BUKTI KORESPONDENSI

ARTIKEL JURNAL INTERNASIONAL BEREPUTASI

Judul artikel : The achievement of water management objectives based on willingness to pay for a water service fee in tidal lowlands

Jurnal : Aquatic Ecosystem Health and Management

Penulis : Muhammad Yazid, Mad Nasir Shamsudin, Khalid Abdul Rahim, Alias Radam, Azizi Muda

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BUKTI SUBMIT ARTIKEL

(Februari 2011)

Water Management Achievement in Tidal Lowlands

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

[1]Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra, Indonesia.
Email: yazid_ppmal@yahoo.com
[2]Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[3]Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[4]Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia

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Abstract

Tidal lowland is located mainly along the lower reach of a river down to the coastal area. It bears many functions including conservation of abundant biodiversity and uniqueness of landscape, protection of surrounding coastal and marine areas, development of resource based activities such as agriculture, fishery, ecotourism and more. Tidal lowland development varies with regard to these various functions.

Water management is a key concept in tidal lowland development, particularly for agriculture development. Its objective includes improving water distribution, recovering cost, and achieving efficient water allocation. Which objective to be achieved relies partly on water users' willingness to bear the cost required to achieve the objective. This study examines the achievement of water management objective based on water users' willingness to pay for water service.

The results indicate that only improvement of water distribution objective can be achieved with current willingness to pay for water service fee. This willingness to pay is significantly affected solely by the income of water users. Therefore, efforts to increase willingness to pay for water service fee to achieve higher water management objective should be directed towards the increase of income of water users.

Keywords: water service fee, willingness to pay

Introduction

Among various objectives of water management, the objectives of improving water distribution, recovering cost, and achieving efficient water allocation are likely to be put into priorities in tidal lowlands. Not only these objectives support the sustainable use of lowland resources, but also provide proper treatments to surrounding coastal areas. To achieve these objectives, fee that covers the cost of water management is required, besides functional water structures and established water management guidelines (Schultz, 2007; LWMTL, 2006). Since this fee is used to carry out operation and maintenance of the system, this fee is considered as water service fee (WSF).

Water service fee has been estimated in various different cost concepts using various different methods (Gonzalez-Alvarez et al., 2006; Bar-Shira et al., 2006; Esteban et al., 2008; Molle et al., 2008). The cost of water depends on a number of hydrological, environmental, and agricultural social and economic variables. The cost of water is determined by the amount of water received, the number of structures serving an area, installation costs, and the present of water rights (Tarimo et al., 1998). Cornish et al. (2004) noted that water charge may vary according to the water sources, degree of water scarcity, irrigation scheme and technology, and farm types. Other factors are also indicated which include supply costs, opportunity costs, social and environmental costs (Global Water Partnership, 2000).

Based on the above discussion, the basis for estimating the cost of water (WSF) in this study was established to include different cost components that may be factored into a calculation of the costs of water management. These cost components include operation and maintenance (OM) costs, capital depreciation and replacement, opportunity costs, and environmental costs. Accordingly, three types of water cost are set to include supply cost (OM costs and capital depreciation and replacement), economic cost (supply and opportunity costs), and the full cost (economic cost taking into account environmental externalities associated with the use of water) as depicted in Figure 1.

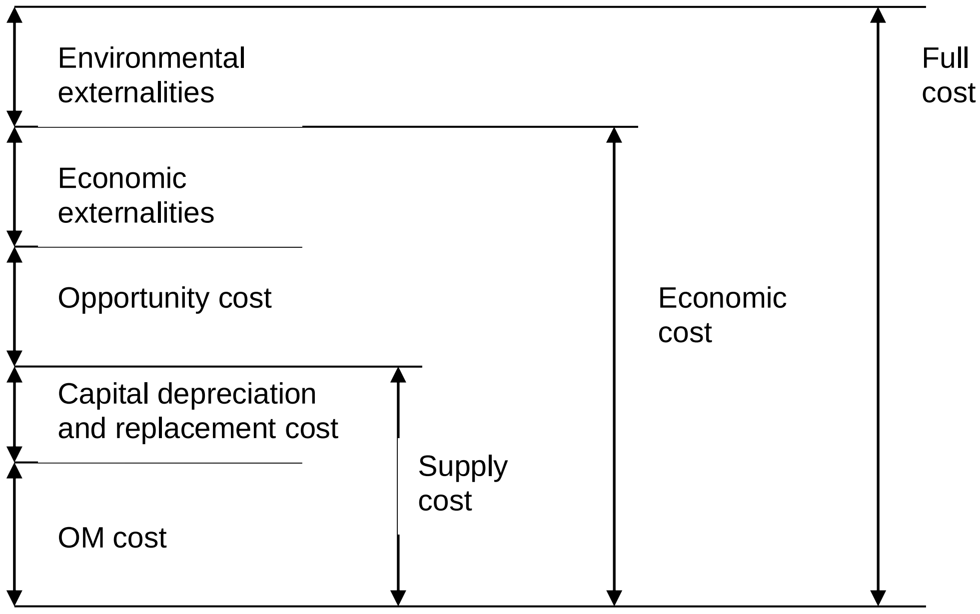

Figure 1. Three types of cost in water charging (adapted from GWP, 2000)

Different costs incurred reflect different water management objectives. Water distribution improvement objective requires only operation and maintenance (OM) costs. Cost recovery objective considers OM costs including or excluding capital depreciation and replacement costs. Whilst efficient water distribution objective requires even higher costs in order to cover opportunity and external costs as depicted in Figure 2. This study examines the achievement of water management objective based on water users' willingness to pay for the cost of water service.

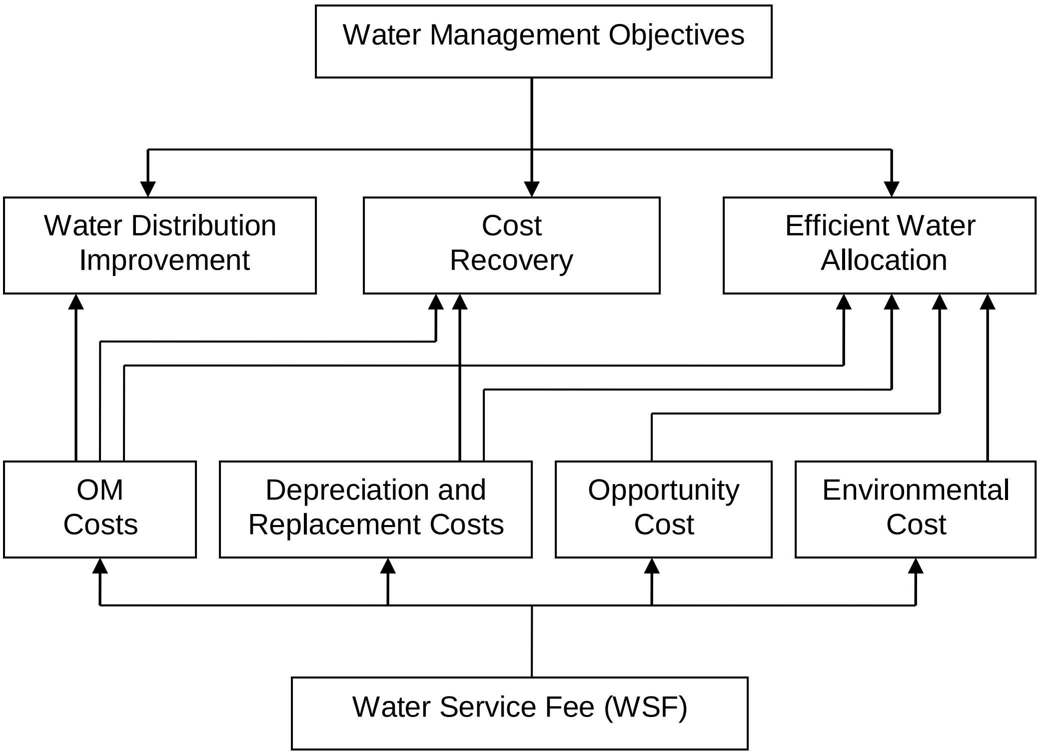

Figure 2. Framework for assessing achievement of water management objectives

Methodology

Due to the absence of direct measures of water management achievement at the field level, it was indirectly assessed using WSF for which water users were actually willing to pay. Actual WTP reflects water users' current ability to pay for WSF. Therefore, it represents the actual achievement of water management objective. Water users' actual WTP for WSF has three consequences on water management achievement as the following:

1. If actual WTP for WSF is less than or equals to OM costs, only water distribution objective is expected to achieve.
2. If actual WTP for WSF also covers depreciation and replacement costs and WUA management cost in addition to OM costs, then the cost recovery objective is expected to achieve.
3. If actual WTP for WSF covers all the costs, the efficient water distribution is expected to achieve.

The WSF for which water users were actually willing to pay was affected by farmers' socio-demographic characteristics such as age, education, family size, length of settlement, socio-economic index, land area owned, and income. The effect of these variables on the actual WSF was modeled in the following equation:

$$W_i = f(Q_i) \quad (1)$$

where *Qi* represent some socio-demographic characteristics

Assuming regression was a sufficient tool to predict the actual WSF, the above model was specified as the following:

$$W_i = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 FAM + \beta_4 SET + \beta_5 SEI + \beta_6 ARE + \beta_7 INC + \varepsilon_i \quad (2)$$

where W_i = actual WSF farmers were willing to pay
AGE = age of farmer
EDU = farmer's education attainment
FAM = family size
SET = years of settlement in the area
SEI = index of some socio-economic factors
ARE = farmland area owned
INC = income from cultivation

The above regression equation was predicted using ordinary least square method to yield with the predicted actual WSF based on its affecting factors (Norusis, 2006). Subsequent to predicting this equation, 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 actual WSF the farmers were willing to pay (Hair, et al., 2008).

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 farm water users were drawn using random sampling from some 10,000 farm water users. Data were collected through field observation, focus group discussion and structured interview.

Results and Discussion

Willingness to pay for water service fee (WSF) may reflect the achievement of water management objectives (WMO). WSF has been assessed through focus group discussion with members of water users association (WUA). Three estimates of WSF were derived from the cost of water management and water management objectives achievement associated with each of these WSF estimates were referred (Table 1).

Table 1. Costs of water management, WSF estimates and WMO achievement

Cost Components	Cost per unit (Rp)[1]	Total Cost (Rp per 256 ha)[2]	WSF (Rp/ha/year)	WMO Achievement
Operation and maintenance cost	1,600,000 (per 16 ha)	80,580,000	WSF_1 = 315,000	Water Distribution Improvement
Capital depreciation and replacement cost	3,180,000 (per 16 ha)			
Management cost	4,100,000 (per 256 ha)			
Opportunity cost	31,500 (per ha)	88,644,000	WSF_2 = 346,500	Cost Recovery
External cost	45,000 (per ha)	100,164,000	WSF_3 = 391,500	Efficient Water Allocation

[1]Unit varies according to the block wherein the cost was applied (secondary block=256 ha; tertiary block=16 ha; farmland=1 ha).
[2]Equals to one water management unit or area of a water users association.

Based on WSF estimates, water distribution improvement can be achieved if actual WTP for WSF is less than Rp 315,000 per hectare per year, cost recovery can be achieved if actual WTP for WSF is Rp 315,000 up to Rp 350,000 per hectare per year, and efficient water allocation can be achieved if actual WTP for WSF is Rp 350,000 or higher. Actual WTP for WSF is respondents' reported amount of WSF they were willing to pay, obtained from the interview with individual respondent. Actual WTP for WSF indicates current status of operation and maintenance of the system. Therefore, it can be utilized in the evaluation of achievement of water management objectives.

In order to measure the achievement of water management objectives based on the amount of actual WSF respondents willing to pay, univariate and multivariate analyses were conducted. Amount of actual WTP for WSF are directly affected by several socio-demographic variables such as age, education, family size, years of settlement, household's socio-economic progress (an index variable), land area owned, and income. Descriptive univariate statistics of these variables are presented in Table 2. The mean actual WTP for WSF is considerably low compared to the cost of operation and maintenance. Based on the figures presented in Table 1, water management objective that can be achieved with the mean actual WTP for WSF as presented in Table 2 (Rp 102,530) is limited to the improvement of water distribution.

Table 2. Descriptive univariate statistic of variables affecting the actual WTP for WSF

Variables	Mean	Standard Deviation	Minimum	Maximum
Actual WSF	102,530	98,594	5,000	500,000
Age (years)	46.78	12.23	22	90
Education (years of schooling)	6.61	2.10	0	14
Family size	3.2	1.06	1	8
Years of settlement	25.73	5.59	5	45
Socio-economic index	17.26	1.82	10	20
Land area owned	1.84	0.99	0.25	12
Income (Rupiah)	12,452,131	7,477,686	1,810,000	105,600,000

The result of regression analysis on the actual WTP for WSF is presented in Table 3. Out of 7 independent variables assumed to affect the actual WSF, income is the only variable that has statistically significant effect on the actual WSF. The coefficient of income indicates that every Rp 1,000 increase in income will increase the actual WSF by Rp 6.

Table 3. Results of Regression on the Actual WTP for WSF

Variables	Un-standardized Coefficients		t	Sig.
	B	Standard Error		
(Constant)	96,896.71	56,026.82	1.729	0.084
Age (years)	-41.177	436.05	-0.094	0.925
Education	-636.34	2,314.61	-0.275	0.783
Family size	2,763.15	4,326.24	0.639	0.523
Years of settlement	-321.96	833.61	-0.386	0.699
Socio-economic index	-2004.51	2410.31	-0.832	0.406
Land area owned	-13,732.52	8,732.07	-1.573	0.116
Income (Rupiah)	0.006	0.001	4.895	0.000***

F-test = 8.116; Sig. of F-test = 0.000

Achievement of higher water management objectives (cost recovery and efficient water allocation) is a necessity in order to support sustainable water management in tidal lowlands. Considering WSF as one of the required components in achieving objectives higher than currently achieved objective (water distribution improvement), the effort to increase farmers' income that affects their willingness to pay for WSF should be facilitated.

Conclusion

It can be concluded from the study that:

1. Three objectives of water management are recognized in tidal lowland agriculture, namely improvement of water distribution, cost recovery, and efficient water allocation.

2. With the value of actual WTP for WSF, the achievement of water management objective is limited to the improvement of water distribution. Neither cost recovery nor efficient water allocation can be realized with this actual WTP for WSF.

3. Among socio-demographic variables assumed to affect the actual WTP for WSF, only income significantly affects it.

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BUKTI REVIEW 1: REFEREE 1 DAN REFEREE 2

(29 September 2011)

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MANUSCRIPT REVIEW FORM

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Author(s): Yazid et al
Title: Water management achievement in tidal lowlands

Check relevant points and elaborate in the COMMENTS SECTION if required

GENERAL:	**YES**	**NO**
1. Does the manuscript present new knowledge, data or an original theory?	[x]	[ ]
2. Does it constitute a comprehensive review?	[ ]	[x]

SPECIFICS:	**YES**	**NO**
1. Does the title and abstract clearly and sufficiently reflect its contents?	[ ]	[x]
2. Does the paper clearly define the objectives of the study?	[ ]	[x]
3. Do the details of the methods sufficiently expose the design of the study?	[ ]	[x]
4. Are the results sufficient for a primary publication?	[x]	[ ]
5. Are the findings, interpretations, discussion & conclusions scientifically sound?	[ ]	[x]
6. Have any pertinent references been omitted from the text or bibliography? (If yes, please suggest some in the Comments Section)	[ ]	[x]
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9. Are there any controversial/political comments? If yes, please advise how to improve or reword.	No	
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The MS is **suitable** for publication as is and without any revisions.	[ ]
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ADDITIONAL COMMENTS FOR REVISIONS & IMPROVEMENT OF THE MS:

The paper has some useful information that is worth publishing. However, the presentation of the whole paper has to be improved according to the comments below.

Title:

Should be more specific and focused on the work accomplished.

Abstracts:

The statements in the abstracts are mainly general. There are no facts and figures to support results and conclusions. The first two paragraphs in the abstract are suitable for introduction section, and should be deleted from the Abstract . The authors need to rewrite the abstract with focus on the objective, methods, results and conclusion with some important facts and figures to support the statements. See AEHMS guidelines for the preparation of a manuscript (available at www.aehms.org/Journal/ins_authors.htm).

Methods:

Detail methodologies are not given. The authors should explain how the data were obtained and analysed to produce the results. Statistical analyses used should be appropriate and clear.

Results and discussions:

Currency used for data analysis should be in USD for easy comprehension and interpretation**.** It would be good if some of the data in Tables can be presented in Figures. All results and conclusions should be supported by statistical evidence.

Results were not critically assessed and compared to previous studies. In fact, not even one reference was used in Results and Discussion section. More recent and relevant references should be used.

SPECIFIC SUGGESTIONS FOR CONDENSING THE MANUSCRIPT:

None. The paper should also be read an expert on socio-economics

REVIEW SUMMARY: (Please summarize briefly the basis of your assessment)

The paper has some useful information which can be published. However, the paper has to be rewritten to make it a presentable and useful publication. The data analysis and presentation have to be improved. Discussion should include assessment of the data, in comparison with previous studies. More references should be used. In addition, English editing is still necessary especially in the Results and Discussion Section.

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GENERAL:	**YES**	**NO**
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2. Does it constitute a comprehensive review?	[ ]	[/]

SPECIFICS:	**YES**	**NO**
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2. Does the paper clearly define the objectives of the study?	[ ]	[/]
3. Do the details of the methods sufficiently expose the design of the study?	[ ]	[/]
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1. The title. According to the title, a reader would expect some analysis that results in an achievement of water management. It is suggested that the title be revised to reflect the actual research findings.
2. The framework. The cost components presented in table one are not consistent with the framework given in figure 1. Please clarify the "management cost" appeared in table 1 but not figure 1.
3. The model and analysis. The units of measurement for all variables used in the regression equation must be specified. This reflects the justification of the model used. For example, if the authors use "ordinary least square method", the dependent variable (W_i in this case) must be continuous and not binding.
4. Conclusion. The authors should improve it, what written was the summary. A reader expects the conclusion drawn towards the policy implication and recommendation.

SPECIFIC SUGGESTIONS FOR CONDENSING THE MANUSCRIPT:

REVIEW SUMMARY: (Please summarize briefly the basis of your assessment)

BUKTI RESPONS TERHADAP REVIEW 1 DARI REFEREE 1 DAN REFEREE 2

(16 Mei 2012 dan 26 Juni 2012)

Systematic Response to Comments/Review of Referees

Referee 1

Author: Yazid et al

Title: Water management achievement in tidal lowlands

Please fill out this form by listing each of the comments of the referee and your response.

#	Referee's Comments/Review	Response/Action Taken by the Author
1	**Title:** Should be more specific and focused on the work accomplished.	Title has been made specific and focused. The new title is **"The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands"**
2	**Abstracts:** The statements in the abstracts are mainly general. There are no facts and figures to support results and conclusions. The first two paragraphs in the abstract are suitable for introduction section, and should be deleted from the Abstract . The authors need to rewrite the abstract with focus on the objective, methods, results and conclusion with some important facts and figures to support the statements. See AEHMS guidelines for the preparation of a manuscript (available at www.aehms.org/Journal/ins_authors.htm).	Facts and figures have been used to support the discussion of results. The abstract has been rewritten and the objective, methods, results and conclusion have been specified in the abstracts.
3	**Methods:** Detail methodologies are not given. The authors should explain how the data were obtained and analysed to produce the results. Statistical analyses used should be appropriate and clear.	The methodology has been reorganized and details on data collection and analysis have been made clear.

4	**Results and discussions:** Currency used for data analysis should be in USD for easy comprehension and interpretation**.** It would be good if some of the data in Tables can be presented in Figures. All results and conclusions should be supported by statistical evidence. Results were not critically assessed and compared to previous studies. In fact, not even one reference was used in Results and Discussion section. More recent and relevant references should be used.	Local currency has been converted into US$. Some approriate statitical evidences (t-test) have been employed to support the findings of the study. Findings from other studies have been referred to the results of this study.

Systematic Response to Comments/Review of Referees

Referee 2

Author: Yazid et al

Title: Water management achievement in tidal lowlands

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1	**The title**: According to the title, a reader would expect some analysis that results in an achievement of water management. It is suggested that the title be revised to reflect the actual research findings.	The title has been modified to reflect the actual research findings. The new title is **"The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands"**.
2	**The framework**: The cost components presented in table one are not consistent with the framework given in figure 1. Please clarify the "management cost" appeared in table 1 but not figure 1.	Management cost is part of OM cost. Therefore, it has been included in the OM cost.
3	**The model and analysis**: The units of measurement for all variables used in the regression equation must be specified. This reflects the justification of the model used. For example, if the authors use "ordinary least square method", the dependent variable (W_i in this case) must be continuous and not binding.	Units of measurement have been specified. The dependent variable is measured in currency (US$). Therefore, it is a ratio level variable and meets the criteria for OLS methods.
4	**Conclusion**: The authors should improve it, what written was the summary. A reader expects the conclusion drawn towards the policy implication and recommendation.	The conclusion has been improved to include policy implication and recommendation.

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Title: The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands

Check relevant points and elaborate in the COMMENTS SECTION if required

GENERAL:	**YES**	**NO**
1. Does the manuscript present new knowledge, data or an original theory?	[x]	[ ]
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SPECIFICS:	**YES**	**NO**
1. Does the title and abstract clearly and sufficiently reflect its contents?	[x]	[ ]
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5. Are the findings, interpretations, discussion & conclusions scientifically sound?	[x]	[ ]
6. Have any pertinent references been omitted from the text or bibliography? (If yes, please suggest some in the Comments Section)	[ ]	[x]
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8. Does the paper follow the AEHMS guidelines for the preparation of a manuscript? (available at www.aehms.org/Journal/ins_authors.htm)	[ ]	[x]
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10. Does the paper need linguistic editing to improve the English?	[x]	[ ]
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BUKTI RESPONS TERHADAP REVIEW 2
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Systematic Response to Comments/Review of Referees

Referee 1

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

Title: The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands

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1	Correction on Abstract line 7.	Space has been deleted.
2	Correction on Introduction paragraph 2 line 5, 7.	The word has been corrected and the sentence has been restated.
3	Correction on Introduction paragraph 3 line 2, 3, 4, 5.	The words have been corrected.
4	Correction on Methodology paragraph 4 line 4 (line spacing).	Line spacing has been placed.
5	Correction on Results and Discussion paragraph 4 line 2, 3.	Units have been changed.
6	Correction on Conclusion #1 line 5.	The word has been changed.
7	Correction on References #2, #7.	References have been corrected.
8	Correction on Figure 1.	Figure caption has been edited.

Systematic Response to Comments/Review of Referees
Referee 2

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

Title: The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands

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ARTIKEL HASIL REVISI
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The achievement of water management objectives based on the willingness to pay for water service fee in tidal lowlands

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

[1]Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra, Indonesia.
Fax: +62 711 580662; Email: yazid_ppmal@yahoo.com
[2]Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[3]Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[4]Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia

Abstract

The objective of the study was to estimate the willingness to pay for water service fee (WSF) in order to assess the expected achievement of water management objectives in tidal lowlands. A survey was conducted in Telang, a tidal lowland area at the Eastern coast of Sumatra, involving 500 water users randomly drawn from approximately 60,000 people living in the delta. Each respondent was interviewed to obtain information regarding socio economic status and the willingness to pay for WSF. The data were analyzed using a multiple regresion to obtain the estimate of WSF and its affecting factors. The results indicated that the mean WSF was US$11.40. With this WSF, only the improvement of water distribution objective can expectedly be achieved. The willingness to pay for WSF was significantly affected solely by the income of water users. Therefore, efforts to increase willingness to pay for WSF to achieve cost recovery and efficient water allocation should be directed towards the increase of income of water users.

Keywords: water service fee, willingness to pay

Introduction

Among various objectives of water management, the objectives of improving water distribution, recovering cost, and achieving efficient water allocation are likely to be put into priorities in tidal lowlands. Not only these objectives support the sustainable use of lowland resources, but also provide proper treatments to surrounding coastal areas. To achieve these objectives, fee that covers the cost of water management is required, besides functional water structures and established water management guidelines (Schultz, 2007; LWMTL, 2006). Since this fee is used to carry out operation and maintenance of the system, this fee is considered as water service fee (WSF).

Water service fee has been estimated in various different cost concepts using various different methods (Gonzalez-Alvarez et al., 2006; Bar-Shira et al., 2006; Esteban et al., 2008; Molle et al., 2008). The cost of water depends on a number of hydrological, environmental, and agricultural social and economic variables. The cost of water is determined by the amount of water received, the number of structures serving an area, installation costs, and the presence? of water rights (Tarimo et al., 1998). Cornish et al. (2004) noted that water charge may vary according to the water sources, degree of water scarcity, irrigation scheme and technology, and farm types. Other factors are also indicated which include supply costs, opportunity costs, social and environmental costs (Global Water Partnership, 2000).

Based on the above discussion, the basis for estimating the cost of water (WSF) in this study was established to include different cost components that may be factored into a calculation of the cost of water management. These cost components include operation and maintenance (OM), capital depreciation and replacement, opportunity and environmental costs. Accordingly, three types of water cost are set to include supply cost (OM costs, and capital depreciation and replacement), economic cost (supply and opportunity costs), and the full cost (economic cost taking into account environmental externalities associated with the use of water) as depicted in Figure 1.

[Figure 1]

Different costs incurred reflect different water management objectives. Water distribution improvement objective requires only operation and maintenance (OM) costs. Cost recovery objective considers OM costs including capital depreciation and replacement costs. Whilst efficient water distribution objective requires even higher costs in order to cover opportunity and external costs as depicted in Figure 2. This study examines the achievement of water management objective based on water users' willingness to pay for the cost of water service.

[Figure 2]

Methodology

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 farm water users were drawn using random sampling from some 10,000 farm water users. Data were collected through field observation, focus group discussion (FGD) and structured interview. Field observation was conducted in order to confirm the area under one tertiary block and the required construction, operation and maintenance activities within each tertiary block. All these required activities were brought in the FGD along with the management activities and economic and environmental issues to be considered in estimating the costs of water management. The estimated costs were then presented to the respondents in the personal interview sessions as estimates of water service fee (WSF) in order to elicit their willingness to pay.

Willingness to pay for WSF reflects water users' current ability to pay for operation and maintenance of irrigation system. Therefore, it represents the expected achievement of water management objectives. Water users' actual WTP for WSF has three consequences on water management achievement as the following:

1. If actual WTP for WSF is less than or equals to OM costs, only water distribution objective is expected to achieve.
2. If actual WTP for WSF also covers depreciation and replacement costs and WUA management cost in addition to OM costs, then the cost recovery objective is expected to achieve.
3. If actual WTP for WSF covers all the costs, the efficient water allocation is expected to achieve.

The WSF for which water users are willing to pay is affected by farmers' socio-demographic characteristics such as age, education, and family size (Fakayode et al., 2010; El Chami, et al., 2009; Chandrasekaran et al., 2009; Amponin et al., 2006). It is also influenced by the land area owned (Chandrasekaran et al., 2009; Laoubi and Yamao, 2008), length of settlement, socio-economic index, and income (Fakayode et al., 2010; Amponin et al., 2006). The effect of these variables on the actual WSF is modeled in the following equation:

$$W_i = f(Q_i) \qquad (1)$$

where *Qi* represent some socio-demographic characteristics

Assuming multiple regression is sufficient to predict the actual WSF, the above model is specified as the following:

$$W_i = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 FAM + \beta_4 SET + \beta_5 SEI + \beta_6 ARE + \beta_7 INC + \varepsilon_i \qquad (2)$$

where W_i = actual WSF farmers were willing to pay (in US$)
AGE = age of farmer (year)
EDU = farmer's education attainment (years of schooling)
FAM = family size
SET = years of settlement in the area
SEI = index of some socio-economic factors
ARE = farmland area owned (ha)
INC = income from cultivation (US$)

The above regression equation was predicted using ordinary least square method to yield with the predicted actual WSF based on its affecting factors (Norusis, 2006). Subsequent to predicting this equation, 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 actual WSF the farmers were willing to pay (Hair, et al., 2008).

Results and Discussion

Willingness to pay for water service fee (WSF) may reflect the achievement of water management objectives (WMO). While WSF was assessed through focus group discussion (FGD) with members of water users association (WUA) based on the cost of water management within a tertiary block, willingness to pay for WSF was estimated based on the results of interview following the FGD. Three estimates of WSF were obtained from the cost of water management and water management objectives achievement were derived from corresponding WSF estimates (Table 1).

[Table 1]

Operation and maintenance cost included salary of gate keeper and maintenance cost of tertiary gates and canal which consists of grass cutting and cleaning of canal banks, sediment removal, and incidental gate repair. Depreciation and replacement costs were investment made in the installation of 2 tertiary gates and 2 culverts for each tertiary block and construction cost of the gates and culverts. Management cost was the expenditure made to carry out the organizational functions of WUA which include the salary of officials, administration cost, and expenditure for meeting and coordination. Similar cost components have been used in other studies, but calculation of costs were based more on technical and engineering approaches (LWMTL, 2006). The total cost was similar to that estimated by the LWMTL when opportunity and external costs were not considered. In addition, the area-based cost calculation (Cornish, et al., 2004) was found to be the most appropriate in tidal lowlands since neither volumetric nor crop-based were technically applicable.

The sum of the first two cost components presented in Table 1 was used to estimate WSF_1. Opportunity cost was the cost of using resources in production (Thomas and Maurice, 2008). In this case, opportunity cost was the cost of using money for the payment of WSF_1 and the amount was assumed to be the annual interest rate of WSF_1. The sum of WSF_1 and the opportunity cost was the WSF_2. WSF_3 was the sum of

WSF_2 and the external cost of contaminated canal water due to the operation and maintenance of water infrastructures.

Based on the WSF estimates, water distribution improvement can be achieved if actual WTP for WSF is less than US$ 35/ha/yr, cost recovery can be achieved if actual WTP for WSF is US$ 35 up to US$ 38.50/ha/yr, and efficient water allocation can be achieved if actual WTP for WSF is US$ 38.50 or higher. Actual WTP for WSF was respondents' reported amount of WSF they were willing to pay, obtained from the interview with individual respondent. Actual WTP for WSF indicated current status of operation and maintenance of the system. Therefore, it was utilized in the evaluation of achievement of water management objectives.

In order to measure the achievement of water management objectives based on the amount of actual WSF respondents willing to pay, univariate and multivariate analyses were conducted. Amount of actual WTP for WSF were directly affected by several socio-demographic variables such as age, education, family size, years of settlement, household's socio-economic progress (an index variable), land area owned, and income. Descriptive univariate statistics of these variables were presented in Table 2. The mean actual WTP for WSF was considerably low compared to the cost of operation and maintenance. Based on the figures presented in Table 1, water management objective that can be achieved with the mean actual WTP for WSF as presented in Table 2 (US$ 11.40) was limited to the improvement of water distribution.

[Table 2]

The result of regression analysis on the actual WTP for WSF is presented in Table 3. Out of 7 independent variables assumed to affect the actual WSF, income was the only variable that has statistically significant effect on the actual WSF. The coefficient of income indicated that every dollar increase in income would increase the actual WSF by US$ 0.006. In addition, the effect of land area owned needed to be considered since its effect was close to the significant level and its coefficient was negative. Its negative coefficient implied that every ha increase in land area owned would decrease the actual WTP for WSF by US$ 1.53.

[Table 3]

Achievement of higher water management objectives is a necessity in order to support sustainable water management in tidal lowlands. Considering WSF as one of the required components in achieving higher water management objectives (cost recovery and efficient water allocation) than currently achieved objective (water distribution improvement), the effort to increase farmers' income that affects their willingness to pay for WSF should be facilitated. The effort to increase farm income can be directed towards improvement in farming practices through optimum use of labor, chemicals, and fertilizers. Through these practices not only WSF payment can be increased, but also sustainable use of chemicals and fertilizers can be realized. In addition, accumulation of land ownership should be avoided since it would negatively affect the WSF payment. Finally, as proved by Hofwegen (2003) sufficient WSF may facilitate strengtheing the role of water users in agricultural water management, thus enhancing a cyclical process that lead to agricultural development in tidal lowlands.

Conclusion

It can be concluded from the study that:

1. Three objectives of water management were recognized in tidal lowland agriculture, namely improvement of water distribution, cost recovery, and efficient water allocation. The achievement of these three objectives should be gradually planned with regard to the ability of

water users to pay for water service fee (WSF) and shared responsibility in water management among policy makers, managers and water users.

2. With the value of actual WTP for WSF, the achievement of water management objective was limited to the improvement of water distribution. Neither cost recovery nor efficient water allocation could be realized with this actual WTP for WSF. In this situation, government support is expected to maintain current capacity of operation and maintenance of water infrastructures.

3. Among socio-demographic variables assumed to affect actual WTP for WSF, only income significantly affected it. Therefore, efforts towards improving farming practices that may immediately lead to increasing farm income should be directed.

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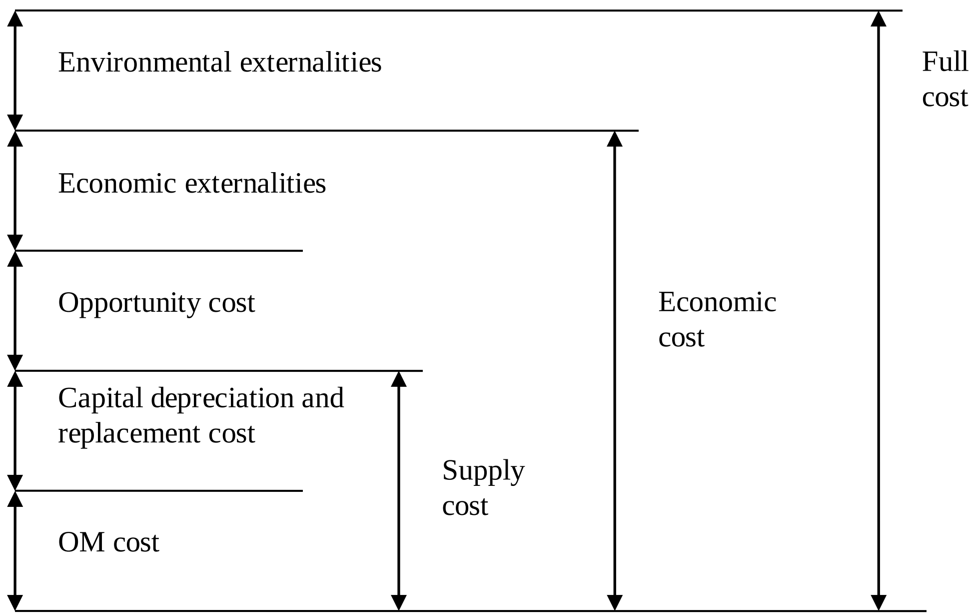

Figure 1. Three types of cost in water charging (adapted from GWP, 2000). OM is operation and maintenance

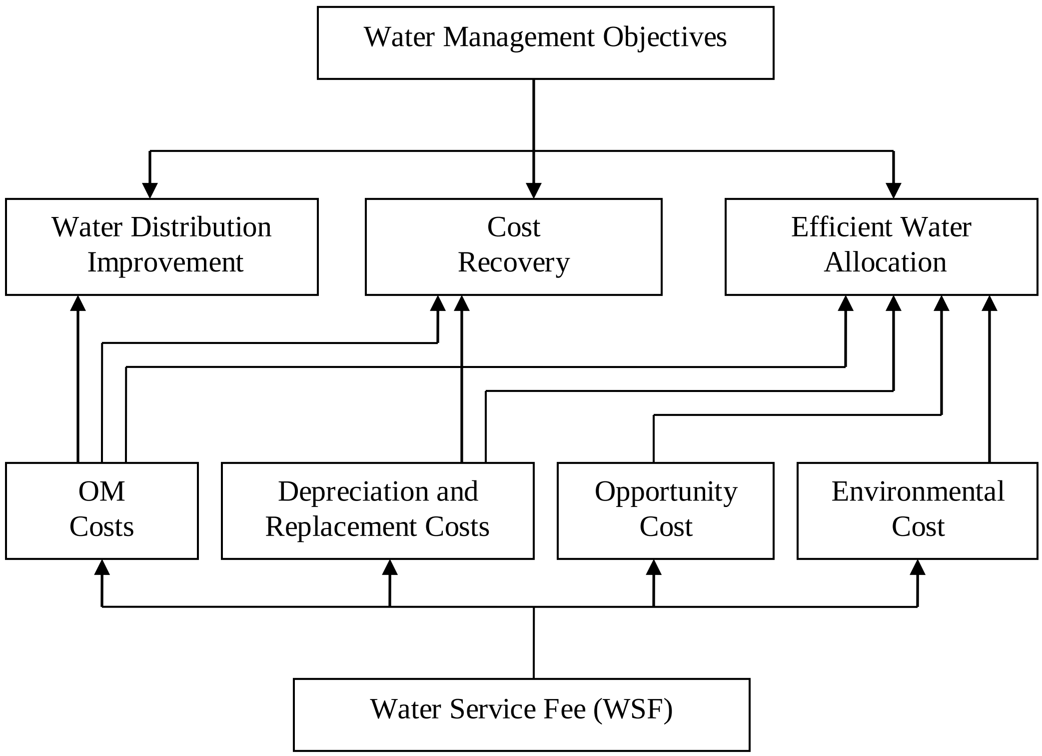

Figure 2. Framework for assessing the achievement of water management objectives

Table 1. Costs of water management, WSF estimates and WMO achievement

Cost Components	Cost per unit (US$)[a]	Total Cost (US$ per 256 ha)[b]	WSF (US$/ha/year)	Expected WMO Achievement
Operation and maintenance cost	206.25 (per 16 ha)	8,953.33	WSF_1 = 35.00	Water Distribution Improvement
Capital depreciation and replacement cost	353.33 (per 16 ha)			
Opportunity cost	3.50 (per ha)	9,849.33	WSF_2 = 38.50	Cost Recovery
External cost	5.00 (per ha)	11,129.33	WSF_3 = 43.50	Efficient Water Allocation

[a]Unit varies according to the block wherein the cost was applied (secondary block=256 ha; tertiary block=16 ha; farmland=1 ha).
[b]Equals to one water management unit or area of a water users association.

Table 2. Descriptive univariate statistic of variables affecting the actual WTP for WSF

Variables	Mean	Standard Deviation	Minimum	Maximum
Actual WSF (US$)	11.40	10.95	0.56	55.56
Age (years)	46.78	12.23	22.00	90.00
Education (years of schooling)	6.61	2.10	0.00	14.00
Family size	3.20	1.06	1.00	8.00
Years of settlement	25.73	5.59	5.00	45.00
Socio-economic index	17.26	1.82	10.00	20.00
Land area owned (ha)	1.84	0.99	0.25	12.00
Income (US$)	1,383.33	831.11	201.11	11,666.66

Table 3. Results of Regression on the Actual WTP for WSF

Variables	Un-standardized Coefficients		t	Sig.
	B	Standard Error		
(Constant)	10.77	6.23	1.729	0.084
Age (years)	-41.177	436.05	-0.094	0.925
Education (years of schooling)	-636.34	2,314.61	-0.275	0.783
Family size	2,763.15	4,326.24	0.639	0.523
Years of settlement	-321.96	833.61	-0.386	0.699
Socio-economic index	-2004.51	2410.31	-0.832	0.406
Land area owned (ha)	-13,732.52	8,732.07	-1.573	0.116
Income (US$)	0.006	0.001	4.895	0.000***

F-test = 8.116; Sig. of F-test = 0.000

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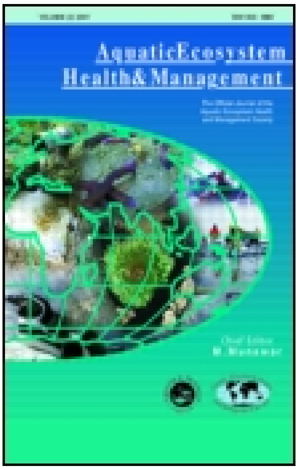

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Muhammad Yazid [a], Mad Nasir Shamsudin [b], Khalid Abdul Rahim [c], Alias Radam [c] & Azizi Muda [d]

[a] Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra, Indonesia

[b] Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[c] Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[d] Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia

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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, Malaysia*
[3]*Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[4]*Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia*
**Corresponding author: yazid_ppmal@yahoo.com*

The objective of this study was to estimate willingness to pay for a water service fee (WSF) in order to assess the expected achievement of water management objectives in tidal lowlands. A survey was conducted in Telang, a tidal lowland area on the eastern coast of Sumatra, involving 500 water users randomly drawn from approximately 60,000 people living in the delta. Each respondent was interviewed to obtain information regarding socioeconomic status and the willingness to pay for WSF. The data were analyzed using multiple regresion to obtain the estimate of WSF and its affecting factors. Results indicated that the mean WSF was $11.40 US. With this WSF, only the improvement of water distribution objectives could expect to be achieved.

Willingness to pay for WSF was significantly affected by the income of water users. Therefore, efforts to increase this willingness in order to achieve cost recovery and efficient water allocation should be directed towards the increase of income of water users.

Keywords: water management, tidal lowland area

Introduction

Among various objectives of water management, the goals of improving water distribution, recovering cost, and achieving efficient water allocation are likely to be priorities in tidal lowlands. Not only do these objectives support the sustainable use of lowland resources, they also provide proper treatments for surrounding coastal areas. To achieve these objectives, a fee that covers the cost of water management is required, besides functional water structures and established water management guidelines (Schultz, 2007; Land and Water Management Tidal Lowlands [LWMTL], 2006). Since this fee is used to carry out operation and maintenance of the system, it is considered as a water service fee (WSF).

WSF has been estimated using various different cost concepts employing various different methods (Gonzalez-Alvarez et al., 2006; Bar-Shira et al., 2006; Esteban et al., 2008; Molle et al., 2008). The cost of water depends on a number of hydrological, environmental, and agricultural social and economic variables and is determined by the amount of water received, the number of structures serving an

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area, installation costs, and the presence of water rights (Tarimo et al., 1998). Cornish et al. (2004) noted that water charges may vary according to water sources, degree of water scarcity, irrigation scheme and technology, and farm types. Global Water Partnership (2000) proposed three types of costs for water charges, namely supply cost, opportunity cost, social and environmental costs.

Based on the above discussion, the basis for estimating the cost of water (WSF) in this study was established to include different components that could be factored into a calculation of the cost of water management. These cost components include operation and maintenance (OM), capital depreciation and replacement, opportunity and environmental costs. Accordingly, three types of water fees were set to include supply cost (OM costs, and capital depreciation and replacement), economic cost (supply and opportunity costs), and the full cost (economic cost taking into account environmental externalities associated with the use of water) as depicted in Figure 1.

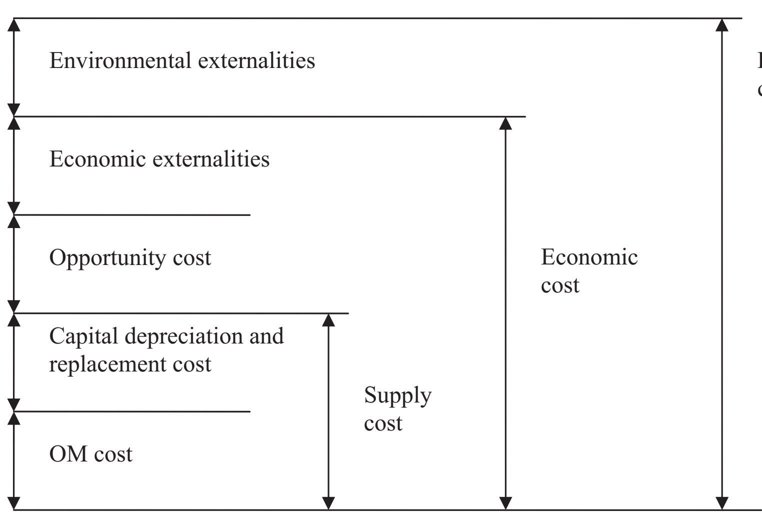
Different costs incurred reflected different water management objectives. Water distribution improvement objective required only operation and maintenance (OM) costs. Cost recovery objective considered OM costs including capital depreciation and replacement costs, whilst efficient water distribution objective required even higher costs in order to cover opportunity and external costs as depicted in Figure 2. This study examined the achievement of water management objectives based on water users' willingness to pay for the cost of water service.

Methodology

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 farm water users were drawn using random sampling from some 10,000 farm water users. Data were collected through field observation, focus group discussion (FGD) and structured interview. Field observation was conducted in order to confirm the area under one tertiary block and the required construction, operation and maintenance activities within each tertiary block. All these required activities were brought in the FGD along with the management activities and economic and environmental issues to be considered in estimating the costs of water management. The estimated costs were then presented to the respondents in the personal interview sessions as estimates of water service fee in order to elicit their willingness to pay.

Willingness to pay reflected water users' current abilities to pay for operation and maintenance of an irrigation system. Therefore, it represented the expected achievement of water management objectives. Water users' actual WTP has three consequences on water management achievement:

1. If actual WTP for is less than or equals OM costs, only water distribution objective is expected to be achieved.



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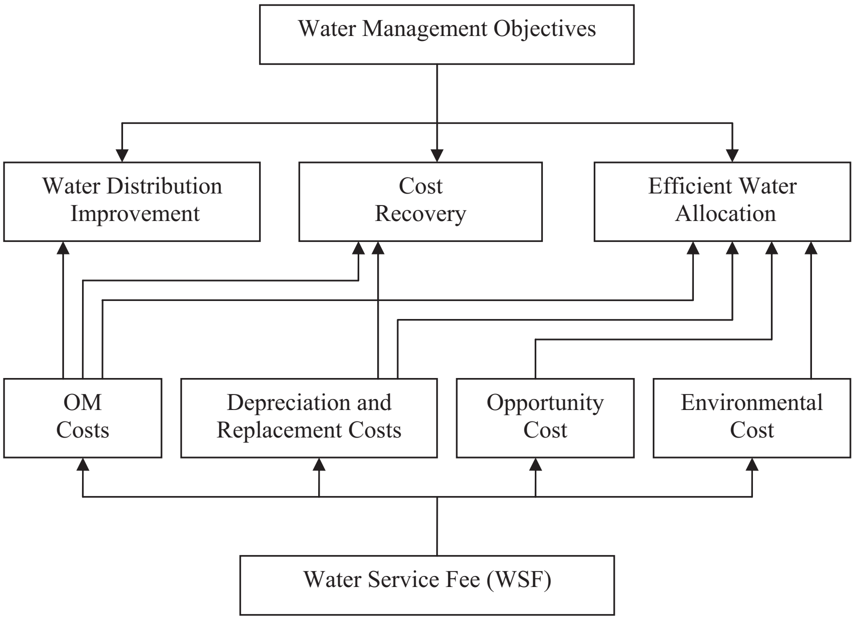

Figure 2. Framework for assessing the achievement of water management objectives.

2. If actual WTP also covers depreciation and replacement costs and WUA management cost in addition to OM costs, then the cost recovery objective is expected to be achieved.
3. If actual WTP covers all the costs, the efficient water allocation is expected to be achieved.

The WSF for which water users are willing to pay is affected by farmers' socio-demographic characteristics such as age, education, and family size (Fakayode et al., 2010; El Chami et al., 2009; Chandrasekaran et al., 2009; Amponin et al., 2006). It is also influenced by the land area owned (Chandrasekaran et al., 2009; Laoubi and Yamao, 2008), length of settlement, socio-economic index, and income (Fakayode et al., 2010; Amponin et al., 2006). The effect of these variables on the actual WSF is modeled in the following equation:

$$W_i = f(Q_i) \quad (1)$$

where Q_i represents socio-demographic characteristics

Assuming multiple regression is sufficient to predict the actual WSF, the above model is specified as the following:

$$W_i = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 FAM + \beta_4 SET + \beta_5 SEI + \beta_6 ARE + \beta_7 INC + \varepsilon_i \quad (2)$$

where

W_i = actual WSF farmers were willing to pay (in \$US)
AGE = age of farmer (year)
EDU = farmer's education attainment (years of schooling)
FAM = family size
SET = years of settlement in the area
SEI = index of some socio-economic factors
ARE = farmland area owned (ha)
INC = income from cultivation (\$US)

The above regression equation was predicted using ordinary least square method to yield with the predicted actual WSF based on its affecting factors (Norusis, 2006). Subsequent to predicting this equation, 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 actual WSF the farmers were willing to pay (Hair et al., 2008).

Results and Discussion

Willingness to pay may reflect the achievement of water management objectives (WMO). While WSF was assessed through focus group discussion (FGD)

Table 1. Costs of water management, WSF estimates and WMO achievement.

Cost Components	Cost per Unit ($US)[a]	Total Cost ($US per 256 ha)[b]	WSF ($US ha^{-1} $year^{-1}$)	Expected WMO Achievement
Operation and maintenance cost	206.25 (per 16 ha)	8,953.33	$WSF_1 = 35.00$	Water distribution improvement
Capital depreciation and replacement cost	353.33 (per 16 ha)			
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[a]Unit varies according to the block wherein the cost was applied (secondary block = 256 ha; tertiary block = 16 ha; farmland = 1 ha). [b]Equal to one water management unit or area of a water users association.

with members of water users association, based on the cost of water management within a tertiary block, willingness to pay was estimated based on the results of the interview following the FGD. Three estimates of WSF were obtained from the cost of water management and achievement of water management objectives was derived from corresponding WSF estimates (Table 1).

Operation and maintenance costs included salary of gatekeeper and maintenance cost of tertiary gates and canal which consisted of grass cutting and cleaning of canal banks, sediment removal, and incidental gate repair. Depreciation and replacement costs were investment made in the installation of 2 tertiary gates and 2 culverts for each tertiary block and construction cost of the gates and culverts. Management cost was the expenditure made to carry out the organizational functions of WUA which included the salary of officials, administration cost, and expenditure for meeting and coordination. Similar cost components have been used in other studies, but calculation of costs were based more on technical and engineering approaches (LWMTL, 2006). The total cost was similar to that estimated by the LWMTL when opportunity and external costs were not considered. In addition, the area-based cost calculation (Cornish et al., 2004) was found to be the most appropriate in tidal lowlands since neither volumetric nor crop-based were technically applicable.

The sum of the first two cost components presented in Table 1 was used to estimate WSF_1. Opportunity cost was the cost of using resources in production (Thomas and Maurice, 2008). In this case, opportunity cost was the cost of using money for the payment of WSF_1 and the amount was assumed to be the annual interest rate of WSF_1. The sum of WSF_1 and the opportunity cost was the WSF_2. WSF_3 was the sum of WSF_2 and the external cost of contaminated canal water due to the operation and maintenance of water infrastructures.

Based on the WSF estimates, water distribution improvement can be achieved if actual WTP for WSF is less than $35 US per ha per yr; cost recovery can be achieved if actual WTP is from $35 up to $38.50 US per ha per yr; efficient water allocation can be achieved if actual WTP is $38.50 US

Table 2. Descriptive univariate statistic of variables affecting the actual WTP for WSF.

Variables	Mean	Standard Deviation	Minimum	Maximum
Actual WSF ($US)	11.40	10.95	0.56	55.56
Age (years)	46.78	12.23	22.00	90.00
Education (years of schooling)	6.61	2.10	0.00	14.00
Family size	3.20	1.06	1.00	8.00
Years of settlement	25.73	5.59	5.00	45.00
Socio-economic index	17.26	1.82	10.00	20.00
Land area owned (ha)	1.84	0.99	0.25	12.00
Income ($US)	1,383.33	831.11	201.11	11,666.66

Table 3. Results of regression on the actual WTP for WSF.

Variables	Un-standardized Coefficients B	Standard Error	t	Sig.
(Constant)	10.77	6.23	1.729	0.084
Age (years)	−41.177	436.05	−0.094	0.925
Education (years of schooling)	−636.34	2,314.61	−0.275	0.783
Family size	2,763.15	4,326.24	0.639	0.523
Years of settlement	−321.96	833.61	−0.386	0.699
Socio-economic index	−2004.51	2410.31	−0.832	0.406
Land area owned (ha)	−13,732.52	8,732.07	−1.573	0.116
Income ($US)	0.006	0.001	4.895	0.000*

F-test = 8.116; *Sig. of F-test = 0.000.

per ha per yr or higher. Actual WTP was respondents' reported amount of WSF they were willing to pay, obtained from the interview with individual respondents which indicated current status of operation and maintenance of the system. Therefore, it was utilized in the evaluation of achievement of water management objectives.

In order to measure the achievement of water management objectives based on the amount of actual WSF respondents were willing to pay, univariate and multivariate analyses were conducted. Amount of actual WTP was directly affected by several socio-demographic variables such as age, education, family size, years of settlement, household's socio-economic progress (an index variable), land area owned, and income. Descriptive univariate statistics of these variables were presented in Table 2. The mean actual WTP for WSF was considerably lower compared to the cost of operation and maintenance. Based on the figures presented in Table 1, water management objectives that could be achieved with the mean actual WTP as presented in Table 2 ($11.40 US) was limited to the improvement of water distribution.

The result of regression analysis on the actual WTP is presented in Table 3. Out of 7 independent variables assumed to affect the actual WSF, income was the only variable that has statistically significant effect on the actual WSF. The coefficient of income indicated that every dollar increase in income would increase the actual WSF by $0.006 US. In addition, the effect of land area owned needed to be considered since its effect was close to the significant level and its coefficient was negative. Its negative coefficient implied that every ha increase in land area owned would decrease the actual WTP by $1.53 US.

Achievement of higher water management objectives is a necessity in order to support sustainable water management in tidal lowlands. Considering WSF as one of the required components in achieving this (cost recovery and efficient water allocation) rather than currently achieved objectives (water distribution improvement), the effort to increase farmers' incomes that affects their willingness to pay for WSF should be facilitated. The effort to increase farm incomes could be directed towards improvement in farming practices through optimum use of labor, chemicals, and fertilizers. Through these practices not only WSF payment could be increased, but also sustainable use of chemicals and fertilizers could be realized. In addition, accumulation of land ownership should be avoided since it would negatively affect the WSF payment. Finally, as proved by Hofwegen (2003) sufficient WSF may facilitate strengtheing the role of water users in agricultural water management, thus enhancing a cyclical process that leads to agricultural development in tidal lowlands.

Conclusions

It can be concluded from the study that:

1. Three objectives of water management were recognized in tidal lowland agriculture, namely, improvement of water distribution, cost recovery, and efficient water allocation. The achievement of these three objectives should be planned gradually with regard to

the ability of water users to pay for a water service fee (WSF) and shared responsibility in water management among policy makers, managers and water users.

2. With the value of actual WTP for WSF, the achievement of water management objective was limited to the improvement of water distribution. Neither cost recovery nor efficient water allocation could be realized with this actual WTP for WSF. In this situation, government support is expected to maintain current capacity of operation and maintenance of water infrastructures.
3. Among socio-demographic variables assumed to affect actual WTP for WSF, only income significantly affected it. Therefore, efforts towards improving farming practices that may immediately lead to increasing farm income should be directed.

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