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Estimating the Economic Value of Ecosystem Services of Pallikaranai Marsh in Chennai City: A Contingent Valuation Approach

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L. Venkatachalam* and **Jayanthi M.**

Abstract

Wetlands generate multiple ecosystem services, part of which enters the production and consumption functions of firms and households, respectively. Since most of these services are 'non-marketed' in nature, the existing institutions fail to capture the economic value that the society would place on them. As a result, economic importance of wetlands gets undermined resulting in sub-optimal allocation of resources for wetland protection. Pervasive negative externalities alter the ecosystem services, causing deterioration in the economic welfare as well. Internalising such externalities and protecting wetlands warrants for monetary valuation of the ensuing non-market benefits and costs reflected in terms of preferences of individuals and households. Pallikaranai marsh, one of the three largest wetlands in Tamil Nadu and the only surviving marsh in Chennai Metropolitan region, is becoming more vulnerable to various negative externalities that affect both the quantity and quality of its ecosystem services utilised by the society. In recent years, Government of Tamil Nadu is investing society's scarce resources to improve the quality of the marsh. What is the expected 'consumer surplus' that the urban households would derive from such an improvement? A contingent valuation (CV) survey was employed among randomly selected households around the marsh to elicit their marginal willingness to pay (WTP) for different levels of improvements in the marsh. The paper discusses the results of the CV survey as well as the validity of such results.

* Corresponding Author. The ideas expressed in this article are personal and should not be attributed to the organisations where the authors are working.

1. Introduction

According to Barbier *et al.* (1997), wetlands are amongst the earth's most productive ecosystems, which act as 'the kidneys of the landscape' because of the functions they perform in the hydrological and chemical cycles and as 'biological supermarkets' because of the extensive food webs and rich biodiversity they support. Two major ecosystem services, food and water that support life on the earth, originate largely from the wetlands. Millennium Ecosystem Assessment [MEA] (2005) reports that capture fisheries in coastal waters alone contribute US$34 billion to gross world product, annually. In developing economies, wetlands generate significant amount of services and benefits that are consumed largely by the poor. For example, the overall regional economic contribution of some of the direct benefits from Chilika Lake in Odisha, India, was estimated to be at Rs. 2 billion per annum (Kumar 2010). This implies that in the absence of Chilika, the society would have lost Rs. 2 billion worth of direct economic welfare per annum. In addition to such direct benefits, wetlands supply a significant amount of aesthetic, educational, cultural, religious, recreational and tourism benefits that are mostly non-tangible and are not being captured by the existing institutions. Groundwater recharged by wetlands plays an important role in supplying fresh water to human beings, with an estimated 1.5–3 billion people dependent directly on it (MEA 2005). Wetlands also generate 'waste disposal service' to various production and consumption activities since they function as 'natural pollution control machines'. The recreational and tourism benefits gain significance as the income elasticity of demand for these benefits becomes high when per-capita income of an economy reaches a higher level and therefore the expected value of developing country wetlands will be much higher than the value being currently estimated. An efficient way of addressing general poverty and environment-related health problems, especially in developing countries, is to protect the local environmental public goods, especially the wetlands (Table 1).

Classification of ecosystem services is a pre-requisite for overcoming certain methodological issues involved in measuring their non-market economic values. The MEA (2005), and subsequently TEEB (2010), classified wetland ecosystem services as indicated in Table 1. The classification, though helpful in understanding broader categories of wetland ecosystem services, may not be suitable for a proper economic valuation exercise. First of all, one cannot quantify individual values of all four types of ecosystem services in money terms due to various practical problems involved (see Carson, 2012). For example, some values can be quantified in some sense and some values are non-tangible; some values are 'site-specific' and some of them are global in nature. Second, economic valuation exercise focuses mainly on those

Table 1: *Different Types of Ecosystem Services Generated by Wetlands*

Ecosystem Services	Examples
I. Provisioning Services:	
Food	Production of fish, wild game, fruits and grains
Freshwater	Storage and retention of water for domestic, industrial and agricultural use
Fibre and fuel	Production of logs, fuel-wood, peat, fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic materials	Genes for resistance to plant pathogens, ornamental species and so on
II. Regulating Services	
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	Groundwater recharge/discharge
Water purification and waste treatment	Retention, recovery and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Natural hazard	Regulation flood control, storm protection
Pollination	Habitat for pollinators
III. Cultural Services	
Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	Opportunities for formal and informal education and training
IV. Supporting Services	
Soil formation	Sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients

Source : Millennium Ecosystem Assessment (2005).

values that change due to marginal changes in the wetland as such. Similarly, there is a problem of 'double counting'. For example, the 'supporting services' contribute to 'provisioning services' and therefore estimating the economic values of both would double-count the actual values. Hence, an alternative classification is warranted for. In environmental economics, the economic values are defined in terms of 'total economic value' (TEV) and the

TEV includes values that are not captured in the conventional classification. More precisely, the TEV includes use values and non-use (or passive use) values. Use value refers to satisfaction derived through direct use of the good or service (e.g., water used for drinking purpose). It is further classified as: (a) direct use value (e.g. irrigation water and water for final consumption); and (b) indirect use value (e.g. enhanced biodiversity, groundwater recharge and flood control). The use values are alternatively classified as consumptive (e.g. consumption of water for drinking purpose which reduces the availability of water in physical units) and non-consumptive use values (e.g. consumption of water for swimming purpose that does not reduce the water in physical unit). The non-use values consist of: (a) option value (i.e. the individuals'/households' willingness to pay a premium for protecting the wetland ecosystem for future use); (b) quasi-option value (i.e. individuals'/households' willingness to pay for protecting the wetland until full information about the wetland is established for decision making); and (c) existence value (i.e. individuals'/households' willingness to pay for mere existence of wetland ecosystem; individual enjoy satisfaction merely from learning of existence of a wetland) (Freeman 1993). The non-use values are special category values and adding these values with the use values does significantly increase the TEV of the wetlands.

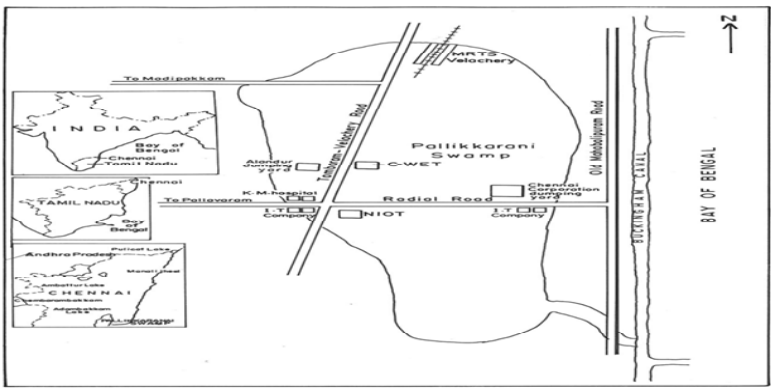
In a growing economy, protecting wetlands from negative externalities and utilising their benefits (including future benefits) at optimum level can maximise the present value of discounted net social benefits. Most of the social benefits of wetlands are not being adequately taken into account in economic and environmental policies and as a result, there arises a trade-off between the development goals and the goals of protecting the wetlands; such a trade-off is also explicit among different wetland ecosystem services, especially, between waste disposal service and all other forms of services. The present paper aims at estimating the expected value of economic welfare of the households to be enhanced by recently initiated policy measures to internalise certain negative externalities that adversely affected the quality of Pallikaranai marsh in Chennai Metropolitan Area (CMA). The economic value of the expected benefits from policy measures, occurring to the households and expressed in terms of their preferences, is estimated through a contingent valuation (CV) survey; the paper also deals with assessing the CV results for its theoretical validity.

2. Description of Pallikaranai Marsh

The Pallikaranai marsh is one among a very few natural wetlands of the Coromandel Coast in South India. It is one of the 94 identified wetlands in the country and one of the three major wetlands in Tamil Nadu. It is an extensive low-lying area covered by a mosaic of aquatic grass species, scrub, marsh

and water-logged depressions. It has a catchment area of 235 sq. km (91 sq. miles) that includes the nearby urban sprawls. It receives an annual rainfall of 1,300 mm, mostly during the northeast monsoon (September–November). Flood water is drained into the sea through a channel called the Okkiyam Maduvu, a contiguous portion of the marsh at Okkiyam Thoraipakkam draining into the Buckingham Canal, which in turn discharges into the Kovalam estuary. Locally known as Kazhiveli (a generic Tamil name for marshes and swamps), the marsh drains about 250 sq. km (97 sq. miles), through two outlets, namely, the Okkiyam Maduvu and the Kovalam creek. The marsh has an international significance since it harbours rich biodiversity, including some of the endangered species as well; since wetlands absorb significant amount of carbon, the marsh contribute to reduce the problem of global negative externality, namely, global warming problem.

Map 1: *Map of Pallikaranai Marshland*



The marsh is known for attracting a variety of migratory birds. As one part of the marsh is fed by freshwater, it contributes significantly to certain use values – flood control, water for industry and households for consumption purpose, fishing and recreational benefits, among others – enhancing economic welfare of user groups at the local and regional level. The flood prevention benefit becomes the most crucial one since the marsh absorbs significant amount of excess rain water, which would otherwise inundate a vast area of the neighbourhood, resulting in economic damages. Similarly, the groundwater recharged by the marsh benefits the society in many different ways: it helps increasing the water availability for household and industrial consumption at a lower cost; it contributes towards improving quality of groundwater in the eastern part of Chennai city, which has deteriorated due to sea-water intrusion; and, it contributes to stabilise the micro climate. The marsh has a potential role to play in mitigating the impact of sea-level raise under the future climate change regime.

2.1. Negative Externalities in Pallikaranai Marsh

Despite its several features, Pallikaranai marsh has been experiencing certain negative externalities caused by various urban activities such as land encroachment, dumping of liquid and solid wastes inside the marsh and other human interventions that adversely affect its ecological balance. In the following section, we discuss some of the major negative externalities that cause disturbance and damage to the marsh.

2.1.1. Encroachment

Encroachment of marsh has been a serious environmental and ecological issue. Encroachment of land completely alters the ecology of the marshland. The opportunity cost of keeping the land under the marsh becomes relatively high, when the value of urban land, especially for real estate purpose, is skyrocketing. As the true economic value of the ecosystem services of the marsh is not reflected by the market forces, the marshland is encroached for high value use, namely for real estate purpose. As the land in CMR for various development purposes is becoming acutely scarce, conversion of marsh becomes an economically feasible choice. As a result, the land area under the marsh is declining rapidly. For example, a recent estimation suggests that the marsh had a land area of 593 ha. in 2000, which declined to 541.61 ha in 2008 (Vencatesan, 2007). In 2013, the land area under the marsh expanded to 618.95 ha due to effort of government of Tamil Nadu to append the previously encroached upon land to the existing marshland (Times of India, October 22, 2011). In 2010, the total area of the marsh that was encroached for various urban activities stood at 273.00 ha (Sujatha, 2010). Properly estimating the economic value of ecosystem services generated by the marsh only would reveal the intensity of the trade-off in economic welfare that arises between land conversion and protecting the marshland.

Table 2: *Expansion of Area under Perungudi Dumpsite in Pallikaranai Marsh (Various Years)*

Year	Area of the Perungudi Dumpsite (ha)
2001	52.77
2004	55.22
2008	65.65
2009	72.99

Source : S. Santhi (2010).

The total area encroached upon by various activities comes to around 347.00 ha, which includes 72.99 ha of solid waste dumpsite (Table 2). Chandramohan and Bharathi (2009) report that over a period of time, the area used for solid waste dumping has increased from 75 acres (i.e. 30.35 ha) to 850 acres (i.e. 344.00 ha) (by both Alandhur Municipal Corporation

and Chennai Corporation). In recent years, the state government has taken certain steps not only to prevent further encroachment but also to recover around 100 ha of land already encroached upon by others and appended it to the existing marshland. It is, however, claimed that the marshland originally had 5,000 ha of water spread area and it implies that the quantum of valuable ecosystem services lost would have been significant.

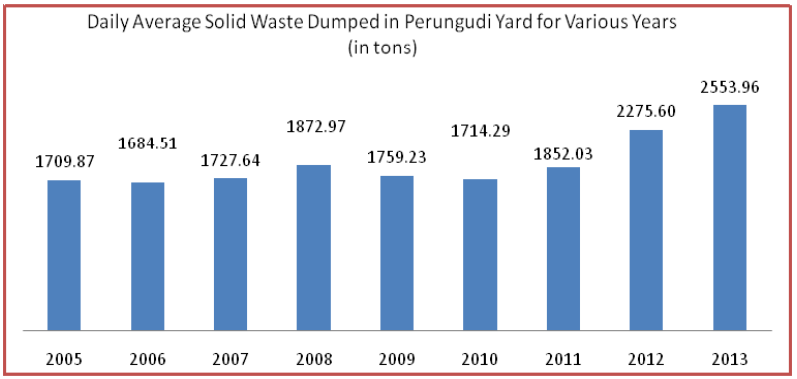
2.1.2. Dumping of Solid Waste

Dumping of solid waste within the marsh has become a common phenomenon. Figure 1 indicates that the daily average quantity of solid waste being dumped in the Perungudi dumping yard located in the marsh is steadily increasing over a period of time. Between 2005 and 2013, the daily average quantity of waste dumped has increased by 49.36 per cent. Chandramohan and Bharathi (2009) claim that around 4,000 tons per day of solid waste is being deposited in the dumping yard within the marshland.

The dumping yard affects the surrounding environment in many different ways: it prevents the rainwater from flowing from upstream areas into the drainage system (i.e. into Okkiyam Madu), causing flood in the upstream region; a 6-meter depth of the garbage prevents the groundwater getting recharged by rain; and birds feeding on the garbage encounter health problems, which could spread to the domesticated birds we all. In addition, solid waste dumping impacts negatively on the entire ecological system of the marsh. The Perungudi dumping yard is located just inside the marsh and is gradually consuming the marsh into its contaminated belly.

The inert waste consisting of sand, drywall and concrete constitute 34.65 per cent of the total wastes dumped in the marsh. The inert waste is not easily decomposed and will stay in the environment for a very long period of time, causing various environmentally harmful effects. One such effect is that it can prevent rain water from percolating into the sub-surface area, adversely affecting the groundwater recharge. The green waste, which is biodegradable, constitutes 32.25 per cent, followed by food waste (8 per cent), timber wood (6.99 per cent), paper waste (6.45 per cent) and consumable plastics (5.86 per cent). Other wastes, such as textiles, industrial plastics, rubber and leather, constitute the remaining 6 per cent of the wastes (see: http://www.chennaicorporation.gov.in/). Since the waste comprises of food materials as well, it potentially causes certain diseases to the animals and birds eating on it. Moreover, we have asymmetric information about the hospital wastes (i.e. if the hazardous wastes from the hospitals and diagnostic centres are being treated properly in the city or part of it gets mixed up with the regular waste being dumped in the marsh is not known).

Figure 1: *Increase in the Quantity of Solid Waste in Perungudi Dumpsite*



Source : Corporation of Chennai.

Due to constant growth in city population and increase in overall material consumption, the solid waste is also likely to increase in the coming years; as the construction industry is progressing well in the city, problems to be created by the building debris are going to be more serious.

2.1.3. Urban Sewage

Another serious negative externality is the harmful urban sewage discharged into the marsh by at least six local civic bodies. Informal sources suggest that around 32 million litres of untreated wastewater per day is being released into the marsh; in 2005–06, a total number of 9,973 tanker lorry loads of raw sewage (especially, human excreta from households) had been drained into the marsh; apart from tanker lorries, there are innumerable non-point sources that carry a significant amount of untreated sewage that enters the marsh in various places. The sewage pollution could potentially affect the rich biodiversity in the marsh, apart from contaminating the surface and groundwater used for various other purposes.

Table 3 indicates the trend in the quantity of sewage being treated by the three sewage treatment facilities located in the marsh. As we have already mentioned, the sewage treated may only be a fraction of a huge volume of sewage coming into the marsh. We are also not sure if the sewage is treated in tertiary treatment facility. The total amount of money spent on sewage treatment implies that in case these treatment facilities were not there, the society would have lost enormous amount of other ecosystem benefits originating from the marsh. At the same time, the society may still be losing valuable ecosystem services due to the untreated sewage that is not quantified at present.

Table 3: *Quantity of Sewage Treated and Operations and Maintenance Cost in Pallikaranai Sewage Treatment Facilities.*

Plant Capacity	Year	Quantity Treated in MLD	O & M Cost (Rs. in million)
60 MLD Plant	2012	19434.64	13.36
	2013 till June	9674.72	6.86
54 MLD Plant	2006–07	13122.00	14.95
	2007–08	19764.00	21.88
	2008–09	19710.00	25.28
	2009–10	19710.00	25.41
	2010–11	19710.00	26.05
	2012–13	16578.95	24.94
Alandur Plant	2003	428.70	2.11
	2004	1029.36	4.34
	2005	2628.43	10.42
	2006	3663.07	184.10
	2007	4161.80	354.84
	2008	4559.60	702.81
	2009	4380.00	1390.67
	2010	4380.00	2759.46
	2011	4730.00	5493.65

Source: CMWSS Board, Chennai.

So far we have discussed only about a few major, visible negative externalities that are adversely affecting the quality of the marsh. There may be other, very serious types of externalities, which we have not highlighted due to lack of information. Due to the negative externalities, a significant amount of valuable ecosystem services is already lost, and if the current situation continues, the marsh may experience irreversible damage in the near future. Under the climate change regime, the marsh is going to play a critical role in enhanced water supply (Palanisami and Meizen-Dick 2000) as well as in mitigating the potential impact of sea-level rise. In addition, the

urban wetland has the potential to augment the 'option value' as the marginal increase in income of the urban households leads to increased demand for recreational benefits (which has an higher level of income elasticity of demand) in future and such demand will be adequately met with by the Pallikaranai marshland. The marsh may also be declared as a Ramsar site soon. In recent years, the state government has initiated several steps to protect the Pallikaranai marsh. In the following section, we discuss the policy measures undertaken and the management plan developed for internalising negative externalities in Pallikaranai marsh, which sets the stage for economic valuation of expected consumer surplus from these measures.

3. Measures to Improve the Quality of Pallikaranai Marsh

The state government of Tamil Nadu has initiated several steps to protect the Pallikaranai marsh. In 2003, the Kanchipuram district officials issued a gazette notification announcing that 548 ha (1,350 acres) of the marshland was classified as Protected Land and during 2005, subsequently, the state government constituted a high-level committee to restore the marsh's ecosystem. During April 2007, the state government declared 317 ha (780 acres) of the marshland as a reserve forest (Gazettee notification G.O.Ms No.52, dated 9 April 2007) under the Forest (Conservation) Act of 1980 and brought the marshland under the jurisdiction of the District Forest Officer, Kanchipuram (Tambaram range). The Kanchipuram district authorities thus transferred the marshland to the forest department headquartered at Palliakaranai itself. Named Pallikaranai Swamp Forest Block, it is the 17th reserve forest area in the Tambaram Range, whose reserve forest area went up to 56.27 square kilometres (21.73 sq mi) with this addition. In September 2013, 131.55 ha of land abutting Velachery Main Road and Thoraipakkam–Pallavaram Radial Road has been declared as reserved land for development of the marsh.

A management plan has been (2011–2015) formulated to carry out various activities with an aim to protect the marsh. These measures include: creating Pallikaranai Conservation Authority to oversee the overall conservation measures of the marsh; allocating a total amount of Rs. 1,575.00 lakh to implement conservation measures spread across 2011–12 to 2015–16; drenching of solid waste dump site in Perungudi in order to scientifically handle the waste and to avoid flooding in the upper reaches of the dumpsite; desilting 800 ha of catchment area of the marsh; sanctioning of any more construction on reclaimed land in and around the marsh; planting of saplings of indigenous species (10,000 trees with the size of 16/ 30 and 2500 with the size of 30/45; and, conducting regular awareness programmes among school children and the general public. Recently, the City Connect and Care Earth, Chennai, prepared an 'Adaptive Management Plan for Conservation

of Pallikaranai Marsh', which lists out various measures to make the status of the marsh better (see http://www.scribd.com/doc/54187332/pallikaranai-marsh-management-plan).

The activities mentioned in the management plan as well as the institutions created – such as, the Conservation Authority of Pallikaranai – would be expected to improve the overall quality of the marsh in a significant way in the coming years. Such improvements would reduce the damage and increase the benefits enjoyed by different stakeholders. What would be the size of the marginal benefits enhanced by all these measures undertaken by the government? The major objective of the present study is to estimate the marginal increase in the economic value of ecosystem services of the Pallikaranai marsh, to be enjoyed especially by the households.

4. Economic Valuation of Ecosystem Services of Pallikaranai Marsh: The Contingent Valuation Approach

We have used CVM to elicit the preferences of the households towards improvements in the marshland. The underlying assumption in the CVM is that the households are the best judges in assessing the economic values of the benefits that they enjoy from the wetland. Wetlands may supply innumerable ecosystem benefits but it is ultimately the households that can place a monetary value on these benefits, based on their preferences, utility and demand. For example, some households may utilise only groundwater recharged by the marsh while some other households utilise not only the groundwater but also recreational benefits. Even among those households utilising groundwater, different households will utilise different levels of groundwater. As the economic values of most of the environmental benefits are invisible, their monetary values can be estimated by eliciting the preferences of the users of these values. These preferences are usually expressed in terms of their WTP value either for maintaining the current level of benefits or for improving the benefits from the current level to a future, higher level. In both the cases, the households are assumed to know exactly the amount of consumer surplus (i.e., Hicksian compensating variation) that they derive from the respective changes in the ecosystem benefits. The CV method, however, is being criticised for attracting various biases and errors that could potentially affect the validity and reliability of its results (Venkatachalam 2004). Therefore, the present CV study is a carefully conducted study by taking into account all best practices of conducting CV survey, especially, in a developing country context.

5.1. Selection of Sample Households

For the present study, we used a stratified random sampling procedure to select the sample households. Since Pallikaranai marsh falls under

Sholinganallur taluk, which comes under Tambaram Revenue Division, we obtained the voters' list from the Tambaram Revenue Division. We selected six revenue wards from the Sholinganallur taluk, namely Pallikaranai, Jalagadampettai, Karapakkam, Thoraipakkam, Perungudi, and Perumbakkam that are located around the Pallikaranai marsh. As selecting households from the entire revenue ward is a costly affair, we selected sub-areas (streets) under each ward on a random basis. The total population of voters in all the six wards stands at 155,193 and for the selected sub-areas, it is 40,858 (i.e., 26.33 per cent of the voters in the six wards). Based on simple random sampling method, we selected the households in each selected sub-areas and the total number of sample households selected comes to 1024, which is 2.5 per cent of the total households of the sub-areas selected.

Table 4: *Details about Sample Households Selected from Different Wards*

Area	TOTAL POLULATION OF SELECTED AREA (as per voters' list)	POPULATION SELECTED FROM SUB-AREAS	TOTAL HOUSEHOLDS SELECTED FOR FINAL SURVEY	TOTAL SURVEY COMPLETED
Pallikaranai	34866	11692	294	426
Jalagadampettai	12267	3682	93	111
Karapakkam	5591	4189	105	132
Thoraipakkam	54726	6242	156	0
Perungudi	35306	11722	293	62
Perumbakkam	12437	3331	83	2
Total	**155193**	**40858**	**1024**	**733**

Source: Computed from Secondary Sources.

It should be noted that out of 1,024 sample households initially selected for the survey, we could complete the survey only among 733 households (i.e. among 72 per cent of the households initially chosen for the survey) (Table 3). Even though the response rate is satisfactory, there are many reasons why we have not been able to complete the survey among all the 1,024 sample households. Since many households around the marsh are living on the once encroached marshland, the 'outsiders' conducting survey about the marsh became a sensitive issue. Many households feared that disclosing any information to the outsiders would lead to possible eviction. The fear of eviction among these households could not be fully eliminated, even though we clearly explained to them that the survey was mainly for research purpose and has nothing to do with eviction. Yet, some of the households flatly refused to give the interview for some reason or other. In areas where alcohol consumption is relatively high, our enumerators could

not even enter those areas to do the survey. Despite all these constraints, we were able to have complete interview among 733 households, which we feel is a sufficient number for estimating the true WTP value.

5.2 Implementation of CV Method in the Study Area

The CV method was implemented in a unique and a non-conventional way in the field. Conventionally, the CV practitioners include a CV scenario in the interview schedule, explaining the nature of the environmental good or service to be provided to the users, the programme through which the good or service to be provided, the method of implementing the programme, the organisation responsible for implementing it, the payment vehicle (such as tax or entrance fee), along with questions reminding about the substitutions and budget constraints, and questions about the WTP or WTA values. One of the problems with the conventional CV method is that it provides only limited options to the respondents, and therefore, the households' choices are restricted. In order to overcome this problem, we have combined both the CVM and choice experiment (CE) to elicit the household preferences for the ecosystem services. For the choice set, we developed three alternative options with seven attributes (see Table 5). The three options are: (a) 'status-quo' position where the current level of quality of the marsh will be maintained in future as well; (b) alternative A where a 'moderate level' of improvements in all the 7 attributes were prescribed; and (c) alternative B, which includes a 'higher level' of improvement. The sample households were presented with all the three choices and they were asked to choose one of the alternatives. We have used the following six bids: Rs. 250, Rs. 500, Rs. 1,000, Rs. 2,000, Rs. 5,000 and Rs. 7,500. The bids were distributed across the two scenarios that depicted the improvements, and were administered randomly across the sample households. The payment vehicle is 'donation' in terms of one-time, annual payment to the Pallikaranai Conservation Authority and for improvements to be carried out during the next five years. In order to capture the 'maximum WTP value', we have also asked a follow-up, open ended-willingness to pay question and registered their final WTP value.

To make the WTP values more valid, we have followed all the standard guidelines that are to be followed while conducting the stated preference surveys (e.g., NOAA 1993). For example, we rigorously trained all the project and field staff on how to conduct the CV surveys. We had several rounds of discussions with the government officials, representatives from civil society organisations, academicians and researchers before finalising the interview schedule in general and CV scenarios in particular. The draft interview schedule was rigorously pre-tested, initially among the project staff and research scholars at MIDS and later on, among a small group of households in the study area. Subsequently, we did a pilot study among

30 households who were selected randomly from different locations in the study area. The payment vehicle (i.e., donation on annual basis as a lump-sum payment) and the bids used in the CE scenarios in the final survey were derived from the relevant information provided by the households with whom we did pre-testing and the pilot study. A close monitoring of the survey by the principal investigator, day-to-day interactions with the field staff, preparing and constantly going through the extensive field notes and getting back to the respondents whenever necessary made our CV study complete in almost all respects. After the data had been collected, we also checked our results for possible biases and errors subjecting the data to statistical analyses. For example, we used a Mann–Whitney test to check if there is a significant difference between the WTP values elicited by different field staff in order to see if there is an interviewer bias (it was not). Therefore, the CV results are assumed to be free from the errors that could be committed during the survey.

Table 5: *Alternative Choice Scenarios Used in the CV Survey*

Attributes	Current status Status-Quo	Alternative 1 (Moderate Level)	Alternative 2 (Higher Level)
Land area of the marsh and encroachment	541 hectares	Increased to 600 hectares	Increased to 700 hectares
Tree plantation and tourism benefits	Inadequate; no access	1/4 area under tree cover with tourism facilities	1/3 area under tree cover with tourism facilities
Biodiversity (birds, plants, reptiles, etc.)	Low level (subject to further vulnerability)	Moderate level (better from current level with less vulnerability)	High level (highest level of protection with no vulnerability)
Solid waste management in the marsh	Current level	Drenching, No burning	Alternative dump site
Waste water treatment and ground water quality	Current level	Secondary treatment	Tertiary treatment
Flood control	Current level	Revamping tank systems	Complete flood control
Cost	Rs.0.00	Rs.-------- per year	Rs.---------per year
I prefer (tick the appropriate)	Status Quo Option	Option A	Option B

5.3. CV Results

Out of 733 sample households, 33 households preferred the 'status-quo' position, which implies that they prefer to accept the current status of the marsh and are not willing to pay for improvements in the quality of the marsh. There may be several reasons for this. For example, the households may prefer having the proposed improvements but, (a) they may not be able

to pay the amount mentioned in the options; (b) they may think that they are already paying for the improvements in terms of local taxes, etc; (c) they may expect the people who cause damage to the marsh to pay for the improvements; (d) they may think that the government should do something about it; and (e) the households may not even prefer any improvement at all. It should be noted that in a society with multiple preferences, some households not willing to pay for the improvement implies that the answers given by the households are genuine and do indeed reflect their true preferences; such genuine answers provide empirical support for the claim that the CVM/CE methods work well in developing countries.

The results suggest that a larger percentage of sample households (i.e. 95.5%) prefer to have improvements in the Pallikaranai marsh and are willing to make onetime payment for such improvements. Only 4.5 per cent households prefer status-quo for which there are reasons which we have already discussed. Out of all the sample households, a relatively larger percentage of the sample households (i.e. 53.50) prefer larger improvements in the marsh. Out of those 700 households that prefer improvements, 53.47 per cent of the household prefer 'higher level of improvements' (i.e. Scenario B) while 42 per cent prefer 'moderate level of improvements' (i.e. Scenario A). So, around 95 per cent of the households prefer the quality of Pallikaranai marsh to be improved from the current level for which they are willing to pay some positive amount. A very interesting behavioral issue that we came across during the main survey was that though the households preferred any of the two levels of improvements, they were not willing to accept the level of bid assigned to each scenario. This implies that the households would certainly prefer to have higher level of improvement but would consider the corresponding cost to be high. Even though the bids were selected from group discussions and pretesting of the interview schedule, such bids were found to be not acceptable to some of the households during the main survey. Here, the open-ended WTP question elicited the maximum WTP values and therefore, in this paper we analyse only the open-ended WTP values.

It should be noted that 57.96 per cent (i.e. 211) of the 364 women respondents and 26.28 per cent (i.e. 97) of 369 male respondents opted for Alternative A. Out of 308 respondents who opted for Alternative A, 57.96 per cent are women and 42.01 per cent are men (Table 6).

Compared to Alternative A, a relatively larger per cent of sample households have chosen Alternative B that describes Higher Level of improvements in the marsh. For example, 53.47 per cent of the households have opted for Alternative B. Out of the 392 respondents who chose Alternative B, 33.92 per cent are women and 66.07 per cent are men. In the case of Scenario B (higher level of improvements), a large number of

respondents who opted for this scenario are women while a larger per cent of respondents who selected Scenario B happen to be men. This may be due to the fact that the women respondents have limited control over economic resources and therefore they might have preferred Scenario A that comes with relatively lesser financial commitments. An alternative interpretation would be that the women might have satisfied with improvements up to moderate level and they might have found the marginal improvement from Alterative A to Alternative B to be not worth the resources to be spent.

Table 6: *Preferences of the Households for Different Scenarios*

Scenarios	Respondents		Total
	Female	Male	
Status-Quo	**20** (60.60) (5.49)	**13** (39.39) (3.52)	**33** (100.00) (4.50)
Scenario A	**211** (68.50) (57.96)	**97** (31.49) (26.28)	**308** (100.00) (42.01)
Scenario B	**133** (33.92) (36.53)	**259** (66.07) (70.18)	**392** (100.00) (53.47)
Total	**364 (49.60)** **(100.00)**	**369 (50.34)** **(100.00)**	**733 (100)** **(100.00)**

Source: Computed from primary data.

Around 95.5 per cent of the sample households are willing to pay a positive amount of money while approximately 4.5 per cent of the households did not express any interest in sacrificing their household income for improvements. As we have already discussed, there are several reasons for the zero WTP value. The maximum WTP value stated by the 'willing' households ranges from Rs. 250 to Rs. 8,000 as annual payment for the next five years. A maximum of 16.2 per cent of the sample households (i.e. 119 households) are willing to pay Rs. 2,000, followed by 14.6 per cent households (i.e. 107 households) who are willing to pay Rs. 1,000 per. Around 12.3 per cent of the households (i.e. 90 households) and 10.9 per cent households (i.e. 80 households) are willing to pay a maximum value of Rs. 500 and Rs. 5,000, respectively. A maximum WTP value of Rs. 7,500 has been stated by 7.2 per cent households (i.e. 46 households). Over 44 per cent households are willing to pay a maximum value up to Rs. 1,000. Another 10.8 per cent households are willing to pay an additional amount of Rs. 500 and this makes approximately 55 per cent of the sample households to express their WTP value up to Rs. 1,500; and 78.9 per cent of the total households are willing to pay up to Rs. 2,500 per annum. Slightly over 92

per cent of the total sample households have stated their maximum annual WTP value up to Rs. 5,000 and another 7.8 per cent households are willing to pay from Rs. 5,001 to Rs. 8,000 (see Table 7).

Table 7: *Frequency of Sample Households Willing to Pay Different Amounts*

Max WTP Value	No. of Households	Valid Per Cent	Cumulative Per Cent
.00	33	4.5	4.5
250.00	53	7.2	11.7
500.00	90	12.3	24.0
550.00	2	0.3	24.3
648.00	3	0.4	24.7
660.00	17	2.3	27.0
670.00	1	0.1	27.1
700.00	3	0.4	27.6
720.00	6	0.8	28.4
750.00	5	0.7	29.1
800.00	1	0.1	29.2
1000.00	107	14.6	43.8
1100.00	3	0.4	44.2
1200.00	1	0.1	44.3
1250.00	5	0.7	45.0
1300.00	1	0.1	45.2
1350.00	3	0.4	45.6
1380.00	10	1.4	46.9
1400.00	10	1.4	48.3
1440.00	1	0.1	48.4
1450.00	14	1.9	50.3
1500.00	31	4.2	54.6
1550.00	3	0.4	55.0
1560.00	1	0.1	55.1
1600.00	13	1.8	56.9
1650.00	1	0.1	57.0
1800.00	4	0.5	57.6
1850.00	1	0.1	57.7
1900.00	14	1.9	59.6
2000.00	119	16.2	75.9
2100.00	1	0.1	76.0
2500.00	21	2.9	78.9
2700.00	10	1.4	80.2
2750.00	3	0.4	80.6
2800.00	1	0.1	80.8
3000.00	4	0.5	81.3
5000.00	80	10.9	92.2

Source : Computed from Primary Survey.

An average household is willing to pay a maximum lump-sum amount of Rs. 2,096.59 per annum for improvements in the quality of Pallikaranai marsh. This implies that in case the proposed conservation measures are carried out adequately, then the households would derive a consumer surplus worth of Rs. 2,096.59 annually for the next five years. The WTP value has a range between Rs. 0.00 and Rs. 8,000.00 and the median value is Rs. 1,450.00, which is found to be lesser than the mean value (Table 8).

Among all the locations, a household from Jalagadampettai is willing to pay a relatively larger sum – i.e. an average amount of Rs. 2,501.16 – than similar households from other locations (Table 9). The next highest average WTP value (i.e. Rs. 21,66.45) comes from the households residing in Pallikaranai. The households in Karappakkam and Perdungudi are willing to pay, on an average, Rs. 1,788.92 and Rs. 1,538.87, respectively. The WTP

values indicate an important aspect, namely, the closer the households to the Pallikaranai marsh the larger is the WTP value for protecting the marsh. Many households have clear perception about the values that they would enjoy from the proposed measures in the marsh, such as, groundwater recharge. Many households reported negative utility that they currently derive from harmful externalities such as air pollution emanating from the dumping yard which might reduce their WTP value significantly. So, the WTP value reflects their marginal benefits derived from the current level to an improved level of quality of marsh. The WTP values are influenced by many different factors and a detailed analysis of it will be carried out in a separate paper.

Table 8 : *Descriptive Statistics – Maximum Willingness to Pay Values*

Total sample households	**733**
Mean	2096.59
Median	1450.00
Mode	2000.00
Standard deviation	2073.29
Range	8000.00
Minimum	0.00
Maximum	8000.00
Sum	1536804.00

Source : Computed from Primary Survey.

Table 9 : *Maximum Willingness to Pay Values - Area-wise*

Area	**Number of Cases**	**Mean**	**Standard Deviation**	**Median**
Pallikaranai	427	2166.45	2206.13	1400
Jalagadampettai	112	2501.16	2345.85	1625
Karapakkam	132	1788.92	1498.89	1450
Perungudi	62	1538.87	1378.20	1450
Total	**733**	**2096.52**	**2073.30**	**1450**

Source : Computed from Primary Survey.

5.4. Validity of CV Results

In this section, we discuss the results from simple validity tests that we conducted by using the CV data. Demand theory suggests that ceteris paribus

when price of a normal good goes up the demand for it will come down. We classified the maximum WTP values into four categories of equal range and estimated the percentage of households willing to pay for improvement in each category (see Table 10). Like a normal demand curve, the relationship between the price (i.e. the stated WTP value) and the quantity demanded of the ecosystem services (in terms of percentage of households demanding the ecosystem services) is found to be negatively correlated. This suggests that the CV results do confirm to the underlying demand theory and therefore, the results do conform to theoretical validity.

Table 10: *Percentage of Households Willing to Pay Different Levels of Bids*

WTP Value	Percentage of Households
From Rs. 0 to Rs. 2,000	43.8
From Rs. 2,001 to Rs. 4,000	31.8
From Rs. 4,001 to Rs. 6,000	16.4
From Rs. 6,001 to Rs. 8,000	7.7

Source : Computed from Primary Data

A scope test would also testify the validity of the results. As economic theory predicts, the marginal WTP values for different levels of improvements should differ as per the prediction of economic theory. For example, the marginal WTP value from the status quo level to higher level of improvement (i.e. Scenario B) should be greater than that of moderate level of improvement to the higher level of improvement (i.e. Scenario B). As predicted, the marginal WTP value from status-quo level to the higher level of improvement is greater than that of the moderate level of improvement to higher level of improvement. That is: (WTP0 →WTPB) > (WTPA→WTPB) = (Rs. 0.00→Rs. 2,482.02) > (Rs. 1,830.68 → Rs. 2,482.02) = (Rs. 2,482.02) > (Rs. 651.00). Similarly, the marginal WTP value from status-quo level to moderate level improvement should be greater than that of moderate level improvement to higher level of improvement. That is: (WTP0 →WTPA) > (WTPA →WTPB) = (Rs. 0.00 → Rs. 1830.68) > (Rs. 1830.68 →Rs. 2482.02) = (Rs. 1830) > (Rs. 651.00). Since the results do confirm to the 'marginal conditions', we conclude that the CV results are theoretically valid.

We also tested if at all the 'anchoring effect' had occurred in the results and if so, how robust it is. In order to test anchoring effect, we estimated the percentage of households saying 'yes' to the closed bids assigned to the respective households. At the outset, it appears that the anchoring effect has indeed occurred in the results since each initial bid assigned attracted a large number of 'yes' answers. However, the mean WTP values estimated for the households that received particular initial bid do significantly differ

from the bid value. For example, the mean WTP value for those households which received Rs. 250 as the initial bid turns out to be Rs. 1,269.75; and similar value for those households receiving the initial bid of Rs. 7,500 is estimated to be Rs. 2,868.85. Therefore, we can conclude that either the anchoring effect did not affect the results in a significant way or the anchoring effect is insignificant. However, advanced statistical analysis of data (such as regression analysis) is required for testing the validity of the results further.

Conclusions

The preferences of the households and the resulting WTP values reveal that the households are more concerned about minimising certain harmful effects that affect the quality of the marsh as well as their welfare. The households in the study area are seriously concerned about the solid waste being dumped in the marshland, huge quantity of untreated sewage released into it and marsh being encroached upon by different agents. Rapid decline in the groundwater table, deterioration of water quality, air pollution from the solid waste dumping sites and flooding of especially the residential areas in the upstream part of the marsh are considered by the households as some of the by-products of the above problems. In order to adapt to the ill-effects caused by the deterioration of the marsh, the households end up sacrificing a significant amount of their scarce resources on alternative activities. For example, depletion and degradation of the groundwater in the study area forced the households to depend on the water markets for most of their water requirements; the households participating in the water markets are found to spend significant amount of their income, which they could have spent on other welfare-enhancing household activities. The amount of WTP values stated by the households implies that there is a significant amount of resource could be saved at the household level in case negative externalities are internalised. Apart from benefits to the individual households, there is a significant social benefit (such as climate stability), which can be tapped through minisming the ill-effects. Similarly, the society can gain substantial welfare if adequate infrastructure is developed for promoting eco-tourism in the marshland.

In the case of validity of the CV results, it is evident that the CV is capable of eliciting the true preferences for complex ecosystem services from the households in a developing country context where conducting CV studies are practically difficult. The simple validity tests suggest that the CV results do confirm to the underlying economic theory and therefore they do reflect the true preferences of the households that would potentially enjoy the consumer surplus enhanced by the improvements in Pallikaranai marsh. Our overall experience suggests that the validity of the CV results

can be achieved only if we are able to incur adequate transaction cost while conducting the CV survey in study area like ours.

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