In the thirst of modernization and industrialization man has contributed pollution to the life and ecology of plants, animals and microbes. Increased demand for food and fiber has led to the chemicalization of agriculture and we have reached on such a stage that modern agriculture is dependent on high yielding varieties, which can only be grown under the influence of fertilizers and pesticides. Pesticides are the man made chemicals which are being used to produce enough cheap food. In India, 90,000 MT of technical grade pesticides are used annually to control pests and plant diseases. The pesticides are classified as insecticides, fungicides, weedicides, herbicides, nematocides and rodenticides; of which insecticides constitutes 77% of the total pesticides used in different agricultural and animal husbandry practices and in public health operations.

Majority of these pesticides are beneficial when used for specific purposes, handled properly and applied as per the recommendations of the manufacturer. However, over the years, there has been a mounting fear and concern that indiscriminate and improportionate use of pesticides may lead to their residues in food chain which may exert their harmful effects in human beings and animals. In an ideal pesticide application, the chemical should fall exactly on the target and be degraded completely to harmless compounds but this never occurs and only some part of the pesticide hits the target pests while remaining drifts into the environment. If we look retrospectively, we find that the use of pesticides started during Second World War when these hazardous and toxic poisons were considered as chemical weapons. A Swiss scientist Paul Muller invented DDT in the year 1939 which was considered as a wonder chemical that kills the insects, pests and was found wonderful in malaria control programmes. But soon after the discovery of DDT, its harmful effects also came into the knowledge of the scientists. In 1944, a famous biologist found harmful effects of DDT in birds, which produced thin shelled eggs, easily broken in nests resulting into failure of reproduction and decline of bird population.

The amount of pesticides used in India is very low (only 0.5 kg/ha) as compared to other developed countries (Japan 12 kg/ha), even then we have much higher pesticide residues in food of our country. There is a gradual increase in production and consumption of pesticides during last few decades. The pesticides consumption increased from 2353 MT during 1955 to 75033 MT (technical grade) in the year 1991-1992 and which is again in the decline phase with the adoption of integrated pest management practices and the pesticides consumption level declined to the level of 43020 MT (technical grade) in the year 2003-2004. About 20% of Indian food products contain pesticide residues above tolerance level compared to only 2% globally. No detectable residues are found in 49% Indian food products compared to 80% globally. It is all because of following reasons which needs to be looked in order to reduce the level of pesticide residues in animal products and other food materials below MRL value. The MRL values of different pesticides viz. Aldrin/ Dieldrin, Benomyl, Carbendazim, Chlorpyriphos, Carbofuran, Chlorfenvphos, Cypermethrin, 2,4-D, DDT, Edinfenphos, Ethion, Fenthion, Fenvalerate, Fexachloricyclohexane (HCH), Lindane, Monochrotophos, Phenthioate, Primiphos methyl, Carbofuran, Phenthoate in meat and eggs ranges from 0.01 to 7.0 ppm.

Reasons for more pesticide residues in India

1. **Indiscriminate and Improportionate use of pesticides:** The use of pesticides is comparatively more in certain crops while in some it is negligible. The farmers use pesticides more frequently and in increased doses than the recommended doses or procedures. It leads to the presence of high amount of residues in food commodities. The pesticides are used improportionately in India in relation to places and the amount of pesticides residue varies from one place to another. Tamilnadu consumes 1.2-2.0 kg/ha of land followed by Andhra Pradesh and Punjab where 0.8-1.2 kg is the rate of consumption. Pesticide residues in the feed and fodder are solely responsible for their accumulation in animal and poultry. The states like Tamilnadu, AP, Punjab, Haryana, and Karnataka have highest use of pesticides in order to get more production while on the other hand the states like Bihar, West Bengal, North eastern states have lowest use of pesticides. It is because of illiteracy of farmers, poor economic conditions or due to lack of awareness. So the food commodities in high using states have more residues of pesticides.

2. **Lack of education:** Most of the farmers or labourers working in the agricultural fields are either
illiterate or having low formal education. They are not able to understand and read the instructions mentioned on pesticide containers or in the literature supplied with them. Their tendency is to use comparatively higher quantity of pesticides than recommended by the scientists/ manufacturers. They ignore the required dilution factor and use much higher concentration of the pesticides. They are even not aware of the harmful effects of the pesticides and do not properly dispose the used containers of the pesticides.

4. Lack of extension activities: Inspite of Krishi Vigyan Kendra, Krishi Gyan Kendras and a network of extension workers of the Government/ NGO’s, there is a lack or deficiency in proper extension activities in India. The farmers are not fully aware about how to use pesticides, what precautions they should take in order to reduce the acute and chronic effects of pesticides? Farmers do not keep proper difference between the last application of pesticide and harvesting the crop, which leads to increased level of pesticide residue in food items and ultimately in animal products.

5. Inadequate literature supplied by the manufacturers: The pamphlets/ literature supplied by the manufacturers along with the pesticide packing is incomplete and inadequate. Though it is written in many regional languages/ scripts but the printing, letter size and quality of paper is so poor that even an educated person cannot read and understand it what to talk of farmers or labours. It has been observed that one of the reasons to use a much higher concentration than the recommended ones is lack of proper literature.

6. For want of more production and profit: Most of the farmers have impression in their mind that spray/use of more pesticide will lead to higher production. Therefore, the desire of more production and profit leads to indiscriminate use of pesticides in crops which ultimately enters in the food chain.

7. Lack of safer pesticides: So far very few pesticides have been discovered which are harmless to human being or other domestic animals. Therefore, farmers have to use the available pesticides only which have a very narrow safety margin.

8. Use of banned pesticides: In our country most of the banned pesticides are available in market and are used in various agricultural operations. This is primary because of the failure of Govt. to formulate and implement effective policies regarding the use of pesticides. Secondly, the socioeconomic condition of farmers does not allow to strictly monitoring the use of dangerous pesticides in agriculture and animal husbandry. These pesticides have been banned because of their acute/chronic harmful effects on the animal/human health. Thus their use adds to the misery and poor health of farmers and consumers. In spite of ban, DDT and BHC are still produced in India and we have 77% DDT and 95% BHC in India out of their total production in world.

9. Man is ultimate consumer: Man is the ultimate consumer of pesticide residues. Through fodder, water, air and other feed stuffs pesticide residues reaches in animals and then through milk, meat, egg and other animal products accumulates in human being. Various pesticide residues have been reported from animal products in our country important among them are DDT, Carbaryl, Hepatochlor, PCB etc. These pesticide residues in animal products and other food items ultimately get accumulated in the man especially in the adipose tissue, blood and lymphoid organs. Most of research on
pesticide toxicity has been directed towards the assessment of their acute effects. When fed to man or animals at very low doses daily for months or years, these accumulated pesticides in body, may harm the normal functions causing various diseases in man and animals.

**Status of pesticide residues in India**

The presence of pesticide residues have been detected in various items and in food chain. The levels of the pesticides are found much higher than expected level because of heavy contamination of environment. A list of commodities is given in which very significant levels of pesticides are recorded (Table 6). Besides, there are human milk, fat or tissue samples screened for the presence of pesticide residues were also found to have very significant levels of harmful pesticides. The BHC has been found from 0.120 to 1.22 PPM in human fat samples. Heptachlor, an organochlorine pesticide was found to be 0.425 PPM and DDT from 0.195 to 1.695 PPM. Even human breast milk is not free from DDT, which was found to have even 2.39 PPM levels. Similarly human blood was found to have a much higher concentration of 12.00 PPM as against of 0.050-PPM safe levels (no effect levels).

The primary concern of the chronic low dose toxicity in man and animals is related to the carcinogenic, teratogenic, mutagenic, immunotoxic, immunopathological and/or neuropathic effects of pesticides. The perusal of literature in this regard reveals the studies directed towards only one or two pesticides while in nature, when a large number of pesticides are present and their combined effect has not been measured; which of course will give very dangerous view. Various Pathological effects of low doses of pesticides in animals and man are as under:

1. **Immunopathological effects:** Immunopathological effects of pesticides in animals and man are classified under acquired immunodeficiency or immunosuppression, autoimmunity and hypersensitivity. They are considered to be the cause of vaccinal failures or occurrence of disease epidemics in animals and man due to lowered immunocompetence. It has also been reported that a state of immunosuppression for a longer period may also lead to the development of neoplasms as the immune surveillance mechanism becomes defective. Such animals also exhibit recurrent bacterial infections due to defective phagocytic machinery of the body. Organochlorine group of pesticides binds with certain proteins of the body to become antigen leading to initiation of an autoimmune response in body. Autoimmune glomerulonephritis or autoimmune hemolytic anemia or autoimmune rheumatoid arthritis are such manifestations in animals and man. Eczema in man was found due to maneb, 2,4-D and 2,4,5-T. DDT has also been known to cause type I hypersensitivity reaction. The dust of pesticides is cause of allergic respiratory disorders like asthma. Cutaneous allergy has been known to occur due to contact of pesticide contaminated food items.

2. **Carcinogenic effects:** Most of organochlorine pesticides like dieldrin, gamma isomer of BHC, DDT and PCB may cause cancer in liver and lung. Indirectly, a state of immunosuppression for a longer period is helpful in increasing the susceptibility of an animal for malignancy. Since many pesticides are known to cause mutation in chromosomes of man and animals, it is considered that they may also lead to carcinogenicity.

3. **Mutagenicity:** Pesticides may cause alterations in structure or number of chromosomes resulting in translocations, mutations and chromosomal breakage. The altered chromosomal number may become lethal during fetal stage. Several pesticides like DDT, Endrin, PCB and HCB are known to cause chromosomal aberrations. The mutagenic effect of pesticide poses a more serious threat to the future of human race.

4. **Teratogenicity:** The accumulation of pesticides in body tissue and congenital birth defects in children has not been well correlated so far. However, there are certain pesticides which causes teratogenic defects in animals. Carbaryl, thiram, propoxur, parathion, lepthaphos, 2,4-D, lindane and diazinon are having teratogenic defects in animals. In mice, cypermethrin, alphemethrin and malathian are found to exert birth defects in baby mice.

5. **Neuropathy:** Most of the organophosphates, organochlorines carbamates may cause neurotoxic effects in man and animals including increased irritation, loss of memory, in coordination of movement, ataxia, delayed response, convulsions, spasms and paralysis. Such changes appear due to demyelination of nerves in central and peripheral nervous system. Pesticide residues are also responsible for marked behavioural changes in man and animals.

6. **Nephropathy:** The pesticide residues present in food stuff may act as hapten and when they bind
with certain body proteins, they may become antigenic. This antigenicity is responsible for initiation of immune response in body and a continuous presence of antigen and antibodies in body may lead to the formation of immune complexes. The immune complexes when produced in excess are deposited in glomerular basement membrane leading to glomerulonephritis, commonly known as renal failure for which patient needs dialysis after a regular interval to survive.

7. **Hepatotoxicity**: The pesticide residues in food may harm liver tissue as they are metabolized here. There are instances of chronic liver disorders leading to cirrhosis. Certain pesticides are not so dangerous but their metabolites cause severe damage to hepatic parenchyma. The cirrhosis once starts; it never stops even after withdrawal of the primary cause.

8. **Reproductive Disorders**: It has been observed that the pesticides are lethal to dividing cells of genitalia. They may cause abnormalities in sperms leading to decrease their ability for fertilization. On the other hand the ova becomes defective and not able to implant on the uterine surface leading to early abortion or miscarriage. DDT has been found to cause weak egg shell in birds leading to their decreased population. The pesticide residues in food, thus may ultimately lead to sterility, early abortion, still births or repeat breeding.

**Strategies to combat with pesticide residues related problems**

A. **Government level**

1. The farmers should be advised about the harmful effects of pesticides so that they should minimize the use of pesticides in crops. They should judiciously use the pesticide in terms of their quantity and frequency.

2. It should be assured that the pesticides produced in country should be distributed proportionately so that the indiscriminate and disproportionate use can be avoided.

3. The harmful pesticides like some organochlorines, organophosphates and carbamates must be banned strictly in India, their production, import or use should be completely banned.

4. To reduce the effect of pesticide residues, some herbal preparations should be developed, which can be scientifically validated to prevent and control the harmful effects of pesticides. The biopesticides developed using indigenous cow urine was found successful in combating the insect/pests. This will certainly give a new direction to the world not to depend on synthetic things.

B. **House hold level / Individual level**

1. Avoid the use of chemical pesticides in house such as mosquito repellents, cockroach killers, sprays, mats, coils, etc. All of them are harmful to the body responsible for making body susceptible to various kinds of ailments.

2. Avoid to use synthetic chemicals, dyes, flavouring agents, preservatives, antifungal and antibacterial agents in food items.

3. Use fresh foods as far as possible and after proper cleaning. Vegetables should be kept in lukewarm water with 0.89% salt for at least 30 min before use.

4. Avoid the shining vegetables fruits such as tomatoes, brinjal, lady’s finger, apple, etc.

5. Try to have such vegetables/fruits/cereals/pulses which are grown organically.