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Estimation of Payment for Ecosystem Services of GKVK : A Resource Economics Study

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Abstract

This study estimates the payment towards ecosystem services of GKVK by the morning and evening strollers. The probability of willingness to pay towards the aesthetic and non-consumptive use value estimated using multinomial logit varies from 0.1 to 0.99 among various categories of strollers. The probability of male working strollers was found to be 0.99. Mean willingness to pay per annum per capita for entering GKVK was obtained using the Censored Tobit Model. The willingness to pay for the working male and female strollers was Rs. 678 and Rs. 200, respectively and for the non-working male and female strollers was Rs. 531 and Rs. 53, respectively. Given the mean willingness to pay of Rs. 678 per person entering GKVK campus, this is a prima facie indicator charge of ID card per year for entering the campus by the strollers to obtain the aesthetic and ecosystem services.

Ghandi Krishi Vignana Kendra (GKVK) is one of the nationally recognized campus of the state agricultural universities. The campus is the habitat to rich biodiversity (Subramanya and Nuthan, 2014). The GKVK campus with a sprawling area of 1384 acres was handed over to the University of Agricultural Sciences Bangalore, to support endless efforts in research, education and extension. The campus is the lung space of Bangalore with its natural beauty and immense biodiversity. In recognition of the efforts of the teachers, researchers, students and the administration, Professors Tasneem Fathima, G. Boraiah and H. C. Govindu of the university conducted a three year survey of the flora and fauna in GKVK and Hebbal campuses and identified 530 plant species including 70 sp. of medicinal plants, six rare plant sp., four species which are endemic (deciduous forests) and one endangered sp. (*Albizia odoratissima*). This attracted the attention of the National Biodiversity Authority and paved the way to declare GKVK as a heritage site as it represented mini Western Ghats. The national biodiversity authority of India declared 412 acres of GKVK as the Biodiversity Heritage Site in 2010, under the Biodiversity Act of 2002. The campus with its rich biodiversity is serving as a repository of diverse flora and fauna *interalia* 13 sp. of mammals, 10 sp. of reptiles, 165 sp. of birds, 530 sp. of plants, 196 sp. of butterflies, as notified by the Government of India No. FEE 132 ENV 2009 dated 2nd Sep. 2010.

The campus hosts natural scrub forests and a botanical garden supported by the Ministry of Forest and Environment, with over 600 rare plant collection with orchard plantations, tree-crop germplasms unique in nature. The Scrub Forest of GKVK are the last remaining patches of the habitat, which spreads from Shivaganga during 1537. GKVK has a very high density of sandal wood growth with ideal condition for natural regeneration.

With the rapid expansion of Bangalore Metropolitan, civil construction, roads, dwellings have mushroomed all around GKVK. This is attracting strollers to the campus in appreciation of ecosystem services best be characterized as non- consumptive use values. A conservative estimate of 1000 strollers are benefiting from visiting GKVK campus every day from 6-8 am and in the evening hours.

Methodology

A reconnaissance survey of strollers was conducted in order to obtain a feel for the type of questions to be designed and the type of responses obtainable pertaining to non-consumptive use vale of

ecosystem services. The main survey was conducted during Sept.-Oct. 2014 by personally interviewing a random sample of 70 early morning / evening strollers who are visiting GKVK solely for the ecosystem services using a pre tested schedule. The benefits provided by the GKVK ecosystem were highlighted to respondents such as: Clean air, water, water recharge , flood control, aesthetic beauty, unique flora of herbs, shrubs, trees, medicinal plants, old growth forests and trees, crop experiments involved in rice, ragi, fox tail millet, barn yard millet, kodo millet, proso millet, pearl millet and little millet; various type of (Napier, Elephant) grasses , agroforestry experiments with mango based, jamun based intercropping in ragi, drip irrigation experiments in paddy, tree arboretum, neem avenue, bamboo forest, minor fruit orchard, botanical garden and a medicinal garden. As there is no direct market for these services the respondents were asked regarding their measure of worthiness of GKVK ecosystem services through their payment for ecosystem services (PES)

Payment vehicle : ID card was designed as an effective payment vehicle since it involves the low transaction cost of collecting the entry fee to GKVK and it has been renewed every year since the ID card has to have its concurrent validity. It was decided to use ID card as a payment vehicle and the strollers were asked to indicate their willingness to pay for ID card per year with the starting point bid of Rs.365 per card. The basis is that the Government of Karnataka charged Rs.10 per day for Lalbagh garden as entry fee. Taking cue from this structure of entry fee, of Rs.10 per visitor day, it was proposed to be Rs.365 per year at the rate of rupee one per visitor day for the retired persons in this study. For those who were employed, this was proposed to be Rs.730 per year at the rate of Rs.2 per visitor day.

Double bounded dichotomous choice method was used to estimate the PES. Based on the responses obtained, the strollers were categorized in to four categories, the first category is the NN (No No) category or the non-paying category, where, the respondent said "No" for the first bid as well as for the lowest bid. NY (No Yes) category is the second category where the respondents said "No" for the first bid and "yes" for the lowest bid. The stroller could also say "Yes" for the first bid, and "No" for the second, YN (Yes No) and "Yes" for the first and "Yes" for the higher bid, YY (Yes Yes). The exogeneous variables such as age, sex (male 1, female 0), occupation dummy (working 1, otherwise 0), Income, Body mass index, were considered and the 4 categories of willingness to pay were taken as endogeneous variable. The base category or the reference category is the non-paying category. Using SPSS (Statistical Package for Social Sciences) the multinomial logit estimates were obtained. In order to obtain the mean willingness to pay towards ID card for visiting GKVK, a "Censored Tobit" model with Annual willingness to pay for stroller for GKVK= f (age, year since visiting GKVK, Income of the stroller, Body Mass Index, sex, occupation) was used.

Results and Discussion

It was found that if the age of the respondent increases by one year, the log of the odds ratio, Probability of No Yes category to probability of No No category (P(NY) / P(NN)), falls by 0.159, the log of the odds ratio, Probability of Yes No category to probability of No No category(P(YN) / P(NN)) will fall by 0.109, and the log of odds ratio of Probability of Yes Yes category to probability of No No category (P(YY) / P(NN)) will fall by 0.277. Thus, the older a person is, the less likely that s/he will stay in the YY, YN, NY categories as compared with non-paying category (NN). It was found that for every year increase in the number of years of visiting GKVK, the log of the odds ratio P (NY) / P (NN), falls by 0.02, and the log of the odds ratio P (YN) / P(NN) will rise by 0.058, and the log of the odds ratio of P(YY) / P(NN) will rise by 0.175. Thus, as the number of years of visiting GKVK increases, it is likely that they will stay in the paying category as compared with non-paying category (Table I).

Using the results obtained from multinomial logit model, probability of WTP (Willingness to Pay) of the strollers in all the four categories were found out. There was a very high probability of 0.99 for the working male stroller to be in the YY category, whereas, the probability of non- working male to be in the category is the least, 0.19 (Table II).

TABLE I

Estimated coefficients of multinomial logit model to estimate the willingness to pay for entering GKVK

Category of strollers regarding WTP		B	Std. Error	Wald	df	Sig.	Exp (B)
No for first bid, yes for second bid	Intercept	10.515	5.046	4.342	1	0.037	
	Age of stroller (years)	-.157	.066	5.689	1	.017	.855
	Years since visiting GKVK	-.011	.099	.013	1	.908	.989
	Body Mass Index	-.052	.136	.143	1	.705	.950
	Income(per month)	0.000	0.000	0.14	1	0.90	1.00
	Sex (female 0,male 1)	-2.695	1.369	3.874	1	.049	.068
	Occupation (working1)	.190	1.054	.032	1	.857	1.209
Yes for first bid, No for second bid	Intercept	10.104	5.348	3.569	1	0.059	
	Age of stroller (years)	-.108	.066	2.702	1	.100	.897
	Years since visiting GKVK	.060	.082	.531	1	.466	1.062
	Body Mass Index	-.171	.154	1.233	1	.267	.843
	Income(per month)	0.000	0.000	0.137	1	0.71	1.000
	Sex (female 0,male 1)	-2.559	1.313	3.798	1	.051	.077
	Occupation (working1)	.965	1.040	.861	1	.353	2.625
Yes for first bid, Yes for second bid	Intercept	18.059	5.654	10.201	1	0.001	
	Age of stroller (years)	-.272	.075	13.166	1	.000	.762
	Years since visiting GKVK	.182	.094	3.783	1	.052	1.200
	Body Mass Index	-.152	.159	.914	1	.339	.859
	Income(per month)	0.00	0.00	1.23	1	0.26	1.000
	Sex (female 0,male1)	-6.475	1.853	12.214	1	.000	.002
	Occupation (working1)	1.316	1.240	1.127	1	.288	3.730

Note: The reference category is: No for the first bid, No for the lower bid.

TABLE II

Probability of WTP by different stroller categories

Category	Characteristic of Stroller		Probability of WTP
	Male / Female	Working / Non Working	
NY (No Yes - Category)	Male	Working	0.83
		Non working	0.19
	Female	Working	0.68
		Non working	0.61
YN (Yes No Category)	Male	Working	0.74
		Non working	0.58
YY (Yes Yes - Category)	Male	Working	0.99
		Non working	0.33
	Female	Working	0.38
		Non working	0.85

The mean willingness to pay was obtained using the Tobit model. The details of the Tobit model results are as under.

WTP 1 =1926 - 32.58 (x1*) + 29.29 (x2*) +.00005 (x3*) - 18.65 (x4*) + 478.40 (x5*) +146.8 (x6*)

WTP 2 =1926 - 32.58 (x1*) + 29.29 (x2*) +.00005 (x3*) - 18.65 (x4*) + 478.40 (x5*)

WTP 3 =1926 - 32.58 (x1*) + 29.29 (x2*) +.00005 (x3*) - 18.65 (x4*) + 146.8 (x6*)

WTP 4 =1926 - 32.58 (x1*) + 29.29 (x2*) +.00005 (x3*) - 18.65 (x4*)

Where,

WTP 1 is the willingness to pay of a working male

WTP 2 is the willingness to pay of a non-working male

WTP 3 is the willingness to pay of a working female

WTP 4 is the willingness to pay of a non-working female.

x1* is the average age, x2* is the average number of years, x3* is the average income, x4* is the average BMI, x5* is the sex dummy (male=1 and female=0) and x6* is the occupation dummy (working=1 and non-working=0)

Using the Tobit model, the dependent variable – amount the strollers are willing towards payment for ecosystem (PES) is treated as a latent variable. Thus, for those strollers who do not want to pay any fee, the NN or No No category, the PES is zero. Thus, as a latent variable, zero payment may mean (1) that the stroller does not want to pay at all eventhough s/he can afford to pay or (2) that the stroller cannot afford to pay or (3) the stroller feels it is his right to use the University common property for which he has already paid through other taxes and hence does not want to pay. Thus, the PES qualifies to be a latent variable to use the Tobit model. It was found that 32.2 per cent of strollers who are willing to pay belonged to working male category and their willingness to pay for the ecosystem services was Rs.678. For the non-working male category, who constituted 21 per cent of the strollers, their PES was Rs. 531. For the working female the willingness to pay was estimated as Rs. 200 and for the non-working female it was estimated as Rs. 53. Thus, there is a wide range of variation in the estimated PES from Rs. 53 to Rs. 678 (Table III).

Proportion of types of strollers of GKVK : Everyday around 1000 people are coming to GKVK for walk. Out of this 25.7 per cent are coming with family, 27.14 per cent are retired people, 65.71 per cent are males and 71.4 per cent of them are visiting GKVK from the last 5 to 15 years. All the strollers were in agreement regarding health benefits, good air and peaceful environment and good crop view of GKVK campus. In addition a majority of the strollers also enjoyed bird watching as also roads free of vehicles and vehicular pollution. More than 50 percent of strollers indicated that they can also purchase good fruits and vegetables and that they can also visit temple during their walk (Table IV).

Reasons for not willing to pay towards ecosystem services : The strollers who were not willing to pay indicated that the ecosystem services are a free gift of nature and hence they are unwilling to pay. In addition they mentioned that GKVK is a common property and they area already paying taxes to BBMP and hence should not be charged. Instead they suggested a free pass can be issued as ID card and indicated that ID card is not practical. If the visit to

TABLE III

Willingness to pay for ecosystem services (PES) at GKVK

	Coefficient	Std. Error	z	p-value	
Intercept	1926	745.127	2.5848	0.00974	***
Age of the stroller (years)	-32.5821	8.52789	-3.8207	0.00013	***
Years since visiting GKVK	29.2985	14.2452	2.0567	0.03971	**
Income (per month)	5.244e-05	0.00433375	0.0121	0.99035	
Body Mass Index	-18.6519	26.2413	-0.7108	0.47722	
Sex (Male 1, Female 0)	478.407	217.636	2.1982	0.02794	**
Occupation (Dummy Working 1, otherwise 0)	146.805	214.039	0.6859	0.49279	

TABLE IV

Proportion of strollers' response to use values in GKVK ecosystem

Use values	Percentage of strollers in agreement of use values
Derivation of health benefits	100.00
Good air for breathing	100.00
To enjoy peaceful environment	100.00
To enjoy bird watching	68.50
To enjoy good crop view	100.00
To enjoy good forest view	44.20
To appreciate view of wild animals such as snakes, wild boars, jackals, peacocks	47.14
To increase/ walk in roads free of vehicular pollution	90.00
To move in roads free of dogs	52.85
To purchases of quality vegetables and fruits at affordable prices	64.28
To Purchase of quality cow milk from GKVK dairy	24.28
To ourchase of flowers at affordable prices	20.00
To visit temple	72.80
To meet friends regularly	38.57

GKVK is charged, they indicated that they would probably shift to Vidhyaranyapuram Park, Devmatha Park, Judicial layout, Jakkur Layout and Sahakaranagar.

Suggestions for improvement : Among the 25 strollers who responded regarding the improvement of GKVK, 16 per cent of them suggested to maintain greenery by planting more trees and not cutting trees for widening roads, building hostels, 20 per cent suggested the need for resting benches (Fig. 1), 12 per cent suggested to strengthen the security system,12 per cent suggested regarding provision of toilet facilities and metal roads, 8 per cent recommended the necessity of CCTV, 4 per cent of strollers suggested for security personnel with walky-talky and street lights. As some were afraid of animals, they recommended to ban pet animals in the campus. The strollers indicated they were willing to pay for one year ID card fee renewable every year.

GKVK campus having earned the distinction of inhabiting the Biodiversity Heritage Site of Karnataka, needs to govern the strollers, visitors in order to sustain the biodiversity. There have been instances of theft of valuables such as sandalwood from the campus from time to time. Thus, in order to preserve the existing biodiversity it is desirable to monitor the visitors / strollers. This study estimates the willingness to pay by strollers towards the annual ID card fee for visiting GKVK as also documents the use values of GKVK ecosystem as perceived by strollers. Thus, the PES

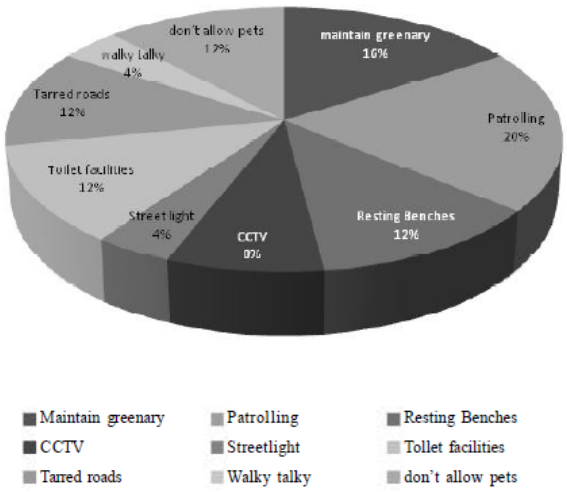

Fig.1: Suggestions from the strollers

qualifies to be a latent variable to use the tobit model. Considering the willingness to pay of the strollers, the study found that the working male strollers were willing to pay Rs.678 per year towards the ID card; non-working male strollers were willing to pay Rs. 531 per year towards the ID card. The working female strollers were willing to pay around Rs.200 per year and the non- working female were willing to pay Rs.53. Thus, there is wide range of variation in the estimated PES from Rs. 53 to Rs.678. The study reveals that a working female stroller is having a very high probability of 0.99 to be there in the paying category as compared with the non-paying category. This can be considered by the UAS in order to streamline the flow of visitors as well as maintain the biodiversity at least in its present form. The ID card for stroller is necessary in order to identify the bonafide users of the GKVK campus for morning walk. In the process the villagers who may visit the GKVK campus for a walk need to be exempted from payment toward ID card and for them ID card may be issued without charge.

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