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Assessment of pesticide hazard related knowledge and practices of agricultural extension workers in selected small-scale horticulture production areas in Ethiopia

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Abstract: There is a recent expansion of modern agriculture in Ethiopia resulting in intensification of chemical pesticide use. Due to an inherent hazard of pesticides to the environment and human health, pesticides need to be properly used, handled and managed. Agriculture extension workers (AEWs) are supposed to give advices on pesticides hazards so as risks due to pesticide use is minimized. A cross-sectional questionnaire survey was done by purposively sampling 69 AEWs in the main horticultural production districts of central eastern Ethiopia. The overall objective of the survey was assessing levels of pesticide hazard related knowledge and related practices of AEWs. More than 90% of the surveyed AEWs have a diploma or lower level of education. 26% and 29 % of the AEWs reported attaining a course and participating in an on job training in relation to pesticide hazards, respectively.7% and11% of the interviewed AEWs mention modern methods of pesticide controls i.e. organic farming and Integrated Pest Management (IPM) practices, respectively. 22% of the AEWs indicate they usually give advices on pesticide hazards in general. Similarly 20% and 11% of the AEWs remarked providing advices on proper storage and disposal as well as occupational exposure prevention methods of pesticides to farmers, respectively. This study underlines a relatively lower educational level of AEWs who do not have enough pesticide hazard related knowledge and cannot or not practically advising on pesticide related hazards. AEWs should have continuous on job capacity building trainings on pesticide hazards in order to minimize environmental and occupational risks due to the intensifying chemical pesticide use in Ethiopian agriculture.

Keywords: Ethiopia; extension workers; knowledge; pesticides hazards

Introduction

Agriculture is the back-bone of Ethiopian economy; it contributes up to 37 % of Gross domestic product (GDP) and 73 % employment (Indexmundi, 2018). In

Ethiopia a record of double digit average growth (10.5%) was observed over the past years (2005/06 to 2015/16), expansion and intensification of agriculture account significantly to this growth (World Bank, 2017). In most low income countries, intensification of agriculture has led to an increase in use of Agro-chemicals including chemical pesticides (Jors *et al.,* 2006). Pesticides are essential part of modern agriculture, without the use of pesticides in warm climates typical of tropical low income countries; there could be an estimated 50% loss of crop production and productivity (Damalas and Eleftherohorinos, 2013). But usually over 90% of the applied pesticides reach non-target environmental destinations other than the target pests (Pimenteln *et al.,* 1993). Therefore, causing human health hazards and environmental risk, as well as numerous effects on other living organisms such as honey bees, fishes, birds, amphibians etc. (Adesuyi *et al*., 2018; Aktar *et al*., 2009).

In a study by Negatu et al (2016a) 6 to 13 folds increase in pesticide use intensity from previous estimates in surveyed agricultural farms in Ethiopia was reported. Other studies have also indicated misuse of pesticides (e.g. use of DDT on food crops), improper handling (e.g. limited use of personal protective equipment), and improper management (e.g. burial of empty pesticide containers or expired pesticides) (Karunamoorthi *et al.,* 2011; Mekonnen and Agonafir, 2002). Also absence of pesticide hazard (environmental and occupational) related formal trainings for farmers was reported (Negatu *et al.,* 2016a). In addition, studies on environmental and occupational effects of pesticide exposure underlined higher health risks to the general public as well as occupationally exposed farmers (Gebremichael *et al.,* 2016 ; Jansen and Harmsen, 2011; Negatu *et al.,* 2016b).

The Ethiopian agricultural extension strategy usually pushes in one way or another for an increased use of Agro-chemical inputs including pesticides (Berhanu, 2009). Agriculture extension workers (AEWs) are supposed to give advices on safe pesticide use, handling and proper disposal. But, in order give proper pesticide risk related extension services AEWs themselves should have an adequate pesticide hazard related trainings and practical knowledge about it. Studies in other low income countries have indicated AEWs are not adequately trained in environmental and occupational hazards aspects of pesticides so that they were not able to provide adequate services to farmers with regard to safe use, handling and disposal of pesticides as well as recommendation in case of acute pesticide poisoning (Grace, 1997; Ngowi *et al.,* 2002; Lekei *et al*., 2014 and Saleh *et al*., 2016).

In Ethiopia, there are few studies on pesticide hazard related knowledge and as-

sociated practices of farmers (Mekonnen and Agonafir , 2002; Negatu *et al.*, 2016a). However, there is a paucity of information on pesticide hazard related knowledge and practices of AEWs who are theoretically a source of information to rural farmers on training and safe usage of new technologies including pesticides. Therefore, this study was to assess the level of pesticide hazard related knowledge and associated practices of selected agricultural extension workers in Ethiopia.

Material and Methods

Study area

The study was conducted in the main horticultural production belt of Ethiopia, located in Central east part of the country where there is an abundant water resources for an intensive horticultural production e.g. Ziway lake. There are two districts (i.e. Dugda bora and Adami Tulu Jido Kombolcha) known for their horticultural crop production in hundreds of small scale irrigated farms located in proximity with Ziway lake, where use of agro-chemicals including pesticides is high. All available agricultural extension workers at the time of interview who are specialized in crop protection and employed at least for 12 months preceding the time of interview were purposively sampled from the two districts and included in the study.

Data collection

Out of 195 AEWs specializing in natural resource management, animal and plant science that was presented in the selected districts. A total of 72 AEWs that specialized in plant science (who are expected to advice the farmers on crop plant issues) were invited to participate. Only 69 AEWs with plant science background (i.e. district level and peasant association AEWs) were present during the exact time of the survey in their respective working areas. The available AEWs were interviewed face-to-face using a structured close-ended questionnaire after verbal consent was obtained for participation in the study.

The questionnaire has three parts to gather information on socio-demographic factors, pesticide-related Knowledge and acquired pesticide hazard related trainings as well as pesticide-related extension services that were carried-out (i) Socio-demographic part of the questionnaire contained five questions e.g. What is your current age ? (ii) The pesticide hazard related Knowledge and acquired relevant tannings part

comprised of five questions e.g. any pesticide hazard related on job trainings? (iii) The pesticide-related extension services part has got two questions, e.g. ever pesticide hazard related training provision to farmers?

Data analysis

The collected data were analysed using Stata SE/12.0 after first computerizing the individual questionnaire data in Epi Data software. Descriptive statistics was used to compare study variables in the data i.e. arithmetic mean (AM) and standard deviation (SD) for continuous variables and frequency and percentile values for categorical variables.

Results and Discussions

Socio-demographic factors

Most of the surveyed extension workers were employed more than two years (94%) and have a diploma or lower level of education (93 %) (Table1). A study on AEWs in Ethiopia also has reported a similar result of lower educational level of agricultural extension workers i.e. majority of available staff members are diploma and certificate holders (Mossie and Meseret, 2014). This indicates that the agricultural extension work in Ethiopia is usually done by those with lower level of higher education that might question their efficiency to provide appropriate advices for farmers in case of extension of newer technologies like pesticides.

Pesticide hazard related knowledge

Only 26% of the AEWs reported taking any course related to pesticide hazards and also 29% have acquired on job short term training in relation to pesticide hazards (Table 2). A similar finding was reported in Tanzanian agricultural extension workers (Ngowi *et al.,* 2002). In general the absence of adequate pesticide hazard related course as well as on job capacity building of AEWs may be an obstacle to provide adequate extension services on pesticide hazards to farmers.

Most of the extension workers mention they know at least an alternative to chemical pesticide use (91%) but all (100%) indicate cultural method /hand weeding as an alternative. Also, only 7 % and 11 % of the interviewed mention modern methods of pesticide controls i.e. Organic farming and Integrated Pest Management (IPM) practices, respectively (Table 2).

Table 1 - Socio-demographic characteristics

Surveyed study variables		Number	%
1.	Educational level		
	First degree	4	5.80
	Diploma	64	92.75
	Certificate	1	1.45
2.	Service year		
	< 2 years	4	5.80
	2-5 years	28	40.58
	6-9 years	22	31.88
	> 10 years	15	21.74
3.	Age		
	< 26	14	20.29
	26-28	20	28.98
	29-32	19	27.54
	> 32	16	23.19

Nevertheless, knowledge to the alternatives of chemical pesticides use is there in surveyed extension workers, the alternative explained by all of the extension workers i.e. traditional hand weeding cannot be relatively applied in the surveyed districts because it is more labor intensive and not practically applicable for horticultural crops in which there are many pest and diseases exist at different stages of crop development rather than mostly weeds in which hand weeding may be an option. In generally knowledge on modern crop-protection methods is essential as environmental safety is a pre-request for sustainable agriculture production and green development.

Most (90%) of the agricultural extension workers agree that pesticide exposure is at least a problem in their working area but majority (70%) indicated it is just a minor problem (Table 2).

Table 2 - Pesticide Hazard related knowledge and trainings

Surveyed variables		Number	%
1.	Any course taken relating to pesticide hazards		
	yes	18	26.09
	no	51	73.91
2.	On job training		
	yes	20	28.99
	no	49	71.01
3.	Alternative to pesticides		
	yes	63	91.30
	no	6	8.70
3.1	Organic farming		
	yes	5	7.94
	no	58	92.06
3.2	Integrated pest management (IPM)		
	yes	7	11.11
	no	56	88.89
3.3	Cultural methods		
	yes	63	100.00
	no	_	
4.	Pesticide exposure problem		
	Not a problem	7	10.14
	Major	14	20.29
	Minor	48	69.57
5.	The main occupational exposure route		
	I do not know	6	8.69
	Inhalation	43	62.32
	Dermal	15	21.74
	Oral	5	7.25

Comparable studies in AEWs in Tanzania (Ngowi *et al.*, 2002) and Kenya (Grace, 1997) similarly indicated only around a quarter of the extension workers perceive

pesticides exposure and poisoning as a major problem in the community they serve. Nevertheless, different studies in Ethiopia have indicated an absence of pesticide hazard knowledge in farmers and no use complete personal protection equipment (Mekonnen and Agonafir, 2002; Negatu *et al*., 2016a) as well as real-world health effects of pesticide exposure in Ethiopian farmers (Negatu *et al.*, 2018 and Nigatu *et al*., 2016).

Also (92%) of the AEWs mention they know the main route of occupational pesticide exposure but only 22 % indicated the exact occupational exposure route which is dermal. This indicates another knowledge gap in the surveyed agricultural extension workers, who might advise farmers to protect only their nose and mouth rather than covering their whole skin particularly of hands, legs and dorsal area. A study in Ethiopia has reported use of a handkerchief as an occupational pesticide exposure prevention method in small scale farmers (Negatu *et al*., 2016a).

Pesticide hazard related extension practices

Concerning pesticide related advises given to farmers most of the extension workers (96%) mention they usually give pesticide related advices (Table 3). But all (100%) indicate provision of advices on how, where and when to apply pesticide on crop fields in their response whereas, only 22 % of the agricultural extension workers stated giving advices on pesticide hazards in general.

Similarly only 11% and 20% of the extension workers mentioned providing advices on exposure prevention and proper storage and disposal of pesticides, respectively. This indicates relatively lower level of pesticide hazard related environmental and occupational advises given to farmers. Which could lead to improper use, handling and disposal of pesticides by farmers that can result in pesticide related hazards to the environmental, to those occupationally exposed farmers as well as the public in general through high pesticide residues levels on horticultural crops.

Nevertheless, there were many challenges including shortage of money and time, the study have many strengths. The main strengths of the study are; first to our knowledge this is the pioneer study published specifically on environmental and occupational pesticide hazard related knowledge and attitude of AEWs in Ethiopia; the other one is a higher response rate of AEWs which is more than 95%. But there are also some limitations of the study including some level of biases. The first one is potential information bias, as AEWs might not exactly remember answers for some of the question due to time dimension (e.g. course taken years back).

Table 3 - Pesticide related advises to farmers

	Surveyed variables	Number	%
1	Any pesticide related Advice		
	yes	46	66.67
	no	23	33.33
2	If yes, which advise do you usually give		
2.1	How ,when and where to apply on crops		
	yes	46	100.00
	no	–	
2.2	How to properly store and dispose		
	yes	9	19.57
	no	35	80.43
2.3	Environmental hazards of pesticides		
	yes	10	21.74
	no	36	78.26
2.4	Occupational hazards of pesticides		
	yes	5	10.87
	no	41	89.13

The other one might be a selection bias since the study area was purposively selected; the result might not exactly represent all small-scale horticultural areas in Ethiopia.

Conclusion

The study indicates relatively lower educational level of agricultural extension workers who do not have enough pesticide hazard related knowledge and cannot or not practically advising on pesticide related hazards. This indicates Ethiopian agriculture extension system must also consider environmental sustainability and health issues as the conventional extension system cannot increase productivity at the same time minimizing environmental damage, rebuilding ecological resources and promote green development (Allahyarin, 2009; Masangano *et al.,* 2016; Musvoto

et al., 2014). Therefore, in order to sustain the environment as well as the recorded agricultural growth in Ethiopia the agricultural extension system should meet the new needs coming with increasing in agro-chemicals use particularly chemical pesticides and deliver services that can meet this requirement by including enough pesticide hazard related lessons for agricultural extension workers in their schoolwork syllabus as well as on job capacity building trainings.

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