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HEALTH HAZARDS OF PESTICIDES IN PAKISTAN

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SUMMARY

This report is a review of the impact of pesticides on human health in Pakistan. The use of pesticides has increased rapidly in the past decades, especially in developing countries. Although the largest quantities of pesticides are still consumed in western countries, most cases of pesticide poisoning are seen in the developing world. Excessive use of pesticides, lack of enforcement of legislation, widespread ignorance of the risks involved, poor labeling, inadequate agricultural extension services and the discomfort of wearing full protective clothing in hot climates all, account for the increased risks of poisoning to both agricultural workers and the general public in developing countries. Contrary to the developed world most of the pesticides used in developing countries are insecticides, which are the most toxic for humans. In Pakistan as in other developing countries, pesticide use has increased dramatically over the last years. Very high temperatures (around 45 degree Celsius) characterize the peak season for pesticides applications in this country. Furthermore, the level of education is very low in rural areas and working conditions of the farmers are poor. Factors such as low willingness to wear protective clothes in the hot season, lack of protective materials and inadequate knowledge about safety precaution put the people of Pakistan at a high risk of pesticide poisoning.

Information on pesticide poisoning in Pakistan is limited. There are only a few publications available, of which the majority lack details on research methodology. However, outbreaks are reported and there are several reports from hospital and community studies. All reports show that pesticides account for a large percentage of acute poisoning cases in the country. Furthermore, the available reports show that acute pesticide poisoning leads to very high mortality. Besides accidental cases of acute poisoning, suicide with pesticide is also mentioned. In addition to acute poisoning, chronic poisoning is also widespread. In studies on accumulation of pesticide residues in tissues and blood 70-100 percent of the people were found positive. People in direct contact with pesticides had an alarming inhibition of the enzyme acetylcholinesterase.

The International Water Management Institute (IWMI) conducted a small-scale study on the use of pesticides in 1997. This was part of a study on agricultural water management. The study was carried out in the irrigated area in the Sindh province. From the farmers interviewed in this area 80 percent used pesticides on their crops. Most pesticides in the area were used on cotton crop. Out of 1080 farmers, using pesticides, 18.7 percent mentioned that anyone in their family had observed a health problem related to use of pesticides. Of these 1080 farmers 60 percent were aware of health hazards of pesticides. Despite some limitations in this study, it became clear that the problem of pesticide poisoning was extensive in Sindh, while the awareness of farmers about pesticide related health problems was low. Health education could be an important step to avoid health problems in this area.

The potential health risks of pesticide use in Pakistan are considerable. As the use of pesticides is increasing, there is an urgent need for interventions to minimize health risks. Since there are only a few reports available about pesticide poisoning in Pakistan, there is need for more research on this subject. Such future research should identify the prevalence of pesticide poisoning and also focus on solutions that are appropriate to and feasible for Pakistan.

1. INTRODUCTION

All over the world pesticides are used to protect crops from different diseases. The increasing demand for food can be met either by cultivating new areas, or by intensifying the use of the existing agricultural areas. As new areas are scarce, intensifying the use of the existing area is necessary. Together with improvements in water management, fertilizers and new plant varieties, pesticides play an important role in increasing agricultural productivity. Pesticides kill pests that are harmful to the crops and can therefore have a positive effect on crop yields. Furthermore pesticides are used in public health programs to control vector borne diseases, such as malaria. Beside these positive effects of pesticides, there are negative effects. Pesticides are chemicals that are intended to kill living organisms and are therefore also poisonous to humans and animals when not used carefully. Furthermore, it is being realized increasingly that pesticides kill insects that are potential predators of agricultural pests (WHO 1979).

The general term 'pesticide' is used to describe all chemicals that destroy pests such as insects, fungi, rodents or nematodes. They can be divided into the categories of insecticides, fungicides, herbicides, weedicides, acaricides, rodenticides, nematicides and fumigants. Insecticides are used to control agricultural, medical, veterinary and household insect pests. Fungicides are for the control of fungal diseases, while herbicides and weedicides are used for the control of weeds. Acaricides are used against mites, rodenticides are used against rodents and other vertebrate pests and nematicides controll nematodes. Finally fumigants are gases used for the control of pests of stored grain and soil borne pests.

The modern synthetic pesticides were developed between 1940 and 1960. In the early years, the insecticidal potential of DDT was discovered in Switzerland and insecticidal organophosphate was developed in Germany. In the meanwhile, work was in progress in Britain, which led to the commercial production of herbicide from the phenoxyalkanoic acid group. In 1945, the British discovered the first soil-acting carbamate herbicides, while the organochlorine insecticide, chlordane was introduced in the USA and in Germany. Shortly afterwards, the insecticidal carbamates were developed in Switzerland. In 1950-55, herbicidal urea derivatives were developed in the USA, the fungicides captan and glyodin appeared, and malathion was introduced. Between 1955 and 1960, newcomers included herbicidal triazines and quaternary ammonium herbicides. Only a few new groups of crop protection compounds have been discovered after this time (Hassall 1982).

The discovery of DDT was thought to be a miracle and a permanent solution to pest problem. Pesticides could save a lot of precious produce and thus save people from starvation. However later it became clear that there are serious environmental and public health problems associated with overuse of pesticides. The first publication that drew attention towards the retention and built-up of organochlorine pesticides in the food chain was 'silent spring' published in 1962 (Carson 1962). 'Silent Spring' has become synonymous with the massive poisoning of birds caused by DDT.

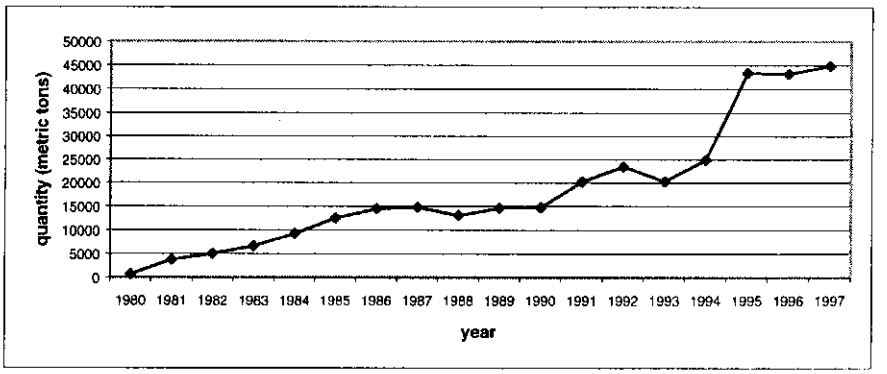
Despite the awareness of its drawbacks, the use of pesticides has increased rapidly in the past decades, especially in developing countries. A fifth of all pesticides are used in developing countries. South East Asia accounts for nearly 40 percent of the pesticides used in the developing world. Although the largest quantities of pesticides are consumed in western countries, most cases of pesticide poisoning are seen in the developing world. Excessive use of pesticides, lack of appropriate legislation, widespread ignorance of the risks involved, poor labeling, inadequate agricultural extension services and the discomfort of wearing full protective clothing in hot climates all, account for the increased risks of poisoning to both agricultural workers and the general public in developing countries. Furthermore most of the pesticides used in developing countries are insecticides, which are

more toxic for humans. This is in contrast to developed countries where the less toxic herbicides are most commonly used (Conway, 1998).

The International Water Management Institute (IWMI) assesses ways to maximize crop yields by improving water management in developing countries. The Health and Environment program of IWMI focuses on public health and environmental impacts of such improvements. During field visits to irrigation schemes farmers and health workers identified acute pesticide poisoning as one of the major health problems. Therefore a study on acute pesticide poisoning has been conducted by IWMI in Sri Lanka. This research showed that hazardous practices during pesticides spraying were due to the impossibility of applying recommended protective measures under local conditions, rather than to lack of knowledge. It was suggested that legislation to restrict availability of the most hazardous pesticides would result in an immediate health benefit. In the long-term improved agricultural extension services to promote alternative non-chemical methods of pest control was proposed as the most important strategy to prevent acute pesticide poisoning in Sri Lanka (Van der Hoek et al. 1998).

In Pakistan as in other developing countries, pesticide use has increased dramatically over the last years (figure 1). Pesticides are mainly used on cotton crops. Very high temperatures (around 45 degree Celsius) characterize the season for pesticides applications on cotton. Wearing of protective clothes is therefore very uncomfortable. Furthermore, the level of education is very low in rural areas of Pakistan and working conditions of the farmers, who spray the pesticides, are poor. Most of the farmers do not have proper equipment and protective clothing. Low willingness to wear protective clothes in the hot season, unavailability of protective materials and inadequate knowledge about precaution makes the people in this area at risk for pesticide poisoning.

Figure 1: Pesticide consumption in Pakistan from 1980 – 1997



Source: Government of Pakistan 1998, Agricultural Statistics of Pakistan 1997-98

The purpose of this report was to review the influence of pesticides on human health in Pakistan. The use of pesticides in Pakistan is described in chapter two, followed by the rules and regulations on the use of these chemicals in chapter three. In chapter four, the impact of pesticides on human health is reviewed and an overview of pesticide poisoning in Pakistan is given. In chapter five the results of a small-scale survey, carried out by IWMI in an irrigated area in the province of Sindh are presented. Finally in chapter six, conclusions and recommendations are given for further research on the negative effects of pesticides on human health

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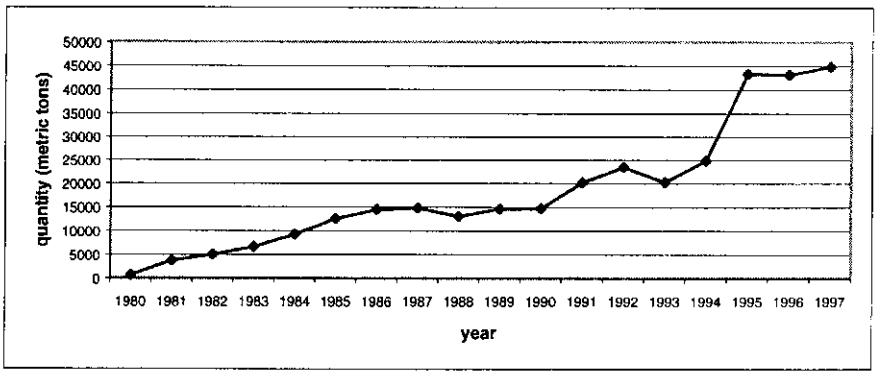

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. 2. USE OF PESTICIDES IN PAKISTAN

The use of pesticides began in Pakistan with the Government importing 254 metric tons of pesticides in 1954. Pesticide consumption increased dramatically after the pesticide import and production was shifted from the public to the private sector in 1980 (table 1).

Table 1: Pesticide consumption in Pakistan

Year	Quantity *(metric tons)*				Value
	Imports	Production*	Ratio	Total	*(million rupees)*
1980	-	-	-	665	39
1981	-	-	-	3677	213
1982	3552	1448	71:29	5000	320
1983	4875	1713	74:26	6588	629
1984	6081	3132	66:34	9213	2256
1985	8270	4260	66:34	12530	2249
1986	8834	5665	61:39	14499	2978
1987	8019	6829	54:46	14848	3259
1988	6256	6816	48:52	13072	2334
1989	6869	7738	47:53	14607	3642
1990	4802	9941	33:67	14742	4581
1991	6157	14056	30:70	20213	5536
1992	6619	16748	28:72	23439	6554
1993	6128	14151	30:70	20279	5384
1994	10693	14176	43:57	24869	5808
1995	20134	23239	46:54	43373	7273
1996	24151	19068	56:44	43219	9987
1997	31036	13836	69:31	44872	9904

* Includes local formulation

Source: Government of Pakistan 1998, Agricultural Statistics of Pakistan 1997-98

Together with the increase in the amount of pesticides used, the sprayed area also greatly increased. In 1998 pesticides were applied to 33.6 percent of the total cropped area (table 2).

Table 2: Area of crops (000 ha) covered by plant protection measures in 1997-98

Crop	Cropped area	Ground spray			Aerial spray		
		Area sprayed	%	Number of sprays	Area sprayed	%	Number of sprays
Paddy	2317	1631	70.4	1 – 2	0	0	-
Cotton	2960	2780	93.9	1 – 4	0	0	-
Sugarcane	1056	918	86.9	1 – 2	0	0	-
Maize	869	383	44.1	1	0	0	-
Oilseeds	663	342	51.5	1 – 2	0	0	-
Tobacco	53	91	170.2	1	0	0	-
Fruit/veg. and others	15121	1586	10.5	1 – 3	47	0.2	?
Total	23040	7731	33.6		22	0.1	?

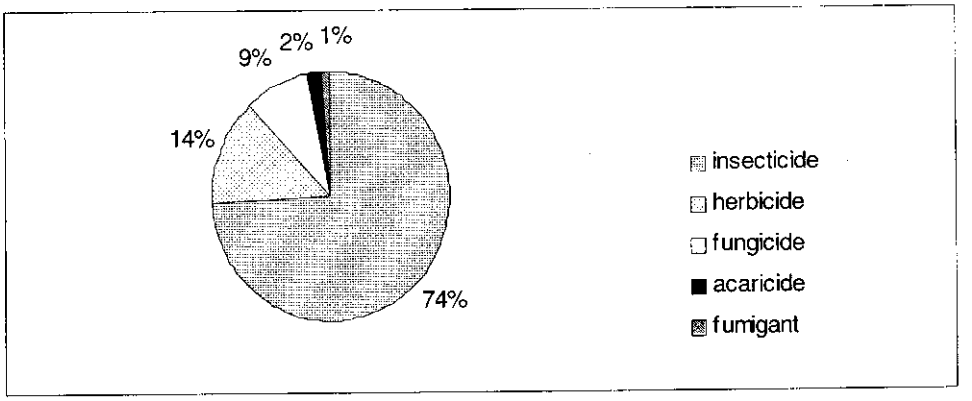
Source: Government of Pakistan 1998, Agricultural Statistics of Pakistan 1997-98

Most pesticides in Pakistan are hand-sprayed on the ground (table 2). This is due to the fact that the majority of the farmers are small landholders and can not afford the more expensive aerial sprays. Aerial spraying is only used at a large scale during outbreaks of pests such as locusts, sugarcane pyrilla, white-backed plant-hoppers or crickets.

Almost 76 percent of all pesticides in Pakistan are used on cotton crops (Khan 1998). The most serious pest on cotton in Pakistan is whitefly, which is the vector of cotton leaf curl virus. Densities of this insect pest gradually increased resulting in a dramatic impact on cotton yields. During the cotton season of 1993, cotton leaf curl virus was responsible for an estimated loss of 3 million bales of cotton, which equals 25 percent of the 1991-92 production figure. Large amounts of pesticides are therefore used to eliminate this insect. Unfortunately, whitefly has developed resistance against many commonly used pesticides (Hussain 1999).

From the example above it is not surprising that insecticides are the most used pesticides in Pakistan (74%), followed by herbicides (14%), fungicides (9%), acaricides (2%) and fumigants (1%) (Khan 1998) (figure 2). This is in contrast to the majority of developed countries where herbicides are the most used pesticide. In the USA for example, herbicides make up 85 percent of the total pesticide use (USDA, 1987).

Figure 2: Different pesticides used in Pakistan



Source: Khan 1998

3. RULES AND REGULATIONS

At present the Ministry of Food, Agriculture and Cooperatives (Islamabad) is the controlling agency for the import and production of pesticides, while the Department of Plant Protection (Karachi) is responsible for the registration and regulation of pesticides. The rules and regulations for pesticide manufacture, import and usage are stated in the Agricultural Pesticides Ordinance (Government of Pakistan 1971) and the Agriculture Pesticide Rules (Government of Pakistan 1973). These rules and regulations were based on the guidelines from the Food and Agricultural Organization (FAO) of the United Nations. The ordinance was amended later with respect to the import of pesticides and punishments for defaulters. To assist and advise the central government on technical aspects of the pesticide ordinance the Agricultural Pesticide Technical Advisory Committee (APTA) was established. It comprises of representatives from universities, Government departments, Pakistan Agricultural Research Council and the Central Cotton Committee.

There are about 300 different pesticides under 1000 commercial brands now registered in Pakistan. Before registration physical and chemical analyses and bio-efficacy tests have to be carried out and are reviewed by the APTA. Once a pesticide is registered, its registration will normally be renewed periodically. Between 1989 and 1993, 23 environmentally hazardous pesticides were banned and de-registered after a review. A list of these banned pesticides is presented in table 3. Despite the fact that the listed pesticides are officially banned some of these pesticides are still available in the local markets. These banned pesticides are smuggled from neighboring countries where they are still available (Baloch 1995).

Table 3: Pesticides de-registered and banned in Pakistan

Pesticide
Binapacryl
Bromophos ethyl
Captafol
Chlordimeform
Chlorobenzilate
Chlorthiophos
Cyhexatin
Dalapon
DDT
Dibromochloropropane + Dibromochloropropene
Dicrotophos
Dieldrin
Disulfoton
Endrin
Ethylene dichloride + Carbontetrachloride(EDCT)
HCH (Mixed isomers)
Heptachlor
Leptophos
Mercury Compound
Mevinphos
Propergite
Toxaphene
Zineb

Source: MINFA (1993),

To control the quality of the pesticides, inspectors have been appointed by the government. Their task is to take regular samples of pesticides available on the market for quality analysis. However, there are not enough inspectors and the appointed persons are not well trained. Furthermore, court procedures in case of adulteration are lengthy and the fines are low in comparison with the profits made in the pesticide business (Ghaffar and Parvaiz 1997).

Monitoring of pesticides in the environment is the responsibility of the Pakistan Agricultural Research Council (PARC). Currently four federal and various provincial institutions handle the actual research projects (Annex 1). Most of the staff of these institutes conducts research on efficacy of pesticides and on pest management packages. Very little emphasis is on ecological and health impacts. Even when research on these subjects is carried out, scientists tend to be cautious in reporting results, which may alarm the public.

4. PESTICIDES AND HUMAN HEALTH

4.1 Global Importance

In 1972 a WHO expert committee estimated that 500.000 cases of accidental acute pesticide poisoning occurred each year, resulting in about 5000 deaths worldwide (WHO 1973). In 1985 a revised estimation of 1 million cases and 20.000 deaths was accepted in an informal consultation (WHO 1986). In the same year another study showed that pesticide poisoning affected about 2.9 million people each year, with 220,000 fatalities. This estimate was made by extrapolation of data from Sri Lanka, where in addition to unintentional pesticide poisoning suicide by ingestion of pesticides is also frequent (Levine and Doull 1992).

In a study carried out in four South East Asian countries (Indonesia, Sri Lanka, Malaysia and Thailand) 2-7 percent of the agricultural workers reported an episode of pesticide poisoning each year. When this figure is extrapolated to all developing countries (830 million agricultural workers), it results in an estimation of approximately 25 million cases of pesticide poisoning each year in the developing world. This number is much higher than earlier estimates because the former results were extrapolated from registered cases only. However, the majority of people who suffer from pesticide poisoning are not hospitalized and as a consequence are not registered (Jeyaratnam 1987, 1990).

4.2 Human Exposure to Pesticides

Pesticides can enter the human body by ingestion, through the skin or by inhalation of fumes. Humans can become exposed during the production, transport and storage of pesticides. Exposure can also occur during application to crops and when people are working near recently sprayed land. Storage of pesticides in the house without precautions can lead to accidental exposure, particularly when these are within easy reach of playing children. In addition the storage of pesticides in homes could also facilitate intentional poisoning. Another mode of exposure is through contact with pesticides accumulated in the environment. Pesticides can accumulate in soil, water and food items. (Masud and Akhtar 1997).

Protective measures should be taken to avoid direct contact while working with these chemicals. In Pakistan, as in other developing countries working conditions are poor and educational levels are low as mentioned before. This prevents people to take an active approach in combating pesticide poisoning. Lack of information about safe use of chemicals, combined with a hot climate which makes wearing of protective clothing uncomfortable are factors responsible for the high risk of poisoning with pesticides (Forget 1991, El Sebae 1993, Liesivouri 1993).

4.3 Effects of Pesticides on Human Health

Pesticide exposure may result in chronic or acute poisoning. Chronic poisoning implies that a person is exposed to small doses of pesticides over a prolonged period of time. Although the health effects of this repeated exposure are not completely clear, there are indications that chronic exposure to pesticides can affect the immune system and can cause cancer, neurological problems and reproductive disorders (Repetto and Balinga 1996). Acute poisoning relates to people who are accidentally, or intentionally exposed to a high dose of chemicals. The symptoms of acute poisoning can vary from skin irritation to a complex systemic illness resulting in death (Forget 1991).

Organophosphate pesticides (for example malathion, parathion), which are the most commonly used insecticides, cause problems in the humans mainly by inhibiting the enzyme acetylcholinesterase.

This enzyme inactivates the neurotransmitter acetylcholine in the body, resulting in the accumulation of this neurotransmitter. Accumulation causes different neurological problems. An episode of acute poisoning with this chemical usually starts with vomiting, excessive sweating, restlessness and fasciculation of the muscles. Generalized fasciculations, coma, convulsion and death will follow soon, if the exposure continued or if the person was exposed to a high pesticide dose. Carbamate insecticides have the same effect on the human body as the organophosphates.

Organochlorine pesticides (for example DDT, dieldrin), are also commonly used in both agriculture and public health. The majority of these pesticides are insecticides, but acaricides, fungicides and herbicides also contain organochlorides. Organochlorinated pesticides cause health problems by stimulating the central nervous system. In mild cases the onset of illness begins with headache, dizziness, sweating, vomiting, and general malaise. In more severe cases generalized convulsions with loss of consciousness can occur. Organochlorinated pesticides tend to accumulate in the environment and are found in soil, water and food items. These pesticides also accumulate in fatty tissues of both animals and humans and in maternal milk.

4.4 Pesticide Poisoning in Pakistan

Information on pesticide poisoning in Pakistan is limited. There are only a few publications available, of which the majority lacks details on research methodology. However, to get an idea of the impact of this problem in Pakistan, an overview of the most useful publications on pesticide poisoning is given in this paragraph. First, reports about acute pesticide poisoning are presented, followed by publications on chronic pesticide poisoning.

4.4.1 Acute Pesticide Poisoning in Pakistan

4.4.1.1 Outbreak reports

Several outbreaks of acute pesticide poisoning have been reported in Pakistan. The first was an outbreak of mercury poisoning in 1963 (Inayatullah 1996). In this case 34 people were affected and four died after eating grain treated with mercury.

Another major poisoning accident occurred in Multan in 1972, during which workers with improper clothing were unloading a consignment of phorate under extreme summer conditions. Seven of them died (Baloch 1985).

The next outbreak reported was an epidemic of organophosphate insecticide poisoning due to malathion. This incident occurred in 1976 among field workers of the Pakistan Malaria Control Program. In the peak month of the epidemic 37 percent of the fieldworkers were affected (2800 cases). Poor work practices resulted in excessive skin contact with absorption of the pesticide through the skin. Elimination of the two most toxic preparations, and special instructions on proper safety measures halted the epidemic (Baker et al.1978).

The most recent outbreak occurred in the summer of 1984, when an epidemic of endrin poisoning was reported in Talagang of the Attock district. Acute convulsions were recorded in 194 affected persons in 18 villages. Seventy percent of the reported cases were children below the age of 10 years. Nearly 10 percent (19 out of 194) of the patients died. The reported cause of the Talagang outbreak was a shipment of contaminated sugar (Rowley et al. 1987).

4.4.1.2 Reports from hospitals

In addition to the reports on outbreaks, there are also reports on cases of pesticide poisoning from hospitals. The first documented study was carried out at the causality department of the Mayo Hospital Lahore. From May 1971 to June 1972, a survey on acute poisoning in children was conducted. Among the 407 poisoning cases, twelve cases were due to poisoning with pesticides. From these twelve children, eight belonged to two families. The fathers were junk dealers and the children came in contact with empty containers of organophosphate esters. Even with exposure to low doses, these organophosphate esters are readily absorbed through intact skin. The other four cases were due to DDT (Sarwar 1973).

The second study was conducted at the intensive care department of the Jinnah Postgraduate Medical Centre in Karachi. Between January 1976 and December 1985, a review of 755 cases of organophosphorus poisoning was carried out. From all 755 cases of acute poisoning admitted to the hospital, 39 percent were due to poisoning with organophosphorus insecticides. Out of these cases, 480 (63.5%) had tried to commit suicide, and 265 (35%) were accidental. The cases of organophosphate poisoning were associated with a significantly higher mortality rate than other cases of poisoning. From the 108 patients who died due to poisoning in 10 years, 73 (67.6%) were due to organophosphate insecticide poisoning (Jamil 1989).

Another study was carried out in the Nishtar Hospital in Multan, from January1986 to December 1986. In this period 112 patients with acute poisoning were admitted. Out of these cases 75 percent were due to poisoning with insecticides, 13 percent were due to poisoning with narcotics or tranquilizers and the remaining 12 percent were due to poisoning with other toxins. The mode of poisoning was mainly accidental (77%). Three persons died in this period (Chaudhry, Noor and Qazi 1992).

Interviews with doctors and a review of pesticide poisoning cases were carried out in 72 health facilities throughout the country by the World Wide Fund for nature (WWF). Interviews with doctors showed that the number of accidental poisoning cases was the highest during summer in the cotton spray season. Lack of knowledge, inadequate precautionary measures and improper storage conditions were regarded as the major causes. There were 448 poisoning cases recorded during the survey but unfortunately the methods of recording and selection of these cases were not clearly mentioned in the report. Of these 205 were accidental (40.4%) and 243 (59.6%) suicidal. The total number of deaths due to accidental and suicidal poisoning was 85 which is equal to 21.3 percent of all reported cases (Baloch 1995).

4.4.1.3 Community survey

Besides hospital studies and reports on outbreaks of pesticide poisoning a community survey on acute health effects of pesticides was carried out in the districts of Bahawalpur, Rahim Yar Khan and Sahiwal. In this area a pilot survey on effects experienced by the farming community was conducted. A sample of 43 individuals (22 males and 21 female workers) was randomly selected and interviewed. In this cotton growing area, and in most of Pakistan males are involved in pesticide spraying whereas the females pick cotton. Of the respondents, 77 percent experienced health problems after using the pesticides. Of these persons, 16 percent complained of blisters on the skin, 42 percent of vomiting, 49 percent of headache and 26 percent of itching and allergic reactions (Jabbar and Mohsin 1992).

4.4.1.4 Cause of acute poisoning

Reports on health impacts on pesticides mainly focus on occupational poisoning. In South and East Asia, suicide with pesticides is also a major problem. Lack of precautions and regulations for storage make these highly poisonous chemicals often easily accessible for intentional poisoning. However, in Pakistan knowledge on this subject is limited due to social and religious factors, which makes research difficult. As suicide is often not registered as cause of death, underreporting is certainly common. Despite this problem intentional poisoning with pesticides has been included in some of the aforementioned hospital based studies on acute pesticide poisoning in Pakistan (table 4).

Table 4: Cause of poisoning in the different hospital based studies

		Cause of poisoning with pesticides	
		Accidental	Intentional
Karachi, Jinnah hospital	Jamil (1998/1990)	35%	64%
Multan, Nishtar hospital	Chaudhry et al. (1992)	77%	23%
Different health facilities through whole country	Baloch (1995)	40%	60%

The study carried out at the intensive care unit of the Jinnah Hospital in Karachi showed that the most common poison used for suicide were pesticides (40%). Most patients were between 11 and 30 years of age and 53 percent were females (Jamil 1990).

Another study on poisons used for suicide was a retrospective case-note analysis carried out for all non-fatal suicidal cases referred to the psychiatric department of the Aga Khan University Hospital in Karachi. Tranquilizers and hypnotics were the leading poisons with 65 percent, followed by organophosphorus insecticides (21%). Among the cases 59 percent were women. The women attempting suicide were younger and more often married as compared to the male cases. Overall, the prevalence of intentional pesticide poisoning can be considered higher than reported in this study, since this study only reported the non-fatal cases of suicide (Khan and Reza, 1998).

4.4.2 Chronic Pesticide Poisoning in Pakistan

Chronic exposure to organophosphorus insecticides inhibits acetylcholinesterase (AChE). The AChE levels in blood can therefore be used to measure chronic poisoning with these pesticides. Measuring the amount of pesticide residues in fatty tissue, maternal milk and blood is another method. Especially organochlorine pesticides, accumulate in the body and the level of pesticide residues is therefore an indicator for chronic poisoning. Both methods have been used in different studies.

In Multan AChE levels were measured in cotton pickers, who pick the first cotton when insecticides are still being sprayed. The study showed that out of 88 females, only one percent had normal AChE level in their blood. In 74 percent of the women there was 12-50 percent inhibition of AChE and 25 percent of the women had an inhibition of 50-88 percent. This is a serious problem, as an inhibition of 30 percent can already be fatal. Out of 33 male cotton workers, 12 percent had normal AChE levels, 51 percent had blood AChE inhibition between 12-50 percent and 36 percent had inhibition between 50-88 percent (Masud 1991).

In another study, serum AChE levels in males aged 18-80 years were measured in a village in the Punjab. It was reported that out of 45 males, 3 had quite low AChE levels, whereas 6 had moderately

low levels. Serum AChE from 17 control subjects was normal. Although the selection procedure of villagers (exposed) and control (non-exposed) subjects was not described in this article, the author concluded that the low levels of serum cholinesterase in villagers were due to actual exposure to organophosphorus pesticides used in the agricultural fields around the village (Khan and Khan 1991). In Karachi, Quetta and Multan, studies were carried out to measure the level of pesticide residues in the body. In the study conducted in Karachi, more than sixty samples of human adipose tissue were analyzed for chlorinated compounds by calorimetric and chromatographic procedures. The samples were taken from a group representative for the general population. The average level of total DDT-equivalent was 25 ppm, total benzene hexachloride (BHC) was 0.48 ppm, and dieldrin was 0.047 ppm. Values varied widely and the frequency distribution was positively skewed (Mughal and Rehman, 1973).

In the Sandeman Provincial Hospital in Quetta, Baluchistan fat tissue and blood were analyzed from 25 patients who underwent a surgical operation,(in most cases a laparotomy). The results of the analysis for hexachlorocyclohexane (HCH) isomers, 4,4'-dichlorodiphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyl-dichloroethane (DDE) showed that there is a great range of inter-individual differences. The concentrations of pesticide-residues were not correlated with age or sex of the patients. As showed in table 5, the median concentrations of all pesticides, except the median for γ-HCH in fatty tissue, were found to be much higher in Quetta than in Germany (Krawinkel et al 1989).

Table 5: Median and maximum levels (µg/l) of chlorinated hydrocarbons in blood and fat tissues in Quetta and Germany

Pesticide		Blood		Fat Tissue	
		Quetta	Germany	Quetta	Germany
4,4'-DDT	Median	0.61	0.13	0.87	0.09
	Maximum	4.83	0.38	10.10	0.42
4,4'-DDE	Median	8.58	2.40	4.76	0.90
	Maximum	32.61	6.50	81.83	4.30
∝-HCH	Median	0.08	0.004	0.06	0.002
	Maximum	1.88	0.018	4.08	0.035
ß-HCH	Median	1.39	0.33	0.89	0.13
	Maximum	6.05	1.70	21.05	0.40
ϒ-HCH	Median	0.29	0.035	-	0.005
	Maximum	0.56	0.31	0.42	0.27

Source: Krawinkel et al. 1989

Pesticide monitoring studies on blood samples of cotton pickers in Multan District in 1992 showed that 22 samples out of 25 (88%) contained pesticide residues. The different pesticides found were, cypermethrin, methamedophos, profenofos, endosulfan, cyhalothrin, dimethoate, monocrotophos, gamma-BHC, deltamethrin, DDT, DDD and DDE, chlorpyrifos, fenpropathrin and alpha-methrin. Similar studies in 1993 showed that out of 50 samples 41 (82%) were found to contain traces of pesticide residues. In 11 of 15 (73%) samples of human milk residues of pesticides were found in 1992. In 1993 18 samples out of 25 (72%) came out positive (Masud and Parveen, 1998). The combined figures are summarized in table 6.

In a study in Karachi, thirty random blood samples were taken for pesticide determination from three different laboratories. All samples were found to contain pesticides. Organochlorine compounds were the most frequently found chemical residues (Naviq and Jahan, 1996).

Table 6: Pesticide residues in cotton pickers' blood and milk from Multan, Pakistan

Pesticide detected	Blood (ppm)	Milk (ppm)	Hazard to humans (FAO/WHO)
Synthetic Pyrethroids			
- Alpha-methrin	Traces - 0.340	0.325 - 1.210	Moderately
- Cyhalothrin	Traces - 2.471	0.241 - 0.629	Moderately
- Cyfluthrin	-	Traces	Moderately
- Cypermethrin	Traces - 1.201	Traces - 0.327	Moderately
- Deltamethrin	Traces - 0.780	-	Moderately
- Fenpropathrin	0.012 - 2.528	-	Moderately
- Fenvalerate	Traces - 0.821	Traces	Moderately
Organophosphorus			
- Chlorpyrophos	Traces	0.012 - 0.417	Moderately
- Dimethoate	0.310 - 1.178	0.510 - 2.964	Moderately
- Methamedophos	0.210 - 1.020	0.712	Highly
- Monocrotophos	Traces - 1.317	0.302 - 2.050	Highly
- Profenofos	Traces - 0.618	Traces - 0.810	Moderately
- Quinolphos	Traces - 1.590	0.558 - 1.003	Moderately
Organochlorine			
- a-BHC	-	0.019	Moderately
- g-BHC	0.027 - 0.640	0.410	Moderately
- d-BHC	0.210 - 0.291	0.114	Moderately
- Dieldrin	Traces	-	Highly
- Endosulfan	Traces - 1.032	0.134 - 0.732	Moderately
- p,p'-DDT	Traces - 0.640	Traces - 0.903	Moderately
- o,p'-DDD	Traces - 1.440	0.413 - 1.410	Moderately
- p,p'-DDE	Traces - 0.432	Traces - 1.210	Moderately
- Diafenthuron	-	0.767 - 5.230	Moderately

Source: Masud and Parveen 1996

4.4.3 Knowledge of Preventive Measures among Farmers

In two different studies in the Punjab province, the knowledge of preventive measures and willingness to apply these measures was investigated. The first study showed that 82 percent of the male applicators of pesticides knew about side effects and took precautionary measures. Of the females interviewed, only 5 percent took precautionary measures. Low educational level of females in the rural areas was mentioned as the main reason for the low awareness of the health hazards of pesticides (Jabbar and Moshin 1992).

In another study carried out in the southern Punjab, small farmers from seven villages in a cotton growing area were interviewed on the use of pesticides. A sample of 30 people was taken from each village, including both men and women. Most of the respondents were not aware of the hazards posed by pesticides. The only method of protection during spraying seemed to be a piece of cloth wrapped around the face. Only in very rare cases, were spectacles, gloves or other protective clothing used. The common practice was to take a bath in the canal after spraying with the pesticide soaked clothes still on. All respondents mentioned that they mixed pesticides with water near water sources in the village. These last two practices present a high risk for pollution of water sources, which are used for domestic purposes and drinking. During the first month of cotton picking, usually done by

women and children without any precautions, pesticides are still applied, which make the working conditions unhealthy. After cotton picking, women reported of complaints such as sneezing, muscular pain, dizziness, nausea, skin burning, itching, cough, headaches and blisters on the body. Weeding, which is done 5 to 6 times a season also leads to contact with pesticides as these are sprayed 6 to 7 times per season (Habeeb, 1996).

5. PESTICIDE POISONING IN SINDH

5.1 Material and Methods IWMI Survey Sindh

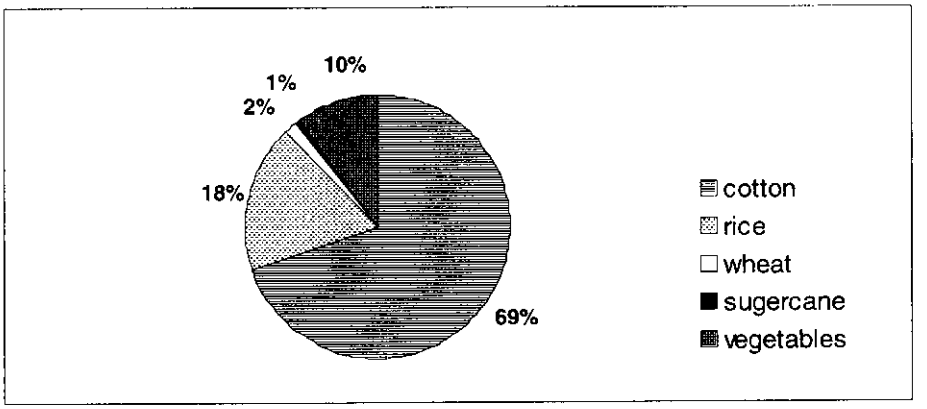
As part of a study on water and salinity management conducted by IWMI in 1997, a questionnaire was administered to farmers about pesticide use. In the questionnaire farmers were asked about pesticide usage, about any health problems of pesticide use in the family, and about the treatment they had sought for the health problems.

The study was carried out in irrigated areas in the Sindh province. Data was collected from 1354 farms evenly distrubuted over 14 canal commands: Begari, Dadu, Desert, Fuleli, Ghotki, Jamrao, Khaipur East, Khaipur West, Lined Channel, Nara, North West, Pinyari, Rice and Rohri Canals. The major crops grown in the area were wheat, rice, sugarcane and cotton. Census data and GIS maps were used for the selection of the farms (Jehangir, Ali 1998). Farmers were interviewed about pesticide use while working in the fields.

5.2 Results Survey Sindh

From the farmers interviewed in this area 80 percent used pesticides on their crops. Most pesticides in the area were used on cotton crop (69%), followed by rice (18%), vegetables (10%), wheat (2%) and sugercane (1%) (figure 3). The mean number of sprays was 2.7 per farm per year.

Figure 3: Crop wise use of pesticide



Out of the 1080 farmers, using pesticides, 18.7 percent mentioned that their family had observed a health problem related to use of pesticides. The cause of these health problems was in 95 percent of the cases accidental, while in 5 percent of the cases intentional poisoning was mentioned. In 70 percent of the cases medical help was obtained from a clinic or hospital. In the rest of the cases the health problems were treated at home. It was not asked if any fatalities occurred.

Sixty percent of the farmers using pesticides were aware of health hazards of these chemicals. Half of these farmers knew this information from the labels on the pesticide containers, while fellow farmers informed 30 percent. The government health officer, agricultural extension officer and media played a role in informing the rest (20%).

5.3 Discussion and Conclusion Survey Sindh

This study gave an overview of the use of pesticides in Sindh and the farmers' perception of pesticide related health problems. The crops on which most pesticides were used and the number of sprays per year were the same as for other areas in Pakistan. However, the results of the farmers' perception and knowledge about health problems caused by pesticides were different from a comparable study carried out in the Southern Punjab (Jabbar and Moshin, 1992). In the Punjab study 77 percent of the farmers reported health problems after using pesticides, against only 18.7 percent of the farmers and their family in Sindh. Since 80 percent of the farmers in Sindh were using pesticides, the magnitude of this problem is obvious even in this province. The awareness of health hazards of pesticides was lower in Sindh (60%) than in the Southern Punjab (82%). The differences between the two studies can partly be attributed to the differences in questionnaire design, the way interviews took place and the different sample size (43 in Southern Punjab and 1354 in Sindh).

Contrary to the Punjab study, the results of the study in Sindh were similar, compared to a study on the farmers' perception of pesticide related health problems carried out in four Asian countries (Indonesia, Malaysia, Sri-Lanka and Thailand) in 1985. In these countries 10-20 percent of the farmers experienced an episode of pesticide poisoning. The awareness of health hazards varied between 26 and 86 percent in these countries (Jeyaratnam, Lun and Phoon 1987).

A limitation of the study conducted by IWMI in Sindh was that people without medical background carried out the interviews. This made it necessary to limit the questions about health effects, so no questions about symptoms or severity of the health problems were included. The only question asked was if anybody in the family ever experienced any adverse health effect of pesticides. The answer was given as yes or no. Another problem was that questions were addressed to the whole family, while the size of the family was not known. The exact size of the population, covered by this questionnaire is therefore not known and prevalence rates can not be calculated.

Despite all these limitations it became clear that the problem of pesticide poisoning is extensive, while the awareness of farmers about pesticide related health problems is low. Since only 60 percent of the farmers using pesticides were aware of health hazards, the percentage of farmers taking precautions to avoid health problems can be assumed even lower. Health education could be an important step to avoid health problems related to the use of pesticides in this area.

6. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Data on pesticide poisoning is limited in Pakistan. A good registration system is not available and only a few surveys were carried out in this respect. Therefore only a few published reports on this subject could be used for this review. However, all reports showed that pesticides account for a large percentage of acute poisoning cases in the country. Furthermore, the available reports showed that acute pesticide poisoning leads to very high mortality. Besides accidental cases of acute poisoning, suicide with pesticide is also mentioned. In addition to acute poisoning, chronic poisoning is also widespread. In studies on accumulation of pesticide residues in tissues and blood 70-100 percent of people were found positive. People in direct contact with pesticides had an alarming inhibition of the enzyme acetylcholinesterase.

Therefore, the potential health risks of pesticide use in Pakistan are considerable. This is mainly due to lack of knowledge about efficient and safe use of pesticides, lack of good protective equipment among farmers and non-availability of a good regulatory system on the sale and use of pesticides. Most farmers have no formal training in the use and handling of pesticides. To make matters worse, the illiteracy rate is very high in the rural areas of Pakistan, and farmers are unable to read instructions on safe and efficient use of pesticides. Many people are therefore unaware of health hazards and precautionary measures, which can be taken to avoid poisoning. The lack of knowledge of efficient use of pesticides frequently leads to over-use. This practice increases the chance of accidental poisoning even further. (Habeeb 1996).

In addition to unawareness regarding the health risks of pesticides, the poor farmers can not afford to buy proper equipment for spraying and protection. Even when financial resources are available, farmers stated that wearing protective clothing is not comfortable under the climatic conditions prevailing in Pakistan. Due to lack of enforcement of legislation a lot of low quality or banned pesticides are still available in the markets. As these pesticides are often toxic to humans, the potential risk of poisoning is even higher. Labels and instructions for use are often missing, which increases the risk of accidental poisoning even further (Baloch 1995).

Overall, the risk of poisoning with pesticides is very high in Pakistan. As the use of pesticides is increasing, there is an urgent need for interventions to minimize health risks. Since the awareness of the health hazards of pesticides is low in Pakistan as shown by different studies, including the IWMI study in Sindh, health education can be an important step. Furthermore it is important to reduce the amount of pesticides used, which could be achieved by integrated pest management, including better water management. In addition it is important to improve the regulatory system of pesticides, to avoid poor quality or banned pesticides reaching local markets and to ensure pesticides are well labeled and packaged. As there are only a few reports available about pesticide poisoning in Pakistan, there is also need for more research on this subject. Such future research should identify the prevalence of pesticide poisoning and also identify solutions to this major public health problem that are appropriate to and feasible for Pakistan.

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ANNEX 1

Pesticide research laboratories in Pakistan

Institute	Year of establishment	No. of Scientists	Activity
Pesticide Research Laboratory TARI, PARC, Karachi	1954	6	Quality control, measurement of residues in food, crops, soil, water, and human tissues.
Pesticide Research Laboratory, Multan	1998	3	Quality control
Plant Protection Institute, Faisalabad:			
• Pesticide Division, Faisalabad	1971	10	Quality control, residues in crop
• Pesticide Quality Control Laboratory, Lahore	1984	3	Quality control, residues in crop
• Pesticide Quality Control Laboratory, Multan	1984	3	Quality control, residues in crop
Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad	1969	2	Residue in food and soil
National Institute of Health, Islamabad	1975	2	Residues in food, human tissues
Toxicol. & Environ. Protection/ Eco-toxicology Research Institute, NARC Islamabad	1987	5	Residues in soil and water, non-target organism studies
Pesticide Laboratory, Chemistry Dept. University of Agriculture, Faisalabad	1982	2	
Federal Environmental Protection Agency Laboratory, Islamabad	1993	2	Pesticide residues in non-targets
Total		38	

TARI – Tropical Agricultural Research Institute
NARC - National agricultural Research Center
PARC - Pakistan Agricultural Research Council