be fall in danger by this poison.**

Index Terms **- Pesticide, toxic, chlorinated, biomagnification.**

INTRODUCTION

In India the pesticide (BHC) production was first time started in Calcutta, year 1952. India is the second largest producer of pesticide after China in Asia and ranked 12th globally according to Mathur, 1999. In the present review paper, I showed the different types of pesticide uses in state West Bengal (India) and their effects on non-target organisms. As we know the pesticide are classified into different ways. These are as follows –

1. By target organism – like insecticide, fungicide, herbicide etc.
2. Type of application – spray, dust, fumigants etc.
3. Mode of action - neurotoxic substances, repellents etc.
4. By the chemical class – organophosphates, organochlorine etc.

But most of these chemical pesticides have a very wide range of side effects on the environment. In the last 50 years the agricultural yield growth has increased dramatically, and the major role has played by Pesticides. As we know that the India's economy is highly depended on agricultural and in West Bengal agriculture is one of the main occupation. So it is very clear that the heavy uses of these pesticides in turn brought very hazardous sides effects in environment and all the living objects. Most of the insecticides come into three classes i.e., organochlorines, organophosphates and carbamates. The pesticides is used in India mainly for cotton crops (45%), followed by paddy and wheat. In West Bengal rice, wheat and different types of vegetables and fruits are cultivated.

PESTICIDES USES IN WEST BENGAL

In the present study, according to ncbi, in West Bengal alpha cypermethrin is used 46 percent then methyl parathion is used 25.6 percent, then in the third position imidacloprid is used 16.4 percent, then dichlorves is used 7.8 percent and phorate is used in 4.2 percent.

In the south part of the Bengal peddy fields the farmers used in average pesticide is 982.38 gm/ha in the cropping year and the range is between 0- 2414.28 gm/ha. Where as in India the average uses of pesticide is 500 gm /ha (according to year 2009). Indian farmers

are used 94 varieties of pesticides in which 65 are insecticides, 26 fungicides and 3 types of herbicides. The Europian Union was already banned 12 varieties of pesticides out of these 94. But in India only 1 was banned out of 94 varieties. Most of these banned pesticides which constituted 20.46 % of the pesticide, contain Endosulfan chemical, which is very much toxic to the environment and enter into the food chain. This Endosulfan concentration is very prominent in the both 24 Paragans and Nadia districts.

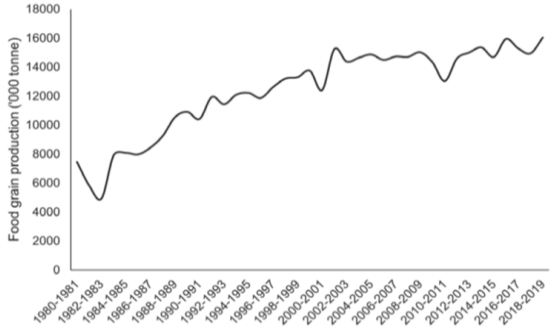

Figure 1: Total food grains (cereals and pulses) production of West Bengal ('000 tonnes)[*Source: Agricultural Statistics at a glance- 2019. Directorate of Economics and Statistics(2019). Govt. of India]*

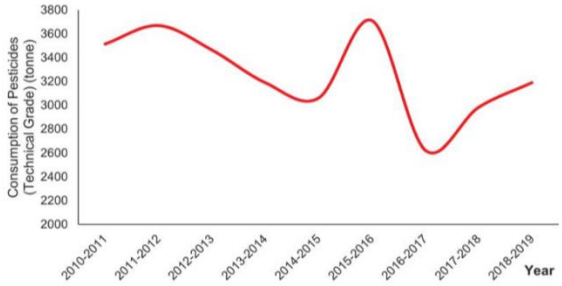

Figure 2: Total Pesticide consumption of West Bengal Source: *The Ministry of Chemical and Fertilizers, Govt. of India., (Assessed from https://www.indiastat.. Com./table/agriculture-data/2/consumption-of-pesticides/206872/1135962/data.aspx.)*

Table: 3- Approved Uses of Registered Insecticides Names

Name of the insecticide	Name of the insecticide	Name of the insecticide
Abamectin 01.90 %EC	Alphacypermethrin 10.00% SC	Beta-cyfluthrin 02.45 % SC
Acephate 75 % SP	Aluminum Phosphide 56% (3g Tablet,10g Pouch)	Benfuracarb 03 % GR
Acephate 97 % DF	Aluminum Phosphide 15 % (12g Tablet)	Bifenthrin 08.80 % CS
Acephate 95 % SG	Aluminium Phosphide 77.50 % GR	Brodifacoum 0.005 %w/w BB
Acephate 95 % SG	Aluminum Phosphide 06 % Tablet	Bromadiolone 00.25 % CB
Afidopyropen 50 g/L DC	Acetamiprid 20 % SP	Buprofezin 25 % SC
Alphacypermethrin 10.00% EC	Barium Carbonate 1%P	
	Carbofuran 03 % CG	
Carbosulfan	Chlorpyrifos	Deltamethrin
Cartap Hydrochloride	Chromafenozide	Dicofol
Chlorantraniliprole	Clothianidin	Diafenthiuron
Chlorantraniliprole	Cyantraniliprole	Diflubenzuron
Chlorfenapyr	Cyenopyrafen 30 %	Dimethoate
Chlorfluazuron	Cypermethrin	Emamectin benzoate
Chlorpyrifos	Dazomet	Ethion
Fenazaquin	Fipronil	Imidacloprid
Fenobucarb (BPMC)	Flubendiamide	Indoxacarb
Fenpropathrin	Flubendiamide	Lambda-cyhalothrin
Fenpyroximate	Flumite	Lufenuron
Fenvalerate	Hexythiazox	Malathion
Propargite	Novaluron	Metaflumizone
Pymetrozine	Oxydemeton-methyl	Metaldehyde
Pyriproxyfen	Permethrin 25 % EC	Methomyl
Pyridaben	Phenthoate	Methyl Bromide
Pyridalyl	Phosalone	Milbemectin
Quinalphos	Profenofos	Monocrotophos
Spinetoram	Spinosad	Spiromesifen
Spirotetramat	Thiacloprid	Thiocyclam HydrogenOxalate

(Registered under the Insecticides Act, 1968)
(UPTO - 30/06/2021); Government of India.

Agro- Climatic Zone of West Bengal

According to Indian Council of Agricultural Research (ICAR), our country is devided into 13 major and 127 micro-level agro-climatic zones. The state West Bengal contain 3 zones out of these devisions. Although this state is devided into 6 agro climatic regions. These are Hill zone, Tarai Zone, Old Alluvial Zone, Gangetic Flood Plain, Lateritic Zone, Coastal Zone.

Table 1: Agro-Climatic Zones of West Bengal-An Overview

SL.NO	AGRO-CLIMATIC ZONE	AREA (ha)	DISTRICTS	MAIN CROPS
1	Hill Zone	2,42,779 (2.79%)	Darjiling (except Siliguri subdivision) and Northern part of Jalpaiguri dist.	Maize, rice, different types of vegetables, potato, soybean, cardamom, ginger, different medicinal plants, tea, orange etc.
2	Terai Zone	12,14,880 (13.99%)	Darjiling (only Siliguri subdivision), Jalpaiguri dist, Alipurduar, Koch Bihar, Uttar Dinajpur (only Islamur subdivision)dists.	Rice, jute, tea, pineapple, potato, pulses, oilseeds etc.
3	Old Alluvial Zone	17,53,757 (20.20)	Dakshin Dinajpur and Part of Murshidabad, Bankura, Haora, Hugli, Barddhaman(undivided), Birbhum, Paschim Medinipur and Purba Medinipur dists	Rice, wheat, maize, jute, mustard, niger, groundnut, sesame, linseed, lentil, black gram, green gram, pigeon pea, vegetables etc.
4	Gangetic Flood Plain	15,30,415 (17.62)	Nadia, Murshidabad, Maldah, Uttar Dinajpur, Barddhaman(undivided), Hoogly, North 24 Parganas and Haora dists.	Rice, wheat, maize, jute, green gram, black gram, pigeon pea, lentil, rapeseed, mustard, groundnut,sesame, linseed, niger, vegetables etc
5	Lateritic Zone	24,84,244 (28.61)	Entire Puruliya and part of Barddhaman(undivided), Birbhum, Bankura, Purba Medinipur and Paschim Medinipur dists.	Rice, maize, millets, vegetables, niger, toria, safflower, mustard, sesame, pulses, potato, vetiver, sabia etc.
6	Coastal Zone	14,56,879 (16.77)	Entire South 24 Parganas and part of North 24 Parganas, Haora and Purba Medinipur dists.	Rice, chilli, vegetables, sunflower, sesame, watermelon, *Lathyrus* etc

Data in parenthesis indicate the percentage of land under the concerned agro-climatic zones.

Sources: 1. Principles of Agronomy. S R Reddy (2010). Kalyani publishers. Ludhiana.2. NARP status reports for different Agro-climatic Zones (1991). Bidhan Chandra Krishi Viswavidyalaya.3. Sahaj kathaybijnanbhittikchashbas. GosthtoNayban (2008). Ananda Agency, Kolkata**.**

EFFECTS OF PESTICIDES ON NON TARGET ORGANISMS EXCLUDING HUMAN

In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects like also disrupt the population of some of the valuable soil invertebrates like earthworms, predatory mites, centipedes and carabid beetles. In West Bengal (Table:1) there are cultivated huge amounts of agricultural crops. So uses of pesticides are also very high. As a result target species as well as non-target species are very much affected.

Effects on fish

Pesticides can enter into surface water as well as ground water from agricultural field and from those area where it is used. These different types of pesticides have different side effects. The DDT (Dichloro di- phenyl tri- chloro ethane) is often banned in India for agricultural used but still it is using in health safety purposes. These DDT can enter into the food chain and hampered the lifecycle of different living organisms. In ground water once the pesticides enter it stay for too many years and take many years to dissipate and also the cleaned-up mechanism is very complex and expensive (Waskom 1994; O'Neil, 1998; US EPA, 2001). In one survey in Bhopal (M.P.),58% of various drinking water sample from hand pumps contain Organo Chlorine pesticides above the EPA standards (Kole and Bagchi, 1995). In West Bengal different thirty-nine varieties of indigenous fish are found in the crop field during the rainy season. Due to uses of chemical pesticides like Cypermethrin (10% EC or 25% EC) in the crop field these fish population are decreasing very fast (Down To Earth, Nov.,2012). It also effects fish behaviour like increased frequency of surfacing and gulping of atmospheric air, decrease in opercular movement, change in swimming pattern and loss of body balance. The Ganga river Dolphin are most vulnerable animals which also affected by this pesticides pollution because this river is the close

proximity to point sources of the pesticide pollution. In China the Yangtze river dolphin (Lipotes vexillifer) and in Pakistan the Indus river dolphins (Platanista minor) are very close to extinction (Renjun, 1990; Perrin et al., 1989,; Reeves et al., 1991; Reeves & Chaudhry, 1998).

Effects on Amphibians:

Many pesticides are interfered with the bodys hormone work and trick our body like that they are hormones. They are also known as endocrine disruptors. These types of pesticides create hermaphroditic deformities in frogs. Due to permeable skin in amphibians the effects in pesticides are much more. The DDT, malathion, parathion, synthetic Pyrethroids like pesticides lead to the immunosuppressive effect, hampered the larval development, reduce the reproductive abilities, make many deformities in their body, decrease the growth rate and reduce the population.

Effects on Birds:

In birds population the effects of pesticides are very dangerous and due to this their population are declined very first and also varied. The agricultural practiced with chemical pesticides alone affects 87% of the globally threatened bird species (BLI,2008). The decline in avian population show a collapsing ecosystem (US FWS, 2002). The BHC used accounts for 40% in India for agricultural purposes and also it is used as a mosquito controlling programme. However, it is recently banned in India. But the effects are still present in the environment. Too many birds species are already been effected for the using of these pesticides like Baya weaver, Passer domesticus, Gyps indicus, Kingfisher Red wattled lapwing, Indian Comorant, Barn swallow, Indian pond heron, Indian openbill birds population became decreases. The Endosulfun is a neurotoxic pesticide which have very high to moderately effected pesticides. The pesticides effects their reproductive system, thinning their egg shell and hampered the calcium metabolisms. The Parathion stops egg production in quail birds and methyl parathion hampered the duration time of ovulatory cycles. Dicrotophos is used in cotton, has been shown to disrupt parental care of sterling nestlings and mother birds spent their time away from the nest. In 1984 in New york at least 5,120 Red winged black bird, Common Grackles and Brown headed cow birds were killed due to using of Parathion in a corn field and another story was from a breeding colony of laughing gulls near Corpus Christi, Texas, where Parathion was applied in a cotton field which was three miles away from the breeding ground. But the result was very awful. Nearly about 100 adult birds and 25% of the colony's chick were died. Some time pesticide exposure can effects the bird's singing ability which led to decrease the chances of successfully attracting a mate. More long-term research is needed on the effects of pesticides on bird population in India.

Effects on livestock:

Pesticide residues in livestock population the pesticides effects by two different ways i.e., either through direct application or through agricultural crops and fodder (Poppenga, 1999). Due to contamination of soil, water and crop, the pesticides enter into the body of the livestock and accumulated in the fat rich substances like milk and fat of the animals (John et.al., 2001). Due to this increasing concentration of pesticides present in milk and meat make a great concern for ensuring food safety and human health. The increasing incidences of pesticide residues in the meat and milk are of a great concern for ensuring food safety and human health.

Effects on soil microorganisms:

The pesticides effects on too many soil microorganisms which are good for soil and enhance the soil fertility and can last for years. It decreases the count of soil bacteria, fungi and the actinomycetes. It lead the poor production and also poor productivity of the soil. The butachlor reduced the Azospirillium and some other anaerobic nitrogen fixer in soil. The DDT, Methyl parathion, Pentachlorophenol reduced the nitrogen fixation in Rhizobium species. The 2,4-D also reduced the nitrogen fixation by the bacteria which live on the bean plant roots (Arias and Fabra, 1993; Fabra et al., 1997), it also effect the blue green algae and reduces the growth and activity of nitrogen-fixing ability (Singh and Singh, 1989; Tözüm-Çalgan and Sivaci-Güner, 1993), and that disturbs the soil bacteria which convert the ammonia into nitrates (Frankenberger et al., 1991, Martens and Bremner, 1993).

Effects on Honeybee:

In cropland farmers used variety of pesticides which are very harmful to honey bee. These pesticides are

enter from different sources like water, air and from different flowers to the honey bee which effect mainly the developing larvae and presumably the adult honey bees and the queen. The residues of pesticides from pollen and nectar are taken by bees and these pesticides residues are then enter to the larvae and adult queen at the time of fed.

CONCLUSION

As West Bengal is mainly agricultural based states so here pesticide used is much more. Different types of crops, vegetables, fruits, cereals are cultivated here. As a result the soil, water and air is polluted through this pesticides pollution. Here also lack of investigation on this topic and therefor so scanty of data on pesticide related illness among non-target organisms. Our target should include the investigation on what type of pesticides are being used, the cultivated products in this zone, out line different non target organisms who actually suffer from pesticide pollution and know the ultimately effect on the biosphere.

It is clear that the using of chemical pesticides in agricultural field harm too many non-target organisms. Different animal species, insects those who are good for environment and helps to run the food chain are very much affected like honey bee, locust, earth worm, birds, fishes etc. The pesticides play a valuable role in controlling the weeds, pathogens, different insect's pathogen and many other pests and at the same time different insects or pests gain the resistant power for using of excessive, unplanned pesticides in farmlands, for health purposes and for domestic purposes. Sometime the users not follow the directions and applying concentration, to use of pesticides which are very dangerous to environment. The chemical pesticides also decline the honey productivity, the soil health and also hampered the food chain.

So it is very necessary to ensure the farmers about the using of pesticides and provide them some govt. and NGO sponsored training programme about the using of pesticides and their related side effects on environment. There is needed some management technique for successful beekeeping. A regular interval of monitoring programme including air, water, soil, different non-target organisms, is needed in the farm land area and also by the help of govt. There needed to practice of IPM, Biopesticides, organic farming, crop diversification in the cultivated region.

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