

Analysis of The Factors Motivating Dairy Farmers in The Southern Slope of Merapi Volcano to Return to Their Endangered Settlement Post Eruption 2010

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Abstract: This study aimed to analyze the factors motivating dairy farmers in disaster-prone area (DPA) in the southern slopes of Merapi volcano to return to their endangered settlement, post 2010 eruption. The research samples, using census method, were dairy farmers in DPA III (Kaliadem hamlet) and DPA II (Gondang Wetan hamlet), both in Cangkringan district. Study site was a disaster-prone areas, directly affected by Merapi eruption in 2010. Villages in the affected areas selected with consideration had the highest population of dairy cattle before the eruption of Merapi 2010 and was the closest village to the peak. Research conducted by the survey method. The results showed that the value of Hosmer and Lemeshow 0.909, so the model was declared fit to the data. Value Omnibus Tests of model coefficients 0.000, it was concluded that the independent variables were used together influence to the willingness of farmers to return to their endangered settlement, post eruption 2010. Nagelkerke R square value of 0.818, which means the ability of the independent variables were explained 81.8% the models. Independent variables that motivated the desire of farmers to return to their endangered settlement were: 1) dairy cattle ownership, 2) education, 3) culture and 4) information. Odds ratio value were respectively: 2.166 (dairy cattle ownership), 1.402 (education), 225.287 (culture) and 0.017 (information). Cultural factors had the highest propensity value for motivating dairy farmers to return to their endangered settlement post the eruption of 2010.

Key words: motivate, endangered settlement, dairy farmers, southern slopes, Merapi volcano

Abstrak: Penelitian ini bertujuan menganalisis faktor-faktor yang mempengaruhi keinginan peternak sapi perah di daerah rawan bencana di lereng selatan Gunungapi Merapi untuk kembali ke dusun asal mereka sebelum erupsi 2010. Sampel atau materi penelitian adalah peternak sapi perah di KRB III (Dusun Kaliadem) dan KRB II (Dusun Gondang Wetan). Kedua dusun termasuk wilayah Kecamatan Cangkringan. Pengambilan responden dilakukan menggunakan metode sensus. Lokasi penelitian merupakan daerah rawan bencana, yang secara langsung terkena dampak dari erupsi Merapi 2010. Desa di daerah bencana dipilih dengan pertimbangan memiliki populasi sapi perah terbanyak pada saat sebelum letusan Merapi 2010 dan merupakan desa terdekat dengan puncak Merapi. Penelitian dilakukan dengan metode survei. Hasil penelitian menunjukkan bahwa nilai Hosmer dan Lemeshow 0,909 sehingga model dinyatakan fit dengan data. Nilai Omnibus Tests dari model coefficients 0,000, maka disimpulkan bahwa variabel bebas yang digunakan secara bersama-sama berpengaruh terhadap keinginan peternak untuk kembali ke lokasi dusun semula sebelum erupsi 2010. Nilai Nagelkerke R^2 0,818 yang artinya kemampuan variabel bebas menjelaskan model sebesar 81,8%. Variabel bebas yang berpengaruh terhadap keinginan peternak untuk kembali adalah: 1) kepemilikan sapi, 2) budaya, 3) informasi dan 4) pendidikan. Nilai Odds Ratio berturut-turut sebesar 2,166 (kepemilikan sapi), 225,287 (budaya), 0,017 (informasi) dan 1,402 (pendidikan). Faktor budaya memiliki nilai kecenderungan yang tertinggi untuk mempengaruhi keinginan peternak untuk kembali ke dusun semula sebelum erupsi 2010.

Kata kunci: keinginan kembali, peternak sapi perah, lereng selatan, gunungapi Merapi

Introduction

Southern slope of Merapi volcano covering four districts: Tempel district in the most

western position, Turi and Pakem district in the middle and Cangkringan district in the most eastern position. Population of dairy cattle on the slopes of Merapi reached 85-90 percent of

the total population in the Special Region of Yogyakarta (DIY). Dairy cattle population in the southern slopes of Merapi before and after the eruption of Merapi in 2010, during the period of 2003 to 2011 can be observed in Table 1. Population of dairy cattle declined very sharply in Cangkringan in 2010 due to Merapi eruption.

Dairy farm in the southern slopes of Merapi has been cultivated for generations by the local society. Farmers in Sleman regency, particularly in Merapi slope are members of farmer groups in dairy cooperatives. There are three dairy cooperatives in Sleman regency: Warga Mulya, UPP Kaliurang and Saroni Makmur. The average of dairy cattle ownership are range from 3-5 tails for every farmer with milk production levels between 9-15 liters/head/day. Number of productive cattle (parent stock) about 50% of the total population (Ilham and Priyanti, 2011).

Widiati et al. (2007) presents the results of the business systems evaluation in a group of dairy farmers Dadi Makmur, Kepuharjo village, Cangkringan district, with Microfinance Institutions (MFI) system, indicates that positive cash of MFI, no payment arrears. Financial feasibility analysis with a 5-year investment and an annual 12% discount factor in Dadi Makmur dairy farmers group shows NPV of Rp141.694,00/productive cattle/month, BCR = 2.62 and IRR = 19%. The results showed that the dairy cattle business is feasible.

Merapi volcano eruption in 2010, had a major impact on economic activities, especially the agriculture-based. Farms are the most severely affected sector. The estimated total loss of farms sector on the slopes of Merapi, including Boyolali regency, Klaten, Magelang and Sleman reached about 88.320 M (Priyanti and Ilham, 2011). Estimates are based on the number of dead cattle, cattle that were already and would be sold, forage land damage and reduced milk production.

Farms sector loss, in Sleman regency was caused by the death of cattle, output prices decline, the decline of milk production and marketing network outage, reached 21 M (Ilham and Priyanti, 2011). Based on data from the Department of Agriculture, Fisheries and Forestry Sleman Regency, 3,413 cattle died including 2,060 dairy cattle on the southern slopes of Merapi (Martoyo, 2011).

Losses and adverse impacts on farms sector as a result of the eruption of Merapi 2010, were also caused by the destruction of feed resources in the area (Prawiradiputra, 2011). Temporary cowshed for handling Merapi victims scattered in 84 locations in Sleman (20 November 2010). Most of the cowshed did not meet the standard, seen from the construction, and facilities available. Farmers were difficult to get source of clean water for the cattle which further aggravated the cattle condition (Priyanti et al., 2011).

In the case of volcanoes, evacuation may be a multifaceted problem because of many secondary effects of such hazards. Lavigne et al. (2008) proposed some constraints of Merapi victims evacuation, namely (1) perception, (2) beliefs/culture, (3) socio-economic constraints, (4) basic knowledge about the danger of Merapi, (5) experience in dealing with crisis, and (6) the interval between the passing eruption period. Gregg et al., (2004) added that someone with a high perception of the risk of volcanic hazards, tended to be the most prepared to deal with natural disasters.

Factors in the evacuation constraints, as basis for the selection of the factors that motivate dairy farmers to return to their endangered settlement. Neumann 1997 in Gaillard and Dibben (2008) states that public dissatisfaction with the new (place of refuge) can worsen feelings of loss of well-being, and to encourage the return of refugees. The research

Table 1. Population of dairy cattle in the southern slope of Merapi 2003-2011(head)

Districts	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tempel	328	374	441	348	284	269	213	178	148
Turi	316	368	430	357	335	338	425	444	269
Pakem	3,201	3,596	3,579	3,190	2,731	2,705	2,107	2,096	1,850
Cangkringan	2,053	2,798	3,095	2,789	2,086	2,012	2,274	25	1,042

Source: Central Bureau of Statistics, Sleman Regency (summarized from Sleman Regency in Figures years 2003-2011)

in Kaliadem hamlet after Merapi eruption in 2006, proved that the variables influencing farmers decision to evacuate or not, is the ownership of dairy cattle, with the direction of the logit coefficient is negative, meaning that if the higher number cattle ownership, the desire to evacuate into getting smaller (Andarwati, 2010).

Behavior (B) is a function of individual characteristics (P) and environment (E). Environmental factors have a great power in determining behavior, sometimes even greater power than individual characteristics. In Environmental Psychology, is the psychological theory-oriented environments, one application is environmental determinism. Differences in the location in which humans live and thrive will result in different behaviors (Helmi, 1999).

After the eruption, people in the disaster area whose homes were destroyed, were forced to flee. Currently, most of the refugees have moved into new homes in relocation sites, or fixed residential (Huntap) provided by the government, while most of the others, return to the original hamlet before eruption of 2010. Based on this background, individual characteristics factors related to livelihood (dairy cattle ownership), life experiences (Inhabitation period), perception of volcanic risk, education, land ownership, and age of farmers, as well as environmental factors, such as culture and information will be made possible influence on behavior of dairy farmers to return to the original hamlet (endangered settlement).

Materials and Methods

Materials

The research material included 84 dairy farmers in DPA III (Kaliadem hamlet) and 50 dairy farmers in DPA II (Gondang Wetan hamlet). Study sites were the disaster-prone areas, directly affected by Merapi eruption 2010. Villages in the affected area, selected with consideration has the highest population of dairy cattle before the eruption of Merapi in 2010 and is the closest village to the peak of Merapi. Samples or study materials were dairy farmers in disaster-prone areas elected. Respondents criteria covered: 1) occupying

these locations since before October 26, 2010 with the premise that they had experienced at least once in the course of her life in danger from the eruption of Merapi, 2) owning and maintaining dairy cattle farming business for at least one year, and 3) Living temporary in the shelter or other places in Cangkringan.

Method

The research was conducted using household survey with interviews involving respondents selected. Sampling was done using the Census methods. In order to determine the influence of individual characteristics such as livelihood (ownership dairy cattle), life experiences (inhabitation period), perceptions of risk, education, land ownership, and age of farmers, as well as environmental factors, such as cultural and information on the behavior of dairy farmers in southern slope of Merapi to return to endangered settlement, using logit model analysis. Gujarati (2003) stated that the logit models expressed in the form of a probabilistic model, where the dependent variable was the logarithm of the probability of a situation or attributes that would apply to the terms or conditions of any particular independent variables. Logit models were used in this study were:

$$Li = \ln \left(\frac{Pi}{(1-Pi)} \right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + D_1 + D_2 + U_i$$

Description:

Li: $\ln \left(\frac{Pi}{(1-Pi)} \right)$: Desire to return (value 0 = survived in relocation and value 1 = return to endangered settlement)

β_0 : Intercept or constants

$\beta_1, \beta_2, \dots, \beta_6$: Regression coefficient of each independent variable

X_1 : Ownership of dairy cattle (tails)

X_2 : Inhabitation period (years)

X_3 : Risk perception

X_4 : Education (number of years of formal education)

X_5 : Ownership of land (m²)

X_6 : Age (years)

D_1 : Dummy for culture (D=0 is not affected by the socio-cultural and kinship system, D=1 are affected by socio-cultural and kinship systems)

D₂: Dummy for the influence of information
(D=0 is not affected by the information, D=1
are affected by information)

U_i: error

Results and Discussion

Characteristics of Respondents

The characteristics of dairy farmers in the southern slopes of Merapi volcano are presented in Table 2. The average of dairy cattle ownership for each farmer was 2.44 heads, indicating a small scale farmer despite the majority of dairy farming (80.60%). A small difference (5.97%) between the average of age and the inhabitation period indicated that a part of farmers were migrants. Farmers education was still low (6.75 years), in that they averagely did not completed nine-year compulsory education. The average land ownership was 3,412.98 m², a quite large property for each farmer, as a potential capital and land for dairy cattle farming, especially for foraging.

Assessment of the perceptions of dairy farmers at Merapi Volcano hazard was based on Likert scale criteria (Azwar, 2005), utilizing five variables with 24 items statement, using 2 categories of low and high. Perception of low and high categories was 24-72 and 73-120, respectively.

The assessment results showed high perception in all dairy farmers in the southern slopes of Merapi, suggesting good perception on Merapi volcano disaster risk in DPA III & II farmers.

Logit Analysis Results

1. Case processing summary. This test was to identify if there was missing data in the analysis. The results showed negative (Table 3), comprising 100% case selected.
2. Significance test model (Omnibus test of model coefficients). Based on the results of the analysis (Table 4) significant value obtained was 0.000 or smaller than 0.05, thereby concluded that the independent variables influenced farmers desire to return to the endangered settlement.
3. The accuracy of classification (Classification table). From the overall 92.5% percentage

(Table 5) with mean of 134 observations, there were 124 observations included in proper classification by logistic regression models.

4. The accuracy of the model (Hosmer and Lemeshow). Hosmer and Lemeshow value of the analysis was 0.909 (>0.05), or no difference between the model and the value of the observations, so it was fit to the data.
5. Partial test of the model building. Variables in the equation presented in Table 6 showed that if the value of sig.<0.05, H₀ was rejected and H_a was accepted.
6. Nagelkerke R Square. Nagelkerke R Square value in the analysis was 0.818, suggesting that the ability of independent variables to explain the model was 81.8%. The whole independent variables including dairy cattle ownership, inhabitation period, risk perception, education, land ownership, age of farmer, culture and information affected 81.8% farmers' desire to return to endangered settlement, while the rest 19.2% was influenced by factors other than the model.
7. Odds Ratio. Odds Ratio values presented in Table 7 (variables in the equation) was the value of Exp (B). Results of analysis for the influential independent variables was 2.166 (dairy cattle ownership); 1.402 (education); 225.287 (culture) and 0.017 for variable information. The results showed that: a) If the number of cattle ownership increased 1 head, then the tendency of farmers to return to endangered settlement increased by 2.166-fold, b) If one year of education increased, the tendency of farmers to return to endangered settlement increased by 1.402-fold, c) If belief in the social, cultural and kinship system increased by one unit, then the tendency of farmers to return to endangered settlement increased 225.287-fold, and d) If confidence in the effect of one unit of information increases, the tendency of farmers to endangered settlement increased 0.017-fold.

Discussion of the Results

Dairy farm was the main livelihood (80.60%) for most of the farmers in the southern slopes of Merapi volcano after the eruption of 2010.

Table 2. Characteristics of respondents

Description	Average
Ownership of dairy cattle (tails)	2.44
Inhabitation period (years)	46.87
Age (years)	48.37
Education (years)	6.75
Risk perception	94.02
Ownership of land (m ²)	3,412.98

Table 3. Case processing summary

Unweighted cased ^a		N	Percent
Selected cased	Included in analysis	134	100.00
	Missing cases	0	0.00
	Total	134	100.00
Unselected cases		0	0.00
Total		134	100.00

^aIf weight is in effect, see classification table for the total number of cases.

Table 4. Omnibus tests of model coefficients

Description		Chi-square	df	Sig.
Step1	Step	124.636	8	0.000
	Block	124.636	8	0.000
	Model	124.636	8	0.000

Table 5. Classification table^a

Observed			Predicted		Percentage correct
			Desire to return		
			0.00	1.00	
Step 1	Desire to return	0.00	76	4	95.00
		1.00	6	48	88.90
Overall percentage					92.50

^aThe cut value is 0.500

Table 6. Variables in the equation

Description		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	Dairy cattle ownership	0.773	0.220	12.308	1	0.000*	2.166
	Inhabitation period	0.078	0.094	0.703	1	0.402	1.082
	Risk perception	0.078	0.065	1.434	1	0.231	1.082
	Education	0.338	0.137	6.084	1	0.014*	1.402
	Land ownership	0.000	0.000	0.345	1	0.557	1.000
	Age	-0.122	0.100	1.496	1	0.221	0.885
	Culture	5.417	1.147	22.326	1	0.000*	225.287
	Information	-4.056	2.015	4.052	1	0.044*	0.017
	Constant	-7.734	6.487	1.421	1	0.233	0.000

The influential independent variables (sig.<0.05), were: 1) dairy cattle ownership, 2) education, 3) culture and 4) information. ^aVariable(s) entered on step 1: dairy cattle ownership, inhabitation period, risk perception, education, land ownership, age, culture, information.

Table 7. The desire to return to endangered settlement

Description	Farmers in DPA III	Farmers in DPA II
Do you want to return to the original hamlet before eruption 2010?		
a. Yes	5	50
b. Undecided	3	0
c. not	76	0
The goal of desire to return:		
a. Residence and farming	5	50
b. Residence	0	0
c. farming	0	0
d. other works	0	0
How about information and prohibition from the government:		
a. notice	83	6
b. Undecided	1	43
c. not paying attention	0	1
What about cultural and kinship with family and neighbors:		
a. influential	6	36
b. Undecided	2	1
c. no effect	76	13

Dairy farm that provided positive economic value (Widiati et al., 2007) became one of the most dominant main job and the main source of income for the family that guaranteed income for the existing farmers. Economic aspects of dairy farming affect the tendency of dairy farmers to return to their village before the eruption of 2010. This condition was because dairy farming required adequate feed sources. Cattle feed, usually obtained from locations around the original residence (village) before the eruption of 2010, became an obstacle when farmers were expelled and relocated. Farmers had difficulty in fulfilling the needs of feed (Prawiradiputra, 2011). In addition, lack of clean water availability, the non-standard construction of cowshed (Priyanti et al., 2011) and the distance between the cowshed at the new location with their home and the source of feed were also factors that caused farmers to return to endangered settlement.

This result was consistent with Lavigne et al., (2008) and Gaillard and Dibben (2008) that the economic aspects of dissatisfaction at the new location made the refugees eager to return to their original location. Economic aspects of dairy farming affected the evacuation constraints (Andarwati, 2010) as well as

influenced farmers to return to the hazardous areas. The results showed that if the number of cattle ownership increased 1 head, then the tendency of farmers to return to endangered settlement increased 2.166-fold. The reason of desire to return to their original location was different between farmers in DPA III and DPA II (Table 8). The former were eager to return because of dairy farm, while the latter was assumedly because the original settlement was relatively safe from disaster. Only five respondents in DPA III returned with a desire to live and farming, but all respondents in DPA II wanted to return to endangered settlement. As supported by Helmi (1999) that farmers' different behaviour was caused by their different location.

Education (formal education period) influenced the tendency of farmers to return to their original location. With higher education, they would be able to access related information about the activity of Merapi volcano from a variety of sources and media, thereby taking the best precaution against the eruptions at anytime of eruption. Good basic knowledge of the danger would affect someone's preparedness, as reported by Lavigne et al., (2008). It was also in line with Gregg et al., (2004) that a person with a high

perception of the risk of volcanic hazards, tended to be the most prepared to deal with natural disasters. Higher education was expected to form a good perception of the risk of disaster and a great attitude to obey warning from the relevant authorities. The results proved that if one year of education increased, the tendency of farmers to return to endangered settlement increased to 1.402-fold.

Cultural factors and kinship with family and neighbors in the surrounding environment, greatly affected the propensity of farmers' desire to return to their village before the eruption in 2010. If belief in the social, cultural and kinship system increased by one unit, then the tendency of farmers to return to endangered settlement rose to 255.287-fold. This result was in accordance with Lavigne et al. (2008) that the aspect of trust, culture, religion and kinship and social networks would affect the activities of the volcanic area. Indeed, strong ties to the original places was closely correlated with reluctance to evacuate or move away from the original location.

Associated with the information from the government and related agencies, there was one respondent in DPA III still hesitated, whereas in DPA II only one respondent who neglected the information or government prohibition. Farmers in DPA III, the head of each household, had signed an agreement with the government, that they obtained a 100 m² plot of land as the property with buildings thereon, valued at fifteen million rupiahs from the government, with one of the requirements, should not return to reside the location of the original village before the eruption in 2010, and may not sell the land and buildings. While farmers in DPA II returned to the original village because their property such as houses and stables, was largely intact reusable. The results indicated that if the belief in the influence of a single unit of information increases, the tendency of farmers to return to endangered settlement increased to 0402-fold. The campaign information to vulnerable communities was expected to increase the perception of risk and to assist them in reducing vulnerability in the face of volcanic hazards.

Conclusion

The results showed that Hosmer & Lemeshow value of 0.909 (>0.05) was fit to the data. Value Omnibus Tests of Model Coefficients 0.000 (<0.05) concluded that the independent variables altogether influenced the farmers' desire to return to their endangered settlement post eruption in 2010. Nagelkerke R Square value was 0.818, indicating the ability of the independent variables explained 81.8% of the models. Independent variables that motivated the desire of farmers to return to their endangered settlement were: 1) dairy cattle ownership (sig. 0.000), 2) education (sig. 0.014), 3) culture (sig. 0.000) and 4) information (sig. 0.044). Odds Ratio value, respectively: 2.166 (dairy cattle ownership), 1.402 (education), 225.287 (culture) and 0.017 (information). Cultural factors had the highest propensity value to motivate the farmers to return to their endangered settlement post the eruption in 2010.

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