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M.S. Swaminathan Research Foundation

2012

Ind. Jn. of Agri. Econ.
Vol.67, No.3, July-Sept. 2012

SUBJECT I
VALUATION OF ECOSYSTEMS SERVICES

Use of Contingent Valuation to Assess Farmer Preference for On-farm Conservation of Minor Millets: Case from South India

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I

INTRODUCTION

Human beings have been evolving crops and varieties based on their preferences since ages. There are several species preferred and improved by them which continue to play a key role in their life. But many among them are found to be neglected due to the changing social and cultural reasons and has thereby slowly disappeared from the existence. Under utility of those species leads to extinction of a species and erosion of genes. Under-utilised plant species can be characterised by the fact that they are locally abundant but globally rare, that scientific information and knowledge about them is scant, and that their current use is limited relative to their economic potential (Gruère *et al.,* 2007a, b).

Minor millets are a group of annual grasses found mainly in the arid and semi-arid regions. They are cultivated on 71.9 million acres in India, accounting for nearly 25 per cent of the total acreage under cereal crops (Nagarajan *et al.,* 2010). In India, drylands play a significant role in meeting the food and fodder requirements of farming communities. Three species of minor millets—finger, foxtail or italian and little millet are widely cultivated. These crops are often classified as "minor or coarse grains" in agricultural statistics. "Minor" refers not only to the smaller size of the grains, but also to their lesser importance in trade. Scientific knowledge about them is

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This study was carried out by M.S. Swaminathan Research Foundation, Chennai, India with the collaboration of Bioversity International, Rome, Italy using financial support received from Syngenta Research Foundation. The lead author of this study was previously employed with M.S. Swaminathan Research Foundation, Chennai, during the tenure of the project. Vijesh Krishna, Senior Research Fellow, Department of Agricultural Economics and Rural Development, Georg-August University of Göttingen, Germany is gratefully acknowledged for developing the contingent valuation method and associated survey instrument which was used to estimate farmers' WTA compensation for participating in the on-farm millet conservation programme. Subash Ghimire is also gratefully acknowledged for his comments.

limited. Despite national efforts to collect minor millet germplasm from farmers, research to improve these crops has been negligible. Lack of attention by the researchers, policy makers, donors, farmers and consumers is increasingly threatening the genetic diversity of minor millets. This constitutes an irreversible loss to humanity, particularly to the poor who heavily depend on these crops for their food and nutritional security, as well as for limited income generation.

In the Kolli hills of Tamil Nadu, a genetically diverse pool of minor millet varieties has long been traditionally grown by the tribal farming communities for their own consumption without being formally traded. Despite a traditional consumption preference for minor millets by the local population, in recent years the area devoted to minor millets has declined considerably. They have tended to be substituted by market-oriented cash crops such as tapioca, coffee, pepper and fruit crops. In response to this development, the M.S. Swaminathan Research Foundation (MSSRF), a leading non-governmental organisation based in Chennai, has been attempting to create an economic stake for farmers in the conservation of these crops over the last 10 years in the Kolli Hills. These programmes aimed to increase the market potential of minor millets through value addition by involving the local farming community (MSSRF, 2002).

As a part of this effort, MSSRF in collaboration with Bioversity International carried out a study to investigate the farmers' decisions related to the continued conservation and use of minor millets in the Kolli hills. The study aimed to facilitate the conservation of agro-biodiversity, improve farmer livelihoods and support policy formulation through the development of innovative economic analytical methods and incentive mechanisms. To this end a stated preference contingent valuation (CV) method was applied in January-May 2010, covering 454 farm respondents from 50 villages. A double bounded dichotomous (follow-up) questionnaire was adopted to assess the potential farmer Willingness to Accept (WTA) compensation for agro-biodiversity conservation. Such an approach is consistent with the emerging development of payment for agro-biodiversity conservation services (PACS) schemes to create incentives for the conservation of agro-biodiversity and improve farmer's livelihood. PACS could potentially provide the farmers with an incentive to sustain the in-situ conservation of threatened, local plant and animal genetic resources. Nonetheless, attention is paid to some generic challenges to be overcome in the implementation of such programmes on the grounds with regard to the identification of potential buyers of conservation services and the complex institutional settings in which PACS would have to be implemented (Narloch *et al.,* 2011a). Under PACS, conservation area is clearly an important conservation goal, as it is closely linked with the ability to produce enough seeds to safeguard the genetic material and to facilitate evolutionary processes in the field. Allocating funds not only to the most competitive bidders but also in a manner that ensures an equitable distribution of payments may to some extent undermine the main motivation behind using (competitive) conservation auctions (Narloch *et al.,* 2011b).

This paper contributes to the literature in two ways. Firstly, only a few previous applied economics studies have investigated the determinants of minor millets in India (Gruere *et al.,* 2007a, b, 2009; King *et al.,* 2009). Secondly, this study adds to the growing literature that employs the use of stated preference methods, mostly contingent valuation methods, to estimate farmer valuation of various components of agro-biodiversity (Ndjeunga and Nelson, 2005; Scarpa *et al.,* 2003a, b).

In the context of agricultural biodiversity, CVM has not been widely employed, while only a few studies have undertaken stated preference techniques to estimate the economic value [including of genetically modified (GM) crops like maize and rice] (Birol *et al.,* 2007, 2009; Horna *et al.,* 2005). CVM was employed for estimating the farmers' derived demand for hypothetical seeds with different useful traits combined as desired by the farmers (Wale *et al.,* 2011). Contingent valuation has been especially useful in ex-ante and ex-post assessment of conservation policy (Pearce and Moran, 2001). However, CVM has been applied extensively in valuing rare and endangered animal species such as pandas (Swanson and Kontoleon, 2000), habitats such as riparian forests (Desaigues and Ami, 2001), and landscapes.

II

CONTINGENT VALUATION (CV) STUDY ON FARMER'S ASSESSMENT OF MINOR MILLET IN KOLLI HILLS

2.1. *Case Study*

The Kolli Hills is a mountainous area with a temperate climate located on the eastern border of Namakkal district in Tamil Nadu. Forests occupy 44 per cent of the total area of 28,293 ha, while agricultural activities take place on 52 per cent of the total area, leaving 4 per cent for other activities (Kumaran, 2004). More than 95 per cent of the inhabitants are tribal people belonging to the Malayali community (MSSRF, 2002). The population density is 119 per sq. km. Pradeep and Rajasekeran (2006) estimated that land under tapioca cultivation represents about 75 per cent of the total dry lands. Irrigated land comprises less than 15 per cent of the total cultivable area (MSSRF, 2002).

Agro-biodiversity in the Kolli hills has been declining over the last three decades due to several factors which has resulted in shrinkage of the area under minor millets cultivation (King *et al.,* 2009). The introduction of cash crops like tapioca, the drudgery involved in the processing of millets, the lack of market linkages for millets, the availability of better transport facilities, and the availability of food grains (especially rice) at subsidised prices through the public distribution system (PDS), have all affected the cultivation and consumption of minor millets in the Kolli hills (King *et al.,* 2009). Interaction with outside merchants since the 1980s has drastically changed traditional agricultural practices in the Kolli hills. Financial support, such as advance crop loans and transportation facilities for tapioca cultivation has been

provided by the merchants and contractors (Kumar-Range, 2001) leading to the large-scale expansion of tapioca cultivation in the uplands and modification of rocky undulating terrains that were traditionally under mixed cropping and monoculture of millets.

The move from subsistence agriculture to commercial agriculture has led not only to the loss of food products but also affected the nutrient quality of the soil due to continuous monoculture of tapioca. In addition to this, the interest and attitude of the tribal community towards commercial horticulture such as silver oak, coffee, pepper and cardamom plantation estates have created even more pressure on traditional agriculture. Commercial agriculture has also resulted in the abandonment of millet cultivation among the younger generation. Moreover, state policies relating to crop loans, subsidies and the favourable conditions for commercial agriculture have shaped the minds of people to neglect the minor millets (King *et al.,* 2009).

Within the five small millet species, there are 19 landraces under cultivation in our study area in Kolli hills. Six landraces are associated with finger millet, six with Italian millet, five with little millet and one each with proso (or common) millet and kodo millet. Seed systems of minor millet crops are mostly autarkic, farmers depend on themselves or other farmers in their community for seed. Traditionally, the Kolli hills region has been known for its genetic diversity in minor millets: little millet, finger millet, foxtail millet, kodo millet and proso millet. Each of these crop species is represented by diverse landraces, displaying diverse morphological and agronomical characters and thereby contributing to preserving agro-biodiversity. Until the mid-1980s minor millets were extensively grown and widely consumed in the Kolli hills mostly as a subsistence crop (Gruere *et al.,* 2007a, b). However, their cultivation has declined due to changing consumption and production preferences in favour of other crops such as tapioca, rice and fruit crops. The change in the land use pattern, cultural practices and food habits has led to the importance of undertaking active conservation measures for the millet landraces in Kolli hills. Consequently, a series of biodiversity projects have been launched using an integrated approach related to the conservation and sustainable use, addressing biodiversity, hidden hunger and poverty.

In the next section, we explain the theoretical framework applied in the context of the on-farm conservation of minor millet, using innovative econometric analytical methods and incentive mechanisms. We use CV survey data collected from five zones of the Kolli hills, to estimate farmers' willingness to accept compensation for participating in a millet conservation programme. Seemingly unrelated bivariate probit (SUBP) regression was used to estimate the determinants of willingness to participate in millet conservation in Kolli hills.

2.2 *Theoretical Framework*

Following Dupraz *et al.,* (2003), the following theoretical framework was used. The behaviour of the farm household is formalised by the maximisation of its utility. Initially in the absence of any proposed contract with the farmers, the budget constraint involves the off-farm incomes and the profit generated from the on-farm activities:

$$\underset{c,m}{Max} U(c,m)$$

$$\text{Subject to } c \leq \prod(p, m, Z) + v \qquad \ldots.(1)$$

$$m \geq 0$$

where c is the household private consumption, expressed in monetary values and m is the millet conservation programme. The function is assumed to be increasing, concave and differentiable in c. The vector Z represents characteristics of the farm and household. The profit function Π (p, m, Z) is assumed to be convex. The p vector includes the prices of factors and products freely allocated. The v vector represents off-farm incomes that are assumed to be exogenous in model (1).

To define the household's willingness to accept compensation for participating in the millet conservation programme, we assume that the farm household is invited to increase its cultivation of millet by a fixed quantity such that:

$$\Delta m = m_1^s - m_0 \succ 0.$$

Its willingness to accept is classically formalised by the surplus variation (WTA^s). This willingness to accept is derived from equation (2), which defines the expenditure function.

$$e(p, m, Z, U_0) = \underset{c}{\text{Min}} \{c - \Pi(p, m, Z); U(c, m) \geq 0\} \qquad \ldots. (2)$$

$$WTA = e(p, m_1^s, Z, U_0) - e(p, m_0, Z, U_0)$$

$$= e(p, m_1^s, Z, U_0) - e_0 \qquad \ldots. (3)$$

Equation (3) expresses the minimum payment that the household would accept in order to increase its production of minor millets from m_0 to m_1.

2.3. *Data Collection*

The study was carried out in five zones (panchayats) in the Kolli hills, namely, Devanur, Alathur, Thiruppuli, Gundani and Selur, where most of the minor millet varieties exist. These zones are assumed to be representative of the broader region. The survey was carried out during January and May 2010, covering approximately 69.4 per cent of the total settlements in the study area, which were selected randomly for the survey. Within each settlement, specific farming households were selected through a semi-random sampling approach, thereby ensuring that at least 50 per cent of our sample within each settlement covered millet cultivators. The trained enumerators initially started by randomly interviewing farming households irrespective of their being millet cultivators or not. Subsequently, if the 50:50 ratios were not being achieved, then the millet farming household were non-randomly selected. The total sample size comprises 454 farm respondents (ranging from 84-96 households per zone). From the survey, we find that 68.7 per cent of the sample households were millet cultivators and 31.3 per cent were non-millet cultivators.

The contingent valuation survey recorded the response of the participants to compensation offers. Given that the property rights of minor millets and their outputs and functions reside with the farmers (Freeman, 2002), the use of a willingness to accept (WTA) measure regarded as the appropriate proxy for estimating the compensation required. This indirect (stated preference) measure is preferred over a market-based (revealed preference) estimate as for most of the farmer family's millets are traded to only a limited extent and there is a shift to other crops. Hence, the respondents are unlikely to be familiar with a direct monetary/market measure of the value of millet output. Instead, compensation payments may be viewed as an appropriate payment vehicle. The environmental effectiveness of the millet conservation programme, however, relies on the voluntary participation of farmers to adopt specific agricultural practices designed to secure specific conservation goals (e.g., to cultivate specific threatened varieties on a specified land area and save some proportion of the seed for planting in future years) in exchange for compensation payments.

The survey questionnaire consisted of four parts. The first part consisted of the socio-economic characteristics of the households. The second part of the questionnaire dealt with the land-use patterns of the farmers. The third part involved a choice experiment and the fourth part a CV method survey. In this paper we report on the latter, together with some of the relevant descriptive statistics gained from the first two sections and CV is discussed. The farmers were initially briefed about the trend and importance of minor millet crops in the Kolli hills and worldwide. After providing this background context, the farmers were asked to classify varieties existing in their zone into most and least preferred variety categories (MPVs and LPVs, respectively). Such categorisation would have drawn upon their productivity and consumption preferences. The drafting of the WTA survey instrument took place

over three months following a pilot study. Pre-testing of questionnaire was done by selecting 10 farm households in each zone, with this information being used to inform changes to the final version (particularly with regard to bid range definition). The list of MPVs and LPVs landraces of the five zones are given in Table 1. Bid cards for MPVs and LPVs were shown to the farmers and they were asked whether they would be willing to participate in the proposed conservation programme in exchange for a certain level of compensation. If they choose to participate in the programme, then would be asked to cultivate a specific landrace on a specific area over a number of different years. They were also required to store 3 kg of quality seed at home for the next production seasons.

TABLE 1. LANDRACES OF THE MPV AND LPV VARIETIES OF MILLETS

Zone No. (1)	Zone Name (2)	Most preferred varieties (3)	Least preferred varieties (4)
1.	Devanur	Arisikaizhvaragu (FM) , Sattaikaizhvaragu (FM), Vellaperumsamai (LM)	Thirivaragu (KM)
2.	Alathur	Karunguliyankaizhvaragu (FM), Karakaizhvaragu (FM)	Mookkanthinai (IM), Karumsamai (LM)
3.	Thirupulli	Sundangikaizhvaragu (FM)	Koranthinai (IM), Sadansamai (LM), Thirigulasamai (LM)
4.	Gundani	Vellaperumsamai (LM), Kattavettisamai (LM)	Panivaragu (CM), Senthinai (IM)
5.	Selur	Perunkaizhvaragu (FM), Palanthinai (IM)	Malliasamai (LM), Perunthinai (IM)

Note: FM- finger millet, LM- little millet, IM-italian millet, CM- common millet and KM- kodo millet.

A double-bounded dichotomous choice (DBDC) model was employed in the CV survey. The essence of the DBDC model is that the respondents are presented with initial bid offers and following their initial responses, a second bid will be offered. This second bid offer is lower if their initial participation response was "Yes" and higher if their initial responses was "No". The attributes of the CV cards is presented in Table 2.

TABLE 2. ATTRIBUTES USED FOR THE CV BID OFFERS

Sr. No. (1)	Attributes (2)	Description (3)
1.	Landrace	Any specific landrace will be asked to cultivate by the surveyed farmers (landrace differ between the households)
2.	Area	Area to be cultivated, 10 cents as a pure crop or 15 cents as a mixed crop.
3.	Contract length	Three types of contract length is used are, 1 year, 2 years and 3 years (contract length will differ between the households)
4.	Support	Cash support is given to both MPV and LPV. (50 per cent will be paid in the beginning of contract and 50 per cent upon successful completion)

The farmers were asked that whether they are willing to participate in the millet conservation programme or not by offering compensation bid prices. The initial bid prices offered for MPVs ranges from Rs.100 to Rs. 750 and LPVs ranges from Rs.250 to Rs.1000. Based on the initial responses the second bid prices were offered, MPVs second bid price ranges from Rs.50 to Rs.1000 and LPVs second bid price ranges from Rs.100 to Rs.1250. The farmers' response to the bid cards offered as compensation in the millet conservation programme is given in Table 3.

TABLE 3. FARMERS' RESPONSE TO THE BID CARDS IN THE MILLET CONSERVATION PROGRAMME

	Number (per cent) of households responds to MPV				Number (per cent) of households responds to LPV			
	Initial bid as		Final bid as		Initial bid as		Final bid as	
Bid (Rs.) (1)	'Yes' (2)	'No' (3)	'Yes' (4)	'No' (5)	'Yes' (6)	'No' (7)	'Yes' (8)	'No' (9)
50	-	-	38 (75)	13 (25)	-	-	-	-
100	51 (44)	64 (56)	38 (69)	17 (31)	-	-	13 (54)	11 (46)
250	55 (49)	58 (51)	90 (56)	72 (44)	24 (21)	91 (79)	10 (28)	26 (72)
500	98 (88)	13 (12)	132 (80)	33 (20)	36 (32)	77 (68)	81 (53)	71 (47)
750	107 (93)	8 (7)	11 (85)	2 (15)	61 (55)	50 (45)	95 (61)	60 (39)
1000	-	-	5 (63)	3 (38)	78 (68)	37 (32)	25 (50)	25 (50)
1250	-	-	-	-	-	-	9 (24)	28 (76)

III

RESULTS AND DISCUSSION

3.1. *Descriptive Statistics*

The descriptive statistics are reported in Table 4. The average household size in the study area is 4.4 members and 87 per cent of the households are headed by males. Only 43 per cent of the heads of household are literate and most households depend on agriculture (67.6 per cent) for their livelihood. According to this survey, the average area of cultivated land during 2009 was 2.6 acres per household, with 12.3 per cent of the land devoted to millet cultivation with a mean yield of 234 kg per acre. About 45.4 per cent of the households are engaged in participatory organisations such as self help groups (SHG) and farmers' organisations, 89 per cent of the households keep their savings in banks, post offices and life insurance corporations (LIC), while 34 per cent of households have taken loans during the years 2006-08, through banks, private money lenders, family friends and Large Scale Multi Purpose Societies (LAMPS). The loans are largely used for household consumption rather than for agricultural purposes.

TABLE 4. DESCRIPTIVE STATISTICS OF THE STUDY AREA

Household social and economic characteristics (1)	Mean (Std. error) (2)
Age of the head of household	44.59 (0.53)
Household size	4.37 (0.08)
Number of males > 14 years old	1.70 (0.04)
Number of females > 14 years old	1.55 (0.03)
Number of Children <= 14 years old	1.11 (1.05)
Total cultivated land during 2009 (acres)	2.60 (0.08)
Millet cultivated land during 2009 (acres)	0.32 (0.02)
Millet yield per acre (in kg) during 2009	234
	Per cent
Distribution of sample between zones	
Zone 1: (Devanur)	19.8
Zone 2: (Alathur)	19.4
Zone 3: (Thirupulli)	21.1
Zone 4: (Gundani)	18.6
Zone 5: (Selur)	21.1
Male headed household	86.6
Literate head of household	42.7
Employment of the head of household	
Agriculture	67.6
Other than agriculture	32.4
Household organisation participation (e.g. SHGs Farmers' Associations, etc.)	45.4
Household savings in banks, post office, LIC, etc.	88.8
Households taking loans during (2006-08)	34.4

3.2. *Seemingly Unrelated Bivariate Model*

Seemingly unrelated bivariate probit (SUBP) regression was used to estimate the determinants of willingness to participate in millet conservation of both MPVs (model-1) and LPVs (model-2) in the Kolli hills. The model estimates are given in Table 5.

The initial response in case of both MPVs and LPVs is significant with the farmers responding positively to the compensation offered, while the follow-up response results suggests the significant impacts of bid value for both MPVs and LPVs are in different direction. The negative value for LPVs shows that the probability of participation is low even with the higher compensation, this result reflects from Zone 1 (Devanur) where Kodo millet (LVP) was traditionally grown and farmers have indicated a strong dislike for the cultivation of its landrace due to low consumption value. The influence of the factor area under millet cultivation is negative for MPVs and LPVs, which reflects the fact that the farmers are shifting from their traditional cultivation of millets to other commercial crops. These results are in line with the findings of King *et al.,* (2009). Millet yield per acre has a positive influence, with farmers preferring varieties with higher productivity. Farmers with larger household sizes are found not to be more likely to undertake millet cultivation and this is also in line with the findings of previous studies. Better educated

TABLE 5. SEEMINGLY UNRELATED BIVARIATE PROBIT

	Coefficient (Std. error)			
	Model - 1 for MPV		Model - 2 for LPV	
Variable	Response 1	Response 2	Response 1	Response 2
(1)	(2)	(3)	(4)	(5)
Bid price (Rs.)	0.0030***	0.0009*	0.0018***	-0.0004
	(0.0003)	(0.0005)	(0.0002)	(0.0003)
Millet land (acre)	-0.4822*	-0.2702	-0.4308*	-0.1579
	(0.2509)	(0.2385)	(0.2547)	(0.2235)
Millet yield (kg/acre)	0.0010	0.0020*	0.0006	0.0020**
	0.0011	(0.0011)	(0.0011)	(0.0010)
Household size (nos.)	-0.0703*	-0.0300	-0.0036	0.0333
	(0.0421)	(0.0380)	(0.0381)	(0.0359)
Age of household (years)	0.0061	0.0024	-0.0070	-0.0043
	(0.0067)	(0.0060)	(0.0059)	(0.0056)
Sex of household head (male=1)	0.2169	0.1731	-0.1254	-0.1760
	(0.2109)	(0.1872)	(0.1910)	(0.1826)
Education of household head (years)	-0.0365*	-0.0257	-0.0285	0.0109
	(0.0218)	(0.0196)	(0.0199)	(0.0186)
Organisation participation	0.5519***	0.3226**	-0.0105	-0.0992
(SHG, farmers club, etc)	(0.1454)	(0.1344)	(0.1294)	(0.1233)
Intercept	-0.7790*	-0.0501	-0.6871*	0.4037
	(0.4291)	(0.4004)	(0.3944)	(0.3947)
Log-likelihood	-489.1666		-582.8664	
rho	0.1727		-0.1148	
	(0.1402)		(0.1218)	
Wald $\chi^2(16)$	111.49***		76.58***	
No. of observations	453		453	

***, ** and * indicate level of significance at 1, 5 and 10 per cent, respectively.

household heads hold preferences for other crops rather than millets. Nevertheless, larger families and better educated household heads have a positive response to the follow-up bid for LPVs, if offered higher compensation. The age of the household head is taken as a proxy for millet farming experience found that their compensation to participate in LPVs is higher than MPVs. The farmers' involved in organisational participation (such as SHG, farmers' association, etc.) have a positive response to MPVs (significant) and negative response of LPVs in the millet conservation programme. Such a finding is also the result of the fact that in order to generate market linkages for minor millets, MSSRF has actively promoted self-help groups (SHGs) among the millet growing communities.

3.3. *WTA Respondents*

In order to estimate the degree of heterogeneity of WTA compensation across households, six household profiles was generated (Table 6).

TABLE 6. HOUSEHOLD PROFILES USED FOR WTA ESTIMATES

(*per cent)*

Profile (1)	Millet farmers (2)	Non-millet farmers (3)
Average Household	68.7	31.3
Profile 1 : Millet farmers	100.0	0.0
Profile 2 : Non-millet farmers	0.0	100.0
Profile 3 : Literate	42.3	43.0
Profile 4 : Illiterate	57.7	57.0
Profile 5 : Organisation participation	49.7	35.9
Profile 6 : Non-organisation participation	50.3	64.1

The first two profiles are associated with farmers who are cultivating millets and not cultivating millet, whereas the following two profiles are associated with literacy levels. The last two profiles are associated with farmer status related to millet crop-related organisations participation such as SHGs and farmers associations. The statistics related to these profiles are reported in Table 6. It is found that 68.7 per cent of the farmers were cultivating millets in the study area, the literacy rate is similar for both millet and non-millet farmers group, and organisation participation rates are higher for millet farmers. The SHGs are a common grassroots institution through which development activities are implemented in many regions of India. Participation is voluntary, and the schemes are based on internal lending incentives (Gruere *et al.,* 2009).

The WTA analysis estimates the welfare loss effectively when the respondents have limited knowledge about market conditions. The WTA of farmers who are willing to participate in the millet conservation programme is furnished in Table 7.

TABLE 7. MARGINAL WTA FOR THE GIVEN PROFILES

Profile (1)	Average WTA price (Rs./acre)			
	MPV		LPV	
	Initial bid (2)	Final bid (3)	Initial bid (4)	Final bid (5)
Profile 1 : Millet Farmers	4728	3403	7406	6494
	(163.14)	(141.95)	(223.90)	(189.28)
Profile 2 : Non-millet Farmers	4840	3468	7462	6566
	(253.69)	(208.49)	(317.02)	(328.27)
Profile 3 : Literate	4605	3401	7303	6716
	(213.12)	(198.08)	(295.30)	(270.67)
Profile 4 : Illiterate	4872	3437	7500	6359
	(179.01)	(143.26)	(232.69)	(202.54)
Profile 5 : Organisation participation	4345	3039	7064	6587
	(196.67)	(178.98)	(295.87)	(259.08)
Profile 6 : Non-organisation participation	5176	3781	7699	6458
	(185.71)	(148.28)	(226.93)	(212.11)

Note: * WTA price indicates for millet cultivation in 1 acre as mono crop and 1.5 acres as inter/mixed crops; figures in parentheses indicate standard error.

The millet farmers are willing to participate at higher compensation levels in the initial bid price offered, but they are still WTA a lower bid price than the initial

compensation offered for both MPVs and LPVs. The same trend is followed by non-millet farmers, although they are willing to accept the higher compensation more than millet farmers. The literate farmers are willing to participate in LPVs millet conservation programme with higher compensation than that of illiterate farmers, which is reflected in SUBP model. The farmers participating in millet related organisations are willing to participate in the millet conservation programme at lower levels of compensation compared to the non-organisation participating farmers. The results suggest that the contingent valuation method used here seems to be an appropriate tool with which to reveal farmer participation decisions regarding a millet conservation programme.

IV

CONCLUSIONS

This paper is based on a contingent valuation survey conducted in tribal farming communities in the Kolli hills, where a genetically diverse pool of minor millet varieties are traditionally grown and consumed are under threat due to several factors. The study aims to facilitate the conservation of minor millets, leading to improved farmer livelihoods and policy recommendations through the use of innovative econometric methods and incentive mechanisms. The result suggests that the farmers are willing to accept less compensation for the varieties, which produce higher yield of MPVs and LPVs. The farmers involving in millet related organisation are willing to accept lower level of compensation for MPVs and higher for LPVs than the farmer who does not participate in the organisation. Given farmers' willingness to participate in a millet compensation programme, it is clear that direct compensation mechanisms can supplement returns so as to encourage the conservation of minor millets in a given year. Periodical re-assessment would nonetheless be needed in order to better understand the compensation demands of the farmers over time. Furthermore, this study shows that direct compensation incentive mechanisms may indeed be able to play a complementary role in the conservation of neglected landraces of millets relative to other types of intervention. These include community-based incentives and policies associated with market linkage development for millets in order to obtain higher prices for farmers, facilitating the availability of quality seeds, improving access to machinery for processing grains and the inclusion of millet in the local PDS.

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