PESTICIDES USE IN QUESTION: AN INDIAN PERSPECTIVE

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India since earlier times has been the land of organic farming. But with the advent of the green revolution, the use of fertiliser and pesticides has increased manyfolds. On one hand, it has helped in increasing the yield but on otherside, the consequences are such which cannot be neglected. This modern agriculture practice has led to degradation in soil fertility, contamination of water, pollution of air and has affected the health of farm workers. Pesticides were predominantly designed to kill pests and they have no doubt succeeded in it. However, they have also poisoned the environment. The darker side of the extensive use of chemicals is now showing results, as pests are becoming immune to these chemicals day by day and therefore there is a requirement for extra strong chemicals which are far costlier. One side effect is the pressure of indebtedness on farmers, which is one of the reasons for farmer suicide. The over reliance on chemicals and their uncontrolled use have indubitably done a great deal of damage and if not checked now, in the longer run the situation could get even worse. Using secondary data, the article reviews the ailing effects of pesticide on soil, water, food and farm workers. The article also suggests some solutions and recommendation followed by a concluding remark on the topic.

Keywords: Agriculture, Pesticides, Chemicals, Pollution, Soil fertility

Introduction

Agriculture has always been the backbone of India and has contributed to the country's progress. With population increasing and agricultural lands diminishing this sector has come under severe stress. There is an immense pressure on the sector to perform. In the past pesticides and fertilisers came to the rescue by acting as a catalyst in stabilising higher yields gained through the use of hybrid seeds. This was the era of Green Revolution but the aftermath has changed dramatically. Perhaps, the side effects of pesticides are quite evident. Hence the attraction towards the pesticides is slowly disappearing.

According to the Directorate of Plant Protection, Quarantine and Storage, the use of pesticides has reduced in recent years because of practices of IPM (Integrated Pest Management), use of bio-pesticides (Neem) and few others (Statistics of Pesticides, 2010). There are several types of organisms which are useful for farming and therefore pesticides have to be very specific about their targets like insecticides, fungicides, rodenticides, herbicides and few others.

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In the 1960s the circumstances were such that country needed Green Revolution and as early as possible since food security was need of the hour but today circumstances have changed perhaps that why M S Swaminathan father of green revolution feels that there is a need of evergreen revolution since “Green revolution has some repercussion like overuse of pesticide and now focus should be given on continuous improvement of productivity without harming ecology. That can be done through organic farming or green agriculture” (M. S. Swaminathan calls for sustainable farm practices, 2013). This is the reason why there is a need to have more research and studies about pesticide and its effect. Surprisingly the adverse effects of pesticides are in public domain still the regulatory and monitoring bodies fail to take any concrete measures.

The rising cases of brain ailments and other acute chronic disease in recent years are also due to the adverse effect of pesticides (Abdollahi, Ranjbar, Shadnia, Nikfar, & Rezaie, 2004). Astonishingly, about fifty thousand children in Kerala are currently affected by various cancers due to the use of lethal pesticides which are banned in various countries (Laxmi, 2016). According to WHO estimate every year 3 million cases of acute pesticide poisoning occur globally (Mittal, Kaur, & Vishwakarma, 2014).

One thing which corporate has been doing since long but keep tight-lipped when asked is that they give incentives, lucrative offers like a foreign trip to dealers and distributors for selling their pesticides for completing the set target but on the face of this they hide the stark truth from innocent farmers about the health hazards of these pesticides. These days this unethical practice has gone to next level and nowadays even farmers are given a gift to use the particular pesticides (Jagga, 2013). These incidents depict the ugly picture of mischief happening due to pesticides. It is quite perceptible that pesticides uses have gone wrong and there is a need to have the curative measures. Therefore, this article not only presents an overview of pesticides use in India and its impact on soil, groundwater, and farm workers, but also tries to give some corrective measures (recommendations). The history of pesticides is presented with the series of events which led to their discovery, and some primitive methods used in place of pesticides in ancient times are mentioned.

**Objective and Methodology**

The objective of the paper is to study the repercussions of extensive pesticides use. The paper portrays the impact of pesticides on soil, groundwater, food and farm workers. Since the adverse effects of pesticides are quite evident these days, therefore, it becomes essential
to study its side effect. Overall the article tries to critically review the excessive pesticide used in agrarian activities these days with a major focus on the harmful effect it has created. Mainly secondary research has been conducted to develop this paper where different articles, journals, websites, government report and other sources have been referred.

**History of Pesticides**

The roots of agriculture practice can be traced back to 12,000 years ago through the pottery, tools and seeds that have been uncovered in archaeological findings. Humans have been around much longer than that and for subsistence, they were dependent on hunting. Since hunting was a risky and exhausting process slowly evolution of farming as a form of agricultural practice for survival took place. Several theories try to address the rationale behind the gradual change in living style of earlier human beings like domestication theory, oasis theory and few more and all these theories state that there is no single factor which leads to this phenomenon. It is also believed that the change in climate at the end of the ice age brought a favourable condition for farming.

As the time passed agricultural practice got better and better and has gone through numerous modifications and transformations. In a recent finding of the University of Oxford, School of Archaeology it came out that manure was used as a form of fertilisers in farms as early as 8,000 years ago (School of Archaeology, 2013). Manure has also been mentioned in some of the ancient text like Krishi-Parashara (Tamboli & Nene, 2005) and Odyssey (Rebsdat & Mayer, 2012). Harappans were the early settlers in India who use to practice farming along the banks of River Saraswati. As the society flourished the farming extended to other areas particularly along the banks of River Ganga. The importance of manure was well known in ancient India. Milk, cow dung, animal bones, fishes were used as manure. Initially, salt, sea water and smoke were used to ward off the pests. Mesopotamians were the first to use sulphur compound as pesticides although it was not used in farms (Unsworth, 2010) Greek and Romans were the ones who started using chemical methods to control plant diseases and weeds (Unsworth, 2010). This was the beginning of chemicals used for pesticides in farms.

Agriculture has a huge dependence on nitrogen for its various processes like nitrogen fixation, photosynthesis etc, therefore, nitrogen is also called the engine of agriculture. However, the form of nitrogen present in the atmosphere does not help the crops in fulfilling their nutrient needs hence there was need of a suitable form of nitrogen (Nitrate). This was well achieved in the beginning
of the twentieth-century when a chemist, Carl Bosch developed the Haber process to utilise the atmospheric nitrogen to synthesise ammonia. Later on, the Oswald process was developed by Wilhelm Oswald which revolutionised the chemical industry and this event could be marked as the genesis of fertilisers. In the year 1948, Dr Paul Muller won the Nobel Prize for discovering the insecticidal properties of DDT (Dichlorodiphenyltrichloroethane) and this was how the origin of pesticides came into being. DDT was used at large scale in WW II for controlling malaria among troops. After the war, it was used as an insecticide in agriculture and since then its use has been enhanced tremendously.

Pesticides are been used in India since 1948 and their production started in 1952 with the help of a manufacturing plant near Kolkata (Bhardwaj & Sharma, 2013). In the era of the 1960s use of pesticides in India increased enormously. This was the phase of green revolution when HYV (High Yielding Variety) of seeds were used and as these seeds were more receptive to pesticides and fertilisers the use of chemicals amplified. Since then the consumption of pesticides in India has grown at an astonishing pace.

**Pesticide Use in Question**

The first recorded death from pesticide in India comes from Kerala back in 1958 due to consumption of pesticide contaminated flour (Bhardwaj & Sharma, 2013). There are other series of event in India like MIC (Methyl Isocyanides) Disaster in Bhopal, Endosulfan case in Kerala and in recent past the death of 30 children in Saran district of Bihar which has brought pesticide use in question (Bhardwaj & Sharma, 2013). Pesticides were once considered a blessing for agriculture but have slowly come to be seen as more of a curse on it. Globally many deaths occur due to cases of pesticides poisoning. These deaths due to pesticides and its adverse effect on environment and health have raised some eyebrows and there is the big question on its use. Is it justified to use pesticides to amplify yield with an adverse effect on ecology? The answer may seem easy with the numerous ailing effects evident these days. The challenge today is not only to reduce but to completely remove the pesticide use. There is a hidden opportunity for the researchers and scientist to come up with innovative solutions to the problem. The challenges may seem immense and mounting task but the reward to overcome these challenges is far more fascinating. There have been campaigns in the past to ban the use of poisonous pesticides and questions have been raised in the Indian parliament to address this issue. The future of the pesticide industry and the use of pesticide in agriculture do not look very bright.
Impact on Soil

The intensified use of pesticides is a common practice in agriculture these days and it has not only polluted the soil but has also affected its fertility. This pollution is not the only threat to micro-organisms residing in soil but also to the ecosystem. Uses of pesticides and fertilisers are also one of the factors of deficiency in micronutrients content of the soil. A prominent example of loss of micronutrient and fertility of soil comes from the state of Punjab (Khajuria, 2016). Deficiency of Zn (Zinc), Mn (Manganese) and Fe (Iron) in soil is a most widespread problem in Punjab (Sadana, Manchanda, Dhaliwal, & Singh, 2010). According to soil scientist Dr Elaine Ingham “Historically, soils have not received the respect nor the attention they deserve. Mechanical and biological processes have not been as well understood as they need to be because the green revolution has masked the severity of the crisis” (McCabe, C-L & Bartram, 2015).

As the Government of India is aiming for a second green revolution in eastern Indian, therefore, a healthier soil becomes quite a necessity. Perhaps the government is rather keen this time not to repeat the mistakes made earlier, therefore, a scheme on soil health was launched in February 2015 with the aim to help farmers to improve productivity with the judicious use of inputs (Damodaran, 2015). Soil health card carries recommendations for fertilisers and nutrients for every individual farmer. In order to maintain a healthy soil and to obtain better nutrient and higher yields, awareness of soil health is essential. This will also help in reducing the uses of pesticides and fertiliser.

Impact on Groundwater

The importance of groundwater, mostly used for drinking and irrigation purpose, cannot be denied in India. But what would happen if this groundwater is not fit for drinking? Do we have another source or are we prepared to search for one? The answer to this question is hard to find and the present scenario does not seem positive. When we look at the reports on groundwater the ugly picture of our menace and negligence comes into open. The groundwater has been contaminated by nitrates. Pesticides are one of the major sources of this nitrte contamination. Eleven states have nitrate concentration above the maximum permissible limit of 45 ppm (Parts Per Million) (Kumar & Shah, 2006). In a study by the Central Pollution Control Board on the quality of groundwater in India, the ugly truth of contamination of groundwater by pesticides is revealed: in some states the percentage of contamination by pesticides discharge or leaching is low in comparison to others states. Perhaps this may not look like a problem today but it is slowly mounting to be one
As it is well known that we use a good amount of pesticide on our farm, hence there is a chance of it to leach deeper into the earth and pollute the groundwater. One of the examples comes from West Bengal “In the Howrah district, the groundwater in many areas are unfit for drinking mainly due to high pesticides contents in it” (Chakraborti, Das, & Murrill, 2011, p. 28). The groundwater is not only polluted by nitrates but fluorides, arsenic and lead mainly due to industrial discharge and some other activities. This problem of groundwater contamination is like an underground time bomb ticking which could explode into an epidemic at any time. Hence if control and monitoring measures are not taken the health of people is bound to get affected. Although the government seems to be concerned, its actions are presently not concrete enough.

### Number of States and Districts where chemicals in groundwater are beyond BIS norms

<table>
<thead>
<tr>
<th>States/Districts</th>
<th>Nitrate</th>
<th>Arsenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of States</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>Total number of Districts</td>
<td>387</td>
<td>86</td>
</tr>
<tr>
<td>Total</td>
<td>387 Districts in 21 States</td>
<td>86 Districts in 10 States</td>
</tr>
</tbody>
</table>

*Source: Central Groundwater Board, 2014 *  
*BIS=Bureau of Indian Standards*

When pollution or contamination of groundwater by nitrate and arsenic is considered, anthropogenic activities play a major role. Agricultural activities are the prime contributor to anthropogenic activities where the use of pesticides, herbicides and insecticides are the major sources of contamination.

### Impact on Food

When crops are treated with pesticides then there are chances that pesticides remain in the final product and enter our food chain. To have a check on the residue of pesticides an MRL (Maximum Residue Limit), ADI (Acceptable Daily Intake), and TMDI (Theoretical Maximum Daily Intake) have been devised. As the name suggests, MRL is the maximum pesticide residue which may be expected in a food product when good agriculture practice is followed. Whenever there is need “Indian parliament sets up a joint parliamentary committee on the critical issue of public interest. Out of five parliamentary committees formed in independent India one was on pesticides residue which shows the severity of pesticide residue problem” (Bhushan, Bhardwaj, & Misra, 2013). But unfortunately the JPC (Joint Parliamentary Committee) was not taken seriously and its recommendations and mandates were not followed properly.
Out of the total pesticides registered in the country, FSSAI (Food Safety and Security Authority of India) has not set an MRL for 59 pesticides (Bhushan, Bhardwaj & Misra, 2013). This makes the policy makers and law making bodies helpless if they want to bring any change in regulation. Table 1 shows the percentage of food samples having residues above the prescribed MRL. In the year 2011-12 only 1.7% of the samples were above MRL but in the subsequent years, it has risen to a maximum of 3% in 2013-14. Although the percentage has reduced in the next year but it still remains at 2.6%. If this steady increase remains then we won’t be able to prevent our food chain from these contaminated foods from entering.

Table 1. Year Wise Details of MRL in Food Commodities Analysed

<table>
<thead>
<tr>
<th>Year</th>
<th>Samples* Analysed</th>
<th>Samples above MRL</th>
<th>Percentage of Sample above MRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12</td>
<td>16,948</td>
<td>290</td>
<td>1.7</td>
</tr>
<tr>
<td>2012-13</td>
<td>16,494</td>
<td>436</td>
<td>2.6</td>
</tr>
<tr>
<td>2013-14</td>
<td>16,790</td>
<td>509</td>
<td>3</td>
</tr>
<tr>
<td>2014-15</td>
<td>20,618</td>
<td>543</td>
<td>2.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>70,850</td>
<td>1778</td>
<td>2.5</td>
</tr>
</tbody>
</table>

*Sample=Food Commodities (Vegetables and Fruits)
Source: (Kumar & Balyan, 2016), p. 3

Impact on Farm Workers

As it is well known that pesticides are poisonous in nature hence direct exposure could be harmful to health. Farm workers are the ones who are at maximum risk. A significant case of farm workers getting ill due to pesticides has been reported in Malwa district of Punjab (Mittal, Kaur & Vishwakarma, 2014). A considerably high number of cancer cases have been seen in this area. The study reveals that not only cancer but other diseases have also come into limelight. The irony of pesticides effects is that now this place is known as cancer capital of Punjab. During the year 2001-02 deaths that occurred due to pesticides poisoning in the month of June totalled 21% of total deaths. “According to the report of India’s Department of Health and Family Welfare (DHFW, 2013), the cancer prevalence (per million) in the Malwa region is 1089 which is much higher as compared to India’s national average cancer prevalence (800/million)” (Mittal, Kaur & Vishwakarma, 2014, p. 379). Since 2001 there is an increase in the number of cancer cases. The other states like Kerala and Andhra Pradesh (Rao, 2016) have also reported cases of cancer due to pesticides have been reported. The situation does not seem good and the regulation of pesticides has never been taken seriously.
The government has neglected the monitoring of pesticides use in farms in the past. Time has arrived to take some bold steps or it would be too late.

**Solutions and recommendations**

Pesticides have slowly contaminated our ecosystem, therefore, there is need to come up with an alternative solution sooner than later. Surprisingly we have several innovative solutions in use today some are traditional and others are modern. The modern technique comes from Israel where they have developed a predator pest and the traditional one comes from India which is cost effective and could be used by the poor third world countries.

**Crop Rotation**: Alternating different crops one after another throughout the year can help in warding off the pests. This helps in preventing the pest to get used to one type of crop if cultivated rotationally rotation. It not only protects the plant from pests but also helps in enhancing the soil fertility if different crops are grown in different seasons. Planting legumes, a plant that helps in enhancing the level of a macro nutrient (Nitrogen) through nitrogen fixing bacteria that resides in the roots, and after these planting crops that require a high degree of nitrogen will help in making sure that soil is healthy every growing season. And a healthy soil helps in fighting with the pests (Mohler & Johnson, 2009).

**Intercropping**: A unique technique to simultaneously cultivate two or more crops on the same field. It works in a way that pests are attracted away from the host crop. Kenyan farmers have designed a “push-pull” intercropping method that cultivates plants that repel pests i.e. pushing them away from the host crop and ones that attract pests i.e. pulling them away from the host crop. The farmers in Kenya grow maize with two types of cereals, one that helps push pests away from the maize, and another that pulls pest away from the maize. This method has helped to reduce the impact of the devastating maize stem borer and increase crop yield (Khan, Amudavi, & Pickett, 2008).

**Crop Diversity**: Crops can be protected from pests by having a rich farm biodiversity. If a large variety of fruits, vegetable and crops are grown on the farm then these plantations are less susceptible to the pest. Generally, it is seen that pests attack more or less on monoculture type of farms where a lot of food is available. It also enhances the yield; keep the nutritional diversity and health. It is an environmentally sound method to control the pest which also helps in checking the soil fertility.
Using Pest against Pest: This method uses pest to kill the pest. Predator pests are grown in the farm to kill or keep away the pests which are the possible threat to crops. The most prominent example comes from Israel the Bio Persimilis mite (Predator Pest) which is found in Israel. It works on mites that attack potato, tomato, cucumber, strawberries etc. This creature acts as a predator for pest on farms and is most fancy among the strawberries farmers of California. These bugs are shipped in a bottle of 2000 or 4000 to more than fifty countries now. Although the side effects of these bugs are not known yet hence it will be premature to talk about the benefits of this pest control method.

Organic Pesticides: Organic pesticides are not only healthier for people and the environment but they allow farmers and producers to make the most out of their resources by turning agricultural outputs into natural pesticides. It is a pest control method which compliments nature and is eco-friendly. Neem leaves, timur, garlic, livestock urine are some of the prominent examples of Organic pesticide.

Time Dilation: In order to control a certain insect pest, the practice of early planting can be done so that as the time comes for the pest to attack the crops, most of crops have outgrown the stage of the attack. This could help in the protection of crop from certain pests.

Light Traps: This is one of the traditional methods being used in India to kill pesticides and as these indigenous methods which were more sustainable are slowly getting obsolete we need to revive them. In this method of light trapping, pests get attracted to light trap at night and then fall into their watery grave below which is a pail of water mixed with kerosene.

Conclusion

The future historians will be amazed to know that for killing of few unwanted species we contaminated the whole environment. That is why Rachel Carson in her Classic book “Silent Spring” says that “The chemical war is never won and all life is caught in its violent crossfire” (Carson, 2002, p. 8). The greatest weaknesses of Indians are food but have we ever thought that the food we are consuming today has been adulterated with pesticides. We are blindly ingesting these cocktails of poisonous chemicals. The amount of pesticide in our food is way more than an average American or a European diet. Humans have been most affected by pesticides. Hence let us not pass on this pesticide poisoning to our next generation. Since the effects of these chemicals on the environment are not evident that easily, perhaps that is the reason why we fail to check on their adverse
effect until a threshold level is reached. Agriculture production is possible without using any pesticide and we must work towards building the world without pesticide. The pesticide-free world is definitely a possibility but the only needed is commitment and desire. We all now know that we have that power to destroy nature but instead, can we use nature to help us live a sustainable life. So the question is do we want this country to be a sick nation or a healthy one? The choice is ours. This frightening truth about the poisoning of India may not have easy solutions but the longer we take to find solutions the shorter will be our lives.

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