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Preface

We cordially invite you to attend 2013 International Conference Agriculture Science and Environment Engineering (ICASEE 2013), Beijing, China during December 19-20, 2013. The main objective of ICASEE 2013 is to provide a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in Agriculture Science, Environment Engineering and Engineering Technology. This conference provides opportunities for the delegates to exchange new ideas and experiences face to face, to establish business or research relations and to find global partnersfor future collaboration.

ICASEE 2013 received over 350 submissions which were all reviewed by at least two reviewers. As a result of our highly selective review process about 130 papers have been retained for inclusion in the ICASEE 2013 proceedings, less than 40% of the submitted papers. The program of ICASEE 2013 consists of invited sessions, and technical workshops and discussions covering a wide range of topics. This rich program provides all attendees with the opportunities to meet and interact with one another. We hope your experience is a fruitful and long lasting one. With your support and participation, the conference will continue its success for a long time.

The conference is supported by many universities and research institutes. Many professors play an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in the review process, and to the authors for contributing their research result to the conference. Special thanks go to our publisher DEStech Publications. At the same time, we also express our sincere thanks for the understanding and support of every author. Owing to time constraints, imperfection is inevitable, and any constructive criticism is welcome.

We hope you will have a technically rewarding experience, and use this occasion to meet old friends and make many new ones. Do not miss the opportunity to explore in Beijing, China. And do not forget to take a sample of the many and diverse attractions in the rest of the China.

We wish all attendees an enjoyable scientific gathering in Beijing, China. We look forward to seeing all of you next year at the conference.

The Conference Organizing Committees
December 19-20, 2013
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Cover page

Title: *Hedonic Property Value of Water Service in Tidal Lowland Agriculture*

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ABSTRACT

Despite its important role in agricultural water management in tidal lowlands, water service has not yet been considered as an input in crop production. The cost of water service is still born to the government budget such that budget cut will consequently results in abandoning of operation and maintenance of water infrastructures. This paper examines whether water service is a determinant of tidal farmland value. A survey involving 500 farmers was conducted in Telang, a rice production center in tidal lowland area of South Sumatra Province, Indonesia. Hedonic Property Value analysis was employed to provide answer to this examination. Analysis revealed that the value of tidal farmland with water service was significantly higher than that without water service. The value of tidal farmland was determined by soil fertility, distance to the local markets, the availability of water service, and farmland productivity. Being one of the significant determinants of tidal farmland value, imposing fee upon water service will expectedly be followed by farmers' willingness to pay for the fee.

Keywords: water service, tidal lowland, agriculture.

INTRODUCTION

Water charging as a policy issue has been adopted in Indonesia through the issuance of The Water Resource Law in 2004 (UU No. 7/2004). However, the term water charging is only implicitly stated in a phrase of "financial responsibility". Farmers (water users) financial responsibility according to the law includes construction, operation and maintenance of water infrastructures at tertiary level. These responsibilities in practice are shared among farmers within a tertiary block, which include routine gate operation (opening or closing of gates according to crop water needs) and tertiary canal and gates maintenance.

Water charging policy has not yet been implemented in tidal lowland irrigation eventhough it has been mandated in the Water Resource Law. Instead of charging, a payment is applied to water user for its membership in water user association (WUA), not for the water used for cultivation. Water charge remains unknown and un

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acceptable to water users. Therefore, water service fee is considered more appropriate term to emphasize that the charge is not for the water itself, but for the service of delivering water down to the tertiary canals to fulfill crop water needs,.

In tidal lowland area of Telang, one tertiary canal serves 16 ha farmland, 8 ha at each side. Two tertiary gates are installed, one at each end of the tertiary canal. Normally, these 16 ha farmland is owned by 8 farmers or 2 ha farmland in the average. Since water management actions directly affect the 16 ha farmland, the operation and maintenance of tertiary water infrastructures are collectively planned and implemented by the farmers, following the planned cropping patterns in the area.

The existence of water service and proper operation and maintenance of water infrastructures contribute to the farm output as well as the value of farmland. The value of farmland is also determined by farmland characteristics [1] such as fertility, relative distance to the market [2], and the existence of facilities to support cultivation [3]. Therefore, the objective of this study was to determine the value of water service and physical, spatial, and economic characteristics of tidal farmland. It was expected that the value of water service could be considered as basis for imposing water service fee for which water users (farmers) were financially responsible.

METHODS

Hedonic pricing (HP) and travel cost method (TCM) are two most commonly used of revealed preference methods. Both TCM and HP have advantages of observing actual behavior. While TCM has particularly been used in estimating non-market value of ecotourism and recreational sites [4], HP was frequently employed in valuing property with regard to the environmental characteristics and changes. It particularly extracts effect of environmental factors on price of goods that include those factors [5] [6] [7]. The hedonic property method has been used to value characteristics of goods that are not formally traded in the market [8]. This method has also been used to estimate the value of open space proximity [9], the improvement in air and water quality [10] and the evaluation of scenic views [11].

In water management research, hedonic method has been used in various studies with regard to water resource as a single resource or water in attachment to land resources. Hedonic method has been used to estimate the minimum payment an owner (of water right) would be willing to accept for the sale or lease of a water right in Douglas County, Oregon, USA [12]. Using the hedonic method, this study has successfully put a monetary value on irrigation water ($261 per acre-foot irrigation water) which is consistent with other studies and actual transaction in the study area. Similar to irrigation water, water service can be considered as an attribute of agricultural farmland which benefit can be valued similarly. Therefore, HP was considered appropriate in this study to value water service as an environmental characteristic that determine the price of tidal farmland as a property.

Hedonic property value of farmland is referred to as the market price of farmland. Its value has been studied based on several characteristics, including soil fertility [1], productivity and spatial aspects [2], and availability of water service [3]. In this study, the value of water service reflects the marginal willingness to pay for discrete change in water service, which is the change from without water service to with water service. Assuming two pieces of farmland that are identical except that one is with water service and the other is without, the difference in market price between the farmlands is attributed to the value of water service for which the farmers are willing to pay.

In this research, the hedonic function for tidal farmland market price was stated as follow:

$$P_i = f\left(Q_S, Q_P, Q_{WS}\right) \tag{1}$$

where P_{i} = market price of tidal farmland
Q_S = the vector representing farmland quality
Q_P = the vector representing proximity of the farmland
Q_{WS} = the vector representing facility on the farmland

The quality of tidal farmland was measured in three indicator variables, namely farmland fertility, productivity, and income obtained from crop production. The proximity of the farmland was defined and measured as the distance of the farmland from the local market. The facility on the farmland was represented by the availability of water service on the farmland and the maintenance of gates and canal connected to the farmland.

Based on the above description, the following regression equation was proposed in order to estimate the function:

$$P_i = \beta_0 + \beta_1 FERT + \beta_2 PRO + \beta_3 INC + \beta_4 DIST + \beta_5 D_{WS} + \beta_6 MAINT \tag{2}$$

where P_i = the market price of tidal farmland per hectare
$FERT$ = fertility level of farmland
PRO = farmland productivity
INC = income from crop production
$DIST$ = distance of farmland to the local market
D_{WS} = dummy variables water service
$MAINT$ = canal and gates maintenance

The above regression equation was predicted using ordinary least square (OLS) method to yield the predicted market price of farmland based on its affecting factors. Subsequently, some statistics were employed to examine the goodness-of-fit of the overall model and the significance of each of the affecting factors. In addition, interpretations on the significant factors were made in term of direction and magnitude of their effects on the market price of tidal farmland [13]. Supposed, the model contained only the intercept and the dummy variable water service, the interpretation was as the following [14]:

$$P_i = \beta_0 + \beta_1 D_{WS} + \varepsilon_i \tag{3}$$

where D_{ws} = 1 for farm with water service and 0 otherwise
The market price of farmland without water service was estimated as:

$$\mathrm{E}\left(P_i \middle| D_{WS} = 0\right) = \beta_0 \tag{4}$$

The market price of farmland with water service was estimated as:

$$E(P_i | D_{WS} = 1) = \beta_0 + \beta_1 \quad (5)$$

Therefore, the intercept β_0 was the mean estimated market price of farmland and the slope coefficient (β_1) was the difference in mean estimated market price between farmland with water service and without.

This study was designed as a survey, conducted in the deltaic area of Telang, South Sumatra, Indonesia. Telang, a reclaimed tidal lowland area for agriculture, is located in the lower reaches of Musi River. Research sample of 500 farmers were drawn using random sampling from some 10,000 farmers, covering 12 secondary blocks (approximately 3,072 ha). Data were collected through field observation and structured interview with the sampled farmers.

RESULTS AND DISCUSSION

As discussed in the methods, tidal farmland value is determined by soil fertility, productivity, income obtained from farming, distance of the farmland from the local market, the availability of water service, and the maintenance of gates and canal connected to the farmland. The mean value of farmland as measured in farmland market price is US$5,261.07 ($\pm$ 1,018.82). The farmland market price varies from as low as US$2,500.00 to as high as US$10,000.00 per ha. The mean market price of farmland with water service is US$5,612.36 per ha, whereas without water service is US$4,807.51 per ha. The mean market price of farmland with water service is significantly higher than that without water service (t=9.399, sig. t=0.000).

Table 1 presents the regression coefficients with the t statistics and significant level of each of the independent variables assumed to determine the farmland market price. Out of 6 independent variables assumed to have an effect on the farmland market price, only one variable that is significant at 90 percent confidence interval, which is farmland fertility. Others are proved to have statistically significant effect on the farmland market price at 99 percent confidence interval, which are: (1) productivity; (2) income; (3) distance of farmland from the local market, (4) the availability of water service, and (5) maintenance of canal and gate connected to the farmland. In Table 1 both direction and magnitude of the effect of these independent variables on the dependent variable are shown. The statistical tests of the regression indicate that the overall model is statistically significant. However, the variation in farmland market price explained by its determinants is approximately 26 percent. There is no collinearity detected in this analysis.

TABLE I. REGRESSION COEFFICIENTS AND THE VALUE OF STATISTICS

Variables	B	Std. Error	t	Sig.
(Constant)	33132758.632	3997802.536	8.288	.000
Fertility	2500777.738	1309442.781	1.910	.057*
Productivity (tons/ha)	1531738.264	497256.682	3.080	.002***
Income ($Rp10^6$)	178810.108	57019.518	3.136	.002***
Distance from the market	-1909067.120	358702.668	-5.322	.000***
Water Service (Dummy)	4058815.800	1256751.765	3.230	.001***
Canal & gate maintenance	3671982.726	1250081.538	2.937	.003***

*Significant at 10%; **Significant at 5%; ***Significant at 1%

Farmland fertility is a statistically significance determinant of farmland price (p=0.057). Its coefficient indicates that farmland fertility is positively related to its market price as expected. Fertility is an important attribute of farmland. Farmland fertility is a result of interaction between physical conditions of the farmland and its accessibility to water infrastructures. The higher the fertility the higher the farmland price would be. Measured in ordinal level, one level increase in fertility would increase its price by about US$250.08.

Productivity which is measured by the yield (tons of rice) per hectare farmland has a positive coefficient as hypothesized. Its effect on the farmland market price is significant. Its coefficient tells that every ton increase in productivity will be followed by an increase in the farmland market price of about US$153.17. Productivity remains an important target in tidal lowland agriculture, especially rice production. With current productivity level of about 5.35 tons per hectare, it can potentially be increased to 10 tons per hectare as has been achieved by few farmers in the study area. Higher productivity will consequently result in higher farmland market price of the farmland.

Income from farming contributes significantly to the price of the farmland. Its coefficient indicates that every million Rupiah increase in total income will be followed by an increase of farmland market price of US$17.88. While farmland productivity seems to directly affect the farmland market price, income affects the farmland market price indirectly through the perception regarding the value of property. Farmers with higher farm income tend to perceive higher value of their property than those with lower income.

The distance of farmland from the local market has a negative sign for its coefficient as expected. This indicates that the further the farmland from the local market, the lower the price of the farmland. For every km increase in the distance of the farmland from the local market, the price of the farmland decreases by US$190.00.

Maintenance of canals and gates as hypothesized has also a positive effect on the market price of the farmland. This variable was measured as a dummy variable which was coded 1 for maintained canals and gates, 0 otherwise. Farmland with maintained canals and gates connected to it has higher market price than that without canals and gates maintenance. Farmland which is connected to the maintained canals and gates has market price which is US$367.20 higher than that which is connected to un-maintained canals and gates. Maintained canals and gates enables farmers to properly irrigate, retain and drainage water from the field according to crop water needs. This condition would ensure the optimum crop growth and maximum yield obtained from the farmland.

The availability of water service significantly affects the market price of farmland. The positive value of its coefficient indicates that farmland with water service has higher price than that without water service. The difference in mean estimated market price between farmland with and without water service is indicated by the value of its coefficient (β_1). This means that the price of farmland with water service is US$405.88 higher than that without water service. This result is in accordance with the hypothesized relationship between the availability of water service with the market price of farmland, proving that water service is an important attribute of tidal farmland.

CONCLUSION

The result of hedonic property analysis indicates that, as a property, the mean price of farmland with water service is significantly higher than that without water service. The value of farmland is significantly affected by the availability of water service beside other characteristics of the farmland (farmland fertility, productivity, distance from the local market, and infrastructure maintenance) and farmer's income. The availability of water service accounts for approximately one half of the difference in the farmland price. Based on the findings of this study, the value of water service can be considered as basis for imposing water service fee for which farmers are financially responsible to contribute in the operation and maintenance of tidal water infrastructures at tertiary level.

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