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Peasant Association Member's Knowledge, Attitudes, and Practices Towards Safe Use of Pesticide Management

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Background *Farmers in the developing world are at risk of pesticide exposure, particularly in low-income countries with a sizable agricultural sector like Ethiopia. The present investigation provides baseline data to develop strategies for the control of pesticide exposure and the prevention of pesticide poisoning.*
Methods *A questionnaire survey of a stratified random sample of peasant farmers belonging to peasant associations was conducted.*
Results *Most surveyed farmers sprayed pesticides without any personal protective equipment. The majority of participants reported using empty pesticide containers for drinking and food storage. Twenty percent of farmers applied pesticides by sweeping with plant leaves in a hazardous manner.*
Conclusions *Ethiopian peasant farmers appeared to have limited knowledge of the hazards of pesticides and generally did not handle pesticides in a safe manner. Active health education campaigns and appropriate training programs should be instigated to promote safe use of pesticides.* Am. J. Ind. Med. 54:965–970, 2011.

KEY WORDS: pesticide management; Ethiopia; peasant farmers

INTRODUCTION

The production and use of synthetic pesticides escalated worldwide after World War II and has stabilized worldwide in recent decades except in developing countries [World Health Organization, 1990]. Agriculture remains the sector using the highest volume of pesticides, followed by vector control. Pesticides are ''poisons by design,'' and are among the most prevalent and serious occupational hazards faced by agricultural workers in developing countries [Ibitayo, 2006].

Pesticides of various kinds have been widely used on farms in Ethiopia for the last four decades. These pesticides are usually organophosphates, carbamates, and, to some extent, organochlorines [Abegaz, 1985]. Pesticide imports into Ethiopia averaged 1.45 tons per annum from 1992 to 2000 [Alemayehu, 2001].

Agriculture is the backbone of the Ethiopian economy and contributes nearly 46% of GDP. Eighty percent of the population of Ethiopia works within the agricultural sector. The majority of farmers in the developing world, especially in countries like Ethiopia, are illiterate and unskilled with little understanding of the health and environmental hazards associated with pesticide handling.

Pesticide sprayers' knowledge, attitude, and practice towards the health hazard of pesticides have not been well-assessed in Ethiopia [Mekonnen and Agonafir, 2002].

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Peasant farmer associations are deep-rooted organizations in Ethiopia and play a crucial role in discussing various agriculture-related issues like the safe use of pesticides, pest control practices, and the introduction of modern agriculture technologies in the farming community. The purpose of the present investigation was to assess the knowledge, attitudes, and practices of Ethiopian peasant farmers with regard to safe use of pesticide management.

MATERIALS AND METHODS

Study Site

The present survey was conducted in Wolkite town, the capital of Guragae Zone, North West of SNNPR state, which is located 156 km southwest of Addis Ababa, the capital of Ethiopia. The town has a total population of 50,000 and at least 14 peasant farmer associations. The major crops in the study area include oats, teff, barley, wheat, horse beans, lentils, and field peas. Average farm size is 3.1 ha, 30% of which is used as permanent pasture or grazing land, and the remainder is cultivated. Of the 14 peasant farmer associations that exist in the study area, we selected two peasant associations (PAs), Tatesa and Rumooga, to participate in the study. Most members of the PA's were active farmers. The survey was undertaken between September and November 2008.

Sampling Technique, Sample Size, and Selection

We selected a random sample of 291 members of two PAs of Tatesa and Rumooga. The desired sample size was determined using the following formula [Aiken, 1988] and found to be 291.

$$n = \frac{NZ^2P(1-P)}{d^2(N-1) = Z^2(P)(1-P)}$$

where, n is the sample size; N is the total number of farmer members of PAs of Tatesa and Rumooga (1,194), Z is the standard normal value at $(1 - \alpha)$ of 95% confidence interval (CI) = 1.96, d is the total error = 0.05, P is the estimated prevalence of the pesticide use.

The study was launched via a meeting with leaders and members of the two invited PAs. The study protocol was reviewed and approved by the institutional review board of the Jimma University, Ethiopia. Written informed consent was obtained from all participants.

Pre-Test

A pre-test of the questionnaire was conducted on a sample of peasant farmers who were not members of the target PA's. The results of the pre-test were reviewed to ensure that vocabulary was appropriate and that there was no loss of meaning. Discrepancies in interpretation or word usage were discussed by the project team and resolved before any interviews were conducted.

Interview and Data Collection

The interview was undertaken among sampled members of the PAs. The questionnaire was prepared in English and translated into the native local language (Amharic) to make it easy to understand and to administer for interviewer and interviewee. Local interviewers were trained in questionnaire administration and were closely supervised during the survey. The questionnaires addressed socio-demographic factors, handling, storage, and application of pesticides, disposal of empty pesticide containers, and appropriate use of personal protective equipment (PPE).

Measures and Analysis

For each of the surveyed members, various measures were created in order to assess their knowledge, attitudes, and practices towards safe use of pesticide management, the role of insects in disease transmission, importance of pesticides for pest control, adverse impact of pesticides on human health and the environment, appropriate use of PPE, storage location of pesticide, types of pest control methods, types of pesticide applicator, and disposal of empty pesticide containers.

Participants whose questionnaire responses indicated a good understanding of the role of insects in disease transmission, the importance of pesticide for pest control, the safe storage of dedicated pesticide container separate from the family's regular food, and the adverse effects of pesticides on health and environment were considered to have a ''good knowledge'' of safe pesticide use.

Farmers who reported never bringing empty pesticide containers home from the farm, who applied pesticide by knapsack sprayer with protective clothing, and who buried empty pesticide containers on the farm received a ''safe'' behavioral score. Farmers who reported applying pesticides with appropriate applicators and used suitable PPE received an ''appropriate'' score. Farmers who reported showering within 15 min of returning home after work received a ''safe'' score for that behavior. Frequencies and percentages of each variable were calculated.

Data Analysis

Statistical analyses were performed with the SPSS 10.1 computer software. Range and mean were analyzed and appropriate tables, graphs, and percentage were

displayed. Level of significance was assessed using 95% CI and *P*-values.

RESULTS

Socio-Demographic Characteristics of the Participants

Demographic features of the 291 participants of the two PA, Tatesa and Rumooga, are given in Table I. Most were male and active farmers. The large majority of participants earn between 300 and 600 Ethiopian Birr per month (1$ = 9.98 Eth. Birr). Few participants had more than 8th grade education.

Knowledge

The majority of the respondents offered multiple responses regarding the role of insects in disease transmission (Table II). The majority of the members of both PAs indicated that insects transmit numerous human and crop diseases. Similarly, 55% of the farmers believed that pesticides are necessary to control pests. 72.9% of members believed that they applied pesticides appropriately. Most farmers had some knowledge about the adverse effects of pesticides on human health and the environment.

Attitudes

Almost all members believed that pesticides are needed for pest control. The majority of the farmers perceived that pests cause problems or discomfort in several ways (Table III).

Practice

Most (76.3%) farmers reported applying pesticides without the use of any PPE (Table IV). Many respondents reported not using appropriate pesticide applicators. One-fifth sweep pesticides with plant leaves. Three-quarters of farmers used empty pesticide containers for food storage or for drinking. Most farmers stored pesticides near or with food or household items.

Farmer income impacted pest control method used. Among 240 participants who reported monthly income, 40% (73 of 194) of farmers with income $\leq$600 Birr/month used traditional methods of pest control versus 11% (6/56) of farmers with income $>$600 Birr/month. Fifty percent (92/184) of poorer farmers also used pesticides to achieve pest control versus 75% (80/107) of farmers with income $>$600 Birr/month.

DISCUSSION

The present study suggests that the great majority of Ethiopian farmers believe that insects play a role in disease transmission and that pesticides are important for pest control. Large amounts of crop yields are lost to pests and diseases, about 30–40% annually, supporting a widespread belief in the need for pest control and the importance of pesticides for pest control in Ethiopia [Abate, 1996].

TABLE I. Socio-Demographic Characteristics of the Members of Tatesa and Rumooga Peasant Associations

Socio-demographic characteristics of respondents	Members of Tatesa PA (n = 160)		Members of Rumooga PA (n = 131)		Total members of PAs (n = 291)	
	Frequency	%	Frequency	%	Frequency	%
Sex						
Male	148	92.5	126	96.2	274	94.1
Female	12	7.5	5	3.8	17	5.9
Monthly income (Ethiopian Birr)[a]						
$\leq$600	97	60.7	87	66.5	184	63.3
$>$600	63	39.4	44	33.6	107	36.7
Occupation						
Farmers	139	86.9	119	90.8	258	88.5
Merchants	11	6.9	7	5.3	18	6.3
Daily laborer	5	3.1	3	2.3	8	2.8
Govt. employees	5	3.1	2	1.5	7	2.4
Religion						
Muslim	150	93.8	121	92.4	271	93.1
Christians	10	6.3	10	7.6	20	6.9

[a]1$ = 9.98 Ethiopian Birr.

TABLE II. Knowledge of Safe Use of Pesticide Management Among the Members of Tatesa and Rumooga Peasant Associations

		Members of Tatesa PA (n = 160)		Members of Rumooga PA (n = 131)		Total members of PA (n = 291)	
Variables	**Responses**	**Frequency of response**	**%**	**Frequency of response**	**%**	**Frequency of response**	**%**
Why should insect pests be controlled?[a]	Transmit malaria	97	60.6	110	84.0	207	71.1
	Transmit eye diseases	82	51.3	86	65.6	168	57.7
	Cause dermatitis	67	41.9	57	43.5	124	42.6
	Spread typhoid fever	78	48.8	61	46.6	139	47.8
	Transmit crop diseases	77	48.1	74	56.5	151	51.9
	Do not transmit any disease	47	29.4	13	9.9	60	20.6
Why are pesticides important?[a]	To control insect pest	84	52.5	76	58.0	160	55.0
	To increase the crop yield	77	48.1	74	56.5	151	51.9
Do you apply pesticides appropriately?	Yes	124	77.5	88	67.2	212	72.9
	No	36	22.5	43	32.8	79	27.1
Could you tell me what are the adverse effects caused by pesticides?[a]	Kill beneficial insects	34	21.3	28	21.4	62	21.3
	Cause air pollution	18	11.3	13	9.9	31	10.7
	Develop pesticide resistance	12	7.5	8	6.1	20	6.9
	Cause death	41	25.6	40	30.5	81	27.8
	Cause vomiting	35	21.9	31	23.7	66	22.7
	Cause headache and nausea	49	30.6	37	28.2	86	29.6

[a]Percentages do not add up to 100, due to multiple responses.

Most participants use pesticides for pest control, and most believe that they are handling pesticides ''appropriately,'' though their practices suggest otherwise. Few use any PPE, and most don't shower after pesticide application. Literacy may be part of the problem, as the participants had limited education. This finding is compatible with the finding that few farm workers read pesticide manufacturers' labels [Avory and Coggon, 1994].

Large worker populations in the developing world are exposed to increasing amounts of pesticides, including

TABLE III. Attitudes of Safe Use of Pesticide Management Among the Members of Tatesa and Rumooga Peasant Associations

		Members of Tatesa PA (n = 160)		Members of Rumooga PA (n = 131)		Total members of PA (n = 291)	
Variables	**Responses**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Do pests cause discomfort?[a]	Contaminating food stuffs	44	27.5	31	23.7	75	25.8
	Results in social stigma	47	29.4	39	29.8	70	24.1
	Transmit several diseases	153	95.6	11	8.4	264	90.7
	Transmit many crop diseases	78	48.8	64	48.9	142	48.8
Do you think pesticides are necessary for pest control?	Yes	154	96.3	124	94.7	278	95.5
	No	6	3.8	7	5.3	13	4.5
How can one reduce the adverse effects of pesticides?	Proper usage and storage	46	28.8	41	31.3	87	29.9
	Create awareness	38	23.8	18	13.7	56	19.2
	Application through traditional method	54	33.8	26	19.8	80	27.5
	Apply least hazardous pesticides	13	8.1	23	17.6	36	12.4
	Exercise environmentally sound methods of application	9	5.6	23	17.6	32	11.0

[a]Percentages do not add up to 100, due to multiple responses.

TABLE IV. Practices of Pesticide Management Among the Members of Tatesa and Rumooga Peasant Associations

		Members of Tatesa PA (n = 160)		Members of Rumooga PA (n = 161)		Total members of PA (n = 291)	
Variables	**Responses**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Which type of pest control do you use?[a]	Traditional method	68	42.5	72	55.0	140	48.1
	Use of pesticides	139	86.9	103	78.6	242	83.2
	Environmental methods	23	14.4	16	12.2	39	13.4
What type of pesticide applicators do you use?	Air compressor	58	36.3	64	48.9	122	41.9
	Duster	11	6.9	6	4.6	17	5.8
	Knapsack sprayer	63	39.4	31	23.7	94	32.3
	Sweeping pesticide with plant leaves	28	17.5	30	22.9	58	19.9
While applying pesticides, which types of protective gear do you use?[a]	Not using any PPEs	128	80.0	94	71.8	222	76.3
	Respirator	15	9.4	14	10.7	29	10.0
	Eye goggles	32	20.0	19	14.5	51	17.5
	Uniform with safety shoes	17	10.6	22	16.8	39	13.4
	Ear muffs	6	3.8	7	5.3	13	4.5
	Any available clothing	26	16.3	15	11.5	41	14.1
Do you take a shower after spraying?	Yes	37	23.1	36	27.5	73	25.1
	No	123	76.9	95	72.5	218	74.9
Where do you store pesticides prior to spraying?	Anywhere with other household items	87	54.4	57	43.5	144	49.5
	Store along with food stuffs	58	36.3	56	42.7	114	39.2
	Keep at separate place	15	9.4	18	13.7	33	11.3
What is the fate of empty pesticide containers?	Bury under soil	11	6.9	6	4.6	17	5.8
	Use for drinking and food storage	121	75.6	97	74.0	218	74.9
	Throw somewhere	21	13.1	25	19.1	46	15.8
	Brought to the vendor	7	4.4	3	2.3	10	3.4

[a]Percentages do not add up to 100, due to multiple responses.

pesticides severely restricted and banned in industrialized countries [Wesseling et al., 1997]. Nearly all surveyed farmers in our study indicated that pesticides can cause numerous adverse effects on health and environment. Similar results had been reported in other studies [Smit et al., 2003; Recena et al., 2006]. This awareness should provide an opportunity to promote use of least hazardous pesticides and integrated pest management (IPM), which could be accomplished by financial incentives to farmers. IPM can dramatically reduce pesticide use while maintaining crop yields [Sherwood et al., 2002]. As a result, introducing IPM could be the acceptable approach to diminish the pesticide impacts on health and environment.

One in five study participants apply pesticides by sweeping with plant leaves, an inexpensive method presumably used by farmers who cannot afford other methods of application. Improper use of pesticides by farmers is known to result in poisoning of occupational origin [Sivayoganathan et al., 1995]. Applicators experience dermal exposure mostly on hands, back, and thighs during the tasks associated with mixing and application [Cole et al., 1998]. The application method of sweeping with plant leaves is hazardous and should be addressed immediately and efficiently by health education campaigns through the PAs. This issue could be resolved by renting pesticide applicators through PAs, which would serve the dual purpose of minimizing pesticide wastage as well as reducing the risk of farmer's exposure to pesticides.

The lack of use of PPEs is due to lack of awareness and affordability. Creating increased awareness and providing PPEs free of charge or at low cost would likely remedy the current situation. Farmers usually mix pesticides in large barrels without gloves, resulting in considerable dermal exposure [Merino and Cole, 2002]. The present study result is consistent with a previous study carried out in Ethiopia [Mekonnen and Agonafir, 2002].

The pesticide storage practices reported in this study are grossly inadequate. A previous study in Ethiopia reported that farmers kept pesticides in the house hanging from the roof or a wall, or, in some cases, outside on top of the roof [Ahrne, 2004]. Pesticide storage is usually relatively brief (days to weeks) but occurs near to farmhouses due to fear of robbery [Merino and Cole, 2002].

Relatively few farmers disposed empty pesticides containers appropriately, and most of the members utilized

empty pesticides containers for drinking, food storage, and other miscellaneous purposes. The present survey results are comparable to a study carried out in Nigeria, where farmers indicated that they disposed pesticide containers by burying (25%), burning (10.4%), throwing into refuse heaps (2.1%), and selling to buyers (25%). Many (35.4%) washed their pesticide containers for other uses, such as storing palm oil [Tijani, 2006]. Improved education and practice of proper pesticide storage and disposal of empty pesticide containers is urgently needed.

CONCLUSION

The findings of the present study clearly suggests that, although Ethiopian farmers had reasonable knowledge about the hazards of pesticides, they had inadequate attitudes and undesirable practices towards safe use of pesticide management due to lack of awareness, deficient training, and limited incomes. There is a need to promote attitudinal changes and to make pesticide applicators and relevant PPE affordable for Ethiopian farmers. As a result, the concerned authorities should initiate active health education campaigns and appropriate training programs to promote the safe use of pesticides and to eliminate or minimize the use of the most hazardous pesticides. Promoting appropriate and alternative eco-friendly pest control technologies like IPM and botanical pesticides may also reduce the use of hazardous pesticides while maintaining crop yields.

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REFERENCES

Abate T. 1996. Ethiopian experience with pesticides—No foundation for food security. Pestic News 33:12–13.

Abegaz G. 1985. The rate of chemical use in development and their impact on the environment. SINET Ethiop J Sci 6.

Ahrne M. 2004. The conditions of pesticide management and possible health hazards in Butajira, Ethiopia. Minor Field Study (MFS)-report. Sweden: Karolinska Institutet.

Aiken LR. 1988. The problem of nonresponse in survey—Research. J Exp Educ 56(3):116–119.

Alemayehu WA. 2001. 'Pesticide use and trends in sub-Saharan Africa'. Response to PAN UK Questionnaire for African government regulators. Addis Ababa: Ministry of Agriculture.

Avory G, Coggon D. 1994. Determinants of safe behaviour in farmers when working with pesticides. Occup Med 44:236–238.

Cole DC, Carpio F, Julian J, Léon N. 1998. Assessment of peripheral nerve function in an Ecuadorian rural population exposed to pesticides. J Toxicol Environ Health 55(2):77–91.

Ibitayo OO. 2006. Egyptian farmers' attitudes and behaviors regarding agricultural pesticides: Implications for pesticide risk communication. Risk Anal 26(4):989–995.

Mekonnen Y, Agonafir T. 2002. Effects of pesticide applications on respiratory health of Ethiopian farm workers. Inter J Occup Environ Health 8:35–40.

Merino R, Cole DC. 2002. Presencia de plaguicidas en el trabajo yel hogar. Chapter 5. In: Crissman CC, Espinosa P, editors. The impact of pesticide use on production, health and environment in Carchi: A compendium of multidisciplinary research and responses. Quito, Ecuador; CIP, 300 pages.

Recena MC, Caldas ED, Pires DX, Pontes ER. 2006. Pesticides exposure in Culturama, Brazil—Knowledge, attitudes, and practices. Environ Res 102(2):230–236.

Sherwood SC, Crissman C, Cole D. 2002. Pesticide exposure is poisoning in Ecuador: A call for action. Pesticides News 55:3–6.

Sivayoganathan C, Gnanachandran S, Lewis J, Fernando M. 1995. Protective measure use and symptoms among agropesticide applicators in Sri Lanka. Soc Sci Med 40(4):431–436.

Smit LA, van-Wendel-de-Joode BN, Heederik D, Peiris-John RJ, van der Hoek W. 2003. Neurological symptoms among Sri Lankan farmers occupationally exposed to acetylcholinesterase-inhibiting insecticides. Am J Ind Med 44:254–264.

Tijani AA. 2006. Pesticide use practices and safety issues: The case of cocoa farmers in Ondo State, Nigeria. J Hum Ecol 19(3):183–190.

Wesseling C, McConnell R, Partanen T, Hogstedt C. 1997. Agricultural pesticide use in developing countries: Health effects and research needs. Int J Health Serv 27(2):273–308.

World Health Organization. 1990. Public health impact of pesticides used in agriculture. WHO in collaboration with UN Environment Programme, Geneva, Switzerland.