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

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

**Abstract**

*Wetlands generate multiple ecosystem services, a part of which enters the production and consumption functions of firms and households. 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, the 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 calls for a monetary valuation of the ensuing non-market benefits and costs, which are reflected in terms of preferences of individuals and households. Pallikaranai marshland, one of the three largest wetlands in Tamil Nadu and the only surviving marshland in Chennai metropolitan area, 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, the Government of Tamil Nadu has been investing the society's scarce resources to improve the quality of the marshland. What are the expected economic benefits that the urban households would derive from such an improvement? A contingent valuation (CV) survey was conducted among the randomly selected households around the marshland to elicit their marginal willingness to pay (WTP) for different levels of improvements in the marshland. The paper discusses the results of the CV survey as well as the validity of such results.*

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

## 1. Introduction

Wetlands, according to Barbier et al. (1997), are among 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' (p. ix). Two major ecosystem services, food and water, that support life on the earth originate largely from the wetlands (TEEB 2010). The Millennium Ecosystem Assessment (MEA 2005) reports that capture fisheries in coastal waters alone contribute $34 billion to gross world product annually. In developing economies, wetlands generate a 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. 200 crore per annum (Kumar 2010). This implies that in the absence of Chilika, the society would have lost Rs. 200 crore 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 policy-making bodies. Groundwater recharged by wetlands plays an important role in supplying freshwater to human beings, with an estimated 1.5 to 3 billion people directly dependent on it (MEA, 2005). Wetlands also provide '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 future value of wetlands in developing countries will be much higher than that 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, particularly the wetlands.

The 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 monetary terms due to various practical problems involved (see Carson 2012). For example, some values can be quantified in physical units and some values are non-tangible; some values are 'site-specific' and some of them are global in nature. Second, economic valuation

**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, fuelwood, 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 | 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).

exercise focuses mainly on those 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 (see Fisher and Turner, 2008). Hence, an alternative classification is warranted. 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 a 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 units). 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; individuals 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.

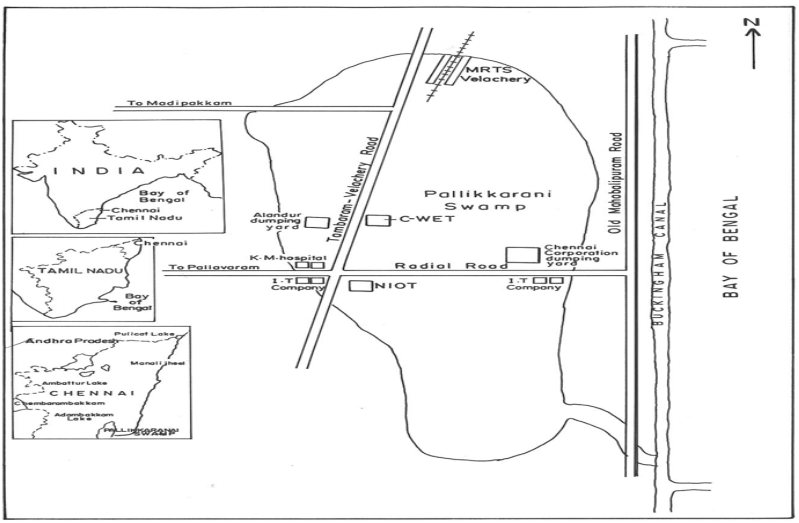
In a growing economy, protecting wetlands from negative externalities and utilising their benefits (including future benefits) at an optimum level can maximise the society's present value of discounted net social benefits. Most of the social benefits of wetlands are not being adequately taken into account 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 marshland 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 theoretical validity of the CV results.

## 2. Description of Pallikaranai Marshland

The Pallikaranai marshland is one of the few natural wetlands along 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. The marshland has an international significance since it harbours rich biodiversity, including some of the endangered species; since wetlands absorb a significant amount of carbon, the marshland contributes to reducing the problem of global negative externality, namely, global warming problem.

**Map 1** *Map of Pallikaranai marshland*




The marshland is known for attracting a variety of migratory birds (Raj et al. 2010). As one part of the marshland is fed by freshwater, it contributes significantly to certain use values – flood control, fishing and recreational benefits, among others – enhancing the economic welfare of the user groups at the local and regional level. The flood prevention benefit becomes the most crucial one since the marshland absorbs a significant amount of excess rainwater, which would otherwise inundate a vast area of the neighbourhood, resulting in economic damage and loss. Similarly, the groundwater recharged by the marshland benefits the society in many different ways: it helps in increasing the water availability for household and industrial consumption at a lower cost; it facilitates in improving the quality of groundwater, which has deteriorated due to seawater intrusion, in the eastern part of Chennai

city; and, it contributes to stabilising the microclimate. The marshland has a potential role to play in mitigating the impact of rising sea levels caused by climate change.

## 2.1. Negative Externalities in Pallikaranai Marshland

Despite its several features, the Pallikaranai marshland has been experiencing certain negative externalities caused by various urban activities such as land encroachment, dumping of liquid and solid wastes inside the marshland 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 marshland

### *2.1.1 Encroachment*

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

The total area encroached upon by various activities comes to around 347.00 ha, which includes a solid waste dumpsite of 72.99 ha (Table 2). Chandramohan and Bharathi (2009) report that over a period, the area used for various purposes including solid waste dumping (by Greater Chennai Corporation) has increased from 75 acres (30.35 ha) to 850 acres (344 ha). According to a recent report by Care Earth Trust (2013), the marshland had 5,500 ha of water-spread area in the year 1965 (see www.scribd.com/

**Table 2** : *Expansion of area under Perungudi dumpsite in Pallikaranai marshland (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).

document/54187332/pallikaranai-marsh-management-plan) and it implies that the quantum of valuable ecosystem services lost over a period of time would have been significant.

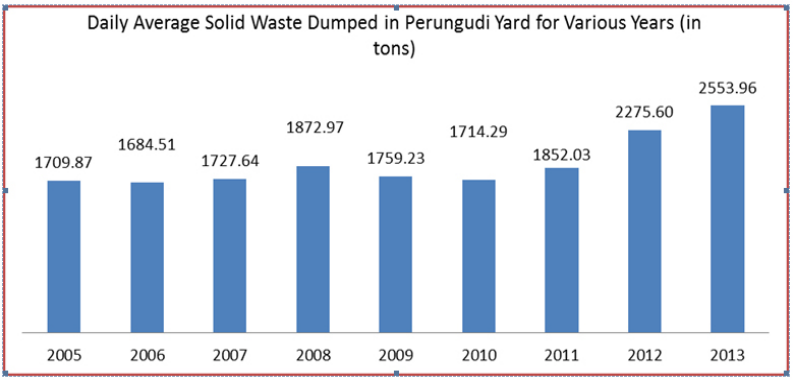
*2.1.2 Dumping of Solid Waste*

Dumping of solid waste within the marshland 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 marshland has been 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 tonnes 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 rainwater from flowing from upstream areas into the drainage system (i.e. into Okkiyam Maduvu), causing flood in the upstream region; a six-meter-deep garbage prevents the groundwater from getting recharged by rain; and birds feeding on the garbage encounter health problems, which could spread to the domesticated birds too. In addition, solid waste dumping impacts negatively on the entire ecological system of the marshland. The Perungudi dumping yard is located just inside the marshland and is gradually consuming the marshland 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 marshland. 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 rainwater from percolating into the sub-surface area, reducing the volume of groundwater recharged. 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

**Figure 1 :** *Increase in the quantity of solid waste in Perungudi dumpsite (in tonnes).*




*Source :* Corporation of Chennai.

plastics, rubber and leather, constitute the remaining 6 per cent of the wastes (see http://bit.ly/2cplo1Q). Since the waste comprises food materials as well, it could potentially cause certain diseases to the animals and birds eating it. Moreover, we have asymmetric information about hospital wastes (i.e. if the hazardous wastes from 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 marshland is not known).

Due to the constant growth in city's population and the increase in overall material consumption, solid waste is also likely to increase in the coming years; as the construction industry is progressing well in the city, problems related to 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 marshland by at least six local civic bodies. Usually, marshlands have the ability to assimilate wastes up to their natural 'carrying capacity' level; once the carrying capacity is exceeded, the quality of the marshland deteriorates. Personal communication with the stakeholders reveals that around 32 million litres of untreated wastewater per day is being released into the marshland and in 2005–06, a total of 9,973 tanker lorryloads of raw sewage (especially human excreta from households) had been drained into the marshland. Apart from tanker lorries, there are innumerable non-point sources that carry a significant amount of untreated sewage, which enters the marshland in various places. Dumping of various types of liquid wastes into the marshland makes it more vulnerable, affecting

its rich biodiversity 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 marshland. As we have already mentioned, the sewage treated may only be a fraction of a huge volume of sewage coming into the marshland. We are also not sure if the sewage is treated in a tertiary treatment facility. The total amount of

**Table 3 :** *Quantity of sewage treated and operations and maintenance cost in Pallikaranai sewage treatment facilities*

| Plant | Year | Quantity Treated in MLD | O & M Cost (Rs. lakh) |
|---|---|---|---|
| 60 MLD Plant | 2012 | 19434.64 | 133.6 |
| | 2013 till June | 9674.72 | 68.6 |
| 54 MLD Plant | 2006–07 | 13122.00 | 149.5 |
| | 2007–08 | 19764.00 | 218.8 |
| | 2008–09 | 19710.00 | 252.8 |
| | 2009–10 | 19710.00 | 254.1 |
| | 2010–11 | 19710.00 | 260.5 |
| | 2012–13 | 16578.95 | 249.4 |
| Alandur Plant | 2003 | 428.70 | 21.1 |
| | 2004 | 1029.36 | 43.4 |
| | 2005 | 2628.43 | 104.2 |
| | 2006 | 3663.07 | 1841.0 |
| | 2007 | 4161.80 | 3548.4 |
| | 2008 | 4559.60 | 7028.1 |
| | 2009 | 4380.00 | 13906.7 |
| | 2010 | 4380.00 | 27594.6 |
| | 2011 | 4730.00 | 54936.5 |

*Source :* CMWSS Board, Chennai.

money spent on sewage treatment implies that were it not for these treatment facilities, society would have lost enormous amount of other ecosystem benefits originating from the marshland. At the same time, the society may still be losing valuable ecosystem services due to the untreated sewage, which is not quantified at present.

So far we have discussed only about a few major, visible negative externalities that are negatively affecting the quality of the marshland. 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 marshland may experience irreversible damage in the near future. In the climate change regime, marshlands are going to play a critical role in enhanced water supply (Palanisamy 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 a higher level of income elasticity of demand) in future and such demand will be adequately met by the Pallikaranai marshland. The marshland may also be declared as a Ramsar site soon. In recent years, the state government has initiated several steps to protect the Pallikaranai marshland. In the following section, we discuss the management plan developed for internalising negative externalities in the Pallikaranai marshland, which sets the stage for economic valuation of expected economic benefits from these measures.

### 3. Measures to Improve the Quality of Pallikaranai Marshland

Azeez *et al.* (2007) came out with a management plan for the eco-restoration of Pallikaranai reserve forest area. The City Connect and Care Earth, Chennai, prepared an 'Adaptive Management Plan for Conservation of Pallikaranai Marsh', which lists various measures to improve the status of the marshland (see http://www.scribd.com/doc/54187332/pallikaranai-marsh-management-plan).

Recently, a management plan (2011–15) formulated by the state government lists out various activities with the aim of protecting the marshland. These measures include: setting up of the Pallikaranai Conservation Authority to oversee the overall conservation measures of the marshland; allocating Rs. 1,575 lakh to implement conservation measures spread across 2011–12 to 2015–16; proposal to dredge the solid waste dumpsite 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 marshland; sanctioning no more construction on the reclaimed

land in and around the marshland; planting of saplings of indigenous species; and, conducting regular awareness programmes among schoolchildren and the general public.

The activities mentioned in the management plan as well as the institutional set-up – such as the Conservation Authority of Pallikaranai – would be expected to improve the overall quality of the marshland 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 marshland, to be enjoyed especially by the households around the marshland.

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

We have used the contingent valuation method (CVM) to elicit the preferences of households for improvements in the marshland. The underlying assumption in the CVM is that 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 marshland while some others utilise not only the groundwater but also get recreational benefits. Even among those households utilising groundwater, the utilisation will vary across different households. 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 willingness to pay (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 type of benefits they consume and the value of benefits that they would derive from the future changes in the ecosystems. The CV method, however, has come in for criticism for its 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 the best practices of conducting a CV survey, especially in a developing country context.

### 4.1. Selection of Sample Households

For the present study, we used a stratified random sampling

procedure to select the sample households. Since the Pallikaranai marshland 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, which are located around the Pallikaranai marshland. As selecting households from the entire revenue ward is a costly affair, we selected sub-areas (streets) under each ward on a random basis. Based on simple random sampling method, we selected the households in each selected sub-areas and the total number of sample households selected for the final survey comes to 1,024, which is 2.5 per cent of the total households of the sub-areas selected.

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. 71.5 per cent of the households initially chosen for the survey) (Table 4). Even though the response rate is considered high (Bateman *et al.* 2002), there are many reasons why we had 'protest response' from the remaining 291 sample households. Since some of the households around the marshland are living on the once encroached marshland, the 'outsiders' conducting a survey about the marshland became a sensitive issue. These households would have suspected that giving interviews would eventually force them to disclose information related to their encroachment of the marshland.

**Table 4:** *Details about sample households selected from different wards*

| Area | Total Households Randomly Selected for the Final Survey | Total Survey Completed |
|---|---|---|
| Pallikaranai | 294 | 426 |
| Jalagadampettai | 93 | 111 |
| Karapakkam | 105 | 132 |
| Thoraipakkam | 156 | 0 |
| Perungudi | 293 | 62 |
| Perumbakkam | 83 | 2 |
| **Total** | **1024** | **733** |

*Source :* Computed from secondary sources.

Some households would have felt that disclosing information would lead to potential eviction but such fear among these households could not be fully eliminated even though we clearly explained to them that the survey was mainly for research purposes and had nothing to do with eviction. In areas where alcohol consumption is relatively high, our enumerators could not even enter those areas to do the survey due to stiff resistance from the alcoholics. Hence, 291 sample households (i.e. 28.5 per cent) protested giving interview for some reason or other. Despite all these constraints, we were able to have completed interviews among 733 households, which we feel is a reasonably sufficient number for estimating the true WTP value. However, a more systematic approach is required for analysing the nature of the protest response and how it affects the mean value and the distribution of the WTP bids.

### 4.2. Implementation of CV Method in the Study Area

The CV method was implemented in a unique and 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 would 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' are provided only with limited choices. In order to overcome this problem, we used choice sets to elicit household preferences for the ecosystem services. For the choice sets, 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 marshland will continue in future as well; (b) Scenario A where a 'moderate level' of improvement in all the seven attributes were prescribed; and (c) Scenario B, which includes a 'higher level' of improvement. The sample households were presented with the three choices and asked to choose one of the scenarios. We 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 also asked a follow-up open-ended WTP question and registered their final WTP value.

**Table 5:** *Alternative choice scenarios used in the CV survey*

| Attributes | Current status Status Quo | Scenario A (Moderate Level) | Scenario B (Higher Level) |
|---|---|---|---|
| Land area of the marshland 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 marshland | Current level | Drenching, no burning | Alternative dump site |
| Wastewater treatment and groundwater 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 |

To make the WTP values more valid, we followed the standard guidelines for 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 scientifically. We had several rounds of discussions with government officials, representatives from civil society organisations, academicians and researchers before finalising the interview schedule in general and choice 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 the 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 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 the respects. After the data was collected, we 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 was a significant difference between the WTP values elicited by different field staff in order to see if there was an interviewer bias (it was not). Therefore, the CV results are assumed to be free from the errors that could have been committed during the survey.

### 4.3. CV Results

Out of the 733 sample households, 33 households preferred the 'status-quo' position, which implies that they prefer to accept the current status of the marshland and are not willing to pay for improvements in the quality of the marshland. 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 marshland 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 CV method works well in developing countries.

The results suggest that a high percentage (95.5 per cent) of the sample households prefer to have improvements in the Pallikaranai marshland and are willing to make one-time payment for such improvements. Only 4.5 per cent of the households prefer status quo, the reasons for which we have already discussed. A relatively large percentage (53.50 per cent) of the sample households prefer higher level of improvements in the marshland. Out of the 700 households that prefer improvements, 53.47 per cent prefer 'higher level of improvements' (Scenario B) while 42 per cent prefer 'moderate level of improvements' (Scenario A). So, around 95 per cent of the households prefer the quality of Pallikaranai marshland to be improved from the current level for which they are willing to pay some 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 considered the corresponding cost to be high. Even though the bids were selected based on group discussions and pre-testing

**Table 6:** *Preferences of the households for different scenarios*

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

*Source :* Computed from primary data.

of the interview, 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 (211 of 364) of women respondents and 26.28 per cent (97 of 369) of male respondents opted for Scenario A. Out of the 308 respondents who opted for Scenario A, 68.50 per cent are women and 31.49 per cent are men (Table 6).

Compared to Scenario A, a relatively larger percentage of sample households chose Scenario B, which describes higher level of improvements in the marshland. For example, 53.47 per cent of the households opted for Scenario B. Out of the 392 respondents who chose Scenario B, 33.92 per cent are women and 66.07 per cent are men. While there was a larger preference for Scenario A among women more men opted for Scenario B. This may be due to the fact that 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 be satisfied with improvements up to a moderate level and they might have found a marginal improvement from Alterative A to Scenario B to be not worth the resources to be spent.

While around 95.5 per cent of the sample households are willing to pay for improvements in the marshlands, the rest 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 (119) are willing to pay Rs. 2,000, followed by 14.6 per cent households (107) who are willing to pay Rs. 1,000 per annum. Around 12.3 per cent of the households (90) and 10.9 per cent households (80) 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 of the households (46). 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 who have expressed 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).

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 marshland. This implies that in case the proposed conservation measures are carried out adequately, then the households would derive a benefit 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 – an average amount of Rs. 2,501.16 – than similar households from other locations (Table 9). The next highest average WTP value (Rs. 21,66.45) comes from the households residing in Pallikaranai. The households in Karappakkam and Perungudi 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 marshland the larger is the WTP value for protecting the marshland. Many households have a clear perception about the values that they would enjoy from the proposed measures in the marshland, 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 marshland. The WTP values are influenced by many different factors and a detailed analysis of it will be carried out in a separate paper.

**Table 7:** *Frequency of sample households willing to pay different amounts*

| Max WTP value | No. of households | Percentage of total | Cumulative percentage |
|---|---|---|---|
| .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 |
| 6000.00 | 1 | 0.1 | 92.4 |
| 7000.00 | 1 | 0.1 | 92.5 |
| 7500.00 | 53 | 7.2 | 99.7 |
| 8000.00 | 2 | 0.3 | 100.0 |
| **Total** | **733** | **100.0** | |

*Source :* Computed from primary survey.

**Table 8:** *Descriptive statistics – maximum willingness to pay values (in Rs.)*

| | |
|---|---|
| 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 (in Rs.)*

| 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.

**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

### 4.4 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 conform to the underlying demand theory and, therefore, the results do conform to theoretical validity.

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 (Scenario A) to the higher level of improvement (Scenario B). As predicted, the marginal WTP value from status quo 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 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 conform to the 'marginal conditions', we conclude that the CV results are theoretically valid.

We also tested whether the 'anchoring effect' had occurred in the results at all and if so, how robust it was. In order to test the 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 a 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.

## 5. 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 marshland as well as their own welfare. The households in the study area are seriously concerned about the solid waste being dumped in the marshland, the huge quantity of untreated sewage released into it and the marshland 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, especially of the residential areas in the upstream part of the marshland, are considered by the households as some of the by-products of these problems. In order to adapt to the ill effects caused by the deterioration of the marshland, 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 requirements; the households participating in the water markets are found to spend a significant amount of their income, which has opportunity cost. The amount of WTP values stated by the households implies that a significant amount of resource could be saved at the household level in case the negative externalities are internalised. Apart from benefits to individual households, there is a significant social benefit (such as climate stability), which can be tapped through minimising the ill effects. The overall results of the study suggest that the marshland is becoming more vulnerable due to various types of negative externalities and further improvements in the marshland are required for enhancing ecosystem benefits on a sustainable basis. More importantly, the solid waste dumping yard and sewage treatment facilities will have to be moved away from the marshland and all stakeholders will have to be effectively involved in managing the marshlands in the coming years.

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 households in a developing country context where conducting CV studies are practically difficult. The simple validity tests suggest that the CV results do conform to the underlying economic theory and, therefore, they do reflect the true preferences of the households that would potentially enjoy the ecosystem benefits enhanced by the improvements in Pallikaranai marshland. 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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