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Original Article

STAKEHOLDER PREFERENCE, DEPENDENCE AND ATTITUDE TOWARDS CONSERVATION OF MANGROVE ECO-SYSTEM IN SOUTH-EAST COAST OF INDIA

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ABSTRACT

A study was undertaken to analyze the relationship between mangrove ecosystem and livelihood security of the local stakeholders in Pichavaram Mangrove Forest (PMF) in Cuddalore district of Tamil Nadu, India. Data were collected from different types of respondents *viz.,* i) Fisherman cum farmer, ii) Tourist dependents and iii) Tourist. The tourist dependents were found to be better educated and better off with their income compared to the fishermen cum farmer. About 75 per cent of the respondents depended mangrove area for fishing. Most of tourists were young and middle aged and also have permanent income. Educated youth showed more interest in visiting places of natural origin. People who travelled by own vehicles had higher visitation rate of 50 per cent than those travelling by hired vehicles owing to the high cost towards logistics.

From the analysis it was understood that the visitation rate was inelastic with respect to the travel cost. The fishermen cum farmer and tourist dependents were willing to pay an amount of Rs.688, Rs.643/annum respectively towards internalizing externalities. The catchment area, monthly income, duration of fishing and education were positively related to WTP and were significant. The average monthly per capita consumption expenditure was Rs.799 for fisherman cum farmer and Rs.859 for tourist dependent households in PMF.

It is obvious that the people who entered into fishing and other mangrove dependent occupations had extensively improved their standard of living. Positive externalities were shoreline protection, increased fish catch and enhanced income, utilization of non – timber forest products, control of soil erosion and water retention. The study comes out with a policy that both the state and central government institutions should protect the mangrove ecology and sea-shore through stringent adoption of regulatory mechanisms. The local social institutions should restrict people from over exploitation and they should provide adequate facilities to the visitors too to encourage the concept of eco-tourism; so that the mangroves would be promoted and conserved significantly.

Keywords: Mangroves- Willingness to Pay- Contingent Valuation- Consumptive Use - Tourism- Externalities- Travel Cost- Institution.

INTRODUCTION

Mangrove forests make up one of the most unique ecosystems on earth in that they thrive where no other trees can survive (in the transition zone between the ocean and land). They are among the world's most productive ecosystems. Mangroves occur on colonized shorelines and islands in sheltered coastal areas with locally variable topography and hydrology (Lugo and Snedaker, 1974). Mangroves occurring along estuaries, backwaters and the deltas function as the most important links between the land and sea. Mangrove forests are estimated to cover an area of about 17 million hectares world over. The total area of mangroves in India is estimated to be 6,740 sq. km and in Tamil Nadu, mangrove coverage is about 150 sq. km. at Pitchavaram and Muthupet (Ajithkumar, 1998). India has a long coastline of about 7500 km including its island territories, which consists of a variety of coastal habitats such as estuaries, mangroves, coral reefs, etc. (Balasubaramanian *et al*., 2000). The coastline of Tamil Nadu has a length of about 1076 km constituting about 15 per cent of the total coastal length of India and stretches along Bay of Bengal, Arabian Sea and Indian Ocean.

Economic and Environmental Importance of Mangroves

The mangroves perform many important ecological roles such as filtering nutrients, stabilizing lagoon shores, providing protection for commercially important fish mass, helping in the continuous formation of soil, in addition to serving as an important migratory point for birds. Mangroves are highly productive biotopes and as such have a vibrant, rich and endemic wildlife. Mangrove forests and the salt marshes connected to them provide food (Moses, 1985). Mangrove forests are vital for healthy coastal ecosystem. The forest detritus, consisting mainly of fallen leaves and branches from the mangroves, provides nutrients for the marine environment and supports immense varieties of sea life in intricate food webs (Odum and Herald, 1975). Wood from Mangrove forests are often collected as firewood. The willow plant is used in crafting furniture and other household amenities and many plants of the mangrove have medicinal uses. Another important environmental service provided by the mangroves is that they build land and protect the shoreline from being washed away in storms (Savory, 1953). The roots and trunks break the force of the waves and the leaves and branches reduce the effects of the wind and rain.

Problem Focus

The general cause of mangrove destruction and degradation has been due to the preference for short-term exploitation (immediate economic benefit) rather than longer-term and sustainable exploitation. In general there is an increasing rate or scale of impact associated with the above and a given mangrove area can be affected by several different activities simultaneously, or over time as land use patterns change. Mangrove deforestation in general results in reduction in fish catch, degradation of clean water supplies and salinisation of coastal soils, erosion, and land subsidence, as well as the release of carbon dioxide into the atmosphere. In fact, mangrove forests fix more carbon dioxide per unit area than any other phytoplankton. Mangrove forests once covered three fourth of the coastlines but today less than 50 per cent remain, and of this remaining forest, over 50 per cent is degraded and not in good form. Hence, the degradation of coastal ecosystems has real and profound economic and social costs, not just in terms of losing shoreline protection services, but also in terms of loss of livelihoods. As such, coastal ecosystems provide products and services which yield both

direct and indirect benefits to residents in coastal areas (Kallesoe. *et al.,* 2008).

Even though a large number of studies have been undertaken in different pockets of the globe to estimate the present level of benefits enjoyed by the local stakeholders, not much attempt has been made to understand the status and the economic and ecological impacts of wetland biosphere particularly with respect to the mangrove ecosystem in India in general and in Tamil Nadu in particular. Hence an effort is made to study the cost and benefits of mangrove ecosystem in the east coast region of Tamil Nadu, where the concentration of mangrove biosphere is substantial.

OBJECTIVES OF THE STUDY

The overall objective of the study is to analyze the association between mangrove ecosystem and livelihood security of the local stakeholders. The specific objectives of the study are

1. To analyze the direct and indirect use values of mangrove ecosystem
2. To study the impact of mangrove ecology on the livelihood security of the local stakeholders, and
3. To assess the stakeholders' attitude and WTP (Willingness To Pay) towards the conservation of mangrove ecosystem.

RESEARCH METHODOLOGY

Purposive random sampling technique was employed in selecting respondents based on the nature of usage of wetland ecosystem (mangrove ecosystem). There were 30 farmer cum fishermen, 30 tourist dependents and 30 exclusive tourists, visiting the Pichavaram Bio Reserve (PBR) selected for accessing the recreational value of the Pichavaram Mangroves. Respondents below the age of 18 years were not interviewed for obvious reasons. The primary and secondary data used in this study pertained to the year 2010. The primary data required for the study were collected through personal interview method with a help of comprehensive interview schedule. The interview schedule for local dwellers covered aspects such as general household characteristics, crop schedules, farming practices, sources of income, extent of dependence on mangrove forests, employment, migration, etc. The schedule for tourist visitors covered aspects such as general characteristics, preference, reasons for preference of the site in question, etc. The data collected were tabulated, processed and subjected to statistical analysis.

Tools and Techniques

Percentage Analysis

The percentage analysis was carried out to estimate the influence of socio-economic variables such as age, education, family size, experience, income generating from direct mangrove products, land holding pattern, livestock possession, etc. and to access the general opinion of the people with respect to different issues of resource conservation and environmental sustainability.

Direct Consumptive Use Value

The direct consumptive use value is the value accruing from the harvesting and consumption of produces from the mangrove forest. In the present study, the benefits from using mangrove forest produces and the benefits attained by grazing livestock in the forest had been included to estimate the direct use value. The various forest products collected by the local people were studied during the survey. The number of visits made to the forest for collection and average quantities of the different products collected in a given period of time was also estimated. The products are not used for commercial purposes and mainly consumed by the locals to meet the household demand and the local market price for the products was used as proxy to estimate the value.

$$Direct\ use\ values = Average\ quantities\ of\ forest\ products\ collected\ per\ household\ annually \times number\ of\ households\ residing\ in\ the\ area \times local\ market\ prices$$

The households residing near the coastal areas owned livestock and they used to graze animals in mangrove forests. The economic value of grazing benefits was estimated by the amount of fodder that would be required to be fed to the cattle if they were not grazed was calculated using average daily requirement of green fodder, dry fodder and other concentrates for animals. The local market price was used as a proxy to estimate the economic value of grazing.

Theoretical Framework

The expenditure incurred in visiting the study area was considered as a revelation of the consumer's preference for recreation. The travel cost was the proxy for the asset value of the site. The demand for recreation was studied as a factor influenced by travel cost and other socio-economic characteristics of the visitors. The problem of multi site visit was common in the study area since it is located near the temple town, Chidambaram. Hence the local costs of travels from the nearest city were used, following Chopra and Kedekodi (1997). The travel cost included pocket cost (cost of travel, boarding, lodging, local ticket fares) and also the opportunity cost of time spent during the visit. Opportunity cost of the trip was the income foregone. Opportunity cost of time was calculated as the salary of a day considering an average of 22 working days a month and 33 per cent of opportunity cost was added to the incurred costs following Englin and Shonakwile (1995).

Semi-Log Linear Regression Model

A semi-log linear model was chosen to estimate the consumer surplus for an individual making visits to the site. In case of a linear form it was given by Consumer Surplus (CS) as the frequency of visit per annum divided by travel cost per visit. The linear functional form implies finite visits at zero cost and has a critical cost above which the model predicts negative visits. The consumer surplus in case of semi log-linear function implies a finite number of visits at a zero cost and never predict negative visits, even at a high cost. Having tried various functional form, it was decided that the linear functional form was the best fit for the data.

The basic model used in this study depicts the number of visits to Pichavaram mangrove forest as a function of factors such as the age, sex, marital status, education, distance travelled, mode of travel and travel cost which were used as independent variables. The model used for the present study was of the following form.

FOVPA (Y) = f {AGE, GND, MST, EDU, INC, LTC, MOST, DST}

Where,

FOVPA (Y) = The quantity of recreational occasions demanded by the i^{th} visitor per year (Frequency of visit per annum).

Independent variables

Symbol used	Description
AGE	Age (Number of years)
GND	Gender (0-Female,1-Male)
MST	Marital status (1 if unmarried, 0, otherwise)
EDU	Years of education (Number of years)
INC	Monthly income (Rupees)
LTC	Travel cost (Rupees)
MOST	Mode of travel (1 if own vehicle, 0, otherwise)
DST	Distance travelled (Kilometers)

Economic Status of Local Stake Holders-Ecotourism

In general, the livelihood opportunities for any household depends on
(i) The physical capital in its possession, (ii) The quality of natural capital it has access to, (iii) The public capital (infrastructure), and (iv) The human capital. In the PBR, apart from private capital (mostly cultivable land), the natural capital is the mangrove forest and estuarine brackish water. Direct conservation efforts are gradually lowering locals' access to this capital. Also, unsustainable uses and mangrove forest exploitation is affecting its quality.

Fishing, tourism and traditional farming play a vital role in providing livelihood opportunities of the community in the study area. A portion of additional income from tourism had also been used to finance children's education and to supplement other household expenses. This enhances the human capital of village households and

created opportunities for new occupations within the region or for migration outside. It also provided the basis of informed decision-making vis-à-vis conservation and sustainable use of natural resources. This exemplified the complex character of social changes that are activated by the cash inflow from tourism (Refer Wunder, 2000 for details) and called for a deeper analysis of expenditure patterns of participating vis-a-vis on-participating households. In general, there was the potential for tourism to add value to local social and natural capital, making them marketable and productive. The social culture and the existence value of the mangrove forest turned into marketable productive assets. In this study, it was examined whether this kind of transition had at least begun to happen in future.

Multiple-Linear Regression

The main statistical analyses applied were descriptive statistics and multiple-linear regression. A multiple-linear regression model was used in this study to estimate the household expenditure which was exclusive for fisherman and mangrove dependents. The model used for the present study was of the following form.

Multiple-Linear Regression Model for Farmer cum Fishermen

HHEXPND = f {AGE, GND, EDU, HHSIZE, INC, LAND, LVSTOCK, TIME, AREA,}

Where,

Dependent variable

HHEXPND = The household expenditure in terms of rupees per month.

Independent variables

Symbol used	Description
AGE	Number of years (Head of households)
GND	Head of households (Male=1; Female=0)
EDU	Years of education (Number of years)
HHSIZE	Household Size : (Number of adult members in the household)
INC	Households income (in rupees per month)
LAND	Land holding size (ha)
LVSTOCK	Number of cattle per household
TIME	Fishing Time (Number of hours per day)
AREA	Area of fishing (1, Near mangroves; 0, Otherwise)

Environmental Improvement

The value of the environmental improvement could be measured either by the individual's maximum Willingness To Pay (WTP) to obtain the improvement (estimated by the compensating surplus) or by the individual's maximum Willingness To Accept (WTA) as compensation to forego the improvement (estimated by the equivalent surplus). The individual's economic value assigned to any economic good depends upon the baseline from which the value is measured. If the baseline was taken to be the status U_0 before the ecosystem change, the individual's value is the WTP for improvements to welfare or the WTA for losses. This approach to valuation was called the compensating variation. On the other hand, if the condition after the ecosystem change is taken as the baseline, the individual value could be measured as the WTA to forego a benefit or the WTP to avoid a loss. This approach to valuation was called the equivalent variation.

The equivalent variation approach could be an appropriate measure compared to compensating variation. It is apparent that the appropriate measure of welfare is related to the property rights of the individual on the asset. Freeman and Myrick (1993) suggested that many valuation problems fall naturally in a WTP scenario. In this study a description of biodiversity of the Pichavaram Mangrove Ecosystem (PMF) and its importance was given to the respondents. The individuals were then asked if they were willing to pay towards the conservation of the reserve. The dichotomous choice question format (bidding game technique), was used to elicit the amount they would be willing to pay. It was followed by an open ended question on maximum WTP.

Bidding Game Technique

The respondent was asked whether he/she was willing to pay a given amount of money for a change in the provision of additional mangrove ecosystem services. If he/she refused, the proposed amount was reduced by a given percentage. The procedure was repeated until the respondent provided a positive answer. The ultimate amount proposed was taken as his/her maximum WTP for obtaining the environmental improvement of Pichavaram Mangrove Forest (PMF). If the individual accepted the proposed amount, it was increased by given percentage. The procedure continued until the individual answered negatively, and the penultimate amount was taken as maximum WTP.

Multiple-Linear Regression

In order to determine the factors influencing the actual willingness to pay for conservation of PMF a multiple-linear regression of the following form was used.

Multiple-Linear Regression Model for Fishermen cum Farmer

The model adopted for estimation of WTP of farmer is described below

WTP= f {AGE, GND, EDU, HHSIZE, MST, INC, LAND, LVSTK, TIME, AREA}

Where,

Dependent variable

WTP= Willingness of the visitors to pay for conservation of PMF in rupees.

Independent variables

Symbol used	Description
AGE	Age (Number of years)
GND	Head of households (1 if male, 0, otherwise)
EDU	Years of education (Number of years)
MST	Marital status (1 if unmarried, 0, otherwise)
HHSIZE	Household size (Number of adult members in the family)
INC	Households income (in rupees per month)
LAND	Land holding size (ha)
LVSTK	Number of cattle per household
TIME	Fishing Time (Number of hours per day)
AREA	Area of fishing (1, Near mangroves; 0, Otherwise)

The dependent variable in the model was the actual amount stated by the respondent as his /her WTP. The independent variables considered were age, gender, marital status, education, monthly income, land, livestock, time and area of fishing. Ordinary least square method was employed to estimate the co-efficient. A linear function form was used for estimation.

Multiple-Linear Regression Model for Tourist Dependents

The model adopted for estimation of WTP of tourist dependents was described below

WTP= f {AGE, GND, EDU, MST, HHSIZE, INC}

Where,

Dependent variable

WTP= Willingness of the visitors to pay for conservation of PMF in rupees.

Independent variables

Symbol used	Description
AGE	Age (Number of years)
GND	Head of households (1 if male, 0, otherwise)
EDU	Years of education (Number of years)
MST	Marital status (1 if unmarried, 0, otherwise)
HHSIZE	Household size (Number of adult members in the family)
INC	Households income (in rupees per month)

The dependent variable in the model was the actual amount stated by the respondent as his /her WTP. The independent variables considered were age, gender, marital status, education, monthly income. Ordinary least square method was employed to estimate the co-efficient. A linear function form was used for estimation.

Garrett's Ranking Technique

Garrett's ranking technique was employed to understand the positive externalities enjoyed by the local people attached to various functions the PMF had been performing. The respondents were asked to rank the given functions, considered most important. The orders of merit given by the respondents were converted into ranks using the following formula.

$$Percent\ position = 100(R_{ij} - 0.5)/N_i$$

Where,

R_{ij} – Rank given for i^{th} factor by j^{th} individual

N_j – Number of factors ranked by the j^{th} individual

The percent position of each rank, were converted into scores by referring the table. The mean score values were arrived for each factor and the factors were arranged in the order of their mean score value.

MAJOR RESULTS

Age of Respondents

It is clear from the Table 1 that majority of the tourist dependents (60 per cent) were in the age group of 36 to 45 years, 50 per cent of the fisherman cum farmer were in the age group of more than 45 years. The age distribution details clearly indicated the dominance of middle age groups who would accept readily the policies related to the conservation of natural resources and protection of biodiversity.

Table 1 Age of Respondents

Age (years)	Fisherman Cum Farmer (No.)	Tourist Dependent (No.)
18 to 25	1	1
	(3.30)	(3.30)
26 to 35	3	6
	(10.00)	(20.00)
36 to 45	11	18
	(36.70)	(60.00)
More than 45	15	5
	(50.00)	(16.70)
Over all	30	30
	(100.00)	(100.00)

* Figures in parentheses represent percentage to total.

Education

The educational status of the sample respondents was analyzed and the results are presented in Table 2. It is interesting to note that more than 40 per cent of the respondents had no formal education. It is a matter of fact that about only 2 to 3 per cent had diploma level education among tourist dependents category and no one had diploma level education in fisherman cum farmer group. The tourist dependents were found to be better educated compared to the rest of the groups.

Income

Income is one of the most important attributes deciding the conservation of biodiversity and developing eco-tourism, as well as to strike a balance between resource conservation and environmental sustainability. The details of income of various groups of sample respondents presented in Table 3 indicates that majority of the respondents earned between Rs.3001 to Rs.6000 a month. The tourist dependents were better off with 50 per cent earning between Rs.6001 and Rs. 8000 per month. The fishermen cum farmer living in the nearby PMF area were poor and depended mainly on mangroves and agricultural lands for their livelihood security. Paddy followed by pulses were the common cropping pattern followed by the farmers.

Table 2 Educational Attainment of Respondents

Education (years)	Fisherman Cum Farmer (No.)	Tourist Dependent (No.)
Illiterate	16	9
	(53.30)	(30.00)
Primary	10	6
	(33.30)	(20.00)
Higher secondary	4	12
	(13.40)	(40.00)
Diploma	0	3
	(0)	(10.00)
Over all	30	30
	(100.00)	(100.00)

*Figures in parentheses represent percentage to total.

Table 3 Income Level of Respondents

Monthly Income (Rs.)	Fisherman Cum Farmer (No.)	Tourist Dependents (No.)
Below 3000	3	2
	(10.00)	(6.70)
3001 - 6000	14	10
	(46.70)	(33.30)
6001 – 8000	12	15
	(40.00)	(50.00)
Above 8000	1	3
	(3.30)	(10.00)
Over all	30	30
	(100.00)	(100.00)

*Figures in parentheses represent percentage to total.

Socio-economic Characteristics of Tourists

Tourists of varying characteristics visit the PMF. Among the sample respondents, only 3.3 per cent were foreigners, 10 per cent were from other states and the rest were domestic tourists. The flow of tourist was regular and maximum during the months of April and May. The characteristics of tourist respondents relevant to the present study are given in this section.

Age of Tourists

The people with more than 45 years of age were only 10 per cent and 20 per cent were between 36 and 45 years of age and 40 per cent were in the age group of 26 to 35 years of age and less than 25 years of age were 30 per cent. It is understood that majority of the tourists were middle aged. The age wise distribution of sample respondents is reported in Table 4.

The mean age was around 33 years and there was a fair representation from all age groups. The table clearly shows that most of them were young and middle aged and only 10 per cent were old age people (elderly people).

Educational Level

People with different levels of education visit the PMF but most of them were educated above higher secondary levels. The details are presented in Table 5.

There were visitors with various levels of education and no one was illiterate. Among the visitors, about 43 per cent were graduates and professional degree holders were 40 per cent. It is interesting to note that educated people preferred to visit showed more interest in visiting places close to nature. Majority of tourists were employees of private firms and college students visiting the PMF in groups of four to eight members, particularly during weekends.

Income

People from various income strata visited the PMF. About 43 per cent had a monthly income of Rs.15001 to 30000, 26 per cent had an income level of

Rs. 5001 to 15000 and 13 per cent had a monthly income of more than Rs 30000.
It is understood that high income people showed more interest in visiting places of natural origin. The details of income are presented in Table 6.

Table 4 Age Wise Distribution of Tourists

Age (Years)	Number *
Less than 25	9 (30.00)
26 to 35	12 (40.00)
36 to 45	6 (20.00)
More than 45	3 (10.00)
Total	30 (100.00)

* Figures in parentheses represent percentage to total.

Table 5 Educational Level of Tourists

Educational levels	Number of Respondents
Primary	2 (6.70)
Higher secondary	3 (10.00)
Bachelor degree	13 (43.30)
Professional degree	12 (40.00)
Total	30 (100.00)

* Figures in parentheses represent percentage to total.

Table 6 Income Level of Tourists

Monthly Income (Rs.)	Number of Respondents
Less than 5000	5 (16.70)
5001 to 15000	8 (26.70)
15001 to 30000	13 (43.30)
Above 30000	4 (13.30)
Total	30 (100.00)

*Figures in parentheses represent percentage to total.

Occupational Structure

It is interesting to note that people with different occupational structure visited the PMF. About 23 per cent of the visitors were professionals like doctors and engineers. Employees in private firms and students comprised 20 per cent each and about 17 per cent were in Government service. Tourists also included the businessmen, non-working home makers, retired persons and others. Private firm employees mainly from Chidambaram and Pudhuchery areas were large in large numbers because the reserve was easily accessible to them due to its proximity. This place is emerging as a tourist attraction of South India in recent times. The occupational details of the tourists are presented in Table 7.

Travel Mode of Tourists

Details of mode of travel used by the visitors and the number of days they preferred to stay expressed their interests in visiting the mangroves. People travelled by owned vehicle were 50 per cent and the rest of them used either a hired vehicle (30 per cent) or used the public logistical services (20 per cent). The Table 8 depicts that about half of the respondents preferred own vehicle to visit PMF due to convenience, minimizing the travel time etc. Respondents, who did not own vehicle, preferred hired vehicles and public utilities. Hired vehicles gave opportunity to the tourists to visit PMF at any time while the public transport was available only at specific time. Though the public transport was the cheapest mode, people preferred hired vehicle due to the specific time schedule of public transport as well as owing to convenience and high opportunity cost of time (Refer fig.5.3).

Tables 7 Occupational Structure of Respondents

Occupation	Number	Percentage
Agriculture related employees	1	3.30
Government servants	5	16.70
Professionals	7	23.30
Private sector employees	6	20.00
Businessmen	2	6.70
Non working home makers and retired personnel	3	10.00
Students	6	20.00
Total	30	100.00

Table 8 Mode of Travel

Mode of Travel	Number of Tourists	Percentage
Public Transport	6	20.00
Own Vehicle	15	50.00
Hired Vehicle	9	30.00
Total	30	100.00

People who travelled by own vehicles had higher visitation rate of 50 per cent than those travelling by hired vehicles owing to the high cost of hired vehicles.
Nearly 70 per cent of tourists visited the place during morning since they can spend more time than visiting in the evening. Only 10 per cent preferred to stay at least one day. Foreign tourists were more interested to stay for a day or more.

Socio-economic Characteristics of Tourist

More than 40 per cent of the respondents were first time visitors, 30 per cent were on their second visit to the mangrove forest and about 27 per cent had already visited the place more than twice (i.e. Frequent visitors). Average age, distance travelled, travel cost and monthly income of respondents were compared among first time visitors, two time visitors and frequent visitors. The average age of single, two-time and frequent visitors was 35, 31 and 29 years, respectively. The socio economic characteristics of the tourists are presented in Table 9.

Average distance travelled for the single, two time and frequent visits were 402 km., 180 km., and 110 km., respectively. The number of visits increased with shorter travel distance. People from nearby areas tended to visit the mangrove forest more often than those living far away.

The average travel cost for the single, two times and frequent visitors were Rs.1560, Rs.758 and Rs.252, respectively. People tended to repeat visit when they spent lower costs per trip. The average monthly income for the single, two time and frequent visitors were Rs. 22478, Rs. 15618 and Rs. 9556 respectively. The 0fisherman cum farmer and tourist dependents dwelling near the PMF area visit the mangrove forest ecosystem regularly. They used to collect and consume various mangrove forest products accumulating direct use value.

Frequency of Visit to Forest

The frequency of visit made by fisherman cum farmer and tourist dependents is reported in Table 10. The fisherman cum farmer visits the mangrove forest more often than the tourist dependents. They visit the mangrove forest more than twice a week to collect fire woods, fodder and other minor mangrove products. Majority of fisherman cum farmer (33 per cent) used to undertake five and three visits respectively in a week to collect firewood, fodder, and grazing animals etc.

Table 9 Socio-economic Characteristics of Tourists

Characteristics (Average)	First Time Visitors (No.)	Two Time Visitors (No.)	Frequent Visitors (No.)
Number of tourists	13 (43.30)	9 (30.00)	8 (26.70)
Age (year)	35	33	29
Distance traveled (km.)	402	180	110
Travel cost (Rs./visit/person)	1560	758	252
Per capita Income (Rs. /month)	22478	15618	9556

*Figures in parentheses represent percentage to total.

Table 10 Frequency of Visits to Forest

Frequency of Visits Per Week	Fisherman Cum Farmer (No.)	Tourist Dependent (No.)
0	0 (0)	13 (43.33)
1	0 (0)	12 (40.00)
2	0 (0)	4 (13.33.)
3	10 (33.33)	1 (3.34)
4	9 (30.00)	0 (0.00)
5	7 (23.33)	0 (0.00)
6	4 (13.34)	0 (0.00)
Total	30 (100.00)	30 (100.00)

*Figures in parentheses represent percentage to total.

The minimum number of visits by fisherman cum farmer to the mangroves was thrice a week. In the case of the tourist dependents, 40 per cent made only a single visit in a week, 13 per cent reported twice a week and only 3 per cent thrice a week. About 43 per cent of tourist dependent did not make any visit to the mangrove forest at all. The principal produces collected were firewood, fodder and timber for their own use and occasionally they used to collect medicinal plants and that too for self consumption.Women, most of them home makers, used to make visits to PMF for collection during the morning and afternoon hours. Apart from collection of products, the tourist dependents enjoyed grazing their livestock in the mangrove wetland eco-system.

Collection of Forest Products by Fisherman cum Farmer

The quantities of mangrove produces collected by fisherman cum farmer are presented in Table 11. Half of the households' surveyed reported collecting firewood. Average collection of firewood was 4.2 kg per day. The collection of firewood was less when compared to those of the fisherman category. About 30 per cent of respondents reported collecting fodder. An average of 5.70 kg of fodder was collected by a household in a day. The average quantities of all products collected by fisherman cum farmer were found to be less compared to the fisherman. It clearly indicated the higher dependence of fisherman on the mangrove eco-system services. It may be due to the reason that fisherman cum farmer had some land so that they could receive additional fodder and firewood to some extent from their own land.

*Figures in parentheses represent percentage to total.

** On a single day, often more than one collection had been performed by some of the respondents.

Nearly 13 per cent reported collecting firewood. An average of 2.80 kg of firewood was collected per household in a day followed by 20 per cent of the respondents reported collecting fodder at an average of 3.70 kg per household in a day. The average quantities of firewood and fodder collected by tourist dependents were less when compared to other two groups. This might be due to the reason that the tourist dependents used other sources of fuel including kerosene and LPG, which are supplied at subsidized price in the government run Public Distribution System (PDS).

Grazing Benefits

Grazing was yet another important mangrove resource usage that people acquired from PMF. It could be understood from Table 13 that the number of livestock per household with respect to fisherman cum farmer and tourist dependents was four and two, respectively. The proportion of households owning livestock was high in case of fisherman cum farmer and the tourist dependents had very few numbers of livestock per household.

Individual Travel Cost Model

A semi-log functional form (i.e. log-lin) of Individual Travel Cost Model (ITCM) was used in this study to estimate the recreational value and the determinants of visitation rate. Number of visits per year was the dependent variable. Age, gender, marital status, education, income, travel distance, mode of travel and travel cost were used as independent variables. The results of the analysis are presented in Table 14.

Table 11 Collection of Forest Produces by Fisherman cum Farmer

Product	No. of Households	Collection Per Visit (kg)	Total No. of Collections Per Households /yr**	Total Collection (kg/year)	Average Collection per Household (kg/day)
Fire wood	15 (50.00)	16	95	1520	4.20
Fodder	9 (30.00)	18	115	2070	5.70
Timber	3 (10.00)	30	2	276	0.20

* Figures in parentheses represent percentage to total.

**On a single day, often more than one collection had been performed by some of the

respondents.

Collection of Forest Products by Tourist Dependents

The mangrove produces collected by tourist dependents are reported in Table 12

Table 12 Collection of Forest Produces by Tourist Dependents

Product	No. of Households	Quantity of Collection (kg)	Total No. of Collections Per Households /yr**	Total Collection (kg/year)	Average Collection per Household (kg/day)
Fire wood	10 (13.33)	16	65	1040	2.80
Fodder	6 (20.00)	18	75	1350	3.70

Table 13 Possession of Cattle and Grazing Pattern

Forest Resource	No. of Cattle per	No. of Household	Total Livestock	Average

User's	Household	s in the Area Owning Cattle	Population (No.)	Grazing Hours per Week
Fisherman Cum Farmer	4	24 (80.00)	96	28
Tourist Dependents	2	11 (36.67)	22	24

*Figures in parentheses represent percentage to total.

Table 14 Estimated Results of Semi-Log Linear Regression Equation

Variables	Co-efficients	t- ratio
Intercept	-0.685	-1.396
AGE	0.019**	2.198
GND	-0.007	-0.045
MST	-0.475**	-2.735
EDU	0.0988***	4.079
INC	0.00001*	1.982
LTC	-0.0002***	-2.942
MOST	0.1734	1.226
DST	-0.0007	-1.277
R-square		0.792
Adjusted R- square		0.713
F –value		10.036

*** Significant at one percent level.

**Significant at five percent level.

*Significant at ten percent level.

It is obvious from the Table 14 that young and educated people made frequent visits to mangrove wetland eco-system than adults. The marital status had a negative influence on visitation rate indicating that bachelors had made more frequent trips to PMF than the families, since families had to make all necessary arrangements in advance and the preference of children in choosing the tourists site was also the most dominant and deciding factor among other things. But on many occasions children have less knowledge and information on the importance of such valuable resources. The variables *viz*, education, travel cost were significant at one per cent level and exhibited the expected signs, while the variables age, marital status were significant at five per cent level. The monthly income was significant at ten per cent level and had the expected relationship. As indicated clearly, education had a significant and positive influence on number of visits. Higher the level of education, greater the number of visits. Educated people understand the significance of the eco-system services and their importance and hence tended to visit such places and enjoy the onsite and off-site benefits. The mean value of independent variables results are presented in Table 15.

Table 15: Mean Value of the Important Independent Variables of the Model

Variables	Arithmetic Mean
AGE	33.43
EDU (Number of years)	14.70
INC (Rs.)	27633
LTC (Rs. per trip)	1241.00
DST (km.)	315.00

Awareness was less for the people with lower levels of education. The travel mode indicated that people who owned or hired a vehicle had higher visitation frequency than those who depended on public transport for logistical services. Personal vehicles were preferred to public transport system, owing to their convenience and flexibility in scheduling the programme. The travel cost had a significant influence on frequency of visits. The negative sign is consistent with the theoretical concepts of an inverse relationship between travel cost and visitation rate. People who earned more used to spend more, every trip they made but did not make more frequent visits. Price of travel was composed of both out of pocket costs and opportunity cost of making the recreational trip (time). Opportunity cost of the trip was the foregone income. Higher the opportunity cost, lower would be the time spent in the absence to work.

Elasticity of Travel Cost

The price elasticity of travel cost was estimated through the given regression result. The elasticity was derived by using the following formula.

$$Elasticity\ of\ demand = Coefficient\ of\ Travel\ cost \times (Mean\ value\ of\ Travel\ cost / Mean\ value\ of\ visits)$$

The price elasticity of demand for recreational visit was estimated to be -0.1566 It indicated that the visitation rate was inelastic with respect to the travel cost; one per cent increase in travel cost would result in only 0.1566 per cent reduction in visitation rate. It emphasized the fact that though the travel cost was a deciding factor in finalizing the number of visits, the non price determinants like age, education, marital status, and income also had considerable influence on visitation rate.

WTP for Internalizing Externalities

The opinion of respondents was sought to know about their willingness to pay for internalizing externalities and the outcome is reported in Table16. It could be observed that 30 per cent of fisherman cum farmer were ready to pay between Rs. 500 to Rs. 1000 per annum. A vast majority of 40 per cent of fisherman cum farmer and tourist dependents were willing to pay in the range of Rs. 250 to Rs. 500 per annum for internalizing the externalities.

Table 16 WTP for Internalizing Externalities

Willingness To Pay (Rs/Annum)	Fisherman Cum Farmer		Tourist Dependent	
	Number	Percentage	Number	Percentage
Not willing to pay	1	3	4	13
Less than 250	6	20	9	30
251-500	12	40	12	40
501-1000	9	30	5	17
More than 1000	2	7	0	0
Total	30	100	30	100

Average Willingness To Pay

The Table 17 explains that the fisherman cum farmer and tourist dependent were willingness to pay an amount of Rs. 688, Rs.643 / annum respectively, towards internalizing externalities.

Table 17 Average Willingness To Pay

S.No	Particulars	Fisherman Cum Farmer	Tourist Dependent
1	Willingness To Pay (WTP) (Rs./Annum)	688	643

Reason for WTP of Local Stakeholders

The respondents were asked to indicate the reasons for their WTP for the conservation of the PMF and the results obtained are presented in the Table 18. A set of four reasons were presented based on the *apriori* knowledge to the respondents to choose from and an option to indicate if the respondents had a different reason other than those indicated. Majority of the respondents (42 per cent) expressed that the conservation of mangrove forest was good for them and to the society at large. About 23 per cent were of the option that the amount indicated was reasonable and another 16 per cent of respondents concerned about the biodiversity and about 10 per cent expressed their willingness to pay and were not sure if they would pay now.

Table 18: Reason for WTP

Reason For WTP	Fisherman Cum Farmer (No.)	Tourist Dependent (No.)
Conservation plan was a good one	11 (13.00)	10 (12.00)
Respondents felt that it was a reasonable amount to pay	10 (12.00)	7 (8.00)
Respondents concerned about the loss of mangroves	5 (6.00)	5 (6.00)
Respondents were not sure if they could pay what they said	3 (3.50)	4 (4.50)
Total	29 (34.50)	26 (30.50)

*Figures in parentheses represent percentage to total.

Reason for Not WTP of Local Stakeholders

The respondents were also asked to indicate the reasons for their not WTP for the conservation of the PMF. The results are presented in the Table 19. In the local stakeholders five were not WTP for the conservation of PMF. Among five, two of them were of the opinion that it was Government's responsibility to conserve the PMF. Others were of different opinion such as non availability of additional income, lack of confidence on the expected changes and the responsibility of the actual user to contribute for conservation the PMF.

Table 19 Reason for Not WTP

Reason For Not WTP	Fisherman Cum Farmer (No.)	Tourist Dependents (No.)	Total (No.)
Respondents did not have adequate income	0	1	1
Respondents did not believe the system would bring the about changes	0	1	1
Government's responsibility	1	1	2
The actual user should pay	0	1	1
Total	1	4	5

Mode of Payment

The Table 20 explains the mode of payment of all the three categories of respondent's viz., fisherman, fisherman cum farmer and tourist dependents. For about 70 per cent of the respondents, the mode of payment was cash and only the remaining preferred to share through kind.

Table 20: Mode of Payment for WTP

Mode of Payment	Fisherman Cum Farmer (No)	Tourist Dependents (No)	Total (No)
Cash	23 (25.34)	23 (22.23)	64 (67.77)
Kind	6 (7.00)	3 (3.33)	21 (23.00)
Not WTP	1 (1.00)	4 (4.44)	5 (6.00)
Total (No)	30 (33.34)	30 (33.33)	90 (100.00)

Frequency of Payment

The Table 21 clearly indicates the frequency of payment of the respondents, viz. fisherman cum farmer and tourist dependents.

Table 21 Frequency of Payment

Frequency of Payment (Annum)	Fisherman Cum Farmer (No.)	Tourist Dependents (No.)
One Payment	4 (4.33)	6 (7.00)
Two time	10 (11.00)	9 (10.00)
Quarterly	10 (11.00)	8 (9.00)
Service needed	5 (6.00)	3 (3.33)
Not WTP	1 (1.00)	4 (4.00)
Total (No.)	30 (33.34)	30 (33.33)

Factors influencing the WTP of Fisherman Cum Farmer

The various factors influencing WTP of the fisherman cum farmer were determined using a linear relation between the WTP and other related socio economic attributes of them. The results are presented in the Table 22.

Table 22 Factors Influencing the WTP for Fisherman Cum Farmer

Variables	Co- efficient	t- ratio
Intercept	-795.274	-1.883
AGE	17.821	1.565
GEN	-34.708	-0.304
EDU	49.336**	2.553
MST	-801.228***	-4.508
HHSIZE	-53.416	-1.371
INC	0.223***	4.936
LAND	-210.371**	-2.035
LVSTK	3.648	0.102
TIME	29.136	0.834
AREA	501.676***	4.396
R-Square		0.957
Adjusted R^2		0.934
F-Value		42.500

*** Significant at one percent level.
** Significant at five percent level.
* Significant at ten percent level.

The respondent's education, marital status, monthly income, land and fishing area were significant with WTP. Education, monthly income and fishing area were positively related to WTP with significant. It is implicit from the analysis that higher level of education of the respondents influenced the WTP for conservation of PMF positively. Educated people try to establish in the young minds, the need and objective feeling of conserving and protecting nature for future generation which involves user cost and security rent. Higher the income higher would be the WTP, People who were fishing near the mangrove and earning more preferred to pay more towards a cause of conservation of PMF. Marital status and land holding were significant and had the expected negative sign indicating that married people and large farmers would tend to pay fewer amounts.

Factors influencing the WTP for Tourist Dependents

The various factors influencing WTP were determined using a linear relationship between the WTP amount and socio economic characteristics of tourist dependents. The results are presented in the Table 23.

The respondents education and monthly income were positively related to WTP and were significant. It is quite clear from the analysis that higher level of education of the respondents influenced the WTP towards for conservation of PMF significantly. It is expected that educated communities would be interested to protect

the ecosystem and their services not only for future use but also for the future generation. It is also a matter of fact that higher the income, higher would be the WTP and it was believed that people earning more choose to pay more towards conservation compliance programmes. As expected, the variable the family size was significant and negatively associated with WTP. It denotes that

higher the family size of the respondents less would be the WTP of the respondents.

Comparison of Fisherman Cum Farmer and Tourist Dependents

Distribution of households across Monthly Per-Capita Consumption Expenditure (MPCE) class showed the average value of Rs. 799 for fisherman cum farmer and Rs. 859 for tourist dependent households in PMF.

Table 23 Factors Influencing the WTP for Tourist dependents

Variables	Co- efficient	t- ratio
Intercept	-144.778	-0.215
AGE	2.708	0.196
GEN	-297.190	-1.643
EDU	31.959*	1.721
MST	-0.646	-0.002
HHSIZE	-115.436**	-2.568
INC	0.226***	4.347
R-Square		0.838
Adjusted R^2		0.796
F-Value		19.904

*** Significant at one percent level.
**Significant at five percent level.
*Significant at ten percent level.

Table 24 Comparison of Fisherman cum Farmer and Tourist Dependents

Particulars	Fisherman Cum Farmer	Tourist Dependents
Number of households	30	30
Average family size	4.5	3.8
Average age	46	38
Households' average landholding (ha)	0.91	0.53
Percentage of landless households	0	60
Percentage of households having livestock	96	45
Percentage of literacy	53	30
Percentage of households undertaking fishing activity	100	0
Man days of farm employment / year	145	120
Per capita monthly income (Rs.)	812	955
Per capita monthly expenditure on food(Rs.)	420	423
Per capita monthly expenditure on non- foods (Rs.)	379	436
Per capita monthly consumption expenditure (RS.)	799	859
Savings and repayment of loan (Rs.)	13	96
Percentage of income spent on food items	53	49
Percentage of income spent on non-food items	47	51

To study the expenditure pattern of the sample respondents, all income categories of the households were taken together. Mean values of per-capita monthly consumption expenditure of food and non-food items of tourist dependents were found to be marginally higher than the other group.

The Household Welfare

The household expenditure of the fisherman cum farmer has expected to influence variables like age, sex, education, family size, income, landholding, livestock population, direct forest utilization pattern, residence ship etc.

The equation for the components of expenditure was estimated by multiple linear regression model. From the regression results presented in Table 25, it is obvious that there had been a decrease in household expenditure with respect to increase in family size, landholding, livestock population, forest dependence and residenceship. The regression results indicated that the gender, education, household size, monthly income, and area of fishing were highly significant. The negative co-efficient of the family size indicated that greater the family size lower would be the level of household expenditure. Positive co-efficient of income indicated that people earning more would be prepared to spend more towards consumption of food and non food items.

Table 25 Regression Result for Fisherman cum Farmer

Variables	Co- efficient	t- ratio
Intercept	539.383	2.708
AGE	-2.865	-0.766
GEN	130.396**	2.019
EDU	-21.632*	-1.851
HHSIZE	-93.983***	-4.094
INC	0.078***	2.806
LAND	-94.208	-1.663
LVSTK	-5.169	-0.260
TIME	21.082	1.042
AREA	205.869***	3.109
R-Square		0.750
Adjusted R^2		0.637
F-Value		6.669

*** Significant at one percent level.
** Significant at five percent level.
* Significant at ten percent level.

The household landholding was insignificant. The livestock population was also insignificant and the negative co-efficient indicated that more number of livestock population would decrease the households expenditure. The time spent by the fisherman cum farmer for fishing was less compared to farming and collection of fodder for their livestock. So they got low income from fishing due to farming and livestock rearing and thereby less per-capita consumption was attained.

Tourist Dependents

From the Table 26 it could be understood that the increase in household expenditures was with respect to increase in age, education, monthly income, land and season. It also clearly indicates that the decrease in household expenditures was due to the increase in household size and gender. The regression analysis indicated that the gender, household size, income and season were highly significant. The negative co-efficient of the family size indicated that greater the family size, lower would be the level of household consumption expenditure. Positive co-efficient of income indicated the positive impact of consumption expenditure, *i.e.,* people earning more are prepared to incur more towards a cause of consumption on food and non food items. The positive co-efficient of season indicated the positive impact of consumption expenditure.

The proportion of literate in a household was not significant but had positive impact on household expenditure and therefore higher literacy rate appeared to forward household's expenditure. Similarly the household landholding was insignificant but the positive co-efficient of the household landholdings indicated that the agriculture landholder spent higher towards food and non-food commodities.

Economic Impacts

The major findings of the regression results regarding the overall impact of PMF was that the people who entered into fishing and other mangrove dependent occupations had extensively improved their standard of living. The additional money generated from tourism by tourist dependents encouraged the households to consume more and spend more on luxurious items. They had also enhanced their expenditure on non-food items proportionately more than food items.

Table 26 Regression Result for Tourist Dependents

Variables	Co- efficient	t- ratio
Intercept	318.958	1.056
AGE	8.744	1.622
GEN	-207.822**	-2.142

EDU	12.531	1.403
HHSIZE	-119.762***	-3.280
INC	0.104***	3.250
LAND	75.137	1.070
SEASON	294.510***	3.378
R-Square		0.895
Adjusted R^2		0.862
F-Value		26.962

*** Significant at one percent level.
**Significant at five percent level.
*Significant at ten percent level.

Environmental Benefits of PMF

Garrett's ranking technique was employed to understand the positive externalities enjoyed by the local people attached to various functions the PMF had been performing. The respondents were asked to rank the given functions, considered most important. A set five important benefits derived from mangrove forests by fisherman and fisherman cum farmer was presented to them with a brief description of each function. They were asked to rank the benefit based on the importance, from individual's perspective and the rankings obtained are presented in Table 27. The performance of shoreline protection such as protection from storm, tsunami and flood by mangrove forest scored a mean value of 72 and ranked first. Next to that increased income due to increased fish catch was ranked. Utilization of non timber forest products ranked third followed by control of soil erosion and water retention and purification.

Table 27: Positive Externalities of PMF to Fisherman cum Farmer

Benefit	Garrett's Mean Scores	Rank
Shoreline protection	72	I
Increased fish catch and enhanced income	60	II
collection of NTFP	50	III
Control of soil erosion	40	IV
Water retention and purification	27	V

Similarly, a set four important benefits derived from mangrove forests by tourist dependents was presented to them with a brief description of each function. They were asked to rank the benefits based on the importance from individual's point of view. The attributes were ranked based on scores and are presented in Table 28.

Among the four, increased tourist flow secured a mean score of 71 and ranked first. It was followed by shoreline protection which ranked second and the control of soil erosion ranked third. Least mean score was given for water retention and it was ranked fourth.

CONCLUSIONS

The results of the study have clearly indicated that the educated, young and high income groups made fewer visits to PMF. People from nearby areas tended to visit the PMF more often. Marital status, travel cost and distance had a negative influence on the frequency of visit to PMF. Respondents involved in the fishing as well as farming activity were willing to pay more for conserving mangrove eco-system than the tourist dependents. Grazing was one of the important resources for the people owning livestock in the PMF. Positive externalities like shoreline protection, increased fish catch, enhanced income, utilization of non timber forest products control of soil erosion, water retention and purification were the benefits realized from mangrove forests by fisherman and fisherman cum farmer. Education, marital status, monthly income, land and fishing area were significant with WTP. Education, monthly income and fishing area were positively related to WTP. It is implicit from the analysis that higher level of education of the respondents influenced the WTP for conservation of PMF positively. Educated people try to establish in the young minds, the need and objective feeling of conserving and protecting nature for future generation which involves user cost and scarcity rent. Higher the income higher would be the WTP, People who were fishing near the mangrove and earning more preferred to pay more towards a cause of conservation of PMF. Marital status and land holding were significant, indicating that married people and large farmers would tend to pay fewer amounts.

Table 28: Positive Externalities of PMF to Tourist Dependents

Benefit	Garrett's Mean Scores	Rank
Increased tourist flow and income	71	I
Shoreline protection	55	II
Control of soil erosion	45	III
Water retention and purification	31	IV

POLICY PRESCRIPTION

The following policy prescription could be suggested from the findings of the study.

1. The increasing dependence of mangrove eco system by the farmer cum fisher folk underlines the need to protect this vital wetland ecosystem for providing a better livelihood opportunity to them.
2. People owning cattle in PMF area enjoyed grazing in the mangrove forest. So the local social institutions should restrict people from over grazing and creating awareness about impact of degradation of mangrove forest.
3. Since the flow of tourist to PMF has been on the raise during the recent years, the local institutions should provide adequate facilities to the visitors for enhancing the visitation rate. By doing so, more people would be attracted towards PMF and the economic and ecological prospects of the mangrove wetland ecosystem could be popularized among the various sections of the society through the concept of eco-tourism.

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