Indonesian Journal of Agricultural Science 6(2), 2005: 59-68

EVALUATION OF FARMERS APPRECIATION IN REDUCING PESTICIDE BY ORGANIC FARMING PRACTICE

Indraningsih, Yulvian Sani, and Raphaella Widiastuti

Indonesian Veterinary Research Institute, Jalan R.E. Martadinata 30 Bogor 16114, Indonesia

ABSTRACT

Vegetables and dairy milk are important commodities in Pangalengan and Lembang, West Java. However, agrochemicals are used intensively and excessively in production system. Therefore, pesticide residues and contamination commonly occurred in agricultural products and environments. The study aimed to assess farmers' attitudes on pesticide toxicity and reducing pesticide residues in animal and food crops products, and investigate the attitude changes of farmers on pesticide use. It was an on-farm research and farmers were directly involved in the study. The attitude change was analyzed on questionnaire and interview base for over 99 respondents in Pangalengan and Lembang between 2001 and 2003. Samples of soils, weeds, cabbages and milk were collected for pesticide residue analysis. Results showed that farmers did not aware on toxicity effects of pesticides in both animal and human health. There was misinterpretation among the farmers where pesticides were regarded as drugs rather than toxic compound to increase productivity. The organochlorines/OCs (lindane and heptachlor) were common pesticide contaminants found in soils of 7.9-11.4 ppb, but no organophospates (OPs) were detected. Both OCs and OPs were also detected in soils of Lembang at a range of 11.53-65.63 ppb and 0.6-2.6 ppb, respectively. There were pesticide residues detected in weeds collected from Pangalengan (8.93 ppb lindane, 2.05 ppb heptachlor, and 33.27 ppb chlorpyriphos methyl/CPM and Lembang (6.45 ppb lindane, 2.65 ppb endosulfan, 6.85 ppb diazinon, and 0.5 ppb CPM). Only endosulfan with least residue level (0.1 ppb) was detected in organic cabbages, whereas lindane was detected much higher (3.7 ppb) in non-organic cabbages. Pesticide residues were not detected in milk of dairy cattle fed on by-products of organic cabbages, but lindane was still present in milk of dairy cattle fed on non-organic cabbages for 7 days subsequently. The present study indicates that the organic farming practice may reduce pesticide residues in animal and agricultural products. Farmers appreciated that pesticides may cause residual effects on their products (95.2%) and affected public health and environment (92.9%). Therefore, they were willing to convert their agricultural practices to organic farming (69.1%).

[*Keywords*: Pesticides, residues, attitude, farmers, organic farming]

INTRODUCTION

Agriculture is an important sector for economic development in Indonesia. The main agricultural produce are rice, vegetables and estate crops and to a small number is livestock, in particular chickens and local breed of cattle (Bali and Ongole cattle).

Pesticides were introduced in 1970s for agricultural practices to improve productivity. Farmers were then becoming dependent to pesticides and to some extent they used excessively and inappropriately until today. There seems to be misperception about pesticides among general population, where pesticides are regarded as drugs rather than toxic compounds, which leads Indonesia as one of the highest pesticide users in Asian region after China and India (Soerjani 1990). Badan Pengendali Bimas (1990) estimated that the use of pesticides increased for 10 years during 1978-1987 for food crops and for 5 years during 1989-1993 for all crops. The total use of pesticides increased from 5,234 t in 1978 to 18,382 t in 1986. This is partly due to subsidy provided by government. However, during the period of 1986-2000, pesticide requirement for food crops decreased as indicated by reduction of pesticide production from 3,487 t to 2,416 t (Direktorat Jenderal Industri Kimia Dasar 2001). The Government of Indonesia had also banned 37 types of pesticide for agricultural use (Menteri Pertanian Republik Indonesia 2001).

The use of agrochemicals has been known to have environmental impacts through its residues and contamination. Contaminated agricultural materials such as soils, water and sediments are suspected as the source of pesticide contamination in agricultural and animal products (Indraningsih *et al*. 1990; Willett *et al*. 1993; Ntow 2003). Some organochlorines (OCs) in particular DDT, lindane and heptachlor, are known as persistent accumulated compounds in the environment since they are non-degradable (Matsumura 1976), which eventually becomes a common residue detected in food crops such as corn, cabbages, rice, tomatoes and soybean (Nugraha *et al*. 1989; Indraningsih *et al*. 1990; Soejitno 2002; Ntow 2003). Animal products such as eggs, meat and milk have also been reported to contain pesticide residues in Indonesia (Indraningsih 1998), Egypt (Ibrahim *et al*. 1994), and Kenya (Kahunyo *et al*. 2001). In Egypt, extensive use of agrochemicals has led

to public health and environmental problems (Yassin *et al*. 2002). In Kenya, Maitho (1992) reported that OCs (DDT, dieldrin, aldrin and lindane) were detected in 22 out of 25 samples of fat tissues. While, DDT has been once detected in human milk in Indonesia and was regarded as the highest level of DDT residues ever being reported in the world (Burke *et al*. 1998; Noren 1993; Shaw *et al*. 2000).

Pesticides could also affect human health and non-target animals. Pesticide poisoning has been reported to occur in ducks, dairy cattle, chickens, and human in some places (Sabrani and Setioko 1983; Indraningsih *et al*. 1988; Njau 1988; Yuningsih and Damayanti 1994). Pesticide poisoning commonly occurred in animal after consuming contaminated feed which showed clinical signs that consisted of hyperaemia, eyes exudation, hyper salivation, diarrhoea, dyspnoea, and finally die (Indraningsih 1998).

Several cases of toxicity or death described above may be resulted from excessive use or misuse of pesticides at farm level, where precaution measure such as wearing protective gears are poorly followed (Lopez-Carillo and Lopez-Cervantes 1993). Most Indonesian farmers do not wear protection gears (masks and gloves) during mixing and applying pesticides. They also regard that pesticides are more as medical ingredient rather than toxic compounds. This has led them to use pesticides excessively and inappropriate proportion. As consequence, farmers have incurred costs more than they had to and the environment has been contaminated with toxic materials. To scale down pesticide use by farmer and to minimize residues and contamination in the environment, some efforts have to be explored, such as introduction of organic farming practice. The study aimed to evaluate the introduction of organic farming technology that utilizes farm resources like livestock and crops to minimize chemical pesticide use and its residues in farm products.

MATERIALS AND METHODS

The study was undertaken in Lembang and Pangalengan of West Java between August 2001 and April 2003. The sites are located at more than 1000 m above sea level with average temperature of 18°C. The main crops grown in these areas are vegetables including potatoes, cabbages, chilies, cauliflower, and tomatoes. Some farmers are also raising dairy cattle of Fresien Holstein breed. Most farmers are working on less than 1 ha land size. However, they are using agrochemicals excessively, in particular organophosphates (OPs) insecticides and fungicides. Around 90% of farmers in Pangalengan and Lembang were practicing non-organic farming using agrochemicals for their production inputs (present study, unpublished data). It indicated that 9 out of 10 farmers are using agrochemicals, in particular pesticides.

The study was undertaken in three components: (1) examination of pesticide residues in soils and farm products such as cabbages and milk to obtain present data on pesticide residues, (2) introduction of organic farming practice in Pangalengan; and (3) analysis of farmers' perception on pesticide use. The level of pesticide residues in soils, milk, and cabbages was evaluated before and after the introduction of organic farming practice. An integrated organic farming of cabbages and dairy cattle was introduced in Pangalengan under an on-farm research activity from October 2001 to January 2002 accommodating 140 farmers as participants. The number of farmers was based on the number of participants and questionnaires being distributed during interviews. Farmers' attitudes of both locations were analyzed for their knowledge on pesticides under direct interviewing.

Examination of Pesticide Residues in Soils and Farm Products

To undertake the analysis, samples consisting of soils, weeds, cabbage and milk were collected from Pangalengan (October 2001) and Lembang (November 2001). Soil samples were collected randomly from five sampling sites of three layers (L1 = 1-10 cm; L2 = 11-20 cm; and L3 = 21-20 cm depth), from each location with an equipment designed for soil sampling of an iron pipe made at three different layers. As cabbages and weeds were fed to dairy cattle, three replication samples were taken from each location to examine its residue contents. These samples were analyzed for pesticide residues using a gas chromatography (GC) with an electron captured detector approach as described by Cassanova (1996).

About 10 g of samples (soils or others) was extracted twice with 20 ml acetone. The extracts were cleaned-up through the Sep-Pak C_{18} column and the florisil column consisting of three layers of 4 g florisil, 2 cm anhydrate sodium sulfate. The eluents were finally evaporated until 0.5 ml volume and re-diluted with 2 ml hexane for further detecting pesticide residues in a GC.

Milk samples were collected directly from FH cattles owned by the local farmers for 10 samples from each

location at 06:00 AM approximately 500 ml for each sample. Pesticide residues were analyzed following an analytical procedure developed by Schenck and Wagner (1995) using a GC. About 5 ml of milk was extracted using organic solvents then cleaned-up through the Sep-Pak C_{18} column and followed by the florisil column consisting of three layers of glass wool, 2 g florisil, and 2 g Na_2SO_4. The sample was finally eluted in 10 ml acetonitrile and evaporated with a rota vapour. The extract was rediluted in 2 ml n-hexane for pesticide analyses using a GC.

Introduction of Organic Farming Practice

Organic farming is an agricultural practice without using agrochemicals including pesticides and chemical fertilizers. As substitute, the project reintroduced botanical pesticides and biological composts that have been known to local farmers. The organic farming practice was introduced by actively involving local farmers in planning, implementing, monitoring, and evaluating stage. The idea was to improve farm productivity and farm product quality by utilizing farm resources, in this case cabbages and dairy cattle. It was conducted in Pangalengan for three phases, i.e. (1) October 2001 to January 2002 for a pilot project of an organic farming; (2) August to October 2002 for evaluation of pesticide residue in wet season; and (3) February to May 2003 for final evaluation of pesticide residues in dry season.

The pilot project covered a 3000 m^2 size of land owned by the local farmers. The land was divided equally into two groups for organic and non-organic farming practices. Cabbage was grown on these lands and its by-products were used as animal feed of dairy FH cattle for feeding trial.

Cabbages was obtained from a local nursery and each land group was planted with 1000 plants for 90-day period of production. Organic farming practice applied local technology using botanical pesticides such as a mixture of *Tagetes* sp., *Manihot* sp. and young bamboo shoots (Aliyudin pers. comm.). Composts of chicken and cattle manures that were processed through biofermentation using commercial biostarter were used as fertilizer. Formula of fermented rabbit or cattle urine was used as a concentrated organic fertilizer. Non-organic farming practice used commercial agrochemicals during crop production period in each type of practice, farmers were asked to monitor and evaluate insect damage, plant diseases, insect invasion, and yield in each type of practice.

Feeding trial was carried out in 10 heads of FH cattle for 15 days subsequently, by allocating 5 heads of cattle to each farming practice and by feeding on cabbage by-products *ad libitum* for subsequent 7-day period. The trial was ceased on day-8 and replaced the cabbage by-products with elephant grass as a normal animal feed. Samples of milk were collected on day-0, day-7 and day-15 for residue analyses.

Analysis of Farmers' Attitudes on Pesticide Use

The analysis was based on data and information collected from direct interviews with farmers. Interviews were carried out through informal meeting and done twice at November-December 2001 and April 2003 for comparison.

Most farmers in these locations had dual daily activities as farmers producing vegetables and milk. In the meetings 140 questionnaires were distributed in two locations (40 questionnaires in Lembang and 100 questionnaires in Pangalengan). Ninety nine questionnaires were returned and valid for analysis, consisting of 37 farmers from Lembang and 62 farmers from Pangalengan. A sample farmer was free to write or express his argument and evaluation in the questionnaire with the guidance of researcher. The questionnaire consisted of information regarding pesticide use, frequency of pesticide application, types of pesticides, pesticide preparation, crop productivity, and knowledge on pesticide use and hazards. Farmers' perception on pesticide use was evaluated to determine the adoption of a better pest management or new technology to minimize pesticide residues. The questionnaires also included information on farmer status (age, education background, land ownership, land size); farming activities (commodity choice, production inputs, types of farming, productivity, the use of by-products); farmer's knowledge (pesticides, equipments, diluting, spraying, protective gears, pests); and farmer's knowledge on health impacts (toxicity, poisoning, clinical signs, handling and hazard) and organic farming.

RESULTS AND DISCUSSION

Pesticide Residues in Soils, Weeds, and Farm Products

Analyses of pesticide residues in soils, weeds, cabbages, and milk prior to the introduction of an integrated organic farming practice showed that OCs, in particular lindane and heptachlor, were commonly found in these areas. In soil samples of Pangalengan, pesticide resi-

dues were low, i.e. 10 ppb for OCs and no organophosphate (OP) was found (Fig. 1). On the other hand, in Lembang OC residue was 65.63 ppb and 10 ppb for OP (Fig. 2). OC residue was higher in 21-30 cm soil depth compared to those found in upper level (1-20 cm depth). This is presumably due to an excessive use of herbicide during the previous crop production. Even though lindane has officially been banned since 1980s, OCs such as lindane and heptachlor are still persistent in the environment because they are difficult to be degradated (Matsumura 1976).

Organochlorine residues were detected in cabbage by-products from Pangalengan, namely lindane (4.5 ppb) and endosulfan (3.95 ppb), whereas an OP residue namely chlopyrifos methyl/CPM (33.27 ppb) was detected in weeds. Similar to the case in Pangalengan, results in Lembang showed that lindane (5.5 ppb) and endosulfan (5.4 ppb) were detected in cabbage by-products. Meanwhile, in weed sample from Lembang, OP residues namely diazinon (6.85 ppb) and CPM (33.27 ppb) were also detected beside OCs such as lindane (6.45 ppb) and endosulfan (2.65 ppb).

Pesticide residues (OCs and OPs) were also detected in the milk samples collected from Pangalengan and Lembang. Pesticide residues in the milk from Pangalengan were between 0.1-71.2 ppb for lindane, 0.5-60.3 ppb for heptachlor, and 0.002-23.9 ppb for diazinon, whereas in Lembang heptachlor and diazinon were detected at a level of 3.0 and 0.1-9.1 ppb, respectively. The overall pesticide residue in milk was higher in Pangalengan than that in Lembang. Although those levels are still below the maximum residue limits (MRL), it is necessary to put awareness on the OC content due to their carcinogenic and immunosupressive effects (Goebel *et al*. 1982; Standar Nasional Indonesia 2001; Waliszewski *et al*. 2003). The presence of pesticide residues in milk appears to be resulted from contaminated cabbage by-products and weeds that were fed to the cattle.

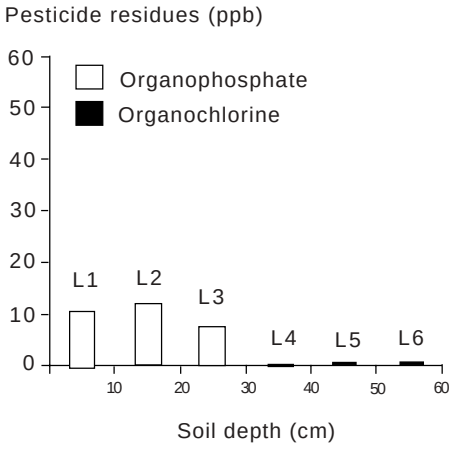

Fig. 1. Pesticide residues in soils of agricultural land in Pangalengan, West Java, 2001; L1 = first layer 1-10 cm depth; L2 = second layer 11-20 cm depth; L3 = third layer 21-30 cm depth.

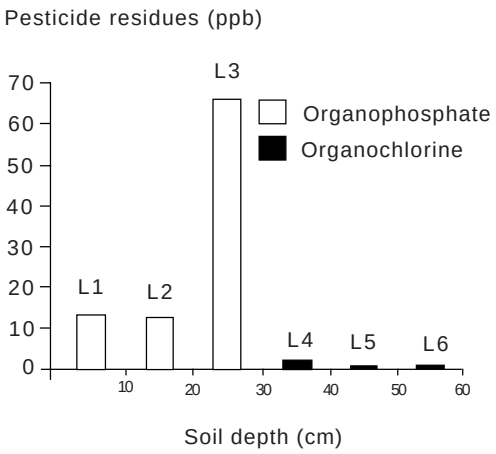

Fig. 2. Pesticide residues in soils of agricultural land in Lembang, West Java, 2001; L1 = first layer 1-10 cm depth; L2 = second layer 11-20 cm depth; L3 = third layer 21-30 cm depth.

Table 1. Pesticide residues found in cabbage by-products and weeds given as animal feed, Pangalengan and Lembang, West Java, 2001.

Location	Type of samples	Pesticide residues (ppb)				
		Lindane	Endosulfan	Heptachlor	Diazinon	Chlorpyriphos methyl
Pangalengan	Cabbage	4.5	3.95	nd	nd	nd
	Weeds	8.93	nd	2.05	nd	33.27
Lembang	Cabbage	5.5	5.4	nd	nd	nd
	Weeds	6.45	2.65	nd	6.85	0.5

Notes: nd = not detected. Average value of three replications.

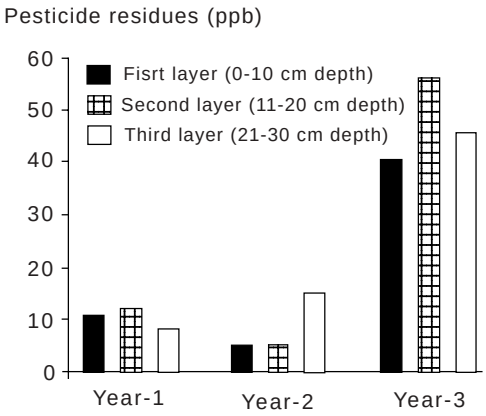

Fig. 3. Total pesticide residues in each layer of soils collected from Pangalengan, West Java.

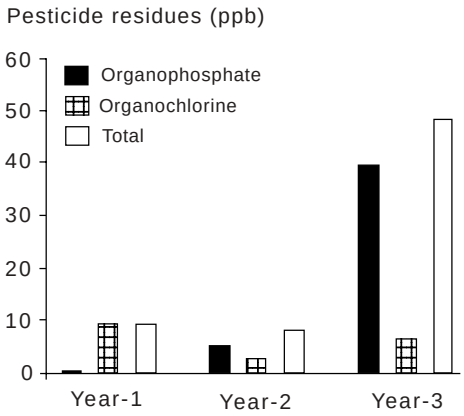

Fig. 4. Average pesticide residues in soil collected from Pangalengan, West Java.

Introduction of Integrated Organic Farming Practice in Pangalengan

Pesticide contamination in soils after adoption of integrated organic farming practices reduced from 9.85 ppb (first year) to 7.97 ppb (second year), but it markedly increased in the third year (47.05 ppb). Increasing in pesticide residues in the third year was suspected due to re-using of agrochemicals by the farmers after the termination of this pilot project.

Complete elimination of pesticide contaminants from agricultural sites usually takes a long time period. By implementing organic farming practice, it takes at least 5-10 years to minimize pesticide residues (OP) in agricultural soils. To clean up the agricultural environment from pesticide contamination, strict control of pesticide application and intensive extension regarding to the widespread impact of pesticides should be imperative (Indraningsih and Sani 2005). Alternative approaches could also be undertaken by introducing bioremediation techniques using microbial (*Bacillus thuringiensis*, *Flavobacterium* sp., and *Arthrobacter* sp.) or specific enzymes originated from plants, microbes or animals to degrade the pesticides (Mallick *et al.* 1999; Rose *et al.* 2003).

Pesticide residue analysis in cabbages showed that only endosulfan with least residue level (0.1 ppb) was detected from organic cabbage by-products, but lindane was detected higher in non-organic cabbages (3.70 ppb) than in organic cabbages. The organic farming practice minimized residues and contamination of agrochemicals in agricultural products as no agrochemicals being used. However, organic and non-organic cabbages could be infected by pests, especially leaf eating insects such as *Plutella* sp. and *Grossy* sp. at 3 months after planting. Damage level due to *Plutella* sp. was higher in the non-organic crops (5.5%) than in the organic crops (4.5%), presumably due to more compact structure and stronger of the non-organic leaves (Fig. 5 and 6). Proximate analysis on the nutritive values of the organic and non-organic cabbage by-products showed no significantly different. However, the organic leaves contained Ca (2.64%) and P (0.27%) higher than the non-organic one which contained 1.67% Ca and 0.24% P.

Pesticide residues were not detected in milk produced from cattle fed by organic cabbage by-products, but lindane was detected in milk of cattle fed by non-organic cabbages for 7 days subsequently, i.e. 75.7 ppb for day-0, 49.6 ppb for day-1, and 10.2 ppb for day-7 (Table 2). It appears that the organic farming practices minimize pesticide residues in animal feed and eventually in animal products such as milk.

Productivity of the organic cabbage farming was slightly higher than that of non-organic cabbage farming, that was 17.8 t ha^{-1} compared to 16.0 t ha^{-1} (Table 2). Production cost of the organic farming was also lower than that of non-organic farming, meaning that there was an efficiency gain in the production cost through minimizing of production cost, i.e. Rp12,150,000 (organic farming) versus Rp18,200,000 (non-organic farming) per ha. In other words, the organic farming is 33.24% more efficient in production costs than the non-organic farming. The break event point of the organic farming (Rp759.4 kg^{-1}) was lower than the non-organic farming (Rp1,022,5 kg^{-1}). If the actual price of organic cabbage was Rp1,000 kg^{-1}, it will give a profit of Rp3,850,000 ha^{-1}. On the other hand, the conventional crops will loss Rp400,000 ha^{-1}. The profitability index of organic farming (1.30) is higher than that of non-organic farming (0.97). Therefore it can be concluded that organic plantation has an investment feasibility by giving a benefit value about 30% from the capital.

Table 2. Productivity of organic and non-organic cabbage in Pangalengan, West Java, 2003.

Productivity	Organic	Non-organic
Yield (t ha^{-1})	16.0	17.8
Production cost (Rp ha^{-1}) (land hiring, labors, production materials, chemical/botanical pesticide)	12,500,000	18,200,000
Break event point (Rp kg^{-1})	759.4	1,022.5
Actual price (Rp kg^{-1})	1,000	1,000
Total revenue/income (Rp ha^{-1})	16,000,000	17,800,000
Profit (Rp ha^{-1})	3,850,000	(-) 400,000
Profitability index	1.30	0.97

Fig. 5. Organic cabbage showing intact leaf, slightly larger, and compact plant.

Fig. 6. Non-organic cabbage showing insect damage, smaller, and loose plants.

The present study shows that the organic farming practices may minimize pesticide residues and contamination in environment and agricultural products. This innovation could be used as an extension model for farmers to change their attitude on using agrochemicals excessively. However, the study also noted that the farmers were back to their initial practice of using excessive agrochemicals when the project was terminated as shown by an increase in the concentration of pesticide residues in soils, cabbage, cabbage by-products in the following year. It appears that an extension program should be conducted continuously with good supervision and control. Periodical monitoring and evaluation are also a necessity.

Analysis of Farmers' Perception on Pesticide Use

Present Status of Farmers' Knowledge and Agrochemical Use

The questionnaire turn-out was moderately high, that is at 70.7% (n = 99) out of 140 expected respondents. Larger respondents were participated in Lembang (92.5%; n = 37) compared to Pangalengan (60%, n = 62) which conducted in three villages of Margamekar (60%; n = 18), Sukamanah (80%; n = 32) and Warnasari (40.0%; n = 12). This indicated that farmers in Lembang were more concerned on agrochemical use.

Farmers have use to apply agrochemicals in their production process. Cabbage is commonly grown three times a year and pests especially leaf eating insects such as *Plutella* sp. and *Grossy* sp. are the limiting factors, therefore, they use more pesticides to control the insects.

Looking at Table 3, the background of respondents varied in term of age, education, land ownership, and size of land (Table 3). Most of them (60.0%) were 20-40 years old, classified as productive age in Indonesia. Most farmers (79.8%) were land owners with less than 1 ha (81.8%). However, 20.2% of them were landless and purely farm workers. Farmers had only finished secondary school (91.9%) and only 8.1% had com-pleted high school. This low education level may have led to farmers' misperception on pesticide use. Most of them regarded pesticides as drug treatment rather than toxic compounds. Therefore, it is not

Table 3. Farmers' characteristics and land ownership in Pangalengan and Lembang, West Java, 2001.

Criteria	Frequency	Percentage
Range of farmer's ages (year)		
20-40	60	60.0
41-60	39	40.0
Educational background		
Lower than high school	91	91.9
Higher than high school	8	8.1
Ownership		
Land owners	79	79.8
Farm owners	20	20.2
Land size (ha)		
< 1	81	81.8
> 1	18	18.2

surprising if they use pesticide more than required. These farmers' characters are common in agricultural practices in Indonesia.

Almost all farmers (99.0%) grew vegetables such as potatoes, cabbages, cauliflowers, tomatoes, and small green pumpkin (Table 4). They practice traditional/non-organic farming and using agrochemicals (90.9%). Few farmers (9.1%), however, had practiced organic farming activity. In the traditional agricultural practices, synthetic pesticides were used by 76.4% respondents, 5.1% used only botanical pesticides, and 17.2% used both. A mixture use of fertilizers i.e. chemical and organic fertilizers were also found (73.7%).

There were an increased number of farmers in using biopesticides such as microbial pesticides (*B. thuringiensis* and *Granulosis* virus) and botanical pesticides (*Quassia amara*, *Ryania speciosia* and *Azadirachta indica*). Some farmers in Pangalengan have also made their own botanical pesticides consisting of *Tagetes* sp., bamboo shoot (*Bamboo* sp.), wild cassava (*Cassava* sp.), *Mucuna pruriens*, *Pierasma javanica*, *Manihot* sp., *Azadirachta indica* and *Melia azedarach*. They believed, their formula were effective in controlling pests of cabbages. Organic fertilizers have also been made from local sources such as fermented rabbit urine. This means that farmers put every effort to use local resources available for their own crops. Therefore, it is not surprised that the average vegetable yield was more than 10 t (30.3%); 5-10 t (20.2%); and 1-5 t ha^{-1} (27.3%). Vegetable by-products are converted as animal feed (53.5%) and given to dairy cattle and only 7.1% were recycled for composting as fertilizers for the next planting. Dairy cattle are also regarded as main commodity as family saving in Pangalengan and Lembang.

Table 4. Farming activities being undertaken in 99 farmers in Pangalengan and Lembang, West Java.

Criteria	Frequency	Percentage
Commodity choice		
Vegetables	98	99.0
Others	1	1.0
Production inputs		
Pesticides		
Chemical	77	76.4
Botanical	5	5.1
Both	17	17.2
Fertilizers		
Chemical	1	1.0
Organic	25	24.3
Both	73	73.7
Types of farming activity		
Non-organic	90	90.9
Organic	9	9.1
Yield (t ha^{-1})		
1-5	7	27.3
5.1-10	20	20.2
>10	30	30.3
Utilization of by-products		
Animal feed	53	53.5
Compost	7	7.1
Unprocessed	39	39.4

Farmers' Knowledge on Pesticide

A total of 90 (90.0%) farmers knew the types of pesticides being used to which 65.5% OPs, 25.3% OCs, and 9.1% other pesticides covering carbamates and botanical pesticides (Table 5). However, pesticides are regarded for treatment purpose and productivity improvement rather than as toxic compounds for pests. This has led to an increase number of pesticide usages.

Although most OCs have been banned in Indonesia since some years ago, the pesticides were still used illegally by some farmers. No information is available on how farmers get the pesticides. Indraningsih *et al.* (2004) reported that OPs commonly used by the farmers were diazinon and chlorpyrifos methyl. Residues of these compounds were also detected in soils, agriculture by-products, and animal products. While carbamates commonly used were carbofuran and paraquat (Sadjusi and Lukman 2004).

Most farmers did not follow the instruction manual for pesticide use regarding on measuring and mixing, discarding containers, and application (Table 5). Large number of farmers used container's cap (42.4%) or spoon (38.4%) for measuring pesticides. Only 9.2% of them used a standard tool such as balance in

Table 5. Farmers' knowledge on pesticide use regarding names, types, and protection gears, Pangalengan and Lembang, West Java, 2001.

Criteria	Frequency	Percentage
Knowing pesticide type	90	90.0
Types of pesticide used		
Organophosphate	65	65.5
Organochlorine	25	25.3
Others	9	9.1
Measurement tools		
Balance	19	9.2
Cap of pesticide can	42	42.4
Non-standard tool	38	38.4
Diluting pesticides		
Following intruction	35	28.3
Approximation	58	56.6
Not known	6	2.0
Freqency of spraying per month		
1-2	28	35.3
4-8	56	58.6
10-12	2	6.1
Not periodically	13	13.1
Protecting gears		
Gloves	13	13.1
Mask	10	10.1
Both	20	20.2
Others	0	0
None	56	56.6
Knowing types of pests	89	89.9

particularly for powdered pesticides. In diluting pesticides, farmers mixed pesticides in the field without considering environmental contamination and health impacts. Spill over of pesticide solution was then commonly encountered. Empty pesticide containers were discarded anywhere which became a source of pesticide contamination. Furthermore, numbers of pesticide applications were more than recommended; 58.6% of the respondents applied 1-2 times a week. Small numbers of them used protective gears during spraying. All of these indicate that pesticides are used inappropriately.

Study on the health impact of pesticide use (Table 6) showed that most of farmers (70.7%) realized that pesticides were toxic, some of them (37.4%) encountered pesticide poisoning in human. Poisoning symptoms commonly found were dyspnoea, dizziness, deep breathing, and nausea. Some farmers consulted local Public Health Care (36.4%) for curing of pesticide poisoning, but most of them (41.4%) cured with their own ways, i.e. cleaning and washing their body. It indicates that they have some knowledge on how to overcome pesticide poisoning. A

Table 6. Farmers' knowledge on health impacts of pesticides, Pengalengan, West Java.

Criteria	Frequency	Percentage
Knowing toxicity	70	70.7
Poisoning in human		
Ever	38	38.4
Never	53	53.5
Not known	9	9.1
Respiratory disturbances		
Ever	46	46.5
Never	40	40.4
Not known	13	13.1
Poisoning in animals		
Ever	46	46.5
Never	40	40.4
Not known	13	13.1
Know how to handle spilled pesticides	58	58.6
Overcoming poisoning		
Ask doctor	36	36.4
Cleaning/washing	41	41.4
Drink milk	6	6.1
Do not know	16	16.2

total of 58 farmers (58.6%) knew to handle pesticide spilling over by cleaning, washing, and covering the contaminated sites.

Attitude Change on Pesticide Use

The pilot project of farmer's attitude on pesticide use was conducted in Pangalengan involved 42 farmers. Results showed that farmers' knowledge on pesticide use is fairly good because a total of 39 farmers (92.9%) knew that pesticides are poison and can contaminate their agricultural products (95.2%). Therefore, most of them used protective gears (96.6%), such as gloves (11.9%), masks (9.5%) or both (71.4%). Few of them (4.8%) used very simple mask and gloves such as sarong, handkerchief, hat and plastic bag to protect them from pesticides. Rate of agrochemical use was still high (88.1%).

Most farmers (83.3%) undertook non-organic farming practices showing that agrochemicals were dominantly used. However, the number of non-organic farming activity reduced from 90.9% to 83.3%. Farmers acknowledged that organic farming practices (66.7%) and botanical pesticides (78.6%) could be used to replace agrochemicals. Presently, farmers were using botanical pesticides (73.8%) and organic fertilizers (90.5%).

The introduction of organic farming practices on cabbage has changed farmers attitude toward safer pesticide management. A total of 42 farmers (100%)

Table 7. Comparation of farmers' attitudes before and after introducing organic farming practice in Pangalengan, West Java.

Criteria	Percentage of some criteria	
	2001	2003
	n = 99	n = 41
Types of farming activity		
Non organic	90.9	83.3
Organic	9.1	16.7
Knowing toxicity	70.7	92.9
Types of pesticides used		
Chemicl pesticides	76.4	27.2
Botanical pesticides	5.1	73.8
Others/both	17.2	0
Protective gears		
Wearing	43.4	96.6
Not wearing	56.6	2.4

knew some advantages of organic farming practices. They were willing to convert farming activity toward organic farming practices (69.1%) to reduce public health risk (21.2%), lower production cost (20.1%), improve food safety and public health (20.1%), and reduce contamination (19.6%) and residual effects in agricultural products (19.0%).

The attitudes change of the farmers after introducing organic farming practices has attracted more attention from farmers (Table 7). The results showed that non-organic farming practices reduced from 90.9 % to 83.3%, toxicity awareness increased from 70.7% to 92.9%, use of protective gears increased from 43.4% to 96.6%, and use of chemical pesticides reduced from 76.4% to 27.2%. Increasing use of botanical pesticides from 5.1% to 73.8% was presumably due to farmers' awareness on synthetic pesticide poison and also some economical reasons because of more expensive price of synthetic pesticides. To minimize more environmental impacts of pesticide on agricultural products and public health, more intensive and continuous efforts should be done involving all communities in larger areas.

CONCLUSION

The overall study shows that pesticide contamination occurred in agricultural land, animal feed (fodders), animal products (milk), and by-product of food crops in Pangalengan and Lembang, West Java. The source of contamination appears to be derived from an excessive use of pesticides during the previous crop production. Pesticide residues were not detected in milk of dairy cattle fed on by-products of organic cabbages, but lindane was detected in milk of dairy cattle fed on non-organic cabbages.

The organochlorines such as lindane and heptachlor became a common pesticide contaminants found in soils of Pangalengan at a range of 7.9-11.4 ppb, but both organochlorines and organophosphates were detected in Lembang at a range of 11.53-65.63 ppb and 0.6-2.6 ppb, respectively. Pesticide residues detected in weeds were lindane, heptachlor, endosulfan, diazinon, and chlorpyriphos methyl. Endosulfan was detected in organic cabbages with least residue level (0.1 ppb), whereas lindane was detected much higher (3.7 ppb) in non-organic cabbages.

There was misinterpretation among the farmers where pesticides were regarded as drugs rather than a toxic compound and farmers became unaware for the toxicity effects of pesticides to both animal and human health. The present study indicates that the organic farming practices may reduce pesticide residues in animal and agricultural products. By introducing organic farming, an improvement of farmers' attitudes about pesticide use appeared in West Java. The farmers were willing to convert their agricultural practices to organic farming (69.1%), to produce qualified and healthy food crops and healthy environment.

ACKNOWLEDGEMENTS

This study was funded by Department for International Development No. 7998 - United Kingdom. The authors would like to acknowledge Ir. Elan Masbulan, MP (Indonesian Center for Animal Science Research and Development) and Ir. Meksi Dianawati, MS (Assessment Institute for Agriculture Technology-West Java) for their assistance during the field study.

REFERENCES

Badan Pengendali Bimas. 1990. Pesticide Use in Planning and Realization for Food Crops. Ministry of Agriculture of Indonesia. 13 pp.

Burke, E.R., A.J. Holden, and I.C. Shaw. 1998. A method to determine residue levels of persistent organochlorine pesticides in human milk from Indonesia women. J. Environ. Sci. Health B:33(6): 645-655.

Casanova, J.A. 1996. Use of solid phase extraction disks for analysis of moderately polar and nonpolar in high moisture foods. J AOAC International 79(4): 936-940.

Direktorat Jenderal Industri Kimia Dasar. 2001. Produksi Pestisida. Direktorat Jenderal Industri Kimia Dasar, Jakarta. p.125.

Goebel, H.S., Gorbach, W. Kauf, R.H. Rimpau, and H. Huttenbach 1982. Properties, effects, residues and analytical of insecticides endosulfan. Residue Rev. 83: 56-88.

Ibrahim, A.M., A.A. Ragub, M.A. Morsey, M.M. Hewedi, and C.J. Smith. 1994. Application of an aldrin and dieldrin ELISA to the detection of pesticides in eggs. Food Agric. Immunol. 6: 39-44.

Indraningsih. 1998. Pengenalan keracunan pestisida golongan organofosfat pada ruminansia. Prosiding Seminar Nasional Peternakan dan Veteriner, jilid I. Pusat Penelitian dan Pengembangan Peternakan, Bogor. hlm. 104-109.

Indraningsih, R. Maryam, R. Milton, and R.B. Marshal. 1988. Organochlorine pesticide residues in bird eggs. Penyakit Hewan XX(36): 98-100.

Indraningsih, C.S. McSweeney, S. Bahri, dan Yuningsih. 1990. Residu endosulfan pada tanah bekas tanam kedelai dan limbah pertaniannya serta kemungkinan pengaruhnya pada ternak. Penyakit Hewan XXII(40): 133-137.

Indraningsih, Y. Sani, R. Widiastuti, E. Masbulan, and G.A. Bonwick. 2004. Minimalisation of pesticide residues in animal products. Prosiding Seminar Nasional Parasitologi dan Toksikologi Veteriner. Indonesian Research Institute for Veterinary Science dan Department for International Development. p. 105-126.

Indraningsih and Y. Sani. 2005. A study on pesticides contamination in animal feed on rice straw origin and its prevention. Prosiding Seminar Nasional Pengembangan Usaha Peternakan Berdaya Saing di Lahan Kering. Fakultas Peternakan UGM, Yogyakarta. p. 108-119.

Kahunyo, J.M., C.K. Maitai, and A. Froslie. 2001. Organochlorine pesticide residues in chicken fat: a survey. Environ. Sci. Technol. 35(10): 1989-1995.

Lopez-Carillo L. and M. Lopez-Cervantes. 1993. Effect of exposure to organophosphate pesticides on serum cholinesterase level. Arch. Environ. Health. 48: 359-363.

Maitho, T. 1992. A study of pesticide residues in bovine fat from Kenya. Zimbabwe Vet. J. 23(2): 67-71.

Mallick, K., K. Bharati, A. Banerji, N.A. Shakil, and N. Sethunathan. 1999. Bacterial degradation of chlorpyrifos in pure cultures and in soil. Bull. Environ. Contam. Toxicol. 62: 48-54.

Matsumura, F. 1976. Degradation by sunlight and other physical factors. *In* Toxicology of Insecticides. Plenum Press, London. 342 pp.

Menteri Pertanian Republik Indonesia. 2001. Keputusan Menteri Pertanian Nomor 434.1/Kpts/TP.270/7/2001, tentang Syarat dan Tatacara Pendaftaran Pestisida. Departemen Pertanian, Jakarta.

Njau, B.C. 1988. Pesticide poisoning in livestock in Northern Tanzania cases investigated 1977-1978. Bull. Anim. Health Production in Africa. 36(2): 170.

Noren, K. 1993. Some aspects of determination of organochlorine contaminants in human milk. Arch. Environ. Contam. Toxicol. 12: 277-283.

Ntow, W.J. 2003. Organochlorine pesticides in water, sediment, crops, and human fluids in a farming community in Ghana. Food Addit. Contam. 20(3): 270-275.

Nugraha, A., I.M. Samudra, Sutrisna, dan A.A. Purnomo. 1989. Analisis residu endosulfan dalam biji kedelai. Seminar Hasil Penelitian Tanaman Pangan. Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor. hlm. 376-382.

Rose, M., A. Crossan, I.R. Kennedy, and F. Sanches-Bayo, 2003. Bioremediation of pesticide residues in the environment. AusAID Card Workshop 3. p. 61-64.

Sabrani, M. dan A.R. Setioko. 1983. Itik gembala dan masalahnya di daerah persawahan di pedesaan. Poultry Indonesia 45: 27.

Schenck, F.J. and R. Wagner. 1995. Screening procedure for organochlorine and organophosphorous pesticide residue in milk using matrix solid phase disperson (MSPD) extraction and gas chromatography. Food Add. Contam. 12(4): 535-541.

Sadjusi dan E.I. Lukman. 2004. Penggunaan pestisida ditinjau dari segi pengamanan lingkungan. Prosiding Seminar Nasional Parasitologi dan Toksikologi Veteriner. Balai Penelitian Veteriner dan Department for International Development. p. 85-96.

Shaw, I., E. Burke, F. Suharyanto and G. Sihombing. 2000. Residues of p,p"-DDT and hexachlorobenzene in human milk from Indonesian milk. Environ. Sci. Pollut. Res. 7(2): 75-77.

Standar Nasional Indonesia, 2001. Batas maksimum cemaran mikroba dan batas maksimum residu dalam bahan makanan asal hewan. Direktorat Kesehatan Masyrakat Veteriner. Direktorat Jenderal Bina Produksi Peternakan, Jakarta.

Soejitno, J. 2002. Pesticide residues on food crops and vegetables in Indonesia. Jurnal Penelitian dan Pengembangan Pertanian 21(4): 124-132.

Soerjani, M. 1990. Trend of pesticide use in Indonesia and Asian countries with negative impact to the environment. *In* S. Prawirosoemardjo and Basuki (Eds.). Crop Protection Toward the Sustainable Agriculture and Environmental Save. Agricon. p. 719-745.

Waliszewski, S.M., R. Villabos-Pietrini, S. Gomez-Arroyo, and R.M. Infanzon. 2003. Persistent organochlorine pesticide levels in cow's milk samples from tropical regions of Mexico. Food Addit. Contam. 20(3): 270-205.

Willett, L.B., A.F. O'Donnell, H.I. Durst and M.M. Kursz. 1993. Mechanisms of movement of organochlorine pesticides from soils to cows via forages. J. Dairy Sci. 76: 1635-1644.

Yassin, M.M., T.A. Abu Mourad, and J.M. Safi. 2002. Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. Occup. Environ. Med. 59: 387-394.

Yuningsih dan R. Damayanti. 1994. Gambaran patologis keracunan insektisida organofosfat pada ayam. Penyakit Hewan 26(47): 53-56.