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Society's Willingness to Pay (WTP) for Environmentally Sound Agricultural Development Programs

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Abstract

Natural resource conservation programs like reforestation, terracing, the construction of small scale water reservoirs and alley cropping can be offered to communities living along river watershed areas to protect the environment. The community's response and willingness to pay (WTP) varies. Related to the environmental conservation programs above, this research was carried out in the Citarum River Basin in West Java, covering the upstream area in Bandung District, the middle stream area in Cianjur District and the downstream area in Karawang Sub-District. The Contingent Valuation Method (CVM) was employed to analyze WTP by communities in the Citarum River Basin for the various programs on offer and the factors that influence WTP in order to obtain recommendations and policy implications for program implementation. The research showed that communities were quite willing to pay for conservation programs; downstream communities were even ready to participate in preventing environmental degradation in upstream areas as this negatively impacts their own communities.

Keywords: *Conservation,Environment Willingness to Pay*
JEL Classification: *Q56, Q57,Q52*

1. INTRODUCTION

Agricultural development in any country has intended and unintended externalities that affect the sustainability of environmental quality. Community activities are one of the factors that determine the quality of the environment. Along a watershed, the government can protect the environment by introducing various natural resource conservation programs. Local communities react differently to these initiatives, depending on their perceptions. The economic value of any resource, whether marketable or non-marketable, is defined as the user's willingness to pay (WTP) for the benefit of resource utilization (Season and Schaffer, 1978; Just, et al., 1982).

WTP is a measure of economic scarcity in terms of the income or other goods a person is willing and able to forego to obtain or maintain a resource, good, or service. Net WTP, the difference between WTP and actual expenditure on the good or service, is used for cost-benefit analysis. Whether WTP is actually collected as cash is largely irrelevant from the economic efficiency standpoint. While it may be politically important to transfer a portion of the user's WTP as actual cash flow, any financial returns are only a transfer of benefits from the user to the recipient. The total economic value received by society does not change, only the distribution of the economic value among members of society (Willing, 1976).

To determine the realistic WTP of respondents to an environmentally sound agricultural program, face to face interviews were carried out during the survey. Individuals were asked to state their maximum WTP. This can be approached in several ways (Hanley et.al, 1997). ***First,*** higher and higher amounts can be suggested to the respondents until their maximum WTP is reached. ***Second,*** a range of suggested values can be given to respondents after they provide information on their typical expenditures. This is expected to help respondents calibrate their replies. ***Third,*** individuals can be asked for their maximum WTP with no value being suggested to them. However, respondents generally find it difficult to answer such questions, especially when they have no prior experience of trading with the program in question. ***Fourth,*** as a closed question, the most realistic payment is suggested. Respondents negotiate until both sides reach a payment agreement. This technique can be difficult and requires more time, but it yields a more realistic respondent WTP. This technique was applied by Selan (2003) to analyze WTP at Soekarno-Hatta International Airport for the noise produced by airplanes.

2. OBJECTIVE

This research has three main objectives. The first is to analyze society's willingness to pay for various conservation programs; the second is to understand the factors affecting WTP; and the third is to provide policy-makers with specific insight, tools and information with which to analyze the role of agriculture within their societies and from which to make informal policy decisions in pursuit of sustainable agriculture and rural development.

3. RESEARCH METHODOLOGY

Contingent Valuation Method (CVM) has been widely used in recent years. CVM uses surveys in which people are asked how much they are willing to pay for a change in the condition of certain non-marketable goods. The basic notion underlying CVM is that a realistic but hypothetical market for buying or selling use or preservation of non-marketable goods can be described to an individual. Key features of the hypothetical market include: (1) description of the resource being valued; (2) means of payment, such as an increase in taxes or a utility bill; and (3) the value of elicitation. The means of payment must be realistic and emotionally neutral for the respondents. To improve realism, the means of payment must be appropriate for the good and the constructed market. In principal, CVM is based on potential behavior, not on actual behavior (Munasinghe, 1992). CVM assesses consumer preferences with respect to observable benefits through investigating consumer's willingness to pay (WTP) for these benefits.

CVM is a market simulation approach that uses direct consumer surveys. In this method, questionnaires are sent to communities which benefit from the environment, asking people directly how much they would be willing to pay for agricultural improvements to the environment (Yoshida et al., 1997 and Yoshida 1999). CVM is the most widely exercised approach for determining the value of non-marketable goods. CVM has been shown to produce benefit estimates close to the true benefit and has also been shown to be reliable in re-testing for user values (Bishop and Hebertein, 1979; Loomis, 1989). Looming (1989) found that CVM was reliable when respondents were asked the same CVM questions approximately nine months after the first survey. Further, Adamivicz and Graham-Tomasi (1991) found that CVM is generally consistent with axioms of revealed choice. CVM has been shown to compare very favorably to other non-market resource valuation techniques for familiar goods and services (Mitchell and Carson, 1989; Cummings, et al., 1986).

Agricultural development has inherent costs and benefits that may not be valued in the market place. In addition, some government agricultural programs not yet initiated may have unknown costs that cannot be summarized from market activity. Thus, CVM can be used to determine the optimal payment to farmers to induce them to use filter strips or to set aside acreage in long term environmental programs.

4. LOCATION AND NUMBER OF RESPONDENTS

Direct and face-to-face individual surveys were conducted in three areas along the Citarum river basin: upstream, middle stream, and downstream. The upstream survey was carried out in South Bandung District at Wayang Mountain. The Jangari village in Cianjur District represented the middle stream, and the Karawang District represented the downstream. A total of 180 respondents were drawn from the three areas with 60 respondents in each area. Stratified random sampling was employed to attract respondents with regard to: (1) area (upstream, middle stream and downstream), (2) status (farm households and professionals), and (3) land holding.

Contingent Valuation Model

Cameron's (1988, 1991) approach assumes that unobserved WTP can be expressed as:

$$WTP_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots \beta_k X_{ki} + \varepsilon_I \quad (1)$$

Where ε_I is independently and identically distributed $(0,\delta^2)$, and X_i are explanatory variables. In this study, the WTP by Citarum watershed area is regressed with various explanatory variables for each program: (1) reforestation, (2) alley cropping, (3) terracing, (4) small scale water reservoirs, (5) irrigation and drainage systems, (6) household wells, and (7) agro forestry.

$$WTP_{up} = \beta_0 + \beta_1 AGE_{1i} + \beta_2 EDUC_{2i} + \beta_3 FEXP_{3i} + \beta_4 PRAG_{4i} + \beta_5 INC_{5i} + \beta_6 LHLD_{6i} + \beta_7 D_{7i} + \varepsilon_I \quad (2)$$

$$WTP_{md} = \alpha_0 + \alpha_1 AGE_{1i} + \alpha_2 EDUC_{2i} + \alpha_3 FEXP_{3i} + \alpha_4 PRAG_{4i} + \alpha_5 INC_{5i} + \alpha_6 LHLD_{6i} + \alpha_7 D_{7i} + \varepsilon_I \quad (3)$$

$$WTP_{dw} = \lambda_0 + \lambda_1 AGE_{1i} + \lambda_2 EDUC_{2i} + \lambda_3 FEXP_{3i} + \lambda_4 PRAG_{4i} + \lambda_5 INC_{5i} + \lambda_6 LHLD_{6i} + \lambda_7 D_{7i} + \varepsilon_i \quad \text{4)}$$

$$\beta_i, \alpha_i, \lambda_i > 0; i = 1, 2, 3, \ldots 7.$$

Where:

WTP_{up} = WTP of upstream Citarum respondents

WTPmd = WTP of middle stream respondents

WTP_{up} = WTP of downstream respondents

AGE = Age of respondent (year)

EDUC = Education level (year)

FEXP = Farming experience (year)

PRAG = Number of household members of productive age > 15 (person)

INC = Total household income (Rp 000)

LHLD = Total land holding (ha)

D = Dummy variable; D=1 for farmers and D = 0 for professionals

Data Analysis

Ordinary least square (OLS) was used to estimate the parameters for each respondent's WTP. Since OLS gives efficient parameter estimates for coefficient determination and magnitude, no other technique was employed. The responsiveness to changes in explanatory variables was computed as elasticity value.

Twenty-one WTP equations were formulated, all with positive parameters. In other words, all explanatory variables included in the model positively influence the variability of respondents' WTP for various programs introduced in each area of the Citarum river basin in West Java.

5. RESULTS AND DISCUSSION

Willingness to Pay (WTP)

The readiness of respondents in the Citarum upstream area to participate in programs to lessen floods, as measured in WTP, is presented in **Table 1** Aggregately, the upstream WTP for seven flood programs was USD 122.24 per household per year, or USD 115.33 for professionals and USD 127.62 for farmers, meaning that farmers were 10.66% more willing to pay than professionals.

Analysis of respondents' WTP for each program indicates that the highest WTP was for reforestation programs at 24.53% and 17.90% for professionals and farmers respectively. Meanwhile the lowest WTP was for the household well program at 9.15% and 7.1% respectively. The next biggest WTP was for agro-forestry programs, followed by terracing and alley cropping.

Meanwhile, the WTP of middle stream respondents for flood prevention programs showed that professional's WTP was about 16.96% higher than farmers at USD 56.28 compared to USD 48.12. Middle stream respondent's WTP was only 41.66% of upstream WTP at USD 50.93 and USD 122.24 respectively. This significant difference is mainly due to the household income gap between the two areas.

Table 1
Citarum Upstream and Middle Stream WTP by Program and Profession, 2003

Program	Upstream WTP			Middle Stream WTP		
	Professional	Farmer	Aggregate	Professional	Farmer	Aggregate
1. Reforestation	28.29 (24.53)	35.6 (17.90)	32.35 (26.46)	9.49 (16.88)	8.77 (18.23)	9.02 (17.71)
2. Alley Cropping	16.4 (14.22)	16.41 (12.86)	16.4 (13.42)	8.89 (15.80)	9.06 (18.83)	9.00 (17.67)
3. Terracing	16.41 (14.23)	16.78 (13.15)	16.7 (13.66)	8.95 (15.90)	6.89 (14.32)	7.6 (14.92)
4. Dams (Water reservoirs)	14.6 (12.66)	15.01 (11.76)	14.83 (12.13)	8.00 (14.21)	6.34 (13.18)	6.91 (13.57)
5. Irrigation and drainage system	15.36 (13.32)	16.06 (12.58)	15.75 (12.88)	7.6 (13.50)	6.46 (13.42)	6.85 (13.45)
6. Household Wells	10.55 (9.15)	9.07 (7.11)	9.73 (7.96)	6.18 (10.98)	5.4 (11.22)	5.67 (11.13)
7. Agro-forestry	13.72 (11.90)	18.69 (14.65)	16.48 (13.48)	7.17 (12.74)	5.2 (10.81)	5.88 (11.55)
Total WTP per household	115.33 (100.00)	127.62 (100.00)	122.24 (100.00)	56.28 (100.00)	48.12 (100.00)	50.93 (100.00)

Note: ( ) percentage of total WTP

Analyzed by program, professionals responded most enthusiastically to the reforestation program, allocating 16.88% of total WTP to the program. This program was followed by terracing and alley cropping at 15.90% and 15.80%. Of the seven programs, the lowest professionals' WTP was for household wells at only 10.98%. Meanwhile, farmers allocated the most WTP to alley cropping programs (18.83%), followed by reforestation (18.23%). Farmers allocated the least to agro-forestry programs (10.81%).

Differing from the areas discussed above, the Citarum downstream area in Karawang Sub-district in addition to examining the WTP for the seven upstream and middle stream programs, also analyzed respondents' WTP for three downstream programs. Respondents' WTP for each program is presented in **Table 2**.

The WTP of downstream respondents to all programs was USD 37.44; USD 34.24 from professionals and USD 39.58 from farmers. Farmer WTP was 9.35% higher than professional WTP. By region, the Citarum upstream respondents had the highest WTP, followed by middle stream and finally downstream respondents.

Of the ten programs on offer, downstream professionals and farmers were willing to pay the most for irrigation and drainage system programs. The WTP for this program was 23.16% (professionals) and 24.89% (farmers) of total WTP. This was followed by reforestation programs at 16.38% for professionals and 17.18% for farmers. Neither respondent group indicated support for the water pump program, with only 1.20% from professionals and 2.12% from farmers of total WTP.

Table 2
Citarum Downstream WTP, 2003

Program	Respondent WTP (USD)		
	Professional	Farmer	Aggregate
UPSTREAM AND MIDDLE STREAM PROGRAMS			
1. Reforestation	5.61 (16.38)	6.8 (17.18)	6.33 (16.91)
2. Alley Cropping	2.53 (7.39)	2.29 (5.79)	2.39 (6.38)
3. Terracing	2.05 (5.99)	2.33 (5.89)	2.22 (5.93)
4. Dams (water reservoirs)	4.49 (13.11)	4.91 (12.41)	4.74 (12.66)
5. Irrigation and drainage system	2.74 (8.00)	2.57 (6.49)	2.64 (7.05)
6. Household Wells	1.46 (4.26)	1.7 (4.30)	1.6 (4.27)
7. Agro-forestry	0.88 (2.57)	1.07 (2.70)	0.99 (2.64)
Total Upstream and Middle Stream WTP	19.76 (57.71)	21.67 (54.75)	20.91 (55.85)
DOWNSTREAM PROGRAMS			
1. Dams (water reservoirs)	6.14 (17.93)	7.22 (18.24)	6.78 (18.11)
2. Irrigation and drainage system	7.93 (23.16)	9.85 (24.89)	9.08 (24.25)
3. Water pump	0.41 (1.20)	0.84 2.12)	0.67 (1.79)
Total Downstream WTP	14.48 (42.29)	17.91 (45.25)	16.53 (44.15)
Total WTP	34.24(100.00)	39.58(100.00)	37.44(100.00)

Note : ( ) percentage of total WTP

The total WTP by area is provided in Table 3 below. In 2003 there were 5,713,000 people or 1,383,000 upstream households; 1,332,000 people or 311,000 middle stream households; and 1,565,000 people or 395,000 downstream households. The total number of residents living alongside the Citarum River was 6,610,000 people or 2,085,000 households. Meanwhile the WTP per household for all programs was USD 122.24 upstream, USD 50.93 middle stream and USD 37.44 downstream; or an average USD 95.70 per household.

Table 3 shows that the WTP for environmental programs totaled USD 169.1 million upstream, USD 15.8 million middle stream, and USD 14.6 million downstream. Therefore, the total Citarum watershed WTP was USD199.5 million. This indicates a very big potential for the Citarum River Basin community to participate in improving natural resource sustainability. Assuming these results reflect reality, this implies that the government does not have to cover all environmental recovery program costs.

Table 3
Total WTP by Citarum River Basin Area, 2003.

Item	Citarum River Basin			Total
	Upstream	Middle Stream	Downstream	
Population (000)	5,713	1,332	1,565	8,610
Number of households (000 unit)	1,383	311	391	2,085
WTP (USD per household)	122.24	50.93	37.44	95.70
Total WTP (USD 000)	169,057.92	15,839.23	14,639.04	199,536.2

Note: Total WTP is calculated based on Citarum River Basin population.
Source: West Java Provincial Agency for Environment Conservation, 2001.

In 2003, the West Java Province government implemented a Clean, Beautiful, and Sustainable (*Bergetar*) Citarum program on 75,000 hectares of depleted land in the Citarum upstream area (the core area responsible for floods, erosion, and landslides). If this plan used WTP funds from the Citarum watershed communities (assuming that all WTP is transferred to the upstream program), there would be USD 2,660.48 per hectare available for the five-year program period. On average, reforestation programs cost USD 6,000 per hectare, thus the government would only need to provide USD 3,339.52 or 55% of the funding, as community WTP participation would cover the remaining 45%.

6. WTP PARAMETER AND ELASTICITY RESULTS FOR CITARUM UPSTREAM PROGRAMS IN BANDUNG DISTRICT

Reforestation Program

The WTP model parameters for reforestation, alley cropping, and rice terracing are presented in **Table 4.** The results indicate that empirical variations in the willingness to pay for reforestation programs can be explained by a model with a determination coefficient (R^2) of 0.8053. In other words, 80.53% of the variation can be explained by exogenous variables in the reforestation program WTP model. These exogenous variables are age, education, farming experience, the number of productive age family members, household income, and land ownership.

In the reforestation program, the age of respondents had a negative effect on WTP: as respondents' age, they are less wiling to pay for these

programs. Education levels also significantly determined respondents' WTP for such programs. Respondents with higher education levels are more aware of the importance of sustainable natural resource efforts (reforestation programs). Similarly, farming experience, the number of productive age family members and household income positively influence the WTP for reforestation programs.

The number of productive family members exerted the strongest influence of all the exogenous variables. For every one unit increase of this variable, WTP improved by 19.93 units. Meanwhile, for every one unit increase in farming experience, WTP increases by 3.1 units. Although relatively insignificant, land holding size also had a positive influence on WTP. While land holding positively influenced WTP for one's own land, its influence varied on WTP for other land.

Elasticity values indicate that the WTP for reforestation programs is less sensitive to exogenous or explanatory variables, as expressed by an elasticity value of less than one. By age and pursuant to elasticity value, the program has the best likelihood for success with relatively younger respondents. The WTP for reforestation programs responded most greatly to age than other variables. Reforestation programs are very difficult to apply based solely on size of household land holding. The dummy variable indicates that farmers are more WTP for reforestation programs than professionals.

Table 4
Upstream Citarum WTP Parameters and Elasticity for Reforestation, Alley Cropping and Terracing Programs, Bandung District, 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Reforestation				
Intercept	226.90952	28.38607852	-	-
Age	6	0.46140785	0.0001	-0.43261
Education	-2.803549	1.33391247	0.2000	0.05800
Farming Experience	1.734483	0.54212924	0.0001	0.20229
Household Members Age > 15	3.110883	3.53644854	0.0001	0.21925
Total Income	19.926700	0.00015552	0.0187	0.04856
Total Land Holding	0.000379	6.01235630	0.5096	0.01756
Dummy Variable	3.996009	9.92858324	-	-
	46.041225			
R^2 = 0.8053	F_{hit} = 27.172	Prob>F = 0.0001		
Alley Cropping				
Intercept	50.888554	19.04816571	-	-
Age	-1.165936	0.30962266	0.0005	-0.35481
Education	2.994113	0.89510729	0.0016	0.19744
Farming Experience	1.979032	0.36378986	0.0001	0.25379
Household Members Age > 15	4.374060	2.37309489	0.0718	0.09491
Total Income	0.000771	0.00010436	0.0001	0.19476
Total Land Holding	26.869884	4.03452555	0.0001	0.23280
Dummy Variable	7.420041	6.66246656	-	-
R^2 = 0.8579	F_{hit} = 39.687	Prob>F = 0.0001		
Terracing				
Intercept	-3.809060	22.94906095	-	-
Age	-0.127861	0.37303013	0.7333	-0.03821
Education	5.764714	1.07841731	0.0001	0.37329
Farming Experience	1.583596	0.43829080	0.0007	0.19942
Household Members Age > 15	0.425935	2.85908365	0.8822	0.00908
Total Income	0.001311	0.00012573	0.0001	0.32527
Total Land Holding	8.013667	4.86076057	0.1060	0.06818
Dummy Variable	23.520753	8.02688056	-	-
R^2 = 0.8578	F_{hit} = 39.655	Prob>F = 0.0001		

Alley Cropping Program

The analysis indicates that 85.79% of respondents' WTP for alley cropping programs can be explained by the variables included in the model and only 14.21% by other variables. Respondent age had a significantly negative effect on WTP for alley cropping. Education, farming experience, number of productive age family members, household income, and size of land holding positively influenced WTP. Based on parameter values, land holding had the biggest influence on respondent WTP.

The WTP for alley cropping was less likely to respond to changes in explanatory variables. In other words, a 10% change in an explanatory variable caused less than a 10% change in the WTP value, as indicated by an elasticity value of less than one. WTP responded most to changes in respondent age and least to changes in the number of productive age family members. This implies that alley cropping programs will be more successful with younger respondents. Similar to reforestation, the dummy parameter value indicates that farmers are more committed than professionals.

Terracing Program

Terracing can prevent erosion and floods. This program is most suitable for upstream farms. The success of terracing very much depends on the response and participation of the local community. The parameter results showed that 85.78% of WTP variability for alley cropping could be explained by the variables included in the model.

Parameter results indicate that although insignificant, respondent age negatively influences WTP. Meanwhile, other variables like education, farming experience, and household income have a significant positive effect on WTP; land holding is significant at 15%. Although the number of productive age family members also has a positive effect on WTP, it is statistically insignificant. Respondents' WTP is most determined by land holding size and least determined by household income. This is because respondents with bigger land holdings are more willing to pay in the hope that terracing will lead to increased land prices. Further, household income level must be taken into account, as terracing is expected to be most successful in higher income areas. The dummy variable indicates that farmers are more willing to pay than professionals.

The parameters for upstream WTP for water reservoirs, irrigation systems, household wells, and agro-forestry programs are presented in Table 5.

Water Reservoirs (Embung) Program

The variability in WTP for water reservoirs can be almost perfectly explained by the exogenous variables as shown by a coefficient of determination (R^2) of 0.9015. In contrast to respondents' WTP for reforestation, alley cropping, and terracing, the age of respondents had a significant positive influence on WTP for water reservoirs. Farming experience also had a positive influence, as did household income and

size of land holding, each statistically significant at 10% and 1% respectively. Although insignificant, respondents' level of education also had a positive effect on WTP. In contrast, the number of productive age family members negatively influenced WTP for water reservoirs.

The WTP for water reservoir programs was less responsive to exogenous variables, shown by an elasticity value of less than one. Still, the WTP for water reservoir programs responded most to changes in the age of respondents. Consistent with other programs, farmers were more willing to pay for water reservoirs than professionals.

Irrigation and Drainage System Program

Analysis indicates that 72.0% of WTP variation for irrigation and drainage system programs can be explained by exogenous variables, and the remaining 28.0% by other variables not included in the WTP model. All parameters followed expectations, except the number of productive age family members, which was negative but statistically insignificant. This means that there was not a strong relationship between the number of productive age family members and WTP. Land holding size had the biggest influence, while household income had the least influence on WTP for irrigation and drainage system programs.

The elasticity value of less than one indicates that respondents' WTP for irrigation is less responsive to exogenous variables. A 10% change in exogenous variables only changed WTP by 1.1-5.6%. The parameters implied that this program will be most successful when executed in communities with higher education levels. Unsurprisingly, farmers are more willing to pay for these programs than professionals.

Household Well Program

Only 68.03% of real WTP for household wells can be explained by the exogenous variables included in the model. However, all parameters followed expectations, with age, farming experience, the number of productive age family members, and household income significantly influencing respondent WTP at 1%, 15%, 1%, and 20% respectively. While education level and land holding size were positive, these did not significantly affect WTP.

WTP elasticity for household wells was less responsive to the above variables. A 10% change in these variables only resulted in a WTP change of 0.04-2.6%. This indicates that the efficacy of upstream Citarum household well programs will be very low. This is further indicated by the small community response to the program: farmers were less willing

to pay than professionals. The program will have little community support as the majority of residents are farmers. Professionals solely see the function of household well as the main source of clean water.

Agro-Forestry Program

Similar to the household well program, only 61.35% of WTP variation for agro-forestry could be explained by the model variables. All parameters followed expectations, except the number of productive age family members. Almost all variables significantly influenced WTP, except household income. Every USD 100 increase in income only causes an increased WTP equal to USD 8. The biggest influence was land holding size; every one unit increase in this variable improved respondent WTP by 25.14 units.

Table 5
Upstream Parameter and Elasticity Results of WTP for Water Reservoirs, Irrigation and Drainage, Household Wells and Agro-forestry Programs, Bandung District, 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Water Reservoir				
Intercept	+-	20.40264482	-	-
Age	9.693127	0.33163934	0.0001	0.57791
Education	1.716955	0.95875667	0.2708	0.07797
Farming Experience	1.068562	0.38965827	0.0940	0.09450
Household Members Age > 15	0.666259	2.54184119	0.0001	-0.35357
Total Income	-	0.00011178	0.0001	0.41431
Total Land Holding	14.731902	4.32141305	0.0003	0.16089
Dummy Variable	0.001482	7.13622198	-	-
	16.789132			
	24.028832			
R^2 = 0.9015	F_{hit} = 60.133		Prob>F = 0.0001	
Irrigation System				
Intercept	-	31.07605924	-	-
Age	70.638691	0.50513274	0.2614	0.18208
Education	0.574420	1.46031946	0.0001	0.57547
Farming Experience	8.378164	0.59350362	0.0001	0.44413
Household Members Age > 15	3.324980	3.87157684	0.2266	-0.10723
Total Income	-4.744490	0.00017026	0.0010	0.15771
Total Land Holding	0.000599	6.58211174	0.0477	0.12084
Dummy Variable	13.389831	10.86945633	-	-
	34.108622			
R^2 = 0.7200	F_{hit} = 16.901		Prob>F = 0.0001	
Household Well				

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Intercept	40.884577	12.42321853	-	-
Age	0.508638	0.20193598	0.0153	0.26101
Education	0.192737	0.58378920	0.7428	0.02143
Farming Experience	0.381444	0.23726384	0.1147	0.08248
Household Members Age > 15	5.199405	1.54773309	0.0016	0.19024
Total Income	0.000097	0.00006806	0.1584	0.04158
Total Land Holding	0.276839	2.63131860	0.9167	0.00404
Dummy Variable	-	4.34526239	-	-
	12.082			
	155			
R^2 = 0.6803	F_{hit} = 13.985		Prob>F = 0.0001	
Agro-forestry				
Intercept	-	43.59595633	-	-
Age	72.315383	0.70864020	0.0350	0.46618
Education	1.539424	2.04865176	0.0001	0.69208
Farming Experience	10.546652	0.83261387	0.0317	0.23543
Household Members Age > 15	1.844861	5.43135453	0.0001	-0.49197
Total Income	-	0.00023885	0.7359	0.02038
Total Land Holding	22.784247	9.23390748	0.0091	0.21673
Dummy Variable	0.0000810	15.24853392	-	-
	25.137352			
	93.923344			
R^2 = 0.6135	F_{hit} = 10.432		Prob>F = 0.0001	

The WTP for agro-forestry programs was less responsive to changes in the explanatory variables as shown by elasticity values of less than one. However, as this program is favored for implementation in the Citarum upstream area, it should initially be implemented in a region with relatively high education levels as WTP is most responsive to changes in education levels. In contrast, it is not suitable if it is pursuant to household income. As almost 95% of upstream residents are farmers, the above approach will have strong support as farmers showed more WTP than professionals.

7. WTP PARAMETER AND ELASTICITY RESULTS FOR CITARUM MIDDLE STREAM PROGRAMS

Reforestation Program

The Citarum middle stream reforestation, alley cropping, and rice terracing program parameter results are presented in Table 6.

The ability of explanatory variables to explain variations in WTP for reforestation at Citarum middle stream is quite good, with a coefficient of determination (R^2) equal to 85.28%. All parameter estimates were positive, following expectations, except age. Almost all of the explanatory variables included in the model strongly influence the variability of WTP

for reforestation, which is statistically significant at less than 1%. The number of productive age family members was the only variable which did not significantly affect the WTP of middle stream respondents.

The elasticity value (<1) indicates that the program will be successful when applied to the middle stream area. For every 10% change in the explanatory variable, the WTP only changed by less than 2%. This is strengthened as the readiness of farmers to participate in the program is lower than professionals.

Alley Cropping Program

Analysis indicates that the explanatory variables can explain the variation in respondents' WTP for alley cropping with a coefficient of determination (R^2) of 0.840. Empirically, parameter estimate of age of respondents had a statistically significant negative effect on WTP at 1%. While other parameters were positive, that easily can be understood. Farming experience and education level had strong positive influence on WTP because both variables are significant at a level of 1%. Meanwhile, size of land holding significantly influences the WTP only at a level of 20%. Finally, the number of productive age family members and household income had no significant effect on WTP in this area.

The elasticity value indicates that WTP for alley cropping did not respond to changes in the explanatory variables. A 10% change in the explanatory variables only led to a change of 0.3%- 6.0% in WTP. Alley cropping is expected to be successful in communities with more farming experience. The readiness of farmers to participate is lower than professionals.

Terracing Program

Explanatory variables empirically explained 84.93% of WTP variation for terracing. Of the six explanatory variables, three variables were negative and three were positive. Education level, farming experience, and land holding size were all positive and had a strong influence on WTP at 1%. The age of respondents, number of productive age family members, and household income parameters were negative.

Table 6
Reforestation, Alley Cropping and Terracing WTP Parameter and Elasticity Results for Middle Stream, Cianjur 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Reforestation				
Intercept	48.670847	3.73730284	-	-
Age	-0.303061	0.04536912	0.0001	-0.17920
Education	2.235254	0.28086910	0.0001	0.19987
Farming Experience	0.655639	0.08483800	0.0001	0.17088
Household Members Age > 15	0.380349	0.36257066	0.2992	0.01578
Total Income	0.000888	0.00022476	0.0002	0.06684
Total Land Holding	18.044475	1.65987467	0.0001	0.12188
Dummy variable	-1.123994	1.15893625	-	-
R^2 = 0.8528	F_{hit} = 41.390		Prob>F = 0.0001	
Alley Cropping				
Intercept	25.023523	6.33889619	-	-
Age	-0.475829	0.07695126	0.0001	-0.36719
Education	3.261698	0.47638635	0.0001	0.38061
Farming Experience	1.751505	0.14389503	0.0001	0.59574
Household Members Age > 15	0.556873	0.61496161	0.3695	0.03015
Total Income	0.000492	0.00038121	0.2028	0.04835
Total Land Holding	3.883293	2.81533867	0.1739	0.03423
Dummy variable	-12.378925	1.96568941	-	-
R^2 = 0.8400	F_{hit} = 37.504		Prob>F = 0.0001	
Rice Terracing				
Intercept	16.221753	8.00003278	-	-
Age	-0.560170	0.09711668	0.0001	-0.39310
Education	4.522827	0.60122556	0.0001	0.47995
Farming Experience	2.272968	0.18160337	0.0001	0.70305
Household Members Age >15	-0.036879	0.77611509	0.9623	-0.00182
Total Income	-0.000106	0.00048111	0.8273	-0.00943
Total Land Holding	15.001186	3.55311098	0.0001	0.12025
Dummy variable	-14.439180	2.48080726	-	-
R^2 = 0.8493	F_{hit} = 40.257		Prob>F = 0.0001	

Only age exerted a strong influence on WTP for terracing. In general, WTP for terracing did not respond to changes in the explanatory variables as shown by an elasticity value of less than one. A 10% change in these variables only produced a 0.01-7.03% change in WTP. Despite this, terracing is recommended for the middle stream area, so long as local farming experience is given priority. In the middle stream area, farmers are less willing to pay for terracing than professionals.

Water Reservoir (Embung) Program

The parameter results for water reservoirs, irrigation and drainage systems, household wells and agro-forestry are presented in **Table 7.**

The ability of explanatory variables to explain the variation of WTP for water reservoir program was not as accurate as for other programs like reforestation, alley cropping, and terracing, yielding only 64.86%. Almost all explanatory variables were positive, except the age of respondents which was statistically insignificant at 20%. Education level, the number of productive age family members and land holding size strongly influenced respondent WTP at 10%. Meanwhile, household income only slightly influenced WTP as it was only significant at 20%. Farming experience was the only variable to have no influence on WTP variation.

Water reservoir programs will be difficult to develop in the middle stream area. This is shown by the very small elasticity values. A 10% change in the explanatory variables only yielded a 0.07- 4.0% changes in WTP. Yet, the positive dummy variable indicates farmers are more willing to pay for water reservoir programs than professionals.

Irrigation Drainage System Program

Parameter (*f*) results of the WTP for irrigation and drainage system programs indicate that the model's variables explain 80.45% of WTP variation. All the variables were found to strongly influence WTP at 10%. However, age and the number of productive family members did not follow expectations.

Similar to the water reservoir program, it will be difficult to develop irrigation and drainage programs in the middle stream area since WTP does not respond significantly to changes in the explanatory variables. For every 10% change in the variables, WTP only changes by 0.9% - 4.6%. If this program is introduced in the middle stream region, it will be most successful in communities with better education levels. Still, the readiness of farmers' WTP is much lower than professionals' WTP.

Household Well Program

The WTP for household wells in the middle stream area could not be properly explained by explanatory variables as seen in the low coefficient of determination (R^2), (only equal to 50.52%). This was the worst WTP model of all the programs introduced to respondents. This indicates that a household well program will be extremely difficult to implement in the Citarum middle stream area.

Table 7

Middle Stream WTP Parameter and Elasticity Results for Water Reservoir, Irrigation and Drainage, Household Well, and Agro-forestry Programs, Cianjur District 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Water Reservoir				
Intercept	17.454100	12.33325464	-	-
Age	-0.119134	0.14971999	0.4300	-0.07056
Education	2.441792	0.92687970	0.0112	0.21871
Farming Experience	0.027558	0.27996893	0.9220	0.00719
Household Members Age > 15	9.686882	1.19649823	0.0001	0.40261
Total Income	0.001001	0.00074171	0.1833	0.07549
Total Land Holding	9.321357	5.47765536	0.0950	0.06307
Dummy Variable	10.062578	3.82453778	-	-
R^2 = 0.6486	F_{hit} = 13.186		Prob>F = 0.0001	
Irrigation and Drainage				
Intercept	17.829452	5.59338675	-	-
Age	-0.246741	0.06790112	0.0007	-0.19208
Education	3.942317	0.42035917	0.0001	0.46408
Farming Experience	0.931494	0.12697172	0.0001	0.31961
Household Members Age > 15	-0.966597	0.54263676	0.0809	-0.05280
Total Income	0.000977	0.00033638	0.0055	0.09686
Total Land Holding	11.743033	2.48423030	0.0001	0.10442
Dummy Variable	-3.296827	1.73450720	-	-
R^2 = 0.8045	F_{hit} = 29.398		Prob>F = 0.0001	
Household Wells				
Intercept	29.686969	5.92880656	-	-
Age	-0.020065	0.07197296	0.7816	-0.01888
Education	1.207502	0.44556693	0.0092	0.17179
Farming Experience	0.225792	0.13458586	0.0997	0.09363
Household Members Age > 15	2.294857	0.57517717	0.0002	0.15150
Total Income	0.000337	0.00035655	0.3497	0.04033
Total Land Holding	1.891165	2.63320267	0.4760	0.02032
Dummy Variable	-4.100381	1.83852076	-	-
R^2 = 0.5052	F_{hit} = 7.293		Prob>F = 0.0001	
Agro-forestry				
Intercept	24.218312	5.68782863	-	-
Age	0.036137	0.06904760	0.6030	0.03279
Education	1.087611	0.42745675	0.0141	0.14923
Farming Experience	0.500264	0.12911558	0.0003	0.20008
Household Members Age > 15	1.590927	0.55179894	0.0058	0.10129
Total Income	0.001762	0.00034206	0.0001	0.20366
Total Land Holding	1.614675	2.52617544	0.5256	0.01674
Dummy Variable	-13.581419	1.76379359	-	-
R^2 = 0.8047	F_{hit} = 29.429		Prob>F = 0.0001	

However, almost all variables were positive, except age, which was insignificant at 20%. Education level, farming experience, and the number of productive age family members were positive and significant at 10%. Household income and land holding size were positive, but insignificant in terms of WTP.

This program will be very difficult to develop in the Citarum middle stream area as WTP did not respond to changes in the explanatory variables, as seen in the elasticity value which nears zero. Further, farmers are less willing to pay for this program than professionals.

Agro-Forestry Program

Our analysis indicates that variations in the WTP for agro-forestry programs are better explained by the explanatory variables, with a coefficient of determination (R2) equal to 0.8047 as seen in Table 7. All the variables were positive. Of the six explanatory variables, four variables significantly affected WTP: education level, farming experience, number of productive age family members, and household income were all statistically significant at 10%. Age and land holding size had no significant effect on WTP.

The WTP for agro-forestry programs also exhibited no significant response to the explanatory variables, as seen in the very small elasticity values of 0.02 – 0.20. Similarly, farmers were significantly less willing to pay for this program than professionals.

WTP Parameter and Elasticity Results for Upstream Programs in the Downstream Area of Karawang District Citarum's downstream communities in Karawang District understand that the flooding in the area is due not only to downstream environmental degradation, but also to upstream environmental damage. Therefore, efforts to lessen downstream flooding must be comprehensive of upstream, middle and downstream programs. Thus, environmental programs in all three areas should be supported by Citarum's downstream communities in Karawang District. This study examines downstream response to upstream, middle stream and downstream area programs. The results for reforestation, alley cropping, and terracing programs are presented in **Table 8.**

Reforestation Programs

The variations in WTP for reforestation programs are excellently explained by the model's variables. All of the variables combined explain 91.38% of the variation in WTP. All parameters followed expectations,

except age and the number of productive age family members, which were negative. Almost all of the variables strongly influenced WTP (significant at 10%), except age, which was insignificant. Education had the strongest influence on the change of WTP; for every one unit change in education, WTP changed by 7.2 units. A one unit change in other variables only changed WTP by 0.001–3.7 units.

The elasticity value of less than one indicates WTP responds less to changes in the explanatory variables. However, WTP responds well to changes in education level, at nearly one (e = 0.98). Farmers are significantly more willing to pay for upstream and middle stream reforestation programs than professionals.

Table 8
Downstream WTP Parameter Elasticity Results for Reforestation, Alley Cropping and Terracing Programs, Karawang, 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Reforestation				
Intercept	-	10.57190854	-	-
Age	49.242731	0.19003437	0.7373	-0.05131
Education	-0.064157	0.85671299	0.0001	0.98059
Farming Experience	7.182973	0.26165224	0.0001	0.37965
Household Members Age > 15	1.141188	1.18630225	0.1007	-0.12263
Total Income	-1.991186	0.00016092	0.0001	0.26242
Total Land Holding	0.000981	1.43898366	0.0139	0.12091
Dummy Variable	3.696163	3.86881197	-	-
	29.217577			
R^2 = 0.9138	F_{hit} = 63.581		Prob>F = 0.0001	
Alley Cropping				
Intercept	0.328546	2.61277894	-	-
Age	0.058924	0.04696577	0.2166	0.12492
Education	0.271037	0.21173108	0.2075	0.09809
Farming Experience	0.192992	0.06466566	0.0047	0.17021
Household Members Age > 15	1.552964	0.29318694	0.0001	0.25355
Total Income	0.000411	0.00003977	0.0001	0.29115
Total Land Holding	0.640033	0.35563552	0.0791	0.05550
Dummy Variable	-0.317235	0.95615190	-	-
R^2 = 0.8990	F_{hit} = 53.402		Prob>F = 0.0001	
Terracing				
Intercept	-4.777538	3.65919865	-	-
Age	0.225934	0.06577559	0.0013	0.51583
Education	0.601368	0.29652952	0.0489	0.23438
Farming Experience	0.185638	0.09056430	0.0467	0.17632
Household Members Age > 15	0.715958	0.41060851	0.0885	0.12588
Total Income	0.000152	0.00005570	0.0094	0.11581
Total Land Holding	-0.744995	0.49806779	0.1422	-0.06958
Dummy Variable	4.756786	1.33909138	-	-
R^2 = 0.6395	F_{hit} = 10.646		Prob>F = 0.0001	

Alley Cropping Program

Almost 89.90% of WTP for alley cropping variation in the downstream area can be explained by the model's variables. All variables were positive and followed expectations. A one unit increase in the number of productive age family members had the biggest influence on WTP at 1.56 units, while the smallest influence was from household income. Except age, all explanatory variables influenced WTP at 1-10%.

WTP was less responsive to changes in the explanatory variables. Every 10% change in the variables could only change WTP by less than 3%. This indicates that alley cropping programs in the upstream area will not be fully supported by downstream communities. Further, most downstream farmer respondents had no knowledge of the program. Yet, farmers are more willing to pay for this program than professionals.

Terracing Program

Terracing parameter results explained only 63.95% of the variation in WTP. Yet, all explanatory variables were positive and significant at 10%, except land holding size, which was negative and significant at 15%.

Similar to other programs, the WTP for terracing did not respond well to changes in the model's variables. The elasticity value for each variable was less than one, meaning that a 10% change in the variables could only cause a 0.7–5.2% change in WTP. Of the variables, WTP responded most to change in age. The elasticity value showed that in the downstream area, younger respondents were more willing to pay than older respondents. This, if this program is implemented, effort should be made to socialize the program with younger community members. Farmers are more WTP for terracing than professionals.

Water Reservoir (Embung) Program

Downstream community WTP for water reservoirs, irrigation and drainage systems, household wells and agro-forestry is presented in Table 9. The construction of water reservoirs in the Citarum upstream area aims to temporarily detain rain fall and thus reduce erosion and floods. These reservoirs could also be used to raise fresh water fish and to stimulate agro-tourism.

The ability of the model variables to explain variations in WTP is good at 81.04%. Age, education, farming experience and household income have a positive influence on WTP. Conversely, the number of productive age family members and land holding size negatively

influence WTP. Almost all of the explanatory variables influenced WTP at 5%, except land holding size, which was significant at 15%.

The WTP for water reservoir programs was less responsive to changes in the explanatory variables. A 10% change in the variables only produced a 0.7–6.7% change in WTP. The best responses were to changes in the number of productive age family members and age. Farmers were more willing to pay for water reservoirs than professionals.

Irrigation and Drainage System Program

The model variables were excellent in explaining downstream variations in WTP for irrigation and drainage programs at 93.08%. Of the six variables, four were positive: education level, farming experience, household income, and land holding size. Furthermore, all explanatory variables strongly influenced WTP and were statistically significant at 1%, except household income, which was insignificant at 20%.

WTP for irrigation programs was less responsive (inelastic) with respect to changes in the model's variables, as seen in the elasticity value of less than one. A 10% change in the variables only produced a 0.02–8.5% change in WTP. The highest response was to changes in education level. This implies that the program will get the most support in downstream communities with higher education levels. Again, farmers are more willing to support this program than professionals.

Household Well Program

The ability of the model variables to explain variations in WTP for household wells was good at 89.79%. The results were similar to the results of the irrigation and drainage program. Of the six variables, four were positive: education level, farming experience, household income, and land holding size. Yet, only farming experience, household income and land holding size had a significant effect at 1%. Only education level had no effect on WTP. The variables that negatively influenced WTP were age and the number of productive age family members, significant at 20% and 5% respectively. This indicates that younger downstream communities with more productive age family members do not consider the program to be important in lessening drought and floods.

The WTP elasticity values imply that the program will be difficult to implement downstream. A 10% change in the variables only produces a 0.6-3.0% change in WTP. Farmers are more willing to pay for the program than professionals.

Table 9
Downstream WTP Parameter and Elasticity Results for Water Reservoirs, Irrigation and Drainage Systems, Household Wells, and Agro-forestry Programs, Karawang, 2003

Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Water Reservoir				
Intercept	17.390781	7.85746096	-	-
Age	0.450124	0.14124107	0.0027	0.48055
Education	1.491638	0.63674301	0.0240	0.27185
Farming Experience	0.578227	0.19447030	0.0049	0.25681
Household Members Age > 15	-8.169181	0.88170680	0.0001	-0.67165
Total Income	0.000554	0.00011960	0.0001	0.19785
Total Land Holding	-1.637869	1.06950962	0.1332	-0.07153
Dummy Variable	8.276371	2.87545422	-	-
R^2 = 0.8104	F_{hit} = 25.641		Prob>F = 0.0001	
Irrigation and Drainage				
Intercept	0.924559	2.46459423	-	-
Age	-0.112320	0.04430209	0.0150	-0.21535
Education	2.585860	0.19972268	0.0001	0.84636
Farming Experience	0.243158	0.06099812	0.0003	0.19395
Household Members Age > 15	-1.077037	0.27655874	0.0003	-0.15903
Total Income	0.000004	0.00003752	0.9158	0.00256
Total Land Holding	2.375855	0.33546552	0.0001	0.18634
Dummy Variable	4.077446	0.90192340	-	-
R^2 = 0.9308	F_{hit} = 80.711		Prob>F = 0.0001	
Household Wells				
Intercept	5.912351	1.90893710	-	-
Age	-0.044943	0.03431392	0.1974	-0.14205
Education	0.116612	0.15469404	0.4552	0.06292
Farming Experience	0.173016	0.04724574	0.0007	0.22749
Household Members Age > 15	-0.449395	0.21420696	0.0420	-0.10939
Total Income	0.000147	0.00002906	0.0001	0.15523
Total Land Holding	2.316580	0.25983287	0.0001	0.29951
Dummy Variable	2.031754	0.69857951	-	-
R^2 = 0.8979	F_{hit} = 52.739		Prob>F = 0.0001	
Agro-forestry				
Intercept	-0.620136	0.91260125	-	-
Age	-0.081049	0.01640438	0.0001	-041267
Education	0.070776	0.07395423	0.3440	0.06152
Farming Experience	0.378008	0.02258667	0.0001	0.80069
Household Members Age > 15	0.643977	0.10240544	0.0001	0.25251
Total Income	0.000029	0.00001389	0.0373	0.05087
Total Land Holding	1.169658	0.12421771	0.0001	0.24361
Dummy Variable	1.084075	0.33396833	-	-
R^2 = 0.9662	F_{hit} = 130.927		Prob>F = 0.0001	

Agro-Forestry Program

Agriculture and reforestation programs (especially industrial forestry) aim to sustain natural resources, improve the environment and generate income. This program is mainly executed in the upstream area of the

Citarum river basin, in Bandung District, West Java. Agro-forestry is expected to be supported by this community since the program does not move people that have cut the forest to engage in extensive farming.

Parameter and elasticity results indicate the excellent ability of the model variables to explain variations in WTP as shown by a coefficient of determination equal to 96.62%. Most explanatory variables were positive, except age. Farming experience, the number of productive age family members, household income, and land holding size strongly influenced WTP, statistically significant at 5%. Although education was positive, it did not significantly influence WTP.

Elasticity values indicate that downstream communities were less willing to pay for agro-forestry than upstream communities. This is shown by the inelastic response of WTP to the model variables. A 10% change in the variables only changed WTP by 0.5–8.0%. Still, farmers were slightly more willing to pay than professionals.

8. WTP PARAMETERS AND ELASTICITY RESULTS FOR DOWNSTREAM PROGRAMS IN KARAWANG DISTRICT

Besides society respond at downstream area to some programs to be executed at upstream and middle area of Citarum, this study also try to investigate respondents' respond to three programs to be developed at their own area in Karawang District, which is representing downstream area of Citarum. The program comprised of water reservoir, irrigation and drainage system, and water pomp. The main target of these programs is the effort to lessen drought and floods during dry and wet season respectively. Following will be elaborated the society respond to these program through analysis of parameter estimates and elasticity. More detail information about variability of respondents' WTP with respect to program such as water reservoir, irrigation and drainage, water pump are presented in **Table 10**.

Water reservoir (Embung) Program

The parameter results showed that the variables could explain 83.92% of WTP for the water reservoir program to be implemented in the downstream area. Age and number of productive age family members negatively influenced WTP, significant at 20% and 1% respectively. Other explanatory variables such as education, farming experience, household income, and land holding size had a positive effect on WTP, all of which were significant at 1%, except land holding, which was significant at 20%.

The elasticity value of all the variables, (less than one), indicates that WTP for the water reservoir program did not respond well to changes in the variables. A 10% change in the program variables only produced a 0.6-5.4% changed in WTP. Farmers were significantly more willing to pay for water reservoir programs than professionals.

Irrigation and Drainage System Program

Many of the floods that occur in the study area are caused by non-functioning irrigation channels and drainage systems as well as by sedimentation in heavy muddy streams, which also affect the number of settlements along the channel. The model variables were excellent in explaining variations in WTP at 93.22%.

As respondents age, their WTP progressively declines, although this is insignificant at 20%. Younger community members are more willing to engage in efforts to lessen flooding. The number of productive age family members yields similar results; there is no significant relationship between WTP and the number of productive age family members and the WTP declined pursuant to the number of productive age family members. Education, farming experience, household income, and land holding size were significant and positive at 5%.

Table 10
Parameter and Elasticity Results for Water Reservoirs, Irrigation and Drainage, and Water Pump Programs if Implemented in the Citarum Downstream Area, Karawang, 2003

Program/Dependent Variable	Parameter Estimate	Standard Error	Prob > (T)	Elasticity
Water Reservoir				
Intercept	2.491225	11.44859906	-	-
Age	-0.284994	0.20579324	0.1734	-0.21253
Education	4.239892	0.92775713	0.0001	0.53975
Farming Experience	1.389184	0.28335012	0.0001	0.43097
Household Members Age > 15	-4.327085	1.28467805	0.0016	-0.24850
Total Income	0.000771	0.00017427	0.0001	0.19226
Total Land Holding	2.039481	1.55831342	0.1977	0.06221
Dummy Variable	19.313575	4.18963870	-	-
R^2 = 0.8392	F_{hit} = 31.308		Prob>F = 0.0001	
Irrigation and Drainage				

continue....

Intercept	-	14.20677058	-	-
Age	34.173254	0.25537250	0.5401	-0.08786
Education	-0.157743	1.15127035	0.0005	0.41554
Farming Experience	4.370083	0.35161421	0.0001	0.41242
Household Members Age > 15	1.779805	1.59417988	0.0284	-0.15518
Total Income	-3.617693	0.00021625	0.0001	0.23673
Total Land Holding	0.001271	1.93373889	0.0001	0.41509
Dummy Variable	18.217839	5.19899731	-	-
	25.419930			
R^2 = 0.9322	F_{hit} = 82.504	Prob>F = 0.0001		
Water Pump				
Intercept	-0.084399	6.60754094	-	-
Age	-0.038072	0.11877324	0.7501	-0.28924
Education	-0.274177	0.53545357	0.6113	-0.35559
Farming Experience	0.182647	0.16353508	0.2704	0.57727
Household Members Age > 15	-0.311699	0.74144992	0.6763	-0.18237
Total Income	0.000124	0.00010058	0.2227	0.31631
Total Land Holding	2.180860	0.89937814	0.0197	0.67775
Dummy Variable	2.639629	2.41804338	-	-
R^2 = 0.3756	F_{hit} = 3.609	Prob>F = 0.0039		

All WTP elasticity values in the model were inelastic, meaning that the WTP for irrigation and drainage programs did not respond to changes in the variables. A 10% change in the variables only produced a 0.8-4.2% change in WTP. However, education, farming experience, and land holding size most significantly determined program success. In general, farmers were more willing to pay for this program than professionals.

Water Pump Program

Heavy floods occur in the Citarum downstream area in Karawang during the wet or rainy season, particularly from November to February. In contrast, during the dry season, many rice fields cannot be properly irrigated due to the limited water supply. Thus, most farmers in the area can only plant rice twice a year. Only a few areas are able to plant secondary crops in the third season. The first rice season is from October to January, and the second season from February/March to May. The third season is June to August. During September farmers concentrate on repairing damaged irrigation canals.

The model variables were unable to sufficiently explain the variations in WTP for water pumps, as shown by the coefficient of determination of only 37.56%. This could be because respondents were not separated by those that experience floods and those that experience drought. Many respondents only experience one or the other, and thus are uninterested in the water pump program.

Many of the explanatory variable parameter estimates were negative. Age, education, and number of productive age family members did not significantly influence WTP. Similarly, although farming experience and household income were positive, they were not significant at 20%. Land holding size was the only positive variable, statistically significant at 5%, indicating that WTP is solely determined by land holding size.

Similar to the two programs previously discussed, WTP for water pumps also did not respond well to changes in the model's variables. A 10% change in the explanatory variables only produced a 1.6-6.8% change in WTP. It is expected that water pump programs will be most successful if they take land holding size into account, especially for those that experience drought.

9. CONCLUSIONS AND POLICY IMPLICATIONS

Conclusion

The readiness of respondents to participate in flood prevention programs was measured by willingness to pay (WTP). On the whole, in the upstream Citarum area farmers were 10.66% more willing to pay than professionals. WTP analysis of each program in the upstream area indicates that the highest WTP by professionals and farmers was for reforestation programs, followed by agro-forestry, terracing and alley cropping programs.

Professionals in the middle stream Citarum area were 16.96% more willing to pay to prevent floods, soil erosion and landslides than farmer respondents. However, WTP in the middle stream area was 41.66% lower than in the upstream area. This significant difference was mainly due to the household income gap between the two areas. Of the seven programs on offer, professionals were most willing to pay for reforestation programs and least willing to pay for household wells at only 10.98% of total WTP. Farmers were most willing to pay for alley cropping and least willing to pay for agro-forestry at 10.81%.

Downstream WTP for all programs equaled USD 34.24 for professionals and USD 37.44 for farmers, signaling that farmers were 9.35% more willing to pay than professionals. By area, WTP was highest upstream, followed by middle stream and finally downstream.

Of the ten programs offered, downstream professionals and farmers were most willing to pay for the construction of irrigation and drainage system in the downstream area. They also supported upstream

reforestation programs. Professional and farmer WTP for this program was 23.16% and 24.89% of total WTP respectively.

Upstream programs were most influenced by household income, land holding size, farming experience, education, and age. Meanwhile, reforestation and alley cropping in the middle stream area were most determined by household income, land holding, age, experience, and education. Finally, downstream the irrigation and drainage system program was most greatly influenced by land holding size, age, education, experience, and the number of productive age household members.

Policy Implication

The government should attract the maximum number of Citarum river basin communities to participate in environmental programs to protect and sustain the region's environment.

Since the main cause of environmental degradation in the area is upstream deforestation by farmers, alternatives should be provided by the local government supported by the central government to: (1) move farmers to more secure land; (2) enforce anti-deforestation laws for the perpetrators of harmful agricultural practices.

The downstream government and community should participate in targeted investments to rehabilitate the Citarum upstream and middle stream areas. The DKI Jakarta government must cooperate with the West Java Province government to solve the problems upstream. Money invested in preventing yearly floods cannot be effective so long as Citarum's upstream area continues to be deforested.

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