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Understanding the Value of Tank Ecosystem A Case Study of Tank in Singanallur, Noyyal Basin

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Wetlands, in particular tank ecosystem, produce numerous benefits that are valued by the stakeholders. Despite the importance, the services are being used as free and infinite as most of them are non-marketed and are undervalued. There prevails increasing interest for concepts of ecosystem services and valuation of such services in recent years. This makes the policy makers to consider all the aspects and work on policies so as to enhance the optimal usage of services and conservation of ecosystem. The purpose of this study is to elucidate the value of Singanallur tank in Noyyal basin, providing provisioning and recreational services by employing valuation methods like market price method, contingent valuation and individual travel cost method and each attributes of the tanks are quantified in monetary terms. The total value of Singanallur tank is Rs. 7.2 million per year.

Key words: Ecosystem services, Tank ecosystem, Valuation.

In recent years the valuation of ecosystem services has turned out to be the most vital, indispensable and fast developing areas of research in the field of environmental economics (Sagoff, 2008). One of the ecosystems indispensable to the sustenance of life, is the wetland ecosystem, as it furnishes multiple benefits viz. provisioning services (food, fresh water, fuel, fibre), regulating services (water treatment, local climate regulation), supporting services (nutrient cycling, water cycling), cultural services (recreation, aesthetic values, spiritual benefits) both in direct and indirect means to numerous stakeholders. Wetlands particularly tanks, provide benefits that have 'public good' aspects i.e. both non-rivalrous and non-excludable (Costanza *et al.* 2014).

Economic valuation of ecosystem services is immense important as it provides an opportunity to drive prioritization and speculative choices by understanding the relative benefits that alternate investments produce. Quantifying the monetary value for those goods and services provided by the tank is called economic valuation that aids in the appropriate management of the resource. This paper deals with the valuation of ecosystem services from the Singanallur tank in Noyyal Basin. The main objective is to quantify the tank attributes in monetary terms by employing valuation methods like market price method, contingent valuation method and individual travel cost method. Based on the nature of the attribute, the valuation methods are used appropriately. It is followed by the summation of all the individual attributes value, thereby deriving the total economic value of the tank.

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Material and Methods

The Noyyal basin in Tamil Nadu comprises of about 31 system tanks. One such tank in Singanallur, Coimbatore district is selected for the study. As the demand for ecosystem services from the tank keep on increasing there is earnest need to study the tanks in Noyyal basin for proper conservation and maintenance. Singanallur tank has command area of about 473.00 acre and the area comprises population of 1012 households (Census, 2011). Out of which 100 households residing around the tanks with in the radius of 5 km were randomly drawn as sample respondents for the study and the socio economic profile of the sample respondents is presented in Table1. Economists have developed a variety of techniques to value the amenities viz. methodology based on market data, consistent with the valuation of marketed goods; revealed preferences, based upon observed behaviour towards marketed good in connection to the non-marketed good of interest and stated preferences in surveys with respect to the non-market good (Schuhmann and Mahon, 2015).

Market price method

Market price method was employed (Adeyemi *et al.,* 2012) for valuing the fishing service in which the sale price of fish in the market (i.e. information of market price) is used to determine the total value of fish from the tanks.

$$V_F = \sum_{i=1}^{n} \sum_{j=1}^{k} Q_{ij} * P_{ij}$$

Where, V_F is the value of fish harvested (Rs. Year^{-1}), Q_{ij} is the Total quantities of j^{th} breed fish harvested

in i^{th} season (kg.Year^{-1}), and Pij is the Sales price of j^{th} breed fish in i^{th} season (Rs.kg^{1}).

Contingent valuation method

The services like habitat for birds from tank ecosystem is valued by aiding the most prominent valuation method called contingent valuation method. It is a questionnaire based survey method of asking people directly about their choice rather than observing the actual behavior of market. Through survey the respondents were asked to quote the willingness to pay for the particular service which in turn is determined by many factors (Siew *et al*., 2015). The factors influencing the Willingness to Pay (WTP) are annual income of the households (INCOME), peoples attitude towards birds' habitat (HAPPY), educational level of the head of the household (EDUCATION) and age of the household head (AGE).

$$WTP = f(\ INCOME, HAPPY, EDUCATION, AGE)$$

The entire variable is expected to influence the Willingness to Pay (WTP) positively. Average willingness to pay per person is captured using CVM and then multiplied by the total population in order to derive total economic value of a good or service. CVM has its own advantage of estimating both use and non-use economic values.

Travel cost method

The fundamental commence of the travel cost method is that, the time and travel cost expenses that individuals incur to visit a site i.e. cost to access the site. Consequently, peoples' willingness to pay for visiting the site can be estimated in the view of the number of visits they make at varying travel costs. The travel cost method is used to assess the economic use values related with ecosystems or sites that are used for recreation. Children park near the tank was estimated by individual travel cost method (Muryani, 2016; Zella Adili and Ngunyali Robert, 2016). The individual travel cost method utilizes the travel expenditure incurred in getting to the site as surrogate for the price by that visitor to the destination (Mugambi and Mburu, 2012). The factors influencing the number of visits made by the respondent to the park were considered and are represented as follows,

$$N = \beta_0 + \beta_1 NCHLDREN + \beta_2\ EDN +$$

$$\beta_3\ DIST + \beta_4 INCOME + \beta_5 TRAVEL\ COST$$

Where, N is the Number of visitors to the park per year (numbers), represents the coefficient of the factors influencing the number of visits, NCHLDREN is the Number of children in the household (numbers), EDN is the Educational level of the head of the household in years of schooling (number of years of education), DIST is the Distance of the tank (km), INCOME is the Income level of the head of the household (Rs.year^{-1}), TRAVEL COST is the Travel Cost incurred per trip to visit the park (Rs.).

The recreation value was estimated from the consumer surplus, the difference between the estimated demand prices and the actual expenses that the visitor incurs during the visit to park (Bharali and Mazumder, 2012) which are obtained as,

$$CS = {}^{1}/_{\beta_t}$$

Where, CS is the Consumer surplus per visit (Rs.), is the Estimated co-efficient of travel cost The value of children park near the tank is calculated using the formula (Muryani, 2016),

$$V_{cp} = CS * N$$

Where, V_{cp} is the Value of children park near the tank (Rs. /year), CS is the Consumer surplus per visit (Rs.), N is the Number of visitors per year (Numbers).

Results and Discussion

Provisioning service- Fishing

One of the major income sources from the tank ecosystem is fishing. The economic value of fishing from the tank is assumed as the gross income by fishing and its sale.

Table 1. Profile of respondents

Socio economic profile	Mean
Age of the household head	43.79
Family size of the respondents	3.40
Education (no of schooling years)	12.47
Annual income of the households (Rupees/ household/year)	492,500.00
Distance of the tank to the residents (Km)	1.97

Fishes are grown and harvested from the month of June to February and the rest of the months, fishing activity are not continued in the study area as they are considered as the breeding season and fishing activity is stopped to ensure the fish populations. The variety of fish species, quantity of fish harvested per year and market price per kg of each species in the tank is presented in the Table 2. The value of tank in terms of fishing service is Rs. 69, 90,000.

Table 2. Value of fishing in the Singanallur tank

Name of the fish species	Quantity of fish harvested (kg/year)	Price per kg of fish harvested (Rs./kg)	Value of fishing (Rs.)
Catla	15000	120	1800000
Roghu	15000	120	1800000
Jelabi	12000	110	1320000
Grass carp	6000	80	480000
Mrigal	6000	130	780000
Cat fish	3000	70	210000
Murrel	3000	200	600000
Total value of fishing (Rs./year)			6990000

Recreational services

Habitat for birds

Migratory birds visit the tank in every season and

it provides happiness in the minds of the people. Birds are an important natural resource and there is a value in preserving them. Contingent valuation method was widely used to value the bird's habitat in the tank ecosystem. The tank dependent community is more concerned about tank ecosystem and they are willing to pay their money for the conservation of birds' habitat. The respondents are willing to pay a maximum amount of Rs.200 per year. The mean willingness to pay by the respondents is Rs.85.65 per year in Singanallur. Majority of the sample respondents (92 percent) are willing to pay for the habitat for bird's service elucidating that the respondents are very much interested in conservation of birds. The results of bivariate logit regression model on factors influencing respondent's willingness to pay for bird's habitat are presented in the Table 3.

Table 3. Parameter estimates of willingness to pay for habitat for birds in Singanallur tank

Variables	Regression coefficient	t- ratio
Constant	-73.46	-6.94
Income	15.11***	13.69
Happy	52.09***	7.09
Education	5.23***	2.98
Age	0.24*	1.71
Average willingness to pay (Rs)		85.65
Total population in singanallur (no of household)		1012
Value for habitat for birds (Rs/year) 86,677.80		

*** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level.

All the factors are found to be significant in positively influencing the respondents WTP. This is due to the fact that people with higher income and higher education tend to pay more for the conservation of birds species in the tank and their happiness towards bird watching is also expected to influence as they feel pleasure watching the birds and tanks act as their habitat.

Table 4. Value of children park near the Singanallur tank

Variables	Regression coefficient	t- ratio
Constant	1.91	4.97
No of children	0.62***	5.42
Education	0.13**	2.18
Distance	-0.09*	-1.73
Income	-1.55E-06***	-3.05
Travel cost	-0.01***	-2.68
Average consumer surplus per visit (Rs)		72.62
No. of visitors per year		2600
Value of children park near tank (Rs/year)		1,88,822.52

*** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level

Older the respondent, higher they are willing to pay for the conservation of bird species and for its habitat (Lee *et al*. 2009; Ansong and Røskaft 2014). The total value for the service (bird's habitat) is Rs. 86,677.80 (Table 3). It is derived by multiplying the mean WTP (Rs.85.65) with total population (1012 household) in Singanallur.

Table 5. Total value of the tank

Services	Attribute	Value (Rs.)
Provisional	Fishing	69,90,000.00
Recreational	Habitat for birds	86,677.80.
	Children park	1, 88,822.52
Total value of the tank		72, 65,500.32

Children park

Children park near the tank is one of the economic benefits receive from the tank by the people residing in Singanallur. It is certain to evaluate this service so as to get the total value of the tank. There are approximately 2600 visitors per year, as on average 50 households visit the park per week. Individual travel cost method is used to value the children park near the tank. The socio-economic variables which influence the number of visits are education, distance, income, number of children, travel cost. The information of number of visits at different travel cost is used to construct the demand function, followed by the estimation of consumer surplus. The relationship between number of visits per month (dependent variable) and travel costs (independent variable) is represented as the demand curve (Fig 1). The area below the demand curve gives consumer surplus per visit. In order to get the total value of Children Park, the consumer surplus is multiplied with the total number of visitors per year (Table 4).

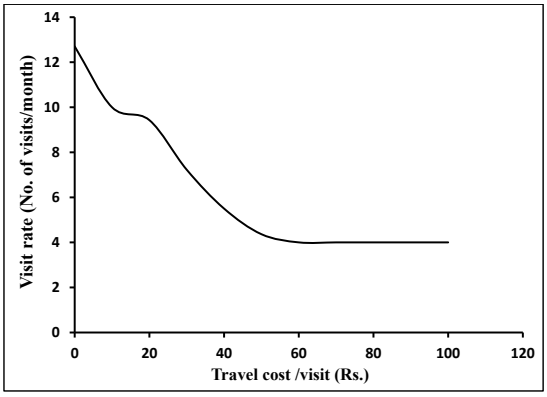

Fig. 1. Demand curve

Distance, travel cost and income negatively influence the rate of visits whereas number of children in the household and education positively influence the number of visits. The total number of visits decreases with the increase in distance, travel cost and income. But the number of visits increases as the when there are more number of children in household. The respondent with higher education visits the park at higher rate. The average consumer surplus obtained per visit is Rs. 72.62 (Table 4). The estimated economic value of in the tank is Rs. 1, 88,822.52 per year (Table 4).

Conclusion

The study found that the total value of the Singanallur tank is Rs. 72, 65,500.32 per year. It is captured by the summation of value of all the attributes provided by the tank viz. fishing and recreational (Habitat for birds and Children park) services (Table 5). It is evident from the result that, the services with market value and the services of non-market value are taken into consideration for accounting the total value of the tank. The study revealed that the recreational services also contribute to the total benefits received from that tank in addition to the provisioning service and is significant in capturing the total value of tank ecosystem. As the recreational services are not typically traded in markets, there is no measure of observed prices for these services. The emergence of ecosystem services and valuation concepts is an explicit attempt to reflect the economic accounting of the unaccounted ecosystem services thereby expanding the scope in the policy options to conserve the ecosystems. Also it is high time that the local stakeholders' and tank dependent communities may be encouraged to conserve the tank ecosystem through new institutional payment for ecosystem approach. The policy of PES may be given adequate importance for better conservation of the tank ecosystem and its services.

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