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A Study of Pesticide Consumption Pattern and Farmer's Perceptions towards Pesticides: A Case of Tijara Tehsil, Alwar (Rajasthan)

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A B S T R A C T

Agriculture is the most important sector of the economy in India as it provides food and livelihood security. The industrialization of agriculture has favored the use of plenty of agrochemicals including fertilizers, pesticides, micro nutrients, and plant growth regulators in the agricultural fields. Pesticides are an integral part of modern agriculture. The use of pesticides in agriculture is obvious for the prevention of crop-damaging pests, fungus, unwanted plants (weeds) and a number of crop-eating animals like rodents etc. The present research was designed to study the consumption pattern of pesticides, farmer's knowledge about the safe handling and application of pesticides and their practices on pesticide usage. In-depth field surveys were undertaken with 500 farmers and complemented with focus Group Discussions, Interview, Questionnaires, and Field Observation. The results showed that the consumption pattern of pesticides included Insecticides (61.11%), Herbicides (22.22%) and fungicides (11.11%). Organophosphates were the most frequently used pesticides followed by neonicotinoid and pyrethroid. It was found that the cotton (93.27%) was the high pesticide consuming agroproduct followed by vegetables (87.2%), wheat (66.4%), millet (52.6%) and mustard (12.6%). It was also observed that the farmers have poor scientific knowledge of handling and spraying of pesticides. Safety measures while spraying of pesticides is not being practiced by the farmer at large. Many of the farmers were found smoking and chewing tobacco while spraying pesticides.49.8% of the respondents claimed immediate health hazards after pesticide application. There is no safe chemical, but there are safe ways to use chemicals.

Introduction

Agriculture is the most important sector of the Indian economy providing employment and livelihood to nearly 70% of the total population. A UN study on global population trends predicts that India will surpass China to become the most populous nation in the world by 2022. With a present size of 1.32 billion, India currently supports nearly 17.84% of the world population, with 2.4% land resources and 4 % of water resources (*A report on* Indian Agrochemical Industry July 2016). The rising population has led to increasing food demand. To meet the food & nutrition needs of a growing population requires a sustainable approach that puts thrust on increasing productivity against the

background of lower yields and decreasing farm sizes. The industrialization of agriculture has favored the use of plenty of agrochemicals including fertilizers, pesticides, micronutrients and plant growth regulators in the agricultural fields. Pesticides are an integral part of modern agriculture. The use of pesticides in agriculture is obvious for the prevention of crop-damaging pests, fungus, unwanted plants (weeds) and a number of crop-eating animals like rodents etc. It is also noted that about 15-25% of potential crop production is lost due to pests, weeds, and diseases.

Further, pesticides play a significant role in keeping many dreadful diseases. In India, pesticides are registered for agriculture, public health and for use in households. As on 30th October 2016, 275 pesticides were registered for use in India, of which about 255 are chemical poisons. An analysis by PAN India revealed that more than 115 pesticides out of the 275 are highly hazardous (Kumar and Reddy, 2017).

A vast majority of the population in India is engaged in agriculture and is therefore exposed to the pesticides used in agriculture. However, exposure to pesticides both occupationally and environmentally causes a range of human health problems. It has been observed that pesticide exposures are increasingly linked to immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities, and cancer. At present, per hectare consumption of pesticides in India is amongst the lowest in the world and stands at 0.6 kg/ha against 5-7 kg/ha in the UK and ~ 13 kg/ha in China.

No denying to the fact that chemical pesticides are the most effective, short-term control method for a variety of crop pests and pathogens but their ill effects on human, animal and environmental health have also been well established as they may enter into the environment through a variety of channels. Some of these modes include percolation through soil particles and groundwater, as a part of run-off water thus entering into surface water bodies, as aerosols when applied as sprays, as residues in various plant parts as well as soil and water organisms. Chemical pesticides tend to persist in soil, surface water bodies as well as groundwater for long periods thus imposing serious health threat for humans and animals (Prashar *et al.,* 2015). The present study aims to assess the consumption pattern of pesticides, the farmer's knowledge about pesticides and there use in the agriculture field.

Study area

The study area is Tijara Tehsil of Alwar district, Rajasthan. It is one of the 14 blocks of Alwar district, situated 48 km to the northeast of Alwar. The importance of the city lies with the presence of Jain temple dedicated to Chandraprabha. It is a pilgrimage site for the Jains and a tourist attraction. The tehsil is situated at latitude of27° 56' 3N and longitude of 76° 51' 21E. Tijara is one of the major agriculture intensive areas of Alwar. Agriculture is the prime source of livelihoods. There is a wide range of crops grown in the area. Agro products include carrots, cauliflowers, mustard, radishes, onions, peas, watermelons, wheat, corn, spinach, guar, bajra (millet) and cotton. Consequently, there is a good supply of fresh vegetables. Many villages have orchards or small collections of fruit trees, so a supply of fresh fruit is also available in season.

Materials and Methods

The study was conducted in the agriculture area of Tijara tehsil, Alwar, Rajasthan for 2 years (2016-2018). The villages were

purposely selected to reflect the importance and scale of agriculture production in the study area. A total of 500 farmers were randomly selected for interviewed and questionnaires. Field survey, group discussion, questionnaire methods are used for data collection. Then, the data collected were tabulated and statistically analyzed using simple statistical tools like average and percentage to interpret the results. From these methods, information was gathered on the cropping system, type of vegetable and crop grown, frequently used pesticides, farmer's knowledge about pesticide handling, application, safety measure and final disposal of a container.

Results and Discussion

Frequently used pesticides in Tijara tehsil

The present study revealed that the farmer uses a variety of pesticides under different trade names belonging to different chemical groups. Many of the pesticides fall under the highly hazardous category of WHO guideline. Table 1 shows the most frequently used pesticides their category, chemical formula, toxicity and the crops in which the pesticides are applied. Most of the farmers reported using pesticides for their crops. The main groups of pesticides used included Insecticides (61.11%), Herbicides (22.22%) and Fungicides (11.11%). The study revealed that Organophosphate were the most frequently used pesticides followed by neonicotinoid and pyrethroid.

Consumption pattern of pesticides in the study area

Regarding the consumption of pesticides in agriculture, cotton (93.27%) is the high pesticide consuming agro product followed by vegetables (87.2%), wheat (66.4%), millet (52.6%) and mustard (12.6%) (Table 2). From Table 3 it was observed that for the production of cotton most of the farmers sprayed pesticide twice (52.28%) or thrice (41.42%) in whole cropping season. 64.8% of respondent farmers were applying pesticides 1-2 times for cropping wheat and 33.6% farmers were not using any type of pesticide for wheat production. Mustard is the least (12.6%) pesticide consuming crop. It was found that 263 (52.6%) respondent were consuming pesticide once (39.2%) or twice (13.4%) for the cultivation of millet and remaining 47.4% respondent was not using any pesticide. Most of the Vegetable producer respondents (82%) were applying pesticides 3 to 4 times in the whole growing season of a particular vegetable.

The results showed that 78.2 % of farmers were having basic knowledge of safe handling, application of pesticides and risk associated due to pesticide exposure but they were not ready to change their attitude towards pesticide practices. Most of the respondents (76.2%) didn't read labels on pesticide containers. Handling and application of pesticides require the use of appropriate protective measures and equipment's, which includes the use of gloves, masks, goggles etc. A large proportion of respondents (46.8%) were using a stick or bare hand (33.8%) for mixing the pesticides. Only 19.4% of respondents use safety measure i.e mask, goggles and gloves to protect themselves from direct exposure to the pesticide. About 47% of respondents were using the mask and the remaining 33.6% were not taking any safety measure. During the field study, it was found that many of the farmers were having the habit of smoking and chewing tobacco while spraying pesticides. Only 166 respondent (33.2%) take bath immediately after application of the pesticide, rest of respondent wash their hand and engaged in their daily routine work (Fig. 1–4).

Farmers knowledge and attitude towards pesticides

Variable	Total respondents	
	Number	Percentage (%)
1. Do you have Knowledge of safe handling, application of pesticides and health hazards?		
Have complete knowledge	174	34.8
Have a little knowledge	217	43.4
Don't have any knowledge	109	21.8
Total	500	100%
2. Do you read pesticide's labels before use?		
Always	37	7.4
Sometimes	82	16.4
Never	381	76.2
Total	500	100%
3. How do you mix pesticides?		
With bare hand	169	33.8
With stick	234	46.8
Wear hand gloves and protective eyes goggles and masks.	97	19.4
Total	500	100%
4. Do you use safety measures?		
Only mask	235	47
Mask, Goggles, Gloves	97	19.4
No- safety measure	168	33.6
Total	500	100%
5. What you immediately after a pesticide application		
Hand wash	273	54.6
Take bath	166	33.2
Take rest and smoke and eat and drink something	61	12.2
Total	500	100%
6. Disposal of empty pesticide containers?		
Incineration	48	9.6
Burring	12	2.4
Throw away on the farm or outside	364	72.8
Reuse the empty container	76	15.2
Total	500	100%
7. Health effect after pesticide application?		
Least health hazard effects:- Headache, itching, tiredness, dizziness	249	49.8
Moderate health hazard:- Dizziness, vomiting or blurred vision or skin sores	88	17.6
Extreme health hazard:- long term illness and need to hospitalize.	7	1.4
No health hazard	156	31.2
Total	500	100%

Table.1 Frequently used pesticides in Tijara tehsil

S.No	Pesticide	Type Of Pesticides	Category	Chemical formula	Toxicity labels	Crop Used
1	Monocrotophos	Organophosphorus	Insecticide Acaricide	$C_7H_{14}NO_5P$	Class Ib	Cotton, vegetables
2	Chlorpyrifos	Organophosphorus	Insecticide AcaricideMiticideNematicide	$C_9H_{11}Cl_3NO_3PS$	Class II	Vegetables, All Crops
3	Acephate	Organophosphorus	Insecticide	$C_4H_{10}NO_3PS$	Class II	Cotton, vegetable
4	Phorate	Organophosphorus	Insecticide Acaricide	$C_7H_{17}O_2PS_3$	Class Ia	Vegetables, Cotton, Paddy.
5	Profenofos	Organophosphorus	Insecticide	$C_{11}H_{15}BrClO_3PS$	Class II	Cotton, Vegetables
6	Triazophos	Organophosphorus	Insecticide	$C_{12}H_{16}N_3O_3PS$	Class Ib	Vegetables
7	Imidacloprid	Neonicotinoid	Insecticide	$C_9H_{10}ClN_5O_2$	Class II	Cotton, Chilli
8	Acetamiprid	Neonicotinoid	Insecticide	$C_{10}H_{11}ClN_4$		Cotton, Vegetables
9	Thiacloprid	Neonicotinoid	Insecticide	$C_{10}H_9ClN_4S$	Class II	
10	Deltamethrin	Pyrethroid	Insecticide	$C_{22}H_{19}Br_2NO_3$	Class II	Vegetables
11	Cypermethrin	Pyrethroid	Insecticide	$C_{22}H_{19}Cl_2NO_3$	Class II	Vegetables
12	Dicofol	Organochlorine	Miticide	$C_{14}H_9Cl_5O$	Class II	Fruits, cotton vegetables,
13	Carbendazim	Benzimidazole	Fungicide	$C_9H_9N_3O_4$	* Class	Groundnut, Crops, Fruits vegetables,
14	Mancozeb	dithiocarbamate	Fungicide	$C_8H_{12}MnN_4S_8Zn$	* Class	Crops, Groundnut, Vegetables, Fruits
15	2,4 D	Dichlorophenoxy acetic acid	Herbicide	$C_8H_6Cl_2O_3$	Class II	Wheat, barley
16	Pendimethalin	Dinitroaniline	Herbicide	$C_{13}H_{19}N_3O_4$	Class II	Wheat, Cotton, Vegetable, Groundnut
17	Atrazine	Triazine	Herbicide	$C_8H_{14}ClN_5$	Class III	Millet, Maize, sugarcane
18	Imazethapyr	Imidazolinone	Herbicide	$C_{15}H_{19}N_3O_3$	Class III	Grountnut, soybean

*S. No. 13, 14 in above table are under technical grade active ingredients of pesticides unlikely to present acute hazard in normal use, as per WHO guideline.

Table.2 Consumption of pesticides among farmers for various agro products

S.No.	**Agro products**	**Total no. of farmers respondent**	**No. of farmer consuming pesticide**	**% of farmers consuming pesticides**
1	Cotton	350	328	93.27
2	Wheat	500	332	66.4
3	Mustard	500	63	12.6
4	Millet	500	263	52.6
5	Vegetables	250	218	87.2

Table.3 Pesticides consumption pattern in various agroproducts

Variables	Number of Respondent	Percentage (%) of respondent
No. of time pesticides applied on cotton?		
One time in the whole growing season	-	-
Two times in the whole growing season	145	41.42
Three-time in the whole growing season	183	52.28
Don't Use Pesticides	22	6.28
Total	350	100%
No. of time pesticides applied on wheat?		
One time in the whole growing season	187	37.4
Two times in the whole growing season	137	27.4
Three-time in the whole growing season	8	1.6
Don't Use Pesticides	168	33.6
Total	500	100%
No. of time pesticides applied on Mustard?		
One time in the whole growing season	63	12.6
Two times in the whole growing season	-	-
Three-time in the whole growing season	-	-
Don't Use Pesticides	437	87.4
Total	500	100%
No. of time pesticides applied on Millet?		
One time in the whole growing season	196	39.2
Two times in the whole growing season	67	13.4
Three-time in the whole growing season	00	00
Don't Use Pesticides	237	47.4
Total	500	100%
No. of time pesticides applied to vegetables?		
One time in the whole growing season	-	-
Two times in the whole growing season	13	5.2
Three-time in the whole growing season	82	32.8
Four-time in the whole growing season	123	49.2
Don't Use Pesticides	32	12.8
Total	250	100%

Fig.1 Percentage consumption pattern of pesticides

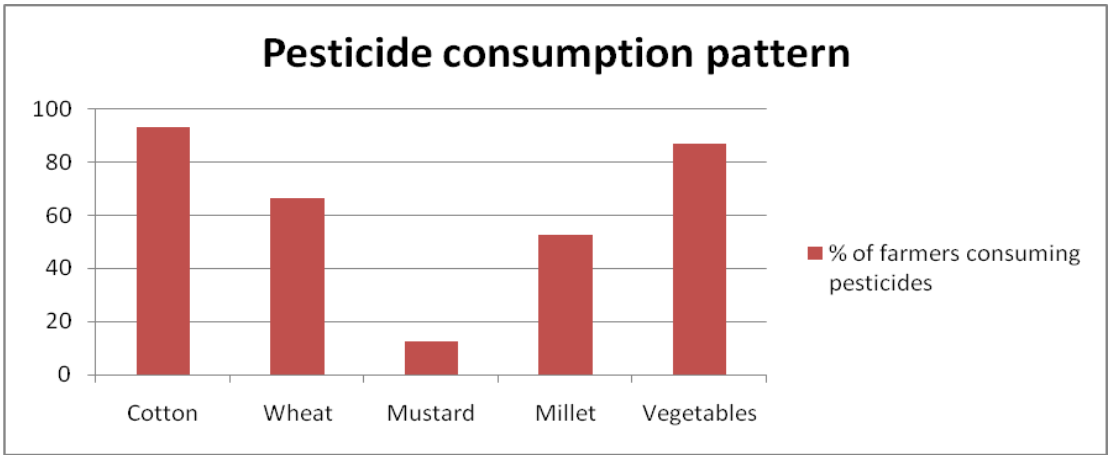


Fig.2 safety measure adopted by the farmer

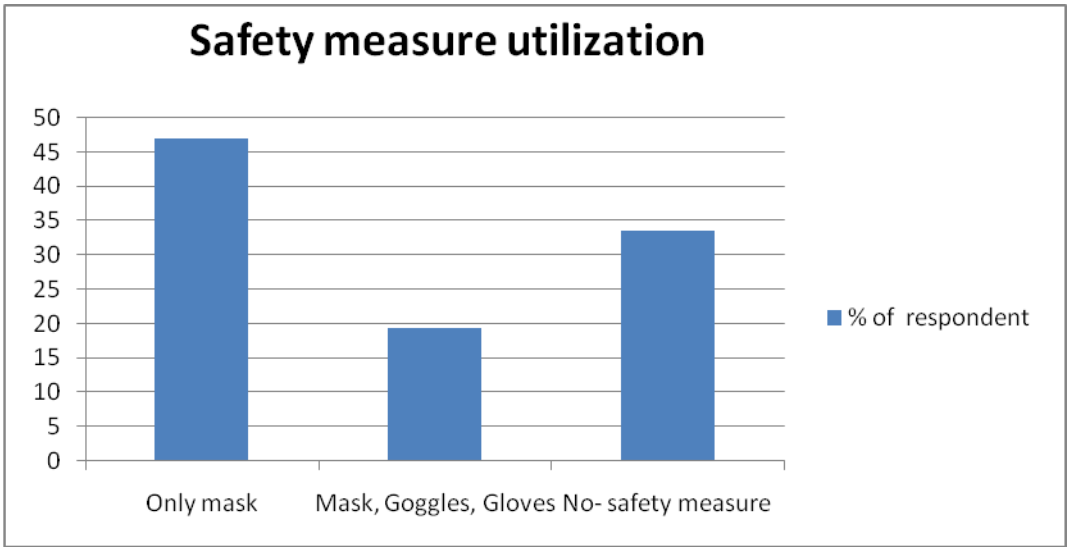
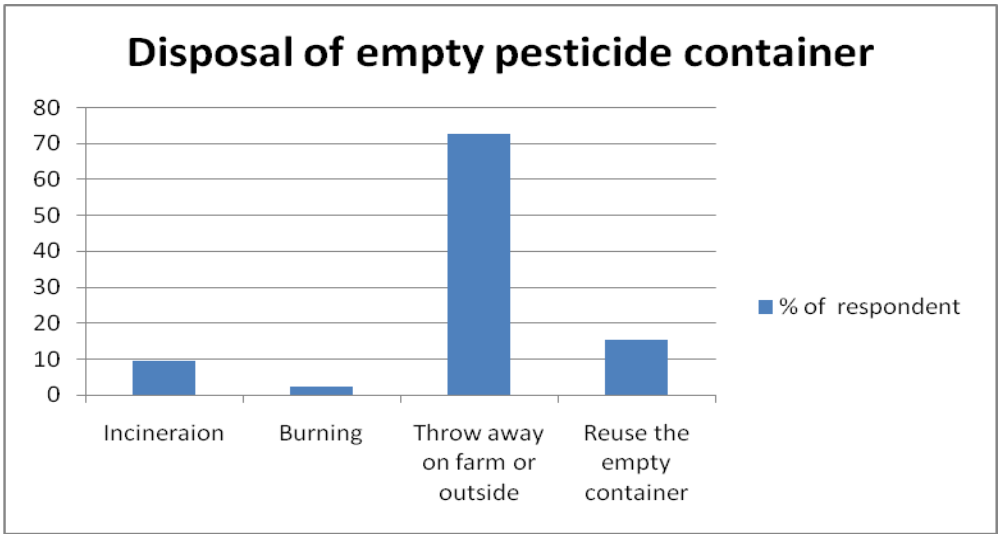


Fig.3 Showing spray handling method without any protective measures

Fig.4 Disposal methods for empty pesticide container



The commonest way of disposing of empty pesticide containers among the respondent farmers (72.8%) was by throwing or discharging them on the field or outside. 9.6% farmer follows the incineration process for disposing of the empty container of pesticide. It was also revealed during the group discussion that some farmers (15.2%) reuse the empty pesticide containers.

Exposure to pesticides both occupationally and environmentally results in serious health hazards. In addition inappropriate and excessive pesticide use and application, lack of proper storage and adopting inadequate protective measures frequently result in harmful health hazards and cause tremendous harm to the environment. The most common health hazards among the sprayer were itching, headache, tiredness, skin sore and blurred vision. Actual health hazards of pesticides are not easily mapped in most circumstance, as they could also be confused with common illnesses. After pesticide application 249 (49.8%) claimed that they felt discomfort and the least health hazards. Moderate health hazard was felt by 88 (17.6%) whereas 156 (31.2%) respondent were not indicating any adverse symptoms.

From the present study, it was concluded that the consumption pattern of pesticides includes Insecticides (61.11%), Herbicides (22.22%) and Fungicides (11.11%). Organophosphate was the most frequently used pesticide followed by neonicotinoid and pyrethroid. In the study area cotton (93.27%) was the high pesticide consuming agro product followed by vegetables (87.2%), wheat (66.4%), millet (52.6%) and mustard (12.6%). From the questionnaire survey done from the farmers concluded that only 78.2 % of respondents were having basic knowledge of safe handling and application of a pesticide. Only a least 19.4% of respondents are using scientific safety measures during the application of a pesticide. The generalized way of disposing of empty container among (72.8 %) farmer were throwing away on the farm and some farmers (15.2%) reuse the empty pesticide containers. It was found that most farmers are aware of risk due to pesticide exposure but they are not ready to change their attitude to take safety measures. The most common effect due to pesticide exposure is skin itching, headache, tiredness, and blurred vision.

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