

ECONOMIC ANALYSIS OF MILK PRODUCTION ON RANGE LANDS IN EXTREMELY ARID DISTRICTS OF WESTERN RAJASTHAN

JAGDEESH C. KALLA, G.N. BHATI, R.S. MERTIA AND A.K. BAWA

Central Arid Zone Research Institute, Jodhpur-342 003

ABSTRACT

The milch-productivity of Tharparkar and Rathi herds kept at Chandan (Jaisalmer district) and Beechwal (Bikaner district) range-lands in extreme arid conditions was evaluated by production function and project evaluation techniques. Despite variations in productivity performances due to breed and spatial factors, the herd size, quantity of fodder grazed and supply of concentrates turned out to be important determinants of milk production at both the locations. The results of measures of project evaluation revealed sound resilience and economic viability of milk production system on improved grasslands at the selected locations. The results conclusively established grassland development programme as a precondition to optimize milk production in arid areas.

INTRODUCTION

Skewed and inadequate rainfall, high wind velocity, high solar incidence, sandy and salinity-prone soils, rocky outgrowths, lack of perennial sources of irrigation contribute to instable and risky productivity performance of the agrarian sector in the desertic region of western Rajasthan. The 11 districts of the region are grouped into four zones (Mann and Singh, 1977).

This study pertains to area representing extremely arid zone receiving, on an average, less than 300 mm rainfall annually. The zone sustains about 16 per cent of arid zone's human population and 29 per cent of its adult cattle units in 49 per cent of its total area (Mann et al., 1977). The landuse classification, on long term basis (1956-83) reveals that about 78 per cent of the area in the region is uncropped (forests 0.40%, barren and uncultivables 19.02%, permanent pastures 3.14%, cultivable wastes 40.34%, long and short fallows 14.74%) which offers vast grazing area having practically no internal costs of maintenance and production. Thus livestock farming is a major agrarian activity in this region.

Milk production is one of the most important constituents of livestock product-mix in extremely arid tract comprising districts of Jaisalmer, Barmer and Bikaner. The value contribution of milk in the total livestock product-mix exceeds 60 per cent

Table 1. Milk production functions and related magnitudes for Rathi breed at Beechwal (Bikaner) and Tharparkar breed at Chandan (Jaisalmer) in arid western Rajasthan, 1977-82

Location	Intercept	Herd size (X_1)	Concen- trates (X_2)	Fodder Value (X_3)	Human labour (X_4)	Medicines & Misc. (X_5)	Fixed capital (X_6)	Season Dummies		R^2
								Lean S_1 (X_7)	Lateral S_2 (X_8)	
Bikaner (n=47)	-399.3456	161.3464**	1.8378**	0.7415 (3.2594)	-1.9690 (2.0443)	0.7352 (1.6362)	0.2229 (4.3495)	-357.7474*	-200.4554 (188.2918)	0.7582
Chandan (n=55)	-316.478	209.6202**	-0.0360	+12.3651** (4.6483)	0.7534* (0.4728)	0.9514 (0.7434)	0.0171 (17.9662)	-0.1899 (94.1868)	-0.1004 (94.8030)	0.9085
		1.6570	-0.0106	+08.182	01.212	0.0557	-0.2543	-0.0406	0.0088	0.8969

** Significant at $P = 0.01$, * Significant at $P = 0.05$

The results revealed that explained variance contributed by fodder production was positive in both cases although its statistical significance was restricted to only Tharparkar animals at Chandan (Jaisalmer). Similarly concentrates had positive and significant contribution for milk production by Rathi animals kept at Beechwal (Bikaner). Only herd size was uniformly positive and had significant contribution in explaining variance in milk production by both Rathi and Tharparkar animals.

Further, in order to check for any bias in the results arising out of multicollinearity (Johnston, 1963), the data were subjected to correlation analysis. The results are set out in Table 2.

A perusal of Table 2 would reveal that winter season dummy (S_3) was related almost to all other variables excepting other season dummies. Besides, heavy degree of association was also discernible for (X_{1ij}, X_{6ij}) , (X_{4ij}, X_{6ij}) , (X_{1ij}, X_{4ij}) , (X_{2ij}, X_{4ij}) , (X_{3ij}, X_{4ij}) , (X_{1ij}, X_{2ij}) . Since X_9 was eliminated to be absorbed into intercept to avoid dummy trap (Rao and Miller, 1972), all others were retained because multiple correlation R exceeded almost all correlation coefficient that were generated for the individual variates in function. It was thus concluded from examination of the correlations that results of production functions would not be affected adversely by the existing amount of multi-collinearity.

Long-term Structure of Costs and Returns

Capital as well as variable costs incurred on the maintenance of milch herds for production of milk were maintained on daily basis on farm records. The same were converted into yearly basis which are presented in Table 3. Amongst capital costs, the bulk of costs at both locations constituted purchase of animals. The variable costs, however, were more or less evenly distributed between concentrates, grazier charges i. e., labour costs and grazing fee reflecting forage consumption by animals at the two locations. On long-term basis for the five year period, highest costs were incurred on grazing fee for Rathi cows which was followed by expenditure on concentrates, and labour charges. Similarly, for Tharparkar herd, labour cost ranked highest which was followed by expenses on grazing fee, and concentrates.

The returns in the present context included value of milk, manure and selling of culled animals. The results are set out in Table 4. The perusal of Table 4 would reveal that manure in initial year and animal selling in terminal year formed the major revenue generating activities in case of both herds at the two locations. However, of the total revenue accrued, milk production contributed about 50 per cent of the total benefits. This was followed by animal selling and manure for Rathi herd and manure and animal selling for Tharparkar herds. Finally, for the five year period, whereas Rathi herd contributed over Rs. 98000, the same was over Rs. 90000 for Tharparkar herd.

Table 2. Inter-correlation between determinants of milk production for the herds of Rathi at Beechwal (Bikaner) and Tharparkar at Chandan (Jaisalmer), 1977-82

	Herd size (X ₁)	Concentrates (X ₂)	Fodder grazed (X ₃)	Human labour (X ₄)	Medicines & Misc. (X ₅)	Fixed capital (X ₆)	S ₁ (X ₇)	S ₂ (X ₈)	S ₃ (X ₉)
X ₁	R 1	0.5007**	-0.1640	0.9784**	-0.0485	0.9733**	0.0222	0.0209	0.4925*
	T 1	0.8270**	0.9881	0.7657**	0.1936	0.4158	-0.0274	0.0186	0.9339**
X ₂	R	1	-0.1199	0.4822*	-0.0533	0.4794	-0.2491	0.3309	0.8474**
	T	1	0.8028**	0.7211	0.1865	0.4007	0.0269	0.1835	0.7909**
X ₃	R		1	-0.1555	-0.1568	-0.1755	-0.1219	-0.0622	-0.0728
	T		1	0.7156**	0.2071	0.3985	0.0089	0.0068	0.8983**
X ₄	R			1	-0.0797	0.9487**	0.0614	-0.0514	0.4585*
	T			1	0.2357	0.4969*	-0.0864	0.1198	0.8019**
X ₅	R				1	0.0132	0.2304	-0.0508	-0.0408
	T				1	0.2379	0.0771	-0.0200	0.2244
X ₆	R					1	0.0449	-0.0309	0.4770
	T					1	0.0363	-0.0866	0.4044*
X ₇	R						1	-0.4841*	-0.3409
	T						1	-0.4995*	-0.1052
X ₈	R							1	0.2743
	T							1	0.0969
X ₉	R								1
	T								1

** Significant at P = 0.01 ; * Significant at P = 0.05.

Table 3. Cost structure for the herds of Rathi at Beechwal (Bikaner) and of Tharparkar at Chandan (Jaisalmer), 1977-82

Particulars	Years											
	1977		1978		1979		1980		1981		1982	
	R	T	R	T	R	T	R	T	R	T	R	T
CAPITAL COSTS												
1. Shed	100	—	100	16	100	16	100	16	100	16	100	16
2. Animal	9000	—	5500	8625	—	430	—	—	—	—	—	—
VARIABLE COSTS												
1. Concentrates	—	—	—	—	5780	5	8236.90	188	6040	2729	474.50	4547
2. Medicines	—	—	—	—	100	—	100	100	100	350	—	360
3. Grazier charges	1233	—	3285	1620	3285	3285	3285	3285	3285	6570	810	6570
4. Grazing fee*	1200	—	3920	1105	5340	2280	7380	2160	8640	2280	2400	3600
5. Misc.	—	—	—	—	300	—	—	200	—	16.50	—	26.50
Total :	11533	—	12805	11366	14905.45	6066	19101.90	5949	18165.65	11961.56	3784.50	15119.90

(R = Rathi; T = Tharparkar).

* Prevalent grazing fee of Rs 30.00 and Rs 10.00 per adult animal per month treated as monetary proxy for forage consumed by animals at Bikaner and Jaisalmer locations respectively

Table 4. Return structure for the herds of Rathi Beechwal (Bikaner) and Tharparkar Chandan (Jaisalmer), 1977-82
(R=Rathi; T=Tharparkar)

Particulars	Years												Total	
	1977		1978		1979		1980		1981		1982		R	T
1. Manure*	1000.00	3000.00	1800.00	4400.00	3600.00	6000.00	4800.00	7500.00	5400.00	2000.00	7200.00	23900.00	27000.00	
2. Milk*	—	—	—	15175.84	—	16372.58	—	15151.10	7298.35	—	17241.40	46699.52	41110.75	
3. Sale of animal.	—	—	—	—	—	—	—	—	—	—	27515.00	27515.00	22819.00	
Total	1000.00	3000.00	1800.00	19575.84	3600.00	22372.58	4800.00	22651.10	12698.35	29515.00	24441.40	98114.52	90929.75	

*Manure evaluated @ Rs 10.00 per q and milk @ Rs 2.00 per kg

Economic Viability

Five criteria viz. Net Present Value (NPV), Discounted Benefit-Cost Ratio (DB-CR), Annuity (A), Internal Rate of Return (IRR) and Pay-Back Period (PBP) were employed to test the economic viability of milk production by Rathi and Tharparkar herds, respectively at Beechwal (Bikaner) and Chandan (Jaisalmer) sites. The results are set out in Table 5.

Table 5. Measures of economic viability of the herds of Rathi at Beechwal (Bikaner) and Tharparkar at Chandan Jaisalmer 1977-82.

Attributes*	Herds	Discounting Rates				
		10%	14%	20%	30%	40%
NPV (Rs)	Rathi	5365.00	2371.70	-875.50	—	—
	Tharparkar	13188.00	9163.00	4738.00	212.00	-2221
DB-CR ratio	Rathi	1.09:1	1.05:1	0.98:1	—	—
	Tharparkar	1.30:1	1.24:1	1.14:1	0.08:1	0.89:1
Annuity	Rathi	1232.20	610.00	-263.00	—	—
	Tharparkar	3028.00	2356.74	1424.96	80.24	-1024.92
IRR (%)	Rathi	—	—	18.38	—	—
	Tharparkar	—	—	—	30.87	—
PBP	Rathi	6th year				
	Tharparkar	5th year				

*NVP=Net present value (Rs.); DB-CR=Discounted benefit—Cost Ratios; A=Annuity (Rs.); IRR=Internal Rate of Return (%).

It can be seen from the results presented in Table 5 that NPV stood at more than Rs. 13,000 for Tharparkar and more than Rs. 5,000 for Rathi herd at 10 per cent discounting. Whereas negative NPV for Rathi herd was obtained at 20 per cent discount, the same for Tharparkar herds was attained at 40 per cent discounting. These variations notwithstanding, the NPV at 14 per cent discounted have been positive for both (Rs. 9163.00 for Tharparkar and 237.00 for Rathi) herds. DB-CR ranged from 1.30:1 at 10 per cent discount to 0.89:1 for Tharparkar herd at Chandan (Jaisalmer). However, the same for Rathi herd at Beechwal (Bikaner) ranged between 1.09:1 for 10 per cent discount to 0.98:1 at 20 per cent discount. At 14 per cent discount rate, both herds generated approximately rate of return amounting to 24 per cent (Tharparkar herd) to 5 per cent (Rathi herd). Similarly, Annuity was positive and more than Rs. 2,000.00 and Rs. 610.00 respectively for Tharparkar and Rathi herd. These magnitudes although showed Tharparkar herd to advantage, both herds turned out to be economically viable. In the final analysis of IRR greater than 14 per

cent in both cases and PBP for not more than 6 years conclusively proved that the long term investment was endowed with strong financial viability of the herd management at both sites.

Sensitivity Analysis

All the five criteria employed to evaluate comparative economic viability of the two herds are based on the assumption of constancy in input as well as output prices, quantity and quality of output and market availability. All these physical, biological and economic factors are seldom constant in dynamic context of productive activity. To circumvent this problem the cost flows were subjected to sensitivity analysis. In the present context six discrete levels were constructed which would reflect downward and upward shifts in cost flow structures. The results are set out in Table 6.

Table 6. Comparative sensitivity of economic attributes for Rathi and Tharparkar herds in arid region of western Rajasthan

Situations	Herds	Economic attributes at 14% discount				
		NPV (Rs)	DB-CR Ratio	A (Rs/yr)	IRR (%)	PBP (yrs)
I. 10 per cent increase in costs without any increase in returns	Rathi	-2876.00	0.95:1	-740.00	9.81	5
	Tharparkar	5310.00	1.12:1	1365.00	23.87	5
II. 10 per cent increase in returns without any increase in costs	Rathi	7857.00	1.15:1	2020.80	28.02	5
	Tharparkar	13929.00	1.36:1	3580.00	38.84	4
III. 10 per cent increase in both costs & returns	Rathi	2610.00	1.04:1	671.00	18.38	5
	Tharparkar	10076.00	1.24:1	2590.00	30.87	5
IV. 10 per cent decrease in costs without any change in returns	Rathi	7681.00	1.16:1	1959.00	28.69	5
	Tharparkar	13012.00	1.38:1	3345.00	39.49	4
V. 10 per cent decrease in returns without any change in costs	Rathi	-3115.00	0.94:1	-801.00	9.81	5
	Tharparkar	4397.00	1.11:1	1130.00	22.99	5
VI. 10 per cent decrease in both costs and returns	Rathi	2132.00	1.04:1	548.00	18.38	5
	Tharparkar	8246.00	1.24:1	2120.00	30.87	5

A perusal of Table 6 would reveal two extreme situations of losses and profits. While situations II and IV represent increase in value added by project, situation I and V represent decline in value added. Similarly situations III and IV represent upward and downward neutral shifts which would essentially produce similar results.

If pessimistic view is taken into account as warranted by situation I and V, Rathi herd would be characterised by negative NPV, DB-CR and A, low IRR (9.81%). Under the same situation Tharparkar herd is likely to be characterised by positive and comparatively higher magnitudes of all attributes including a high (23.87) per cent IRR. Similarly under the optimistic set of circumstances Rathi herd would generate higher NPV, DB-CR (15 per cent), A (Rs. 2020) and IRR (28.02%). Tharparkar would have much higher magnitudes of these attributes leading to 36 per cent DB-CR and about 39 per cent of IRR. The results conclusively reveal that Rathi herd would comparatively be more sensitive to changes in externalities as well as internalities. For, in case of Rathi from scarcity oriented IRR of about 10 per cent the same could shoot upto 28 per cent under optimal conditions. The same for Tharparkar ranges from 23-39 per cent. It can thus be concluded that Tharparkar herd is more stable than its Rathi counterpart. Despite variations, PBP under all circumstances did not vary sizeably. It can thus be conclusively established that both Rathi and Tharparkar herds would be economically viable. However, later would be more stable under extreme conditions.

Conclusion and Policy Implications

The results presented in the present study conclusively reveal that size of herd as well as fodder availability play crucial role in milk production under extremely arid conditions. The viability analysis further revealed that on long-term basis, maintenance of both Tharparkar and Rathi herds are economically viable. It thus follows that if livestock farming is preceded by grass farming for provision of sure and adequate supply of fodder, the milk production would assume desirable growth-oriented economic viability. Such situation would be motivational if both fiscal and policy instruments in the State are geared to make grass growing and livestock production comparatively advantageous. Unless a double pronged strategy of fiscal and monetary encouragement is followed, milk production in the region would continue to lose its traditional economic edge over other agrarian enterprises in the arid region of western Rajasthan.

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