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This chapter discusses the need for agricultural importance for which extensive use of pesticides has become mandatory, which had led to the degradation of the environment and to the hazardous implications on human health. Further, the necessity to introduce Bt-cotton, its eco-friendliness, the benefits rendered to the cotton growers were presented in this chapter. Besides, the objectives lay down to conduct the research, hypotheses expected, scope and limitations of the study along with the organization of the study were also depicted in detail.

1.1 Agriculture pesticides and environment

Agriculture is one of the most ancient and significant sectors of India, the only means of living for almost two-third of the employed class in India. It has occupied almost 43 percent of India’s geographical area. It is still an important contributor to India’s Gross Domestic Product (GDP) even after a decline in agriculture share and still plays a vital role in the growth of socio economic sector. With a vast population base and it’s growing demand for food needs, the related burden on agriculture has increased severely extract more agricultural productivity.

As agriculture evolved into a more productive activity, it became more energy-intensive too. Since agriculture is closely associated with the environment,
it has a major impact on land use, soil, water biodiversity and the landscape and the intensive agriculture has disrupted ecological balance. In the process of extracting higher productivity on par with the growing demand, the varieties of crops chosen, though highly-yielding, were found to be prone to epidemic diseases. To protect the crops from the epidemic diseases caused by pests and diseases, it is compiled to use large quantities of pesticides and insecticides.

The widespread use and disposal of agriculture pesticides by farmers, large plantations and the general public causes environmental contamination. It is estimated that the 68 percentage of such contamination is a result of agricultural uses, followed by industrial and commercial uses (17 percentage) and home and garden application (15 percentage). Following release into the environment, pesticides may give rise to different consequences on environment. Pesticides which are sprayed can become airborne and may eventually end up in soil or water. Pesticides applied directly to the soil may be washed off the soil into water or may percolate through the soil to lower soil layers and ground water.

The application of agriculture pesticides directly to bodies of water, for weed control or indirectly as a result of run-off from soil or other routes, may lead not only to the build-up pesticides in water, but also cause pollution to the air through evaporation. As these pesticides may be broken down or degraded by the action of sunlight, water or other chemicals or microorganisms, this degradation process usually leads to the formation of less harmful residues but in some
instances can produce more toxic and hazardous products. The pesticides become resistance to the degradation by any means and thus remain unchanged in the environment for longer periods of time. The ones that are most rapidly broken down have the shortest time to move or will otherwise have a diverse effects on humans or other organisms. The ones which last the longest, the so-called persistent pesticides can build up in the environment leading to greater potential for adverse effects on human population.

Living organisms play a significant role in the movement of pesticides in the environment. This is particularly important for pesticides which can accumulate in living creatures. Despite this complexity, it is possible to identify situations that can pose concern and to try to minimize them. However, there are significant gaps in the knowledge of pesticides movement in the environment. So, it is essential to regulate unnecessary release of pesticides into the environment.

As a result of decades of high pesticide application in agriculture crops, the environment has been degraded, causing severe damage to the structure and function of ecosystems. In addition, the economic loss incurred as a result of environmental pesticide pollution is enormous. Many of the pesticides used are highly toxic resulting in tens of thousands of users being injured or dying every year. Consequently, it is essential to prevent pesticide use to improve the environmental conditions, to increase the knowledge of the farmers about
disadvantages of pesticide, so as to regulate the pesticide pollution of the environment.

1.2 Usage of agricultural pesticides in India

Green revolution in India was ushered with the increased use of pesticides and increased input of agricultural fertilizers and using better farm techniques. In spite of increase in food production, many of agriculture farmers of India are not aware of the environmental hazards occurred due to usage of pesticides. The farmers of India are using one-third of pesticides that are consumed in third world countries and it is 25 percentage of its agricultural lands (Satyavelu Reddy, 1985). The undue persistence, high toxicity and developing resistance of the Organo Chlorin, Organophosphate and Carbonate insecticides led to ban or restrictions on their use in many developed and developing countries including India.

The usage of pesticides in India began in 1948 when Dichlorodiphenyl trichloroethane (DDT) was imported for the control of malaria and Benzene heaxachloride (BHC) for locust control. India started pesticide production with manufacturing plant for DDT and Benzene Hexachloride (BHC) in the year 1952. India produced over 5,000 metric tones of pesticides. In 1958, there were approximately 145 pesticides were registered for use, and the production has increased to approximately 85,000 metric tones annually. During financial year 2007, India ranked second in Asia (behind China) and twelfth globally in
pesticide production. In value terms, the size of the Indian pesticide industry was estimated at 74 billion for 2007, including exports of 29 billion.

1.3 Effects of usage of agricultural pesticides on environment

Over 98 percentage of pesticides sprayed and 95 percentage of herbicides reach a destination other than their target species, including non target species such as air, water, bottom sediments, and food (Miller, 2004). Pesticide contaminates land and water when it escapes from production sites and storage tanks, when in runs off from fields, when it is discarded, when it is sprayed aerially, and when it is sprayed into water to kill algae (Tashkent, 1998). The amount of pesticide migrated from the intended application area is influenced by the particular chemical’s properties, its propensity for binding to soil, its vapor pressure, its water solubility and its resistance to being broken down over time (Kelloggs et.al., 2000). Factors in the soil, such as its texture, its ability to retain water, amount of organic matter etc., are the key factors that influence the pesticide contamination level. Some pesticides contribute to global warming and the depletion of the Ozone layer adversely (Reynolds, 1997).

1.4 Effects of usage of pesticides on human health

World Health Organization (WHO) reported that pesticides use caused 3.5 to 5 million acute poisonings a year with about 20,000 workers dyed from exposure every year, most of them in developing countries. Recent studies
predicted that the actual deaths might be around 3, 00,000 (Gunnell and Eddleston, 2003 Buckley et.al, 2004 Srinivas et.al, 2005). Residues in air, water and foods, have led to much more concern over the undesirable effects on environment and human health (Al-Saleh, 1994). Exposure to pesticides both occupationally and environmentally causes different types of human health problems. It is estimated that approximately 10,000 deaths annually due to use of chemical pesticides worldwide, with about three-fourths of these deaths occurring in developing countries (Horrigan, 2002).

A vast majority of the population in India (56.7 percent) was engaged in agriculture and was therefore exposed to the pesticides used in agriculture (Gupta, 2004). Pesticides being used in agricultural tracts are released into the environment and come into human contact directly or indirectly. Human beings are exposed to pesticides present in environmental media (soil, water, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. Exposure to pesticides results in acute and chronic health problems. The severity ranges from temporary acute effects like irritation of eyes, excessive salivation to chronic diseases like cancer, reproductive and development disorders etc (Yassi, et.al., 2001). Oluwole et.al., (2009) observed that commonly used pesticides comprised of herbicides (48.3 per cent), fungicides (28.2 per cent) and insecticides (23.5 per cent). Of these, 86.7 percent are classified as ‘highly’ hazardous by the World Health Organization (WHO) and have been banned or restricted in many developed countries. Most of the agriculture farmers (94.7
percent) had received no formal training on safe pesticide use and mixing of different products. Farmers suffered from discomforts ranging from eye irritation (91.3 percent), skin problems (87.3 per cent) nausea (86.0 per cent), headache (83.3 percent) and vomiting (58.0 percent).

There is a dearth of studies related to these issues in India. A study which looks into the health effects of acute pesticide among the cotton growers of India dealing with the agricultural practices of the farmers regarding pesticide use and their health impacts is required to make informed policy decisions to bring about changes in the agricultural practices in India (Mancini et al., 2005).

1.5 Benefits of Bt-cotton farming

Bacillus thuringiensis cotton (Bt cotton) is produced by inserting a synthesis version of a gene from the naturally occurring soil bacterium Bacillus thuringiensis, into cotton plant. The primary reason is to induce the plant to produce its own Bt toxin to destroy the bollworm a major cotton pest. The gene causes the production of Bt toxin in all parts of the cotton plant throughout its entire life span. When the bollworm ingests any part of the plant, the Bt-cotton toxin pierces its small intestine and kills the insect. Bt-cotton contains a foreign gene cry 1AC obtained from Bacillus thuringiensis which is an aerobic bacterium characterized by its ability to produce crystalline inclusions during sporulation. Bt-cotton being a transgenic plant, produces an insect controlling protein, the gene for which has been derived from the naturally occurring bacterium Bacillus.
thuringienesis sur sp Kurstaki (B-E-K). This bacterium was first discovered by Japanese bacteriologist in 1901 and subsequently in 1915, a German scientist isolated the crystal toxin in Thuringien region of Germany. Bacillus Thuringiensis was registered as a microbial pest control agent in 1961 under the Federal insecticide and rodenticide act in the United States of America (U.S.A). With the advent of bio-technology, this bacterial gene had been introduced genetically into the cotton seeds, and it protects the plants from bollworms, a major pest of cotton. The worms feeding on the leaves of a Bt-cotton plant become lethargic and sleepy and are gradually eliminated. The cotton hybrid containing BT gene produces its own toxin for bollworm attack thus significantly reducing chemicals insecticide use and providing a major benefit to cotton growers and also to the environment.

The introduction of transgenic crops in 1996 had been a substantial increase in the area of cotton cultivation (Chaturvedi, 2002). The Monsanto Company of USA developed Bt-cotton is one of the widely grown transgenic crops. It is currently grown in a large number of countries, including United States of America, China, India, Australia, Argentina, South Africa and Indonesia. Bt-cotton farming has spread very rapidly in China had reported positive experience with Bt-cotton. There is a good demand from the formers since it reduced the cost of pesticide application as well as the exposure to pesticide. In China, the Government of China had played a major role in providing Genetically Modified (GM) technology to the formers (Pray et. al., 2002).
1.6 Bt-cotton farming in India

In India, Bt-cotton formulations have been registered under Pesticides Act, 1968. The ministry of Environment and Forest had notified the rules for the moisture, use import, export and storage of hazardous micro organisms under the Environmental Protection Act, 1986. Genetically Engineered (GE) organisms or cells, 1989, notification issued by the ministry of Environment and Forest under the Environment Protection Act, 1986, the areas of research in large scale application of Genetically Modified Organisms (GMOs) and products made their from throughout India.

Based on the recommendation of review committee for Genetic Manipulation (RCGM), the Genetic Engineering Approval Committee (GEAC), in its 32nd meeting held in New Delhi on 26th March 2002, approved Mahyco’s Bt-cotton for commercial cultivation, pronouncing it to be safe and beneficial. This was a landmark decision as Bt cotton happened to be the first ever agricultural biotech product to receive official approval and with it India made its long awaited entry into commercial agriculture biotechnology. This approval has specified three Bt -hybrids viz Mech 12, Mech 162 and Mech 184 which had undergone all the trials and it was initially granted for three years. With the advent of the Integrated Pest Management (IPM) technique, the use of bio pesticides and Genetically Modified (GM) seeds have increased. Use of GM seeds might diminish the use of insecticides but the use of herbicides may improve.
Globally, GM seeds are used mainly for commercial crops like cotton, maize, soybean and canola. In India, Bt cotton is widely used and the acreage stood at 6.20 million ha for 2007, a growth of 63 percent over the previous year.

1.7 **Statement of the problem**

The present study has been conducted to find out

1) Whether the farming of Bt-cotton is eco friendly?

2) Whether the farming of Bt-cotton has reduced the usage of pesticides?

3) Whether the adoption of Bt-cotton farming has accorded benefits to the farmers towards health problems?

4) Whether Bt-cotton farming has improved the socio-economic status of the farmers?

1.8 **Objectives of the present study**

The objectives of the present study are as follows:

1) To evaluate the environmental benefits of Bt-cotton farming.

2) To study and estimate the pesticides usage pattern in Bt-cotton farming.

3) To analyse the impact of pesticide usage on human health and assess the same in Bt-cotton farming.

4) To assess the socio-economic benefits of Bt-cotton farming.
1.9 Hypotheses

The following hypotheses have been adopted in light of the above objectives.

1) Bt-cotton farming will result in positive environmental effects and prevents the environmental pollution.

2) The use of pesticides will be reduced after the introduction of Genetically Modified (GM) seed in cotton farming.

3) Introduction of Bt-cotton will conserve and protect the health of the farmers from hazards caused by pesticide usage.

4) Bt-cotton farming affords to increase the yield and improve socio-economic status of the farmers.

1.10 Scope of the study

This study is proposed to analyse the adoption of Bt-cotton farming improves the eco friendliness and conserves the environment. The scope of the study is limited to assessing the benefits gained by the Bt-cotton farmers in Guntur district of Andhra Pradesh through farming of Bt-cotton. Further, this study estimates the socio-economic standards of the farmers to find out whether there is any improvement in their living standards and hygienic health after adopting Bt-cotton practice. Thus the scope of the study is limited to the study on Bt-cotton cultivation and its cultivators in Guntur district, Andhra Pradesh India.


1.11 Limitations of the study

The primary data pertaining to the environmental, health and socio-economic standards of the Bt-cotton farmers were collected through a field survey, conducted amongst the sample farmers and the information extracted from them. Since this method involves memory base, intensive care has been taken to obtain information accurately to a possible extent. However, all these involves human memory base.

The secondary data was collected from government offices, documents and published works, journals and other citation reports that includes both published and unpublished including E-based information.

1.12 Organization of the study

The outline of the thesis is as followed: It consists of 5 chapters and the details of which are presented in individually refer to the prominent of focal contents of each chapter.

Chapter one emphasizes the need for the increased agricultural produce and the necessity of using toxic pesticides and fertilizers to increase agricultural produces. At present, the need for higher produces has compelled the farmers to use pesticides extensively. The extensive use of pesticides has done hazardous damage to environment and human health was also presented in this chapter. Further, the introduction of Bt-cotton in India and the adoption of Genetically Modified (GM) seed in cotton farming are also precisely discussed. Different
aspects of research study such as statement of problem, objectives and hypotheses of the study were presented. Besides, the scope and limitations of the study and organization of the study were also presented in the chapter 1.

It is necessary to review the previous works on the similar aspects by the researcher and take in their perception and views into consideration for conducting the research further. Hence, in depth review of literature has been carried out and these reviews were presented in the chapter 2.

Appropriate and strategic design and methodological plan is mandatory to probe deep into the problem of the research study. Hence, the procedural steps, such as, research design, locale of the study, sampling procedure, variables and their measurements, construction of interview schedule, methods of collecting data and statistical tools used to accomplish the objectives laid down for the investigation were presented vividly in the chapter 3.

Chapter 4 deals with the results and discussion obtained from the analysis of the primary data and the secondary data, and the primary data, pertaining to the problem of the study. The results obtained in the present study were discussed critically and compared these findings with earlier researchers.

A brief summary of the research work besides conclusion and suggestions were presented in the chapter 5. This chapter summarizes the findings of the present study conclusions drawn, suggestions for further research were depicted in detail.