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FACTORS THAT AFFECT THE CONSERVATION FARMING OPERATION ON VEGETABLE CROPS IN TARAKAN

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ABSTRACT: *The application of conservation technique at the farmers level has shown initiatives of the farmers to apply land conservation techniques based on local knowledge and understanding of the farmers about the ecological process that relates to erosion and land management, so that a part of the farmers apply the conservation technique. Objective of the research was to analyze factors that affect implementation of the conservation farming operation. This research was conducted at Kampung Enam District, East Tarakan Subdistrict, Tarakan, from July to August 2013. Results of the research showed that implementation of the conservation farming operation of the farmers in Tarakan were high and medium levels. Factors, such as knowledge on conservation technique, age, duration of the farming operation, numbers of the family's member, and the arable land have significant effect on the implementation level of conservation farming. However, knowledge about the importance of conservation farming and formal education have insignificant effect.*

KEYWORDS*:* Conservation Farming Operation, Vegetables, Application Level

INTRODUCTION

Vegetable farming is a farming system, which is mostly applied by farmers in Indonesia for many reasons, such as higher income in comparison with other farming systems, relatively short duration of planting, and easier breeding technique. Results of the research at the River Course Zone of Kaligarang in Central Java and the River Course Zone of Citarum in West Java have shown the increasing income of the farmer in vegetable sector, 25 to 40 times higher than crops and mixed farm. However, vegetable farmings are mostly developed by the farmers on marginal lands at the mountain ranges, which are characterized by topographic inclination, high rainfall, without sufficient conservation and relatively high agrochemical material, so that it is frequently considered as activity that is not environmentally safe, seasonal crops farming, such as vegetables, on sloping land mostly causes erosion if it is not accompanied by land conservation.

Vegetables are horticultural products, which are mostly grown by farmers in Tarakan and spread over the subdistricts. One of them is the District of Kampung Enam of the East Tarakan Subdistrict. The interesting thing of such vegetable farming in this region is the farmers' abilities in managing farming operation on inclining topographic land, > 15% on the average. The vegetable farming in this region is done by the Toraja Tribe and it has lasted for ± 35 tahun. Besides the inclining topographic land, some obstacles that must be faced are (a) difficult and costly means of production (all means that support the production) (Wahyuni, 2009); (b)

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infertile land due to it is dominated by red-yellow Podsolic and Ultisol soil, which tend to less fertile and susceptible to erosion; (c) land property status is obscure; (d) high rainfall that reaches 310 mm/month on the average. Referring to condition of the vegetable farming at the District of Kampung Enam of the East Tarakan Subdistrict, such farming is susceptible to erosion. Diverse negative impacts have emerged in relation to vegetable farming at the inclining area, which demand the farmers to apply the conservation technique. Results of the research showed that application of the conservation technique on vegetable farming could reduce the erosion to the tolerable soil loss (tolerable soil loss, erosion <13.5 ha/ton/year) and reduce the nutrient loss. Moreover, according to Abrol, I.P., R.K. Gupta and R.K. Malik (2005), this farming system has succeeded in supporting high productivity, conserving biological varieties and protecting the environment.

Application at the farmer level has still been faced on obstacles as the results of the research : (a) requires much power and takes longer time; (b) could reduce population of the crops; (c) limited household resources (capital and workforce), and individual conservation without accompanying with the same efforts in the community would not give significant outcomes, status of land property (Mulyoutami et.al., 2003); (d) trigger the pest infection, which could reduce the production, lack of capital, and status of land property; (e) application of the conservation techniques, which frequently lead to physical-mechanical approach that bring about difficulties for the farmers, so that the application at the farmer level has still limited on project-scale and after that, the farmers would return to the existing farming pattern without considering in the interest of conservation (Sutrisna dkk, 2010); (f) condition of the farmers who still completely lack, which make them give priority on short-term profit in comparison with long-term profit from the application of conservation techniques (Nuraeni et.al., 2012).

Even the research above showed some obstacles that caused low application of the conservation techniques at the farmer's level, but some research have also showed initiatives of the farmers to apply the conservation techniques based on local knowledge as a result of the research by Mulyoutami *et.al*., (2003) toward coffee-based farming in Sumberjaya of West Lampung showed the farmers' understanding on the ecological process that relates to erosion and land management, so that a part of the farmers apply the conservation techniques. The research on vegetable farming in Rejang Lebong Regency, Bengkulu, has shown diverse efforts to prevent any erosion, which may be caused by the farmers, based on local knowledge and adaptation to inclining topographic condition of the farming land.The description above has become the base in determining review of this research by reviewing local resources-based conservation farming practices and their effects on quality of land resources, production, and income of the farmers.

METHOD OF THE RESEARCH

The research was conducted at the District of Kampung Enam, Subdistrict of East Tarakan, and Tarakan. The main reasons of choosing the location were (1) in general, (1) the farming land for vegetable lies on the slope of > 15%, (2) one of vegetable farming centers in Tarakan, (3) the applied conservation technique in farming system. The research was conducted from March 2013 to July 2013. Method in determining the respondent used the simple random sampling that refers to opinion by Arikunto (1993), the amount of sampes should pursue the provisions as follow : (1) if number of the objects are less than 100, it is better to take them all; (2) if the numbers are more than 100, we could take 10 – 15 percent or 20 – 25 percent or more,

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which depend on time, workforces, fund, width of the observed area, the extent of data, and the risk of the research, as well as homogeneity level of the samples.

Therefore, based on the preliminary data, it showed that there was four farmer groups at location of the research, which were established by the Department of Agriculture and Crops in Tarakan that consisted of 30 members of each group, so that total population of the farmers at location of the research were 120 members, and it can be said that the respondents were 60 members (50% of the total population). Application of the conservation farming is affected by factors in the farming system, therefore an analysis is required on factors that affect the application of conservation farming by the regression function used SPSS version 21.

The function model of the conservation farming implementation in this research is:

$$Y = \alpha 0 + \alpha 1X1 + \alpha 2\ X2 + \alpha 3\ X3 + \alpha 4X4 + \alpha 5X5 + \alpha 6\ X6 + \alpha 7X7 + \alpha 8X8 + u$$

In which:

Y	=	implementation of conservation farming operation
X1	=	knowledge on the need of conservation
X2	=	knowledge on benefit of conservation
X3	=	knowledge on technique/ the way of conservation
X4	=	age of the farmer (years old)
X5	=	formal education
X6	=	duration of farming operation (year)
X7	=	number of family's member (people)
X8	=	width of arable land (ha)
α0	=	intercept/constant
α1,.., α8	=	coefficient of regression
u	=	error term

RESULT AND DISCUSSION

Description of Land Resources Characteristic for Conservation Farming

Result of the interview with the vegetable's farmers at the District of Kampung Enam, Subdistrict of East Tarakan, has shown that the applied conservation farming cannot be apart from land resources characteristic of the farming, such as types and characteristics (properties) of the soil, inclination slope, and climate (rainfall) in Tarakan. Soil type in location of the research is red-yellow podsolic, which is well-known as quartz soil. Such type of soil comprises of organic horizon and thin organic mineral, while the next layer below it mostly contains loam (clay) and has red to yellowish color. It was formed from igneous rock and *tufa*, which generally have fine texture, clump structure, less stable aggregate of the soil and low permeability as well as low nutrient content, so that it can be said that fertility of such soil type is low as well, both physically and chemically. Table 1 presents the analysis result of the soil samples in 2009 at location of the research that has not been cultivated by the farmers, which showed pH status of the soil that was rather sour with total low N, as well as KTK and C-organic, and texture of the soil is sandy loam.

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Table 1 Physical and Chemical Properties of the Soil in Vegetable Farming at the District of Kampung Enam District, Subdistrict of East Tarakan

Observation	Unit	Value	Criteria
pH (H_2O)	-	5.85	Rather sour
N	%	0.12	Low
P_2O_5	(mg/100g)	0.75	Very low
K_2O	(me/100g)	6.46	Very low
KTK	(me/100g)	14.89	Low
C-org	%	1.67	Low
Texture	% fraction		Sandy loam

Source : Laboratory Analysis of Soil Science, Faculty of Agriculture UBT (2009)

Furthermore, soil analysis has been done on soil sample of two different slant of the slope at the farming lands, which have been cultivated by farmers as presented in Table 5.2 as follow :

Table 5.2 Chemical Properties of the Conservation Farming on Two Different Slopes

Slope (%)	pH (H_2O)	N (%)	P_2O_5 (ppm)	K_2O (ppm)	KTK (me/100 g)	C-org (%)	Texture
0-8 %	4.65 Sour	0.54 High	59.68 Very high	48.21 High	10.87 Low	0.92 Very low	Clayey
15-30%	5.03 Sour	0.79 Very high	77.34 Very high	54.69 High	14.06 Low	1.01 Low	Clayey

Source : Laboratory Analysis of Soil Science, Faculty of Agriculture UBT (2013)

The table above does not show any basic differences between condition of the soil at the slant of slope 0-8% (flat/smooth) and condition of the soil at the slant of slope 15-30% (steep), by pH of the soil is acid and N value (%), P_2O_5 as well as K_2O are high and very high, while KTK and $C_{organic}$ have low values and very low values. If this is analyzed by comparing condition of the uncultivated land and the cultivated land, it shows different values of N, P_2O_5, and K_2O. For the uncultivated land, it shows that N, P_2O_5, and K_2O have lower values in comparison with the cultivated land. It was presumed that the application of fertilizer, which is made of the shrimp waste, has affected those three elements. Quality of the shrimp waste is good enough, based on the nutrients content, and it is deserved to be applied as fertilizer as stated by Nurhasanah et.al. (2011), liquid-organic fertilizer that made of the shrimp waste has the most dominant macronutrient by the nutritional order Ca > N > P > Mg > K > S and the micronutrient elements are Fe > Cu > Zn > Mn.

Slant of the Slope

Slant of the slope is measurement of the relative land slope toward the level plane, which is generally stated in percent or degree. Arsyad (2006) stated that the most two influential topographic features on surface flows and erosion are slant and length of slope, erosion would be greater along with the steep slope. As presented in Table 5.3 above, Tarakan area is dominated by the slope class of 0-2% for about 12.109 Ha or 48.28% of total area of Tarakan, which means that most of the area is a plain. Meanwhile, distribution of the slant slope at the

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District of Kampung Enam, Subdistrict of East Tarakan, is dominated by the slope class of 0-2% (flat/smooth) and 15-40% (slant to rather steep), as well as location of the research on varying slant of slopes from 0% to >15%. Such varying slant of slope at location of the research will affect the extent of surface flows and erosion as stated by Arsyad (2006) that the surface flows and erosion would be greater on ununiform slope than the uniform one. Erosion is the soil loss or parts of the soil, which are eroded by water or wind. Erosion will cause the loss of fertile soil at the surface layer, which is good for the plant's growth, and reduce the soil's ability to absorb and sustain the water. The soil, which is dragged along by the water flows, will be brought into the water source and will be settled on the decelerating water flows, which so-called sediment (Arsyad. 2006).

However, the test, which was done to find out sedimentation on the farming land, was based on the land slope, kinds of vegetable, and age of the crops, as presented in Table 5.3 below :

Table 5.3 Mean of Sedimentation on Conservation Farming Land Based on Land Slope, Kinds of Vegetable and Age of the Crop

Slope (%)	Mean of Sedimentation (cm)					
	Mustard Greens		*Ipomoea* spp.		Spinach	
	0-7	14-30	0-7	14-30	0-7	14-30
0-6	5.5	7.8	7	7.1	5.8	8
16-30	4.5	5.5	5	5	8	8.3

Source : Primary Data Processing (2014)

Rainfalls

Rainy season in Tarakan lasts from October to April and followed by Dry season that lasts from April to October. However, this condition is frequently unpredictable. There is no rain during rainy season and vice versa. The extent of rainfall shows the amount of water volume on certain area and can be expressed in water height (mm). Rainfall in Tarakan is relatively high as reported in 2012 that average rainfall ranged from 244.2 mm to 673.1 mm by monthly rainfall is 400 mm on average.

The Application Level of Conservation Farming

Application of the conservation farming is the application of water and soil conservation principles in farming system that has been done by more emphasizing on planting arrangement pattern without building the erosion control structure in order to increase land productivity and reduce or eliminate the negative impact of land management, such as erosion, sedimentation, and flood. Vegetable farming system at location of the research has applied some conservation techniques, and such techniques are generally selected in without any difference among the farmers. The application level in this research is divided into 5 levels that based on percentage of the application on the arable/cultivated land of the respondent, such as (1) very low (not existed), (2) low (1-25%), (3) medium/tolerable (25-50%), (4) high (50-75%), and (5) very high (>75%).

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Table 5.7 Spread of the Respondent's Response on Application of Conservation Farming

No	Question	Spread of the Respondent's Response (percent)				
		1	**2**	**3**	**4**	**5**
	Treatment of terrace	15.0	26.7	28.3	21.7	8.3
	Planting perennial crops	56.7	31.7	11.7	0	0
	Planting crops as terrace reinforcer	48.3	33.3	15.0	3.3	0
	Building the infiltration duct	6.7	35.0	45.0	10.0	3.3
	Building water disposal channel	1.7	11.7	43.3	16.7	26.7
	Application of stable manure	43.3	45.0	10.0	1.7	0
	Application of mulch	0	0	0	0	100
	Application of organic fertilizer (shrimp waste)	0	0	0	0	100
	Mean	21.7	23.3	18.3	6.7	30

Source : Primary Data Processing (2014)

If it is analyzed from the whole applicable conservation techniques, the application level of the respondents is divided into four levels, low, tolerable, high, and very high. **Low** application is a planting technique of perennial crops as terrace reinforcer and the use of stable manure. Low application of the respondent was due to most of the respondents do not implement those three techniques or if it is applied, they just applied on a small part of their cultivated land (1-25%).The **tolerable** application is the conservation technique by building terrace and water infiltration duct. Such technique has only been applied on the inclining land (25-50%) out of the whole arable/cultivated land. Meanwhile, the building of water infiltration duct has also been done at specific part of the cultivated land, such as hole or small well to collect water in order to be used to water the crops just in case of no rain or to wash the harvested vegetables. The building of water disposal channel is **high** applicable conservation technique that reaches 50-75% of the cultivated land width. The disposal channel is a small ditch, ÷ 30 cm in diameter, which leads to the river or reservoir, so that the embankment would not be submerged. This disposal channel is also functioned as partition between embarkments.

The application of mulches and organic fertilizer, shrimp wastes, through conservation technique has reached **very high** level or application of the farmer has reached > 75% out of the cultivated land. The applicable mulches are made of fresh grasses that were found around the farming land, and they have been cut up into small pieces before applicable as mulches. The related grasses should have no internodes because the grasses that have internodes are easily grown and potential to become weeds. However, the applied fertilizer made of the shrimp waste is derived from remains of the shrimp's carapace and the tail as well, which have been sun-dried and pound into coarse flour. The shrimp waste has better quality in accordance with the nutrients content, so that it is deserved to be applied as fertilizer as suggested by Nurhasanah et.al. (2011), the liquid organic fertilizer made of the shrimp waste has the most dominant macronutrient content by the nutritional order Ca > N > P > Mg > K > S and micronutrients of Fe > Cu > Zn > Mn.

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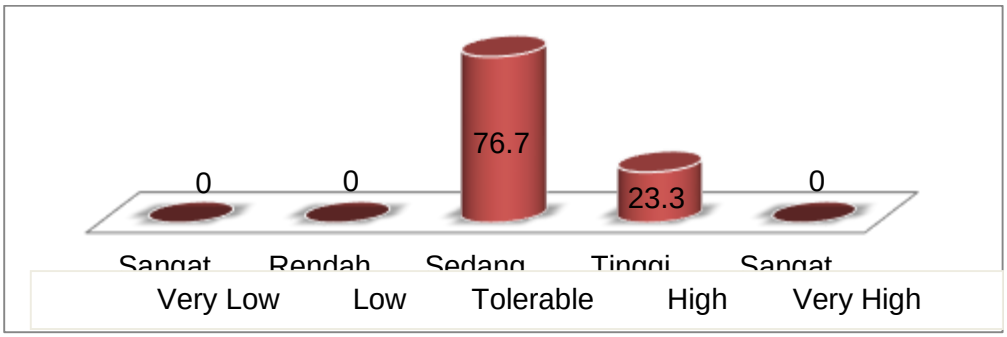

Figure 5.5 The Application Level of Conservation Farming

Factors that Affect the Application of Conservation Farming

Anova of factors that affect the application of conservation farming (appendix 3) shows that F_{count} is 767.12 by probability value < 0.001, which means that it rejects H_0 or independent variable (x) that comprises of : knowledge about the importance of land conservation (x1), knowledge about the benefit of land conservation (x2), knowledge about land conservation techniques (x3), Age (x4), formal education (x5), duration of farming operation (x6), number of the family's dependent (x7), and width of the cultivated land (x8) have simultaneously affected on application of the conservation farming.

Furthermore, coefficient of correlation ($r = \sqrt{R^2}$) is 0.99579, which shows positive and close relationship among variables, while the adjusted-determinant coefficient value (R^2) is 0.99031, which means that varying application levels of the conservation farming are affected by some factors, such as knowledge about the importance of land conservation, knowledge about the benefit of land conservation, knowledge about land conservation techniques, age, formal education, duration of farming operation, number of the family's dependent, and width of the cultivated land for about 99.03% and 0.97% is affected by other factor, which is not included in the model.

Effect of each (partial) independent variable (x) on the dependent variable (Y) of the model and multi regression equation is presented in Table 5.8. Results of data analysis showed that variables of knowledge about land conservation techniques, age, duration of farming operation, number of the family's dependent, and width of the cultivated land have significant effect on trust level of 90% toward the application of conservation farming.

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Table 5.8 Result of the Equation Parameter Estimation on Application of Conservation Farming

Variable	Coefficient	Standard Error	t_{count}	Pr > | t |
Knowledge about the importance of Land Conservation (x1)	0.090177	0.089921	1.00	0.3206
Knowledge about the Benefit of Land Conservation (x2)	0.128623	0.093807	1.37	0.1762
Knowledge about the Land Conservation Technique (x3)	0.528677	0.116753	4.53	< .0001*
Age (x4)	0.084955	0.049690	1.71	0.0933*
Formal Education (x5)	0.326190	0.617611	0.53	0.5996
Duration of Farming Operation (x6)	-0.09015	0.045158	-2.00	0.0512*
Number of Family's Member (x7)	0.307642	0.182622	1.68	0.0981*
Width of Arable (Cultivated) Land (x8)	12.92228	5.103984	2.53	0.0144*
Notes : * significant in trust level of 90%				

Source : Primary Data Analysis (2014)

Variable of the knowledge about the importance of conservation farming has positive and insignificant influence by t_{count} = 1.00 and probability value 0.3206 > 0.10. This is due to less knowledge of the farmers about the importance of conservation farming application on their farming system, therefore it can be concluded that the application of the available conservation technique is not actually based on knowledge about the importance of conservation farming, but on other factors in that farming system. Variable of the knowledge about the benefit of conservation farming has positive and insignificant influence by t_{count} = 1.37 and probability value 0.1762 > 0.10. Apparently, application of some conservation techniques is not based on knowledge about benefit of each applied technique, but on knowledge, in general, about benefit of the conservation technique in order to prevent any erosion/landslides.

Variable of the knowledge about the conservation farming technique has positive and significant influence on application of the conservation farming by t_{count} = 4.53 and probability value <.0001 < 0.1, which means that this variable has significant influence on application of the conservation farming due to farmers at location of the research have already known well the conservation technique, such as building terraces, disposal channel, and using mulches on their farming system. Positive coefficient shows the same direction between knowledge about the conservation techniques toward application of the conservation farming, in which improving knowledge of the conservation technique will increase application of the conservation farming.

Age variable has positive and significant influence on application of the conservation farming by t_{count} = 1.71 and probability value 0.0933 < 0.10. This is due to the farmers' ages belong to the productive ages, 20-40 years old, so that they physically have abilities to apply the conservation technique and more brave in decision-making to improve their farming operations.

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Formal education has no influence on application of the conservation farming by t_{count} = 0.53 and probability value 0.5996 > 0.10. In general, the education background of the farmers at location of the research is elementary school and few of them were graduated from senior high school. However, the applicable conservation techniques are similar among the farmers. It shows that formal education does not affect their decision to apply the conservation farming. Duration of farming has negative and significant influence on application of conservation farming by t_{count} = -2.00 and probability value 0.0512 < 0.1, which means that this variable has significant influence on application of the conservation farming. Negative coefficient shows a reverse influence between variable of farming duration and application of the conservation farming, in which the duration of farming does not always increase application of the conservation farming due to if the farmers thought that they have sufficient outcomes, they tend to avoid any change in their farming system and prefer to continue their activities that have lasted for years.

Number of the family's member has positive and significant influence on application of the conservation farming by t_{count} = 1.68 and probability value 0.0981 < 0.10. Number of the family's member is potential workforces in farming operation so that the farmers would not face any difficulty in applying the conservation farming techniques. Width of the cultivated land has positive and significant influence on application of the conservation farming by t_{count} = 2.53 and probability value 0.0144 < 0.10. Farmers who have narrow land tends to not applying the conservation farming techniques by reason of it would narrow the farming land, which is going to be cultivated.

CONCLUSION AND SUGGESTION

Conclusion

1. Characteristic of land resources on conservation farming operation in Tarakan has shown various slants of slope from 0% (flat/smooth) to >15% (steep), type of the soil is Red Yellow Podsolic and Latosol, by pH of the soil is acid and N value (%), P_2O_5 and K_2O are high and very high, while KTK and C-organic have low values and very low values, and average monthly rainfall reaches 400 mm.
2. Application of the conservation farming in Tarakan is high and medium (tolerable).
3. Factors, such as knowledge on conservation technique, age, duration of the farming operation, numbers of the family's member, and the arable land have significant effect on the implementation level of conservation farming. However, knowledge about the importance of conservation farming and formal education has insignificant effect.

Suggestion

1. Application level of conservation farming operation in Tarakan is high even though the farmers have not had higher knowledge about conservation farming operation, therefore more intensive building has been applied to improve knowledge of the farmers in order to achieve higher application of conservation farming operation.
2. Role of the related institutions should be improved whereas the conservation farming operation has become local learning in farming operation in Tarakan.

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