RESOURCE PRODUCTIVITY AND CONCENTRATION IN MILK PRODUCTION IN CATTLE AND BUFFALOES AROUND KARNAL (HARYANA)

S.B. AGARWAL, R. K. PATEL and P. KUMAR*
National Dairy Research Institute, Karnal

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SUMMARY

The relative importance of dairy inputs in milk production and inequalities in milk production pattern in different orders and stages of lactation for cows and buffaloes are dealt with. The concentration ratio and milk production function techniques are used to attain the objectives of the study. Better feeding and management practices of bovines can increase the milk production of bovines. Increasing levels of concentrates will contribute to the productivity. In order to obtain precise estimates of supply of milk, and its cost of production due weights should be given to species, order and stage of lactation of bovines.

Introduction

The milk production potential varies in different lactations and is the net outcome of feeds, management genetic and environmental effects. Lactation-wise studies of production function and concentration in milk production assume considerable significance (Kumar *et al.* [4]). Some of the studies on feed-milk relationship, conducted in the past, utilised the data on organised dairy farms which had limited applicability under average farming conditions. The present study is based on the data maintained by milk producers under the village management conditions and has been undertaken with the objectives (i) to examine milk production pattern and concentration in milk production (ii) to study input-output relationship for milk production and resource productivity and (iii) to study the effect of dairy management on milk yield of cows and buffaloes.

*Scientist S—3 (Agril. Econ.), Division of Ag. Econ., IARI, New Delhi-110012.

2. Materials and Methods

2.1 The data for the present study were taken from the survey conducted around Karnal during 1972-74 to study bovine development and milk production. A multistage stratified random sampling was adopted for recording the data on milk yield, feeds and fodder and dairy management practices. The data on milk yield was collected by actual weighment while data on fodders and feeds consumed per day per animal and on management practices followed by milk producers for bovines were collected by oral enquiry and relates to the day of visit.

2.2 *Concentration Ratio (C.R.)*

The following concentration curve technique was used to work out inequalities in milk production pattern for cows and buffaloes in different orders and stages of lactation.

$$Y_i = b_1 p_i + b_2 p_i^2 + U_i$$

i refers to classes of milk production levels, Y_i is the cumulative percentage share of total production in ith class, p_i is cumulative percentage of milking animals in the ith class, U_i is random error, b_1 and b_2 are the least square estimates of parameters of concentration curve. The concentration ratio is given by

$$C.\,R. = 1 - b_1 - \frac{200}{3} b_2$$

2.3 *Milk Production Functions*

Feeds and fodders have been consistently observed as the most important input in milk production (Jacob *et al.* [2], Kumar *et al.* [3], Kumar and Singh [5]). The dairy management is also postulated a crucial factor which influences the milk production of the milch stock. It is therefore important to evaluate the effect of better dairy management on milk yield. Dairy Management index was constructed on the basis of feeding, breeding and management practices followed by the milk producers for dairy animals. The factors identified and score assigned to each factor are listed in the Appendix I. This management index has been included as one of the explanatory variables in the milk production function. Though the stage of lactation is not a resource but the inclusion of it in the milk production function will help in providing an unbiased estimate of the resource productivity in milk production. This led to the following type of milk production functions:

$$\text{Linear} : Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + U$$

$$\text{Cobb-Douglus} : Y = a\,x_1^{b_1}\,x_2^{b_2}\,x_3^{b_3}\,x_4^{b_4}\,x_5^{b_5}\,U$$

Where Y is the daily milk yield in kg per milking animal, x_1, x_2 and x_3 are the daily expenditures in Rs. on green fodder, dry fodder and concentrates respectively, x_4 is dairy management index and x_5 is the stage of lactation in months and U is random error.

3. Results and Discussions

3.1 *Milk Yield and Concentration in Milk Production pattern*

The average daily milk yield and concentration ratios for different orders and stages of lactation both for cows and buffaloes are presented in Table-1 and the concentration curves have been presented in the Appendix II.

TABLE 1 — AVERAGE DAILY MILK YIELD (KGS) AND CONCENTRATION RATIOS FOR DIFFERENT ORDERS AND STAGES OF LACTATION

Species	*Stages of lactation*	*Order of lactation*				
		1	*2*	*3*	*4*	*5 and above*
Cows	Upto 3 months	3.66 (0.26)	3.63 (0.16)	4.01 (0.23)	3.46 (0.30)	—
	3-6 months	3.60 (0.25)	3.16 (0.32)	3.31 (0.30)	2.47 (0.34)	—
	Above 6 months	2.10 (0.41)	2.19 (0.68)	1.72 (0.38)	1.78 (0.55)	—
	Overall	3.16 (0.31)	2.94 (0.28)	3.00 (0.35)	2.57 (0.37)	—
Buffaloes	Upto 3 months	5.54 (0.16)	6.05 (0.20)	5.79 (0.17)	5.71 (0.17)	5.29 (0.21)
	3-6 months	4.96 (0.19)	5.10 (0.13)	5.27 (0.16)	5.17 (0.18)	4.51 (0.22)
	7-9 months	3.42 (0.22)	4.04 (0.25)	3.78 (0.22)	3.83 (0.21)	3.44 (0.21)
	Above 9 months	2.30 (0.35)	2.30 (0.25)	2.57 (0.20)	2.46 (0.26)	1.97 (0.33)
	Overall	4.45 (0.25)	4.50 (0.32)	4.57 (0.22)	4.24 (0.26)	3.54 (0.10)

Note. Figures in parenthesis are the concentration ratios.

The average daily milk yield increased upto 3rd lactation for buffaloes thereafter it declined. In case of cows no trend was discernable. As the stage of lactation advanced, the milk yield generally decreased both for cows and buffaloes. Inequalities in milk production pattern were observed both for cows and buffaloes in different orders and stages of lactation. These were higher for cows as compared to buffaloes. This suggests the need for intensifying the cattle improvement programmes for high yields in the region. Thus to obtain the precise estimates of supply of milk, cost of production of milk due weight be given to the species, order and stage of lactation.

3.2 *Milk Production Function*

Linear and log linear regression models were fitted to study input-output relationship. The linear function explained more variation compared to the log linear model and was therefore used for further analysis. The least squares estimates for different order of lactations for linear model are presented in Table-2 both for cows and buffaloes.

Feeds and fodders, dairy management and stage of lactation together explained 41 to 43 percent variation in milk yield for cows and 42-56 percent for buffaloes in different order of lactations. The estimated equations were found to be statistically significant at 5 percent level of significance indicating goodness of fit to the data. All the regression coefficients of explanatory variables were statistically significant and with the expected signs. Significance of regression coefficient of management index showed that management index has significant effect on milk yield and plays an important role in increasing the productivity of bovines. The concentrates were found to be most important ingradient in milk production followed by greens and dry fodders both for cows and buffaloes. The share of concentrate in total feeds and fodders expenditure was very low. This small share and high marginal physical product revealed that the increasing level of concentrates will augment the milk yield of cows and buffaloes.

3.3 Elasticities and resource productivity

The production elasticities of resources were worked out for comparing the relative importance of various resources used. Production elasticities and marginal value products have been presented in Table-3.

The production elasticities and productivity for inputs were generally higher for cows compared to buffaloes. This implies that milk production for cows can be increased more rapidly compared to buffaloes at the existing level of genetic production potential if proper attention with

TABLE 2—ESTIMATED LINEAR MILK PRODUCTION EQUATIONS

Species	Order of lactation	Constant	Estimated regression coefficients for					R^2
			Green fodder	Dry fodder	Concentrates	Management index	Stage of lactation	
Cow	1	1.9500**	0.0046***	0.0002	0.0142***	0.0253	—0.1922***	42.9
		(0.8153)	(0.0014)	(0.0023)	(0.0030)	(0.0158)	(0.0382)	
	2	0.5352***	0.0053***	0.0026*	0.0130***	0.0432***	—0.1786***	40.9
		(0.6174)	(0.0012)	(0.0015)	(0.0027)	(0.0110)	(0.0238)	
	3	2.6121***	0.0035**	0.0004	0.0103***	0.0234*	—0.2883***	41.7
		(0.7874)	(0.0014)	(0.0022)	(0.0039)	(0.0138)	(0.0358)	
	4	0.7851	0.0047***	0.0064***	0.0094**	0.0353**	—0.2046***	41.1
		(0.7855)	(0.0015)	(0.0019)	(0.0043)	(0.0168)	(0.0358)	
	Overall	1.2162***	0.0045***	0.0026***	0.0119***	0.0359***	—0.2117***	40.5
		(0.3593)	(0.0006)	(0.0009)	(0.0016)	(0.0068)	(0.0158)	
Buffalo	1	1.8909	0.0043***	0.0008	0.0040***	0.0463***	—0.1863***	42.5
		(0.8480)	(0.0009)	(0.0013)	(0.0012)	(0.0147)	(0.0284)	
	2	4.1221***	0.0014**	0.0020***	0.0045***	0.0345***	—0.3379***	55.5
		(0.5883)	(0.0007)	(0.0007)	(0.0008)	(0.0102)	(0.0198)	
	3	4.2614	0.0019***	0.0003	0.0024**	0.0339***	—0.3366***	46.4
		(0.5630)	(0.0007)	(0.0009)	(0.0009)	(0.0097)	(0.0198)	
	4	4.2497***	0.0012	0.0019*	0.0020*	0.0337***	—0.3370***	45.7
		(0.7311)	(0.0002)	(0.0011)	(0.0012)	(0.0127)	(0.0228)	
	5	1.7186*	0.0040***	0.0030*	0.0038*	0.0498***	—0.2358***	49.7
		(1.0084)	(0.0013)	(0.0018)	(0.0018)	(0.0182)	(0.0256)	
	Overall	3.3882***	0.0025***	0.0015***	0.0036***	0.0376***	—0.2850***	46.1
		(0.3156)	(0.0004)	(0.0004)	(0.0005)	(0.0056)	(0.0096)	

***Significant at 1% level of significance; **Significant at 5% level of significance; *Significant at 10% level of significance.
Figures in parenthesis indicate the standard errors of the regression coefficients.

TABLE 3—ELASTICITIES AND MARGINAL VALUE PRODUCTS

Species	*Input*	*Production elasticity*	*Marginal value product* (Rs)
Cows	Green fodder	0.2227	0.45
	Dry fodder	0.0488	0.26
	Concentrates	0.0324	1.19
	Management	0.0123	3.59
Buffaloes	Green fodder	0.1668	0.31
	Dry fodder	0.0585	0.19
	Concentrates	0.0163	0.45
	Management	0.0086	4.70

regard to feeds and management be given to cows. The elasticities of production were highest for green fodder followed by dry fodder, concentrates and minimum for management component both for cows and buffaloes. The production elasticity of management is estimated 0.0123 for cows and 0.0086 for buffaloes. The marginal value of management suggest that the milk producer can efford the management cost (per point of index) upto Rs. 3.59 for cows and Rs. 4.70 per buffaloes. The marginal value product and price ratios of feeds and fodders were observed to be less than expectation for concentrates in cows. This revealed that the expenditure was more on feeds and fodders in comparison to their contribution in milk production and hardly any scope was left for increasing the milk yield through green and dry fodders on economic grounds. The only way of increasing the productivity remained through adoption of improved dairy husbandry programmes which can add to the genetic production potential in milch stock. Thus the reallocation of feed resources and better dairy management practices can play a significant role in increasing the milk production of milk stock.

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APPENDIX-I

FACTORS OF DAIRY MANAGEMENT AND SCORES ASSIGNED

Factors			*Score*
1. Number of times fed	—	One time	1
		two times	2
		three times	3
2. Type of feed	—	Green fodder	3
		Dry fodder	1
		both	2
3. Animals fed	—	Individually	2
		Group	1
4. Concentrate fed	—	No	0
		Yes	1
5. Form of fodder	—	Chaffed	2
		unchaffed	1
6. Minerals	—	Not fed	0
		fed	1
7. Stall well ventilated	—	Yes	1
		No	0
8. Sanitary condition of stall	—	Very clean	3
		Clean	2
		Not clean	1
9. Drainage of the stall	—	Good	3
		average	2
		poor	1
10. Shading provided during summer	—	Yes	1
		No	0
11. Veterinary facilities	—	Availed	1
		not availed	0
12. Artificial insemination facilities	—	Used	1
		not used	0
13. Bull used for service	—	Improved	1
		local	0

APPENDIX-II

ESTIMATED FITTED CONSTANTS OF CONCENTRATION CURVES FOR COWS AND BUFFALOES

Species	*Stages of lactation*	*Order of lactation*									
		1		*2*		*3*		*4*		*5 & above*	
		Linear Component	*Quadratic Component*	*Linear*	*Quadratic*	*Linear*	*Quadratic*	*Linear*	*Quadratic*	*Linear*	*Quadratic*
Cows	Upto 3 months	0.2312	0.0076	0.5458	0.0044	0.3261	0.0067	0.1529	0.0082	—	—
	3-6 months	0.2554	0.0074	0.0895	0.0089	0.1115	0.0089	—0.0132	0.0101	—	—
	Above 6 months	—0.2031	0.0119	—0.0557	0.0056	—0.1159	0.0111	—0.7035	0.0173	—	—
	Overall	0.0868	0.0091	0.0660	0.0092	0.0056	0.0099	0.0558	0.0103	—	—
Buffaloes	Upto 3 months	0.5109	0.0048	0.4365	0.0054	0.5099	0.0048	0.5050	0.0049	0.3860	0.0060
	3-6 months	0.4430	0.0055	0.6128	0.0038	0.5291	0.0046	0.4810	0.0051	0.3869	0.0060
	6-9 months	0.3768	0.0060	0.0473	0.0106	0.3758	0.0061	0.4163	0.0056	0.1857	0.0080
	Above 9 months	—0.0023	0.0097	0.2469	0.0075	0.4188	0.0058	0.2370	0.0075	0.0391	0.0095
	Overall	0.2511	0.0074	0.0101	0.0101	0.3478	0.0064	0.2540	0.0073	0.9669	—0.0011

Constants of Concentration curves for estimating the concentration ratio to measure inequalities in milk production pattern: