Key Determinants of Forest-dependent Guyanese' Willingness to Contribute to Forest Protection: an application of the Contingent Valuation Method

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Abstract- Determining the willingness of forest-dependent Guyanese to contribute to forest protection is of strategic importance to forest management policy, particularly for Guyana – a high forest cover, low deforestation (HFLD) Amazonian tropical country whose government has articulated through several national development strategy documents, including the Low Carbon Development Strategy and the Framework Green State Development Strategy – a commitment to green development. Our research centred on the willingness of Forest-dependent Guyanese – persons who dwell and ply their trade in hinterland and riparian forest areas of the country – to contribute to forest preservation and restoration as demonstrated through their willingness to accept (WTA) and willingness to pay (WTP). WTA and WTP were elicited by the Contingent Valuation Method (CVM) – a method used to elicit value people attribute to goods and services not traded in the market, such as the improvement of environmental states. Using the CVM, the research sought to ascertain the key determinants of WTA and WTP for Guyana's forest preservation and restoration. Our research found primary commercial activities of the study sites and income to be the key determinants of WTA and WTP. Our paper asserts that forest-dependent Guyanese should feature centrally in forest management policy and practice; the primary economic activities of forest communities should be taken into account when forest protection programmes are formulated; and income of forest dwellers should serve as a gauge of forest dwellers' ability to contribute financially to forest protection programmes.

Index Terms- Contingent Valuation Method, willingness to pay, willingness to accept, Hicksian surplus, forest-dependent Guyanese

I. BACKGROUND AND INTRODUCTION

Forest extraction and forest preservation have, traditionally, been polar activities, serving antithetical interests. The Co-operative Republic of Guyana, hereafter referred to as Guyana, is an Amazonian high forest cover, low deforestation (HFLD) emerging green state wealthy in biodiversity; approximately 84 percent of the country's area is covered by lush rainforest. Deforestation over the past quarter-century – caused primarily by mining, logging and agriculture – has been minimal in Guyana. The Food and Agriculture Organization (FAO) published data showing an infinitesimal decline of Guyana's forest cover across 25 years, from 84.63 per cent in 1990 to 83.95 per cent in 2015 [1]. Consequently, forest protection has high ecological, social and economic importance to this small developing country whose economy depends heavily on the forest extractive sectors, and whose future development is envisaged to proceed on a green pathway, as articulated by several national development strategy documents, principal among them the Low Carbon Development Strategy (LCDS) [2] and the Framework Green State Development Strategy (GSDS) [3]. Important to forest protection is the involvement of forest-dependent people. Part of this involvement can be determined through their willingness to accept (WTA) and willingness to pay (WTP) for forest preservation and restoration. WTA and WTP are welfare estimates elicited by the Contingent Valuation Method (CVM) – a stated-preference method which elicits respondents' Hicksian surplus contingent on an alternative, enhanced environmental state that would benefit persons who are willing to pay to improve the state from the status quo.

While the market value of the forest may be easily ascertained by an account of the price for which timber and nontimber forest resources are traded in the market, the nonmarket value of the forest – embodied by its ecosystem services and functions - is not as easily discernible. However, as a result of decades ecosystem assessment and valuation, a heightened awareness and appreciation of these services and functions have begun to set in. The Millennium Ecosystem Assessment (MA) [4], undertaken from 2001 to 2005, was the first major international effort to cite what it terms ecosystem services and explore the linkages between these ecosystem services and human wellbeing. Subsequently, The Economics of Ecosystems and Biodiversity (TEEB, 2010) [5] study was conducted to properly valuate biological diversity and ecosystems. These two studies have proposed a suite of ecosystem services and functions, and advanced comprehensive approaches to assessment and valuation of ecosystems and biodiversity. While there may have been

external assessment of Guyana's forest ecosystem, authors of this paper know of no forest valuation attempted prior to the research that informs this paper. Consequently, the attempt at determining the determinants of WTA and WTP and welfare estimates for forest preservation and restoration here is the first of its kind in the anglophone South American country.

Ecosystem assessment and valuation have been agreed globally to be important prerequisites for ecosystem management policy and action. The MA framework was designed to help all stakeholders understand the current state of major ecosystem services, trends in their production and flows, as well as major pressures and threats, management decisions and policy formulations [6]. Termed as 'environmental services' [7], and subsequently, 'ecosystem services' [8], the most frequently referenced definition is: 'Ecosystem services are the benefits people obtain from ecosystems' [4]. These include provisioning services such as food, water and timber; regulating services that affect climate, air quality and water quality; cultural services that provide recreational and aesthetical pleasure; and supporting services such as soil security, photosynthesis and nutrient cycling [4]. Additionally, TEEB was mandated by the G8+5 countries to 'initiate the process of analysing the global economic benefit of biological diversity, the costs of the loss of biodiversity, and the failure to take protective measures versus the costs of effective conservation' for the principal purpose of addressing 'the needs of major user groups: national and local decisionmakers, business and the wider public' [5]. The study encompassed robust ecosystem assessment and valuation, acknowledging mankind's unsustainable use of nature's resource and the need for urgent sustainable management. More specifically, TEEB has set the foundation for a 'systematic appraisal of the economic contribution of biodiversity and ecosystem services to human well-being; and for routine steps to prevent that contribution being lost or diminished through neglect or mismanagement' [9]. It is within this context that we attempted a nonmarket valuation of protection options of Guyana's forest.

The forest is an ecosystem to which the livelihoods of most humans are linked intimately, particularly in developing countries. Forests globally represent substantial goods and services that benefit humankind. These include timber, fuelwood, genetic materials, watershed protection, carbon sequestration and cycling and tourism [7]. While ascertaining the market value of these forest goods and services is relatively simple, determining the nonmarket value of the forest has proved challenging; it has only been possible through contingent valuation which elicits individuals' willingness to pay for forest restoration, forest conservation or forest ecosystem functions and services [10, 11, 12]. These studies which have been conducted in recent years have all suggested there is substantial public support for forest conservation [13].

One of the most comprehensive approaches to forest valuation proposed cites five key steps: a clear definition of the decision to be made; a clarification of the purpose of the valuation, its purpose and outputs; a clear identification and determination of input and output information needs, and constraints to meeting those needs; choice and application of relevant valuation methods and techniques to meet the information needs; and identification of value uncertainties [14]. Consequently, our research endeavoured to ascertain the key determinants of forest-dependent Guyanese' willingness to accept or willingness to pay for preservation or restoration of one hectare of degraded forest, and determine the significance of WTA and WTP estimates and whether they could sustainably support forest protection programmes. The CVM was determined to be appropriate for eliciting WTA and WTP. And forest-dependent Guyanese were considered the most appropriate sample population because they were most likely to be directly affected by both forest degradation and forest protection, despite uncertainties relative to stated WTA and WTP.

Finally, the goal of the study is to inform forest management policy and action and aid in the country's bid to pursue green development.

This research paper is organised according to the following main sections:

1) Background and Introduction
2) Materials and Methods
3) Results
4) Discussion
5) Conclusion

II. MATERIALS AND METHODS

Elicited by face-to-face administration of survey adopting the Contingent Valuation Method (CVM), data was organised methodically for analysis and analysed by descriptive and inferential statistics to determine welfare estimates and key determinants of WTA and WTP among forest-dependent Guyanese. The software package IBM SPSS Statistics was used to perform statistical analyses.

II.1. Contingent Valuation Method

The Contingent Valuation Method (CVM), a stated-preference method relevant to the valuation of all kinds of ecosystem services, was developed in the USA in the 1960s with an aim to measure the monetary values that individuals place on goods, services and amenities that are not traded in the market [15].

Applied directly to respondents who are, in essence, consumers in a hypothetical market situation, the CVM aims at eliciting respondents' willingness to pay (WTP) and willingness to accept (WTA), thereby revealing their Hicksian surplus when presented with a scenario concerning the state of a public good and an alternative contingent on their payment. It can be used to determine both use and non-use values, and is the most controversial of nonmarket valuation methods [16].

The survey instrument was designed and administered in accordance with specifications of the Report of the National Oceanic and Atmospheric Administration (NOAA) on Contingent Valuation [17]. Prior to administration of survey, researcher discussed with respondents the state of the country's forest ecosystem, its decline as a consequence of mining, logging and agriculture, and the difference between market value and nonmarket value of the forest. Subsequently, respondents were provided both dichotomous-choice items and open-ended questions to demonstrate their willingness to accept and willingness to pay for forest preservation and restoration, given the relevant hypothetical situations.

II.2. Statistical Analysis

Summary statistics – measures of central tendency and dispersion – were used as a first-order data analysis application. The arithmetic mean - hereafter referred to as mean - median and mode where applicable are the measures of central tendency used; standard deviation and variance are the measures of dispersion used.

Moreover, for the purpose of extrapolating findings to the population from which the representative sample was drawn and determine associations of statistical significance, the relevant parametric and nonparametric tests were conducted to determine the correlation between independent and dependent variables, the significance of such correlations where they existed, and the nature or direction of such correlations. Additionally, the tests were conducted to assume or reject the null hypotheses and produce predictive welfare estimates. Having determined the measures of best fit, the Pearson Product-Moment Correlation Coefficient, simple linear regression, multiple linear regression and logistic linear regression were the inferential statistics employed.

III. RESULTS

III.1. Demographic Characteristics

Survey was conducted at six study sites across six Administrative Regions of the country. All study sites are hinterland and riparian areas, with one being a new municipality. The residents were mostly indigenous peoples. However, some communities emerged as a consequence of mining and logging operations. Survey was conducted among 357 respondents. 30 questionnaires were unusable because of lack of completeness and illegibility. The final 327 usable survey instruments were all completed, for a response rate of 91.6 percent. Of these 327 respondents, 139 (42.5%) were males and 188 (57.5) were females. Respondents aged from 16 to 88, with 188 (56%) being 35 years and younger. The majority of respondents – 255 (78%) - had at least secondary education. The highest number of professionals were teachers (76); miners, loggers and farmers combined for 95 (29%) of the total of number of respondents. It should be noted that many respondents held two or three job titles simultaneously. For example, many respondents who wrote they were miners were also loggers; many who stated they were famers were also loggers and shop owners or transport operators.

III.2. Descriptive Statistics

For simple summary of data, the most applicable measures of central tendency and variability were considered to be the arithmetic mean, standard deviation and skewness. For robustness of accuracy and predictability of willingness to accept and willingness to pay estimates, bootstrapping was applied to data. These are shown in Table 1. Summary statistics of the dichotomous-choice items are presented in Table 2.

Table 1: Summary statistics of willingness-to-accept and willingness-to-pay estimates

	Descriptives	Statistic	Std Error	Bias	Std Error	95% Confidence Interval	
						Lower	Upper
Willingness to Accept (WTA) for forest preservation in lieu of $10,000 from mining, logging or agriculture	Minimum	$3,000					
	Maximum	$10,000					
	Mean	**$7,674.31**		4.29	87.34	**$7,510.69**	**$7,845.57**
	%WTA	**76.74**				**75.11**	**78.46**
	Std Deviation	1604.307		-4.775	45.212	1516.144	1690.654
	Skewness	-0.460	0.135	-0.001	0.102	-0.662	-0.255
Willingness to Pay (WTP) for forest restoration from monthly income of $300	Minimum	$0					
	Maximum	$150					
	Mean	**$46.48**		-0.09	1.70	**$43.20**	**$49.91**
	% WTP1	**15.49**				**14.40**	**16.64**
	Std Deviation	31.131		-0.113	1.409	28.234	33.895
	Skewness	0.850	0.135	-0.014	0.129	0.589	1.095
Willingness to Pay (WTP) for forest restoration from monthly income of $400	Minimum	$0					
	Maximum	$200					
	Mean	**$63.69**		-0.14	2.43	**$58.82**	**$68.53**
	% WTP2	**15.92**				**14.71**	**17.13**
	Std Deviation	43.899		-0.176	2.202	39.376	48.000
	Skewness	1.081	0.135	-0.011	-0.110	0.836	1.291
Willingness to Pay (WTP) for forest restoration from monthly income of $500	Minimum	$0					
	Maximum	$300					
	Mean	**$82.04**		-0.21	3.14	**$75.85**	**$87.96**
	% WTP3	**16.41**				**15.17**	**17.60**
	Std Deviation	58.023		-0.266	2.787	52.311	63.057
	Skewness	1.117	0.135	-0.009	0.118	0.875	1.325
Willingness to Pay (WTP) for forest restoration from monthly income of $600	Minimum	$0					
	Maximum	$400					
	Mean	**$101.42**		-0.27	3.91	**$93.90**	**$109.01**
	% WTP4	**16.90**				**15.65**	**18.17**
	Std Deviation	72.409		-0.350	3.485	65.299	78.927
	Skewness	1.133	0.135	-0.012	0.137	0.872	1.391
Willingness to Pay (WTP) for forest restoration from monthly income of $700	Minimum	$0					
	Maximum	$500					
	Mean	**$124.68**		-0.35	4.69	**$115.74**	**$133.66**
	% WTP5	**17.81**				**16.53**	**19.10**
	Std Deviation	87.643		-0.440	4.141	79.368	95.305
	Skewness	1.055	0.135	-0.017	0.153	0.761	1.358
Valid (listwise	**N**	**327**		**0**	**0**	**327**	**327**

Table 2: Summary statistics of responses to the dichotomous-choice items used in the Contingent Valuation survey

Dichotomous-choice Item		Frequency	%	Bias	Standard Error	95% Confidence Interval	
						Lower	Upper
Does the forest have nonmarket value?	Yes	**327**	**100**	0	0	100	100
Is the forest nonmarket value greater than the market value?	Yes	**307**	**93.9**	0	1.3	91.1	96.3
	No	20	6.1	0	1.3	3.7	8.9
	Total	327	100	0	0	100	100
Is mining, logging or agriculture of any direct economic benefit to you?	Yes	**232**	**70.9**	0	2.5	65.7	76.1
	No	95	29.1	0	2.5	23.9	34.3
	Total	327	100	0	0	100	100
Would you be willing to forego economic benefit of deforestation?	Yes	**304**	**93.0**	0	1.4	89.9	95.7
	No	23	7.0	0	1.4	4.3	10.1
	Total	327	100	0	0	100	100

As it relates to willingness to accept, the average respondent claimed to be willing to accept ~$7,674 as the lowest compensation for forest preservation in lieu of $10,000 received from mining, logging or agriculture annually. In essence, respondents overall were willing to forego ~$2,326 of the annual $10,000 they could have received from commercial activities that resulted in deforestation in favour of forest preservation.

And as it pertains to the willingness to pay for forest restoration, respondents demonstrated a positive WTP with increase in income – from a percentage of 15.49 at the $300 income level to 17.81 at the $700 income level, with an increase interval of $100. This represents a consistent increase in WTP at an increasing rate despite an increase in income at a decreasing rate.

Three dichotomous-choice items elicited responses affirming respondents' belief that the forest had nonmarket value, and their willingness to accept lower compensation for forest preservation then the income they could receive from forest-extractive activities. All 327 respondents believed the forest had nonmarket value, while 307 (94%) respondents believed the nonmarket value of the forest was greater than the market value. 304 respondents (93%) responded 'Yes' to the WTA dichotomous-choice item, although ~71 percent of all respondents revealed – in response to the fourth dichotomous-choice item - that mining, logging and agriculture were of direct economic benefit to them.

III.3. Inferential Statistics

III.3.1. Pearson Product-Moment Correlation Coefficient

The Pearson Product-Moment Correlation Coefficient was performed to determine the statistical significance and direction of correlation among all variables, as shown in Table 3. There were found to be significant correlations, appearing in bold text in Table 3, among key variables at the 0.01 and 0.05 levels. For example, the study site Moruca, used as an independent variable in the correlation analysis, is shown to have a significant correlation with WTA and WTP at the 0.01 and 0.05 levels. Two-tailed correlation was used to detect correlation of statistical significance both positive and negative. Wherever statistical significance in correlation between the key outcome variables – willingness to accept and willingness to pay – and key predictor and controlled variables exist, these relations were analysed deeper by application of multiple linear regression.

Table 3: Correlation among dependent variables willingness to accept and willingness to pay and the key independent variables study sites and income increase

Variables	Mean	Std Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	35.70	14.70	1																	
2. Sex	1.57	0.50	-0.157	1																
3. Education	2.02	0.84	-0.142	-0.07	1															
4. Annai	0.21	0.41	-0.08	0.044	0.287**	1														
5. Moruca	0.39	0.80	0.01	-0.059	-0.205	-0.253	1													
6. Mara	0.30	0.91	0.183**	-0.061	-0.299	-0.172	-0.165	1												
7. Mahdia	0.81	1.61	-0.09	-0.015	0.190**	-0.258	-0.248	-0.168	1											
8. Ituni, Kwakwani & Aroaima	0.86	1.9	0.103	-0.052	0.039	-0.233	-0.224	-0.152	-0.229	1										
9. Bartica	0.73	1.97	-0.093	0.151**	-.109*	-0.191	-0.184	-0.125	-0.188	-0.17	1									
10. DC Item 1	1.06	0.24	**0.117***	-0.064	-0.006	0.089	**-0.126**	**0.253****	-0.033	-0.048	-0.095	1								
11. DC Item 2	1.29	0.455	-0.140	0.005	**0.317****	**0.552****	**-0.180**	-0.058	0.081	**-0.273**	**-0.198**	0.062	1							
12. DC Item 3	1.07	0.26	-0.021	0.043	-0.02	-0.023	**-0.136**	**0.186****	0.040	0.002	-0.03	0.080	0.008	1						
13. WTA Amount	7674.31	1604.31	-0.049	-0.015	-0.081	-0.068	**-0.133**	0.011	-0.043	**0.209****	0.047	0.012	-0.057	**0.399****	1					
14. WTP1	46.48	31.13	-0.064	0.043	-0.076	-0.021	**-0.155**	**0.348****	0.087	**-0.231**	0.053	-0.009	0.014	-0.049	**-0.237**	1				
15. WTP2	63.69	43.90	-0.046	0.072	-0.076	-0.028	**-0.156**	**0.378****	0.074	**-0.218**	0.034	-0.002	-0.008	-0.079	**-0.266**	**0.929****	1			
16. WTP3	82.04	58.02	-0.067	0.054	-0.08	-0.041	**-0.132**	**0.382****	0.058	**-0.190**	0.006	0.001	0.019	-0.064	**-0.258**	**0.874****	**0.952****	1		
17. WTP4	101.42	72.41	-0.057	0.042	-0.056	-0.029	**-0.132**	**0.382****	0.069	**-0.186**	-0.026	0.010	0.028	-0.062	**-0.264**	**0.836****	**0.936****	**0.977****	1	
18. WTP5	124.68	87.64	-0.082	0.048	-0.05	0.004	**-0.129**	**0.330****	0.068	**-0.167**	-0.044	-0.003	0.046	-0.066	**-0.267**	**0.799****	**0.898****	**0.956****	**0.981****	1

Pearson Product-Moment Correlation Coefficient: **. Correlation is significant at the 0.01 level *. Correlation is significant at the 0.05 level Number: 327

WTA in Table is abbreviation of willingness to accept. WTP is abbreviation of willingness to pay. Each numeral represents the corresponding income level.
DC Item 1 refers to the first dichotomous choice item: Is forest nonmarket value greater than forest market value?
Item 2 refers to the second dichotomous choice item: Is mining, logging or agriculture of any direct economic benefit to you:
Item 3 refers to the third dichotomous choice item: Would you be willing to forego economic benefits of mining, logging or agriculture in lieu of a lower compensation for forest preservation?

III.3.2. Multiple Linear Regression – Willingness to Accept

Regression performed using the outcome variable willingness to accept compensation for forest preservation in lieu of the annual earnings of US$10,000 from mining, logging or agriculture shows significant correlation between the outcome variable and the explanatory variables study sites and the dichotomous-choice item on willingness to forego economic benefit of extraction in lieu of forest preservation, as shown in Table 4.

Table 4: Results of multiple linear regression with willingness to accept as outcome variable

Willingness to Accept	Unstandardised Coefficients		Standardised Coefficients			95 % Confidence Interval for β	
	β	Standard Error	Beta	t	Sig.	Lower Bound	Upper Bound
Sex	11.045	173.508	0.003	0.064	0.949	-330.327	352.417
Age	-7.501	5.665	-0.069	-1.324	0.186	-18.646	3.644
Education	-141.896	101.755	-0.074	-1.394	0.164	-342.096	58.304
Job Title	-68.954	22.078	-0.168	-3.123	0.002	-112.391	-25.517
Study Sites	191.374	52.966	0.204	3.613	0	87.164	295.584
Forest nonmarket value > forest market value?	-162.426	358.078	-0.024	-0.454	0.65	-866.936	542.085
Weight of nonmarket value	-47.958	26.048	-0.099	-1.841	0.067	-99.207	3.29
Direct economic benefit of mining, logging or agriculture	133.449	205.694	0.038	0.649	0.517	-271.249	538.148
Willingness to forego economic benefit of extraction in lieu of preservation compensation	2,436.448	312.039	0.389	7.808	0	1,822.518	3050.378
F	10.227						
R	0.474						
R^2	0.225						
Adjusted R^2	0.203						
ΔR^2	0.225						

III.3.3. Multiple Linear Regression – Willingness to Pay

Regression analysis performed with willingness to pay across five income levels as the outcome variable shows statistically significant correlation between the outcome variable and the explanatory variables study sites and dichotomous-choice item on willingness to forego economic benefit of extraction in lieu of forest preservation, as shown in Table 5.

Table 5: Result of multiple linear regression with willingness to pay (WTP) across five income levels

WTP with increase in Income	**WTP1**		**WTP2**		**WTP3**		**WTP4**		**WTP5**	
Variables	**β**	**t**	**β**	**t**	**β**	**t**	**β**	**t**	**β**	**t**
Age	**-0.204**	**-1.825**	**-0.26**	**-1.678**	**-0.46**	**-2.217**	**-0.534**	**-2.059**	**-0.752**	**-2.34**
Sex	1.864	0.576	6.167	1.375	6.106	1.017	6.889	0.917	8.457	0.909
Education	0.118	0.055	1.207	0.404	0.757	0.189	2.703	0.539	0.829	0.134
Annai	-3.918	-0.745	-4.976	-0.672	-11.151	-1.139	-12.621	-1.029	-7.691	-0.519
Mara	**12.666**	**5.457**	**19.684**	**6.124**	**27.906**	**6.483**	**34.606**	**6.43**	**35.03**	**5.253**
Mahdia	1.223	0.929	1.304	0.716	2.21	0.906	2.646	0.867	1.853	0.49
Ituni, Kwakwani & Aroaima	**-3.366**	**-2.725**	**-4.802**	**-2.808**	-4.314	-1.883	**-5.687**	**-1.986**	**-7.067**	**-1.992**
Bartica	0.138	0.124	-0.505	-0.329	-0.398	-0.193	-1.738	-0.675	-3.814	-1.196
Forest nonmarket value > forest market value	-0.118	-0.227	0.166	0.23	0.581	0.601	0.972	0.804	0.852	0.569
Weight of the nonmarket value of the forest	-13.81	-1.943	-17.913	-1.82	-20.82	-1.58	-23.677	-1.437	-30.762	-1.507
Direct economic of mining, logging or agriculture	-4.135	-0.94	-8.877	-1.457	-4.32	-0.529	-6.262	-0.614	-6.274	-0.496
Willingness to forego economic benefit of deforestation	**-16.432**	**-2.633**	**-30.134**	**-3.487**	**-36.468**	**-3.151**	**-45.025**	**-3.112**	**-52.822**	**-2.947**
F	7.436		8.679		7.774		7.642		6.101	
R	0.47		0.499		0.479		0.475		0.435	
R^2	0.221		0.249		0.229		0.226		0.189	
Adjusted R^2	0.192		0.22		0.2		0.196		0.158	
ΔR^2	0.221		0.249		0.229		0.226		0.189	

III.3.4. Simple Linear Regression – Willingness to Pay

Having established that there is an increase in WTP with increase in income, a simple linear regression was performed with WPT at each income level as the outcome variable and income increase as the explanatory variable. The mean willingness to pay at every income level was used as the outcome measure (plotted on the Y-axis) and the corresponding income amount as the explanatory variable (plotted on the X-axis). The outcome of the regression analysis is shown in Table 6. This has shown an average increase in WTP amount of $19.4 at every new income level.

Table 6: Results of simple linear regression with mean willingness to pay (WTP) as outcome variable

	Unstandardised Coefficients		Standardised Coefficients			95 % Confidence Interval for β	
Willingness to Pay	β	Standard Error	Beta	t	Sig.	Lower Bound	Upper Bound
Income Level	**0.194**	0.007	0.998	29.277	.000	0.173	0.215
F	857.16						
R	0.998						
R^2	0.997						
Adjusted R^2	0.995						
Δ R^2	0.997						

The best-fitting line (regression line) and exponential curve generated by increase in WTP and corresponding income level are shown in Figure 1. This output illustrates that as income increases from $300 to $400, the mean WTP amount increases from $46.5 to $63.7; an increase in income from $400 to $500 results in an increase of mean WTP from $63.7 to $82; an increase in income from $500 to $600 results in an increase in mean WTP from $82 to $101.4; and an increase in income from $600 to $700 results in an increase in mean WTP from $101.4 to $124.7. These figures are all shown in Table 1. The mean increase from one income level to the next is approximately $19.4, as shown in Table 6.

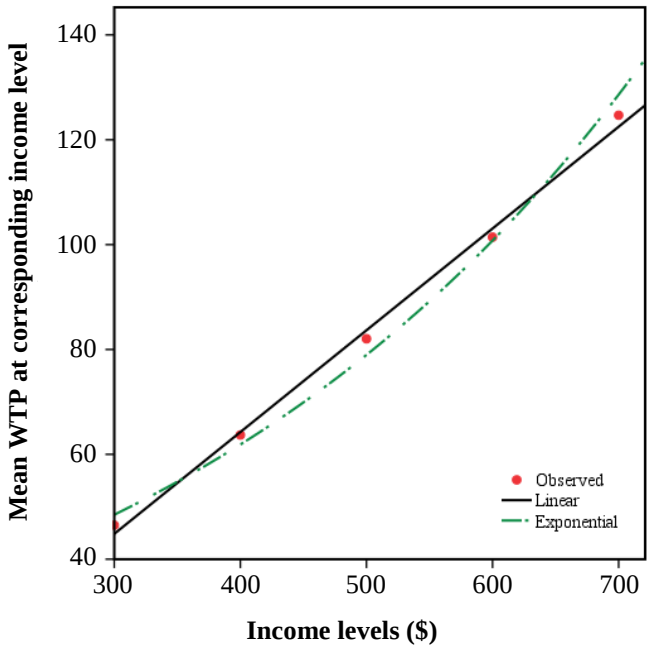

Figure 1: Best-fitting line and exponential curve of increase in willingness to pay (WTP) with corresponding increase in income

IV. Discussion

We should commence our discussion by briefly defining the terms willingness to accept (WTA) and willingness to pay (WTP). Brown and Gregory (1999) [18] reason that WTA and WTP are equivalent measures of economic value. WTP 'reflects the maximum monetary amount that an individual would pay to obtain a good' and WTA 'reflects the minimum monetary amount required to relinquish the good.' Moreover, 'WTP therefore provides a purchase price, relevant for valuing the proposed gain of a good, whereas WTA provides a selling price, relevant for valuing a proposed relinquishment' [18]. According to our findings, the most statistically significant determinants of WTA WTP were study sites' economic characteristics, respondents' positive response to the WTA dichotomous-choice item, and increase in income. Though other variables may not have been shown to have statistically significant correlations with WTA and WTP, sex and age, in particular, were determined to have significant cumulative effect on welfare estimates over the long term - and were used as controlled variables. In adherence to the guidelines of the NOAA Panel Report, only the most conservative welfare estimates have been extrapolated to the population.

Firstly, in response to the dichotomous-choice items, all 327 respondents believed the forest had nonmarket value; 307 (94%) of respondents believed the nonmarket value of the forest was greater than the market value; 304 respondents (93%) responded 'Yes' when asked whether they would be willing to accept a lower compensation for forest preservation in lieu of what they currently received as earning from mining, logging or agriculture. Responses to these three questions were almost entirely positive despite only 71 percent of all respondents revealing – in response to the fourth dichotomous-choice item - that mining, logging and agriculture were of direct economic benefit to them. This suggests that forest-dependent Guyanese – regarding the forest as having nonmarket value – generally preferred to preserve the forest as opposed to extract it for its market value, once provided with some compensation, albeit less than the amount they likely would have earned from the extractive sectors. Their lack of direct economic benefit from forest extraction neither negatively impacted their consideration of the forest's nonmarket value nor prohibited their willingness to contribute to the ecosystem's preservation.

Secondly, the mean willingness to accept of $7,674 as the least compensation for forest preservation in lieu of $10,000 received from mining, logging or agriculture annually in essence represents a mean willingness to contribute $2,326 annually to forest preservation. This 23 percent contribution toward forest preservation elicited by WTA is arguably greater than what would have been offered through a willingness to pay elicitation item. For our study, we found an average increase in WTP of $19.4 with every $100 increase in salary. If respondents were willing to pay $124.68 (17.81% of income) at the $700 income level, then we can project they would be willing to pay $144 at the $800 income level, and $163.5 at the $900 income level. Even at the $900 income level, the WTP of 18.16 percent of income is lower than what could be estimated from a monthly WTA contribution from a corresponding monthly income. For example, the $10,000 respondents hypothetically earned annually represents a monthly income of $833.33, and 23 percent of this amount is $191.7, about $28 more than what respondents would possibly have offered through WTP at the $900 income level. This finding is in keeping with the literature that posits that WTA estimates are generally higher compared to WTP estimates – a reality that puts estimates elicited by CVM at odds with neoclassical economic theory, and has caused the NOAA Panel to discourage the use of WTA. Economic and psychological explanations have been advanced in an attempt to unravel the disparity in estimates elicited by WTA and WTP [18]. Factors such as income and substitute effects, endowment effect, implied value and profit motive [18] and [19] have all been proposed as causes of divergence. However, from our estimation and interactions with respondents, WTA estimates in our research are higher than WTP estimates because respondents were generally more willing to forego voluntarily – not by force – money they did not yet possess than pay money they had in hand. We argue that the divergence we have found is not so significant that the abandonment of WTA is of policy exigency. In fact, we propose that it is of policy and strategic importance to elicit both WTA and WTP for forest preservation and restoration.

Additionally, the mean WTA by study site was evidently determined by the primary commercial activity of that study site. Where mining and logging are the predominant commercial activities, the mean WTA is considerably higher, that is, the willingness to forego earning from commercial activities is significantly lower. Case in point: in Ituni, Kwakwani and Aroaima, the predominant commercial activities are mining and logging. The mean WTA of this study site is $8,411 which represents a willingness to forego a mere $1,589 for forest preservation. This demonstrated willingness to forego is significantly lower than the $2,726 respondents of Moruca – a community in which agriculture is predominant – expressed a willingness to forego, as shown in Table 7. WTA, therefore, is inhibited by mining and logging. This is a logical conclusion given that preservation and mining or logging are mutually exclusive; mining and logging are inimical to preservation and vice versa, and those who earn significantly from forest extraction are least willing to forego such economic benefits of extraction to contribute to preservation.

Table 7: The mean willingness to accept (WTA) amount for forest preservation in lieu of $10,000 from mining, logging or agriculture by each study site

Study Site	Number of Respondents (Households)	WTA Amount (US$)	Mean WTA (US$)	Percentage WTA
Annai	68 (489)	507,500	7,463	74.63%
Moruca	**64 (1501)**	**463,499**	**7,242**	**72.42%**
Mara	33 (25)	255,000	7,727	77.27%
Mahdia	66 (709)	497,500	7,538	75.38%
Ituni, Kwakwani & Aroaima	**56 (1,147)**	**471,000**	**8,411**	**84.11%**
Bartica	40 (2,219)	315,000	7,875	78.75%

And thirdly, as it pertains to the willingness to pay for forest restoration, increase in income was shown to have the most significant effect on WTP. This corresponds with the findings of several contingent valuation and welfare economic studies across the globe [20, 21, 22]. Respondents have demonstrated a positive WTP with increase in income – from 15.49 percent of income at the $300 income level to 17.81 percent of income at the $700 income level - with an income increase interval of $100. This represents a consistent increase in WTP at an increasing rate despite an increase in income at a decreasing rate. The WTP 15.49 percent of income of $300 – approximately Guyana Dollars 60, 000 – looks realistic and reliable. Guyanese public-sector employees are required to pay approximately 33 percent of gross income in tax beyond the G$60,000 tax threshold, and between 14 and 16 percent value added tax. The positive increase in WTP suggests two things in particular: forest-dependent Guyanese' appreciation of the need for investment in and willingness to contribute to forest protection, and the reality that as discretionary income increases, so does the willingness among forest-dependent Guyanese to pay for forest protection. Consequently, it is the increase of discretionary income that impacts increase in WTP, and not merely an increase in gross income. We believe that if the increase in expenditure was directly proportional to the increase at income across the four income levels examined, the WTP may have been less positive.

Moreover, commercial activities also had statistically significant effect on WTP. As was observed between study sites and WTA, respondents of study sites at which mining and logging are the primary commercial activities demonstrated lower willingness to pay for forest restoration than respondents of study sites at which agriculture is the primary economic activity, albeit this variance between most and least WTP being smaller than the variance between least and most WTA.

Given the aforementioned willingness to accept and willingness to pay estimates, conservative estimates can be extrapolated to the entire population to determine how much each community is likely to forego or pay for forest preservation and restoration – forest protection. The aggregate WTA and WTP amounts are herein determined by the upper bound of the mean WTA and the lower bound of the mean WTP multiplied by the number of households within the communities in which research was conducted at the 95 percent confidence interval, as shown in Table 1. With the six study sites having a total number of 6,090 households, as per the 2012 Population and Housing Census conducted by the Bureau of Statistics, Guyana, the most conservative annual WTA at the 95 percent confidence interval is $47,779,521 of a possible $60,900,000. This represents a willingness to forego $13,120,479 annually (21.5% of annual earnings). The most conservative monthly WTP from a monthly income of $300 at the 95 percent confidence interval is $263,088 of a maximum income of $1,827,000 (14.4% of monthly income). At the $700 income level, the most conservative monthly WTP at the 95 percent confidence interval is $704,857 of a maximum income of $4,263,000 (16.5% of monthly income). These estimates suggest that forest-dependent Guyanese' were willing to invest significantly in protection of the tropical forest. Many researchers and publicists have asserted that citizens of tropical countries were likely to be more willing to pay to protect their forests than citizens of non-tropical countries [23]. Moreover, forest-dependent people, indigenous people were considered to demonstrate and represent the most significant willingness to contribute to forest protection among all peoples [24, 25, 26].

V. Conclusion

We have found that it was worth conducting the contingent valuation (CV) study using both willingness to accept (WTA) and willingness to pay (WTP), for each held strategic importance for forest policy and management, especially if forest-dependent Guyanese were to be required, hypothetically, to foot the bill for forest any protection programme. Respondents demonstrated greater willingness to forego earnings from forest-extractive activities in lieu of compensation for forest preservation than they demonstrated willingness to pay for forest restoration. This is in keeping with findings of many researches which have compared WTA and WTP estimates. Despite the NOAA Panel's apprehension regarding the reliability of estimates elicited by WTA question, we found both WTA and WTP estimates to be reflective of respondents' consciousness of national taxation realities and their own ability to give based on their discretionary income. The mean WTP of 16.53 percent of a monthly income of $700, and the mean WTA of 78.46

percent - at the conservative level of the 95 percent confidence interval – both represent reasonable estimates and forest-dependent Guyanese' willingness to contribute significantly to forest protection.

In addition, forest-dependent Guyanese' willingness to pay for forest preservation was an important indicator of these forest-dwelling people's interest in forest protection. This should be taken into account by forest policy developers and forest managers. However, this willingness should not suggest that any forest restoration or preservation programme should be funded exclusively by forest-dependent Guyanese. It suggests that these people should be made – as much as practical - the chief agents of forest protection. They of all citizens may be willing to accept the least remuneration for their services in and pay the most for forest protection programme.

Finally, the research considered forest protection of critical importance for a number of reasons. Foremostly, the forest is habitat of countless species of flora and fauna. Secondly, the forest serves ecosystem functions and provides ecosystem services. And lastly, the forest has value as a biotic component of Earth's biosphere, and is the ecosystem on which the continuity of much of terrestrial life depends. Further study should be conducted to validate the findings of our study and reinforce the awareness and forest-value consciousness our research has aroused among indigenous and forest-dependent people of Guyana.

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