

6 DETERMINANTS OF PRODUCTIVITY

Irrespective of whether the past growth is driven by numbers or productivity, the latter is crucial to sustain output growth in the long run. Productivity is mainly defined by the genetic constitution of the animal. The extent to which the genetic potential can be realised depends on quantity and quality of feeding, management, health care, etc. In this section a probe is made into the factors that influence milk and meat yields.

6.1 Determinants of Milk Yield

At the existing level of technology and prevailing organisation of production; there is considerable scope to raise productivity of the milch stock. This is manifested by the difference in actual and attainable yield (Attainable yield varies across breeds. *Amritmahal*, *Hallikar*, *Deoni* and *Khilari* are the prominent cattle breeds in Karnataka. The attainable yield per lactation is reported to be 542 Kgs for *Hallikar*, 880 Kgs for *Deoni*, 215 kgs for *Khilari* and about 500 Kgs for *Amritmahal*. For crossbred cattle the attainable yield is about 3000 kgs per lactation. *Murrah* and *Surti* are the important breeds of buffalo found in Karnataka with milk production potential of about 1600 and 1800 kgs per lactation. For details see, Pundir and Sahai (1997)). Further, there are interregional differences in the adoption of technology and performance of dairy animals (Annex Table V). Notwithstanding interregional differences in production performance, current mean yield of indigenous cattle is about three-fourths of the attainable yield for the predominant breeds in Karnataka -*Hallikar* and *Amritmahal* and *Deoni*. Yield gap for crossbred cattle is to the tune of 50 per cent. A gap of similar magnitude exists for buffaloes too.

To examine the factors that influence productivity of milch stock, regression equations are estimated using district level cross-section data with annual milk yield per milch animal (AMYD) as the explanatory variable. Means and standard deviations of the variables are provided in Annex Table VI.

6.1.1 Selection of variables

Technological change is likely to have a profound impact on the future structure of output growth. Since breed improvement in cattle has been an important component of India's livestock development policy, per centage of crossbred in total milch cattle population (XBRED) serves as a good proxy for technological change in dairy sector.

Further, in many parts of the country including Karnataka, buffalo population is growing faster than cattle. Moreover, milk yield of buffalo is higher than that of indigenous cattle. Thus, to assess whether such a shift in herd structure could help increase milk production/productivity, per centage of milch buffaloes in the total milch stock (BUFF) is considered as one of the factors in raising overall milk productivity.

Gains from technology and shifts in herd structure cannot be realised to its full capacity if inputs such as feed fodder, animal health services, etc. are in short supply. Feed fodder supply is central to any livestock activity. Since milch bovines are largely stall-fed, area under fodder crops in a district in relation to bovine milch stock (FMA) is taken as a proxy for feed fodder supplies. Feed fodder supplies however, vary across the land holdings. *A priori*, it is expected that the feed fodder constraint is more severe on marginal and small holdings, compared to medium and large holdings. Therefore, the per centage of marginal and small land holdings in the total holdings (PSMF) is also included in the set of explanatory variables.

Role of institutions and infrastructure in livestock development needs no underscoring. In India, animal health infrastructure and dairy cooperatives have witnessed significant growth over the last two decades, which are likely to impact milk yield. Incorporating the density of

public funded animal health institutions (DAHS) in the regression analysis captures impact of animal health services on milk yield.

Dairy co-operatives have emerged as a powerful catalyst in transforming the dairy sector in some of the states in the country. Consequentially, milk production increased *via* popularising dairying as a profession. Vertical marketing linkages between producers and consumers got strengthened in the process. While the role of dairy co-operatives in augmenting milk production is well recognised, their impact on productivity is ambiguous (Alderman, 1987). This is captured by including intensity of primary dairy co-operatives (DCOP) in a district in the analysis.

Independently, each of the specified variables is important in milk production. Some of these particularly XBREED, DAHS and DCOP are highly correlated and embodiment of all these together in the equation would affect the regression estimates (Correlation between variables XBRED and DAHS is rather high (0.88). Similarly, it is 0.75 between DAHS and DCOP). In order to arrive at an unbiased and precise estimates, different combinations of explanatory variables were tried, separately for cattle and buffalo as well for their weighted milk yield (Linear and log-linear functions were tried to examine the effect of various factors on milk yield. Based on coefficient of determination and significance of variables the linear form gave a better fit. We also tried to capture the variation in yield across different agro-ecological zones by including zone dummies, however none of these turned out to be significant). The equations for the weighted milk yield however, provided the best fit (Table 13).

Table 13 :
Linear estimates for determinants of milk yield, 1995-96

Dependent variable: Annual milk production in Kgs per milch animal (AMYD)

Explanatory variables	Eq. I	Eq. II	Eq. III	Eq. IV	Eq. V	Eq. VI
Per cent of crossbred milch cattle in total milch cattle (XBRED)	16.98 (6.03)***	-	15.16 (5.86)***	-	-	17.51 (9.33)***
Per cent of milch buffalo in total milch stock	3.10 (1.41)	-2.11 (0.78)	-	-	-	4.80 (2.77)**
Number of veterinary institutions per 100 sq. km of geographical area (DAHS)	-	163.52 (3.50)**	-	16.88 (3.64)***	181.87 (5.56)***	-
Number of dairy co-operatives per 100 sq. km of geographical area (DCOP)	1.99 (0.23)	2.80 (0.45)	4.67 (0.52)	6.01 (0.48)	-	-
Area under fodder crops per 100 milch bovines (FMA)	9.58 (0.56)	43.17 (1.78)*	20.79 (1.25)	36.15 (1.63)	40.32 (2.02)**	-
Per cent of marginal and small land holdings in total holdings (PSMF)	-2.46 (1.59)	-5.43 (2.50)**	-3.37 (2.37)**	-4.79 (2.41)**	-4.76 (2.46)**	-
Constant term Coefficient of determination (R ²)	364.55 0.86	552.59 0.73	539.4 0.84	429.21 0.73	419.51 0.72	150.36 0.84
F value	17.64	7.87	20.23	9.95	13.85	43.6

Figures in parentheses are t-values. ***, ** and * indicate significance level at 1, 5 and 10 per cent respectively.

6.1.2 Results

As anticipated, XBRED has a positive and significant impact on AMYD, endorsing our observation that future growth in milk production would be technology driven. The regression estimates for cattle milk yield also indicate the same (Annex Table VII). The relationship between BUFF and AMYD is positive and significant in only one of the estimated equations. Here only herd-structure variables are considered. Nevertheless, this suggests that effecting a shift in herd structure in favour of buffaloes can augment milk production and productivity.

Coefficient of FMA is positive and significant in several equations. This underscores the fact that adequacy of feed fodder resources would be a critical factor in realising the potential of the dairy sector. Lalwani (1989) also made similar observations. The impact however, varies across economic classes as the association between AMYD and PSMF is negative and significant. Thus, yield improvements on marginal and small land holdings would be constrained by feed fodder scarcity. Alderman (1987) too observed that milch stock owned by the landless and marginal farmers is less productive than those owned by others. This implies that medium and large farm households who hold 39 per cent of cattle and 51 per cent of buffalo would gain relatively more from yield improvements resulting due to improved feed fodder supplies.

The association between AMYD and DAHS is positive and significant. This is on expected lines. Development of animal health services in the country has significantly reduced the incidence of animal diseases and avoided yield loss (Singh, et. al., 1998). Animal health services also influence milk production through dissemination of yield increasing technology and breeding services. It may be noted that in Karnataka the animal health coverage is better in regions with relatively higher incidence of crossbred cattle, and the correlation coefficient between the two is high (0.88). This corroborates the fact that crossbred animals require better health care, compared to indigenous animals. As production growth becomes technology oriented, quantitative and qualitative improvements in health services would be indispensable. So also breeding programme must have an explicit emphasis on development of disease resistance.

The impact of dairy co-operatives is positive on milk yield but insignificant. This can be explained by looking into the objectives and performance of dairy co-operatives. The primary objective of dairy cooperatives is to strengthen the vertical marketing linkages. Provision of inputs and other livestock related services to the farmers are incidental and a bonus. In this context, Prasad et al (1995), observed that despite the existence of a good network of milk co-operatives in the state, their involvement in activities such as fodder development and input supply was rather limited. Further, the performance of dairy co-operatives in the state is not very encouraging. By 1990, about 50 per cent of the dairy cooperatives were in the red (World Bank, 1996).

These finding support our earlier observation that future growth in milk production would result from a shift in herd structure in favour of high milk breeds of cattle and buffalo, and improvement in feed fodder supplies. Institutional support in terms of health, breeding services, and marketing would catalyse this process.

6.2 Determinants of Meat Yield

Meat yields of all the species have remained stagnant over the last two decades. A significant breakthrough in breed improvement of meat producing animals is yet to occur. Meat yield of sheep and goat is expected to be influenced by variation in availability of grazing lands (GLAND), climatic condition- mainly normal rainfall (RAIN) and intensity of animal health services (DAHS). The estimates of regression are presented in Table 14.

Table 14 :
Linear estimates of determinants of ovine meat yield , 1995-96.

Explanatory variables	Sheep	Goat
Forests, pastures and grazing lands (Hectares/ 100 ovine)	0.00034 (6.10) ^{***}	-0.0000052 (0.14)
Number of veterinary institutions per 100 sq. km of geographical area	0.0603 (1.09)	-0.01734 (0.47)
Annual rainfall (mm), 1994-95	-0.00073 (9.75) ^{***}	-0.000046 (0.91)
Constant term	13.05	12.47
Coefficient of determination (R ²)	0.86	0.10
F value	31.94	0.57

Figures in parentheses are t values. ^{***}Significant at one per cent level.

Explanatory variables account for 86 per cent of the variation in sheep meat yield. The association between SMEAT and GLAND is positive and highly significant, which highlights the role of common property resources in sheep production systems. This has implications for production growth particularly in the short run suggesting that sheep meat yields can be increased through proper management of grazing resources.

Evidence suggest that sheep perform better under arid and semiarid conditions because of adaptability factors (ICAR, 1996). A negative and significant relationship between rainfall and sheep confirms this (Dummies for different regions were tried in the regression exercise. They however, proved to be insignificant). As in case of milk, health services also influence the sheep meat yield, though the association between the two is statistically non-significant.

On the other hand, goat meat yield (GMEAT) is not influenced significantly by any of these variables. As in case of sheep, it was expected that availability of grazing lands would have a positive and significant influence on meat yield of goat, however, the coefficient turn out to be negative and non-significant. This is on account of differences in grazing habits between sheep and goats. While goats can graze on shrubs, herbs and grasses, sheep graze mainly on grasses on the ground. Rainfall has a negative but non-significant impact on the performance of goats. This is because goat is hardier than sheep and can adapt to all types of climates and management conditions (CIRG, 1997). Animal health services too do not have any significant influence on goat meat productivity.

Results indicate that arresting degradation of common property resources would be critical in breaking the stagnation in yield. Though common grazing land does not appear to be an important determinant of goat meat yield, role of common property resources should not be undermined in the development of small ruminant sector. Furthermore, support to small ruminant farmers in terms of animal health services, extension, etc. is rather weak. The relationship between animal health services and meat yield bears testimony to this argument.