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APPENDIX 1

YIELD PER ACRE OF VARIOUS ENTERPRISES IN THE STUDY AREA, PUNJAB : 1974-75 AND PRODUCT PRICES USED FOR THE DEVELOPMENT OF INPUT-OUTPUT MATRICES

Enterprise	Average yield at existing level (quintals)	Yield at optimum level (quintals)	Product prices (Rs./quintal)
1. Maize (hybrid)	7.88	16.00	76.00
2. Paddy (IR-8)	29.00	30.00	76.00
3. Cotton (*desi*)	3.00	6.00	225.00
4. Groundnut	5.25	8.90	200.00
5. Sugarcane	236.00 (cane)	360 (cane)	12.00
6. Wheat	14.75	17.00	113.00
7. Barley	8.00	11.50	100.00
8. Gram	5.00	6.00	200.00
9. *Metha*	3.00	—	—
10. Dairy enterprise			
(*a*) Buffalo	1,080 litres (1,620 litres/lactation)	1,200 litres/year (1,800 litres/lactation)	Rs. 1.75 per litre of buffalo's milk
(*b*) Cross-bred cow	1,764 litres (2,205 litres/lactation)	2,000 litres (2,500 litres/lactation)	Rs. 1.50 per litre of cow's milk

LACTATIONWISE PRODUCTION FUNCTION AND CONCENTRATION IN MILK PRODUCTION FOR HARYANA COWS

P. Kumar, R. K. Patel and K. C. Raut*

INTRODUCTION

Milk production is a complex process and can be conceived as a function of several variables. The knowledge of relative importance of the resource inputs influencing milk production is essential for the dairy farmer for introducing desirable changes in his operation at the micro level and for the policy-maker for formulating plans for improvements in dairy cattle productivity based on sound economic principles at the macro level. Although few studies have been undertaken in the country to assess the resource productivity, milk production functions were not ascertained for different individual lactations.[1] The milk production potential varies in different lactations and is the net outcome of the genetic and environmental effects. Thus the lactationwise studies on input-output relationships in milk production assume considerable

* Assistant Professor, and Head, Division of Dairy Economics, Statistics and Management, National Dairy Research Institute (I.C.A.R.), Karnal, Haryana, and Statistician-cum-Associate Professor, Institute of Agricultural Research Statistics, New Delhi, respectively.

1. For example, see (*i*) T. Jacob, R. K. Srivastava and V. N. Amble, "A Study on Resource Productivity in Milk Production," *Indian Journal of Agricultural Economics*, Vol. XXVI, No. 1, January-March, 1971, (*ii*) T. Jacob, V. N. Amble, M. L. Mathur and A. Subba Rao, "Milk Production Functions and Optimum Feeding Schedules," *Indian Journal of Agricultural Economics*, Vol. XXIV, No. 2, April-June, 1969, (*iii*) P. Kumar and K. C. Raut, "Some Factors Influencing the Economy of Milk Production," *Indian Journal of Agricultural Economics*, Vol. XXVI, No. 2, April-June, 1971, (*iv*) Ghansham Dass Aul, *et. al.*, "Milk Production Functions in Ludhiana," *Indian Journal of Dairy Science*, Vol. XXVII, No. 4, December, 1974, (*v*) P. Kumar, *et al.*, "Economic Response of Feed on Milk Production for Different Breeds of Milch Cows," Brief Communication, *XIX International Dairy Congress*, Vol. IE, 1974.

significance. Some of the studies conducted in the past utilized the data generated on organized dairy farms or research institutes. The economic parameters thus obtained from these studies had limited applicability under average farming conditions. The present investigation deals with the relative importance of various inputs in milk production as this pertains to individual lactations of animals on typical farms to generate economic information that will make the farmers aware of the production potentialities of their milch animals. Further, an attempt has been made to study the concentration in milk production according to the order of lactation. Studies on concentration in milk production are especially important in view of the low level of productivity of our milch animals raised under various socio-economic constraints.

DATA AND METHODOLOGY

The data collected from a large-scale survey conducted by the Institute of Agricultural Research Statistics in Hissar district of Haryana State constitute the basis of the study. The survey attempted to estimate the cost of raising young stock and of maintaining adult cattle and buffaloes during 1963-66. A stratified multi-stage random sampling was used for the selection of sample units.

For the present study the data collected on Haryana breed of cows were utilized. The complete data on lactation length, dry period, milk yield, feeds and fodder, labour, depreciation on animals and other miscellaneous expenditure were considered which were available for only 106 cows in different lactations. Under village nanagement conditions, it is absolutely difficult to collect complete information on a large number of animals for a complete lactation which nevertheless remains a serious limitation of such studies.

Economic interpretation of the relationship between milk yield—the dependent variable (y)—and the independent variables ($x_{i's}$) was based on production function analysis. The Cobb-Douglas type of production function of the following specification was estimated using the least squares technique.

$$Y = a x_1^{b_1} \; x_2^{b_2} \; x_3^{b_3} \; x_4^{b_4} \; U$$

where :

Y =average daily milk yield per milch cow in litres,

x_1=average daily expenditure on feeds per milch cow in rupees,

x_2=paid labour costs incurred per milch animal per day in paise,

x_3=value of family labour per milch animal per day in paise,

x_4 =depreciation on cows and other miscellaneous expenditure* per milch animal in rupees,

* Miscellaneous expenditure includes expenses on medicines and other petty recurring expenditure.

U =disturbance term,

a =constant, and

$b_{i's}$=elasticities of production of respective factor inputs.

Concentration curve technique was used to work out the inequalities in milk production pattern for cows in different order of lactations. The concentration curve relates to the proportion of milking cows to the proportion of total milk produced for different levels of milk production. The concentration curve was obtained by plotting the cumulative percentage share of total production against the corresponding cumulative percentages of milking cows population and successively joining these points by a straight line. The magnitude of concentration of a given production pattern was measured in terms of concentration ratio which is twice the area between Lorenz curve and the equalitarian line. The ratios can vary between zero for total equality and one for total inequality.

RESULTS AND DISCUSSION

Milk Production Function

Cobb-Douglas production functions were used for economic analysis. The estimated production equations expressing milk yield as a function of feed, paid labour, family labour and depreciation on cows and other miscellaneous expenditures as they pertain to each order of lactation, are given in Table I.

TABLE I—ESTIMATED PRODUCTION EQUATIONS FOR EACH ORDER OF LACTATION

Order of lactation	Regression equation				
First		0.5743**	0.0680	0.1245	0.2168*
	Y = 0.0359	x_1(0.2803)	x_2(0.1249)	x_2(0.3420)	x_4(0.1224)
	R^2= 0.657 N=40				
Second		0.6178**	—0.0080	0.2696	0.1968*
	Y = 0.0270	x_1(0.2803)	x_2(0.0304)	x_3(0.4398)	x_4(0.1093)
	R^2= 0.533 N=23				
Third		1.4548***	—0.0595	—0.0067	0.2653*
	Y = 0.008	x_1(0.3408)	x_2(0.1963)	x_3(0.0349)	x_4(0.1396)
	R^2= 0.550 N=23				
Fourth		1.2835***	—0.1564	—0.0034	0.2994*
	Y = 0.0036	x_1(0.4183)	x_2(0.1964)	x_3(0.0121)	x_4(0.1663)
	R^2= 0.433 N=20				
Overall		0.5942***	—0.0604	0.1994	0.2441**
	Y = 0.0733	x_1(0.1396)	x_2(0.1297)	x_3(0.3075)	x_4(0.1235)
	R^2= 0.488 N=106				

Note : Figures in parentheses give the respective standard errors of the coefficients.
* Significant at 10 per cent level.
** Significant at 5 per cent level.
*** Significant at 1 per cent level.

A perusal of the fitted production equations revealed that the value of R^2 ranged from 0.43 in the equation for the fourth lactation cows to 0.66 in the case of the first lactation cows, implying thereby that the dairy inputs, namely, feed, labour, depreciation and miscellaneous expenditure taken together explained about 43 to 66 per cent of the total variation in the milk yield.

The regression coefficients of feed (x_1) were all positive and significant. These results, as expected, show the positive response of feed to milk production.[2] The regression coefficients of the Cobb-Douglas type of production function gave the elasticities of milk production directly with respect to various inputs. The elasticity of production was highest for feed of all the other inputs, implying thereby that feed was the major and the most significant factor influencing milk yield. So far as the different lactations are concerned, the production elasticities of feed were elastic for the third and fourth order of lactations whereas they were inelastic for the first and second order of lactation cows. The feed elasticity tended to increase from the first to the third lactation, recording a slight decline in its magnitude in the fourth lactation. It is thus evident that there is relatively greater scope of increasing milk production through manipulation of levels of feed regimes for the cows running in the third and fourth lactations.

The elasticity coefficients of depreciation on cows and miscellaneous items of expenditure (x_4) were also found positive and significant in all orders of lactations. This goes to show that one per cent change in investment on milch cattle would result in 0.22, 0.20, 0.27 and 0.30 per cent change in milk yield of cows in the same direction in the first to the fourth lactation respectively.

The coefficients of labour were observed to be negative in the majority of cases and were not significant. This indicated that additional utilization of labour would go waste instead of giving any additional return in terms of milk yield.

Concentration in Milk Production

The lactationwise cumulative percentage of milking cows and their corresponding cumulative share in total milk production for different levels of milk production have been worked out and presented in Table II. It is evident that the production level upto 799 litres registered a decline in milch cattle population from 67 to 55 per cent as one moves from the first to the fourth order of lactation. On the other hand, in the production groups 800 litres and above, the percentage of cows increased from 33 to 45 as we move from the first to the fourth lactation. It is further evident from Table II that 66.66, 60.86, 60.86 and 55.00 per cent of low yielding (below 800 litres per lactation) animals in the first, second, third and fourth order of lactations

2. Similar results were obtained by T. Jacob, *et al.*, *op. cit.*, *Indian Journal of Agricultural Economics*, January-March, 1971, Table II, p.49. Also see Ghansham Dass Aul, *et. al.*, *op. cit.*, Table I, p. 286.

TABLE II—CONCENTRATION IN MILK PRODUCTION FOR DIFFERENT ORDER OF LACTATION COWS

Lactation yield (litres)	Order of lactation							
	First		Second		Third		Fourth	
	Cumulative % cows in milk	Cumulative % of milk production	Cumulative % cows in milk	Cumulative % of milk production	Cumulative % cows in milk	Cumulative % of milk production	Cumulative % cows in milk	Cumulative % of milk production
Upto 499	25.00	13.03	34.78	16.36	26.08	8.50	20.00	8.00
500-649	41.66	26.60	52.17	29.66	47.82	27.29	40.00	22.77
650-799	66.66	51.09	60.86	38.69	60.86	40.41	55.00	37.03
800-949	74.99	60.12	73.91	54.38	78.26	62.42	65.00	48.73
950-1099	83.32	72.11	82.60	66.55	86.95	74.63	85.00	75.36
1100-1249	91.65	85.75	91.30	80.19	91.30	82.11	90.00	82.91
1250-1399	100.00	100.00	91.30	80.19	91.30	82.11	100.00	100.00
1400 and above ..	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

accounted respectively for 51.09, 38.69, 40.41 and 37.03 per cent of the total milk production. This implies that there are inequalities in milk production pattern for Haryana cows in different order of lactations.

The data in Table I were used to draw the Lorenz curve. The concentration ratio has been worked out with the help of Lorenz curve to measure and compare the inequalities in milk production pattern for cows in different lactations and is presented in Table III.

TABLE III—LACTATIONWISE CONCENTRATION RATIO

Order of lactation	First	Second	Third	Fourth
Concentration ratio ..	0.230	0.302	0.267	0.256

Among the different lactations the second lactation cows exhibited the highest concentration (0.302) in milk production, whereas it was minimum for the first lactation cows. The pattern of milk production for cows in the third lactation was nearly as uniform as that in the fourth lactation. It may, therefore, be inferred that although there are inequalities in milk production pattern from the first to the fourth lactation, for the purpose of estimating the cost of milk production or projecting the supply of milk in a given region, the third and fourth lactation cows could be grouped together.

CONCLUSIONS

The foregoing analysis suggests two major conclusions. First, the milk production functions revealed positive and significant response of feed to milk production. This indicated that feed was the major and the most significant factor influencing milk yield. Further, production elasticities of feed were found to be elastic for the third and fourth order of lactations, implying thereby that dairy farmers had a greater scope of increasing milk production through manipulation of levels of feed regimes for their cows running in these lactations. The regression coefficients of depreciation on cows and miscellaneous items of expenditure were also found positive and significant, broadly indicating that the higher initial investment in milch stock was important for increasing the milk productivity.

Second, the inequalities in milk production pattern were observed for cows in each order of lactation. This suggests that to obtain precise estimates of supply of milk and cost of milk production in a given region, due weightage be given to milch stock in different lactations and production distribution.

GROWTH TRENDS IN BOVINE POPULATION IN HARYANA

R. P. Singh, M. K. Chaudhry and Himmat Singh *

Livestock holds the key to prosperity in an agricultural State and it is a major plank in the foundation of Haryana's economy. Bovine wealth plays an important role next to agriculture in the State. According to the 1966 livestock census, the animal husbandry sector contributed about 13 per cent (Rs. 53.8 crores) to the State's income as against 7 per cent for all-India. The State has a highly developed livestock sector and is famous for its well-known breeds of "Haryana Cows' for producing best quality bullocks and 'Murrah' buffaloes for high milk yield in the country. A large number of cattle and buffaloes are exported every year to other States of the country. Haryana has also the rare distinction of exporting its world famous Murrah buffaloes to South-East Asia, U.S.S.R. and Brazil.

The State comprising of 44,222 sq. km. of area has 2.9 million head of cattle and buffaloes which comes to 65.6 per sq. km. as against the all-India average of only 7.62. Thus, Haryana occupies a significant position on the animal husbandry map of India. Therefore, an attempt has been made to study the growth trends in bovine population in Haryana during 1961-66 and 1966-72 inter-census periods. The specific objective of the study was to find out the various trends in growth rates of different categories of cattle and buffalo population and their projections for future planning.

* Department of Economics, Haryana Agricultural University, Hissar.