Voice : A Biannual & Bilingual Journal
2023 August, Vol : 15, No. 1, pp.34-44

Pesticide use and Their Impacts on Health of Farmers: A Study in Rajapur Area, Bardiya (Nepal)

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Article History: Received: June 13, 2023 Reviewed : July 17, 2023 Accepted: August 9, 2023

Abstract

A study was conducted in the Rajapur municipality and Geruwa Rural municipality to determine the types of pesticides used in agriculture and their potential effects on farmers' health. Interviews were conducted with 240 farmers from 12 villages in the study area, and the information provided suo moto by the farmers were analyzed. This study found that the farmers frequently use pesticides in the extremely risky to highly deadly categories, such as carbamates, pyrethroids, organophosphides, and organophosphates. It has been discovered that the majority of farmers in the study area are ignorant of the dangers to human health presented by the mentioned pesticides and the consequences of their careless handling. Farmers cover their faces with cloth fabric masks and smoke tobacco to protect them. In addition, it was noticed that after spraying the pesticides, other typical farming activities continued in the agricultural fields. So, there is also a possibility that these pesticides will directly come into touch with women, children, and other field employees. There were numerous illnesses and physiological abnormalities with various indications and symptoms. A significant relative risk (RR) was also noted. It was discovered that the farmers of the study area have poor state of health which was aggravated by the lack of awareness and failure to implement suitable preventive measures regarding use of pesticides.

***Key words*:** Agriculture, health hazard, pesticide, Rajapur area, relative risk

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ISSN : 2091-2161

Introduction

Chemicals called pesticides which are used in agricultural operations to defend crops against pests. These substances can be categorized as insecticides, fungicides, herbicides, rodenticides, repellents, and fumigants. Pesticides contribute to higher crop quality and yields, but they can also give farmers occupational diseases. Most pesticides have a broad range of activity and kill both species that are targets and those that are not. Many of these compounds are difficult to degrade; they persist in soils, seep into groundwater, and significantly damage the environment. Moreover, they have the ability to penetrate living things, bio-accumulates in food chains, and subsequently impact human health. The amount of pesticides applied and the symptoms of sickness among farmers as a result of exposure are directly correlated (Kishi et al., 1995). The vast majority of farmers are ignorant of the many types of insecticides, the poisoning strength, safety measures, and possible risks to human health as well as the environment (Yassin et al., 2002). Currently used insecticides include synthetic pyrethroids, carbamates, organophosphates, chlorinated hydrocarbons, and zinc compounds, all of which are known to cause cancer in humans (Vainio, 1999). Tumors, cancer, birth deformities, reproductive issues, liver, kidney, and brain organ damage are some of the detrimental effects on human health that occur from this. Pesticide storage may result in acute and/or chronic exposures with negative health effects. Pesticide residues in food and water may increase the common indirect exposures experienced by the general population, despite the fact that inhalation, cutaneous, and oral modes of exposure are the most common.

The knowledge level regarding the hazardous reactions of pesticide exposure on health of mankind is expanding day by day (Andersen et al., 2008; Clapp et al., 2008). Due to poor governance, low user hazard knowledge, insufficient use of personal protective appliances, wrong application method, and the use of extremely toxic pesticides, adverse health impacts are more prevalent in developing countries. Despite the wide range of issues they have, pesticides remain a necessary component of agro-ecosystems in modern agriculture. The quantity of import of foreign pesticides in Nepal is growing daily and comes in a variety of forms. According to the most recent data, Nepal imports 562 metric tons of pesticides annually, of which 32% are insecticides, 44% are fungicides, 23% are herbicides, and 1% are other pesticides (PRMD, 2016a).

Pesticides have long been known to have negative impacts on human health, and over the past few decades, the dangers of chemical pesticides have come to light. Many of the chemicals used in pesticides are carcinogenic (Galloway et al., 1987), and strongly associated with the cancer emergence (Leiss & Savitz, 1995) or could result in defective birth (Arbuckle & Sever, 1998; Dumanoski, 1996). Giri et al. (2002) revealed gene altering effects of Malathion, Cypermethrin, and Carbosulphan. It may result in chromosomal aberration, sister chromatid exchange (SCE), and sperm abnormalities in mice.

Exposure to pesticides causes both long term and acute health issues, including reproductive and developmental disorders, cancers etc. (Yassi et al., 2001). The pesticide using rate in Nepal is increasing at the rate of 10-20% in each year with average of 396 g/ha, but in commercial vegetables production area its increasing rate is higher i.e., 1600g/ha and pesticide imports have increased fivefold since 2007-08, from 132 tons to 635 tons in 2017-18 (GC & Neupane, 2019). Most pesticides are linked to negative impacts on human health and the environment in many poor nations like Nepal because they are misused and handled improperly by untrained farm workers (Naidoo et al., 2010). Sharma et al. (2012) presented a report on pesticides use in Nepal and impacts on health issues and environment. Majority of the population (66%) in Nepal, work in agriculture, where they are exposed to the pesticides. Due to this, more thorough research on the agricultural practices of farmers and the health effects of pesticide use is urgently needed in order to influence policy decisions and modify agricultural practices in Nepal. Pesticides prevalent in the environment can enter a person's body through a variety of methods, including inhalation, ingestion, and skin contact. Taking these factors into consideration, a research was conducted among farmers in the Rajapur area of Bardiya district, Nepal to examine the different facets of use of pesticides in agriculture and its potential effects on health conditions of users.

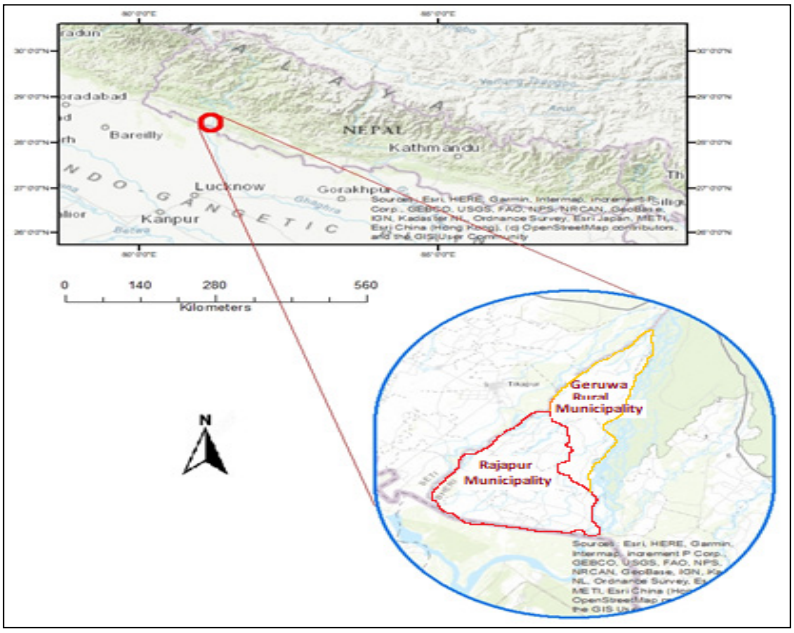
Materials and methods

Study Area

The Rajapur area's agricultural communities were the focus of the present investigation. For the purpose of investigation 7 villages of Rajapur municipality and 5 villages of Geruwa rural municipality were selected as study area. The key crops of this area include Paddy, wheat, mustard and vegetables.

Fig 1

Study Area



Methods of data collection

The questionnaire for interview was created in accordance with the redesigned set of (Kishi et al., 1995) for collecting information on the length of time pesticides were used, the types of pesticides, exposure to the pesticides, preventive measures used, the information source, and symptoms of illnesses in relation of exposure to the pesticide, etc. Using information provided suo moto by the farmers; a cross-sectional survey was conducted to gather information on indications and symptoms. Each interview lasted between 25 and 30 minutes, after which the total data was analyzed. To determine if there is a connection between the symptoms experienced by farmers and pesticide exposure, the data collected were compared with the pattern of pesticide usage.

240 farmers (189 male and 51 female) from the Rajapur municipality and Geruwa rural municipality in the Bardiya district were all interviewed who were actively engaged in the application of pesticides. A total of 12 villages (7 from Rajapur municipality and 5 form Geruwa rural municipality) were selected for interview (Table 1). Total 20 farmers were chosen from each village for interview purpose. Male and female sample populations were selected for interview on the basis of age group identifying whether or not they are engaged in pesticide spraying (Table 2).

Table 1

Name of village selected for interview

S.N.	Rajapur municipality	S.N.	Geruwa rural municipality
1	Badalpur village	1	Pashupatinagar village
2	Muraya village	2	Manau village
3	Tedhiya village	3	Gola village
4	Bhimmapur village	4	Janaknagar village
5	Durganagar village	5	Patabhar village
6	Tapara village		
7	Nayagaun village		

Relative risk (RR value)

The difference between a group member's chances of being infected compared to a group member's chances of getting the same disease is known as the relative risk (RR). In the current study, the percentage of the more affected group, the sprayers, by the less affected group, the non-sprayer, was used to calculate the relative risk between the two groups of farmers.

Relative Risk (RR)

Table 2

Sample Population Characteristics

Age Group	Male		Female		Total
	Sprayer	Non-sprayer	Sprayer	Non-sprayer	
<20	4	5	0	6	15
21-30	30	12	2	12	56
31-40	45	10	4	15	74
41-50	42	8	0	8	58
51-60	15	6	0	4	25
>60	7	5	0	0	12
Total	143	46	6	45	240

Result

The study of exposure to pesticides was primarily based on identifying whether the farmers are engaged in pesticide spraying or not. 149 (62%) of the 240 farmers from 12 villages who were interviewed in the study were spraying pesticides and the sprayers were mostly male and the dominant age group of between 30 – 40 years (Table 2). Majority of farmers were found working in paddy and wheat fields, and others were engaged in cultivation of additional agricultural goods like mustard, soybean, and vegetables.

The most frequently used pesticides reported in this area of Bardiya district were found to be Cypermethrin, Chloropyriphos, Carbofuran, Fenvalerate, Deltamethrin, Alphamethrin, Carbosulfan, Sulphas, and Malathion. The toxicity of the pesticides used by farmers of this region ranged from slightly hazardous to highly hazardous (Table 3).

Table 3

List of the Pesticides Used

Common Name of pesticide	Chemical family	No. of Users	% N=149 (No. of Sprayer)
Highly hazardous			
Profenofos	Organophosphate	60	40.26845638
Cypermethrin	Synthetic pyrithroids	149	100
Carbofuran	Carbamate	90	60.40268456
Fenvalerate	Synthetic pyrithroids	70	46.97986577
Chloropyriphos	Organophosphate	145	97.31543624
Deltamethrin	Synthetic pyrithroids	75	50.33557047
Alphamethrin	Synthetic pyrithroids	69	46.30872483
Carbosulfan	Carbamate	60	40.26845638
Sulphas powder	Organophosphide	80	53.69127517
Slightly hazardous			
Malathion	Organophosphate	90	60.40268456

Factors influencing direct contact to pesticides

1. Time spent for pesticide application

Farmers are exposed for an average of 12.8 years, ranging from less than 8 months to 50 years. Most of them have been using pesticides for the last 8 to 12 years. Most of them, who farm primarily vegetables, apply pesticides twice a month.

2. Personal habit of sprayer

Use of the proper personal protective equipment is necessary when handling pesticides and applying them in the field at the recommended concentration to prevent exposure to the pesticide. This requires the use of protective gear like hand ware, face masks, suitable footwear, a helmet, etc. It was reported that the sprayers in the research region neglected to take the proper personal safety precautions when handling pesticides. Additionally, it was noticed that the farmers mixed the various pesticides with water with their bare hands in a container or directly into the spraying jars. Very few farmers utilize masks made of worn-out or old cotton cloth called Gamchha.

It was also identified that other routine agricultural activities continued throughout the agricultural field after spraying the pesticides. Consequently, there is also an indirect chance that these pesticides will come into contact with women, children, and other workers in the field.

Sickness symptoms among farmers

The questionnaire was designed to encompass the symptoms and indicators of pesticide exposure to find out the prevalence of sign and symptoms of sickness (Table 4). The question of whether the symptoms occurred during or right after pesticide application was put to the sprayers. The non-sprayers were used as a point of reference while performing the fieldwork, during, or just after using pesticide. The signs and symptoms of sickness were observed in 149 sprayers and 46 non-sprayers. The signs and symptoms that were more frequently reported were burning/itchy eyes (53.6%), red skin/dermatitis (42.9%), dry and sore throat (43.6%), excessive salivation (40.2%), running/burning nose (36.9%), (Table 4). Headache, eye discomfort, skin itching, confusion, restlessness, and other acute symptoms have been noted as a result of pesticide use and it has been also noted that long –term pesticide use resulted lung issues such as COPD, neurological problems, and other health issues (Khanal et al., 2022)

Since the farmers reported these indications and symptoms suo moto, it had been challenging to verify incidence of the specific signs or symptoms of illness.

Table 4

Prevalence of signs and symptoms and relative risks among the population

Sign and symptoms	Sprayers (n=149) No. (%)	Non-sprayer (n=91) No. (%)	Relative Risk (R.R.)	95% CI	P-Value
Burning/Itchy eyes	80 (53.6%)	32 (35.1%)	1.52**	1.11 - 2.1	0.0087
Shortness of breath/cough	28 (18.8%)	15 (16.4%)	1.14	0.64 -2.02	0.65
Nausea/vomiting	50 (33.5%)	22 (24.2%)	1.38	0.9 - 2.13	0.13
Blurred vision	35 (23.4%)	32(35.1%)	0.66*	0.45 - 1.0	0.049
Dry and sore throat	65 (43.6%)	20 (22%)	1.98**	1.3 - 3.04	0.0017
Excessive salivation	60 (40.2%)	25 (27.5%)	1.46	0.99 - 2.2	0.05
Running/Burning nose	55 (36.9%)	19 (20.9%)	1.76*	1.12 - 2.8	0.013
Red skin/dermatitis	64 (42.9%)	24 (26.4%)	1.62*	1.1 -2.4	0.014
*p < 0.05, significant					

Notably, the sprayer groups exhibited the majority of the indications and symptoms more frequently than the non-sprayer groups. The relative risk ranged from 0.66 to 1.98. The exposure components of spraying pesticides were strongly linked to excessive salivation, burning/itchy eyes, red skin/dermatitis, running/ burning nose and dry, and sore throat in farmers with higher relative risk (RR = 1.46 to 1.98). Other sign and symptoms observed in the farmers were blurred vision, shortness of breath/cough, and nausea/vomiting with lower relative risk (RR = 0.66 to 1.38) (Table 4).

Discussion

The majority of the pesticides used in agricultural field of the research area fall into the slightly hazardous to highly hazardous category. Pesticides made of organophosphorus chemicals, which function by interfering with the transmission of nerve impulses which results the weakness of the muscles and paralysis.

The synthetic pyrethroid insecticide cypermethrin is very active and applied to manage and kill pests in a wide range of crops. According to Giray et al. (2001), rats exposed to cypermethrin had 20% less S-methylglutathione and suffered tissue damage brought on by free radicals. Moreover, it has been observed that cypermethrin causes mutation of genes in spermatogonium of Drosophila (Batiste-Alentorn et al., 1986) and in mice, gene toxicity and formation of defective spermatozoa (Bhunya & Pati, 1988). Malathion is a frequently used organophosphorous pesticide that has been used in significant domestic pest eradication programs. Malathion is a well-known cholinesterase inhibitor that causes acetyl choline and other bodily choline-esters to be hydrolyzed at Ach receptors. It has already been proved to cause abnormalities in the epithelium of mammary gland of rat, influencing the carcinogenesis process. These alterations take place in the neurological system by increasing cholinergic stimulation. Concerns about the possibility of genetic damage have been raised

by the widespread use of malathion in various control programs (Flessel et al., 1993). According to reports, the synthetic pyrethroid of third generation, fenvalerate, prevents intracellular communication (Flodström et al., 1988; Wärngård & Flodström, 1989). One of the most commonly used organophosphorus insecticides, chloropyriphos, has been linked to the development of neurotoxicity, with a focus on the immune system (Barone Jr et al., 2000; Pope, 1999).

It has been found that the majority of farmers of the research area are unaware of the hazardous effects on health posed by the mentioned pesticides and they don't know result of their negligent handling. Farmers protect themselves by wearing cotton fabric masks. Because of this, pesticides actually absorb more quickly (Kishi et al., 1995). Most of the farmers are noticed consuming tobacco during spraying. It is unhealthy to chew or smoke while spraying in an attempt to lessen the unpleasant feeling due to pesticides. Ideally, it should be avoided to combine different pesticides. Because mixing pesticides can change their chemical properties and increase their harmful effects on health in addition to their cumulative impacts on the environment and this could be deadly. As Salameh et al. (2004) has already stated, the health of farmers is negatively impacted by the use of risky pesticides in combination with a lack of precautions.

Women and young children were seen engaged in other agricultural fieldwork while pesticides were being sprayed during the study. Numerous reproductive health issues in the reproductive age range may develop from this pesticide exposure. Many research projects in Nepal (Atreya & Sitaula, 2010; Dahal, 1995; Pujara & Khanal, 2002) has documented widespread use of chemical pesticides in vegetable growing areas of Nepal, raising concerns about potential health risks. Since these farmers have been using pesticides for over twelve years in this area, it is likely that many of them have long-term exposure to pesticides, which could have long-term negative effects on their health. Young people appear to spray pesticides more frequently than older adults, which could harm their reproductive systems. Chronic diseases like Asthma, diabetes, hypertension, ocular illnesses, kidney failure, and others have been proven to be associated with pesticide exposure. Farmers, who are more likely to be exposed to pesticides, were found to have a high prevalence of asthma (Hoppin et al., 2002). According to the findings, farmers had a higher prevalence of decreased vision, which may be related to long-term pesticide exposure. It was reported that among the population who sprayed, farmers were more likely to experience the signs and symptoms of pesticide exposure. The non-sprayer population may have a higher prevalence of various signs and symptoms as a result of indirect pesticide exposure or previous pesticide exposure. Thus, it can be inferred that focus needs to be placed on the adoption of preventative measures and raising knowledge of their potentially harmful consequences among farmers generally and in all agricultural fields where such practice is lacking.

Conclusion

The majority of pesticides used in agriculture of research area fall into the slightly hazardous to highly hazardous category. The synthetic pyrethroid insecticide cypermethrin is very active and applied to manage and kill pests in a wide range of crops. Malathion is a well-known cholinesterase inhibitor that causes acetyl choline and other bodily choline-esters to be hydrolyzed at Ach receptors. It has been found that the majority of farmers of the research area are unaware of the hazardous effects on health posed by the mentioned pesticides and they don't know result of their negligent handling. Farmers protect themselves by wearing cotton fabric masks and consuming tobacco. The health of farmers is negatively impacted by the use of risky pesticides in combination with a lack of precautions. Many research projects in Nepal have documented the widespread use of chemical pesticides in vegetable-growing areas of Nepal, raising concerns about potential health risks. Young people appear to spray pesticides more frequently than older adults, which could harm their reproductive systems. Chronic diseases like asthma, diabetes, hypertension, ocular illnesses, kidney failure, and others have been linked to pesticide exposure. Farmers, who are more likely to be exposed to pesticides, were found to have a high prevalence of asthma and decreased vision. The non-sprayer population may have a higher prevalence of various signs and symptoms as a result of direct pesticide exposure or previous pesticide exposure. Therefore, the focus needs to be placed on adopting preventative measures and raising knowledge of their potentially harmful consequences among farmers generally and in all agricultural fields where such practice is lacking.

Acknowledgment

I would like to express my high gratitude to the members of my family specially Mr. Rabindra Kumar Chaudhary, who helped me during data collection in the study area. They play a source of information during field survey and interview. I convey my sincere thanks to the farmers of the Rajapur municipality and Geruwa rural municipality who provided the information and helped directly in giving shape to this article.

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