Degradation of Common Pastures: An Economics Perspective of its Impact on Livestock Farming and Coping Strategies[§]

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Abstract

The study has examined the farmers' perception regarding deterioration of pasturelands, its impact on livestock farming and the factors affecting farmers' willingness to contribute to a participatory pasture development programme. It is based on the primary data collected from sheep farmers of semi-arid and arid regions of Rajasthan in the year 2008. A large proportion of farmers have perceived deterioration of the pastureland which has resulted in the reductions of wool yield per animal (18%), body weight of sheep (20%) and age of disposal of lambs (45%). The major coping mechanisms adopted by the farmers have been identified are: reduction in total livestock holding (86%), reduction in sheep flock size (55%), grazing on alternative fodder sources (30%), increased frequency of migration (59%), increased duration of migration (41%), and disposal of male lambs at an early age (76%). The reduction of pastureland has resulted in cost escalation for sheep farming, particularly for the landless and small farmers. Double Bounded Dichotomous Choice (DBDC) method of Willingness to Pay (WTP) has been used to analyze the factors affecting the association of farmers with a participatory pasture development programme. The bivariate probit model estimated using this data has indicated that the expected cost and the concerns regarding inequitable distribution of benefits affect WTP negatively, whereas flock size affects it positively. The farmers in the arid region have been found more forthcoming towards a participatory management strategy. The study has highlighted the importance of awareness generation about the participatory management strategy and its incorporation as a component of livestock development programmes.

Introduction

The role of common property resources (CPRs) is manifested in providing food, fodder and fuel, supplementing income and employment and providing some social gains to the villagers. In the arid and semi-arid regions of India, one important component of CPRs is the common pasturelands which supply fodder and grazing land for livestock and thus help sustain a number of livestock which would not have been permitted by individuals' owned land, especially for small farmers (Jodha, 1986). One of the major livestock groups that depend predominantly on these grazing lands are small

ruminants — sheep and goat — that are raised mainly by resource-poor farmers (Pasha, 1991). Ever since Jodha's pioneering work (1985, 1986) has demonstrated the livelihood augmenting role of common lands and impact of its decline, considerable interest has generated in understanding its dynamics and the measures to ameliorate its decline (Chopra *et al.*, 1990; Menon and Vadivelu, 2006).

Pasturelands, which fall under the common property regime, have two basic characteristics, viz. exclusion is difficult and yield is substractible (Gebremedhin *et al.,* 2002). The incentive of the individual beneficiaries is to appropriate the benefit as much as possible and it would gradually lead to its deterioration (Hardin, 1968). Therefore alternate solutions including manipulation of the property rights like privatisation, imposition and enforcement of use rules by external forces such as

government or other agencies or state ownership of resources are proposed (Wade, 1986). But, it is highly unlikely that the natural resource problems can be solved by the private or state property alone. Therefore the collective action with the involvement of members of the community is being increasingly recognised as a viable alternative to privatisation or state ownership of resources (Rasmussen and Meinzen-Dick, 1995; Baland and Platteau, 1996). Singh *et al.* (1996) have discussed the importance of participatory approach in improving the productivity of common pasturelands.

Development of pasturelands with the participation of members of the community necessitates the availability of local institutions or organisations. However, the effectiveness of the participatory action depends on the individuals' incentives to contribute to the programme (Baland and Platteau, 1996). Underlying these incentives in the case of livestock farming are the perceptions regarding the severity of decline of the pastureland, its impact on their livestock-rearing practices, income from livestock origin, the economic cost of coping mechanisms and the net individual benefit from the intervention. Understanding these factors is an essential take-off point in policy formulation that will enact a model for participatory pasture development. In this background the present study was undertaken with the specific objectives of examining the (i) perception of farmers regarding the decline of pastures and its impact on livestock- farming, (ii) strategies adopted by the farmers to cope up with the decline of pastures and, (iii) factors affecting farmers' willingness to contribute to a participatory pasture development programme. The data were collected from the sheep breeders of Rajasthan, which has a sheep population of about 10 million (GoI, 2003). Sheep suffer more from the decline of pasturelands as they are exclusively raised on these lands.

Data and Sampling Framework

The analysis was carried out by using primary data collected from the districts of Ajmer and Bikaner of Rajasthan. It is the state where significant contribution of the common pastureland towards rural livelihood has been observed (Jodha, 1986; Menon and Vadivelu, 2006). These two districts were purposively selected as they are typical of semi-arid and arid regions of the state, respectively and have large sheep population. From each district, one tehsil and from each tehsil, six

villages were randomly selected and from each village five sheep breeders were selected randomly. A total of 60 farmers were surveyed with 30 farmers from each district. The information was collected by personal interview using structured survey schedule during January 2008. The survey schedule contained questions regarding the farm and family background of the farmers, sheep-rearing practices followed by them, the income and expenditure on sheep farming, the changes in production condition of sheep and raw wool, coping mechanisms adopted by farmers and farmers' willingness to pay for participatory pasture development programme.

Contingent Valuation Approach

To examine the factors affecting farmers' willingness to contribute in a participatory pasture development programme, contingent valuation (CV) approach was used (Mitchell and Carson, 1989; Carson, 2000). In our survey, Double Bounded Dichotomous Choice (DBDC) method of CV was employed. For this, a hypothetical situation of implementation of a participatory pasture development programme in which the farmers have to contribute a definite amount of money for grazing was explained to the farmers and their willingness to pay (WTP) was elicited[1]. Here, the initial bid was proposed to the farmers and depending upon the answer to the first bid, a second bid was proposed, which was higher than the first bid for a "yes" response and lower for a "no" response for the initial bid. We denoted the first bid with P*, and the second bid with P^H if it was higher, and with P^L, if it was lower than P*. Accordingly, there were four possible response groups: (G1) respondents who said "yes" to both the bids, so that WTP $\geq$ P^H; (G2) those who said "yes" to the first bid, but "no" to the second bid so that P* $\leq$ WTP < P^H; (G3) those who said "no" to the first, but "yes" to the second bid, so that $P^L \leq$ WTP < P*; and (G4) those who said "no" to both bids, so that WTP < P^L. The bids were distributed randomly in the survey schedules to get the desired variation.

Model

Since the data was collected by using DBDC method, we had two discrete responses from every farmer for the first and second bids. Since the second response was related to the first response, estimating the two responses independently or pooling them

together to estimate a single equation may lead to invalid results (Greene, 1997). Therefore, we used a bivariate probit model to estimate the factors affecting the WTP of the farmers. It included two related equations with jointly distributed normal error-terms as follows:

$$Y_1 = \alpha_0 + \Sigma \alpha_i x_i + e_1 \qquad ...(1)$$

$$Y_2 = \beta_0 + \Sigma \beta_j x_j + e_2 \qquad ...(2)$$

$$Corr\ (e_1, e_2) = \rho$$

where, Y_1 and Y_2 are the binary responses to the WTP questions; x_i and x_j represent socioeconomic and price variables and α and β are the coefficients to be estimated. This model provides information on what variables are crucial for each of the responses to the WTP question. The probability of outcome of bivariate probit model can be expressed as follows:

$$P_{yy} (Yes_1 / bid_1 , Yes_2 / bid_2) = \\ \Phi_2 (wtp_1 > bid_1, wtp_2 > bid_2 , \rho)$$

$$P_{yy} (Yes_1 / bid_1 , No_2 / bid_2) = \\ \Phi_2 (wtp_1 > bid_1, wtp_2 < bid_2 , \rho)$$

$$P_{yy} (No_1 / bid_1 , Yes_2 / bid_2) = \\ \Phi_2 (wtp_1 < bid_1, wtp_2 > bid_2 , \rho)$$

$$P_{yy} (No_1 / bid_1 , No_2 / bid_2) = \\ \Phi_2 (wtp_1 < bid_1, wtp_2 < bid_2 , \rho)$$

where, Φ_2 is the joint bivariate normal cumulative density distribution.

Model Specification

In our analysis we were guided by five sets of factors as regressors— price factor, equity concerns, human endowment, production endowment and agroclimatic endowment. The price (here the bids for pasture development) which was to be directly paid to the implementation agency would affect the demand for the particular method and may prove chief determinant of farmers' decision. The influence of the price factor was captured by including first and second price bids in the regression equations. Based on the theory of demand, we expected a negative sign for these variables. The equity aspect of the benefit sharing of the programme affects the willingness of the farmer to participate.

The distance of the pastureland from the dwelling of a farmer's household was included to capture the equity concerns of the farmers. Analysis of WTP of

the farmers with respect to the distance had shown that the distance reduces the WTP of the farmers for public goods (Biel *et al.,* 1997). Farmers might apprehend that those who were closer to the pastureland would benefit more from the developed pasture. On this premise, we hypothesized a negative sign for this variable on WTP.

Adoption of new methods/ approach is also influenced by the production endowment of the farmers, say in the form of capital or asset holding. The production endowment of a farmer was captured by two factors, viz. size of operational holding and size of sheep flock. In agriculture-based economies, the size of operational holding could be considered as proxy for the wealth of a farmer. The wealth of farmers was expected to have a positive influence on the WTP and therefore we expected a positive sign.

The flock size was hypothesized to influence the WTP positively. It was because the frequency and duration of migration in search of fodder was more for larger than smaller flocks. To avoid the migration, larger flocks might be more intended to contribute to develop local pastures.

The human endowment factors enable the potential participants to understand the new approach, decode the information and thereby help in effective participation in the programme. We considered the family size of a farmer and the membership of farmers in various farm-related organisations or NGOs to exclusively capture the effect of the human endowment factor. It was hypothesized that the membership of farmers in various farm-related organisations would affect the WTP positively. The family size is a proxy for potential household labour supply also (Kshirsagar *et al.*, 2002). Larger families could provide the labour needed for the migration of sheep and it reduces the propensity to develop pastures. Therefore, the family-size was hypothesized to influence the WTP negatively.

The urge to participate in a pasture development programme might also be influenced by the carrying capacity of the existing pastureland which varies across agroclimatic regions (McPeak, 1998). The effect of agroclimatic variation was captured by dummy variable for aridity (1 for arid zone, 0 otherwise). Farmers in the arid zone were hypothesised to have higher prospects of WTP as the fodder scarcity is a severer concern for them than for the farmers of semi-arid zone. Therefore, positive sign was expected for this variable.

Results and Discussion

The general information regarding the farms and household background of the farmers is given in Table 1. The farmers were generally middle-aged and only one-third were literate. Though the average size of operational holding was as high as 6.4 ha, the land was low in productivity due to poor irrigation facility. The average number of livestock with a farmer was 150, of which sheep accounted for nearly 83 per cent.

Perception about Decline of Pastureland

Decline in area under pastureland was widely reported by the farmers (75 per cent) (Figure 1). It was 90 per cent in semi-arid zone and 60 per cent in arid zone. Across different farm sizes, a higher proportion of landless and small farmers reported about the reduction in pastures area in their locality[2]. The small farmers perhaps could perceive the reduction in pastureland area more intensively than their counterparts perhaps due to the higher cost of coping mechanisms for them (see Table 6 also).

Amongst reasons for the loss of pastureland, encroachment of pastureland by the private parties was the major cause (reported by 72 % farmers), followed by allotment of these lands by the government for various other activities (12 % farmers). As reported by many farmers, the economic power and socio-political clout of the encroachers insulate them from the easy access of the law of the land and encourages the like-minded to emulate this. This puts the farmers to bear the brunt of the situation in terms of adverse impact on sheep production.

The quantitative and qualitative decline in the pastureland affected the flock size and its economic performance adversely (Table 2). A significant number of farmers (75-87 %) reported continuous reduction in wool productivity and body weight of the animals in the past 15 years[3]. Nearly 87 per cent farmers also reported reduction in the average age of disposal of lambs. It was 18 per cent in the annual wool yield per adult sheep and 20 per cent in body weight at marketable age (about six months) for male lambs (Table 3). Reduction in the arrival of wool in the markets of Rajasthan has been reported by the State Government also (GoR, 2004). The reduction in age at which the male lambs were disposed for meat purpose was about 52 per cent in the Ajmer district and 41 per

Table 1. Socio-economic characteristics of sheep-rearing households in Ajmer and Bikaner districts

Parameter	Ajmer	Bikaner	Overall
Average age of the farmers (years)	44	47	46
Caste of the farmers (%)			
a. General	3	7	5
b. Backward community	87	77	82
c. SC&ST	10	16	13
Literacy (%)	33	33	33
Membership of organizations (%)	13.3	3.3	16.7
Average size of operational holding (ha)	5.7	7.2	6.4
Main occupation (%)			
a. Agriculture	30	43	37
b. Animal husbandry	67	57	61
c. Business			
Nuclear family (%)	73	63	68
Family size (No.)	9.9	9.2	9.6
Livestock holding size (No.)			
a. Sheep	122	129	125
b. Goat	14	28	21
c. Cattle	2	3	3
d. Buffalo	2	1	1
e. Camel	1	0	0
f. Total livestock	141	161	150
g. Total small ruminants	136	157	147

Source: Field survey by authors

cent in the Bikaner district, leading to considerable loss of animal wealth prematurely. Generally the male lambs are disposed after the age of 6 months, time by which they cross period of maximum growth rate. The average age of sale of male lambs in Ajmer district was only 4.7 months and about 12 per cent of lambs were sold before even attaining the age of three months (Figure 2). Early sale of male lambs has been recognised as a major problem in small ruminant production (GoI, 2007) and is leading to early loss of precious livestock wealth and hampers the prospects of higher meat production. However, in the western part of Rajasthan the animals are disposed off at an older age so as to harvest wool. The wool produced in the arid western part of Rajasthan (particularly from *Magra* breed) is regarded the best carpet grade wool in the world and fetches premium price (Bothra, 2003).
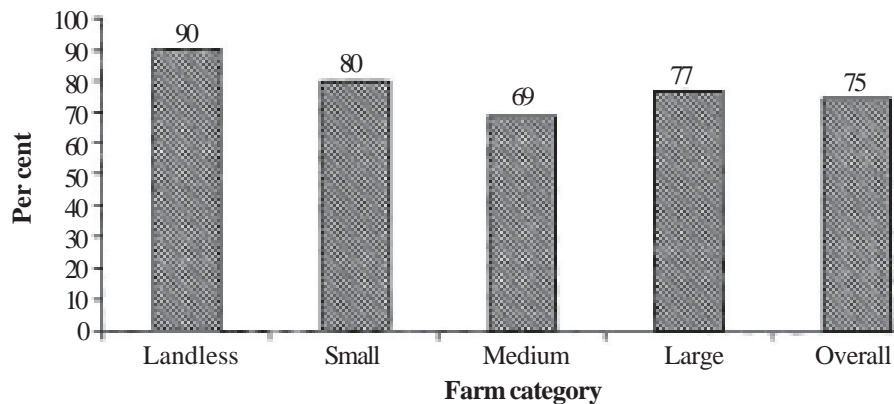
Figure 1. Percentage of farmers reporting reduction of pastures

Table 2. Percentage of farmers reporting reduction in flock performance over years

(per cent)

District	Wool productivity	Body weight	Age of disposal of lambs
Ajmer	76.7	83.3	93.3
Bikaner	73.3	90.0	80.0
Overall	75.0	86.7	86.7

Source: Field survey by authors

Coping Mechanisms

Deterioration of the pastureland had ushered in a set of coping mechanisms (Table 4). The most widely practised measure was the reduction in flock size of sheep. The number of new entrants into the sheep-farming was on a gradual decline. As a result the total sheep population in the state had declined from 16 million in 1997 to 10 million in 2003 (GoI, 2003). Though many other factors including availability of alternate occupations, persistent drought situations, disinterest of the younger farmers to undertake sheep farming
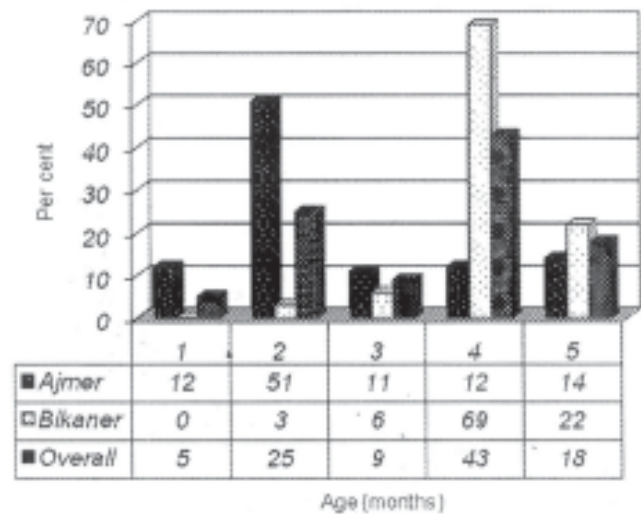

	1	2	3	4	5
■ Ajmer	12	51	11	12	14
□ Bikaner	0	3	6	69	22
■ Overall	5	25	9	43	18

Figure 2. Distribution of age of disposal of lambs

and failure to integrate sheep farming with the crop sector also contributed to this phenomenon, the quantitative and qualitative decline of pastureland was the major reason.

Searching for alternate source of nutrition was another important coping strategy. The major alternative

Table 3. Change in the flock size, wool productivity and age of disposal of lambs

District	Wool productivity			Body weight			Age of lamb disposal		
	Earlier (g/sheep/ year)	Currently (g/sheep/ year)	Change (%)	Earlier (g/sheep/ year)	Currently (g/sheep/ year)	Change, (%)	Earlier (g/sheep/ year)	Currently (g/sheep/ year)	Change (%)
Ajmer	1655	1367	-17.4	14.2	11.2	-21.1	9.7	4.7	-51.9
Bikaner	1605	1312	-18.3	13.4	10.8	-19.6	21.2	12.4	-41.4
Overall	1630	1339	-17.8	13.8	11.0	-20.3	15.5	8.6	-44.7

Source: Field survey by authors
See Note 3 also

Table 4. Coping mechanisms adopted by farmers to adjust with the degradation of pastures

(effective percentage)*

Coping mechanisms	Ajmer	Bikaner	Overall
a. Reduced the total number of livestock	92.3	77.8	86.4
b. Reduced the flock size	53.9	55.6	54.4
c. Started grazing on alternate sources	19.2	44.4	29.6
d. Increased the frequency of migration	46.2	77.8	59.1
e. Increased the duration of migration	26.9	61.1	40.9
f. Reduction of age of sale of animals	86.5	64.0	75.7
g. Any other	11.5	5.56	9.1

Source: Field survey by authors

*based on the number of farmers who reported reduction of the pastureland

sources of green fodder for small ruminants were the harvested land and the fodder trees. We collected information about the number of days the farmers depended predominantly on harvested crop land and on fodder trees (Table 5). It was found that farmers depended on the harvested land for nearly 65 days in a year, which was 20 per cent more than the practice 15 years earlier. Similarly, the dependence on fodder trees for top feed increased by 17 per cent. This has led to indiscriminate lopping of the trees on the fields as well as on the public land. The impact of the changes in the feeding habit was felt more severely by the landless and small farmers as compared to large landholders. This change in the feeding portfolio had affected the cost structure of sheep farming as well. Of the expenditure of Rs 7113/year spent towards cost of feeding for an average flock of 125, the top feeds from fodder trees accounted for 45 per cent (Table 6). The expenditure on top feed was generally higher for small landholders than large landholders, in both absolute and relative terms. Thus, the quantitative and qualitative decline of pastures has led to cost escalation, particularly for landless and small farmers.

Another major adjustment mechanism was the increase in frequency and duration of migration (Table 4). Several sheep breeders who had not migrated earlier, were practising short-term migrations now. The state animal husbandry department has also reported similar trends (GoR, 2004). The number of sheep migrated was around 20 lakh during 1996-97, (14 % of the total sheep population in Rajasthan) (based on 1997 Livestock Census), but it increased to nearly 26 lakh in 2002-03 (26 % of total population) (based on 2003 Livestock Census). Thus, migration of sheep is on increase in absolute number as well as proportions to total sheep population.

Cost and Returns in Sheep Farming

The cost and returns in the sheep farming are summarized in Table 7. The overall total expenditure was Rs 14477 and the gross return was Rs 61089, giving a net return of Rs 46612 for an average flock of 125 sheep. In gross return, the share of animal sale was maximum (74 %), followed by wool (12%), milk (7%) and manure (7%). The net return per sheep was

Table 5. Changes in the dependence of farmers on alternative grazing sources

(No. of days)

District	Harvested land			Fodder trees		
	Earlier	Currently	Change (%)	Earlier	Currently	Change (%)
Ajmer	58	71	22.4	66	70	6.1
Bikaner	51	60	17.7	54	71	31.5
Overall	54	65	20.4	60	70	16.7

Source: Field survey by authors

See Note 3 also

Table 6. Cost of feeding across farmer categories

Category	Fodder tree (%)	Harvested field (%)	Grains (%)	Dry fodder (%)	Concentrate mixture (%)	*Gur* (%)	Oil (%)	Total expenditure (Rs)
Landless	62.0	12.4	0	0	2.1	5.3	18.3	5246
Small	40.2	8.5	0	20.7	15.7	2.5	12.5	8574
Medium	47.1	0.9	1.8	35.9	0.5	0.4	13.4	6332
Large	39.0	0.0	3.5	45.5	3.1	1.2	7.7	8873
Overall	45.2	3.8	1.6	30.7	4.7	1.7	12.3	7113

Source: Field survey by authors

Table 7. Expenditure and net return from sheep farming

Item	Ajmer	Bikaner	Overall
Expenditure			
Feed and fodder (%)	49.9	48.2	49.1
Labour (%)	26.4	34.2	29.9
Veterinary care (%)	14.3	12.1	13.3
Miscellaneous (Rs)	9.4	5.5	7.7
Total expenditure (Rs)	16079	12876	14477
Return			
Animal sale (%)	73.9	74.1	74.0
Wool (%)	9.4	15.0	12.2
Manure (%)	9.3	4.7	7.0
Milk (%)	7.3	6.2	6.8
Gross Return (Rs)	51059	71118	61089
Net return (Rs)	34980	58242	46612
Net return per sheep (Rs)	287	451	373
Flock size	122	129	125

Source: Field survey

higher in Bikaner (Rs 451) than in Ajmer (Rs 287). Such a significant difference was mainly due to the difference in the age of disposal of animals — 5 months in the Ajmer district and nearly 12 months in the Bikaner district. The decline of pasture productivity and change in the age of disposal of lambs had negatively affected the net returns of sheep production. There was a difference in the contribution of wool also; it was Rs 4810 (9.5%) in Ajmer and Rs 10667 (15%) in Bikaner. Such a significant difference was constituted by higher price and higher quantity of wool in Bikaner than in Ajmer district. Among cost items, the major component was feed and fodder (49%), labour (30%) and veterinary care (13%). The pattern of the expenditure was almost same in both the districts. However, the marginal cost of sheep farming was higher in the case of the semi-arid region compared to the arid region. It was largely due to difference in sheep-rearing practices. The farmers in arid region are traditionally migratory and follow transhumance system, whereas those in the semi-arid region are generally sedentary, and follow short distance-short duration migration (Bharara, 1989). Therefore, the cost on feed and fodder is higher for the semi-arid system, pushing up the marginal costs. Decline of the pastures deteriorated the situation. Here, the important optimisation strategy adopted by the farmers was to keep the flocks at a manageable level by disposing the male lambs at a younger age. But, it has resulted in a decline of net return, as could be observed from the Table 7.

Factors Affecting Willingness to Participate in a Pasture Development Programme

The distribution of farmers according to their Willingness to Pay (WTP) for the first and second bids is given in Table 8. Out of the total respondents, nearly 68 per cent farmers were ready to pay the first bid. But of the 68 per cent farmers, 25 per cent were not ready to pay when an increased bid was proposed. Thirty-two per cent farmers responded negatively to the first bid, of which 12 per cent farmers were ready to pay when a reduced bid was proposed. However, 20 per cent farmers were not willing to pay even with a reduced fee. Thus, a wide variation was observed in the farmers' response towards participatory pasture management programme when expenditure is involved. To have a clear view on the factors which influence the WTP of the farmers, a bivariate probit model was estimated and the results are presented in Table 9.

All the estimated coefficients had signs consistent with the expectations, except for the organizational

Table 8. Distribution of farmers according to their WTP

Bid value &Thresholds for grazing (Rs Per 100 sheep)	Y/Y (%)	Y/N (%)	N/Y (%)	N/N (%)	Total number of respondents
Rs 200 (Rs 400 & Rs 100)	80.0	13.3	0	6.7	15
Rs 400 (Rs 800 & Rs 200)	54.6	18.2	9.1	18.2	11
Rs 600 (Rs 1200 & Rs 300)	22.2	44.4	11.1	22.2	9
Rs 800 (Rs 1600 & Rs 400)	16.7	33.3	16.7	33.3	12
Rs 1000 (Rs 2000 & Rs 500)	30.8	23.1	23.1	23.1	13
Overall	43.3	25.0	11.7	20.0	60

Note: "Y" indicates "yes" response and "N" indicates "no" response
Source: Field Survey

Table 9. Estimates of bivariate probit model for willingness to pay

Variables	Description of variables	Mean	Equation 1	Equation 2
Constant	-	-	1.7014 (3.880)	1.4404 (2.8388)
ln BID1	Natural log of initial bid	6.22	-0.9661* (0.5796)	-
ln BID2	Natural log of follow-up bid	6.47	- (0.3669)	-0.8729**
ln DIST	Natural logarithm of distance of the pastureland from the dwelling (km)	0.93	-0.2630 (0.3737)	-0.6400* (0.4030)
FLYSIZE	Family size (No.)	9.55	0.0137 (0.0316)	-0.0472 (0.6520)
ORGMEM	Dummy variable for farmers membership in various organisations (1 for member, 0 otherwise)	0.083	-0.3903 (1.3319)	2.5189 (22.6967)
HOLDING	Operational size of holding (ha)	6.40	-0.0218 (0.0357)	-0.0123 (0.0261)
ln FLOCKSIZE	Natural log of sheep flock size	4.61	1.0547** (0.4707)	1.0095** (0.4821)
ARIDITY	Dummy variable for arid climate (1 for Bikaner and 0 for Ajmer)	0.5	0.7725* (0.4650)	1.3755** (0.5356)
log likelihood function			-54.30	
Rho			0.97*** (0.28)	

Notes: ***, ** and * indicate significance at 1 per cent, 5 per cent and 10 per cent levels, respectively.

   Figures within the parentheses indicate standard errors

   Natural logarithm of the variables for distance and flock size has been used to reduce extreme variations.

membership of farmers, operational size of holding and family size. However, the coefficients were not significant for these variables. In line with the theory of demand, the bid values (logarithm) had a significant negative effect on the WTP for both the bids. This clearly indicated that the farmers were sensitive to cost aspects while participating in a public utility programme.

Therefore, extensive efforts may be needed to educate and motivate the farmers as well as to provide institutional support to involve them in participatory pasture development programme.

   The distance of the pastureland from the dwelling had a negative impact on the WTP (with weak

significance), probably due to the apprehension of the farmers that those who were proximate to the pastureland would be benefited more than farmers at farther places.

Among the personal endowment variables, the family size of the farmers and their membership in farmers' organisations did not have a significant impact on the WTP. The variable for the flock size was positive and significant as expected. The farmers with large flock had to travel long distances in search of fodder and often had to undertake migration. In the study it was observed that while only 20 per cent of the small farmers undertook migration, it was 58 per cent and 100 per cent for medium and large farmers, respectively. Development of pastures in the locality itself helps in reducing the frequency and duration of migration, thereby reducing the drudgery of sheep farming.

The operational size of holding retained a negative sign for both the first and second bids, contrary to the expectations. But it was statistically insignificant, probably due to the fact that as the asset position of the farmers would improve, they would get the opportunity to access alternate fodder sources. This reduces the incentive for pasture development. The dummy variable for aridity had a positive sign for the WTP of the farmers, as per the expectation. As explained in the methodology part, this might be because the farmers in the arid zone were facing greater difficulties in grazing their sheep due to low carrying capacity compared to the farmers in the semi-arid regions and therefore they were ready to contribute more to pasture development programme.

Conclusions

Quantitative and qualitative decline of common pastureland has been found to affect the economic performance and sustainability of sheep production in the semi-arid and arid regions. The farmers have pointed out the encroachment by the private parties to be the most important reason for reduction of pastureland, which calls for immediate attention of the government. The decline of the pastureland has led to a significant reduction in the body weight and wool yield of animal. The coping strategies adopted by the farmers are tedious and calls for research and development support in terms of providing quality animal feeds at affordable price, minimizing the socio-legal hurdles faced by the

migratory sheep flocks and incentives for restricting early disposal of lambs. Efforts to improve the production and productivity of sheep farming are on progress in Rajasthan. Improvement of the pasture productivity has to be incorporated as an important component in these efforts. Participatory pasture management with beneficiary contribution is considered as an appropriate step to conserve the pasture and augment productivity. The participation in such programmes is sensitive to net individual benefits and therefore this aspect has to be taken into account while fixing the beneficiary contribution. The concerns regarding the inequitable distribution of benefit affect farmers' participation in such programmes negatively. Allaying these concerns bears the key role in ensuring the success of the programme.

Notes

(1) The question used for collecting data under DBDC format of WTP was as under:

Suppose some reliable agency is willing to develop the pastureland so that the pasture productivity would be increased for use of the livestock. The management of the improved pasture will be rested with the management committee formed by the villagers themselves with the active co-operation of the implementing agency. The cost of development of the pasture would be collected as grazing charge/fee from the villagers who would like to graze their animals in the developed area. The charge/fee towards this can be made in the form of money at the start of every year. Are you willing to pay the following amount for grazing your sheep for one year? (The initial bid asked was to the farmers at the rate of Rupees per 100 sheep for easy comprehension)

(2) The farmers having operational holding of 0 ha, < 2 ha, 2-10 ha and > 10 ha were classified as landless, small, medium and large farmers, respectively.

(3) The farmers were asked to compare various parameters of sheep production followed currently with those 15 years ago, based on their recall. The term "earlier" used in the Tables and text indicates the figures 15 year ago.

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