INTRODUCTION AND SCOPE OF THE STUDY
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Introduction:

Eversince the introduction of DDT as an insecticide after the discovery of its insecticidal properties by Muller and his coworkers in 1939 (Lauger et al, 1944), a large number of organic compounds have been synthesized and introduced as effective pesticides. At present over 900 pesticides are produced and marketed for use all over the world. Even in our country at present over 100 pesticides are registered for pest control purpose. Before the advent and widespread use of pesticides, insects, mites, weeds and fungi caused heavy crop losses affecting the economy of the country and that became part of pest supremacy over man's progress in the world's history. But as it stands today the pesticides are considered to be indispensable if man has to achieve a more abundant supply of food. India has taken a gigantic task in achieving self sufficiency in feeding the growing population. To reach this goal, high priority has been allotted to the production and use of pesticides. Public Health Programmes are vitally dependant upon the use of pesticides whereas these chemicals have helped to increase life expectancy in our country through control of pest vector diseases which had claimed millions of lives in the past. Besides these two major uses chemical pesticides are also used in veterinary practice to control pests infestation in cattle and poultry. In forestry in the past, use of pesticides had been limited for termite control in timber yards etc. Now a days and even more in future the devastation of forests wealth
by some pests would involve greater use of pesticides. Recently these chemicals are also used for domestic hygiene purposes to control flies, cockroaches and other harmful insects. It is indisputable that in the near foreseeable future the developing countries need for pesticides will continue to increase for the betterment of the life of the people.

Pesticides in Public Health:

Direct or indirect economic and social benefits from the use of pesticides particularly in disease control have not been well recognised. The impact of pesticides on the quality of life and on the social status of man is less understood. The world wide death rate caused by germ spreading insects is so staggering that it has never even been totalled up with accuracy. In human society the killing disease are not necessarily the most important, but those which undermine health and efficiency and result in general suffering are often more damaging. Before the discovery of DDT, India had a major problem to control malaria. About hundred millions people suffered from malaria in the sub-continent every year and out of which a million died as a direct result. In a subsequent estimate made in 1952, about 75 millions suffered annually. Simmons (1959) has described the contribution of DDT and other chlorinated insecticides in the control of insect borne communicable diseases like malaria, filaria, dengue, urban yellow fever, french fever etc. In his review he points out that malaria control brought about by DDT, increased life expectancy in India. Such a welfare of the community may be expected to follow improvement in the health of the society. The Govt. of India
formulated a Malaria Eradication Programme in 1953-54 and switched to a nationwide Malaria Eradication Programme in 1958-1959. The operation covers practically the entire population. In our country, the annual loss of income because of malaria after World War II has been estimated as $1 billion. Malaria eradication efforts reduced this loss by 99.8 per cent by 1965. Now with the recurrence of malaria, the problem of loss of man power has re-emerged. The whole National Malaria Eradication Programme is dependant upon the use of chemical pesticides.

Hayes and Simmons (1950) have also reported the most dramatic accomplishment in public health was the control of major epidemic of louse-borne typhus in densely populated heavily infested populations under war time conditions.

Pesticides in Agriculture:

The impact of modern pesticides in Agriculture is nothing short of revolutionary in the developed countries. Yield per hectare of all major crops have increased steadily as also the total output of all food crops. It has been estimated by Food and Agricultural Organisation (PAO) that cessation of all use of crop protection chemicals in USA would reduce total output of crops by 30% and increase the price of farm products by 50-70%. In USA, the average return of crops on expenses in pesticides is 6.7 times, the equivalent return in Canada is 7 times (Green, 1976). The returns obtained from use of pesticides will very, but it is beyond doubt that use of chemical pesticides is highly productive. The benefits of pesticides are nowhere more apparent than in Japan
where they have played a great role in Agricultural self-sufficiency and economic growth. Ministry of Agricultural and Forestry of Japan estimates that pesticides have added 8 times to their own value to the gross national products (Patel, 1975). In our country, it has also been demonstrated that per hectare yields of crops can be substantially increased by the use of pesticides. The cost benefit ratio of pesticides is 1:7 as against 1:3.5 for fertilisers (Prasad, 1976).

The damage done by pests and diseases to crops are quite significant. It is very difficult to estimate even approximately the magnitude of this damage. Various surveys have been made to estimate the damage which is varying from 10-30% and which costs the nation as high as Rs. 5,000 crores in the worst year of pests or disease attacks (Pesticide, 1975). This financial as well as material loss would be considerably more with the increased yield as a result of advocating the use of high yielding seeds specially those of hybrid varieties which are known to be susceptible to pest infestations. It is not only the growing crops that may require chemical treatment to control pests, foodgrains and other commodities need the treatment in store as well. About 70% of the foodgrains produced in the country is stored in small containers in the villages and effective chemical control that may be applied safely and be practical to be used by villagers needed to be developed if serious loss of food due to storage has to be prevented.

In view of the great benefits from insecticides, it is no wonder that their production and consumption has increased
during the last two decades throughout the world. The demand for pesticides in this country too, has been increasing fairly rapidly in the course of last several years. Against a consumption of 2,350 tonnes in 1955-56, the consumption in 1974-75 has been about 47,000 tonnes. Since chemical control of pests has been regarded to be the most important means of reducing damages caused by pests and diseases, the consumption of these chemicals are bound to rise rapidly. It is estimated that the demand for pesticides by 1978-79 will be around 77,000 tonnes (Pesticide Information, 1975).

'It is reasonable to examine at this stage whether this large scale use of pest control chemicals in Agricultural and Public Health Programmes has any disadvantages. Is there a price to be paid? These chemicals have been deliberately developed to be toxic to some living organisms and this is the reason for their commercial utility. Since there is a unity between all forms of life, even unintentional entry of pesticides to humans or animals might produce adverse effects. Under these circumstances, there would be a possibility of health risks to the operatives who are actually engaged in handling and spraying them. There is the possibility of hazard to children, when the carelessness of adults permits them access to such chemicals. Since crop protection chemicals are applied to plants which will produce edible crops and, in some cases, to the crops themselves, there is the possibility that small residues of the chemicals might remain on the crop until it is eaten by the consumer and that, if this happens, it might be deleterious to the consumer's
health either acutely or in the long term. Furthermore, since crop protection chemicals are sprayed widely over large areas, there is the possibility that they may drift on the wind and that small concentrations may build up in the atmosphere at large. They might be hazardous to beneficial insects such as bees, to wild animals and birds. Chemicals which fall on to the soil can be washed down into it by rain and eventually find their way into lakes and rivers etc. and where they might adversely affect fish and other aquatic life. All these are risks which have to be weighed against the benefits which the pesticides produce.

For proper understanding of the toxicity hazards, these chemicals have been classified either on the basis of chemical structure or physical property or persistence. For convenience of understanding their use, these have been grouped on the basis of pest species specificity like Insecticides for the control of insects; Fungicides for fungus; Herbicides for herbs or weeds; Rodenticides for killing rodents; Nematocides for the treatment against nematodes and so on. Out of these, insecticides constitute the most important group of chemicals which are used for public health purposes. There are two main groups of insecticides on the basis of biodegradability. Persistent type: These include organochlorine insecticides; e.g. DDT, HCH, Endrin, Aldrin, Dieldrin, Heptachlor, Endosulfan, Chlordane etc. Non persistent type: includes organophosphates and carbamates.

The toxicity of insecticides is quite variable. The persistent type of insecticides are potential environmental
pollutants and the non persistent types are usually more concerned with immediate health hazards. It is precisely because of their stability, persistence and effectivity against large number of pests that compounds such as DDT, HCH and the chlorinated cyclodienes are often the insecticides of choice for public health and agricultural purposes. The persistence of these organochlorine insecticides, has also caused many of the problems associated with their use. This very property now suggests a complex problem to man and his environment. During the last decade, many scientific reports have shown the presence of the persistent pesticides in man and the environment i.e. food, air, water and soil and even in mother's milk (Durham, 1965; Kraybill, 1969). The man and animals are exposed to these chemicals over their entire life time mainly through the food chain, which is responsible for more than 90% of the total exposure of the general population (Kraybill, 1969). Air and water constitute negligible source of organochlorine insecticides for man (Breidenbach, 1865; Tabor, 1965; Abbot et al, 1965, 1966; Stokinger, 1969). Human exposure to organochlorine pesticides evokes certain biochemical and pharmacological responses one of which is inevitable accumulation and storage in tissues (Hayes, 1960). Accumulation of organochlorine insecticides in adipose tissues of general population have been found and reported from many parts of the world. The significance of these residues need to be understood. This is more so for us as the report of Dale et al (1965) suggests that pesticide residues in Indian population are amongst the highest reported from various countries.
Scope of the Study:

A society which expects to reap the benefits of modern technological advances such as the use of chemical pesticides in Public Health and agriculture must learn to control the adverse side effects of these tools, whatever they may be. In order to achieve maximum benefits, efforts be directed to minimise adverse side effects arising from use of pesticides and for this there is need to assess the magnitude of the problem existing in the country and device solution to their problems which are applicable under our conditions. In pesticide research the needs are most evident for monitoring the local environment, specially the food, which is mainly responsible for pesticide intake in general population. The magnitude of the pesticide pollution can be judged by monitoring the pesticide residues in the body fat of the population. However, to establish the impact of these potentially toxic chemicals on the community, there is utmost need and urgency to evaluate health hazards from pesticides in occupationally exposed persons where the exposure is much higher. As a corollary to these field studies, laboratory experimental studies can be effectively used to provide indepth information in respect to their effects.

At present, insecticide HCH is indigenously produced in very high quantities. (24,298 tonnes in 1975 against 3,891 tonnes in 1960. (Pesticide Association of India, 1977). This chemical has been recommended for use in Agriculture as well as publich health purposes. Recently with the re-emergence of malaria on a large scale and concomitant development of
resistance in mosquitoes to DDT the national Malaria Eradication programme is largely dependent upon the use of HCH. There is hardly any report about the toxicity hazards of this chemical under local conditions, which is absolutely necessary to provide information to safeguard the people against any possible deleterious effects of HCH. The present work has been designed on above prerequisites and principles with the following main objectives:

1. To assess the present state of body burden due to HCH in general population.
2. Evaluation of potential dietary intake of HCH by monitoring the residues of HCH in raw food commodities and in prepared meals.
3. Evaluation of health risks in occupationally exposed workers i.e. malaria spraymen and formulators as compared to the unexposed people.
4. Animal experimental studies to collect information about acute and subacute toxicity of HCH and the joint toxicity with malathion, another important insecticide being used largely in the country for the public health programmes.

The above studies, it is aimed, will help us in proper evaluation and better understanding of the risks associated with the use of HCH and will thus go a long way in ensuring safe use of this insecticide in our Malaria control and agricultural programmes and to combat overall environmental pollution due to this chemical.