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Knowledge, attitude, and practice of Indonesian farmers regarding the use of personal protective equipment against pesticide exposure

Maria G. C. Yuantari · Cornelis A. M. Van Gestel · Nico M. Van Straalen · Budi Widianarko · Henna R. Sunoko · Muhammad N. Shobib

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Abstract The use of synthetic pesticides in tropical countries has increased over the years, following the intensification of agriculture. However, awareness among farmers of the importance of protecting themselves from hazards associated with pesticide application is still lacking, especially in Indonesia. This paper reports results of an inventory on knowledge and attitudes regarding pesticide use by melon farmers of a village in Central Java, Indonesia. The importance of using personal protective equipment such as hats, masks, goggles, boots, and gloves on agricultural land is known and well understood by the farmers. However, in practice, only 3.8 % were wearing glasses and 1.9 % were using boots. In fact, the masks used only consisted of a part of their shirt tied around the mouth. The farmers were not wearing long pants and shirts with long sleeves and used the same clothes for more than 1 day without washing. Almost no farmers used personal protective equipment that was standard, in good condition, and complete. Based on the results of statistical analysis, no significant relationship was found between knowledge and attitude on the required practices on the one hand and the use of personal protective equipment in practice on the other hand. This shows that improved knowledge and attitudes are not enough to change the behavior of farmers to work in a healthy and safe way. The gap between knowledge and practice needs to be bridged by a more interactive and participatory training model. It is therefore of paramount importance to develop a special toolkit for pesticide risk reduction which is developed in a participatory manner involving the farmers as the main actors through a series of focus group discussions and field simulations.

M. G. C. Yuantari · B. Widianarko · H. R. Sunoko
Environmental Science Doctoral Program,
Diponegoro University,
Imam Bardjo, Semarang, Indonesia

B. Widianarko
e-mail: widianarko@unika.ac.id

H. R. Sunoko
e-mail: hennarsunoko@gmail.com

C. A. M. Van Gestel · N. M. Van Straalen
Department of Ecological Science, Faculty of Earth and Life Sciences, VU University Amsterdam,
De Boelelaan 1085, 1081 HV Amsterdam, Netherlands

C. A. M. Van Gestel
e-mail: kees.van.gestel@vu.nl

N. M. Van Straalen
e-mail: n.m.van.straalen@vu.nl

B. Widianarko
Graduate Program on Environment and Urban Studies,
Soegijapranata Catholic University,
Pawiyatan Luhur IV/1, Semarang, Indonesia

M. G. C. Yuantari (✉) · M. N. Shobib
Faculty of Public Health, Dian Nuswantoro University,
Nakula I/5, Semarang, Indonesia
e-mail: mgcatur.yuantari@dsn.dinus.ac.id

M. N. Shobib
e-mail: sobebajah@gmail.com

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Introduction

In Indonesia, agriculture is an important economic sector. The country contributes significantly to the global production of a wide variety of tropical products, and agriculture provides an income for the majority of Indonesian households. Farmers are always trying to improve their crop production, and one way to do this is by minimizing the development of pests like insects and fungi. So, over the years, the use of pesticides has increased. In Indonesia, the number of registered pesticides has grown from 1557 in 2006 to 2628 in 2010. Increased use of pesticides not only occurs in Indonesia. A survey performed in 2008 showed that worldwide agricultural pesticide usage has increased by approximately 15 % since 2003 as measured by the total consumption of active ingredients (Mcgee 2010).

The use of pesticides not only increases crop yield but it may also have negative impacts. According to the World Health Organization, 500,000–1,000,000 people per year around the world suffer from health effects due to pesticide poisoning and about 500–1000 people per year suffer from fatal impacts such as cancer, infertility, and disorders of the liver. In 2000, approximately 300,000 incidents of chemical poisoning were reported, leading to the death of 70,000 children (WHO 2004). Jintana et al. (2009) reported that 88.9 % of the farmers in Thailand mixed pesticides with their bare hands, 69.8 % applied a higher concentration than recommended, and none of them used a form of personal protective equipment. In Vietnam, 19 % of the farmers used pesticides classified by the World Health Organization as class I, i.e., harmful to the health of farmers, consumers, and other subjects (Van Hoi et al. 2009).

Exposure to pesticides can cause a variety of disorders and diseases (Goldner et al. 2010; Adigun et al. 2010). Pesticide exposure may reduce the activities of acetylcholinesterase and butyrylcholinesterase, causing dizziness and headache. Mental health symptoms are associated with pesticide use, e.g., the occurrence of depressions (Weisskopf et al. 2013). The use of pesticides may also increase the likelihood of developing Hodgkin lymphoma disease (Navaranjan et al. 2013). Health impacts of pesticides may be a financial burden for farmers as they incur higher expenses for treatments related to the use of pesticides (Devi 2009a, b; Garming and Waibel 2009; Atreya et al. 2011).

When used in an incorrect or improper way, pesticides may seriously endanger the health of farmers and their families, consumers, and the environment. Water and soil pollution due to the use of fertilizers and pesticides has been investigated by Yamamoto (2003) in Japan and Wang et al. (2007) in China. Research conducted in India showed the presence of pesticide residues in milk, which was due to the unfavorable location of agricultural land near a milk processing facility (Srivastava et al. 2008). The increased use of pesticides, particularly endosulfan and cypermethrin, is also related to failure of breeding in honeybees, fish, and birds (Nafees et al. 2008).

Research related to the knowledge, attitude, and practice on the use of pesticides has been done in some countries like India, where it showed a good level of knowledge of farmers who do follow good practice. But, it also showed that there are still many farmers who behave unsafe, and there are farmers who do not use personal protective equipment during spraying (Mohanty et al. 2013). This is also done in Pakistan, where the level of knowledge of farmers on applying pesticides was shown to be less good, demonstrating the need for training the farmers (Aslam et al. 2007). Similar research in Palestine by Zyoud et al. (2010) showed that there is a relationship between farmers' knowledge about pesticides and the level of education, experience, and the information they obtain from pesticide sellers. Nevertheless, the farmers seemed to be unaware of pesticide risks and they lacked safety education, while they also did not take enough protection.

A possible strategy of relieving farmers from the health risks associated with pesticide exposure is to deploy a program of awareness and information. Various attempts have been made to increase the knowledge about integrated pest management with a minimal use of chemical pesticides (Mancini et al. 2006; Lund et al. 2010). It remains, however, uncertain to what extent increased knowledge among farmers does actually lead to a safer use of pesticides. This will require a comparison of pesticide use practices between informed and uninformed farmers.

In this study, we therefore investigated the question whether knowledge about protective equipments actually contributed to the safe use of pesticides. We assessed the relationship between the use of personal protective equipment and the knowledge and attitude of

farmers by means of a survey among a group of melon planters in a village on Central Java, Indonesia.

Methods

We conducted a cross-sectional study from May to July 2013 in the village of Curut, District Penawangan Grobogan, Central Java, Indonesia. Melon farmers in this village are using pesticides to protect their crop from insects and fungi. This study included 57 out of 226 farmers living in the village. The selection of farmers was based on the following criteria: farmers who lived in the village of Curut, had been working as a farmer for at least one year, and were willing to act as respondents.

Data were collected through interviews, using a questionnaire. Preparation of the questionnaire was based on literature about the use of personal protective equipment (Jirachaiyabhas et al. 2004; Stadlinger et al. 2011; Weigel 2012) with some modifications according to the local context. The questionnaire was divided into three parts, with questions on knowledge, attitude, and the actual use of personal protective equipment (PPE) during spraying.

A Kolmogorov Smirnov test showed that the data on knowledge, attitude, and the use of protective equipment were not normally distributed; therefore, a frequency analysis was applied. For both knowledge and attitude, the median value was used to distinguish between a "good" and a "poor" category. To test the association between knowledge of protective equipment and its practical use, the farmers were cross-tabulated for knowledge, attitude, and practice using the two categories good and poor. A chi-square test was applied to test the null hypothesis of no interaction between knowledge and practice and between attitude and practice.

Results

The respondents included 56 male and 1 female farmers and were aged between 25 and 60 years with an average length of employment in the area of about 18 years with a standard deviation (SD) of 9.9 years. Farmers' knowledge about the importance of personal protective equipment to be used when mixing and spraying pesticides was good; 98.1 % of the farmers were able to answer correctly the questions about personal protective equipment and could mention the type of personal protective equipment that should be used in specific cases. They were also well aware of the health risks associated with pesticide use and almost all of them could mention one or more symptoms of acute pesticide poisoning (Table 1). About one half of the farmers admitted that pesticide poisoning is a common phenomenon (Table 2). Farmers were aware of pesticide exposure pathways to the body, which is shown by the result that more than 80 % responded correctly to questions on the uptake of pesticide exposure through the skin and by digestive and respiratory exposure. All farmers knew that pesticides can be harmful to their health.

Similarly, farmers' attitudes towards the use of personal protective equipment were also good (Table 2). More than 80 % agreed that personal protective equipment is needed in agriculture either at the time of mixing or spraying. The farmers knew that the wearing of masks, shirts with long sleeves, and boots would protect them from the most acute dangers of pesticide exposure. However, the farmers' practice of using personal protective equipment was not in proportion with their knowledge and attitude (Table 3). Many farmers did not use personal protective equipment properly and appropriately. In fact, only 3.8 % were wearing protective glasses, but even then not protecting their eyes, and only 1.9 % did wear boots. There were many farmers who did not use caps, masks, shirts with long sleeves, long pants, and gloves. The knowledge and attitudes of farmers about the use of personal protective equipment was not in line with their practice in the field. Table 4 shows the results of tabulating farmers across the two categories of knowledge and attitude on the one hand and practical use of protective equipment on the other hand. If knowledge and attitude actually influence practice, a strong interaction would be expected. However, the outcome of the chi-square test was not significant showing that the use of protective equipment did not depend on knowledge or attitude.

Discussion

For everyone working in a dangerous environment, it is compulsory to use personal protective equipment. A proper protection can enhance not only the safety of the workers but also work productivity (Health and Safety Executive 2005; Weigel 2012). Guidelines have been developed for simple protective measures during

Table 1 Knowledge among farmers on the use of personal protective equipment (PPE) in melon culture

Statement	Correct answer (%)	False answer (%)
It is important to use personal protective equipment when spraying with pesticides	98.1	1.9
Farmers mentioned the following PPE to be used during mixing and spraying pesticides:		
Hat	82.7	17.3
Protective glasses	76.0	23.1
Mask	96.2	3.8
Long sleeves	84.6	15.4
Gloves	86.5	13.5
Pants	78.8	21.2
Boots	63.5	36.5
Pesticides can enter the body through the skin	90.4	9.6
Skin exposed to pesticides will harm the health of farmers	80.8	19.2
Ingested pesticides will harm the health of farmers	100	
Inhaled pesticides will harm the health of farmers	100	
The use of PPE can prevent poisoning when spraying pesticides	96.2	3.8
Nausea is a symptom of pesticide poisoning	67.3	32.7

Results are based on a questionnaire held among farmers in the village of Curut, District Penawangan Grobogan, Central Java, Indonesia

outdoor spraying of pesticides, such as the use of headgear, protective masks, and boots.

In the village of Curut, Central Java, Indonesia, the knowledge of melon farmers about protective equipment to be used in agriculture was good. More than 98 % of the farmers knew the importance of personal protective equipment, and almost all of them were able to define which types of personal protective equipment should be used on the farm and during pesticide spraying.

The good knowledge and attitude about the use of personal protective equipment was, however, not followed by good practice. Based on the statistical analysis, there was no significant relationship between knowledge and attitudes towards using protective equipment on the one hand and practice on the other hand.

Table 2 Farmer attitudes towards the importance of wearing personal protective equipment (PPE)

Statement	Agree (%)	Disagree (%)
I do not have to use a full set of PPE	19.2	80.8
The following PPEs are essential to wear during spraying with pesticides:		
Hat	94.2	5.8
Glasses	75	25
Mask	96.2	3.8
Long sleeves	100	
Gloves	96.2	3.8
Trousers	98.1	1.9
Boots	55.8	44.2
I don't need to use PPE during pesticide mixing	25	75
I must use PPE when spraying pesticides	94.2	5.8
PPE is important to prevent the body from pesticide poisoning	98.1	1.9
For farmers, pesticide poisoning is common	46.2	53.8
After contact with pesticides, the entire body must be cleaned by bathing	98.1	1.9

Results are based on a questionnaire held among melon farmers in the village of Curut, Distric Penawangan Grobogan, Central Java, Indonesia

Table 3 Farmer practices in the use of personal protective equipment (PPE) during pesticide application in melon culture

Statement	Always (%)	Rarely (%)	Never (%)
Practice of farmers during pesticide mixing			
I wear a hat during mixing of pesticides	90.9	3.8	5.8
I wear glasses when mixing pesticides	7.7	1.9	90.4
I use a mask when mixing pesticides	73.1	15.4	11.5
I wear a long-sleeved shirt when mixing pesticides	94.2	1.9	3.8
I use gloves when mixing pesticides	48.1	13.5	38.5
I wear long pants when mixing pesticides	71.2	19.5	17.3
I wear boots when mixing pesticides	1.9	5.8	92.3
Practice of farmers during pesticide spraying			
I wear a hat when spraying pesticides	90.4		9.6
I wear glasses when spraying pesticides	3.8	1.9	94.2
I use a mask when spraying pesticides	71.2	15.4	13.5
I wear a long-sleeved shirt when spraying pesticides	98.1	1.9	
I use gloves when spraying pesticides	44.2	15.4	40.4
I wear long pants when spraying pesticides	76.9	9.6	13.5
I wear boots when spraying pesticides	1.9	3.8	94.2

Results are based on a questionnaire held among farmers in the village of Curut, District Penawangan Grobogan, Central Java, Indonesia

Jones et al. (2008) argued that farmers are more concerned with increasing returns to higher economic value than with their own health. Farmers' lack of knowledge in regard to pesticides is often attributed to the fact that many farmers are illiterate. The high costs of personal protective equipment also make that they do not give priority to their personal safety (Sam et al. 2008; Salameh et al. 2004; Oluwole and Cheke 2009). Aslam et al. (2007), Zyoud et al. (2010), and Mekonnen and Agonafir (2002) also argued that the knowledge of farmers about pesticides and personal protective equipment is generally low, so there is a need for training to increase the awareness among farmers. However, our study shows that increased knowledge will not necessarily improve practice. Farmers in Curut have a good knowledge about the effects of pesticides on their own health, but this knowledge is not implemented in practice. The neglectful behavior of the farmers has become habitual.

Table 4 The relationship between knowledge and attitude on the one hand and the use of personal protective equipment (PPE) on the other hand

Variable	Practical use of PPE		Total	*p* value
	Good	Poor		
Knowledge				0.313
Good	9	14	23	
Poor	9	25	34	
Total	18	39	57	
Attitude				0.683
Good	7	13	20	
Poor	11	26	37	
Total	18	39	57	

Results are based on a questionnaire held among melon farmers in the village of Curut, District Penawangan Grobogan, Central Java, Indonesia. The association between knowledge and practical use and between attitude and practical use is evaluated using chi-square tests in a 2×2 cross-classification table of farmers. The *p* values show that there is no significant association

A way to reduce exposure to pesticides of farmers is the development of a pesticide toolkit. Knowledge of farmers can also be increased in small focused group discussions (LePrevost et al. 2013). In addition, familiarizing the farmers with the meaning of the pictograms on pesticide labels is useful for communicating risk information and may also help protecting the health of the farmers and the environment (Rother 2008). Toolkit-based information technology to reduce pesticide exposure has also been developed with the name Community-Focused Exposure and Risk Screening Tool (C-FERST) (Zartarian et al. 2011). The gap between knowledge and practice needs to be bridged by a more interactive and participatory training model. It is therefore of paramount importance to develop a special

toolkit for pesticide risk reduction which is developed in a participatory manner involving the farmers as the main actors. Focus group discussions and field simulations may be useful instruments to achieving this goal.

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