ADOPTION OF INNOVATIVE TECHNOLOGY OF TOFU INDUSTRY AND LIVESTOCK WASTE PRODUCTS IN RURL AREA

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ABSTRACT

This study was aimed to determine factors that influence technology adoption of waste product from tofu industry and livestock. Sumber Mulyo village, Gunung Kidul District, Daerah Istimewa Yogyakarta Propince was selected as a sample by considering this village as a central of tofu home-industry and feedlot raising. Primary data were collected from 40 respondents. Multiple Regression and Path Analyses were occupied as a statistical test. The results showed that waste contribution, number of labor, number of livestock raised, production scale and organization membership affected to technology adoption by 39.53 percent, while 60.47 percent were from unpredicted factors. Production scale was the largest direct influence to adoption by value of 20.45 percent.

(Key words: Technology adoption, Tofu industry, Waste product, Path analysis)

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PENYERAPAN ADOPSI TEKNOLOGI PEMANFAATAN LIMBAH INDUSTRI TAHU DAN LIMBAH PETERNAKAN DI DAERAH PEDESAAN

INTISARI

Penelitian ini ditujukan untuk menentukan faktor-faktor yang mempengaruhi adopsi teknologi pemanfaatan limbah industri tahu dan peternakan. Desa Sumber Mulyo, Kabupaten Gunung Kidul, Daerah Istimewa Yogyakarta dipilih sebagai sampel dengan pertimbangan bahwa desa ini merupakan sentral industri tahu skala rumah tangga dan penggemukan sapi potong. Data primer diambil dari 40 responden. Analisis statistik yang digunakan adalah Analisis Regresi Berganda dan Analisis Jalur. Hasil penelitian menunjukkan bahwa sumbangan limbah, jumlah tenaga kerja, jumlah ternak yang dipelihara, skala produksi dan keanggotaan dalam organisasi mempengaruhi tingkat adopsi teknologi sebesar 39,53 persen, sementara 60,47 persen dari faktor-faktor di luar prediksi. Skala produksi merupakan pengaruh langsung yang paling besar terhadap adopsi teknologi yaitu sebesar 20,45 persen.

(Kata kunci : Adopsi teknologi , Industri tahu, Limbah , Analisis jalur)

Introduction

Characteristics of tofu liquid waste were determined by composition of organic matter of soybean and total number of the content of each organic matter, i.e. water, protein, nitrogen, and essential amino acids. Mahmud et al. (1990) analyzed that composition and total number of organic matters of soybean varies and this would determine the quality of soybean.

Liquid waste of tofu generally contains highly organic matter. If it is thrown to the waters continuously, it can affect to the physical and chemical characteristics of the waters, that are decreasing soluble oxygen and increasing the need value of biological oxygen (BOD) and chemical oxygen (COD) which affect to human health (Hammer, 1977). Based on the Sofyan's study (1999) quality of liquid waste of tofu in Mojosongo, Surakarta, it was found that average suspended solid (SS) was 106.5 mg/liter, NH_3^+ was 152.2 mg/liter, and BOD was 137 mg/liter. Based on the water quality standard of type B, these parameters are not recommended.

There are many central of tofu home industries in several villages of Gunung Kidul District, Yogyakarta Province. They produce waste product of tofu which become source of water and air pollutions. If it can manage well, it could get social benefits by using waste product of tofu for cattle feed. Therefore, the producers of tofu industry can also raise the cattle as additional family income.

An adult cattle can produce fresh manure daily average of 7.5 ton/year or 5 ton compost, which contain about 30 kg N, 15 kg P_2O_5 and 7.5 kg K_2O (Hadmadi, 1982). The good way of managing cattle manure is compost.

Today, use of compost and waste tofu are appropriate technologies which most popular in the cattle farmers. They recognize these technologies as an innovation which could adopted for increasing their family income.

Rogers (1995) defines innovation is an idea, practice, or object that is perceived as new by individual or other unit of adoption. Newness in an innovation need not just involve new knowledge. Someone may have known about an innovation for some time but not yet developed a favorable or unfavorable attitude toward it, nor have adopted or rejected. "Newness" of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt.

This study, therefore, aimed to determine factors influence to technology adoption of tofu industry and livestock waste products.

Material and Method

Descriptive Analysis was employed in this study as a basic method. Gunung Kidul district, Yogyakarta province was selected as local sample, due to a lot of cattle raised in this area. While Sumber Mulyo Village was selected as a village sample for conducting this study, since Sumber Mulyo was considered as center of tofu home-industry. A total of 40 head of households were selected as respondents by simple random sampling. Regression analysis was used to analyze the factors affected technology adoption of waste products, by using formula:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + D + e$$

Where,
Y= technology adoption of waste products (percent)
a= intercept
X_1= experience in cattle raising (year)
X_2= educational attainment (scoring)
X_3= contribution to the family income (rupiah/year)
X_4= number of labor (person)
X_5= scale of tofu waste production and or cattle manure (kg/day)
X_6 = number of cattle raised (head)
D = organization membership as dummy variable
1: as member of cattle farmer group
0: non-member of cattle farmer group
$b_1, b_2, b_3, b_4, b_5, b_6$ = estimated parameter
e = error

Regression coefficient was estimated by Ordinary Least Square (OLS), while deviation in the cross section (heterocedastic) using Generalized Least Square (GLS) by Park-test in order to have a constant variance or BLUE estimator (Gujarati, 1988), beside Goodness of Fit-test, F-test, and t-test. Path analysis was employed to analyze the direct effect of independent variables to the dependent variables, combination effect of independent variables to dependent variables and also effect from the residue or outside the model (Mueller et al., 1977).

Results and Discussion

Sumber Mulyo Village consisted of 250 households which 150 households were raising cattle. Simental, Brangus, Limousine, Thaurin were the breeds which generally raised; while Ongole Crossed breed were very few. Population of cattle in this village were more than 400 heads, this was supported by availability of field pasture and additional feed from waste product of tofu industry.

Table 1 showed the summary of socio-demographic characteristics of the respondents. From the data, it can be explained that educational attainment in the village was generally low. About 57.7 percent of respondents finished primary school, while who reached junior high school and senior high school were 15 percent and 17.5 percent, respectively. This condition was not significant affected to their work, especially maintaining cattle have no need high education in this village, just have experiences. Average of respondents' age was 51 years old. The older of respondents' age tends to have lower physical ability. So that, maintaining their cattle needs help from family members. Average of family members was 5 persons. This number was quite enough for family labor.

Maintaining the cattle had already been generated from their parents. Average of their experience was 17 years. Respondents who member of the cattle farmer organization were only 30 percent. They thought that cattle raised was not their main source of income, while they did not have organization as a tofu producers yet.

Table 1. Socio-demographic characteristics of respondents

n = 40

Characteristics	Number	Percent
Educational attainment		
-dropped-out from primary school	4	10
-Primary school	23	57.5
-Junior high school	6	15
-Senior high school	7	17.5
Age		
Mean = 51		
Standard deviation = 10.2		
Main occupation		
-Tofu industry	18	45
-Non tofu industry	20	55
-farmer	(15)	(37.5)
-seller	(5)	(12.5)
Number of family member		
Mean = 5 persons		
Standard deviation = 0.64		
Number of cattle raised		
Mean = 6 heads		
Standard deviation = 1.82		
Experience in cattle raising		
Mean = 17 years		
Standard deviation = 4.27		
Organization membership		
Member =	12	30
Non-member =	28	70

Table 2. Regression analysis of predicted factors affect to technology adoption

Variable	Estimation Coefficient	Standard Error	t-test
Experience	-0.00147	0.001	-1.355^{ns}
Educational attainment	-0.01752	0.016	-1.070^{ns}
Waste contribution	0.001346	0.001	2.282**
Labor	-.016900	0.009	-1.849*
Number of cattle raised	0.009299	0.003	3.210***
Production scale	0.001624	0.001	1.952*
Organization	0.116	0.033	3.549***
Constant	0.274	0.065	4.208
R^2	0.733		
R^2 adjusted	0.724		
F-test	15.609		
F-table	2.420		

Remarks.
ns = not significant
* = significant at 0.10 level
** = significant at 0.05 level
*** = significant at 0.01 level

Table 3. Regression analysis of factors significantly affect to technology adoption

Variable	Estimation Coefficient	Standard Error	t-test
Waste contribution	0.001334	0.001	2.289***
Labor	-0.014400	0.009	-1.622*
Number of cattle raised	0.008513	0.003	2.995****
Production scale	0.001526	0.001	1.886**
Organization	0.107	0.029	3.649****
Constant	0.202	0.042	4.782
R^2	0.758		
R^2 adjusted	0.722		
F-test	21.276		
F table	1.490		

Remarks:
ns = not significant
* = significant at 0.15 level
** = significant at 0.10 level
**** = significant at 0.01 level

Table 2 shows the result of Regression analysis of independent variables, namely, experience, educational attainment, waste contribution, labor, number of cattle raised, production scale, and organization membership) were predicted affect to dependent variable (technology adoption). Analysis shows that adjusted R squared is 0.724 meaning that 72.4 percent of the variance in technology adoption can be predicted from the combination of independent variables, while the remaining of 26.70 percent was from unpredicted variables which cannot be explained in the model.

The result also shows that the value of F-test (15.609) is greater than the value of F-table (2.420), this indicates that the combination of the predictors significantly combine together to predict technology adoption

. Partially, by the t-test, independent variables, i.e., waste contribution, labor, number of cattle raised, production size, and organization affect to technology adoption, while experience and educational attainment did not affect to technology adoption.

The five factors which influent to technology adoption, then re-analyzed by regression analysis, which shown in Table 3. To give more explanation that can be analyzed by path Analysis, Li (1981) recommended that Path Analysis used based on least of number of variables, hence, can be determined a system as the main discussion from the significant variables, which influence to dependent variable.

Waste contribution, labor, number of cattle raised, production size, and organization affect to technology adoption. Contribution to the family income effect ($P \leq 0.05$) to rate of technology adoption in the positive direction. It suggests that the higher contribution to family income, it would be the higher rate of technology adoption. The higher contribution to the family income, the farmer would be more increase the rate of adoption of technology in order for cost efficiency and additional value; it caused increasing the family income. Number of labor effect ($P \leq 0.15$) to the rate of technology adoption by negative direction. It means that the more number of labor it would be the lesser the rate of technology adoption. Usage the waste products usually were not employed by family members, but employed the skilled hired labor by salary, while using labor from family members, usually only dominantly by the head of family. Number of cattle raised effected ($P \leq 0.01$) to the rate of technology adoption in positive direction. Meanings, the more number of cattle raised, it would be the higher rate of technology adoption. The more cattle raised, the more manures can be produced. The tofu producers in big scale could produce more tofu waste and be able raising more number of cattle. This affected to the contribution of waste which was produced to increase the family income. Production scale affected ($P \leq 0.10$) to the rate of adoption of technology in the positive direction. It suggests that the biggest scale of production it would be the higher rate of technology adoption. It caused by the more number of cattle raised, the more manure would be produced. The tofu producers in the big scale would produce more waste of tofu, and be able to maintain of cattle in the bigger numbers. It affected to contribution of waste to the family income. Production size positively effected at 10 percent confidence level. The bigger scale of production, it would be the higher effort farmer to adopt technology in order to improve income. Organization membership positively affected ($p \leq 0.01$) to technology adoption. Member of organization would get more information (included information of appropriate technologies) than non-member of organization.

The effective relationships between independent variables, i.e. waste contribution, number of labor, number of cattle raised, production size, and organization membership, and technology adoption were analyzed by formula of $n(n-1)/2$, where, n is number of dependent variable and independent variables. From the formula, Path Analysis in this study consisted of 15 effective relationships.

Table 4. Summary of regression analysis explains the percentage of dependent variables influent to independent variables

Independent Variable	Dependent Variable	Percentage of Explanation
Waste contribution	Technology adoption	8.56
Number of labor	Waste contribution	0.91
	Number of cattle raised	28.92
	Technology adoption	10.78
Number of cattle raised	Waste contribution	0.97
	Production scale	57.92
	Technology adoption	16.17
Production scale	Waste contribution	6.03
	Labor	87.61
	Technology adoption	20.45
Organization membership	Waste contribution	0.36
	Labor	2.85
	Number of cattle raised	12.99
	Production scale	0.23
	Technology adoption	12.70

Based on Table 3, it can be seen that the biggest direct effect from independent variables was production scale. The bigger size of production, farmers would effort more to apply technologies. Production scale directly affected to technology adoption by 20.45 percent, indirect effect to technology adoption through waste contribution (6.03%) and number of labor (87.61%), and was direct effected by number of cattle raised (57.92%) and organization membership to production scale (43.04%). This value was still affected by residue (56.96%). Combination effect of interaction between independent variables and dependent variable was 39.53%, while effect from outside the model (e1) was 60.47% (Figure 1).

Waste contribution to family income directly affected to technology adoption by 8.56% and was directly influenced by number of labor (0.91%), Number of cattle raised (0.97%), production scale (6.03%), and organization membership (0.36%). The combination effect among number of labor, number of cattle raised, production scale and organization membership to waste contribution was 1.68%. This value was affected by unpredicted factors (residue or e2) was 98.31%. Number of labor directly affected to the technology adoption (10.78%), indirect effect of dependent variable through waste contribution (0.91%) and number of cattle raised (28.92%), and was directly affected by production scale (87.61%) and organization membership (2.85%).

Combination effects between production scale and organization membership was 78.43%. This value also still be affected by unpredicted variables (residues) e3 by 21.57%. Number of cattle raised directly affected to technology adoption (16.17%), indirectly affected to technology adoption through waste contribution by 0.97% and production scale by 57.92% and directly affected by number of labor (28.92%), and organization membership (12.99%).

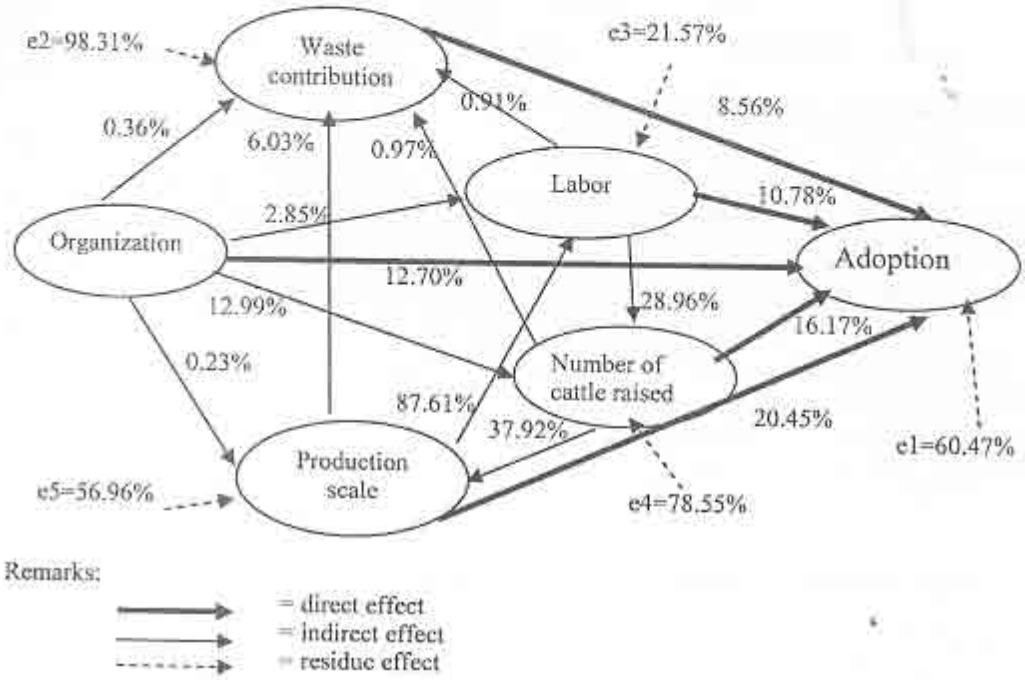

Figure 1 Structural model of relationships among variables

Combination effect between number of labor and organization membership was 21.45%. This value was affected by residue (e4) by 78.55 percent. Organization membership directly affected to technology adoption by 12.70 percent, indirectly affected to technology adoption through waste contribution, number of labor, number of cattle raised, and production scale. The relationship between organization membership and technology adoption was caused by direct relationship of organization membership itself. Relationship among variables can be drawn by structural model (Sosrodiharjo, 1986).

Conclusion

The highest direct effect of factors influence technology adoption of waste product was production scale. The interaction effect of waste contribution to the total of family income towards technology adoption of waste product was 39.53 percent, while effect from outside of model (unpredicted factors) was 60.47 percent. Meanings, the technology adoption of waste product from tofu industry and livestock in Sumber Mulyo village have not been optimally reached yet.

Considering to potential of waste production size, the development of technology should be more intensive which

involving farmers, extension worker, and local government, in such a way, waste usage as by-product also can be considered to improve farmers' family income.

References

Gujarati, D. 1988. *Basic of Econometrics* (in Bahasa Indonesia). Erlangga. Jakarta.

Hadmadi. 1982. *Compost.* (in Bahasa Indonesia). C.V. Bunirestu. Jakarta.

Hammer, M.J. 1977. *Water and Waste-Water Technology*. SI version. John Willey and Sons. New York.

Mueller, J.H., K.F. Schuessler, and H.L. Costner, 1977. *Statistical Reasoning in Sociology*. Houghton Mifflin Company, Boston.

Rogers, E.M. 1995. *Diffusion of Innovations*. 4th Edition. The Free Press. New York.

Sofyan, A. 1999. *Characteristics of Liquid Tofu Waste, Environmental Problem and Management in Mojosongo, Surakarta*. (in Bahasa Indonesia). Master's Thesis. Environmental Science, Interdisciplinary Department, Gadjah Mada University. Yogyakarta.

Sosrodihardjo, S. 1986. Construction of Stuctural Model and Path Analysis. (in Bahasa Indonesia). PAU-Social Study-UGM, Yogyakarta.