The presence of honey bees in intensive pesticides use area:
Case study in Pangalengan and Majalenga

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Abstract. Pesticide action can leave a residue in plant, including in the nectar and pollen of the flowers. Besides residues, sprays of pesticides could also make unintended possible effect to honey bee and other pollinators. Pollinators have a great impact on plant productivity, so it was important to keep the pollinators in healthy and in high diversity for sustainable of environment, food, and economy. The research was aimed to obtain valuable information regarding on pesticide use in both locations. The survey was divided into two steps. First, we did a preliminary survey to determine representative locations of study, and then followed by the second step, it was in-depth interview of pesticide use directly with 61- and 51 respondents in Pangalengan and Majalenga, respectively. Ninety six pesticide trademarks were applied by farmers in Pangalengan, meanwhile, 83 trademarks were in Majalenga with the variable bioactive compound. Neonicotinoids as bioactive of some pesticides were found only in one farmer from Pangalengan who used Alika (pesticide brand name). Besides, there were 13 active ingredients of fungicides, 15 insecticides, one herbicide, and one molluscicide found in Pangalengan. In Majalenga, there were 9 active ingredients of fungicides, 19 insecticides, and one molluscide. They usually applied herbicides, insecticides, and fungicides at least twice a week during crop cultivation. Although some farmers may be aware of pesticide hazards, adequate protection is hardly taken to minimize the risks. Sixty percent of farmers mentioned the presence of honeybees on their land. Farmers’ knowledge in the use of pesticides is appropriate and safe for both the health of pollinators and farmers when applying pesticides in the field.

1. Introduction

Pesticides including herbicides, insecticides, and fungicides are commonly used to prevent or manage pests such as weeds, insects, and plant pathogens, while reducing the amount of labor, fuel, and machinery used for pest control. Vegetable crops were the largest users of pesticides than other crops, accounting for 30% of total sales. This trend has been confirmed in surveys of chili crops in West Java in 2002, where the adequacy of crop protection is a major factor affecting production and profitability of chili crops [1]. However, pesticide action can leave a residue in plant, including in the nectar and pollen of the flowers. Besides residues, sprays of pesticides also could possibly make unintended effect to honey bees and other pollinators [2]. Therefore, it is necessary to maintain the pollinators, especially in areas that have large farming fields of pollinator dependent crops such as mango, rambutan, durian, melon, water melon, pumpkin, and zucchini. In addition to pollinators, the dangers of pesticides also occur to farmers, as in the case of Magelang, as many as 14.3% of farmers as revealed by the study are declared by spraying methods that do not comply with the proper rules and not use personal protection...
The existence of pollinators especially honey bee in farmers’ field and application of pesticides by farmers is our concern for sustainable production of crops.

The field survey were conducted in West Java, which has a large agricultural area producing food crops, horticulture, estate crops, industrial and also forestry crops. These two locations having large areas of farming as well as forestry systems are Pangalengan and Majalengka. Both areas supply many agriculture- and forestry-based products, and also cross-fertilizing crops such as cabbage, carrot, cucumber, guava, mango, and many other tropical crops which are depended on pollinators. Among pollinators, honey bee is well known since it has many benefits for human being.

Information regarding on pesticides use which supports pollinator health and pesticide use status in both agriculture and forestry farming systems of Pangalengan and Majalangka is needed in order to get information regarding type, concentration, brand name, and other issues related to pesticide use in farmers’ field. there were two necessary activities to get relevant data and information such as: preliminary study for determining relevant site of observation and in depth interview of farmers, face to face interview, related to the application of pesticides (type, dose of application, concentration, etc). These are fundamental for assessing pollinator health and pesticide use status in order to design next experiment and other possible sustainable management action plan.

2. Materials and Method

This study was divided into two steps. Firstly we did a preliminary survey to determine representative location of study. Secondly in depth interview of pesticide use directly at farmers’ field.

2.1 Preliminary survey

This activity was done in order to determine representative locations of study. We visited some specific areas both in Pangalengan and Majalangka. We also visited government office such as Office for Forestry and Estate Crops, and Office for Food and Horticulture Crops for obtaining secondary data related to explore pesticides use by farmers and the presence of apiary.

2.2 Interview of Pesticides Use

The activity was performed to assess pesticides use by farmers. The sample location was determined by using purposive sampling in which representative location was deliberately selected. The materials used were as follows: Global Positioning System (GPS), questionnaire, cameras, stationery and other tools. Data were collected then descriptive analysis was performed.

In depth farmers interview (face to face) was directly conducted in famers’ field using questionnaire. The data recorded were as follows: farmer personal data, education background, crops they cultivated and pesticides applied, type of pesticide applied, dose, application interval, knowledge of farmers related to pesticide, farmers’ perception for the presence of honey bee in the field.

3. Result and Discussion
3.1 Preliminary survey

Preliminary survey showed that the representative locations have been determined according to locations with large areas of farming in Pangalengan and Majalengka. In Pangalengan, some promising locations were Cilaki, Malabar, Ciwidey, and border area of Pangalengan-Garut (Cisewu). In Majalengka some representative locations were Argapura (Sukasari Kidul and Teja Mulya), Raja Galuh and Lemah Sugih.

3.2 Survey of Pesticides Use

Data regarding on pesticides use was obtained by interviewing the farmers directly in the field. Data collected were education background, crop they cultivated, pesticides application, type of pesticide, dose, application interval, knowledge of farmers related to pesticide, and farmers’ perception regarding on the presence of honey bee in the field.

3.2.1 Farmer background

Age characteristics are one of the characteristics that have a close relationship with the ability to do daily work. Based on the results of the study it was found that 61 respondents in Pangalengan and 51 respondents in Majalengka, the youngest age was 17 years and farmers using pesticides were dominated by the elderly. The age of farmer ranged from 46 to 55 years old (Table 1). These data should be taken into consideration since the age of farmers is getting old. It is suggested that regeneration of farmers should also be programmed by government though formal and informal education. Public-private partnership to attract more young generation to get involved in agriculture should be conducted. Strategic Plan of Ministry of Agriculture 2015-2019 mentioned that improvement of human resources in agriculture should be implemented soon.

| Age range (years)       | Number of Respondents in Pangalengan | Number of Respondents in Majalengka |
|-------------------------|--------------------------------------|-------------------------------------|
| 17-25 (late adolescence)| 5%                                   | 6%                                  |
| 26-35 (early adulthood) | 13%                                  | 12%                                 |
| 36-45 (late adulthood)  | 23%                                  | 12%                                 |
| 46-55 (early age)       | 33%                                  | 33%                                 |
| 56-65 (late age)        | 15%                                  | 25%                                 |
| > 66 (old)              | 11%                                  | 12%                                 |

Phases of Adulthood according to Department of Health of Indonesia (2009) [4]

Farmers with education level graduated from high school in Pangalengan were 39% and elementary schools 31%, while farmers in Majalengka were 65% graduated from elementary school (Figure 1b). It seems likely human resources in agriculture for both agriculture centres need to be improved. It is expected that education of farmers will be soon improved since future agriculture will be more challenging and Indonesia has entered Asean Free Trade Area (AFTA) in which high qualified farmers will be required in order to solve many problems and challenges. Low level of education, as found in Majalengka, might be led to low productivity and less competitive in managing agriculture as reported...
in Ghana. In this country farmer education has a positive effect on farm productivity [5]. This condition seems to be relevant to Indonesia condition.

In this survey, most farmers (65% in Majalengka and 56% in Pangalengan agree; 27% in Majalengka and 43% in Pangalengan strongly agree, Figure 1a) believed that applying pesticides will guarantee their harvest, even though they also realize that pesticides harmful to other insects (Figure 1a) and consumers (Figure 1c). Most likely the farmers get a lot of information about the safety of pesticide use from pesticide packages, newspapers, television and other media, such as counseling services, and others. It is thought that extension services provided by the government are rarely conducted as revealed by some farmers.

**Tabel 2.** Education background of respondents in Pangalengan dan Majalengka

| Level of Education  | Pangalengan | Majalengka |
|---------------------|-------------|-------------|
| No Formal School    | 0%          | 4%          |
| Elementary School   | 31%         | 65%         |
| Junior High School  | 20%         | 14%         |
| Senior High School  | 39%         | 14%         |
| Diploma 1           | 2%          | 0%          |
| Diploma 2           | 0%          | 0%          |
| Diploma 3           | 3%          | 0%          |
| Bachelor's degree   | 5%          | 4%          |
| Magister's Degree   | 0%          | 0%          |
| Doctoral's Degree   | 0%          | 0%          |

Most respondents agreed or strongly agreed that pesticide use in food production reduces food safety. The respondents were well aware that pesticides are harmful to the environment and human health. The majority of the sample (over 80%) agreed or strongly agreed that pesticide use adversely affects human health. With regard to respondents’ perceptions of their personal health risks, most of the farmers thought using pesticides would adversely affect their own health.

Perceptions of farmers can be influenced by their own knowledge either getting information from counseling or others. Fig. 2 reports on farmers’ main sources of information regarding pest control and pesticide application. It can be seen that the most important information source regarding pest control and how to apply pesticides is communicated with other farmers, followed by pesticide retailers.
Only 5% and 20% were in Pangalengan and Majalengka, respectively, reported that they had acquired information on pest control and pesticide application from government extension services (Figure 2a). As many as 49% and 41% were Pangalengan and Majalengka, respectively, reported that they believed that the use of pesticides was not dangerous (Figure 2b). Ineffective extension services are considered as a key factor leading to the overuse of pesticides in developing countries. It is likely very few farmers learned about safety use of pesticides via media, e.g., the internet, television, books or newspapers.

Figure 1. Farmers’ perceptions a) on pesticide use for securing crop production, b) on the impact of pesticides to other insects, and c) on Pesticide Risk on Consumers Health

Figure 2. Main source of information on pest control and pesticide use: (a) Agriculture extension on pesticide use; (b) Agriculture extension on danger of pesticide
3.3 Pesticides Use

Horticultural plants that often sprayed by pesticides are potatoes, tomatoes, red chili, shallots, and shallots. Of the 3207 pesticide brands registered in Ministry of Agriculture Indonesia year 2016 [6], there were 96 pesticide trade brands were applied by farmers in Pangalengan, while 83 were in Majalengka with bioactive variable components. There were 14 active ingredients of fungicides, 15 of insecticides, one of herbicide, and one of molluscicide found in Pangalengan. In Majalengka, there were 9 active ingredients of fungicides, 19 of insecticides, and one of molluscicide. Neonicotinoids as bioactive from some pesticides were only found in one ingredient from Pangalengan with the active ingredient imidacloprid. Seed treatment is not carried out by most farmers. It seems that farmers have many choices to apply pesticides for controlling pests and diseases. Training on the safe use of pesticides application in both locations should be more frequently conducted by public or private institutions. Farmer knowledge in safety procedure is very important in order to keep safe for human and environment; however, most farmers (56%) in Faridabad, India, did not implement safety procedures in their farming. This condition is likely to be equal for Indonesia as developing country [7].

Dose application of pesticide in Pangalengan was according to guideline as written in pesticides’ package however interval application was very short, within 1 until 2 days. Differ with Pangalengan, farmers in Majalengka, they generally sprayed pesticides two times a week. Farmers in Majalengka found many pollinators than in Pangalengan according to their observation.

UTZ Organization (2015) [8] classifies the types of pesticide active ingredients into two types, namely prohibited pesticides and monitoring pesticides. Pesticides in monitoring scheme are active ingredients that are not prohibited but have the potential to pose serious and/or cumulative risks to human health and/or the environment. The use of active ingredients mentioned in the list is only permitted on certified harvest if: 1) all steps of Integrated Pest Management (IPM) have been followed, 2) alternative pesticides that are not too dangerous are not available, and 3) specific recommendations for reducing or reduce the risk associated with the dangerous nature of the product has been carried out. While forbidden pesticides are pesticides, all uses are prohibited by final legislation, to protect human health or the environment.

3.4 Insecticides

In Figure 3, five pesticides were banned i.e., beta siflutrin, carbofuran, carbosulfan, permethrin, and cypermethrin, meanwhile five of them are monitoring pesticides, namely abamectin, deltamethrin, fipronil, imidacloprid, and thiamethoxam, while others are not classified between the two.

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**Figure 3** Active ingredients of insecticides in a) Pangalengan and b) Majalengka
Abamectin and profenofos were the most widely used active ingredient of pesticide in Pangalengan and Profenofos in Majalengka. Abamectin is an active ingredient of pesticides used to treat pest caused by *Spodoptera, Liriomyza, Thrip*, etc. Usually, they found in many chilli, onion, potato, etc. Profenofos is an active ingredient of pesticides used to treat pest caused by *Spodoptera, Plutella, Thrip*, etc. It is a contact and stomach poison. Usually, they applied this pesticide for controlling pest on chilli, onion, potato, etc. The active ingredient abamectin is very risky if inhaled by human [8].

3.5 Fungicides

There were 16 active ingredients of fungicides in Pangalengan and Majalengka (Figure 4). Chlorotalonyl was the most widely used fungicide’s active ingredient in both locations. Chlorotalonyl is an active ingredient of pesticides used to control diseases caused by phytophthora, colletroticum, alternaria, etc. Usually, they found in many chili and tomato. The active ingredient Chlorotalonyl is very risky if inhaled by humans [8]. Of the two types of classification of the list of pesticides [8], in the active ingredient of fungicides commonly used there are four lists of pesticides in monitoring, while the list of prohibited pesticides does not exist.

![Active ingredients of fungicides in Majalengka](image)

**Figure 4.** Active ingredients of insecticides in a) Pangalengan and b) Majalengka

3.6 Herbicide and Molluscicides

In Pangalengan, there were one herbicide and one molluscicide, whereas, in Majalengka, there was only one molluscicide. Propaquizafop is systemic herbicides (Table 5). It used to control weeds, ex: Echinocloa sp., Cynodon sp. Metaldehyde has molluscicided that control Achatina sp. in cabbage. Fentin acetate used to control Pomacea canaliculata in rice.

3.7 Farmer’s perception for the presence of honey bees in the field

The results of the interview showed that 60% of farmers said that the presence of honey bees on their field was abundance (Figure 5). General information about honey bee from interview showed that *Apis cerana* was more plenty than *A. mellifera* and *A. dorsata*. It is likely that land covered by large forestry area had much honey bee population. During the rainy season, honeybees were much easier found in the field, while during the dry season they could be found also in many agricultural crops. When it rains,
honey bees will stop foraging and will only stay in the hive, but in the dry season they will gather water to keep the colony cool [9, 10]. These qualitative findings should be more explored to verify the real fact regarding on honey bee populations and health in the field.

### Table 3. Active ingredients of herbicide and molluscicides in Pangalengan and Majalenga

| Active ingredients of herbicide in Pangalengan | Number of farmers |
|-----------------------------------------------|-------------------|
| Propaquizafop                                 | 1                 |

| Active ingredients of molluscide in Pangalengan | Number of farmers |
|-------------------------------------------------|-------------------|
| Metaldehyde                                     | 1                 |

| Active ingredients of molluscide in Majalengka  | Number of farmers |
|-------------------------------------------------|-------------------|
| Fentin acetate                                  | 1                 |

**Figure 5. Farmer's perception for the presence of honey bees in the field**

4. Conclusion

The respondent farmers used a wide variety of pesticides, such as insecticides, herbicides, fungicides as well as mixed formulations of fungicides and insecticides. The majority of the respondents reported that they usually apply herbicides, insecticides and fungicides at least twice a week during crop season. Although some farmers may be aware of pesticide hazards, but adequate protection is hardly taken to minimize risks. Pollinators perceived by farmers to be presence in their field in Pangalengan and Majalengka. Further confirmation on the abundance and diversity of pollinators using the most pesticide applied that found from this survey should be performed.

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