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Non-market valuation of *natural and environmental* resources in Central *America and the Caribbean*

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An inventory and assessment was made of 15 non-market valuation studies in Central American and Caribbean countries. Most utilized the contingent valuation method to determine willingness to pay for drinking water or protected areas. The method used suffered from a reliance on open-ended bidding, information framing and contingent scenarios lacking detail, limited population samples, and possible cultural-strategic biases associated with surveying local residents. Problems observed with respect to the single travel cost method study reviewed were a reliance on poor quality census data rather than visitor survey data, and unrealistic assumptions regarding transportation cost estimates, single-destination visitors, and consumer surplus levels of international visitors. The two hedonic valuation method studies reviewed suffered from the existence of heterogeneous neighbourhood market segments and the inability to obtain reliable property values. In conclusion, various strategies and a research agenda to improve non-market valuation studies in Central American and Caribbean countries are suggested.

I

Introduction

Non-market valuation methodologies are commonly used to place monetary values on various natural resources and environmental amenities in developed countries. The contingent valuation method (CVM) uses surveys to determine people's willingness to pay for hypothetical improvements in different types of natural resources or environmental services which do not have market prices. The travel cost method (TCM) estimates demand curves for recreational resources based on observed travel and other expenditures in order to determine the underlying economic value of those resources. The hedonic valuation method (HVM) measures the value of environmental goods by quantifying the effect that their provision or absence has on the actual market prices of related goods such as housing or property values.

There is considerable interest in applying non-market valuation methodologies in developing countries also, in spite of the fact that the economic valuation of many environmental goods and services which do not have market prices, even in developed countries, is not without errors and potential problems. The interest in the use of non-market valuation studies in Central America, the Caribbean, and other developing countries is due to the fact that many of these countries are now experiencing significant environmental impacts and degradation of natural resources associated with development efforts (Dasgupta and Mäler, 1996). There is therefore a critical need to be able to quantify the value of environmental goods and services and environmental impacts in these countries within the context of policy-based cost-benefit analyses.

In spite of the thousands of non-market valuation studies that have been conducted throughout the world (over 1600 CVM studies alone), a 1993 literature review found only 25 cited (published and unpublished) non-market valuation studies in developing countries (Ekbohm, 1993). Less than 40% of these studies were published in refereed journals or edited books and most were focused on the valuation of water supplies or protected areas. The majority (13) were CVM studies, while there were eight TCM and four HVM studies. This closely follows the relative distribution of non-market valuation studies in developed countries.

A great deal of the published non-market valuation literature in developed countries has focused on methodological issues associated with the appropriateness, validity, and reliability of these methodologies. It has generally been concluded that in spite of both theoretical and practical limitations, the CVM, TCM and HVM methods are generally valid and appropriate for valuing many types of different environmental goods and services in those countries. However, very few similar methodologically focused non-market valuation studies have been undertaken in developing countries. In other words, it seems to have been implicitly assumed that non-market valuation methods pioneered and tested in the United States and Western Europe can be directly applied and used in Central America, the Caribbean, and other developing regions.

Exceptions to this are the books by Dixon, Scura, Carpenter and Sherman (1994) and Georgiou, Whittington, Pearce and Moran (1997) which, on the basis of summarized case studies, explore the potential uses, advantages and problems associated with a variety of non-market valuation techniques that have been used in a variety of developing countries throughout the world. Several other published studies have discussed the methodological issues associated with the use of the CVM method in developing countries, including Whittington, Smith and others (1992), the World Bank Water Research Team (1993), Shyamsundar and Kramer (1996), and Hardner (1996). Similarly, the advantages and difficulties in using the TCM method in developing countries have been discussed in at least two cases by Edwards (1991), and Navrud and Mungatana (1994). However, no known research has yet been conducted on the applicability and reliability of the HVM method in developing countries.

The few existing developing country non-market valuation case studies with a methodological focus have almost always been confined to a few individual countries or locations, while making the implicit, or in some cases the explicit, assumption that their results are applicable to other developing countries, regardless of site-specific socioeconomic, cultural, and resource degradation characteristics. Since it has not

yet been established whether the conditions, applicability, and usefulness of non-market valuations are similar in all of the developing countries of the world, it is proposed that cross-country or regional evaluations and assessments of non-market valuation methods should be undertaken.

The objective of the present study is to make an inventory and a critical assessment of the non-market valuation method studies or, more specifically, of the contingent, travel cost and hedonic valuation method studies that have been conducted in different Central

American and Caribbean countries. This geographical focus of the assessment is limited to this region rather than covering all the developing countries of the world, because these countries of Middle America share similar cultures and languages (Spanish and English), as well as many similar development strategies and environmental degradation problems. To the best of the author's knowledge, no previous inventories or assessments of non-market valuation methods have yet been made for the countries of Central America and the Caribbean.

II

Non-market valuation studies

The inventory of non-market valuation studies in the countries of Central America and the Caribbean was made through an extensive review of the available books, journals, research theses and consulting studies and is summarized in table 1. While this inventory is considered comprehensive up until 1997, it should be realized that additional non-market valuation studies in these same countries, especially those in the "gray literature", and those conducted in the last year may possibly not have been accounted for in this inventory.

CVM studies are by far the most frequent type of non-market studies that have been conducted in the

countries of Central America and Caribbean, and in fact only one TCM and two HVM studies have been conducted in those countries. Almost all of these non-market studies have taken place in Costa Rica, for two specific reasons. First, Costa Rica is the host country of the only two educational centres in the region that offer graduate degrees in the field of environmental economics and also of many of the region's international development organizations. Second, Costa Rica has in the last decade been at the forefront of many conservation and sustainable development programmes in Central America.

III

Contingent Valuation Method studies in Central American and Caribbean countries

The contingent valuation method (CVM) is the most common of the non-market valuation methods. It attempts, through the use of a survey, to measure individuals' willingness to pay for hypothetical improvements in various natural resources and other public goods, including the preservation of ecosystems, air and water quality, and a long list of other natural resources and environmental goods and services. Years of CVM research covering a wide spectrum of methodological issues involving a variety of different environmental amenities have resulted in wide acceptance of this

method as a reliable valuation technique, even though it is recognized that there is a risk that it may be poorly applied or misused (Mitchell and Carson, 1995).

Almost all 12 of the CVM studies conducted in Central American and Caribbean countries were focused on the valuation of either the supply of drinking water or the establishment and conservation of protected areas. Only three of these studies are to be published as journal articles or book chapters, and only two (Whittington, Briscoe, Mu and Barron,

TABLE 1

**Central American and Caribbean countries:
Inventory of non-market valuation studies**

Study/Topic	Year	Location(s)	Author(s) ^a	Type of publication
<i>CVM Studies</i>				
WTP (Willingness to Pay) for a sewer system	1988	Barbados	McConnel and Ducci, 1989	Paper
Estimating WTP for water services in developing countries: A case study in southern Haiti	1990	Laurent, Haiti	Whittington, Smith and others, 1992	<i>Economic Development and Cultural Change</i> , 38(2) 293-311.
User fees at protected areas in Costa Rica	1991	Poas, Manuel Antonio and Cahuita Parks, Costa Rica	Baldares and Laarman, 1991	<i>Valuing Environment Benefits in Developing Countries</i>
Nature tourism and its development in Guatemala: assessing current trends and future potential	1992	Tikal, Guatemala	Barry, 1992	Master Thesis
Ecology and economics of Bonaire Marine Park	1993	Bonaire Marine Park, Bonaire Island	Scura and van 't Hof, 1993	World Bank publication
National park entrance fees in Costa Rica	1995	Poas, Manuel Antonio and Irazú parks, Costa Rica	Chase, 1995	Master Thesis, Cornell University
Valuation of non-priced amenities provided by the biological resources of a preserve	1995	Monteverde Preserve, Costa Rica	Echeverría, Hanrahan and Solórzano, 1995	<i>Ecological Economics</i> 13, 1995
WTP for improved communal water services	1995	Limon and Guanacaste Costa Rica	Aguilar and Sterner, 1995	Working Paper 1995:8, Environmental Economics Unit, University of Gothenburg, Sweden
Economic valuation of water supplies from La Tigra National Park	1996	Tegucigalpa, Honduras	Salgado, 1996	Master Thesis, Research and Training Center for Tropical Agronomy (CATIE), Costa Rica
WTP to enter Costa Rica's National Parks	1996	Poas, Manuel Antonio, Costa Rica	Pinazzo, 1995; Shultz, Pinazzo and Cifuentes (forthcoming)	Master Thesis, CATIE, Costa Rica
Economic valuation of water in poor neighbourhoods of El Salvador	1997	Apopa, San Marcos and Ilopango, El Salvador	Mendoza, 1996	Master Thesis in progress, National University, Costa Rica
Economic benefits of maintaining ecological integrity of the River Mameyes	1997	Puerto Rico	González-Caban and Loomis, 1997	<i>Ecological Economics</i> , 20(4)
<i>TCM Studies</i>				
Valuing ecotourism in a rain-forest preserve	1991	Monteverde, Costa Rica	Tobias and Mendelsohn, 1991	<i>Ambio</i> , 20(2), 1991
<i>HVM Studies</i>				
Economic values of sewage and flooding risks associated with Turrialba rivers	1994	Turrialba, Costa Rica	Shultz, 1994	Study
Resource characteristics and farm values in a multiple-use pristine tropical watershed	1996	Pacuare River, Costa Rica	Shultz, Sáenz and Hyman, 1996	<i>IUCN Global Bio-Diversity Forum</i>

^a For more details, see Bibliography at the end of this article.

1990, and Echeverría, Hanrahan and Solárzano, 1995) include methodologically based validation focuses within their study designs.

Most of these studies utilized open-ended bidding question formats, contained limited information framing and contingent scenarios, were based on limited sample populations, and were potentially exposed to cultural-strategic biases associated with the use of personal surveys of local residents. These problems were found most often in the CVM studies conducted by graduate students or professionals (both national and international) working permanently in the countries in question. However, it should be noted that the few studies conducted by experts from outside the region that did not display any detectable structural problems were either focused only on international visitors or were conducted with levels of financial resources significantly higher than those generally available in Central America, the Caribbean, and other developing countries. A more detailed analysis of the specific problems found in these CVM studies is presented below.

Open-ended bidding formats were used in almost half of the CVM studies, rather than discrete or iterative bidding formats. While being relatively simple to design and administer, such open-ended formats can often appear very hypothetical and dissimilar to many real world market transactions, and may be subject to strategic biases associated with free-riders who intentionally over or understate their true willingness to pay. In contrast, discrete bidding (also known as dichotomous choice or referendum bidding) has become the most widely accepted and used CVM bidding format, as the yes/no question format closely matches the way consumers make choices in the marketplace. This format has also been shown to minimize both hypothetical and strategic biases, and to be consistent with utility maximization theory, which facilitates the estimation of statistically robust mean willingness-to-pay values (Cummings, Brookshire and Schulze, 1986, and Mitchell and Carson, 1995.).

There are two specific reasons why the problematic open-ended bidding format has been used so extensively in these CVM studies in Central America and the Caribbean. First, it is likely that there is a lack of knowledge in these countries regarding recent CVM literature and state-of-the-art methodologies. Second, and closely related to this, there is a general scarcity of trained economists and statisticians specializing in environmental economics working in the

region who are capable of estimating and interpreting the relatively more complex non-linear willingness-to-pay regression equations associated with discrete and iterative bidding formats. Hopefully, both of these constraints will be removed in the coming years with the continuation of recently initiated campaigns to train environmental economists in these countries. Specifically, both the National University of Costa Rica (UNCR) and the Research and Training Centre for Tropical Agronomy (CATIE), which is located in Costa Rica but serves the entire region, are actively working to this end. Both these institutions have recently begun to offer regional master's level graduate programmes, in ecological economics and environmental economics respectively (Shultz, 1996). In addition, the Swedish International Development Agency (SIDA), through its Environmental Economics Programme administered by the Environmental Economics Unit of the University of Gothenburg, in conjunction with CATIE, has been actively promoting capacity-building in environmental economics in Central America and in certain Caribbean countries through a variety of educational and training programmes that include non-market valuation workshops and training seminars.

Limited information framing and/or contingent scenarios were noted in almost all of the CVM studies reviewed, even though there are many explicit references and warnings in the literature regarding the need to provide detailed information on the actual situation surrounding the natural resource being valued (this is known as "information framing"), as well as an explicit description of the proposed change in the resource (known as "contingent scenarios") (Mitchell and Carson, 1989 and 1995).

With regard to the CVM studies on drinking water supply, one (Salgado, 1996) simply asked respondents, without giving any description of the current or proposed future water system, the following question: "If your water system was permanently improved, what would you be willing to pay for this service?" Another study (Mendoza, 1996) included slightly more specific information by presenting respondents with the question: "Assume that you will be offered a better service, which means good quality water with no scarcity of water. You can trust in the new system to provide good drinking water at all times of the day and year ... What is your willingness to pay?". Again, no specific information was provided to respondents regarding the details of the existing or proposed water systems. At the other end of the spectrum, however, one

of the CVM studies (Whittington, Briscoe, Mu and Barron, 1990), which was conducted in rural Haiti, contained detailed information framing and even went as far as to show survey participants photographs of proposed water supply systems before asking about their willingness to pay.

Regarding the studies on protected areas, one (Chase, 1995) simply asked respondents: "In your opinion, what is a fair price for this park?" and, "If the entrance fee for only this park were increased, what would be the daily per-person price for which you would decide not to visit this park?". Another study (Pinazzo, 1995) offered slightly more specific information to respondents with the question: "If the infrastructure and services in this park are greatly improved, would you be willing to pay \$(BID) for the entrance fee in a future visit?". However this CVM question still lacked specific information regarding exactly what the improvements to park infrastructure and services would be. Two justifications put forward for this lack of detailed information framing were that the willingness-to-pay question was intentionally non-site-specific in order to evaluate the use of the CVM to value different types of parks (in this case a volcano and a beach park with very different characteristics and needed improvements) and second, that because the surveyed respondents had just visited the park in question, they were therefore expected to have a fairly good idea of the quantity and quality of existing park infrastructure and services (Shultz, Pinazzo and Cifuentes (forthcoming)).

The protected-area-related CVM survey with the most complete information framing and contingent scenarios was conducted by Echeverria, Hanrahan and Solórzano (1995) and included the following question: "On your trip up to the Monteverde Cloud Forest Preserve, you may have noticed large deforested areas visible from the road that are now grass cattle pastures that are being used for agriculture or plain unused eroded hills. In earlier times, these areas were covered with tropical forests similar to the Monteverde forest you have just visited. Monteverde itself is regularly threatened by colonists and settlers, who seek to remove the forest and convert it to cattle pastures or other agricultural uses. Imagine no organization presently exists to prevent such conversion ... Would you be willing to make payment of \$ X per year from your own income to support a non-private organization which will protect the preserve and guarantee its continued existence?".

While this study provided more detailed information than the other studies, this contingent scenario still did not specifically mention how the proposed organization would protect the preserve, nor did it suggest a viable means whereby respondents could make payments.

There are two possible reasons why many CVM studies in Central American and Caribbean countries have not incorporated sufficiently detailed information framing and contingent scenarios. First, as stated earlier, it is likely that many economists in these countries may be lacking knowledge and information about CVM literature and state-of-the-art methodologies. Hopefully, in the near future these limitations will be remedied as a result of the previously described educational and training efforts in the region in the field of environmental economics. A second possible reason for lack of specific information framing in the CVM questions is that they try to keep willingness-to-pay scenarios as short and simple as possible in order not to confuse respondents or possibly, as mentioned in one of the Costa Rican CVM protected areas studies (Shultz, Pinazzo and Cifuentes (forthcoming)), to facilitate comparison of willingness-to-pay values among different study sites with different characteristics. It is recommended that further research be conducted to evaluate the potential magnitude of different types of information bias when estimating willingness-to-pay values for different types of natural resources in different locations. In the meantime, it is strongly advised that researchers working in Central American and Caribbean countries try to include more detailed information framing and contingent scenarios in their CVM surveys.

The use of limited population samples was noted in all of the reviewed CVM studies associated with the valuation of protected areas. Specifically, only actual visitors to the various protected areas were surveyed, through on-site entrance or exit surveys. This is acceptable if the intention of the studies was only to determine willingness-to-pay values for future return visits to these protected areas. However, if the intention of the studies was to determine the willingness to pay of all possible visitors (both actual and potential) to a particular protected area (and hence the total consumer surplus value of the protected area, which is usually what economists will be interested in estimating), then a biased sampling frame is being used. A possible solution which would avoid sampling the

complete (actual and potential) population of international visitors to protected areas would be to carry out spot surveys of international tourists at random points throughout the country or, better still, when leaving the country at the international airport(s). The task of randomly sampling and surveying a complete population of residents of a particular Central American or Caribbean country is much more problematic and potentially expensive, however, because many of the residents of these countries do not have mailing addresses and/or use well-defined street addresses, thus voiding the potential use of population lists and/or telephone directories as sampling frames. Furthermore, most residents do not have telephones in their homes and telephone surveys themselves are not widely used or accepted. Finally, a large percentage of residents in these and other developing countries live in rural areas that are difficult to access, so that the administration of personal (face to face) household surveys, even if based on stratified survey designs, is likely to be a time-consuming and expensive activity. It is therefore proposed that further research be conducted in these countries regarding the validity and cost effectiveness of surveying national residents.

Finally, the existence of possible cultural-strategic biases associated with personal surveys of resident populations was noted in two of the reviewed CVM studies (Echeverría, Hanrahan and Solórzano, 1995, and Shultz, Pinazzo and Cifuentes (forthcoming)), and it is suspected that this could be a potential problem with other CVM studies in Central America, the Caribbean and other developing countries. In the CVM literature, incidences of strategic bias have been noted in the form of respondents intentionally reporting false willingness-to-pay values in order to influence the valuation process (Cummings, Brookshire and Schulze, 1986). The two CVM case studies assessed here, however, are suspected of suffering from cultural strategic bias, which is believed to be different from traditionally defined strategic bias. Specifically, it is suspected that resident respondents in the above two CVM studies of protected areas in Costa Rica may have falsely reported their willingness-to-pay values not in order to intentionally manipulate the valuation of a resource, but rather as a result of their unfamiliarity with personal surveys and the process of providing candid and truthful responses to interviewers. In the United States and other developed countries where CVM survey work was pioneered, most people are very familiar with

answering a wide range of personal, mail, and telephone surveys on a wide range of subjects. Generally speaking, it is believed that these developed country respondents, who have more experience with surveys, are less likely to feel embarrassed about answering negatively to a willingness-to-pay question than are local residents of Costa Rica and possibly other Central American, Caribbean and developing countries who are not as accustomed and/or familiar with survey questionnaires, and in particular personal surveys and their intended non-personal, truth-seeking and confidential nature. The first of these suspected occurrences of cultural strategic bias is in the Monteverde forest preserve CVM study by Echeverría, Hanrahan and Solórzano (1995), where Costa Rican visitors were found to value the protected area 13% higher than foreign visitors (a statistically significant difference), in spite of the fact that their incomes were about 345% lower than those of the foreign visitors. Similarly, in a second Costa Rican CVM protected area study by Shultz, Pinazzo and Cifuentes (forthcoming), it was noted that the willingness-to-pay values among residents (US\$11 and US\$13) were almost 600% higher than the actual entrance fees of US\$2, while foreigners' willingness-to-pay values were on average only 250% higher than the existing entrance fees.

In Central American and Caribbean countries, the existence of strategic bias has been tested for *a priori* in only one case, in southern Haiti, where two groups of respondents were offered different willingness-to-pay scenarios, each with a different likelihood of actually having to pay (Whittington, Briscoe, Mu and Barron, 1990). In this particular case, however, strategic bias was not found to be statistically significant. It is suggested that the previously described educational efforts in the region in the field of environmental economics be continued or expanded in order to help improve the levels of understanding of CVM literature and methodologies. Likewise, it is suggested that CVM research efforts be undertaken in Central America, the Caribbean and other developing countries to carefully evaluate the existence of cultural strategic biases among local residents and, more specifically, to determine whether willingness-to-pay responses vary with different survey and question formats, and particularly if there exist differences in willingness-to-pay values as between face to face personal interviews versus survey formats that allow respondents to state their willingness-to-pay in a more private and confidential manner.

IV

Travel Cost Method studies in Central American and Caribbean countries

The travel cost method (TCM) is the second most frequently used non-market valuation method in developed countries. It is based on the estimation of a demand curve and corresponding levels of consumer surplus for a recreation site by assuming that the price of consuming recreation at that site varies directly with the distance visitors travel to the site and their related travel costs (Clawson and Knetsch, 1966). The TCM is a particularly important valuation method because many public parks and protected areas are free or have very low and/or subsidized entrance fees, meaning that their existence and protection is likely to be associated with high levels of consumer surplus. Specific applications of the TCM method include determining the net economic values of existing, modified, or proposed recreation sites, predicting travel behaviour and visiting patterns for individual sites or groups of related recreation sites, and forecasting changes in the visiting of recreation sites resulting from changing site conditions or changing tastes and income levels of visitors (Ward and Loomis, 1986).

The only known TCM study that has been conducted in a Central American or Caribbean country is the study by Tobías and Mendelsohn (1991), which estimated that the consumer surplus of the Monteverde tropical rain-forest preserve in Costa Rica, for both national and foreign visitors, was between US\$400,000 and US\$500,000 annually, corresponding to a per-person value of US\$35 and a per-hectare value of US\$1250.

The study was based on a zonal variant of the TCM method that involved collecting the addresses of national visitors to the preserve to determine their home districts (cantons) of origin. Average visitation for each district was then calculated by dividing observed visitation by the population of each district based on census data, while the travel costs of visiting the preserve from each of the home districts was calculated through a composite average of distance travelled and out-of-pocket costs. Demand functions relating visitation rates to travel costs and district-

level population density and illiteracy rates were then estimated for each district in order to calculate levels of consumer surplus or, more specifically, the difference between what visitors actually paid and what their demand curves indicated they were willing to pay as measured by their total travel costs. Finally, consumer surplus values were aggregated across districts and extrapolated to foreign visitors.

It was noted in a previous review (Georgiou, Whittington, Pearce and Moran, 1997) that this Monteverde TCM study calls for several caveats and displays various potential flaws, including assumptions that the cost of travel time was equal for all visitors, that visits were not part of multiple-destination trips, and that foreigners valued the reserve the same way as local residents. The single-destination assumption is particularly doubtful, because there are many other natural resource and recreation sites in this same region of the country, meaning that visits to the preserve are likely to have been part of a multiple-destination trip for many visitors. To ensure that this assumption was correct, it would have been necessary to actually survey visitors to the preserve.

There are two additional methodological flaws in this study, both of which are suspected also to be problems with the use of the TCM method in other developing countries. First, census data in Costa Rica is very limited in terms of quantity and quality and is a poor substitute for personally surveying visitors in order to determine their characteristics and tastes, which is necessary for estimating demand curves. Specifically, the only explanatory variables included in the Monteverde travel demand model were illiteracy rates and population densities. In line with this, the demand model estimated by the study had a very low adjusted R^2 value of .156 and only one significant variable (price).

The second serious problem with the study is that it is doubtful that the districts (cantons) used to represent visitors' zone of origin accurately represent different travel costs to the site, because most of Costa Rica's population (over 60%), live in the Cen-

tral Valley in cantons within, or closely surrounding, the capital city of San José. In fact, the real travel time and costs associated with visiting the Monteverde preserve are mostly a function of the last 30 kilometers of travel to the preserve on a very rough, unpaved mountain road that is often only accessible with a four-wheel-drive vehicle. Therefore, travel costs to the site are not a simple linear distance-based relationship from the park to the zones of origin as the authors have assumed, and it is unlikely that small differences in distances between visitors' home districts would significantly affect their travel costs. Also, the authors have not distinguished between visitors who travelled to the preserve via public,

group or private transport, each of which have significantly different cost structures.

From the observations concerning this single case study, it is recommended that future TCM studies in Central American and Caribbean countries utilize direct surveys of visitors rather than secondary data sources, in order to collect a wider range of explanatory socioeconomic variables representing their travel patterns and costs, and especially to determine whether they are single- or multiple-destination visitors. It is also recommended that more research be undertaken regarding the relative levels of consumer surplus of both foreign and local visitors visiting specific types of recreation sites before making assumptions that they are equal.

V

Hedonic Valuation Method studies in Central American and Caribbean countries

The hedonic valuation method (HVM) is the least commonly used of the three non-market valuation methods. As applied to the valuation of natural resources and environmental amenities, it is based on indirect valuation of resources without market prices by quantifying the statistical relationship between a market good with a known price (usually housing or property values) with a range of attributes or characteristics (including the provision of natural resources and environmental amenities) that are known to influence the price of the marketed good. Typically, a hedonic price function is modelled using a multivariate statistical model where housing or property value is the dependent variable, and the various characteristics of housing or properties (including house size, age, location, etc., as well as natural resources and environmental services) are the explanatory variables. Characteristics representing natural resources and environmental amenities (hereafter referred to simply as resources) may be either positive (such as a scenic view) or negative (such as proximity to a garbage dump). They are usually represented by the distance from a house or property to a particular resource, or through some other ordinal measure of resource quantity and/or quality such as noise, smell or visibility levels. The partial differentiation of the estimated hedonic price function with respect to the

resource in question results in a marginal implicit price function which can then be used to calculate the marginal value of the resource by using the mean values of the quantity of the resource present, the quantities of other resources, and the price of the market good (Freeman, 1979).

The HVM method has been used in developed countries to measure the indirect values of water and air pollution, recreational sites and other environmental amenities, but the method has been attempted in Central American and Caribbean countries in only two known cases, both of which were unsuccessful and therefore have not been published. The first study, in the city of Turrialba, Costa Rica, attempted to estimate the relationship between housing values and proximity to the Rio Colorado river, which was assumed to be a negative environmental amenity because of the discharge of untreated sewage into the river and frequent flooding damage (Shultz, 1994). Housing values based on owners' self-assessments, along with structural housing characteristics and distances to the river, were collected for 102 randomly selected homes in the city. The resulting hedonic price model was of very poor quality, with a low R^2 of 0.35 and an insignificant joint F-test, and only one of eight independent variables were statistically significant. There are two suspected reasons for the fail-

ure of this HVM model. The first is the existence of highly heterogeneous (non-zoned) market segments in the community, which is a situation common in many small to medium-sized towns and cities in Central America and the Caribbean, where residential, commercial and/or industrial zoning ordinances have historically not been implemented or strictly enforced, often resulting in highly heterogeneous housing and commercial structures along with widely varying and mixed land uses within individual neighbourhoods. In the HVM literature, it is seen as necessary to identify and incorporate homogenous neighbourhood characteristics within distinct market segments in order to account for many omitted variables which can influence property values (Freeman, 1979).

The second problem was that most of the surveyed homeowners had a very difficult time self-assessing the market value of their homes, because most had either built their homes themselves, often over a period of many years, or had inherited them. Since housing values are the key dependent variable in hedonic models, it is not surprising that the resulting hedonic model was of such poor quality.

This lack of reliable housing values was also the suspected reason for the failure of a second HVM study in Costa Rica which attempted to estimate the relationship between farm property values and the natural resource characteristics of the Pacuare River watershed of Costa Rica (Shultz, Sáenz and Hyman, 1996). Farm characteristics such as size, topography, land uses and soil conditions, as well as distances to roads and a nearby river, scenic views, quantity and quality of primary forests, and owner-assessed farm property values, were collected for 43 farms in the eastern half of the watershed. The two specific questions used in asking farmers about their farm values were: "*If you were to buy a nearby farm very similar to your present farm today, how much would*

you be willing to pay?" and "*What is the minimum you would be willing to sell your farm for, today?*". However, in most cases farmers were unable or unwilling to reveal the value of their farms either because of the lack of a local real estate market in the area or their lack of experience in buying and selling farms. A third possible reason for the inaccurate reporting of farm values is that some of the farmers may have strategically concealed the true values of their properties in order to avoid property taxes or to influence potential sale prices in the future.

These problems related to unreliable housing and farm value data are endemic to all Central American and Caribbean countries, but are most evident in rural areas and small to medium-sized urban areas that do not have active and developed property markets. It is therefore recommended that research efforts be carried out in these countries to develop strategies and models for predicting housing and property values more accurately. This is currently being done with respect to the Pacuare River case study described above, through the estimation of a multivariate regression model where the dependent variable (farm value) is a weighted average of the owner-assessed value, sales (tax) transaction data, and an independently assessed value made by a knowledgeable local real estate agent or banker. The corresponding explanatory variables in the model will be factors known to influence local property values such as farm size, physical characteristics (topography, soils), farm location and accessibility, levels of infrastructure (water, electricity, telephones, stores), the possession of legal ownership documents, and land use production values. Such a model is in fact the reverse of a traditional HVM model, but if successful it could be used to help determine actual housing and/or farm values which in turn would be useful for the estimation of various types of HVM models in the future.

VI

Summary and conclusions

This article has inventoried and assessed the known non-market valuation (CVM, TCM, and HVM) studies carried out in Central American and Caribbean countries in order to illustrate the potential opportunities and advantages, as well as the constraints and limita-

tions, of these methods for use in these countries. Many of the problems associated with these non-market valuation methods are related to the specific socioeconomic, cultural and natural resource development conditions of individual Central American and

Caribbean countries, and most of these issues have not been explicitly considered in the non-market valuation literature based on case studies conducted in other parts of the world.

The majority of non-market valuation studies in Central American and Caribbean countries have been conducted in Costa Rica, and most of these focused on the valuation of drinking water supply and protected areas. Specific problems associated with many of these studies included a reliance on simplified yet problematic open-ended bidding formats, a lack of detail in information framing and contingent scenarios, problems in defining and surveying population samples, and the danger of possible cultural-strategic biases associated with the use of personal surveys of local residents.

Problems with the single TCM study evaluated included its reliance on poor-quality secondary census data, unrealistic travel cost estimates based on overly simple linear travel distance estimates, and the unfounded assumption that domestic visitors to the site were single-destination visitors with levels of consumer surplus less than or equal to those of international visitors.

Finally, problems with the two failed and unpublished HVM studies were a lack of well-developed property markets, which resulted in unreliable housing and property values, and the existence of highly heterogeneous, non-zoned, neighbourhood market segments.

It is obvious that both environmental economists and development professionals in Central America, the Caribbean and other developing countries will have an increasingly strong interest in the coming years in using non-market valuation methods in order to place monetary values on many key natural resources and environmental amenities so that they may be included in cost-benefit analyses of various development projects. From the lessons learned from the application of non-market valuation methods in developed countries, and from the results of this present assessment of 15 non-market valuation studies in Central America and the Caribbean, it is clear that caution should be used in adapting and applying these valuation methods in such countries.

Generally speaking, in order to improve the quality of non-market valuation studies in Central America and the Caribbean it is proposed that the existing educational and training activities in the region in the field of environmental economics, including those of CATIE, the University of Gothenburg and SIDA, be continued or, if possible, expanded. It is also suggested that further non-market valuation research with a strong methodological focus be conducted in order to further evaluate the feasibility, reliability and improvement of non-market valuation studies in these and other countries and regions of the developing world.

(Original: English)

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