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IMPROVING IRRIGATION WATER EFFICIENCY IN PADDY AGRICULTURE THROUGH A BETTER WATER PRICING POLICY IN THE JATILUHUR IRRIGATION AREA, WEST JAVA, INDONESIA

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ABSTRACT

Water shortage is a long standing problem in Java and its condition is getting worse over time. The problem is not simply due to deterioration of natural resource, but also because demand for water steadily increases. This study is an attempt to use water charge policy to improve water use efficiency and inter-sector allocation which the government has apparently ignored by implementing a dual water charge policy. By this policy the government provides irrigation water to paddy agriculture with almost no water fee, while supply of water to industry and other urban sectors is apparently charged with expensive fee. This study was conducted in the Jatiluhur irrigation area of West Java to investigate the possibility of increasing irrigation water fee (ISF) for rice farming. The methods used are Residual Imputation Approach (RIA), Contingent Valuation Method (CVM) and regression analysis. The research was conducted in the cultivation seasons of 2016/2017, from October 2016 to September 2017 with a total sample of 471 farmers. The cropping season was divided into two, namely wet season and dry season. This study confirmed that it is possible to improve irrigation service fee (ISF) in this region. The current fee paid by paddy farmers is only about three percent of the economic contribution of irrigation water to paddy production value. Because paddy farming is economically profitable, it does make sense to raise ISF. However, local farmers who are mostly poor could reject this proposal because of its adverse impact on their family income whose size is relative small. Anticipating this problem, the government should implement a policy to compensate such income reduction.

Keywords: irrigation water service fee, willingness to pay, water use, residual imputation approach

INTRODUCTION

Rice is the most important staple food for Indonesia and the government has strongly committed to meet its rice demands from domestic production. Such a strong commitment for pursuing rice self-sufficiency was the government's agenda since five decades ago. In 1984, in the era of President Soeharto, a rice self-sufficiency was attained for the first time since the independence from Dutch colonial in 1945 (Hobohm 1987). However this great achievement was not sustained. Over the last two decades, Indonesia has pursued rice self-sufficiency. Java island is a single major source of rice, contributing more than 50% of the national production. Achieving and maintaining rice-self sufficiency means raising domestic production to meet its ever growing domestic demands, due to high population growth. The average annual population growth for 2010-2016 in West Java Province, Java Island, and Indonesia are 1.54%, 1.25% and 1.36%, respectively (BPS 2017). Such a high population growth requires Indonesia to increase rice production of about 0.5 million ton per annum if it does not want to import rice from overseas market. However, this is not easy to realize. Apart from a continual decline in area for rice production notably in Java, another major problem is water irrigation. While its supply declines due to environmental degradation, demands for water increase not only from agriculture, but also notably the industrial sector.

Java faces a worsening water scarcity problem with intense competition for water use among economy and public sectors (Syaukat and Fox 2004). Currently Java has the highest irrigation water demand of 1,838.28 m^3/sec compared to other islands, where Sumatra Island at 1,726.79 m^3/sec and Sulawesi Island at 644.41 m^3/sec (Soekmono 2014). In considering the seriousness of water problem in Java, Hatmoko, a prominent water irrigation researcher, recommended the government implement a policy for gradual shift of agriculture from this island into outer islands of the country[1]. When resource scarcity prevails, efficiency in its use becomes a necessity. Meanwhile economic theory dictates that scarcity commands a positive price for use of a scarce resource. The scarcer its supply the higher the price to be paid for its use so that its user is motivated to use it more efficiently. However, this conservation logic is not applied in dealing with the water scarcity in Java. In fact, Syaukat et al. (2014) claimed there is no price for water irrigation in the whole of Indonesia. Water charge is simply land area i.e., per hectare basis, not volumetric. In this way, dual price strategy is applied whereby expensive water fee is applied to municipal and industry use, while very cheap water tariff is applied for agriculture. This water pricing strategy will not promote efficiency in using irrigation water since it does not treat users equally (Johansson 2000; Sumaryanto 2006; Syaukat and Siwi 2009).

The current condition of increasing competition for water use makes it desirable to improve water fee for agriculture in Java. In pursuing this ultimate goal, the study will investigate four research questions. First, how much is economic value (economic rent) of irrigation water in paddy production? Second, has the water charge paid by paddy farmers exceeded the economic rent of irrigation water in paddy production? Third, is there any room for raising irrigation water charge? Fourth, how much is willingness to pay of the farmers for water irrigation and what factors affecting it? Findings from this investigation will be synthesized to formulate some recommendations to improve irrigation water charge. The study was conducted in Jatiluhur Dam system of West Java Province. It is a multi-function dam whose function is not only to generate electricity, but also to provide fresh water for urban sectors (industries and households), and irrigation especially for paddy farming. The Jatiluhur dam system is very crucial for pursuing rice self sufficiency since its irrigation area covers five districts of West Java province which are major rice producing areas in Java.

Globally water supply has increasingly shifted from direct human use to agriculture because irrigated agricultural lands continually increase (Cai et al. 2003). At present, about 18% of the global agricultural land is irrigated land. In addition, more than two thirds (71%) of the irrigated land are located in developing countries, including Asia (Johansson 2000). Competitive water use between agriculture and urban sector (industry and urban households) is continuous. This competition has been at the cost of reduction of supply of water to agriculture to allow for increase of water supply for industry and urban households. As a consequence, the performance of irrigation systems in these countries is declining (Rosegrant and Ringler 2000).

Water from Jatiluhur dam system is mostly used for paddy agriculture. However, allocation of water from this system into the agriculture gradually declined (Katiandagho 2007; Hadipuro 2007; Slametto 2012). The relevant question is how to promote water use efficiency and conservation? Johansson (2000) argues that water pricing should be used as an instrument to promote water use efficiency and conservation. Underlying this argument, one can correctly claim all sectors, including

[1] "Jawa Rentan Krisis Air" (Java is highly risky of water shortage) available at http://mediaIndonesia.com/news/read/41795/jawa-rentan-krisis-air/2016-04-22. Accessed at 21 January 2017.

agriculture, have to pay a "correct" price for water that it uses.

However, such a water payment rule does not apply for paddy agriculture in Indonesia, including in Java. There is no price for water irrigation in this country (Syaukat et al. 2014). Farmers do not pay volumetric tariff for irrigation water, but fixed fee per hectare of land. Allocation of water is merely based on cost recovery. Two water schemes are applied by the water utility, *Perum Jasa Tirta II*, by charging a volumetric tariff for raw water allocated to the industrial and municipal sectors, while for agriculture sector the utility charges no volumetric tariff, but fixed rate based on land area. This cost recovery pricing strategy is not supportive for promotion of water use efficiency since it treats users not equal. Efficiency in use of water will be realized only when (same) water price is applied to all users and it will also promote equality in allocation of water among users (Johansson 2000; Sumaryanto 2006; Syaukat and Siwi 2009). Meanwhile, the government needs to employ water pricing to encourage paddy to use irrigation water more efficiently (Sumaryanto 2006).

Water pricing uses various methods such as: volumetric pricing, output-input pricing, area pricing, tiered pricing, two-part tariff, and water market pricing (Tsur and Dinar 1997; Johansson 2000; Syaukat 2000), water pricing, non-volumetric water pricing, and water markets (Boswoth et al. 2002; Mole and Berkoff 2007) or area-based pricing, volumetric pricing, and market equilibrium pricing (Chifamba et al. 2013). Actually, all the pricings can be grouped into three categories because all methods, outside of volumetric water pricing and market pricing, can be categorized as non-volumetric pricing (Johansson 2000).

In Indonesia, volumetric water pricing is not only expensive, but also has constraints, because of numerous small irrigated land, inadequate tools and mechanisms to apply it. Not only is the cost of using non-volumetric pricing much cheaper, but also it is easier to manage since water charge can be determined based on output, area of water irrigation and price of farm land (Johansson et al. 2002). Another issue related to pricing of irrigation water is economic value that it generates for farmers as they will pay if its use results in economic value. There are three methods to measure economic value, namely: hedonic pricing (HP), residual imputation approach (RIA), and the alternative cost approach (ACA) (Young 1996). HP can be applied in a situation where market can provide data to estimate *willingness to pay* (WTP) of users or quality of environment. RIA is a method that measures productivity when water is treated as input. This measurement determines shadow price of unpriced input by residual imputation and under special conditions can be used to measure value of natural resource used in production of particular product (Ashfaq et al. 2005). RIA measures the economic contribution of water (water rent) in the production process (Heady 1952). In using RIA, incremental contribution of each input must be estimated. If prices of all inputs are identified, except irrigation water, residual value of production after deduction of contribution of all other inputs whose price is identified becomes the value of irrigation water.

Although water scarcity is increasingly pronounced, none of the discussed methods of water pricing is applied in Indonesia. Farmers on irrigated land do not pay for water, rather make a contribution, "iuran", or *Iuran Pengelolaan Irigasi* (IPI) or irrigation water service fee (ISF). It covers use of water and maintenance of water infrastructures. Although ISF is relatively small, a majority of farmers are not willing to pay. It is desirable to understand what factors determine willingness to pay (WTP) for irrigated water before designing water pricing policy.

RESEARCH METHODOLOGY

Location. The study was carried out in the Jatiluhur Irrigation Scheme located in West Java Province. This scheme obtains its water resource from the Jatiluhur dam system which is a multifunction dam system. Its water resource is used not only for irrigation, but also supplied for the generation of electricity and to industry and urban households. The Jatiluhur Irrigation Scheme involves the total irrigated farmland of 223,090 hectares divided into three main areas of irrigation, namely West Tarum irrigation area (44,475 hectares), North Tarum irrigation area (87,194 hectares) and East Tarum irrigation area (91,421 hectares). The West Tarum includes Karawang and Bekasi Districts, while the North Tarum covers Karawang District, and the East Tarum include Karawang, Subang, and Indramayu Districts. These large areas are one of major producers of rice in Java.

Respondents and sampling procedure. The main source of information used for this study is farmers who operated rice farm during the period October 2016 to September 2017. There are two rice cultivation seasons, wet season cultivation, or *musim tanam rending* and dry season cultivation, or *musim tanam gadu*. A simple proportional random sampling technique was used (Gaspersz 1991) to select a number of farmers who operated rice farm during the two cultivation seasons in the Jatiluhur Irrigation Scheme. The total number of respondents is 471 farmers consisting of 105 farmers of the West Tarum irrigation area, 171 farmers of the Nort Tarum irrigation area and 195 farmers of East Tarum irrigation area.

Method for estimating the economic value of water. RIA derivation requires two postulate principles. First, competitive balance requires that resource (input) prices equal the marginal value of the product (for each resource i, $P_i = VMP_i$). Producers are assumed to maximize profits. The second postulate requires that the total value of the product be divided up, so that each resource paid according to its marginal productivity and the total value of the product can be completely divided up by each contribution input (Heady 1952, Debertin 1986).

Based on the two postulates above, it can be illustrated that in an agricultural production process, to produce an agricultural product notated (Y) which is produced using four factors of production, namely: capital (K), labor (L), natural resources or other inputs such as land (R) and irrigation water (W), so that the production function can be written as follows:

$$Y = f(K, L, R, W) \qquad (1)$$

Furthermore, it can write the second postulate with the assumption that the input market and output perfectly competition, the price is assumed to be fixed (given). Based on the second postulate above:

$$TVP_Y = (VMP_K\, Q_K) + (VMP_L\, Q_L) + (VMP_R\, Q_R) + (VMP_W\, Q_W) \qquad (2)$$

where, TVP_Y is the total value of product Y, VMP_i is the value of marginal product of resource i (K, L, R and W), and Q is the quantity of resource (input) i. If factors and products are assumed to be in a perfectly competitive market, prices can be treated constant. The first postulate (which confirms that $VMP_i = P_i$) then (2) becomes:

$$TVP_Y - (P_K\, Q_K + P_L\, Q_L + P_R\, Q_R) = P_W\, Q_W \qquad (3)$$

$P_W\, Q_W$ measures the economic contribution of irrigation water to TVP. It's known as “water rent”. When the volume of irrigation water (Q_W) is known, the value of the water unit (P_W) can be measured, usually called "price of water". It is assumed that all variables (3) are known, except the price of water (P_W), so it can be solved to find out the P_w by determining the shadow price of the water as follows:

$$Pw^* = [TVP_Y - (P_K\, Q_K + P_L\, Q_L + P_R\, Q_R)] / Qw \qquad (4)$$

Method for estimating the willingness to pay for water. Water irrigation is a quasi private good so that it is a non-marketable input. Therefore, market price for irrigated water does not exist. Instead, the Stated Preference Method (SP) can be used. Two approaches included in the SP approach are Contingent Valuation Method (CVM) and Choice Experiment (CE). CVM is a direct method of economic assessment through the question of willingness to pay someone, while CE is an indirect method of economic valuation (Fauzi and Anna 2005). CVM is used to estimate farmer WTP values calculated both individually and in total population. WTP estimation uses a formulation from Hanley and Spash (1993) which is modified with the following stages:

Stage 1, forming a hypothetical market. Consumer behavior will be measured in a hypothetical situation; ***Stage 2,*** obtaining bid value (bids) through surveys. Based on the value of this offer will get the WTP value of each respondent; ***Stage 3***, calculate the estimated average WTP (EWTP). Furthermore, the estimated average WTP is calculated by the formula as follows:

$$E(WTP) = \sum_{i=1}^{n} W_i \, P_{fi} \qquad (5)$$

Where E(WTP) is the average WTP estimate, Wi is the lower limit of the WTP Class i, P_{fi} class is the relative frequency of the class in question, n is the number of classes (intervals), i is the class (interval) of WTP (i = 1 , 2,3, ... n); ***Stage 4,*** determine the total WTP value (TWTP). The total WTP of farmers is estimated by using a formula:

$$T(WTP) = \sum_{i=1}^{n} \left[\frac{n_i}{N}\right] P \qquad (6)$$

Where, TWTP is the willingness of the farmer population to pay for irrigation services fee, WTPi is the willingness of the respondents (sample) to pay, n is the total area of sample land that is willing to pay for WTP, N is the total area of sample land, P is the total land area of the farmer population, and i is a sample; i = 1,2,3, ..., n; ***Stage 5,*** Evaluation of CVM, evaluating the CVM model can be seen from the level of reliability of the WTP function to find out whether the CVM carried out can provide a true description of the size of the farmer's research.

Econometric model of factors affecting the WTP value. Multiple linear regression model is used to determine the factors that affect the value WTP of farmers in improving irrigation services. Multiple Linear Regression analysis model with the estimation of Ordinary Least Square (OLS) as follows:

$$WTP_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \cdots + \beta_i X_i + E_i \qquad (7)$$

where: WTP_i is the middle value of the WTP to improve irrigation water services, X_1 = farm income (Rp/year), X_2 = farming experience (years), X_3 = number of household members (persons), X_4 = education (years), X_5 = age (years), X_6 = knowledge of irrigation services fee (dummy variable) that is not knowing IPI = 0 and knowing IPI = 1, X_7 = service of irrigation (dummy variable), service not good = 0 and good service = 1, X_8 = distance of location to the nearest water source (meters), and X_9 = participation of farmers in operation and maintenance (dummy variables) that is inactive = 0 and active = 1.

RESULTS AND DISCUSSION

Economic contribution of irrigation water. Technically, economic contribution of irrigarion water (water value or water rent) is simply a residual, meaning its amount is obtained after reduction of all cost elements, except water, from the total value product (total revenue), calculated on a per hectare base. The economic value of irrigation water on paddy production is quite significant (Table 1). As operators who use commercial inputs for the production of paddy, farmers are very much concerned on the extent of profit they obtain from their farming operation. It is the same as farm profits, assuming that there is no irrigation water fee. The water value is equivalent to 18.57% and 20.51% of the total value product (total revenue). Inasmuch as paddy farming operation lasts for about four months, paddy farming operation in the Jatiluhur irrigation area is very profitable, with a profit margin of about 4.5% per month.

Table 1. Estimation of irrigation water value for paddy production at wet and dry cultivation season of 2016/2017 in Jatiluhur irrigation area

Size of Farms (Ha)	Wet Season			Dry Season		
	Total Revenue	**Total Cost**	***Water Value (Rp/Ha)***	**Total Revenue**	**Total Cost**	***Water Value (Rp/Ha)***
< 0.5	24,069,545	19,602,279	4,467,327	26,678,858	21,441,295	5,237,563
0.50 ≤ L ≤ 1.0	24,766,206	20,174,718	4,591,489	27,579,078	21,899,659	5,679,419
> 1	26,380,404	21,443,888	4,936,517	29,403,734	23,048,422	6,355,313
Total	**24,974,575 (100.00)**	**20,335,668 (81.43%)**	**4,638,909 (18.57%)**	**27,827,651 (100.00%)**	**22,117,907 (79.49%)**	**5,709,744 (20.51%)**

Note : US$ 1.00 = Rp 14,000 (Indonesian rupiahs)

Water irrigation service fee. Water irrigation service fee (ISF) is not determined by the Jatiluhur water authority, but local officers, *ulu-ulu*, who manages water distribution at the tertiary water channel, and maintains it as well. The *ulu-ulu* is also a farmer and member of farmers' organization. The ISF represented a payment for water service received by the farmers. The average contribution collected by *ulu-ulu* (ISF) is 20 kg of husked rice or *gabah kering giling* (GKP). In this case, ISF can be in terms of regular rice or glutinuous rice which is more expensive. The weighted average prices of the husked rice received by the farmers are Rp 5,428 and Rp 5,638 per kg, respectively, in the wet and dry seasons. The average ISFs per hectare collected by *ulu-ulu* per season is slightly higher during the dry season compared to wet season (Table 2). This occurs because the weighted average price of the husked rice is higher in the dry season than that of the wet season. The average ISF could be classified into four categories. A large number of farmers (73.46%) pay the ISF on this category i.e., between Rp 102 to Rp 117 tousands/ha/season, and about 5.73% of farmers pay ISF in the fourth category (more than Rp 117 thousand/ha/season).

Table 2. The ranges and weighted average of ISF for 2016/2017 in Jatiluhur irrigation area

Ranges of ISF (Rp 1000 /Ha/CS)	Wet Season			Dry Season		
	ISF (Rp/Ha)	**n**	**%**	**ISF (Rp/Ha)**	**N**	**%**
72 < ISF ≤ 87	72,036	12	2.55	72,239	13	2.76
87 < ISF ≤ 102	93,642	86	18.26	97,250	85	18.05
102 < ISF ≤ 117	111,332	346	73.46	113,870	346	73.46
ISF > 117	137,083	27	5.73	138,810	27	5.73
Total	**108,558**	**471**	**100.00**	**112,654**	**471**	**100.00**

(%) percentage to that of the total respondents

The irrigation water charges are almost negligible compared to the water value (Table 3). This is not unique to the Jatiluhur irrigation system as it also occurs in other irrigation areas, Bogor Regency in West Java and Kudus Regency in Central Java (Syaukat et al. 2014).

Table 3. Relative value of ISF compared to the economic water value in Jatiluhur Irrigation Area, cultivation seasons of 2016/2017

Cultivation Season	Water Value (Rp/Ha)	Water fee (ISF) (Rp/Ha)	Relative Value of ISF Compared to Water Value (%)
Wet	4,638,909	108,558	2.34
Dry	5,709,744	112,654	1.97

Estimation of value of *willingness to pay* for irrigation water. As the farmers have actually made an irrigation service fee (*ISF)*, comparing the value of WTP and *ISF* will indicate as how much to raise the current water charge.

(1) Hyphothetical market. In this study, farmers were asked about the current condition of the irrigation canal, problems, and quality of service. Based on this, the farmers then asked their WTP when there is improvement regarding the quality of irrigation services into their fileds.

(2) Obtain a bid value. WTP values are obtained by offering respondents a number of choices. The starting points were the ISF value paid by the farmers (Rp/ha/season) (Table 2). The initial value of the bids is set at Rp 110,000 and Rp 113,000 per ha, respectively for the wet and dry season with an average increase of Rp 30,000. The increase in value is based on changes in the increase in ISF per season that occurred in Jatiluhur irrigation area, which is an average increase of 5 kg of husked rice per ha.

Among the 471 respondents, there were 321 farmers (68.15%) who were willing to pay and 150 were not willing to pay (31.85%). Analysis of WTP is focused on respondents who are willing to pay for irrigation water. The average land ownership of the farmers started as small as 0.10 ha and the largest 3.50 ha. Farmers who have large farms tend to respond willingly ("yes") to increase the bids. Farmers who have small land, have average bids value below the median bids value, while farmers who have large land, average bid value is above the median. The median of WTP is about Rp 470,000 per hectare and Rp 503,000 per hectare, respectively, for the wet and dry seasons, which are above the current ISF average.

(3) Estimate of average WTP. During the wet season, the largest percentage of the respondents are in class of Rp 442,000 to Rp 607,000, with the estimated average WTP at Rp 187,905 and Rp 179,735 per ha, respectively, for wet season and dry season (Table 4). The estimated total average WTP is about Rp 431,416 and Rp 466,581 per ha, respectively, for the wet and dry cultivations. Thus, in the dry season, the WTP of farmers tended to increase along with the increase in the value of bids. When the income of farmers increase, the WTP of farmers for irrigation water tends to increase too.

Table 4. Estimation of individual WTP in Jatiluhur Irrigation Area, 2016/2017.

	Interval Class of WTP (Rp/ha)/Seasons	Frequency (Person)	$EWTP_{Min}$ (Rp/ha)	$EWTP_{Max}$ (Rp/ha)	EWTP Average (Rp/ha)
Wet	110,000 – 275,000	72	24,673	61,682	43,178
	276,000 – 441,000	85	73,084	116,776	94,930
	442,000 – 607,000	115	158,349	217,461	187,905
	608,000 – 773,000	49	92,810	117,997	105,403
	Total	**321**	**348,916**	**513,916**	**431,416**
Dry	110,000 – 275,000	65	22,274	55,685	38,980
	276,000 – 441,000	64	55,028	87,925	71,477
	442,000 – 607,000	110	151,464	208,006	179,735
	608,000 – 773,000	82	155,315	197,464	176,389
	Total	**321**	**384,081**	**549,081**	**466,581**

(4) Estimate of total value of population WTP. The estimated total values of WTP are Rp 193,614,753 and Rp 207,243,802, respectively, for wet season and dry season (Table 5). The values of WTP are far above the current level of water charge (ISF) set for the famers in Jatiluhur irrigation area. These indicate that the potential consumer surplus of the farmers are available and can be used to improve irrigation water services.

Table 5. Estimation of the total WTP of the population in Jatiluhur Irrigation Area, 2016/2017.

Interval Class of WTP/Seasons	Frequency (persons)	Land areas of the samples (ha)	Land areas of the population (ha)	Total WTP (Rp/season)
Wet season				
110,000 – 275,000	72	17.68	35.72	6,875,697
276,000 – 441,000	85	31.14	62.91	22,553,374
442,000 – 607,000	115	77.28	156.11	81,881,965
608,000 – 773,000	49	59.00	119.19	82,303,717
Total	321	185.10	373.94	193,614,753
Dry season				
110,000 – 275,000	65	15.58	31.48	6,059,014
276,000 – 441,000	64	20.85	42.12	15,100,766
442,000 – 607,000	110	63.52	128.32	67,301,625
608,000 – 773,000	82	85.15	172.02	118,782,398
Total	321	185.10	373.94	207,243,802

Estimation *Bids Curve.* The farmers' total bid curve for irrigation water in Jatiluhur irrigation area based on the results of the WTP survey are presented in Figure 1 and Figure 2. The WTP curve could represent a demand curve because the cheaper the cost of irrigation water use, the more farmers are willing to pay and vice versa, the more expensive the use of irrigation water, the fewer farmers will be willing to pay. In these two figures, WTP for irrigation water in the wet season are lower than the dry season. Graphically, the demand curve of the WTP for irrigation water slightly shifts upwards for the dry season.

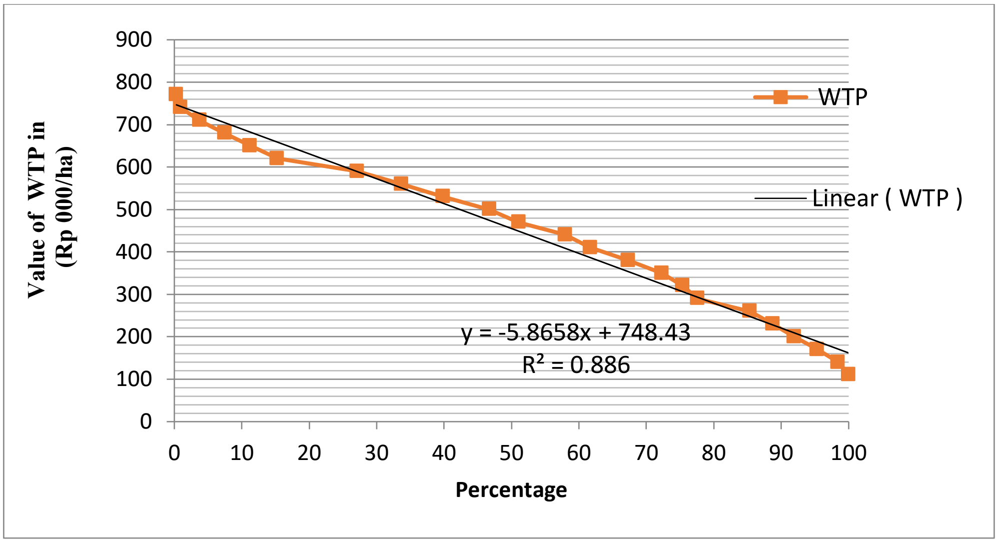

Fig. 1. Total farmers WTP in Jatiluhur Irrigation Area, Wet Season

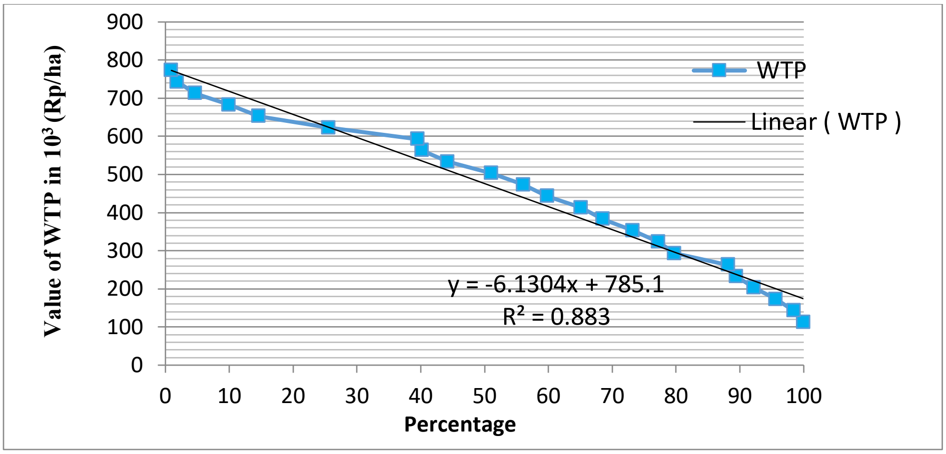

Fig. 2. Total farmers WTP in Jatiluhur Irrigation Area, Dry Season

Consumer Surplus. The consumer surplus is the difference between WTP and irrigation service fees (ISF) paid by the farmers. The calculation of consumer surplus value is estimated from the demand function of previously formed irrigation water WTP. Based on Table 2, on the average, the local farmers pay a ISF about Rp 108,558 and Rp 112,654 per ha, while the estimated average WTPs are Rp 431,416 and Rp 466,581 per ha, respectively, for the wet and dry seasons. Thus, the values of consumer surplus are Rp 322,858 and Rp 353,927 per ha, respectively, the wet and dry season (Table 6). These values indicate the benefits to the famers from consuming irrigation water in the paddy production. Thus, for the two seasons, there is a potential of extracting more water charge of as much as Rp 676,784 per ha. This value is a surplus received by the farmer, since the value of WTP is higher than the ISF paid by them. This value can be realized if there is an improvement the irrigation channel service can be implemented.

Table 6. Consumer surplus for irrigation water in Jatiluhur Irrigation Area, wet and dry cultivation season of 2016/2017.

Season	WTP Average (Rp/ha/season)	ISF Average (Rp/ha/season)	Consumer Surplus (Rp/ha/season)
Wet	431,416	108,558	322,858
Dry	466,581	112,654	353,927
Total Two Seasons	897,997	221,213	676,784

(5) Evaluation of CVM survey. The CVM survey conducted in the study is reliable with an R^2 greater than 0.15, so it can be used to predict factors that influence the estimated value of WTP and the model can be used properly (Table 7).

Factors affecting value of willingness to pay. An econometric model for analyzing factors affecting value of WTP of individual farmers is formulated. The estimates of this model as well as indicators of the model fittest are presented in Table 7. The model is fit as indicated by relatively high R-square (0.547), no multicolinierity (VIF < 5) and no autocorrelation (DW>DU). Only four out of nine independent variables have a significant effect on the value of WTP of individual farmers' WTP. Three factors (farmers' income X_1, farming experience X_2, and quality of irrigation service X_7) have a positive, while another one (outlet of irrigation X_8) has negative effect on value of WTP. Both famers' income and farming experience have a positive effect on famers' WTP so that the increase of farmers' income and the length of farming experience will increase the value of water charge that farmers are willing to pay. The quality of irrigation service also positively affects the farmers' WTP value. The better quality of irrigation service, the higher value of irrigation charge that farmers are willing to pay. This means that the farmers will be willing to pay a higher water charge for a better water irrigation service. The government needs to improve the current quality of water facilities and distribution if it wants to raise irrigation water charge. In contrast, distance of farm from main irrigation outlet (X_8) negatively affects the value of water charger. The farther the location the lesser is the value of the water charge that the farmers are willing to pay. This implies that water charge should be imposed differentially according to distance of the farm from the main distribution outlet.

Table 7. Factors affecting the value of farmers WTP in Jatiluhur Irrigation Area, Wet and Dry Seasons, 2016/2017.

Variables	Jatiluhur Irrigation Area		
	Coefisient	**P-value**	**VIF**
Constant	104561.14	0.000	
Farmer's Income (X_1),	0.0016675**	0.000	1.222
Farming Experience (X_2)	250.000**	0.001	1.355
Number of Household's members (X_3)	-1008.3595*	0.050	1.192
Length of Farmer's Formal Education (X_4)	295.88458	0.204	1.113
Age of Farmer (X_5)	-22.940565	0.782	1.274
Knowledge about *ISF* (X_6)	-1087.5269	0.404	1.004
Quality of Irrigation Service (X_7)	14270.538**	0.000	1.291
Distant of Farmland from Main Outlet of irrigation (X_8)	-3.007381**	0.006	1.179
Farmer's Involvement in Irrigation Management (X_9)	-583.25942	0.666	1.042

Annova F-hit =43.939*; $P < 0.005$
$R^2 = 0.560$; Adjusted $R^2 = 0.547$
Durbin Watson =1.879, DW > DU, 1.879 > 1.868 or 4-DW > DU, 2.121 > 1.868 : no autocorrelation

Notes : ** Significant with $\alpha = 1\%$, * Significant with $\alpha = 5\%$

CONCLUSION AND POLICY RECOMMENDATION

Economic contribution of irrigation water to the value of paddy farming production is quite large. However, the value of ISF that farmers actual pay is very small. There is a scope to increase ISF inasmuch as there is a large positive gap between the value of ISF that farmers are willing to pay and the actual ISF. Farmers'willingness to pay are affected by farmer's income, farmer's length of farming experience, quality of irrigation service and the distance of farms from the main distribution outlet.

Water shortage in Java is getting worse due to high population growth, industrialization and deforestation, among others. Improving this condition requires more effective measures such as raising the current ISF. The current charge is relatively very small compared to water irrigation contribution to value of paddy. From the perspective of profitability of paddy farming there seems no reason to reject the proposal for raising the current ISF. Paddy farming in Jatiluhur is very profitable so that it is possible to raise water charge without turning its operation to become a loss.

Although profitability of paddy farm is high, paddy farmers are generally poor since their land areas are quite small. The raise in water charge will reduce profit of the paddy farm which will affect adversely farmer income. However, such income reduction will not be a logical argument to reject the policy of raising irrigation water charge since it is desirable to motivate the paddy farmers to use irrigation water efficiently and to improve sectoral water allocation. This study has shown that the farmer's income affects positively the value of irrigation water charge that they are willing to pay. This implies that reduction of profit due to the raise of water charge will make them less willing to accept the new water charge policy. To anticipate this problem, the government should implement policies to improve income of rice farmers.

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