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by Muhammad Yazid

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RICE-BASED WATER SERVICE FEE ASSESSMENT IN TIDAL LOWLAND AGRICULTURE

Muhammad Yazid[1], Mad Nasir Shamsudin[2], Khalid Abdul Rahim[3], Alias Radam[3], Azizi Muda[4]

Abstract

Water service fee (WSF) is a key factor in water management in tidal lowland agriculture in Indonesia. Collected from the farmers, WSF is used to finance the operation and maintenance (O&M) of water infrastructures at tertiary level to complement government budget that is directed for O&M at secondary and primary levels. However, neither government budget nor WSF is sufficient to finance O&M at its respective level. WSF is insufficient to finance O&M at tertiary level since there is no reliable measures of WSF for which farmers are responsible to contribute.

This study aimed at estimating the current costs of water distribution and estimating the value of water service in order to assess WSF. To achieve the objective, the study employed production function estimation with rice as the main crop. Data were collected through field survey on randomly selected farmers at Telang Delta, the rice production center for tidal lowlands of South Sumatra, Indonesia.

The study results in three estimates for WSF based on the costs of water distribution, each indicates the supply cost, the economic cost, and the full cost respectively. The value of water service in rice production is higher than any WSF estimates. Water service is proved to be a significant determinant of rice production. Therefore, the use of rice-based WSF estimates is recommended for the formulation of WSF in tidal lowland agriculture.

Keywords: rice, water service fee, tidal lowland

Introduction

Water service fee (WSF) is a fee that is imposed to water users for benefit gained from the available water for agriculture activities. As a fee, WSF reflects several common terms such as irrigation water price (Tarimo et al., 1998), economic value and marginal value of water (Kanazawa, 1993; Butcher et al., 1972) or specific terms such as shadow value (Gisser et al., 1979) and scarcity rents (Moncur and Pollock, 1988). WSF is

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[1] Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra, Indonesia.
[2] Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor D. E., Malaysia.
[3] Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor D. E., Malaysia.
[4] Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak Darul Rizuan, Malaysia.

implemented for certain objectives, including cost recovery (Molle et al., 2008) and water use efficiency (Singh, 2007; Gonzalez-Alvarez et al., 2006).

WSF is considered a key factor for successful agricultural water management. In Indonesia, WSF has been amended in the Water Resource Law (UU 7/2004) in form of farmers' financial contribution in water management at tertiary level.

WSF is collected from water users on some bases including volumetric base, crop base, area base, and tradable water right (Cornish et al., 2004). Nevertheless, WSF currently collected from farmers was not based on any one of these measures. Instead, some types of fee are collected according to the agreement among farmers within one water management unit, equivalent to one association of water users (WUA). For example, entry fee, obligatory fee, and voluntary fee, but none is directly related to water management purposes. This is due to both the absent of objective measure of WSF and unclear role and function of an association.

In need of providing measure for agriculture water management in tidal lowlands, a study was designed to preliminary assess the financial value of water service in order to estimate WSF. Since rice is the main crop cultivated by majority of farmers in tidal lowland, the basis for this assessment would be a combination of crop and area bases.

Methodology

This study was designed as a survey, conducted in Telang, South Sumatra, Indonesia. Telang is among the most productive reclaimed tidal lowland areas due to the use of modern inputs (high-yielding varieties, chemicals) and supported by relatively better water management system. Water service fee has been collected, but neither is it based on proper assessment nor is it used for water management purposes.

Research sample of 500 farm households were drawn using random sampling from some 10,000 farm households, covering 12 secondary blocks (approximately 3,072 ha). Data were collected through field observation and structured interview with the sampled farmers.

Data were mostly quantitative in nature. Therefore, data analysis was carried out using some statistical tools. The assessment of WSF was based on relative contribution of water management on rice production. This relative contribution was estimated using linear regression based on a Cobb-Douglas production function (Coelli, 1995) as the following:

$$\ln Y_i = \beta_0 + \beta_1 \ln SEED + \beta_2 \ln CHEM + \beta_3 \ln FERT + \beta_4 \ln LABOR + \beta_5 D_{WS} + \varepsilon_i$$

where Y_i = total rice production in Tons
$SEED$ = seed used in kg
$CHEM$ = chemical used in Rupiah
$FERT$ = fertilizers used in Rupiah

LABOR = labor used in man-days
D_{ws} = dummy variable water service for 0 = without water service and 1 = with water service

Results and Discussion

Production Costs, Production and Productivity in Rice Cultivation

As a primary production process, farming employs several primary inputs such as seed, fertilizers (N, P, K), pesticides (herbicides, insecticides, and fungicides), labor and equipment. The costs incurred in rice cultivation are presented in Table 1. These costs are estimated based on per hectare rice cultivation in the first planting season.

Table 1. Costs of rice cultivation per hectare in the study area

Inputs	Types of Inputs	Unit	Volume	Unit Cost (Rp)	Total Cost (Rp)
Seed	Rice seed	Kg	63.5	6,000	381,000
Pesticides	Herbicides[1]	n.a	n.a	n.a	344,770
	Insecticides[1]	n.a	n.a	n.a	72,480
	Fungicides[1]	n.a	n.a	n.a	107,000
Fertilizers	Nitrogen	Kg	220	1,300	286,000
	Phosphorus	Kg	121	2,300	278,300
	Potassium[2]	Kg	n.a	n.a	13,910
Labor	Land preparation	Man day	10	50,000	500,000
	Planting	Man day	4.5	50,000	225,000
	Fertilizing	Man day	2	50,000	100,000
	Controlling	Man day	2	50,000	100,000
	Harvesting[3]	Man day	51	50,000	2,550,000
Total					4,958,460

Notes:
[1]Various types with various unit (L, ml, Kg, gram, etc) such that only total cost is applied.
[2]Only few samples used this type of fertilizer such that average volume is not relevant.
[3] Consists of harvesting and threshing. Harvesting cost is in shared product with the ratio 1:7 (12.5% for labor, 87.5% for owner). Threshing cost is Rp 50 per Kg output. All of these expenses are made equivalent to man day.
n.a not applicable

Rice production varied from as low as 1.5 Tons to as high as 79.2 Tons of on-farm dried paddy due to the variation in area cultivated (0.25-12 ha). The average production was 9.75 Tons (sd=5.70 Tons) and the average cultivation area was 1.84 hectares (sd=0.99 ha). Average productivity was 5.35 Tons on-farm dried paddy per hectare (sd=0.88 Tons).

The Value of Water Service in Rice Cultivation

Valuation of water service in rice cultivation was carried out using Cobb-Douglas production function of which water service was one the input factors besides seed, chemicals, fertilizers, and labor. To estimate the effect of these variables, a regression analysis was performed. Table 2 presents the results of regression analysis. Based on t-test, chemicals, fertilizers, labor and water service have significant effect on rice production.

Table 2. Regression coefficients and the value of t-test statistics

Variables	Coefficients	Std. Error	t	Sig.
(Constant)	-3.910	.212	-18.449	.000
Seed	.023	.026	.901	.368
Chemicals	.034	.018	1.828	.068*
Fertilizer	.128	.026	5.030	.000***
Labor	.782	.028	28.374	.000***
Water Service (Dummy)	.040	.013	3.026	.003***

Note:
Dependent variable is total rice production
All variables are in logarithmic, except water service
R Square = .936; F-test = 57.083; Sig. of F-test = .000
*Significant at 10%; **Significant at 5%; ***Significant at 1%

The coefficient of dummy variable water service is positive and significant. Considering "0" for "without water service" and "1" for "with water service", the positive value of this coefficient can be interpreted that rice production of the farmland with water service is 4 percent higher than that without water service (exponentiated 0,040 is 1.0408, subtracting 1 from this gives 0.04, multiplying this by 100 gives 4 percent)). Taking the mean rice productivity of the farmland without water service as the basis (5.3180 Tons per hectare), this productivity is expected to increase to 5.5350 Tons per hectare when the respondents employ water service on their farmland.

Taking productivity as the basis for calculation, the change from without water service to with water service in rice production will increase the productivity by 0.217 Tons per hectare (the difference in productivity between with and without water service). In monetary term, this increase in productivity is equal to Rp 455,700 per hectare, assuming the price of on-farm dried paddy at local market is Rp 2,100 per kg. This is considered to be the value of water service in rice cultivation.

In comparison, WSF estimated using the cost of water service varies from Rp 315,000 to cover supply cost, Rp 346,500 to cover economic cost, to Rp 391,500 per hectare per year to cover full cost (Table 3). Therefore, the value of water service (assuming only one crop per year) is higher than the cost of water service. This value is sufficient to cover even the highest WSF (that covers the full cost of water service) by which the current agricultural water management in tidal lowland can be sustained.

Table 3. Costs of water service (per year) and WSF estimates (per ha per year)

Type of Cost	Cost Components	Block Area Applies		Total (Rp)	WSF (Rp/ha/year)
		Tertiary	Secondary		
Supply Cost	OM cost	1,600,000		80,580,000 (per 256 ha)	WSF_1 = 315,000
	Capital depreciation and replacement cost	3,180,000			
	WUA management cost		4,100,000		
Economic Cost	Opportunity cost	31,500 (per ha)		88,644,000 (per 256 ha)	WSF_2 = 346,500
Full Cost	Treatment cost of contaminated water in the canals	45,000 (per ha)		100,164,000 (per 256 ha)	WSF_3 = 391,500

Conclusion

1. Water is an unavoidable input for agriculture. Water service is needed to provide water properly according to crop water requirement. In tidal lowland agriculture where water management is a key factor, water service has been proved to be a statistically significant contributor in rice production.

2. The present of water service in rice cultivation contributes to an increase in income. This increase is considered to be the financial value of water service upon which a fee may reliably be imposed.

3. The value of water service is higher than any estimates of WSF such that it may cover the highest cost (the full cost) that can sustain current agricultural water management in tidal lowlands.

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