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PESTICIDE USE PATTERN AND AWARENESS OF PESTICIDES USERS WITH SPECIAL REFERENCE TO POTATO GROWERS IN NEPAL

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ABSTRACT

This study was carried out from September, 2008 to May, 2009 to explore awareness of pesticide users in special reference to potato growers on pesticide safety labels, pesticide handling and application practices that might potentially expose them to chemical hazards. Data was based on a stratified random sample of 471 pesticide practitioners (potato growers, field workers, extension officers, and pesticide dealers) across Nepal's' major potato production zones using structured interview schedules. This paper presents social characteristics, understanding of labels and pictograms on pesticide packages, source, preparation, and storage of pesticides, disposal of pesticide containers, practitioners' preventative measures and understanding of WHO classes of pesticides among farmers, technicians, pesticide dealers and cooperatives. Awareness level of pesticide users is comparatively low in Nepal and it should be improved by providing safe alternatives of chemical pesticides and by implementing awareness raising programs.

INTRODUCTION

Use of pesticide started in Nepal since early 1950s; with the use of DDT for malaria eradication (Manandhar, 2005) followed by other groups of pesticides like organochlorines (BHC, dieldrin, and chlordane etc), organophosphates (Ethyl parathion, methyl parathion, malathion and oxydemeton methyl etc), carbamates and synthetic pyrethroids with steadily increasing consumption trend. In earlier days, Nepal government's emphasis was on import and distribution of chemical pesticides among farmers' communities to solve agricultural pest problems that created environmental pollution, resurgence of pest and hazardous effect to human and animal health. Annually, 344.9 mt (active ingredient) of agriculture related pesticide is being consumed in Nepal. The composition of total amount of pesticide includes 114.7 mt. insecticides, 166.8 mt. fungicides and 53.5 mt herbicides and 9.8 mt others (PRMD, 2012/13). So far, 1098 commercial products grouped under 108 common names of pesticides have been registered in Nepal. Among them, 44; 31; 18; 2; 4; 6 and 3 are insecticides, fungicides, herbicides, rodenticides, acaricides, biopesticides and other pesticides, respectively (PRMD, 2012/13). Government of Nepal has banned 15 pesticides, they are DDT, BHC, aldrine, dialdrin, endrin, chlordane, lindane, heptachlor, toxaphene, mirex, phosphamidon, organomercury compounds, monocrotophos and methyl parathion and Endosulfan (PRMD, 2012/13).

Nepal government has passed the Pesticide Act in 1991and approval to Pesticide rules in 1994 and enforced since July 16, 1994. In addition, Environment Protection Act has been formed in 1997 for the management of activities related to environment protection and commenced. On the basis of the act Environment Protection Rules have been enforced in June 26, 1997. The rules cover the issues of initial environmental examination (IEE) and environmental impact assessment (EIA), prevention and control of pollution, proposals requiring environmental impact assessment. In Nepal, there are no comprehensive records that indicate the volumes of pesticides used in agriculture and therefore released to the environment. Nepalese farmers are not much aware of safe use of pesticide. They do not apply pesticides following proper precaution measures and methods. Application of pesticide in higher doses is common among the potato growers that cause waste of pesticides and reduction in actual profit in final produce.

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Generally, farmers make decision of pesticide application once they just notice pests in the field irrespective of damage level and farmers prefer highly toxic pesticides. Pesticide use pattern changes over time and effected by availability of alternate pesticide, market price, efficacy and the demand of market and so on. In Nepal, many studies on pesticide use have been conducted but the issues have not been explored in totality. In reality, available information at hand only suggest us very rough estimation of the real status of pesticide use in Nepal due to ever changing nature of pesticide use pattern and marketing system. Regular monitoring on different issues of pesticide could be a good way to update the ever-changing situation.

The study was carried out during September, 2008 to May, 2009 to know distribution and consumption pattern of pesticide existed among potato growers and other stakeholders. The study will be helpful for monitoring the farmer's activities on pesticide use.

Objectives

- To explore the status of pesticide use and its related consequences regarding potato cultivation in Nepal.
- To explore awareness and general pesticide use practices of potatoes growers and other stakeholders on pesticide, storage, distribution, application, safety measures and disposal.

MATERIALS AND METHODS

Site Selection and sampling

Twenty potato growing districts of Eastern, Central, Mid-western and Far-western development region of Nepal were selected for field survey. They cover high hill (Solukhambu, Jumla and high hill area of Sindhupalchowk) mid-hill (Arghakhanchi Dadeldhura, Kaski, Kavrepalanchowk, Kathmandu, Lalitpur, Bhaktapur, Parvat, and Makawanpur), and plain agro-ecological zones (Chitwan, Dang, Banke, Bardiya, Kailali and Nawalparasi) Table 1. More than 500 farmers were interviewed using semi-structured questionnaire including 5-58 vegetable (especially potato) growers from each districts. Cost effectiveness of the study has been duly considered (Table 1).

Questionnaire Preparation

Important issues related to the study were thoroughly reviewed, parameters set and survey questionnaire designed accordingly. Literacy rate, land holding, experience of crop cultivation, past experience of pesticide use, source of information about pesticide, precaution measures, disposal practice, and awareness on pesticides use were the major issues included. Same set of questionnaire was used for all categories of respondents. Personal contact and discussion with key informants and experts were also done to clarify the complex issues.

Field Survey

Team members of field survey were trained and necessary instructions were given to them before conducting the field survey. Pre-testing of questionnaire was also done at one of the sites of Bhaktapur district to make it more lucid, informative, qualitative and valid. More than 500 respondents were interviewed during the field survey. Among them, 5 and 28 potato growers of Solukhambu and high hill areas of Sindhupalchowk districts had never used the pesticide. That is why; the respondents mentioned above have not been included in the analysis. Data analysis was done by using the computer software SPSS-10.

RESULTS AND DISCUSSION

Field survey data has been categorized and dealt issue wise and described as below.

Demography and land tenure status

Majority of farmers (91.7%) interviewed fall under young or middle-age category i.e. between 25 and 50 years age group. Educational level of respondent found comparatively low. About 1.7% of farmers were illiterate and biggest group of farmers (25.3%) have obtained 12 years of formal education (up to intermediate level) with sufficient reading and writing skills (especially Nepali) followed by farmer's group, who have obtained graduate level education (Table 2).

Table 1. Sampling plan

S.No.	Geographical Region	Districts	No. of Respondents			
			Farmers	Agriculture Extension Personnel	Traders	Farmer's Co-operatives
1	High hill	Jumla	10	0	0	0
		Solukhambu	05	0	0	0
2	Mid-hills	Arghakhanchi	30	0	0	15
		Dadeldhura	08	0	0	0
		Kathmandu	33	0	0	0
		Paravat	29	0	0	0
		Kavrepalanchowk	34	15	9	0
		Dang	10	0	0	0
		Makwanpur	23	0	0	0
		Kaski	30	0	0	0
		Lalitpur	31	0	0	0
		Bhaktapur	30	0	0	0
		Sindhupalchok	28	0	0	0
		Dhading	17	0	0	0
		Salyan	05	0	0	0
3	Terai	Chitwan	25	0	0	0
		Kailali	32	0	0	0
		Nawaprasi	25	0	0	0
		Banke	30	0	0	0
		Bardiya	30	0	0	0
	Total		465	15	9	15

Source: Fieldwork, 2008.

In terms of land tenure issue, 83.4% of farmers have own land while 3.4% have been using the land in rent. Majority of farmers (36.7%) have been involved in cultivation and they have crops cultivation experience of more than 10 years (Table 2). Only 36.7% farmers have been using pesticides for last 10 years. Family and wage labor was dominant but few of them found using hired labor (Table 2).

Table 2. Types and characteristics of respondents

Types and characteristics	Number	Percentage
Occupational Categories		
Farmer	461	91.7
Agriculture Technician	15	3.2
Pesticide dealer	9	1.9
Representatives of farmer's co-operatives	15	3.2
Sex		
Female	134	28.5
Male	337	71.5
Age (years)		
Up to 25	87	18.5
25-50	294	62.4
More than 50	89	18.9
Education level		
Illiterate	8	1.7
Literate (below 5 class)	101	21.4
5-10 class	104	22.1
SLC-IA level	119	25.3
BA-MA level	110	23.4
Above MA level	29	6.2
Land ownership		
Own land	393	83.4
Land in rent	16	3.4
Both type of land ownership	62	13.2
Experience of farming		
1-5 years	67	14.2
6-10 years	88	18.7
11-15 years	83	17.6
16-20 years	60	12.7
>20 years	173	36.7
Experience of pesticide use (years)		
1-5 years	190	40.3
6-10 years	120	25.5
>10 years	153	32.5
Work force		
Household labour	137	29.1
Wage labour	25	5.3
Both	307	65.2

Source: Fieldwork, 2008.

Awareness on pesticide use

In order to understand respondent's knowledge on pesticides use, 16 pictograms were shown to them and allowed to write the meaning whatever they understand. Pesticide pictograms were used to measure the understanding level of rural farmers as an efficient tool. Pesticide pictograms labels were illustrated with self-explanatory pictures (Table 3). The majority of farmers did not understand pictograms, what for they are used. More than 90% of respondents did not understand the meaning of pictograms related to liquid and granule pesticide handling procedure and 56.3% understood the application-use a hydraulic spray atomizer (Table 3). Among the nine advisory pictograms presented, six pictograms were known by 60% farmers and common and easy understandable pictograms were about using protective gloves, washing after pesticide application and wearing mask while applying the pesticides. Few of them correctly understood the instruction such as wearing protective clothing (Table 3).

Table 3. Labels of understanding of Pictograms (%)

Pictograms	Meaning	*N*		*%*	
		Yes	*No*	*Yes*	*No*
Activity pictograms					
	Handle carefully - liquid product	42	429	8.9	91.1
	Handle carefully - powder or granulated product	29	442	6.2	93.8
	Application - use a hydraulic spray atomizer	265	206	56.3	43.7
Advisory pictograms					
	Use protective gloves	375	96	79.6	20.4
	Wash after use	352	119	74.7	25.3
	Wear a mask	367	104	77.9	22.1
	Wear a water proof apron	197	275	41.8	58.4
	Use a face shield	40	431	8.5	91.5
	Wear spact	342	129	72.6	27.4
	Wear boots	312	159	66.2	33.8
	Wear a pesticide respirator	50	421	10.6	89.4
	Wear protective clothing	18	453	3.8	96.2
Environmental hazard					
	Dangerous/harmful for livestock and poultry	154	317	32.7	67.3
	Dangerous/harmful for wild animals and birds	96	375	20.4	79.6
	Dangerous/harmful for fish/Do not contaminate water	153	318	32.5	67.5
Children hazard warning					
	Keep locked away and out of reach of children	192	279	40.8	59.2

Source: Fieldwork, 2008.

Majority of respondents do not care about environmental hazard due to pesticide application. Only about less than 30% participants understood the pictograms related to pesticide hazard ness (such as those displaying the danger signal for livestock and poultry, wild animals and fauna of water). However, a higher number of respondents were able to identify the danger of water and fish contamination and danger for domestic animals than wild animals and bird's intoxication. Less than 50% respondents were able to describe the meaning of the hazard warning pictogram related to children correctly (Table 3).

Source of information

Instruction written on the pesticide label has little importance to majority of the pesticide users of Nepal. Majorities (58.8%) of respondents rely / believe on pesticide dealer/ retailers and some of them rely on neighbor's advice (18%). Government agencies have minor role on pesticide management issues (Table 4) in Nepal.

Table 4. Sources of information

Source	N	%
Pesticide dealer	277	58.8
Agriculture technician	214	45.4
Neighbor	85	18
Others	11	2.3

Source: Fieldwork, 2008.

Pesticide preparation place, application, storage and disposal practice

No matter, whatever may be sources of information, majority of respondents (57.7%) prepare pesticide in field itself before its application. It is found that pesticides usually kept mostly in a separate store within house along with agricultural tools (40.6%), which is followed by store in outside house (37.8%). Practice of storing pesticide within house that increased the risk of accidental poisoning (Table 5). Farmers have different practices for disposing the empty pesticide containers after application. Disposing of empty pesticide container in the pit has been practiced by majority of farmers (46.9%) followed by throwing in the crop field (22.3%), burning (16.8%) and so on (Table 5). Some of the farmer even used to use empty container of pesticide for home purpose rather than throwing or burning that may directly affect the user (Table 5). Similar finding have reported by Giri (1990), Klarman (1987) and Dahal (1995) in their reports**.** Their reports have indicated that farmers are not aware of proper and safe use of chemical pesticides. Chemical pesticides are commonly known as *"Kit Nasak Aushadi"* (Insect destroying Medicine), and they are handled carelessly. Sometimes Nepalese farmers are using very crude method for chemical pesticide spray. They even use the broom to apply pesticides (Dahal, 1995). A study carried out by Giri (1995) in Surkhet and Banke district of mid western development region of Nepal mentioned that vegetable growers, consumers and pesticide dealers of the region were not sufficiently aware of pesticide hazards.

Use of safety measures

None of respondents strictly follow the safety measures as recommended. However, majority of farmers (62.6%) use to wear a piece of cloths or cover mouth.

Table 5. Pesticide preparation place, storage and disposal practice

	Number	Percentage
Pesticide preparation place		
In home	88	18.7
In the field	272	57.7
Nearby water source	101	21.4
Pesticides storage place		
In bed room	10	2.1
In kitchen	7	1.5
Normal store room	75	15.9
Separate store room	191	40.6
Store outside house	178	37.8
Disposal of empty pesticide containers		
Home use	24	5.1
Disposing in pit	221	46.9
Throwing in sewage canal	37	7.9
Throwing in stream or canal	56	11.9
Burning	79	16.8
Throwing in crop field	105	22.3
Throwing in forest	41	8.7

Source: Fieldwork, 2008.

Approximately , half of the respondents (41%) of respondents use to take bath after pesticide application where as approxmatly one fourth (26.1%) of the them use to spray pesticides according to wind direction to protect them against direct contact of pesticide but none of them are following complete precaution measures while applying the pesticides (Table 6). Giri *et al.* (2006) have carried out similar type of study and found that majority of the vegetable farmers of Nepal found not using any safety measures while applying the pesticide. Another big category of respondents found not applying pesticides in bright sunshine and windy time which is practiced as a common precaution measure taken against the hazardous effect of pesticide. Few farmers of Dhankuta (25%), Morang (46.7%), Sunsari (50%), Kavrepalanchowk (3.3%), Banke (26.7%), and Kanchanpur (14.3%) found adopting the practice of covering face with cloth during pesticide application. Some potato growers found using sunglass, gas mask, gumboot, gloves, apron, and wearing full sleeve shirt to protect them against pesticide.

Table 6. Use of preventive measures

Preventive measures	Number of respondents	Percentage
wearing gloves	139	29.5
wearing shoe	77	16.3
wearing hat	104	22.1
wearing spectacle	71	15.1
wearing apron	131	27.8
spraying according to wind direction	123	26.1
Taking bath after application	193	41
wearing a piece of cloth over mouth and nose	295	62.6
Others	7	1.5

Source: Fieldwork, 2008.

Knowledge on pesticide types and label

Approxmatly fifty percent of the respondents do not care to read pesticide label before using it because pesticide labels are written in languages other than Nepali and it is too technical and they do not consider it much important for growers. A considerable number of farmers (17%) simply trust to pesticide dealer and follow their advice rather than to read and follow written instruction, where as 7.45% of them think no need to read the pesticide label and 3% blindly believe on

efficacy of pesticide (Table 7). Studies carried out by Eve (1995) have shown that reading and writing ability is high considering the geographical and resource constraints encountered by those providing education in the region. It seems that technical language used for instructions discourages farmers to read pesticide label. Giri *et al.* (2006) have also reported that more than fifty percent (65.4 %) of Vegetable growers of Nepal were found aware regarding pesticide label and it's expire date. Hill vegetable farmers found more conscious than the farmers of plain region regarding the issue.

Table 7. Reading pesticide label and reason of not reading the label

Reading of pesticide label	Number	Percentage
Yes	237	50.3
No	226	48
Causes of not reading pesticide label		
Illiterate	68	14.4
Trust on pesticide dealer	80	17
Trust on pesticide	14	3
Rely on neighbor	40	8.5
No need to read	35	7.4

Source: Fieldwork, 2008.

Knowledge on FAO pesticide classification and toxicity level

Question regarding understanding the FAO pesticide classification and toxicity level was asked to the respondents. Among the respondents, 76.4% did not understand and found unfamiliar with the words written on the labels and, therefore, not able to distinguish toxicity levels through the color-coding scheme (Table 8). Few farmers were able to perfectly understand the FAO classification of Red1, Red2, Yellow, blue and Green and their respective toxicity level (22.5%), 17%, 21.7%, 16.3% and 21.2% respectively (Table 8).

Table 8. Knowledge on FAO pesticide classification and toxicity level

FAO class understanding	Meaning	N	%
Yes		111	23.6
No		360	76.4
Red1 (Ia)	Highly toxic	106	22.5
Red2 (Ib)	Toxic	80	17
Yellow (II)	Medium toxic	102	21.7
Blue (III)	Less danger	77	16.3
Green (U)	Least danger	100	21.2

Source: Fieldwork, 2008.

Types of pesticides used

Nepalese farmers are using various types and wide range of chemical insecticides to cope with ever-increasing pest problems. Among them, organophosphates and synthetic pyrethroids are major. In addition, Malathion and Mencozeb (DM-45) have been found widely used chemical pesticides by farming community (Table 9). Similar information has been explored in study carried out by Giri *et al.* (2006). The report mentions that vegetable growers of different districts and development regions have been using a long range of pesticides but products being used in different districts are different by number and producer companies. Types of pesticides used in hilly and mid and far western development region are comparatively less than eastern and central terai regions. Majority of the pesticides belongs to organophosphate and synthetic pyrethroid groups. Among the pesticides, numerous products of registered and even not registered are in use.

Table 9. Types of pesticides in used in Nepal

Trade name	Pesticide group	WHO classification	Numbers of respondents	Percentage
Insecticides				
Malathion	organophosphates	III	182	38.6
Rogar	organophosphates	II	51	10.8
Endosulfan	organochlorines	II	187	39.7
Nuvan	organophosphates	Ib	80	17.0
Metacid	organophosphates	Ia	47	10.0
DDT	organochlorines	Ia	1	0.2
Rogohit	organophosphates		1	0.2
Cholripyriphos	organophosphates		57	12.1
Cypermethrin	synthetic parathyroid	II	14	3.0
Fenfen	organophosphates	II	1	0.2
Endokill	Organochlorines	II	1	0.2
Decsis	organophosphates	II	8	1.7
Currenter	organophosphates	IB	2	0.4
Metasystox	organophosphates	Ia	4	0.8
Super D			1	0.2
Fungicides				
Keronoxyl			20	4.2
Copper oxychloride	Copperoxychloride		1	0.2
Bavistin	Carbendazim	NH	8	1.7
Blitox	Copperoxychloride		3	0.6
DM-45	Mencozeb	U	173	36.7
Copperoxide	Copperoxychloride		27	5.7
Hinosan	Carbendazim		1	0.2
Benomyl		U	15	3.2
Endofil-45	Mencozeb		1	0.2
Dhanucup			1	0.2
Curex			1	0.2
Sixer			1	0.2
Carbedigm	Carbendazim		1	0.2
Indofil	Mencozeb		1	0.2

Note: Ia-Highly toxic; Ib-Toxic; II-Medium toxic; III-Less danger and U-least danger
Source: Fieldwork, 2008.

Conclusion and Recommendation

Potato growers of high hills do not use chemical pesticides, whereas potato growers of mid hills and plain areas use chemical pesticides frequently with minimum protective measures. The chemical pesticides used come under organophosphate, synthetic pyrethroids, mencozeb, carbendazim and copperoxychlroride group. Indosulfan and DDT are even being used which come under organochlorin group. Among the insecticides, DDT has been banned by Nepal government but still is in use. Pesticide users found very poor in label reading practice and following the instruction in Nepal. It may be due to use of foreign language, unclear instruction of the label as well as carelessness of the users. Awareness level of potato growers of Nepal on pesticide use is comparatively low and it should be improved through providing safe alternatives of chemical pesticides as well as awareness programmes. It is recommended that pesticide reading issue should be duly included in every training related to plant protection by the government and non government authority involved in Nepalese agriculture.

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