



Pesticide Use among Farmers in Sokoto, North Western Nigeria: A Descriptive Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author NCO designed the study, managed the literature search, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MOO and NL managed the analyses of the study. Author NL acquired the data. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2017/34922

Editor(s):

(1) Janvier Gasana , Department of Environmental & Occupational Health, Robert Stempel College of Public Health & Social Work, Florida International University, USA.

Reviewers:

(1) Elvis Djam Miensah, University of Ghana, Ghana.

(2) Marize de Lourdes Marzo Solano, University of Campinas, Brazil.

Complete Peer review History: <http://www.sciencedomain.org/review-history/20037>

Original Research Article

Received 19th June 2017
Accepted 8th July 2017
Published 14th July 2017

ABSTRACT

Aims: The study aimed to assess the pattern of pesticide use and application practices among farmers and factors influencing such practices in Sokoto, North western Nigeria.

Study Design: It was a cross sectional descriptive study.

Place and Duration of Study: it was carried out in April 2017 among crop farmers in the 4 agricultural zones of Sokoto state.

Methodology: A two stage sampling technique was used to recruit 220 farmers. A semi-structured interviewer administered questionnaire was used to collect data which was imputed and analyzed using SPSS IBM version 20.

Results: The mean age of the respondents was 35.95 ± 14.37 years. Only 10 (4.5%) were females. Most 143 (65.3%) used pesticides in the past year with 63 (45.7%) using it occasionally. More than half 83 (60.1%) attested that when purchasing pesticides, they were supplied with safety instructions but only 37 (26.8%) followed the instruction. Of the 220 respondents, only 19 (13.8%) mixed pesticides with hands wearing gloves while majority 131 (94.9%) applied pesticides by

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spraying. Unsafe practices identified were eating food while spraying 35 (26.7%), storage of empty pesticide can at home 77 (55.8%), using the empty pesticide bottle to store water at home. Factors found to be statistically significantly associated with pesticide use were respondents' age ($X^2 = 83.35$; $P < 0.05$); method of farming ($X^2 = 3.75$; $P = 0.05$) and years of working ($X^2 = 64.48$; $P < 0.05$).

Conclusion: The study identified that most of the farmers used pesticides, did not follow instructions while spraying and exhibited some unsafe practices while using the pesticide. It is therefore imperative that the farmers are educated on the risks associated with pesticide use and how to prevent such risks.

Keywords: Pesticide; farmers; occupational exposure; Sokoto; North Western Nigeria.

1. INTRODUCTION

Intensification of agriculture around the world has led to an increase in the use of pesticides. However, despite the contribution of pesticides to agricultural production, evidences in the last few decades have shown that they could also be detrimental to human health and the ecosystem [1]. Pesticides have substantially contributed to the controlling of pests and increasing crop yields in meeting the food demand of escalating population and control of vector-borne disease [2]. Exposure to pesticides is one of the most important occupational risks among farmers in developing countries [3]. According to the World Health Organization (WHO), 20% of pesticides are used in the developing countries and the trends of pesticides use is increasing [4]. Nigeria ranked first according to Bull among West African countries importing pesticides from the United Kingdom having imported 16,462 metric tons of pesticide in 1980 [5-6]. It has been estimated that there are 250,000 deaths annually from pesticide self-poisoning worldwide, accounting for 30% of the suicides globally [7]. The World Health Organization maintained that an estimated 3 million farmers in developing countries experience acute poisoning from pesticide and 18,000 of them eventually die from this [4]. Nigeria is not immune to this phenomenon, 112 people were hospitalized and two children died after eating beans preserved with pesticides in Bekwara Local Government Area of Cross Rivers state. Again, 120 students of a secondary school in Doma, Gombe State became sick as a result of eating food items contaminated by pesticides [8].

Though Pesticides are beneficial, inappropriate use can be counterproductive and can have significant human health consequences and hence should essentially be subject to safe and judicious use [9]. Many users are inadequately informed about potential short and long-term risks, and the necessary precautions in the

correct application of such toxic chemicals are not always made [10]. It is therefore mandatory that we ensure the safety of the user due to the hazardous nature of pesticides. Importantly, all farmers must get acquainted with the correct application of registered agrochemicals for use and ensure that all safety measures are strictly adhered to, if they are to live healthy lives [11]. This study aimed to assess the patterns of pesticide use and application practices among farmers and factors influencing such practices in North western part of Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

Sokoto State located in the North western part of Nigeria, has 4 agricultural zones viz; Sokoto, Gwadabawa, Isa and Tambuwal each having an average of 5 – 6 Local government areas (LGAs) [12]. Arable and livestock farming is the main stay of the state's economy accounting for a significant proportion of the Gross domestic product (GDP) and responsible for about 70% of the total employment [13]. Major dry season vegetable crops which are mostly grown under irrigation include onion; carrot; rice; wheat and garden egg [12].

2.2 Study Design

A cross –sectional descriptive design was used for the study.

2.3 Study Population

Crop farmers in the 4 agricultural zones of Sokoto state who had been involved in farming for more than one planting season were eligible to participate in the study.

2.4 Sample Size Determination

Using the proportion of farmers who used personal protective equipment (PPEs) while

applying pesticides in a previous study = 15% [14], the sample size was determined by using the formula $n = z^2pq/d^2$ [15] and allowing for 90% response rate, 220 farmers were recruited for the study.

2.5 Sampling Technique

A two-stage sampling technique was used to select the respondents for the study. Using simple random sampling by balloting, 1 LGA from each of the 4 agricultural zones was chosen. Allocation of the number of respondents required from each chosen LGA was done based on the total number of respondents in each LGA. Then using a systematic sampling technique, the respondents for each LGA were selected using the sampling interval of each LGA. The number of farmers in each selected LGA (N) was obtained (from the association of farmers) and this was divided by the number of farmers proportionally allocated to each LGA (n) to obtain the sampling interval for each LGA. A random number was then chosen between 1 and the sampling interval and the first farmer on the list was then recruited with subsequent farmers chosen using the sampling interval.

2.6 Study Instrument

A Semi-structured interviewer administered questionnaire containing open and close-ended questions was used to collect information from the farmers. The questionnaire was adapted from published articles [16-18]. It sought to answer questions on pattern of pesticide use (before, during and after application). The questionnaire was developed in English and translated to Hausa by a Hausa scholar. Five students from the school of health information technology were recruited to assist the principal researcher on data collection. They were trained and the questionnaire was pretested and administered in Hausa language (the local language of the respondents).

2.7 Data Management

Data was sorted, entered into and analyzed using Statistical software for social sciences (SPSS) version 20 by the principal researcher. Descriptive data was summarized using mean and standard deviation while categorical variables was summarized using proportions and percentages. Pearson's chi-square was used to determine relationship between categorical

variables. The level of significance was set as $P = 0.05$. Results were presented in tables.

2.8 Ethical Considerations

Ethical approval was sought from the State ethical committee, permission was sought from the association of farmers. Informed consent was obtained from each respondent.

3. RESULTS

3.1 Sociodemographic Characteristics of Respondents

The mean age of the respondents was 35.95 ± 14.37 with an age range of 11 – 80 years. Majority of the respondents 210 (95.5%) were males while only 10 (4.5%) were females. Over half of the respondents 118 (53.6%) had quaranic education, only 19 (8.6%) had tertiary education and most 147 (66.8%) were married. (Table 1). (Level of education was categorized as Quaranic education, Primary education, Secondary education and Tertiary education according to Nigerian educational system).

Table 1. Distribution of respondents by sociodemographic characteristics (n = 220)

Variables	Frequency (%)
Age range of respondents (years)	
10 – 20	45 (20.5)
21 – 30	49 (22.3)
31 – 40	43 (19.5)
41 – 50	50 (22.7)
>50	33 (15.0)
Sex	
Male	210 (95.5)
Female	10 (4.5)
Level of education	
None	6 (2.7)
Quaranic	118 (53.6)
Primary	31 (14.2)
Secondary	46 (20.9)
Tertiary	19 (8.6)
Marital status	
Single	73 (33.2)
Married	147 (66.8)

3.2 Farming Activity of Respondents

Majority of the farmers 205 (93.2%) owned farm lands, over half 128 (58.1%) practiced fadama farming and three quarters 168 (76.4%) practiced manual farming. Most of the farmers cultivated vegetables 118 (84.3%) and grains 121 (68.0%).

3.3 Pesticide Use

A good proportion 143 (65.3%) of the respondents had used pesticides on their farm during the past year and most 127 (92.0%) knew the names of the pesticides used. The mean duration of pesticide use by the farmers was 3.21 ± 2.31 years. Over a third 63 (45.7%) used pesticide occasionally, 62 (44.9%) applied pesticide for weed control and 60 (43.5%) applied it before planting. More than half 83 (60.1%) attested that when purchasing pesticides, they were supplied with safety instructions but only 37 (26.8%) followed the instruction.

Table 2. Pesticide use by respondents (n = 220)

Variables	Yes (n/%)	No (n/%)
Do you use pesticides on farm	138 (62.7)	82 (37.3)
Do you know names of pesticides	127 (92.0)	11 (18.0)
Did you use pesticides during the past year?	143 (65.3)	76 (34.7)
Frequency of use of pesticides		
Regular		
Seasonal	49 (35.5)	
Occasional	26 (18.8)	63 (45.7)
Period of use of pesticides		
Before planting	60 (43.5)	
Immediately after planting	61 (44.2)	
Occasional	17 (12.3)	
Purpose of applying pesticide		
Weed control	62 (44.9)	
Pest control	42 (30.4)	
Rodent control	13 (9.4)	
Fungi control	21 (15.3)	
Any instruction when purchasing pesticides?	83 (60.1)	55 (39.9)
If yes, do you read and understand?	28 (33.7)	55 (66.3)
If you cannot read, do you get help?	40 (48.2)	43 (51.8)
Do you follow instruction on label?	37 (26.8)	101 (73.2)

3.4 Mixing and Application of Pesticide

Very few of the respondents 19 (13.8%) mixed pesticides with hands wearing gloves. Most 131 (94.9%) applied pesticide by spraying and 76 (58.0%) did so when it was windy. A good number 80 (61.1%) sprayed 2 or more mixed pesticide and 61 (44.2%) sprayed the recommended concentration.

Table 3. Mixing and application of pesticides

Variables	Yes (n/%)	No (n/%)
How do you mix pesticides?		
With bare hands	37 (26.8)	
With hands wearing gloves	19 (13.8)	
With stick but bare hands	62 (44.9)	
With stick wearing gloves	20 (14.5)	
Do you apply pesticides by spraying?	131 (94.9)	7 (5.1)
If yes, do you spray it when it is windy?	76 (58.0)	55(42.0)
Do you spray 2 or more mixed pesticides?	80 (61.1)	51(38.9)
Concentration of pesticide sprayed	61 (44.2)	
The recommended	13 (9.4)	
More than the recommended	9 (6.5)	
Less than the recommended	55 (39.9)	
Based on my personal experience		

3.5 During Spraying

Thirty-five (26.7%) of the respondents ate food while spraying, only 5 (3.8%) wore wide brimmed hat and 47 (35.9%) wore gloves while spraying.

Table 4. Spraying of pesticides by respondents

Variables	Yes (n/%)	Responses
During spraying, do you do the following?		
Smoke	8 (6.1)	
Drink water/alcohol	19 (14.5)	
Eat food	35 (26.7)	
Chew gum	14 (10.7)	
Which of the following do you wear while spraying?		
Wear gloves	47 (35.9)	
Wear googles	18 (13.7)	
Wear mask	22 (16.8)	
Wear boots	32 (24.4)	
Wear overalls	7 (5.3)	
Wear wide brimmed hat	5 (3.8)	

3.6 After Spraying

After spraying, majority 122 (93.1%) washed their hands with soap and water, 79 (60.3%) cleaned the sprayers' nozzle using a thin wire and most 90 (68.7%) did not display a red flag to warn others. Over half 77 (55.8%) stored the empty pesticide can in their homes and 58 (42.1%) used the empty cans to store water at home.

Table 5. Activities after spraying

Variables	Yes responses (n/%)
Practices observed after spraying	
Wash hands with soap and water	122 (93.1)
Change clothes	81 (61.8)
Bath immediately	85 (64.9)
How do you clean the sprayers' nozzle?	
By blowing air through it with your mouth	35 (26.7)
By using a thin wire	79 (60.3)
Others	17 (13.0)
Do you display a red flag after spraying to warn others?	41 (31.3)
Where do you store empty pesticide can?	
In a specific storage site on farm	61 (44.2)
In the home	77 (55.8)
What do you do with empty pesticide bottle?	
Storage of water at home	58 (42.1)
Storage of food stuff at home	24 (17.4)
Throw it on garbage sites	26 (18.8)
Burying or burning	30 (21.7)

3.7 Factors Influencing Pesticide Use

Factors found to be statistically significantly associated with pesticide use were

respondents' age ($X^2 = 83.35$; $P < 0.05$); method of farming ($X^2 = 3.75$; $P = 0.05$) and years of working ($X^2 = 64.48$; $P < 0.05$).

Table 6. Factors influencing pesticide use

Variables	Pesticide use		Chi-square/P-value
	Yes n(%)	No n(%)	
Age-group			
10 – 20	5 (11.1)	40 (88.9)	
21 – 30	25 (51.0)	24 (49.0)	$X^2 = 83.35$
31 – 40	35 (81.4)	8 (18.6)	$P < 0.05$
41 – 50	43 (86.0)	7 (14.0)	
>50	30 (90.9)	3 (9.1)	
Sex			
Male	133 (63.3)	77 (36.7)	$X^2 = 0.22$
Female	5 (55.6)	4 (44.4)	$P = 0.64$
Level of education			
None	3 (50.0)	3 (50.0)	
Quaranic	80 (67.8)	38 (32.2)	
Primary	19 (61.3)	12 (38.7)	$X^2 = 4.06$
Secondary	24 (52.2)	22 (47.8)	$P = 0.39$
Tertiary	12 (66.7)	6 (33.3)	
Method of farming			
Manual	100 (59.5)	68 (40.5)	$X^2 = 3.77$
Mechanized	38 (74.5)	13 (25.5)	$P = 0.05$
Years of work (years)			
0 – 5	21 (27.3)	56 (72.7)	
6 – 10	23 (74.2)	8 (25.8)	$X^2 = 64.68$
>10	94 (83.9)	18 (16.1)	$P < 0.05$

4. DISCUSSION

Pesticides may be the most prevalent and serious occupational hazard faced by farmers and are known to be harmful to both man and the environment [19]. The study showed that majority of the respondents were males with very few being females. This shows the dominance of male gender in farming in the study area. Crop farming is mostly an outdoor activity and this could be restricting for most females who are under 'purdah' in this part of the country. (A cultural practice that forbids the woman from going outdoors without the express permission of her husband). This finding is similar to that of a study conducted in the South Western part of Nigeria [20]. It was also revealed in the study that over half of the respondents were not formally educated. This might imply that they might not adopt safe practices while using pesticides as it has been postulated that high literacy level may influence adoptions of safe practices [21]. Similar studies in developing countries have also reported low educational level of farmers [22-25].

It was shown in the study that most of the farmers used pesticides in their farms mostly for weed control. Studies in Uyo and Oyo State, Nigeria found that farmers used a variety of pesticides in their farms [26– 27]. The prevalence of mixing two or more pesticides and using the pesticides based on their experience was high among the farmers in this study; this practice could put the farm workers at risk, due to the synergistic or potentiating effect of chemicals [28]. This finding was corroborated by a study in Vietnam which found that the majority of the farmers mixed different insecticide products [29].

It was reported in this study that most of the farmers ate or drank while spraying. Similar behavior was reported in studies in India [30]. It has been observed that such behavior contributes to the farmers' increased exposure to pesticides which could be detrimental to their health in the short and long term [31]. Very little proportion of the farmers used personal protective equipment (PPEs) while spraying. It can be postulated that non-availability of such PPEs could be the reason why very few utilized them. People who work with these chemicals should receive proper training on their safe use and PPE to minimize exposure and reduce health risks [32]. For most pesticides, using protective measures results in a decrease of exposure to pesticides. Similar reductions are seen for farm workers using gloves compared to

those not using gloves [33]. In a similar study in India, unsafe practices among pesticide users was also reported [34].

Also, it was demonstrated that the farmers exhibited some unsafe practices such as storage of pesticide can at home and using the empty pesticide cans to store water at home. Such unsafe practices have been shown to expose children and adults to hazardous risks and this constitutes one of the main problems associated with pesticide use in developing countries [35]. These unsafe practices were also noted in a similar study in Palestine [36]. It was also noted in this study that some farmers disposed the empty pesticide cans in the field and by burying and burning. Disposal of the empty containers in the field or by throwing them near or into local waste containers is a totally unsafe practice and has been reported as a major problem in a number of studies [37–39]. Although distributors and suppliers recommend burying and burning as a means of disposal of empty pesticide cans, they can be potentially hazardous to human health and the environment and should be discouraged as many farmers do not have knowledge of safe burning and burial procedures [40].

Factors found to be statistically significantly associated with pesticide use were respondents' age; method of farming and years of working. Farmers who have been working for years might have been using pesticide for such duration, hence, the association. This is disturbing as long term exposure to these chemicals have been found to be detrimental to health [7]. It is therefore imperative that farmers are well educated on the risks involved in their work so that they can live healthy lives whilst providing for their families.

5. CONCLUSION

The study identified that most of the farmers used pesticides, did not follow instructions while spraying and exhibited some unsafe practices while using the pesticide. It is therefore imperative that the farmers are educated on the risks associated with pesticide use and how to prevent such risks.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Tadesse A, Asferachew A. An assessment of the pesticide use, practice and hazards in the Ethiopian rift valley. Africa Stockpiles program. 2008;Annex 6:61.
2. Konradsen F, Van der Hoek W, Cole DC, Hutchinson G, Daisley H, Singh S, Eddleston M. Reducing acute poisoning in developing countries-options for restricting the availability of pesticides. Toxicology. 2003;192:249-261.
3. Coronado GD, Thompson B, Strong L, Griffith WC, Islas I. Agricultural task and exposure to organophosphate pesticides among farm workers. Environ. Health Persp. 2004;112:142-147.
4. World Health Organization. The WHO recommended classification of pesticide by Hazard and guidelines to classification. WHO, Geneva; 2000.
5. Bull D. A growing problem, pesticides and the third world poor. OXFAM, Oxford. CILSS (Institut du sahel)/ CEA (Nations unies); 1982.
6. Okunade SO. Control of household and Garden pest. 2nd Edition. Oladapo Idowu Printing Press, Kano; 2009.
7. Chitra GA, Muraleedharan VR, Swaminathan T, Veeraaghavan D. Use of pesticide and its impact on health of farmer in south India. 2006;12(3):228-33.
8. Shaibu I. 'NAFDAC bans 30 agrochemical products' Vanguard; 2008. Available:www.allafrica.com (Accessed on Wednesday, 22nd May, 2017)
9. Hori T, Avilez I, Iwama G, Johnson G, Afonso LO. Impairment of the stress response in *Brycon juveniles* (*Brycon amazonicus*) exposed to low concentrations of phenol. Comp. Biochem, Physiol. C. Toxicol. 2008;34:21-29.
10. Damalas CA, Ilias Eleftherohorinos G. Pesticide exposure, safety issues, and risk assessment indicators. International Journal of Environmental Research and Public Health. Web of Science; 2001.
11. Akunyili D. Safe and responsible use of agrochemicals. Workshop in Gombe, Gombe State; 2008.
12. C-GIDD (Canback Global income distribution database). Canback Dangel. (Retrieved 2017-05-07)
13. NPC. The population census result, Abuja. Federal Government of Nigeria; 2006.
14. Adeola RG. Perceptions of environmental effects of pesticides use in vegetable production by farmers in Ogbomoso; Nigeria. Global journal of Science Frontiers Research Agriculture and Biology. 2012;7(4);1.
15. Araoye M. Research methodology with statistics for health and social sciences. Ilorin; Natherdex. 2004;118-119.
16. WHO field surveys of exposure to pesticides: Standard protocol; Geneva. 1982;5-6.
17. Defeo KL. Pesticides' retailers' exposure to pesticides in La Paz; Bolivia in Department of Environment and Occupational health. Emory University, Atlanta, Georgia. 2009; 73.
18. Yassin MM, Abu Mourad TA, Safi JM. Knowledge, attitude, practice and toxicity symptoms associated with pesticide use among farm workers in the Gaza strip. Occup. Environ. Med. 2002;59:387-394.
19. Ibitayo OO. Egyptian farmers' attitudes and behaviors regarding agricultural pesticides: Implications for pesticide risk communication. Texas Southern University, U.S.A; 2007.
20. Owolabi KE, Okunlola JO. Farmers' utilization of indigenous knowledge, techniques for the control of cocoa pests and diseases in Ekiti State, Nigeria. Asian Journal of Agricultural Extension, Economics & Sociology. 2015;4(3):247-258.
21. Odoemelam LE, Ajuka PN. Indigenous farm management practices among rural farmers: Implications for sustainable environment in South-East Agro-Ecological Zone, Nigeria. Discourse Journal of Agriculture and Food. 2015;3(1):7-14.
22. Hurtig AK, San Sebastián M, Soto A, Shingre A, Zambrano D, Guerrero W. Pesticide use among farmers in the Amazon basin of Ecuador. Arch Environ Health. 2003;58(4):223-8.

23. Recena MC, Caldas ED, Pires DX, Pontes ER. Pesticides exposure in Culturama, Brazil—knowledge, attitudes, and practices. *Environ Res.* 2006;102(2):230-6.
24. Oliveira-Silva JJ, Alves SR, Meyer A, Perez F, Sarcinelli PN, Da Costa Mattos RC, et al. Influence of socioeconomic factors on the pesticides poisoning, Brazil. *Rev Saude Publica.* 2001;35(2):130–5.
25. Mekonnen Y, Agonafir T. Pesticide sprayers' knowledge, attitude and practice of pesticide use on agricultural farms of Ethiopia. *Occup Med.* 2002;52(6):311–5.
26. Augustine Udoh J, Comfort Umoh E. Utilization pattern of pesticides by Nigerian farm households. *Indian Res. J. Ext. Edu.* 2011;11(2):6-14.
27. Ugwu JA, Omoloye AA, Asogwa EU, Aduloju AR. Pesticide-handling practices among smallholder vegetable farmers in Oyo state, Nigeria. *Scientific Research Journal.* April 2015;3(4):40-47.
28. Allaby M. *The concise oxford dictionary of ecology.* Oxford: Oxford University Press; 1994;378.
29. Paul VM, Nguyen TTC, Arnold VH. Farmers' knowledge, perceptions and practices in mango pest management in the Mekong delta, Vietnam. *International Journal of Pest Management.* 2001;47(1): 7-16.
30. Sameer Abdulla Al-Haddad, Adel Salman Al-Sayyad. Pesticide Handlers' Knowledge, Attitude and Practice. *Bahrain Medical Bulletin.* 2013;35(1).
31. Gaber S, Abdel-Latif S. Effect of education and health locus of control on safe use of pesticides: A cross sectional random study. *J Occup Med Toxicol.* 2012;7:3.
32. Gomes J, Lloyd OL, Revitt DM. The influence of personal protection, environment hygiene and exposure to pesticides on the health of immigrant farm workers in a Desert country. *Int Arch Occup Environ Health.* 1999;72(1):40-5.14.
33. Woodruff TJ, Kyle AD, Bois FY. Evaluating health risks from occupational exposure to pesticides and the regulatory response. *Environ Health Perspect.* 1994;102(12): 1088–96.
34. Gaber Singh B, Gupta MK. Pattern of Use of personal protective equipment and measures during application of pesticides by agricultural workers in a rural area of Ahmednagar District, India. *Indian J Occup Environ Med.* 2009;13(3):127-30.
35. Wesseling C, McConnell R, Partanen T, Hogstedt C. Agricultural pesticide use in developing countries: Health effects and research needs. *Int J Health Serv.* 1997; 27(2):273–308.
36. Sa'ed Zyoud H, Ansam Sawalha F, Waleed Sweileh M, Rahmat Awang, Suleiman Al-Khalil I, Samah Al-Jabi W, Nihaiia Bsharat M. Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications; 2010.
37. Hurtig AK, San Sebastián M, Soto A, Shingre A, Zambrano D, Guerrero W. Pesticide use among farmers in the Amazon basin of Ecuador. *Arch Environ Health.* 2003;58(4):223–8.
38. Recena MC, Caldas ED, Pires DX, Pontes ER. Pesticides exposure in Culturama, Brazil-knowledge, attitudes, and practices. *Environ Res.* 2006;102(2):230–6.
39. Avory G, Coggon D. Determinants of safe behavior in farmers when working with pesticides. *Occup Med.* 1994;44(2):236–8. London L. Agrichemical safety practices on farms in the Western Cape. *S Afr Med J.* 1994;84(5):273–8.
40. WHO. World Health Organization, safe use of pesticides. Fourteenth report of the WHO expert committee on vector biology and control. *World Health Organ Tech Rep.*1991;813:1–27.

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