

PARTNERS IN FOREST CONSERVATION: “WILLINGNESS-TO-WORK”
(WTW) TO PROTECT LOCAL FOREST RESOURCES
IN CALAKMUL, CAMPECHE, MEXICO*



James F. Casey**

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Abstract

Recently the number of contingent valuation studies conducted in developing countries has increased. Many have been done to value access to clean water, but there are still very few applications to tropical forest resources. In light of the fact that tropical forests cover a mere 7% of the earth's land surface, yet provide estimates of up to half the world's biota, there is a distinct need for more information pertaining to the value of tropical forests. An important consideration in protecting tropical forests is local participation. This paper uses an application of the discrete-choice contingent valuation method to estimate the willingness of farmers in southeastern Mexico to participate in forest conservation efforts. Results suggest farmers are willing to work slightly less than three days per month in order to conserve an area of community forest.

Keywords: Forest Conservation, Local Participation, Contingent Valuation, Calakmul, Mexico.

Resumen

En años recientes ha habido un incremento en el número de estudios de valuación contingente en los países en vías de desarrollo. Muchos de estos estudios se han realizado para valorar el acceso al agua limpia, pero hasta la fecha hay pocas aplicaciones a los recursos de los bosques tropicales. Dado que éstos cubren únicamente el siete por ciento de la superficie terrestre, no

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** Department of Economics, Washington and Lee University, Correo electrónico: caseyj@wlu.edu

obstante lo cual se estima que contienen hasta la mitad de la biota del mundo, existe una clara necesidad de generar más información relativa al valor de los bosques tropicales. Una consideración importante en la protección de los bosques tropicales es la participación local. Este artículo emplea una aplicación del método de valuación contingente por elección discreta, para estimar la disposición de los campesinos del sureste de México a participar en los esfuerzos a favor de la conservación del bosque. Los resultados sugieren que los campesinos están dispuestos a trabajar poco menos de tres días al mes a fin de preservar un área de bosque comunitario.

Palabras clave: Conservación forestal, local participación, valuación contingente, Calakmul, México.

Résumé

Récemment le nombre d'études d'évaluation contingentes s'est accru dans des pays en voie de développement. Beaucoup ont été réalisées pour évaluer l'accès à l'eau propre mais très peu d'entre elles ont trouvé des applications aux ressources des forêts tropicales. Les estimations font apparaître que les forêts tropicales ne couvrent que sept pour cent de la superficie des terres émergées de la planète mais qu'elles constituent environ la moitié de la flore et de la faune au niveau mondial; il s'avère donc indispensable d'obtenir davantage d'informations sur la valeur des forêts tropicales.

Or, pour protéger ces forêts, il est très important de prendre en considération la participation de la population locale. Cette étude applique la méthode d'évaluation prudente et contingente grâce à laquelle peut être estimée la volonté des fermiers du Sud-Est du Mexique à participer aux efforts de conservation des forêts. Selon les résultats de l'étude, les fermiers seraient éventuellement disposés à travailler un peu moins de trois jours par mois afin de préserver une aire de forêt communautaire.

Mots-clés: Conservation des forêts, participation de la population locale, évaluation contingente à Calakmul au Mexique.

Resumo

Recentemente tem ocorrido um crescimento no número de estudos de avaliação contingencial, conduzidos em países em fase de desenvolvimento. A maioria destes estudos se destinam a examinar o acesso à Água Limpa, e são poucos ainda os programas dedicados ao estudo dos recursos das florestas tropicais. Considerando o fato de que as florestas tropicais cobrem sete por cento da superfície terrestre, além de prover aproximadamente metade da biota do mundo, há uma real necessidade de maiores informações que reflitam a importância das florestas tropicais. Uma importante consideração dentro do processo de proteção das florestas tropicais é a participação da população local. Este artigo utiliza uma aplicação do método de Escolha Discreta de avaliação contingente para estimar a disposição dos fazendeiros do sudeste mexicano em participar dos esforços de conservação das florestas. Os resultados sugerem que os habitantes das florestas estão propensos a trabalhar pouco menos de três dias por mês a fim de preservar as áreas das comunidades florestais.

Palavras chave: Conservação de Florestas, Participação Local, Avaliação Contingencial, Calakmul, México.

Summary (non-technical)

Applications of the contingent valuation method (cvm) in developing countries are growing, but there are still only a handful dealing specifically with forest resources. The paper uses the cvm to estimate the willingness of farmers in southeastern Mexico to participate in forest conservation efforts. Special attention is paid to the cultural context of ejido life and the implications for cvm. The area for the study is southeastern Mexico, an area of tremendous biodiversity. Mexico ranks fourth in the world, after Indonesia, Brazil and Colombia, in terms of biodiversity. However, this diversity of life is threatened. Current estimates of rates of deforestation in Mexico range from 400,000 to 1,500,000 hectares per year, or about 2% of total forest cover in the country. In southeastern Mexico the rate is even higher. One potential answer to limiting the conversion of tropical forests to other land uses is the creation of parks and reserves. Mexico has been a leader in this area, but the problem remains one of local participation and the willingness and ability of poor farmers to contribute to conservation and benefit from it. Therefore, a survey question was designed in order to elicit the willingness of farmers to participate in efforts to conserve an area of forest within the local community. The primary question of the paper is whether farmers are interested in conserving forests, and, if they are, how much time they are willing to contribute to efforts to conserve forests. The answer is clear. Farmers exhibit a strong willingness-to-work for forest conservation, and the responses are consistent with economic theory—*i.e.*, costs matter. Farmers in southeastern Mexico are interested in forest conservation and are willing to contribute to efforts to conserve forest resources. Therefore, their input and participation should be included at every step in the process of conserving forests in southeastern Mexico and, hence, of biodiversity protection.

Introduction

Applications of the contingent valuation method (cvm) in developing countries are growing, but there are only a handful dealing specifically with forest resources (Shyamsundar and Kramer 1996, Mekkonen 2000, Kohlin 2001, Hammitt *et al.*, 2001). It is disturbing to note that forest policy in the tropics is being conducted primarily without any quantitative analysis of the total economic value of the forest. The cvm is one potential tool for changing this situation (Shultz *et al.*, 1998). Kohlin (2001) is quick to point out the challenge of proving the relevance of cvm in developing countries and the importance of

using it in the policy context, and not solely as an abstract exercise in non-market valuation. The primary question of this paper is whether or not farmers in southeastern Mexico are willing to contribute time and effort to conservation efforts in the region. I use an application of the discrete-choice CVM to estimate the willingness of farmers to participate in a conservation effort. Special attention is paid to the cultural context of ejido life and the implications for CVM.

National Parks and Forest Conservation

One response to concerns about deforestation in Mexico has been the creation of National Parks and Reserves. The creation of National Parks and biological reserves protects forest by prohibiting human disturbance other than scientific and perhaps limited recreational activity. Throughout the 1990s, the creation of biosphere reserves and ecological parks in Mexico has increased substantially (<http://earthtrends.wri.org/pdf/library/countryprofiles>). Biosphere reserves are areas of terrestrial and coastal ecosystems, internationally recognized within the framework of UNESCO's Man and the Biosphere (MAB) Programme. They are nominated by national governments and must meet a minimal set of criteria and adhere to a minimal set of conditions before being admitted into the World Network. Each Biosphere Reserve is intended to fulfill three basic functions, which are complementary and mutually reinforcing: a conservation function—to contribute to the conservation of landscapes, ecosystems, species and genetic variation; a development function—to foster economic and human development that is socio-culturally and ecologically sustainable; to provide support for research, monitoring, education, and information exchange related to local, national, and global issues of conservation and development.

A key component, in regards to the effectiveness of parks and reserves, are the people living near the boundaries of the park. Most often, poor, primarily subsistence-level, farmers inhabit these areas. This is certainly the case in southeastern Mexico, where household income is less than 11,000 pesos (Casey *et al.*, 2002). For tropical forest conservation efforts to be successful, local individuals must be willing and able to participate in the development and implementation of conservation programs. Based on this premise, the rest of the paper is structured as follows. Section 2 describes the current situation in Mexico with emphasis on Calakmul, Campeche. Section 3 discusses issues related to CVM design and survey implementation. Section 4 estimates the model and presents results and a discussion of these results. And, Section 5 contains a brief conclusion.

Mexico: The Case of Calakmul, Campeche

Mexico ranks fourth in the world after Indonesia, Brazil, and Colombia in biodiversity (Toledo, 1988). Mexico has the highest diversity of reptiles in the world and the second

greatest mammal diversity, and it holds 8.7% of the world's amphibian species, 11% of reptile, bird, and mammal species and 14% of all fish species. Furthermore, 32% of Mexico's terrestrial vertebrates and 40-50% of her plant species are endemic (Mittermeier, 1988; Alcérreca, *et al.* 1988; Flores-Villela and Gerez, 1988). This biological richness results from great habitat variation and diverse ecological regions, complex topography, climate, geology, and geographical location. Ecosystems throughout Mexico range from deserts to mangrove swamps and tropical rainforests.

Current estimates of rates of deforestation in Mexico range from 400,000 to 1,500,000 hectares per year, or about 2% of total forest cover in the country (Barbier and Burgess, 1996). These estimates, however, do not account for the large geographical differences in rates of deforestation throughout Mexico. Rates of deforestation vary substantially over geographic regions, with the largest losses occurring in tropical evergreen forests, located almost entirely in the southeastern part of the country (Cairns *et al.*, 1995). According to Deininger and Minten (1999), the rate of deforestation throughout the 1980s in Southeast Mexico was four times the global rate (See table 1). In the 1990s, the estimate of annual deforestation rates for all of Mexico was 1.2%, according to FAO data (<http://www.fao.org/forestry/fo/fra/index.jsp>).

Table 1
Deforestation in Mexico by Region

<i>Region</i>	<i>Deforested Area 1980-1990 (1,000 ha)</i>	<i>Annual rate of deforestation (%)</i>
Northwest	1 474	1.92
Pacific Center	2 669	2.98
Pacific South	5 561	3.75
Southeast	3 662	3.81
Total for Mexico	19 198	2.94

Source: Table 2 in Deininger, Klaus W. and Bart Minten (1999), Poverty, Policies, and Deforestation: The Case of Mexico. *Economic Development and Cultural Change*, 13, 313-344.

In this same period, Mexico increased its parks and reserves system dramatically. The figures given in table 2 account for only biosphere reserves —and not all types of parks and reserves— so they do not reflect the total effort by Mexican authorities. The number of biosphere reserves has almost doubled, and the land area protected by these reserves has increased almost sixfold (table 2). One of the largest biosphere reserves in Mexico is the Calakmul Biosphere Reserve (CBR), located in southeastern Mexico in the state of Campeche (Ericson, 1996).

Table 2
Biosphere Reserves in Mexico

<i>Year</i>	<i>Number of Reserves (X 1000 ha.)</i>	<i>Area</i>
1990	6	1 288
1994	10	5 393
1999	11	6 688

Source: http://earthtrends.wri.org/pdf_library/country_profiles

The Calakmul Biosphere Reserve

Covering 723,185 hectares, the CBR is the largest tract of protected tropical forest in Mexico and an important site for biodiversity conservation. Established in 1989 by presidential decree, the reserve is located in the state of Campeche, in the Yucatán Peninsula (Ericson *et al.*, 1999). Its forests are contiguous with those of the Petén in Guatemala and the foothills of the Maya Mountains of Belize. The CBR is an important element in a larger system of protected areas, which form an ecological corridor of over two million hectares stretching between central Yucatán, northern Guatemala, and the Belizian forests. In 1993, UNESCO's Man and the Biosphere Programme accepted Calakmul into its international network of biosphere reserves.

The Reserve is a patchwork of mature disturbed forest, secondary growth vegetation of less than 25 years, and savanna-type flood plains. The present state of the forest both within the reserve and in the surrounding ejido communities is a result of timber extraction, forest clearing for agriculture, and cattle ranching and the extraction of "chicle." The most abundant tall trees include chicozapote (*Manilkara zapota*) and ramón (*Brosimum alicastrum*) (Ericson *et al.*, 1999). Prominent commercial species are mahogany (*Swietenia macrophylla*) and Spanish cedar (*Cedrela odorata*). Despite transformations in the landscape, the CBR is home to charismatic, threatened, and endangered mammals such as jaguars (*Panthera onca goldmani*) (an estimated population of 125 to 180 resides in the southern nucleus of the reserve), howler monkeys (*Alouatta pigra*), spider monkeys (*Ateles geoffroyi*), and tapir (*Tapirus bairdii*). Thirty percent of the bird species sighted in the reserve breed in the United States and Canada and use these forests as their wintering grounds (Ericson *et al.*, 1999). Some of these neotropical migrants such as the hooded warbler (*Wilsonia citrina*) and the swainson's warbler (*Limnothlypis swainsonii*), are threatened or endangered species (Ericson *et al.*, 1999). In addition to the flora and fauna of Calakmul, there are, of course, the human inhabitants.

Population in the area is increasing due to migration mostly from the neighboring states of Tabasco, Chiapas, and Veracruz. In 1960 Campeche was one of the less populated states in Mexico, with a population density of 2.9 persons per square kilometer. By 1990,

this number reached 9.41 persons per square kilometer and has continued to increase throughout the 1990s (Ericson, 1996). There are approximately 200 ejidos¹ in close proximity to the CBR. The ejido land-tenure system played an important role in the contingent valuation experiment.

The Contingent Valuation Experiment

Several issues arise in determining the appropriate format for the contingent valuation question. Two important decisions are: 1) the use of open-ended or closed questions and 2) the use of willingness to accept (WTA) or willingness to pay (WTP) as a value measure. The most popular design for estimating WTP is the dichotomous-choice closed question (Whitehead, 2000). In addressing the issue of WTA vs. WTP, this paper introduces a third choice, willingness to work (WTW). An explicit discussion of the WTP *versus* WTA argument can be found in Shyamsundar and Kramer (1996). The decision to use WTW, which is a measure of willingness to pay with time instead of money as the “medium of exchange,” was based on several considerations. First, farmers in this region of Mexico earn less than 11 000 pesos annually and exist primarily in a subsistence setting with incomplete markets. Second, work obligations are an important element of social life in Mexico’s agrarian communities.² Theoretically, ejido life is based on principles of community, and spending time helping neighbors or working on village projects is very common.³ Therefore, the concept of working to protect a public or community forest is not unusual. Lastly, the ejido system did not permit the sale of land.⁴ In any other land-ownership context, this issue would have to be addressed as a WTA question. This would simply entail asking the farmers to sell their land for money, but the cultural and legal complexities of the ejido system did not present such a simple alternative.

¹ “Ejido refers to agrarian reform communities granted land taken from large landowners as a result of the agrarian struggles during the Mexican Revolution (1910-1917)... Such land is held corporately by the persons who make up the ejido. Originally, the ejido bestowed use rights on a list of recipients, while the state retained ultimate property rights. Ejido land could not be sold or rented, but holders could pass their use rights on to relatives. As a result, many families have worked the same parcels of land for several generations. In 1992, changes amending Article 27 of the Mexican Constitution made it possible to privatize ejido land following a complex process of land measurement, certification, and individual titling” (Dayton-Johnson, 2000:191).

² Comment from an anonymous referee.

³ Although the reality of ejido life does not always strictly conform to this ideal, I did find a sense of community in all of the ejido in which I worked. I worked in 15 ejidos from January through March while living in Ejido Alvaro Obregon. My experience in 1997 exposed me to a form of “communal” living that I have not again experienced since returning to the United States.

⁴ (Ericson *et al.*, 1999) Land markets are emerging due to changes in the federal constitution and major land tenure reforms in the early 1990’s. During the past couple of years more than 100 hectares of land in Xpujil have been sold.

The question was designed to elicit the willingness of farmers to participate in efforts to conserve an area of forest within the community. This specific question was part of a larger survey aimed at analyzing farmers' agricultural practices and preferences for agroforestry. Considerations in the development of the survey included 1) the need to convey that no products could ever be taken from the forest, 2) the fact that forest was communal, *i.e.*, public, and 3) the requirement of working to insure the protection of the forest. Using the CVM in this context is very different from conducting a standard mall-intercept, mail, or telephone survey. The length of the survey and the amount of time to complete it were important considerations, as was the total amount of information presented to the respondent. Therefore, in this context, the survey's simplicity is, perhaps, the most important feature. The question of how best to elicit reliable information in the simplest of contexts was the main issue in designing the CVM experiment. To this end, focus groups with local farmers and extension agents, as well as informal conversations with several extension agents, were used.⁵ In addition, the question was pretested on a subsample of farmers. In the end, choices were made in terms of 1) explicitly defining the commodity, 2) explicitly defining the tradeoff, and 3) using reminders of constraints for the sake of simplicity. However, the goal was not necessarily to estimate a monetary amount for a specified increase in forest area, but rather to gain some insight to farmers' willingness to contribute to conservation efforts. Therefore, the following question was asked of a total of 185 farmers.

Suppose your ejido is considering a new program for conserving an area of communal forest. In the forest area, there will be no extraction of wood, plants, chicle, nothing. This area is only to protect plants, animals, water and air quality for the future. However, it will be necessary for each member of the community to work X number of days each month in the forest. Are you willing to do this?

Participants were randomly assigned to one of seven bid levels, ranging from one to seven days per month. Individual farmers were interviewed during the period, January 1998 through March 1998. Farmers were also asked about their current farming methods, experience with tree harvesting, and interest in participating in an agroforestry development program. Farmers from 15 ejidos were interviewed. The total population to choose from consisted of all the ejidos participating in *consejo*, the regional council for development in Calakmul. At the time, there were 60 communities participating in *consejo*. The decision to conduct a stratified random sample of the entire region was predicated on two factors. First, the amount of rainfall in the southeast is substantially higher than in the northwest,

⁵ The survey instrument was translated into Spanish with an emphasis on local use of the language by Ing. Carlos Reyes. Ing. Reyes was, at the time, an employee of the International Center for Research in Agroforestry and had been working in the region for several years prior to my arrival.

so I stratified by rainfall zone. These zones were chosen based upon several conversations with local forestry and agricultural extension workers and their impressions of rainfall patterns in the region. I was not able to obtain actual rainfall data, so the dummy variable approach is used as a next best alternative.⁶ Secondly, a decision was made to interview a minimum of 20% of the total communities in *consejo* and to interview a minimum of 20% of the individuals in each community. Table 3 contains a list of each of the communities surveyed, the total population in each community, the number of people interviewed, and some socioeconomic information for each ejido.



Table 3
Ejidos Surveyed and socioeconomic information

EJIDO	# of ejidatarios	Ejidatarios Surveyed	# of Age children	Years in present place	Distance to fields	Primary forest Ha/person	% of total land			
							area in primary forest	Current AF users %	Participation in gov/ngo programs	
Ley de Fomento	44	15	33.1	3.1	7.9	4.8	70.2	70%	20%	33%
Felipe Angeles	24	10	39.4	4	3.9	0.73	20.9	52%	50%	80%
11 de Mayo	57	17	38.8	3.8	11.1	2.4	23.9	48%	35%	59%
La Guadalupe	84	22	41	5.1	12.4	2.2	18	45%	23%	27%
Josefa Ortiz	34	13	33.2	3.7	10.5	1.4	8.5	36%	31%	46%
El Refugio	30	12	31.3	2.8	9.1	2.5	32.2	61%	58%	50%
Carmen II	58	16	37.2	3.6	19.7	4.3	9.8	24%	25%	31%
Castellot	20	13	37	2.3	8.7	1	22.8	57%	31%	46%
Heriberto Jara	54	9	45.6	7.1	14.8	3.6	10.1	51%	56%	44%
Centauro del Norte	60	10	39.4	3.8	8.9	2.8	88.7	89%	10%	40%
20 de Junio	57	11	33.1	5.6	7.4	3	43.1	86%	27%	27%
Nueva Vida	40	10	46.5	3	8.1	3.2	27.7	55%	20%	60%
16 de Septiembre	26	8	39.3	4.9	6.3	4.2	20	40%	0%	63%

Empirical Model and Results

The primary question of this paper is whether farmers are interested in conserving forests, and, if so, how much time they are willing to contribute to forest-conservation efforts. Numerous approaches have been suggested for estimating the appropriate value for use as a welfare measure. In this case, I am interested in farmers' willingness-to-work (WTW), because the tradeoff is not monetary; rather, it is the specific number of days a farmer would be willing to work to contribute to forest conservation. The dichotomous-choice format was chosen to elicit this response. Therefore, the probability of an affirmative

⁶ Ideally I would have preferred to have individual rainfall data from INEGI or CONAB, or some other reliable source, but my conversations with Ing. Uc and other local agricultural technicians allows me to feel comfortable with the "proxy" estimation.

response to the single bound question depends on the probability that WTW , with a random error, is greater than the number of days asked of the respondent ($DAYS$).

$$\Pr(\text{YES}) = \Pr(WTW + \varepsilon > DAYS) \quad (1)$$

It is assumed that e is normally distributed, and since the response to the number of workdays is a discrete (non-continuous) variable, a standard probit model is employed (Whitehead *et al.*, 2000). For any individual in the sample, we can observe the choice of *yes* or *no*, and therefore define a discrete economic variable y as the outcome:

$$\begin{aligned} Y = 1 & \quad \text{if the individual says "yes, I am willing to work"} \\ Y = 0 & \quad \text{if the individual says "no, I am not willing to work"} \end{aligned}$$

Since we assume the individual is maximizing utility, $Y=1$ when the individual derives more utility from working to preserve an area of forest than from not working the specified number of days per month ($DAYS$). That is,

$$\begin{aligned} U_f &= \text{utility from working in the forest preserve} \\ U_n &= \text{utility from using this time for leisure} \end{aligned}$$

Then,

$$Y = 1 \quad \text{if } U_f > U_n \quad (2)$$

$$Y = 0 \quad \text{if } U_n \geq U_f \quad (3)$$

The outcome of the choice is random because the researcher cannot predict with certainty the response of a randomly selected individual. The choice of whether or not to work to preserve forests is a function of both observable and unobservable characteristics of the individual farmer. To determine the probability (\Pr) that a randomly selected farmer chooses $Y = 1$, the probit model is appropriate, as it is a nonlinear (in the parameters) statistical model that achieves the objective of relating choice probability (\Pr) to explanatory variables in such a way as to keep the probability in the $[0,1]$ interval (Whitehead *et al.*, 2000). Economic theory tells us that the probability of an affirmative response will decrease with increases in the number of workdays ($DAYS$).

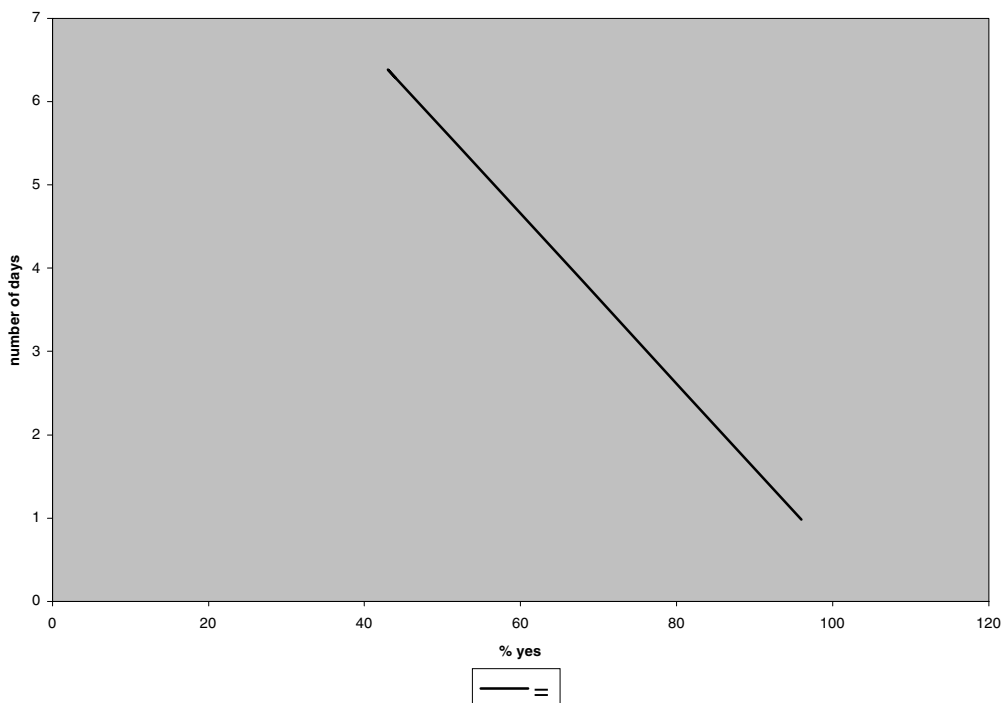


Figure 1. Demand curve

Therefore, the estimated equation is

$$\text{Pr}(\text{YES}) = Xb + \varepsilon \quad (4)$$

where b is a vector of the probit coefficients and X is a vector of explanatory variables including the number of workdays ($DAYS$). Mean w_{TW} can then be estimated at the means of the independent variables using the procedures developed by Cameron (1987).

The Ejidatarios of Calakmul

It is difficult to arrive at generalized conclusions about the farmers that inhabit the area around the Calakmul reserve. One farmer may be in his late 50s, may no longer have children at home, and may have lived in his present location for over 15 years. The next farmer may be in his 20s, with 8 or 9 children living at home, and may have moved to the region within the past two years. Also, interestingly, on average, farmers in Calakmul keep over 56% of their total land area in primary forest cover. Moreover, on average, when farmers arrived at their present locations, approximately 22% of the primary forest (roughly 10 hectares) had already been cleared, —that is, on average, these farmers have cleared only 11 hectares, or an additional 24% of the total land area. The typical *ejidatario*

living in Calakmul is 38 years old, with 4 children living at home. He has lived on his present ejido for 11 years and walks almost 6 kilometers daily to and from his field. This farmer has access to almost 50 hectares and currently has almost 30 hectares forested. In addition, he has about five hectares under production and an annual income from agriculture and forestry of 11 428 pesos, or, at the present (1998) exchange rate, approximately US\$1,200. Lastly, of all the farmers we interviewed, 43% had participated in some type of forestry-related development program, but when asked if they had any forestry experience on their own *parcelas*, in addition to their agricultural practices, only 17% responded in the affirmative.

The ejido with the largest total amount of primary forest remaining is Centauro del Norte, located immediately adjacent to the biosphere reserve, and it also has the largest percentage of primary forest remaining. Ejido Josefa Ortiz has the fewest remaining hectares of primary forest per farmer and also the smallest percentage, at only 36. The newest arrivals to their current ejido are farmers living in Felipe Angeles, and those living in their present place the longest are the farmers at Carmen II. With respect to walking distance to their fields, again we find Felipe Angeles and Carmen II at the extremes. Ejidatarios in Felipe Angeles walk about three-quarters of a kilometer to their *parcelas* and those at Carmen II walk almost 4.5 kilometers, one-way, per day. El Refugio and Heriberto Jara have the highest percentage of farmers currently using agroforestry as a production method, with 58% and 56%, respectively. Lastly, farmers at 20 de Junio and La Lupe are least likely to have participated in a development program, and farmers at Felipe Angeles are the most likely to have had contact with a governmental or non-governmental development practitioner.



Willingness-to-Work

The response to the number of workdays is first analyzed by looking at the percentage of affirmative responses to each workday level. The percentage of affirmative responses follows the expected pattern, based on standard economic theory of demand, decreasing at each interval from 96% at 1 day to 44% at 7 days.

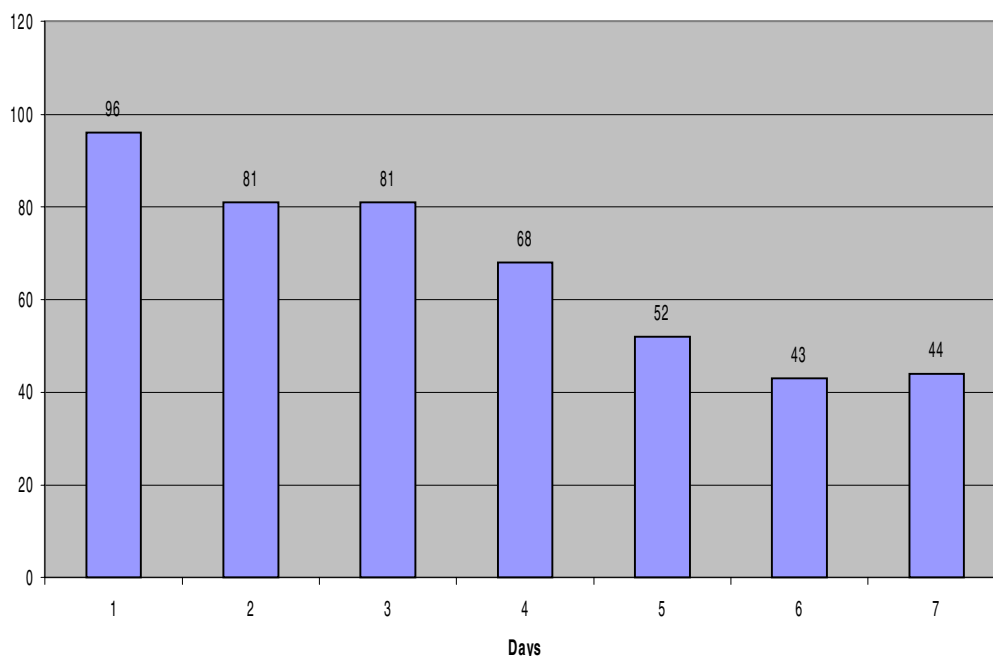


Figure 2. Percent yes response

Based on a nonparametric technique⁷ suggested by McConnell and Haab (1997), the estimated wtw is 4.6 days per month. The econometric equation is then specified with the survey data, as follows:

$$Y = B + B1(\text{COSTS}) + B2(\text{SOCIOECONOMIC}) + B3(\text{ENVIRONMENTAL ATTITUDE}) + e$$

$$B1 = (\text{Bid, distance})$$

$$B2 = (\text{income, strata, kids, education, years, seeds})$$

$$B3 = (\text{trees, success, participate, experience, forest})$$

The response to the wtw question is regressed on the explanatory variables thought to influence the decision to participate in a forest-conservation effort. There are three categories of explanatory variables: 1) cost variables, 2) socioeconomic variables, and 3)

⁷ The Turnbull Estimator, which is explained in full detail in the McConnell and Haab (1997) paper.

environmental-attitude variables. Cost variables include the number of workdays (*DAYS*) and the distance from the house to the farm (*DISTANCE*). Socioeconomic variables designed to account for heterogeneity in the population include (*INCOME*), number of children living at home (*KIDS*), a dummy variable to differentiate between those with and without primary level of education (*EDUC*), the number of years living at the current location (*YEARS*), farmers' belief that have a good seed source in their forest (*SEEDS*), and residence in an area with higher annual rainfall (*STRATA*). Environmental attitude variables include acres of trees planted on the farm (*TREES*), survival rate of current tree plantations (*SUCC*), participation in conservation and development programs (*PART*), forestry-related experience (*EXP*), and hectares of forest remaining on the farm (*FOR*). A description of each variable with mean values, standard deviations, minimum and maximum values is found in table 4.

Table 4
Variables Included in Model Specification

<i>Variable name and description</i>	<i>mean</i>	<i>Stand Dev.</i>	<i>min</i>	<i>max</i>
Response: 1 if yes, 0 if no	0.665	0.47	0	1
DAYS: number of workdays	3.9	1.9	1	7
Distance: The distance the farmer has to travel to get to his fields	2.9	2.3	0	10
*Strata: Dummy variable 0 if NW zone and 1 if SE zone.	.39	.49	0	1
Kids: number of children living at home	4	2.9	0	12
Education: dummy for those who have completed primary school	.39	.49	0	1
Years: The number of years farmer has been living at the present location	10.9	6.4	.3	36
Income: Total income from the sale of agricultural and forestry related products	11363	12269	0	63000
Experience: Farmers who had agricultural experience before colonizing to Calakmul and have since obtained; Some forestry experience received a 1 and all others a 0	.17	.37	0	1
Trees: The number of hectares currently planted in an agroforestry system	1.3	2.5	0	15
Forest: Hectares of forest on the farm	28	24.7	0	95
Success: Dummy variable indicating farmers who say they are happy with their current plantation. 1 if yes, 0 if no	.31	.46	0	1
Seeds: Dummy variable indicating whether or not the farmer thinks the local forest is a good source for seeds and seedlings. 1 if yes, 0 if no	.53	.5	0	1
Participate: If a farmer has participated in any forestry-related program he receives a 1, and all others 0.	.46	.5	0	1

The most important explanatory variable, as expected, is the number of workdays: *DAYS* is negative and significant at .001. Importantly, the sign and magnitude of the effect of *DAYS* is robust across the two estimations. Other variables of significance are *EXP* (.01), *FOR* (.01), *DIST* (-.01), *SUCC* (.01), and *STRATA* (.05). The distance variable suggests that farmers who live farther from their fields are less likely to be willing to work for a forest preserve. Perhaps this is due to the extra distance of walking to work, which for some farmers is up to 10 km one-way, per day (see table 5). The three variables that are positive and significant tell an interesting story. Farmers with forestry experience, larger areas of forest remaining on their own farms, and previous success with planting trees are more likely to be willing to work to preserve a forest area. These make up three of the five environmental attitude variables. These variables suggest that farmers who preserve more of their own land in forest and have been successful at propagating trees on their farms are more willing to work for the conservation of a “public” or communal forest area.

Although the signs and magnitude of the probit coefficients are indicative of changes in the probability of an affirmative response, they need to be re-parameterized in order to determine their marginal impacts and to develop the wtw estimate using Cameron’s (1987) technique. Evaluated at the mean for each of the explanatory variables, the marginal effect measures the change in the probability of an affirmative response of a one-unit change in the explanatory variable. For example, an increase in the bid amount from 3.9 days to 4.9 days decreases the probability of a *yes* response by approximately 10%. For each of the dummy variables the marginal effect is for the discrete change from 0 to 1. For example, farmers with forestry experience are 26% more likely to respond affirmatively than those without this experience. Farmers who are satisfied with their current tree plantations are 22% more likely to respond affirmatively than those who have not been successful, and a one-hectare increase in forest area leads to a 0.6% increase in the probability of an affirmative response. The final step is to estimate the wtw for a forest preserve.

$$E(\text{WTW}) = \sum XB \quad (5)$$

$$B = -(\delta/\alpha)$$

δ = vector of all estimated coefficients


α = the estimated coefficient of the *DAYS* variable

In applying Cameron’s (1987) technique, we find that the mean willingness to work is an estimated 2.7 days per month. This is slightly more than one weekend per month, which does not seem unrealistic. It is even more believable when one considers the importance of community service in ejido life and the distinct possibility that working with friends on a communal project might be worthwhile in and of itself. Note that when we consider only the *DAYS* variable the estimate is more than twice the estimate from the

full model. The simple model greatly inflates the wtw estimate, and controlling for other influences in the estimation is crucial for developing reliable welfare estimates.

Conclusion

In the past decade we have witnessed an increase in applications of the CVM in developing countries (Shyamsundar and Kramer, 1996; Mekkonen, 2000; Kohlin, 2001; Hammitt *et al.*, 2001). The focus of this paper was to determine farmers' willingness-to-work in order to conserve local forest resources. Life in these small villages on the Yucatán Peninsula of Mexico is rooted in community service. Members of the community often donate their labor services to community projects. Hence, subsistence farmers were asked a contingent valuation question, in order to determine their willingness-to-work to create and maintain a local forest conservation area. Not surprisingly, farmers exhibit a strong willingness-to-work for forest conservation, and the responses are consistent with economic theory—that is, costs matter.

The probit model is well specified and based on accepted criteria, and the wtw estimate provides suggestive evidence that the typical farmer is willing to work slightly less than three days per month to insure the conservation of local forest resources for future generations. Certainly, there is a need for more research on the use of non-market valuation techniques for valuing environmental resources in this context. The results of this study suggest the CVM may be a useful tool for determining the viability of local participation in forest conservation efforts. Farmers in southeastern Mexico are interested in forest conservation and are willing to contribute to efforts to conserve forest resources. 

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