A market-based mechanism as an alternative solution for watershed management: a case study of the Ciliwung Watershed, Indonesia

Article *in* International Journal of Global Environmental Issues · January 2019

DOI: 10.1504/IJGENVI.2019.10023932

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Abstract: The complexity of managing the Ciliwung Watershed in Indonesia has resulted in various externalities such as flooding in the capital city of Jakarta. A non-structural approach using a market-based instrument such as a payment for environmental services (PES) scheme could be considered an alternative policy to overcome such externalities. A compensation mechanism is expected to induce incentives to conserve the watershed in the upstream area with the goal of reducing flooding downstream. This study attempts to determine the amount of compensation that should be paid by the governmental agency in Jakarta to upstream communities to maintain and improve the quality of the watershed area. The contingent valuation method (CVM) was used to obtain the households' willingness to pay (WTP) as a basis for compensation. Lessons learned concern watershed management and the implications of using the PES scheme.

Keywords: payment for environmental services; PES; watershed management; contingent valuation method; CVM; willingness to pay; WTP; Indonesia.

Reference to this paper should be made as follows: Saridewi, T.R. and Fauzi, A. (2019) 'A market-based mechanism as an alternative solution for watershed management: a case study of the Ciliwung Watershed, Indonesia', *Int. J. Global Environmental Issues*, Vol. 18, No. 2, pp.171–186.

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1 Introduction

One of the most distinctive features of Jakarta as the capital of Indonesia is that the city is regularly inundated with floods. During the rainy season every year, the Greater Jakarta area, including its central business districts, is affected by flooding. The flooding has disrupted daily activities, damaged infrastructure and caused other environmental problems. The economic loss associated with this natural hazard rose significantly from Rp 9.8 trillion (US$8.6 billion) in 2002 to almost Rp 20 trillion (US$17.6 billion) in 2013, using the average exchange rate of US$ 1 = 11,350 rupiah (Rp). In terms of linear average loss, this is equivalent to US$2.3 billion per year over 11 years. A much lower figure of US$ 321 million of average annual loss was obtained by Budiyono et al. (2015), Central Management of Citarum-Ciliwung Watershed (2011) and Kompas (2013), using the expected value formula, which takes into account the probability of flooding.

Even though factors such as land subsidence, poor sewerage systems and infrastructure systems have contributed to continuing and worsening floods in Jakarta, poor management of the Ciliwung Watershed is considered the major contributor. Among the 14 rivers that flow into the Jakarta area, the Ciliwung River is the largest and the longest. As part of the downstream area of the Ciliwung Watershed, Jakarta has undergone massive urban development leading to a reduction in catchment areas, soil degradation and other environmental problems. The areas along the riverbank are the most vulnerable to illegal occupation and urban sprawl. The relatively cheaper price of land and unclear property rights make these areas prone to land squatting. All of these factors contribute to the flooding in Jakarta and the socio-economic costs that come with it.

So far, the government's response to overcoming floods in the greater Jakarta area is through a 'structural approach' such as building reservoirs, ponds and infiltration wells or normalising the water body. Such an approach, however, is not a 'silver bullet' to solving the continuing problem of flooding in the Ciliwung Watershed, as it is a necessary but insufficient condition to address floods in the capital city. The structural approach also might involve public funding, which represents opportunity costs to society. For example, it is reported that, to normalise the Ciliwung River, as much as Rp 5 trillion (US$384,615) is needed (Antara News, 2012). This funding represents an opportunity cost that could be used for other productive activities such as building infrastructure, health and education. Even though both public funding and the payment for environment service schemes that we are proposing in this paper would involve an opportunity cost to society, the mechanism and impact would be different. Public funding is obtained through a taxation mechanism in which the amount that is paid by the society is fixed and mandatory. In contrast, the PES scheme is rather voluntary and the amount that should be paid is determined based on the society's willingness to pay (WTP).

In addition to the drawbacks of using structural approaches is the presence of transaction costs. Transaction costs for the infrastructure for a watershed program are often greater than the cost of technology transitions in a buy-back water program (Marshall, 2013). Budiyono et al. (2015) stated that a structural approach in the management of floods in Jakarta will be more expensive in the future because of physical and social changes in the community. The combination of several factors such as land subsidence, bad drainage, an increase in population and economic growth would lead to higher costs in the future since changes in those factors would undoubtedly impose costs on public funding.

Other various structural approaches involve relocation. This type of approach has also been used by the government of Jakarta to deal with the Ciliwung Watershed problem. In 2015, the Jakarta administration relocated the community of Kampung Pulo, which was located illegally on the Ciliwung riverbank, to a low cost apartment building. Consequently, it was expected that the flooding in Jakarta would be reduced or terminated. Yet the relocation did not solve the problem. Instead, the flooding merely shifted to other parts of the city: mainly the watershed in south Jakarta. The relocation also created many socio-economic problems for the former Kampung Pulo residents. Moving to a low-cost high-rise building displaced the socio-economic structure of the community, as its members were used to working close to the riverbank. The relocation thus increased the community's expenditures and caused the loss of livelihood for its members.

Thus, a complementary, alternative approach to the structural approach is needed. Several studies have shown how important the 'non-structural approach' is in a watershed management system. This approach is a solution based on non-physical construction. It uses the market and other socio-cultural factors to address watershed management. Vollmer et al. (2015) argued that the cultural services of the Ciliwung River play a crucial role in water rehabilitation. Other researchers such as Vatn (2010), Muradian et al. (2010) and Molle et al. (2010) showed that the institutional approach matters in watershed management. Van den Hurk et al. (2014) stated that the participation of the public in flood-risk management in England gave a better result than the participation of the public in the Netherlands where flood-risk management was dominated mainly by structural approaches. One of the key findings is that institutions in the UK play a greater role in a risk-based approach than Dutch institutions. Vollmer et al. (2015) added that a structural approach undertaken for the rehabilitation of a river, such as the normalisation of the Ciliwung River, has been unable to provide social benefits. Thus, it is unsurprising that international institutions today shift the technical and structural aspects and steps of flood management into an integrated flood risk management program (Ward et al., 2013).

In addition to cultural and institutional approaches, a market-based approach is commonly used to estimate the WTP of users for rehabilitation and conservation in a watershed area. For example, Holmes et al. (2004), Zhongmin et al. (2003), Ojeda et al. (2008) and Amigues et al. (2002) used a market-based approach to estimate the WTP for river or basin conservation programs. The payment for environmental services (PES) scheme, which is a market-based approach, is also gaining popularity in watershed management studies. For example, Alemayehu et al. (2009) used a PES scheme to estimate the WTP for a conservation program in the Blue Nile basin. Similarly, Kosoy et al. (2007) studied how a PES scheme could be used as a conflict resolution instrument in watershed management in Central America.

PES schemes are currently being adopted in Indonesia as an alternative for watershed management and as an incentive for a conservation scheme in the upstream area. Existing practices include PES schemes in the regencies of Cirebon and Kuningan for water provision, and the Cidanau PES scheme in Banten Province between the upstream community of the Cidanau River and the Krakatau Steel Industry downstream (Suyanto et al., 2005). These schemes are not only considered acceptable and attractive for both upstream and downstream communities, they are also mandated in Indonesia's Environmental Act 32/2009. Two critical questions remain, however, concerning PES schemes in Indonesia:

a the appropriate level of payment

b the method by which the payment is determined.

This study attempts to answer these questions. The urgency of determining the WTP for conservation of the Ciliwung Watershed is not only due to the fact that none of existing mechanisms use a market-based scheme, but also because it is timely for the residents of the greater Jakarta area to determine the amount of compensation they are willing to provide to the upstream community. This study is the first to assess the value of the WTP in the Ciliwung Watershed, and it could serve as policy input for the province of Jakarta and other West Java provinces in implementing a compensatory mechanism for watershed protection.

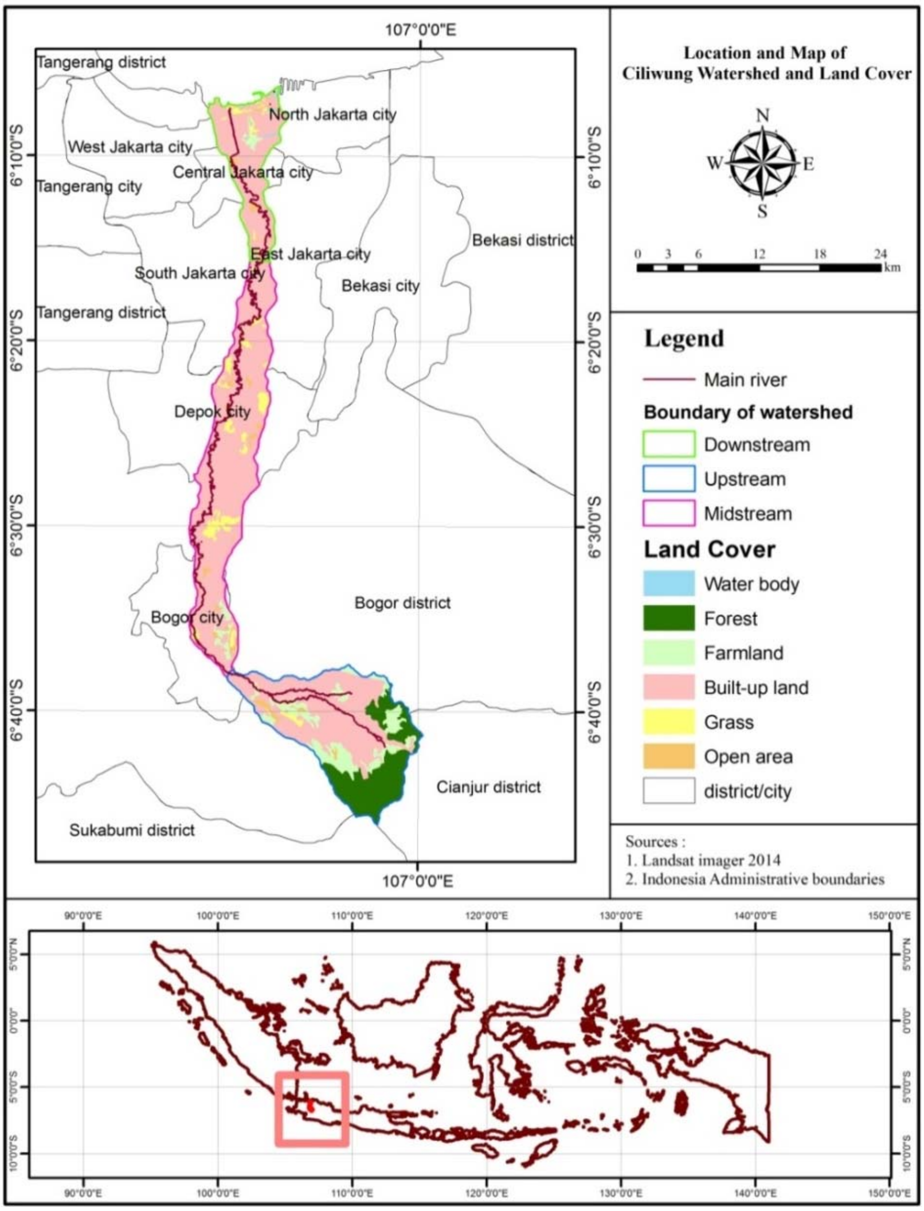
The rest of the paper is organised as follows. Section 2 contains a description of the Ciliwung Watershed, while Section 3 comprises an introduction to the PES scheme as a vehicle in managing the Ciliwung Watershed. In Section 4, the method used to answer the research questions is presented. Section 5 contains the results and discussions. Finally, the conclusions are presented in Section 6.

2 Brief overview of the Ciliwung Watershed

The Ciliwung Watershed covers an area of 386.10 km^2 along a 117 km main river. The watershed extends from West Java Province in the south to Jakarta Province in the north with an overall river length of 807.93 km. Based on toposequence, the upstream and midstream areas of the Ciliwung Watershed cross several districts and cities, such as Bogor and Depok, while the downstream area lies entirely in Jakarta Province (see Figure 1). Approximately 5 million people comprising 1.3 million households reside in the Ciliwung Watershed. As a result, population density in the watershed is relatively high. This high density is attributed to a high demand for land and the scarcity of land in Jakarta.

The density of human settlement along the Ciliwung Watershed has changed the land cover of the watershed so that almost 90% of the downstream and midstream area are occupied by human settlement. This shift of composition has resulted in the reduction of forests and other catchment areas upstream. For example, from 1990 to 2014, the forested area was reduced from 30.3% to 27.9% of the total upstream area (see Table 1). During the same time period, other catchment areas were reduced from 28.5% to 20.6% of the total upstream area (Table 1). Predictably, therefore, an increase of flooding in the downstream area is due to the reduction of catchment areas upstream and the low absorption ability of the downstream area due to land conversion.

Figure 1 Location, map and land cover of the Ciliwung Watershed (see online version for colours)



Source: *Landsat* image in 2014

Table 1 Land cover of each location (%)

Year	*Location*	*Water body*	*Forest*	*Farmland*	*Grass*	*Open area*	*Built-up area*
1990	Upstream	0.2	30.3	26.2	0.8	1.2	41.2
2000	Upstream	0.5	29.7	25.5	0.8	1.8	41.6
2010	Upstream	0.6	28.9	24.5	1.0	1.2	43.8
2014	Upstream	0.4	27.9	17.9	0.7	1.5	51.6
1990	Midstream	0.4	0.0	6.4	9.0	2.9	81.2
2000	Midstream	0.5	0.0	5.8	9.2	2.7	81.8
2010	Midstream	0.4	0.0	5.5	9.3	2.7	82.1
2014	Midstream	0.4	0.0	2.1	8.4	3.0	86.2
1990	Downstream	4.0	0.0	3.1	4.3	4.0	84.6
2000	Downstream	2.4	0.0	3.1	4.8	4.1	85.6
2010	Downstream	2.5	0.0	2.6	4.7	4.4	85.7
2014	Downstream	2.5	0.0	2.6	4.5	4.2	86.1

Notes: Data from *Landsat* images in 1990, 2000, 2010 and 2014.

The Ciliwung Watershed area is also characterised by diverse economic activities. A significant shift in economic activities from mainly agricultural activities to industry, trade and services has occurred during the last decades (Central Management of Citarum-Ciliwung Watershed, 2011). This shift has resulted in the mass conversion of paddy fields to non-farming purposes. As a result, there has been a decline in land ownership among farmers living in the watershed area. The average land ownership of small farmers is now around 0.12 hectare per household compared to 0.2 hectare per household for the national average (Central Management of Citarum-Ciliwung Watershed, 2011). This decline in land ownership has significant implications for food production and environmental conservation, as it has contributed to a decline in the quality of land and water resources and thus agricultural production. Other implications relate to the link of rural-urban development. The decline in rural land productivity will undoubtedly threaten urban sustainability (Westlund, 2014).

The combined factors of land conversion and the reduction of land ownership among farmers have complicated conservation programs in the watershed area. The sedimentation of reservoirs and the river in the midstream and downstream watershed is occurring. This raises serious concerns for the overall management of the Ciliwung Watershed as well as for the protection of the capital city from regular flooding during the rainy season.

3 PES as a vehicle for Ciliwung Watershed management

PES schemes for watersheds have been widely implemented in developed and developing countries, and PES is deemed an effective tool to resolve upstream and downstream conflict (Kosoy et al., 2007; Muñoz Escobar et al., 2013). When used appropriately, a PES scheme can overcome mismanagement, improve the behaviour of communities toward the environment and provide a better livelihood for residents of rural communities (Engel et al., 2008; Jindal et al., 2007). In Indonesia, this scheme has been formally recognised under Environmental Act Number 32/2009, and it has been implemented in various ways. The PES scheme for watershed management provides incentives to an upstream community to conserve the upstream area (Fauzi and Anna, 2013). In this case, the upstream community serves as the 'provider' and the downstream community serves as the 'user' within the PES framework.

One of the critical steps in establishing a PES scheme is to determine the WTP of the community for the improvement of watershed services and for other conservation programs (Fauzi and Anna, 2013). Thus, a proper assessment is required to determine the WTP of a PES scheme. In the Ciliwung Watershed, the amount of money derived from the WTP could be used to estimate the amount of compensation payable to the upstream community. This amount would also serve as a benchmark for determining the 'monetary value' of the Ciliwung River. The monetary value would serve as a 'signal' to the user that there are costs and benefits associated with the use of water services. Without such a proper market signal, externalities in the form of the over-consumption of ecosystem services derived from the watershed will occur. The availability of the significant monetary value of the ecosystem in the upstream area would also provide crucial supporting services to the urban area, which is Jakarta in this case. As stated by Kourtit et al. (2015), specialisation of rural functionality could provide complementary services to an urban area. Thus, the development and establishment of a PES scheme for the Ciliwung Watershed area is needed urgently.

4 Methods

4.1 Survey settings

This study uses the contingent valuation method (CVM) to assess the WTP of the society for watershed protection. The improvement of river quality using the CVM involves three main stages:

a identification of the goods and services to be evaluated

b construction of a hypothetical scenario

c monetary value elicitation (Pearce et al., 2006).

Among these three stages, stage 2 (i.e., construction of a hypothetical scenario) is critical, since it directs how respondents will react to hypothetical policy scenarios. This stage will involve three elements:

a a change in watershed policy

b a description of the hypothetical payment

c determination of the method of payment.

The policy scenarios in this study were developed under flooding and not-flooding scenarios, while the description of a hypothetical payment was assumed as direct payment (cash transfer) through a hypothetical institution (regencies or an autonomous body).

In order to obtain the monetary value of a mean WTP, the study uses dichotomous choice or binary choice questions instead of open bid questions. The binary choice questions are then followed by double-bounded choice questions. The reason for utilising both binary choice and double-bounded choice questions is that this technique makes it relatively easy for a respondent to answer with a specific value of a bid (Carson et al., 2003; Loomis et al., 2000). The double-bounded choice questions essentially form a follow-up bid aimed to improve the efficiency of estimation (Hanemann et al., 1991).

To administer the survey, the respondents were divided into groups randomly and each group was asked to give their WTP for a specific monetary value ranging from Rp 5,000 to Rp 20,000. The questionnaires were tested with experts and a smaller group of respondents prior to the actual survey. The experts asked to participate in this survey were 30 members of the coordinating team of the Ciliwung-Cisadane Watershed management area. These team members are involved in Ciliwung Watershed planning, so they are assumed to have sufficient knowledge of the problems and challenges faced in Ciliwung management. The amount of the stated WTP was then used as a benchmark for designing a questionnaire.

The respondents in this study are residents living along the Ciliwung riverbank in the Jakarta area. They are familiar with flooding in the area and have experienced the socio-economic impact of flooding. The respondents were selected purposively (i.e., those who have lived in the Kampung Pulo Jatinegara area). Prior to relocation, Kampung Pulo was an area of public spotlight with respect to flooding in Jakarta. The people of Kampung Pulo built their houses along the Ciliwung riverbank without building permits. Hence, their presence in Kampung Pulo could be considered illegal. It is in the interest of this study to select Kampung Pulo residents to assess their views and their WTP for the Ciliwung Watershed management. Out of 250 distributed questionnaires, 76 were returned and evaluated. Based on the central limit theorem, the sample of at least 30 respondents is sufficient to conduct the analysis. In addition, the participants in the sample were drawn from flood affected areas: hence the respondents are almost homogeneous or the variation in samples is rather small. Before they were asked about their WTP for improved environmental services, the respondents were invited to discuss environmental services. After gaining an understanding of the scenarios, the respondents agreed that environmental services play an important role in flood control in Jakarta.

The estimated values of the WTP were analysed using the referendum of a probit model. The dependent variable used was the WTP. If the respondent was willing to pay, then a value of 1 was written. If the respondent was not willing to pay, a value of 0 was written.

In the single-bounded CVM questionnaire, each respondent was asked to choose a ‘yes’ or ‘no’ response for a specific value of bid. The independent variables used were bid, gender, education and income. The bids were divided into four different values:

a Rp 5,000

b Rp 10,000

c Rp 15,000

d Rp 20,000.

In this study, the respondents were asked to discuss flooding in Jakarta and the reduction of catchment areas both upstream and downstream. They were also asked to discuss problems and possible solutions associated with flooding in Jakarta, as well as their contribution to overcome the problem (such as a contribution in monetary or non-monetary terms). Their responses were then used as a proxy for their WTP toward environmental protection for the Ciliwung Watershed area.

To obtain valid responses to the CVM questionnaire, the respondents were informed about the upstream communities who will receive the payment. The upstream communities are the landowners of 8.4% of the watershed area. Around 13,000 farming households and 10,000 farm workers are expected to be the recipients of the PES program. The recipients are asked to conserve the upstream area. They are also asked to practice sustainable farming in order to conserve the catchment area.

4.2 Econometric model

The analysis of the WTP, especially the mean WTP, was carried out using the random utility model (RUM). In RUM, we do not observe a person's WTP directly. Instead, we infer it from the response to the offer of proposed scenarios (Whitehead and Blomquist, 2006). If the person approves the bid, then his/her WTP will be greater than the value offered and vice versa.

If we denote that the 'observed WTP' is WTP* and the bid is '*B*', the relationship between the inferred WTP and the bid is as follows:

$$WTP = 1 \text{ if } WTP^* > B \text{ and } WTP = 0 \text{ if } WTP^* < B \tag{1}$$

It is commonly assumed that the general form of the *WTP** is a linear form. That is,

$$WTP^* = z_i \beta + u_i \tag{2}$$

where *WTP** is latent variable, β is vector parameters, z_i is variables, and u_i is error term.

Since the output of a single-bounded CVM questionnaire is either 'yes' or 'no', then the probability of the respondent answering 'yes' can be written as:

$$\begin{aligned} \Pr\left(yes = 1 \middle| z_i\right) &= \Pr\left(WTP^* > B_i\right) \\ &= \Pr\left(z_i \beta + u_i > B_i\right) \\ &= \Pr\left(u_i > B_i - z_i \beta\right) \end{aligned} \tag{3}$$

If it is assumed that $u_i \sim N$ (0, σ2), then

$$\begin{aligned} \Pr\left(yes = 1 \middle| z_i\right) &= \Pr\left(v_i > \frac{B_i - z_i' \beta}{\sigma}\right) \\ &= 1 - \Phi\left(\frac{B_i - z_i' \beta}{\sigma}\right) \end{aligned} \tag{4}$$

This equation can also be written as:

$$\Pr\left(yes = 1 \middle| z_i\right) = \Phi\left(z_i' \frac{\beta}{\sigma} - B_i \frac{1}{\sigma}\right) \tag{5}$$

where $v_i \sim N(0, 1)$ and Φ(.) is the standard normal cumulative distribution.

The equation is known as a probit model. The difference between this model and the traditional probit model lies in the additional variable bid (Bi). With the probit model, the mean WTP can be estimated using coefficients obtained from the probit models: namely, the vector coefficients associated with the independent variable and the vector coefficients associated with the bid. The mean WTP values associated with one of the independent variables (e.g., the gender dummy) can be obtained through the equation. Estimation of the mean WTP was carried out using the STATA code developed by Lopez-Feldman (2012).

5 Results and discussion

In terms of gender, the respondents of this study were 59.21% male and 40.79% female. Of the respondents, 2.63% had passed elementary school, 6.58% had passed junior high, 67.11% had passed senior high school and 23.68% were university graduates. The percentage of respondents whose income level was under Rp 1 million (US$100 per month) was 5%, and the percentage of respondents who had an income level higher than Rp 3 million (US$300 per month) was 20%. The majority of respondents (75%) had an income level between Rp 1–3 million (US$100–300 per month). The descriptive statistics of the sample are presented in Table 2.

Table 2 Descriptive analysis of variables

Variables	*Mean*	*Min.*	*Max.*	*Standard deviation*
Bid	12,500.00	5,000	20,000	5,627.31
Education				
1 Elementary school	3.12	1	4	0.63
2 Junior high school				
3 Senior high school				
4 University				
Income				
1 <Rp 1 million	2.14	1	3	0.48
2 Rp 1–3 million				
3 >Rp 3 million				

The respondents were asked for their opinion on the cause of flooding in Jakarta. The majority (78%) said that garbage thrown in the river is the major cause of flooding, while 28% said the narrowing of the riverbanks and silting is the main cause of flooding. Some respondents (6%) thought that the growing number of buildings along the riverbanks and the lack of a recharge area is the cause of flooding in Jakarta. This suggests that there is some level of awareness and public understanding of environmental issues.

With regard to the WTP for conservation and rehabilitation, the analysis shows that the percentage of respondents who are willing to pay for a PES scheme is greater than the percentage of respondents who are not willing to pay. The distribution of respondents and their bids is presented in Table 3. From Table 3, it can be seen that the proportion of respondents who said 'yes' is higher than the proportion of those who said 'no' to the bid offered. The table also indicates that, as the bid gets higher, the 'yes' response declines. This is consistent with a bid price curve.

Table 3 The WTP values of each bid (in %)

Answer	*Bid (Rp)*				
	5,000	*10,000*	*15,000*	*20,000*	*Total*
No	21.05	36.84	47.37	63.16	42.11
Yes	78.95	63.16	52.63	36.84	57.89
Total	100.00	100.00	100.00	100.00	100.00

Table 4 presents the results from the probit model. As it can been seen, the ‘bid’ variable is statistically significant while other explanatory variables (e.g., gender and income) are not statistically significant at a 99% confidence interval. Even though ‘education’ is significant at a 97% confidence interval, in a CVM study, the ‘bid’ variable is the most important variable in determining the WTP. In addition, based on Lopez-Feldman (2012), using explanatory variables evaluated at their mean values would not change the value of the WTP significantly. Thus, these variables were dropped from the model in further analysis.

Table 4 Probit regression

WTP	*Coef.*	*Std. err*	*z*	*P > |z|*
bid	–0.000095	0.0000308	–3.08	0.002*
gender	–0.2878415	0.3235871	–0.89	0.374
educ	0.6792784	0.3116051	2.18	0.029
income	0.1199074	0.3892016	0.31	0.758
_cons	–0.7942151	–0.7942151	–0.89	0.372

Note: *significant at 99%.

The result from this study is similar to the results of studies by Zhongmin et al. (2003), Van Hecken et al. (2012) and Moreno-Sanchez et al. (2012). The negative value of the bid coefficient indicates that, if the value is increased, the probability of the respondents answering ‘yes’ will decrease. This result is consistent with the descriptive analysis above.

In the next stage, a probit regression was run to include the bid variable only (excluding the other explanatory variables). Table 5 presents the result of this regression. It shows that there is consistency in the negative relationship between the ‘bid’ variable and the WTP variable. It changes the magnitude of the coefficient from –0.00095 in the first run to –0.000734 in the second run.

Table 5 The probit regression of the WTP using the bid variable as an independent variable

WTP	*Coef.*	*Std. err*	*z*	*P > |z|*
bid	–0.0000734	0.0000273	–2.69	0.007*
_cons	1.134304	0.381878	2.97	0.003*

Note: *significant at 99%.

Based on the result from Table 5, the mean WTP can be calculated from the coefficient. The mean WTP is around Rp 15,447 (US$1.2) per household per month. Using a confidence interval of 99%, the mean WTP falls between Rp 11,037 (US$0.8) and Rp 19,858 (US$1.5) per household (Table 6).

Table 6 The WTP value using the probit regression

WTP	*Coef.*	*Std. err*	*z*	*P > |z|*
WTP	15,447.75	2,250.313	6.86	0.000*

Note: *significant at 99%.

As stated previously, this study used follow-up questionnaires employing double-bounded elicitation to improve the efficiency of the mean WTP estimation. Table 7 presents the result of the double-bounded estimation. It shows that the mean WTP is around Rp 13,974 (US$1.1) per household per month. This value is slightly lower than the value obtained from the single-bounded elicitation. Nevertheless, it is much closer to the actual community's WTP such as the garbage fee paid by each household per month.

Table 7 Logit regression of the WTP

	Coef.	*Std. err*	*z*	*P>|z|*
Beta				
_cons	13,974.21	818.6381	17.07	0.000*
Sigma				
_cons	5,142.636	601.9908	8.54	0.000*

Note: *significant at 99%.

The WTP values can be used as the basis for determining the value of compensation for environmental services by multiplying the number of households in the Ciliwung Watershed (Suyanto et al., 2005). The number of households is Rp 1,319,569, so the amount of compensation is Rp 18.5 billion (US$1.4 million).

The result of the WTP analysis shows that the community's WTP for watershed improvement and rehabilitation is twofold. First, there is an awareness among the community living in the Ciliwung Watershed of the necessity to participate in better management of the watershed system. This result could be a strong argument against the common view that community awareness within the watershed is very low, and it indicates that the community's participation could be considered when dealing with watershed management. Second, the average household value of the WTP could be considered as a benchmark for the compensation mechanism between Jakarta Province and West Java Province. The value could also serve as a benchmark mechanism to implement existing regulations on the PES scheme as stipulated in the Indonesian Environmental Act 32/2009. Even though the PES scheme is recognised in this act, no mechanism regarding how to implement the assessment of the WTP is drawn. Therefore, this study could serve as an empirical example of how to assess such a value.

However, assessing the WTP is one thing, but implementing the PES scheme in the watershed system is another. As noted in Fauzi and Anna (2013), implementing the PES scheme in Indonesia in general, and in the watershed system in particular, is a complex issue. Fauzi and Anna (2013) stated that the complexity of the institutional aspect could hinder the effectiveness of the implementation of a PES scheme in Indonesia. Similar analysis was found in Australia (Ananda and Proctor, 2013) and Japan (Sarker et al., 2014). Ananda and Proctor (2013) found that the inflexibility of institutional management in watersheds represents the most critical obstacle to collaboration with management, while Sarker et al. (2014) showed that the effective complex management of a water system such as irrigation could only be mitigated through ‘a tailor-made’ policy to facilitate user autonomy. Thus, in the Ciliwung Watershed, the complexity of instituting and implementing a PES scheme might be mitigated through a tailor-made mixed policy mechanism that utilises factors such as the special status of Jakarta as a capital city and current regional regulations.

In addition to the complexity of instituting a PES scheme, the implementation of it in watershed management requires further consideration. Even though this study shows that the Ciliwung Watershed community is willing to participate in watershed management, as indicated by its WTP value, translating this WTP into a PES mechanism might not be straightforward. Lapeyre et al. (2015) noted that the implementation of a standard PES scheme in Indonesia might overlook other socio-cultural contexts. Their study showed that farmers in the upstream watershed area tend to join a PES scheme out of intrinsic motivation rather than in response to economic incentives. It also showed that the land use pattern along the watershed might not depend on economic incentives, but rather on its socioeconomic and historical context. These findings, along with similar findings in other developing and developed countries, could serve as lessons learned for implementing a PES scheme in the Ciliwung Watershed.

In the context of this study, an evident lack of trust from the community toward the local government might also impede the implementation of a PES scheme in the Ciliwung Watershed. In fact, when we conducted the first interview with respondents about their WTP to the program, the respondents responded negatively to the proposed bid since they did not trust how the program would be delivered. Only after we explained that the scheme is mandated by law and thus would be delivered using a good governance framework were the respondents willing to participate in the study and respond positively to the bid we proposed. This situation implies that trust could be a significant leverage factor in the effectiveness of the PES scheme along with other institutional aspects.

6 Concluding remarks

Watershed management in areas such as the Ciliwung River is a complex issue. This is especially true when the watershed plays a major part in determining the fate of a capital city such as Jakarta in dealing with a natural hazard. The flooding that occurs frequently in the capital city is attributed to a great extent to the watershed management of the Ciliwung River. The structural approaches that are being pursued by the central and local governments are insufficient to address the problem. Thus, a non-structural approach such as a market-based instrument could serve as a complementary instrument to mitigate flooding in the capital city and in the watershed in general. In addition, the implementation of a PES scheme, as a market-based instrument, is both timely and relevant to the Indonesian watershed system. It is timely because it has strong support in the form of legislation and in terms of the willingness of the Jakarta government to administer the mechanism. It is relevant because it supports current methods proposed by both Jakarta and West Java to estimate he appropriate amount on a compensation scheme to avoid externalities in the greater Jakarta area. This study shows that the community living along the Ciliwung River is willing to participate in a PES scheme, as shown by their positive WTP for better management of the Ciliwung Watershed.

Using the CVM, this study shows that the average WTP is around Rp 13,974.21 (US$1.1) per household per month. This is equivalent to a total value of Rp 18.5 billion (US$1.4 million) per month or US$16.8 million per year. This monetary figure could be used as a benchmark for both the upstream (West Java) and downstream (Jakarta) areas to negotiate and settle the compensation mechanism to mitigate the natural hazard attributed to the Ciliwung River. As of January 2014, the Jakarta Administrative Government has pledged around Rp 1.2 trillion (US$92,307) as a grant to West Java Province to restore some conservation areas in the upstream area (Tempo, 2014). The amount of compensation for our CVM study is far less than the amount of that pledge. Finally, cultural and other institutional and social contexts should be considered when implementing a PES scheme in watershed management, as these aspects play a large role in the effectiveness of PES implementation.

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