The influence of price of pesticide to its application

The influence of price of pesticide to its application

S F Ayu[1*] and D Aulia[2]

[1]Faculty of Agriculture, Universitas Sumatera Utara, Medan, Indonesia.
[2]Faculty of Public Health,Universitas Sumatera Utara, Medan, Indonesia.

E-mail: *sfa@usu.ac.id or srifajar.ayu@gmail.com

Abstract. Plant vegetables in Gajah and Bulan Baru Villages usually used excessive pesticides, that cause a negative impact on consumers and farmers who apply it. Some influential factors include in the used of pesticide are prices of pesticides, output prices, the size of land and farming experience. This study wants to analyze the influence of these variables on pesticide application. Sample in the study area was carried out by the census, 20 mustard farmers, 35 tomato farmers, and 35 cabbage flower farmers. To solve the study problem, the linear regression function method is used. Pesticide prices have a negative and significant effect on the use of pesticides in vegetable crops mustard, tomatoes and flower cabbage. Land area variables have a positive and significant effect only on mustard plants. Other variables were found to have no significant effect on pesticide use. It is recommended to the government to influence the price of pesticides so that it can reduce the use of it and at the same time introduce an integrated pest protection system and encourage the use of biological pest control.

1. Introduction

Simpang Empat Subdistrict is one of the 17 sub-districts in Karo District, which has the largest planting area of vegetables. This area produce tomatoes, cabbage, potatoes, chinese cabbage, beans and carrots. This area is the highest area in Karo Regency, at an altitude between 1050-1400 meters above sea level [1].

Planting vegetables in this sub-district, especially in Gajah and Bulan Baru Village still relying on the use of pesticides. The main purpose of using pesticides is to protect vegetables and fruits from losses caused by pests and diseases that affect production. However, the farmer in these villages usually used excessive pesticides, that cause a negative impact on consumers and farmers who apply it.

Prior research by authors on the use of pesticides and their impact on 75 vegetable farmers in Simpang Empat subdistrict, Karo district, North Sumatra showed that 60% of respondents applied pesticides in excess of the packaging instructions. Respondents were also found not to use a complete protective device. Almost 70% of respondents have mild toxicity complaints and based on blood cholinesterase levels are also found most respondents have mild toxicity [2]. Further study of technical efficiency in the use of pesticides also indicate that the uses of pesticide as production inputs on tomato commodities, Chinese cabbage and cauliflower are not technically efficient [2]. This encourages the author to analyze what socio-economic factors influence the use of pesticides among these vegetable farmers.

Some influential factors include pesticide prices, output prices, land area and farming experience. According to ref. [3] pesticides are often considered as an important input in agricultural production and contribute significantly to the total cost of production. Profits maximizing farmers are expected to respond and adjust their input using levels to change in the prices of this input. So, changes in the price of pesticides are expected to affect changes in the use of pesticides.

The output price or production price in this study is the price of tomatoes, the price of flower cabbage and the price of mustard yield will determine the amount of farmers' income. Increasing prices of these harvested products will increase farmers' income. According to ref. [4] this increase in income will encourage farmers to increase the use of pesticides in order to produce higher production and income.

The length of area will influence the use of pesticides. Farmers who have large areas of land tend to have sufficient capital to buy production inputs such as pesticides. These farmers also tend to feel the high risk if they have to lose their crops if they do not use pesticides. So it is expected that there will be a positive relationship between land area and pesticide use [5].

Ref [6] argue that farming experiences tend to affect the use of pesticides. Young inexperienced farmers tend to be afraid of taking risks and using lots of pesticides and vice versa for experienced farmers. Thus they argue that the use of pesticides will decrease with increasing farming experience. Meanwhile ref. [7] stated that young farmers tended to be more susceptible to the dangers of pesticides compared to older farmers.

Based on these studies, this study wants to analyze the influence of these variables in the study area, namely in Gajah Village and Bulan Baru Village, Simpang Empat District, Karo District. Tests are carried out separately because in practice, farmers allocate different amounts of land in a cropping system. Furthermore, different crops have different types and frequencies of pest infestation. Therefore, the influence of an individual crop on pesticide use cannot be determined a priori, although a positive association with certain crops is expected. If stated explicitly, this study aims to analyze the effect of pesticide prices, land area, farmer experience and prices of produce (tomatoes, flower cabbage and mustard greens) on the use of pesticides in these plants.

2. Materials and Methods

This research was conducted in Gajah Village and Bulan Baru Village, District, Simpang Empat, Karo District. This is because this study is an advanced study of previous studies. What's more because in this village, there are businesses of tomatoes, mustard greens and flower cabbage, as well as the villages that most produce tomatoes, mustard greens and Cabbage Flowers in Simpang Empat District.

Determination of samples in the study area was carried out by the census. This means that all tomato, mustard and flower cabbage farmers in Gajah Village and Bulan Baru Village were used as research samples. The number of mustard farmers is 20 farmers. The number of tomato farmers is 35 farmers, and the number of Cabbage Flower farmers is 35 farmers.

Data collected in the form of primary data and secondary and primary data, in the form of observations and interviews directly with farmers. Secondary data such as land area, tomato productions were obtained from relevant agencies, such as the Karo District Agriculture Office, Karo Regency Statistics Center, USU libraries and electronic media such as the Internet.

To solve the study problem, the linear regression function method is used with the following equation:

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \mu \quad (1)$$

With:
Y = Use of Pesticides on Tomato or Mustard or Cabbage Flower (Kg)
X1 = Price of Pesticides for Tomato or Mustard or Cabbage Flower (Rp.)
X2 = Area of Tomato or Mustard or Cabbage Flower (Ha)
X3 = Experience of tomato or mustard farming or flower cabbage (year)
X4 = Price of Tomato or Mustard or Cabbage Flower (Rp.)
β = Regression Coefficient
μ = Error term

Regression equations were analysed to explain the effect of independent variables on pesticide prices, land area, farming experience and the price of products on pesticide use as the dependent variable. The value obtained from regression analysis is the magnitude of the t- value and F-value and the coefficient of determination. The t-value is used to test statistically whether the regression coefficients of each independent variable used separately have a real or no effect on non-free parameters.

3. Results and Discussion

With the many problems that occur due to pesticide abuse in Gajah Village and Bulan Baru Village, Simpang Empat District, Karo District based on the results of previous studies; efforts must be found to overcome them. Knowing the factors that significantly influence the use of pesticides in Gajah Village and Bulan Baru Village is very important. Thorough knowledge about what were affected the use of pesticides certain efforts can be made to influence farmers to use pesticides wisely. Before describing the results of multiple regression analysis on all three vegetable commodities (tomatoes, mustard greens and flower cabbage), the average use of pesticides, pesticide costs and the area of the farmers who are the study respondents will be discussed. Data is presented in Table 1.

Table 1. The average amount of pesticide use, pesticide costs and land area of the study respondents.

	Mustard	Tomatoes	Cabbage Flower
The amount of pesticide use (Kg/Ha)	9.320	24.290	5.166
The cost of pesticide/Ha (Rp)	1,120,204	5,348,638	1,785,242
The land area (Ha)	0.25	0.27	0.33

The use of pesticides shown in Table 1. does not depend on land area but looks very specific to the type of plant. Cabbage flower although has the largest area of land among the three types of vegetables but does not become a plant that requires an average number of the largest pesticide use. Tomato plants are considered to be more vulnerable and require a greater amount of pesticides. This causes the average cost of pesticides in tomatoes to be the highest.

Furthermore, the F-value and the Determination Coefficient will be discussed in the results of multiple linear regression analysis. These values are presented in Table 2.

Table 2. The Determination Coefficient

Mustard

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.895a	.801	.748	627.48698

Tomato

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.688a	.473	.402	5,489.97828

Cabbage Flower

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.789a	.623	.573	873.61557

Based on Table 2. it can be seen that the highest determination coefficient is in the equation model for mustard plants that is 80.1% of the models can explain the use of pesticides. The smallest value of the coefficient of determination is on the model for tomato plants. Equation models for flower cabbage plants can explain up to 62.3% of pesticide use.

The results of the novarian analysis then present the value of F. A significant value of F indicates that the t test can be continued. The results of the novarian or variance analysis are presented in Table 3.

Table 3. Result of ANOVA Mustard, Tomatos and Cabbage Flower

Mustard

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23724756.274	4	5931189.068	15.064	.000
	Residual	5906098.726	15	393739.915		
	Total	29630855.000	19			

Tomato

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	810622471.532	4	202655617.883	6.724	.001
	Residual	904195845.611	30	30139861.520		
	Total	1714818317.143	34			

Cabbage Flower

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	37847629.580	4	9461907.395	12.398	.000
	Residual	22896124.706	30	763204.157		
	Total	60743754.286	34			

The F value for each commodity based on the variance results shows that all three equations have a significant F value. It means that the t test can continue. This means that together the variables tested affect the use of pesticides.

The results of the t-test of multiple regression analysis for each model representing the three types of vegetables are presented in Table 4.

Table 4. The Result of t-value

	Mustard			Tomato			Cabbage Flower		
	B	T	Sig.	B	T	Sig.	B	T	Sig.
(Constant)	-1518.859	-1.119	0.281	11373.945	1.741	0.092	3,993,995	1,863	.072
Price of Pesticide	-0.007	-3.773	0.002	-0.005	-4.481	0.000	-0.004	-5,368	.000
Land area	6788.416	2.541	0.023	15516.909	1.575	0.126	24,837	.020	.985
Experience	-26.315	-1.16	0.264	-22.053	-0.207	0.837	-5,504	-0.409	.685
Price of commodity	0.503	0.634	0.535	3.716	1.508	0.142	1,225	2,000	.065

Pesticide price variables were found to have a negative and significant effect on the use of pesticides for mustard, tomato and flower cabbage. This shows that in accordance with the theory farmers respond to changes in price increases by reducing pesticide use and vice versa. This is done to keep the profit in production. The results of this study are in accordance with the ref. [8,9]. Based on estimates of Tobit prices were a significant factor influencing the decision to use pesticides [8]. Meanwhile ref. [9] found that prices

are a determinant of the use of pesticides in chocolate plants. In Indonesia, Joko Mariyono and Irhim found that there was a decrease in the use of pesticides with rising prices of pesticides. Thus the variable price of pesticides can be used to influence farmers not to overuse pesticides [10].

The land area was found to have no significant impact on the use of pesticides in the three types of vegetables. This insignificant result was also found in the study of ref. [9] and [11]. In contrast, Anang and Amikuzuno's study found a significant relationship between land area and pesticide use. This means that not all farmers who have large planting areas use excessive pesticides [12].

Findings regarding the experience of farming show results that do not significantly affect the use of pesticides. Previous studies by May Lwin OO state that increasing experience will reduce pesticide use in accordance with the findings of this study, but this result was not significant [13]. However,experienced farmers use more pesticides [11,14]. Another study found no significant influence between farming experience and pesticide use [9,12].

Finally, the study also found no significant effect of output prices on pesticide use. Although normatively the increase in output prices will increase farmers' income, what happens is that farmers tend not to want to change the dose of their pesticides because they feel they are in accordance with the dose they want. This finding is different from the results of ref. [15,16], which found a significant relationship between commodity prices and pesticide use.

4. Conclusions

Pesticide prices have a negative and significant effect on the use of pesticides in vegetable crops mustard, tomatoes and flower cabbage. Land area variables have a positive and significant effect only on mustard plants. Farming experience found to have no significant effection pesticide use in the three kinds of vegetables. Finally, the output prices also have no significant impacts on the dose of pesticide used by the farmer. It is recommended to the government to influence the price of pesticides so that it can reduce the use of pesticides but still introduce an integrated pest protection system and encourage the use of biological pest control.

References

[1] Badan Pusat Statistik Kabupaten Karo [BPS-Statistic of Karo Regency] 2017 Kabupaten Karo Dalam Angka 2017 [Karo Regency in numbers] (Karo, Indonesia: Badan Pusat Statistik Kabupaten Karo [BPS-Statistic of Karo Regency])

[2] Ayu S F and Aulia D 2018 Technical efficiency of pesticide application on tomato, chinese cabbage and cauliflower in simpang empat sub-district Karo Regency *CSSPO Int. Conf. (Kuching)* (E3S Web Conference) **52** 00045

[3] Rahman S 2003 Farm-level pesticide use in Bangladesh: Determinants and awareness Agr. Ecosyst. Environ **95** 1 pp 241-52

[4] Rahman S and Routray J K 1998 Technological change and women's participation in crop production in Bangladesh *Gender Technological Development* **2** pp 243-67

[5] Rikoon, J S, Constance D H and Geletta, S 1996 Factors affecting farmers' use and rejection of banded pesticide applications *J. Soil Water Conserv.* **51** 4 pp 322-34

[6] Al Zadjali S, Morse S, Chenoweth J and Deadman M 2014 Factors determining pesticide use practices by farmers in the Sultanate of Oman *Sci. Total Environ.* **476-477** pp 505-12

[7] Ntow W J, Gijzen, H J, Kelderman P and Drechsel P 2006 Farmer perceptions and pesticide use practices in vegetable production in Ghana *Pest Manag. Sci.* **62** pp 356–65

[8] Tijani A and Nurudeen S 2012 Assessment of farm level pesticide use among maize farmers in Oyo State Nigeria *food science and quality management* **3** pp 1-8

[9] Adeniyi I A, Oguntokun W F and Ibiyinka O 2017 Determinants of the extent of pesticide use in Nigerian farms *Afr. J. Soil Sci.* **5** pp 347-55

[10] Mariyono J and Irham 2001 Usaha menurunkan penggunaan pestisida kimia dengan program pengendalian hama terpadu [Efforts to reduce chemical pesticides use through integrated pest management program] *Jurnal Manusia dan Lingkungan* **8** 1 pp 30-6

[11] Idris A, Rasaki K, Folake T and Hakeem B 2013 Analysis of pesticide use in cocoa production in Obafemi Owode Local Government Area of Ogun State Nigeria *J. Biol. Agric. Hortic.* **3** pp 1–9

[12] Anang B T and Amikuzuno J 2015 Factors influencing pesticide use in smallholder rice production in Northern Ghana *Agric. For. Fish.* **4** pp 77–2

[13] Oo M L, Yabe M and Khai H V 2012 Farmers' perception, knowledge and pesticide usage practices: a case study of tomato production in Inlay Lake Myanmar *J. Fac. Agr., Kyushu Univ*. **57** 1 pp 327–31

[14] Rahman S 2015 Agroecological, climatic, land elevation and socio-economic determinants of pesticide use at the farm level in Bangladesh *Agric. Ecosyst. Environ* **212** pp 187–97

[15] Rahman S and Chima C D 2018 Determinants of pesticide use in food crop production in southeastern Nigeria *Agriculture* **8** 35 pp 1-14

[16] Rahman S 2016 Jointness in farmers' decision to apply pesticides in multiple crops and its determinants at the farm level in Bangladesh *Int. J. Pest Manage.* **62** 2 pp 149-57

Acknowledgments
The research was funded by the Ministry of Research, Technology and Higher Education of the Republic of Indonesia (Kemenristekdikti) with scheme DRPM, based on contract number 156/UN5.2.3.1/PPM/KP-DRPM/2018