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User's Appraisal and Valuation of Changes in Renewable Natural Resources Status: A Case Study from Chhattisgarh

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I

INTRODUCTION

Rural communities have an intrinsic relation with local renewable natural resource base and ecosystems which are essential for their very survival. These communities have their own perspective about status, importance, and utility of natural resources with a diverse inventory of long accumulated knowledge and experience. Such knowledge can be revealed through participatory interactions with rural community (Mukherjee, 1997). Local perspective on natural resources is important in identifying the issues not accounted for by markets. For many natural resources markets do not exist and hence under many situations they are depleted beyond regeneration capacity. Even when markets are available for some natural resources such as, land, water, freshwater aquaculture and forest products, markets are often distorted and do not reflect true values. Hence, the allocation and use of natural resources often takes place in a non-market or surrogate market situations which makes the valuation process more complex. Perspective of local communities is the major route to understand the changes in the natural resources for designing appropriate policy to sustain or restore such resources (Reddy, 1998). Participatory appraisal can be used to facilitate a community to become aware of and analyse the trends or changes in natural resources, and assign values to maintain or restore a particular resource (Chamber, 1992; Mukherjee, 1997; Gill 1997). While the importance of participatory appraisal as an approach and methodology is well recognised in analysing livelihood strategies, the use of this approach in understanding the dynamics of rural renewable natural resources (RRNRs) from the user's perspective has not received due attention so far. An attempt has therefore been made in this study to estimate how local people have their own rationale and assessment of changes in RRNRs. It focuses on the appraisal and valuation of RRNRs from the user's perspective by using Participatory Appraisal and Contingent Valuation methods in Boria-Khurd village of Chhattisgarh state in India.

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II

METHODOLOGY

Resource Profile of the Studied Village

This study was carried out in Boria-Khurd village of Dharsiwa block of Raipur district of Chhattisgarh. The village Boria-Khurd is located in south-east of Raipur city and 12 kilometers away from the Raipur headquarters. The village represents fairly well agro-climatic socio-economic condition of Chhattisgarh plain. The climate of the study area is characterised by sub-tropical parameters. The average rainfall of the study area varies between 1187 mm to 1200 mm. The onset monsoon season extends from the mid-June to early October which accounts for more than 90 per cent of the total precipitation of the rainfall during the month of July-August. The winter season (November to February) is relatively warm and short with mean temperature of 25° to 30°C between December and March followed by very hot and dry weather in May to June 40°C to 45°C (summer season). In the village four general classes of soil are found, i.e., gravely sand, sandy loam, loam and loamy clays corresponding to the locally known names Bhata, Matasi, Dorsa and Kanhar. Seventy per cent of the soil comprise Kanhar while Dorsa, Matasi and Bhata, consist of 20, 5 and 2 per cent respectively. The village has different categories of common water bodies, grass lands and multipurpose tree and fruit plantation areas. A resource profile of Boria Khurd village is presented in Table 1.

TABLE 1. RESOURCE PROFILE OF BORIA-KHURD VILLAGE

Sr. No. (1)	Particulars (2)	(3)
1.	Total geographical area (ha)	423.625
2.	Total cultivated area available (ha)	267.75
3.	Net cropped area (ha)	242.55
4.	Double cropped area (ha)	25.20
5.	Area under fruits/multipurpose tree plantation (ha)	36.844
6.	Area not available for cultivation (ha)	37.509
7.	Pasture and grazing land (ha)	65.869
8.	Sourcewise irrigated area (per cent)	
	(a) Canal	282.63 (53.19)*
	(b) Tubewells	55.680 (10.48)
	(c) Tanks	143.09 (26.93)
	(d) Stop Dam with 0.8 water spread area	50.00 (9.41)
9.	Average annual rainfall (mm)	1187
10.	Freshwater bodies available for fish culture	
	(a) Boria-Khurd irrigation tank (with water spread area in ha)	1 (35.00)
	(b) Pond (with water spread area in ha.)	1 (0.60)
	(c) Other uses of tank/pond	domestic, tending cattle, irrigation, growing vegetables/trees/bunds and recreation.

(*Contd.)*

TABLE 1. (CONCLD.)

Sr. No. (1)	Particulars (2)	(3)
11.	Soils (types)	Sandy loam and loamy clays
12.	Cropping pattern (per cent of gross cropped area)	
	(a) Paddy	90.27
	(b) Wheat	5.63
	(c) Other rabi crops	4.19
13.	Cropping intensity (per cent)	110.39
14.	Average size of holding (ha)	1.70
15.	Distribution of land holding (per cent)	**
	(a) Marginal	26.53 (7.30)
	(b) Small	36.74 (30.61)
	(c) Medium	32.65 (47.80)
	(d) Large	4.08 (14.29)
	(e) Total	245 (100)
16.	Per capita income (Rs./year)	10610.00
17.	Total population (No.)	5376
18.	Population density (person/ha)	12.69
19.	Male population (per cent)	40.51
20.	Female population (per cent)	38.13
21.	Literacy rate (per cent)	67.00
22.	Scheduled caste population as per cent of total population	8.52
23.	Scheduled tribes population as per cent of total population	29.61
24.	Percentage of cultivators	15.80
25.	Percentage of agricultural labourers	39.06
26.	Total number of households	452
27.	Total number fishermen households	34
28.	Livestock density	
	(a) Per ha cultivated area	3.37
	(b) Per ha grazing land	12.43
29.	Source of drinking water	
	(a) Hand pumps (No.)	20
	(b) Community wells (No.)	25
	(c) Tubewells	9
30.	Village level institutions	
	FCs/WUA/Panchayat/Primary school/Veterinary dispensary/Rural bank/co-operative society/primary health care	1 each

*Figures in parentheses indicate source wise irrigated area.
** Figures in parentheses indicate percentage of area covered under respective size of holdings.

Methods for User's Appraisal and Valuation and Data Base

The village RRNRs undoubtedly provide valuable tangible services with consequently high preservation, conservation and utilisation value (Marothia, 2001). These resources are multipurpose and multiuse in nature with technical, socio-economic-cultural and environmental interdependencies. As a result these resources suffer with spatial and temporal externalities due to pollution, natural and created use

conflicts, property rights regimes and institutional arrangements and mechanism for adjusting allocation (Marothia, 2007). Under such conditions it becomes imperative to analyse the village community perception and their willingness to pay for utilising and arresting degradation of common resources. Participatory Rural Appraisal (PRA) and Contingent Valuation Method have been used in this study to estimate appraisal and willingness to pay for RRNRs from the user's perspective.

Participatory Rural Appraisal (PRA): In participatory rural appraisal inquiry, villagers were motivated to present their views regarding the renewable natural resource inventory of the village to understand how they are assessing these resources. Information related to common water bodies, namely, canal, tank, pond, common property land resources (CPLRs), multipurpose tree species and fresh water aquaculture were gathered with the help of group of villagers men and women. With the aim of learning from villagers about their renewable natural resources, they were requested to draw resource profile, indicate their resource priorities, to score and rank the resources as well as problems associated with the depletion of a particular resource. Moreover, they were asked about the effectiveness of local institution to manage a resource under question. Villagers presented diagrams, maps, etc., visually on the floor by using locally available raw materials like stones, seeds etc. These methods were used to critically look into the issue of how far participatory rural appraisal can be used in natural resource appraisal according to user's perception. PRA also helps in understanding the qualitative nature of resource profile which can not be quantified.

Willingness To Pay (WTP): Willingness to pay was estimated using Contingent Valuation Method (CVM). CVM or stated preference method uses a direct approach to elicit WTP. Resource users express their WTP assuming if a market existed for the improved services associated with these resources. Close-ended questionnaire format was used to carry out Contingent Valuation Survey. The respondents were asked whether or not they will be willing to pay a single specified sum. In other words, in a close-ended format the respondents decision involves a dichotomous choice, the answer is either a yes or a no (see Marothia, 2001 for close-ended CVM application). For CVM data were collected from the individuals to capture the value they attach to resources, as resource users. For this purpose respondents were asked how much they are WTP for maintenance, protection and restoration as well as use of the major renewable natural resources, namely, common water bodies, common property land resource (CPLRs), fresh water aquaculture and multipurpose tree species. About 125 respondents (i.e. 26 per cent of the total households) were selected by using probability proportionate to size technique subject to the condition that at least 10 respondents should be included in the sample from each of the five categories of the farm, i.e., landless, marginal (>1ha), small (1-2ha), medium (2-4ha) and large (>4ha). The total sample of 125 respondents represent 44.94 per cent as

landless, 14.61 per cent marginal, 20.22 per cent small, 17.98 per cent medium and 2.25 per cent large. For assessing WTP for utilisation and restoration of resources all the 125 respondents were interviewed during October 2001 to April 2002 using well structured questionnaire.

Specification of WTP Function and Variables

Linear and semi-log (with log of dependent variable) form of functions were estimated using Ordinary Least Squared (OLS) technique for estimating willingness to pay for common water bodies, common pool land resource, multipurpose tree species and fresh water aquaculture.

Linear Regression Equation

$$WTP = a + b_1 (Age) + b_2 (Sex) + b_3 (family\ size) + b_4 (HHIN) + b_5 (HHEDU) + b_6 (TAREA) + b_7 (TLVO) + b_8 (IPR) + b_9 (DIR) + b_{10} (PRD) + b_{11} (Time)$$

Semi-log Model

$$Log\ (WTP) = a + b_1 (Age) + b_2 (Sex) + b_3 (family\ size) + b_4 (HHIN) + b_5 (HHEDU) + b_6 (TAREA) + b_7 (TLVO) + b_8 (IPR) + b_9 (DIR) + b_{10} (PRD) + b_{11} (Time)$$

Where,

WTP	=	Willingness to pay (dependent variable),
a	=	Intercept (constant),
b_1-b_{11}	=	Regression coefficients (regression parameters),
Age…Time	=	Explanatory variables (independent variables),
WTP	=	f (Age, Sex, family size, HHIN, HHEDU, TAREA, TLVO, IPR, PRD, DIR, Time)

Where,

WTP	=	Willingness to pay (Rs./household/year),
Age	=	Chronological age of respondent (year),
Sex	=	Sex of the respondent (M/F) coded 1 = men, 2 = women,
Family size	=	Number of family members (number),
HHIN	=	Household income (Rs./year),
HHEDU	=	Education of the respondent dummy variable coded (a) unity if literate (b) zero if illiterate,
TAREA	=	Total farm area owned (ha),

TLVO = Total livestock owned (number),
IPR = Interest in maintenance, protection and restoration of resource
Dummy variable coded (a) unity if interested (b) zero if not interested,
DIR = Distance to resources from the place of residence (m),
PRD = User's perception of resource degradation
dummy variable coded (a) unity if degraded (b) zero if not degraded,
Time = Time spent in collecting a resource (hr).

The above functional form was used for assessing WTP for common water bodies, common pool land resource, multipurpose tree species and fresh water aquaculture.

Definitions of Variables

WTP = Amount of money a household is willing to pay to use a resource in terms of rupees per year,
Age = Chronological age of the respondent according to the year of birth,
Sex = Sex of the respondents as men and women.
Family size = Number of family members in each family,
HHIN = Total annual income of the household from farm, income from agricultural wages, service and other income sources.
HHEDU = Education of the respondent as illiterate or literate,
TAREA = Total farm area owned by the household in hectare,
TLVO = Total livestock owned by the respondents such as cattle, buffaloes, goats, poultry etc.,
IPR = The resource users' interest in maintenance, protection and restoration of the particular resource,
DIR = Distance to resource from the place of residence of the respondent,
PRD = User's perception of resource degradation to capture the resource user's opinion, whether the resource is degraded or not degraded,
Time = The time spent for collecting the particular resource. For a example, time spent for collecting drinking water.

III

RESULTS AND DISCUSSION

User's Perception Towards Status of Resources and WTP

The results obtained through different methods of PRA adopted in this paper are summarised in Table 2. User's perception clearly indicate that most of the resources under investigation are in the process of degradation due to poor governance of local institution and open access of common pool resources. Resource users and non-users

TABLE 2. NATURAL RESOURCE STATUS, USER'S PERCEPTION, OWNERSHIP, MANAGEMENT AND WILLINGNESS TO PAY

Resources (1)	No. (2)	Major uses (3)	No. of total users (4)	Per cent of respondents (5)	Users Perception on status of NRS (6)	Users WTP for arresting resource deterioration and improving services (7)	Non-users WTP for arresting resource deterioration and improving services (8)	Ownership (9)	Institutions involved in management (10)
Canal	2 with 2 km length	Irrigation, bathing and recreation	160	45.00	Poor maintainence, inflected with weeds, bunds eroded, poor delivery across water courses, weak WUA	Rs.182-460	Rs.50-230	SDWRD	WUAs
Irrigation tank	1	Irrigation, fisheries, recreation bathing, tending cattle and other domestic activities	190	37.90	Polluted water due to hospital and domestic wastes, bund erosion, conflict over water use	Rs.166-555	Rs.71-362	SDWRD	FCS, WUA, Panchayat
Stop dam	1	Irrigation, domestic activities	22	60.00	Polluted water, silted, poor drainage	Rs.88-425	Rs.20-75	SDWRD	Panchayat
Community pond	1	Fishing, domestic use	70	100.00	Polluted due to unconstrained use of fish feed and manure	Rs. 78-188	Rs.15-60	Panchayat	Panchayat
Private tube wells	9	Irrigation	59	60.00	Declining ground water levelling summer	Rs.100-410	Rs.60-260	Private	Private
Community open wells	25	Drinking water, household purpose	28	100.00	Polluted water	Rs.61-192	Rs.34-116	Panchayat	Panchayat
Common grass land	65.81 ha.	Fodder, soil	125	100.00	Degraded due to intensive grazing, encroachment	Rs.230-1585		Panchayat	Panchayat
Multipurpose tree plantations	28 tree species with 30 major uses	Fodder, fuel, fruits	125	100.00	Disappering fast, indiscriminate cutting	Rs.104-322	Rs.157-400	Panchayat	Panchayat
Natural stream (nala)	1. length 2 Km	Domestic, tending cattle, fisheries	105	100.00	Less polluted	Rs.22-250	Rs.18-50	Panchayat	Panchayat

Note: SDWRD – State Department of Water Resource Development; WUA – Water Users' Association; FCS – Fisheries Co-operative Societies.

expressed their WTP with very high amount despite poor per capita income of the villagers. WTP of course varies according to the different users group. However this analysis is based on collective perceptions and responses. It is important to note that the information provided during PRA by the villagers was similar to village records, verifying reliability of PRA. In view of the villagers resources degradation process can be arrested with collective action and enforceable institutional arrangement under common property regime.

Willingness to Pay

The results of the Ordinary Least Squares (OLS) specifications with linear and semi-log regressions based on contingent valuation of renewable natural resources, namely, canal, tank, nala (flowing water stream), tubewells, common wells, stop dam, pond, CPLRs and multipurpose tree species and fresh aquaculture in common water bodies are shown in Table 3. Willingness to pay was elicited from the respondents regarding their annual contributions towards maintenance and protection, better and improved service of the above selected major renewable natural resources. Better and improved service was defined under each resource. Three dummy variables were used in case of education (HHEDU), interest in protection of resource (IPR) and perception of resource degradation (PRD) with other independent variables, namely, age, sex, family size, total income of the households (HHIN), total area owned (TAREA), total livestock owned (TLVO), distance to resource (DIR) and time spent in resource (Time). Time spent in resource variable was considered in case of canal, tubewells, wells, stop dam to find out the significance of time spent for collecting water for drinking and irrigation purposes, in case of multipurpose tree species to find out the time they spent for collecting fuel, fodder and small timber and in case of fresh water aquaculture in common water bodies to find out the significance of how much time they spent for catching fish. All other variables were used in each resource commonly.

The results of users WTP, obtained from linear and semi-log functions, clearly indicate that all RRNRs of the studied village are in the process of deterioration and users are keen to arrest this process. In case of common water bodies household income, farm area, livestock, distance from resource, time spent to access the resource and women's positive responses are important parameters of WTP. The results pertaining to CPLR and multiuse trees in terms of degradation to expression of interest to protect are mixed. This may be due to natural regeneration capacity of these resources which slows down the process of degradation and in turn indicate poor visibility in terms of users perception in empirical estimation.

TABLE 3. WILLINGNESS TO PAY FOR RESTORATION OF RURAL RENEWABLE NATURAL RESOURCES

Resource (1)	Estimation technique (2)	Constant (3)	Age (4)	Sex (5)	Family size (6)	HHIN (7)	HHEDU (8)	TAREA (9)	TLVO (10)	IPR (11)	DIR (12)	PRD (13)	Time (14)	R^2 (15)
Canal	Linear	-90.91	0.302	26.912	-0.939	0.0006	19.32	2.446	9.831	-18.947	88.409	-8.115	97.872	0.834
			(0.475)	(1.160)	(0.709)	(2.749)***	(0.875)	(0.3028)	(4.344)***	(0.417)	(1.655)*	(0.186)	(11.462)***	
	Semi-log	-2.503	0.001	-0.14	0.001	-9.7	-0.11	0.129	0.035	3.523	0.108	0.816	0.168	0.946
			(0.430)	(0.880)	(0.114)	(0.623)	(0.719)	(2.291)**	(2.198)**	(11.086)***	(0.289)	(2.674)***	(2.818)***	
Tank	Linear	-223.689	-1.426	-30.699	-0.071	0.003	-32.283	-22.654	3.356	213.991	388.986	131.388	-	0.481
			(1.015)	(0.572)	(0.022)	(6.222)***	(0.729)	(1.344)	(0.628)	(0.955)	(3.966)***	(1.640)*	-	
	Semi-log	2.401	-0.005	-0.02	0.004	1.62	-0.019	0.102	-0.007	-0.813	1.14	0.267	-	0.28
			(1.183)	(0.132)	(0.451)	(0.778)	(0.151)	(1.688)*	(0.467)	(0.894)	(4.063)***	(1.164)	-	
Nala	Linear	-40.759	0.334	33.49	0.486	0.0004	-12.834	-8.951	-0.95	-24.757	243.335	80.715	-	0.294
			(0.592)	(1.48)*	(0.379)	(1.807)*	(0.691)	(1.262)	(0.432)	(0.387)	(2.847)**	(1.25)	-	
	Semi-log	-2.579	0.009	0.282	-0.005	3.391	0.232	-0.294	-0.032	3.264	1.519	0.12	-	0.738
			(1.094)	(0.860)	(0.302)	(1.079)	-0.861	(2.853)***	(1.013)	(3.500)***	(1.219)	(0.128)	-	
Tubewell	Linear	-12.75	0.403	18.067	-0.938	-0.0008	-4.193	35.815	-1.893	-32.402	-56.638	-210.785	200.801	0.87
			(0.379)	(0.439)	(0.392)	(1.888)*	(0.120)	(2.540)**	(0.455)	(0.551)	(1.327)	(3.111)***	(17.089)***	
	Semi-log	-3.307	0.004	0.006	0.001	8.241	-0.017	0.376	0.002	3.327	0.192	0.251	0.259	0.941
			(0.903)	(0.040)	(0.198)	(0.500)	(0.129)	(6.750)***	(0.124)	(14.319)***	(1.137)	(0.937)	(5.586)***	
Common wells	Linear	-47.05	0.462	12.164	0.243	-0.0001	3.697	-2.295	5.738	-57.233	144.262	-32.712	158.806	0.93
			(2.22)**	(1.486)	(0.478)	(1.286)	(0.558)	(0.908)	(6.219)**	(2.321)**	(2.322)**	(1.490)	(21.710)***	
	Semi-log	-2.735	-0.002	-0.181	0.006	4.682	0.032	0.009	-0.012	4.094	1.068	-0.276	0.626	0.968
			(1.093)	(1.825)**	(1.084)	(0.474)	(0.399)	(0.314)	(1.123)	(13.671)***	(1.416)*	(1.042)	(7.051)***	

(Contd.)

TABLE 3. *(CONCLD.)*

Resource (1)	Estimation technique (2)	Constant (3)	Age (4)	Sex (5)	Family size (6)	HHIN (7)	HHEDU (8)	TAREA (9)	TLVO (10)	IPR (11)	DIR (12)	PRD (13)	Time (14)	R^2 (15)
Fresh water aquaculture	Linear	7.792	0.068	-9.604	-0.018	-5.60E-06	8.791	1.015	0.11	433.26	-127.93	-444.94	123.585	0.871
			(0.292)	(1.043)	(0.035)	(0.060)	(1.184)	(0.361)	(0.124)	(10.715)***	(2.730)***	(11.380)***	(16.135)***	
	Semi-log	-2.762	0.005	-0.408	0.006	9.582	-0.116	0.009	-0.007	4.511	-0.01	-1.941	0.89	0.845
			(1.145)	(2.303)**	(0.580)	(0.562)	(0.816)	(0.182)	(0.441)	(5.794)***	(0.011)	(2.580)**	(6.036)***	
Stop Dam	Linear	-41.332	0.523	0.214	-0.056	7.44	12.018	0.023	1.735	102.331	-88.246	-58.796	93.911	0.743
			(1.494)	(0.016)	(0.069)	(0.550)	(1.059)	(0.005)	(1.224)	(1.589)*	(1.172)	(1.007)***	(9.340)	
	Semi-log	-3.192	0.002	0.07	0.004	3.18	-0.025	-0.002	0.002	4.617	2.422	-0.973	0.396	0.961
			(0.589)	(0.703)	(0.603)	(0.319)	(0.301)	(0.055)	(0.145)	(9.654)***	(4.132)***	(2.071)**	(5.135)***	
Common ponds	Linear	55.998	-0.68	-17.497	-0.687	-1.65	1.362	1.662	-1.135	76.729	338.353	-20.269	-	0.578
			(1.799)*	(1.153)	(0.778)	(0.114)	(0.114)	(0.363)	(0.786)	(1.235)	(5.916)***	(0.336)	-	
	Semi-log	-2.919	0.003	-0.208	-0.005	-2.95	0.175	-0.003	-0.001	5.487	1.173	-0.9911	-	0.958
			(0.953)	(1.704)*	(0.715)	(0.256)	(1.795)*	(0.076)	(0.054)	(10.849)***	(2.541)***	(2.004)*	-	
CPLRs	Linear	325.487	0.518	55.642	-0.091	0.001	79.238	37.032	-7.628	-272.951	792.154	-31.3353	-	0.444
			(0.325)	(0.899)	(0.026)	(1.405)	(1.549)*	(1.756)*	(1.247)	(1.072)	(4.863)***	(0.608)	-	
	Semi-log	1.85	-0.003	-0.534	0.031	3.71	-0.131	0.032	-0.043	0.15	3.096	-0.126	-	0.206
			(0.263)	(1.388)	(1.406)	(0.999)	(0.409)	(0.244)	(1.127)	(0.932)	(3.023)***	(0.387)	-	
Multipurpose tree species	Linear	19.661	0.909	-14.125	-4.897	-0.0001	-39.767	36.022	3.209	0.826	-65.851	104.365	55.794	0.458
			(0.852)	(0.341)	(2.015)**	(0.333)	(1.176)	(2.802)***	(0.793)	(0.005)	(1.954)**	(0.611)	(7.730)***	
	Semi-log	3.63	0.006	-0.995	-0.002	-2.53	-0.194	0.184	0.046	-0.089	-0.145	-1.148	0.099	0.176
			(0.621)	(2.674)***	(0.112)	(0.693)	(0.638)	(1.598)*	(1.253)	(0.053)	(0.480)	(0.748)	(1.400)	

IV

CONCLUSIONS

From the point of view of user's appraisal and valuation of RRNRs this study provides some meaningful findings. PRA and CVM are appropriate methods to examine the process of resource degradation and expression of user's interest to arrest such process. RRNRs of the studied village are deteriorating at a faster rate and user's are therefore WTP to reverse this trend. All the natural resources considered in this study are essentially common pool resources and controlled under different property right regimes by few local institutions. To arrest the degradation process distributed or shared governance model can be adopted which involves a share of authority among different groups/stakeholders/agencies at different decision-making levels (Marothia, 2002). This seems appropriate in view of the decentralisation governance or panchayat raj institutions emerging in resource management in the country.

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