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Research Priorities in Livestock Statistics [1]

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I feel greatly honoured to have been invited to deliver this prestigious lecture in memory of Dr. V.G. Panse during the 59th Annual Conference of the Indian Society of Agricultural Statistics. It is the 27th lecture in the series (after his demise on 22 July, 1969). I wish to convey my deep sense of gratitude to the President of the Society, the Executive President, the Secretary and the members of the Executive Council for giving me the opportunity of delivering this memorial lecture. This lecture was delivered in the past by eminent persons like Prof. P.V. Sukhatme (the 1st lecture in 1973), Dr. Manmohan Singh (in 1984 when he was Governor of Reserve Bank of India), Dr. D.J. Finney, Dr. V.K.R.V. Rao, Dr. K.N. Raj, Shri J.S. Sarma, Dr. G.R. Seth, Prof. Prem Narain and others.

Dr. Panse was my teacher in 1951 and 1952 in the Statistical Wing of ICAR and I had the privilege of working under his guidance from 1953 to 1966 when he was the Statistical Adviser, ICAR. I was also one of the Joint Secretaries of the Indian Society of Agricultural Statistics when he was its Secretary. Today, it has indeed provided me an ideal opportunity to pay tribute to my teacher and guide during my scientific career. During this period, I worked in various projects like cost of production of milk and other livestock products, specialized dairy farming, training of primary reporting agency for improvement of agricultural statistics, model agronomic trials and a few more projects.

After the transfer of crop survey wing to NSS, Dr. Panse made efforts to strengthen the IARS (now IASRI) by undertaking a number of schemes relating to livestock and dairying. In fact, there was a time when more than 75% of projects in progress were related to animal husbandry. Today, perhaps a very few projects are being undertaken. He was a pioneer in the development of statistical methodologies and applied research in Agriculture and Animal Husbandry Statistics. The topic I have chosen today for the lecture would have interested him most.

It has been realized that research is the backbone of various innovations resulting in accelerated production and therefore calls for a need of attaching high priority. Reliable data base is essential to carry out research in any sector of economy. Livestock sector is almost neglected in this aspect although it has the potential to generate employment and promote domestic consumption and even exports. Timely and reliable livestock statistics are required for formulation and implementation of realistic programmes in livestock sector and for periodic evaluation of their impact on national economy.

LIVESTOCK CENSUS

Livestock numbers are the basic requirements for estimation of each component in livestock sector and its contribution to the national income. Quinquennial livestock census is the main source at present to obtain reliable data on livestock numbers with adequate details. In 2003, the 17th livestock census was conducted in the country. The results show that there is marginal decrease (-0.54%) in livestock population as compared to previous census in 1997. However, there is wide variation among categories of livestock. Although there was 5.78% decrease in cattle population, the buffaloes population increased by 7.45% during the five years. Among cattle, there was an increase in crossbred cattle by 12.60% but the indigenous cattle declined by 7.85%. Only two species of livestock have shown steady increase in their number in previous 10 censuses carried out during last 50 years and these are buffaloes and mules. Increase in

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Table 1. Status of bovine population in Census 2003 as compared to 1997

	Increase in cattle population	Decrease in cattle population
Increase in buffalo population	**(A)** Gujarat, Meghalaya, Mizoram, Orissa, Tamil Nadu, Uttaranchal, Delhi, Andaman & Nicobar @ (17%)	**(B)** Andhra Pradesh, Bihar, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh @ (57%)
Decrease in buffalo population	**(C)** Assam, Chhattisgarh, Nagaland, West Bengal @ (14%)	**(D)** Goa, Karnataka, Kerala, Punjab, Tripura, Manipur @ (9%)

Note :
- In Jharkhand, only for 2003 census figures are reported.
- Increase in cattle population in Arunachal Pradesh, Sikkim, Lakshdweep, Pondicherry but no change in buffalo population.
- Decrease in cattle population in Chandigarh, Dadar & Nagar Haveli, Daman & Diu but no change in buffalo population.

@ Percentage of bovine population

buffaloes is mainly for getting higher milk production. The mules which are kept mostly in hilly regions of J&K, Himachal Pradesh, Uttaranchal, northern part of U.P. are increasing may be due to more transportation of goods and for tourists. The number of poultry birds is also increasing due to more demand for egg and poultry meat. State-wise figures reveal interesting picture. Hardly any critical analysis of livestock census data is made. However, realizing its importance, the Technical Committee of Direction (TCD) for Improvement of Animal Husbandry and Dairying Statistics, in its meeting held in October, 2004 have taken steps to examine some aspects of census results.

The decline in livestock population can be viewed from the human population angle.

Trend in livestock population

Year	Livestock population per 1000 human population			
	Total Livestock	Bovine	Ovine	Equine
1971	645	423	196	26
1981	614	384	211	19
1991	556	341	196	19
2001	470	277	177	16

In 1971, there were 645 livestock per 1000 human population and the number declined steadily to 470 in 2001. The bovine population also declined accordingly. Whereas the growth of human population was at a rate of more than 2 per cent per annum, it was comparatively less for livestock. The pressure on land for food and cash crops made people to push livestock downward.

In order to examine the bovine population as per livestock census, the states have been put under four groups (Table 1) according to increase/ decrease in cattle and buffalo population.

- States put in group (A) which possess about 17% of bovine population, showed increase in both cattle and buffalo population.
- About 57% bovine population are possessed by the states in group (B) where there was decrease in cattle population but increase in buffalo population. This trend may be for having animals (buffaloes) for higher milk production.
- Group (C) states possessing about 14% bovine population show increase in cattle population and decrease in buffalo population. These states are located in eastern region where preference is for cattle.
- States put in Group (D) possessing about 9% bovine population have shown decline in both cattle and buffalo population. This has drawn the attention of TCD which has rightly suggested for studying the situation firstly in Kerala. Punjab is equally important for undertaking such a study.

There was increase in crossbred cattle in almost all states except in Haryana, Punjab, Kerala and Uttar

Pradesh where both crossbred and non-descript cattle decreased.

Some observations are made about a few states from the four groups.

In Gujarat, both cattle (51.1%) and buffalo population (48.9%) increased by 8.4% and 11.5% respectively. Among cattle only 8.7% are crossbred and remaining indigenous which are likely of the well-known Kankrej breed. Although crossbreeding is gaining momentum, people in rural areas are cautious as they may not loose their hardy Kankrej breed of cattle and Surta buffaloes. Preference for buffalo milk in the area may also be a reason for increase in buffalo population.

Livestock population in J & K is higher than even human population. Ovines are more than bovines mainly due to large sheep population. More than 50% of mules in the country are in J & K. Cattle constitutes 74.2% and buffalo 25.8%. Although crossbred cattle increased, the overall cattle population decreased by 5.1% mainly due to large reduction in the number of indigenous cattle. Buffalo population increased by 32.9% mainly for higher milk production.

In West Bengal, cattle population was predominant constituting 94.5% and buffaloes 5.4%. There are 519 livestock per thousand human population, of which 249 bovines, 253 ovines and remaining other livestock. Higher ovine population is mainly due to large number of goats. Although cattle population increased and buffalo population decreased, crossbred cattle constituted only 6 per cent.

Since TCD has suggested to critically examine the reason for decline in cattle population in Kerala and to take up a research project, it should not be only for a fact finding study. It is to be seen what research elements can be incorporated in it. Some points may help in formulation of the project.

Kerala had no recognized breeds of cattle or buffaloes in the past, except for the small sized 'Vechur' breed which is extinct now. Indo-Swiss project for cattle breeding in 1963 in the high ranges of Kerala started cross-breeding programme using Brown-Swiss, Jersey, Holstein-Friesian and Red Dane. The crossbred animals named as 'Synthetic breed' was known as 'Sunandini' in Kerala. It is to be seen whether this 'Sunandini' exists in any corner of Kerala and if so what are the performance characteristics. In Kerala, the total cattle and buffalo population is steadily declining. There were 137 bovines for every 1000 human population in 1981 which declined to 73 in 2001. Of the bovines 97% are cattle and 3% buffaloes. About 81% of cattle in Kerala are crossbred and remaining 19% indigenous cattle (Table 2). A doubt is raised and that is: how the crossbreds which constituted about 49.9% of cattle in 1992 could increase to 78.6% in 1997 and 81% in 2003. Although the crossbred cattle increased in 1997 and

Table 2. Bovine population ('000) in Kerala/ Punjab

	1992	1997	2003
Kerala			
Crossbred	1759 (46.0)	1957 (75.2)	1826 (78.7)
Indigenous	1765 (46.2)	533 (20.5)	428 (18.5)
Total Cattle	3524 (92.2)	2491 (95.7)	2254 (97.2)
Buffaloes	296 (7.8)	111 (4.3)	65 (2.8)
Total Bovine	3820	2602	2319
Punjab			
Crossbred	1628 (18.2)	1828 (20.8)	1531 (19.1)
Indigenous	1281 (14.4)	810 (9.2)	508 (6.3)
Total Cattle	2909 (32.6)	2638 (30.0)	2039 (25.4)
Buffaloes	6008 (67.4)	6171 (70.0)	5995 (74.6)
Total Bovine	8917	8809	8034

NB: Figures in parenthesis are the percentages of total bovines during the year.

decreased in 2003, substantial decrease in indigenous cattle resulted in overall decrease in cattle population in 2003. The decline in cattle population may be due to:

- Decrease in the number of households keeping bovines and family members preferring other profession
- low yielding animals (indigenous and even crossbreds of higher order of lactation) sold to neighbouring states like Karnataka and Goa
- sending animals for slaughter
- decrease in holding size and people preferring plantation crops rather than food and seasonal crops, and less preference for draught animal power
- stopping subsidies provided earlier for crossbreeding programmes

In the project envisaged, these facts may be considered for adopting a well designed questionnaire.

The situation in Punjab similar to Kerala is worth investigating. Population of both cattle and buffaloes decreased during last decade. There were 493 bovines for thousand human population in 1981 which declined to 331 in 2001. Of the bovines 74.6% are buffaloes and 25.4% cattle. About 75% of cattle are crossbred and 25% indigenous. Whether the indigenous cattle are really nondescript or these are well known Hariana breed in the tract. Fast decline in so called indigenous cattle may result in elimination of recognized Hariana breed. Similar is the situation in the case of buffaloes. The tract is known for Hariana cows and Murrah buffaloes. Perhaps Hariana cows are being replaced by crossbred cows which are high yielders. Similarly buffaloes might have been replaced or despatched to eastern states. Decrease in adult male cattle may be due to farmers' preference for mechanization in agricultural operations rather than the draught animal power.

In Karnataka cattle and buffalo population decreased but crossbreds increased from 4.8% in 1992 to 16.8% in 2003. It is more likely that the low yielding local cattle are being replaced by crossbred ones. The situation in Goa is similar to Karnataka and needs no detailed discussion.

COST OF PRODUCTION

Estimation of cost of production of livestock products is of fundamental importance in the interest of both producers and consumers. The biggest incentive for increasing production is an assured market and remunerative price to the producer. For maximizing individual farmer's return as well as for improving overall efficiency, study on cost of production is indispensable. A fund of information which would be available through such studies can be used for livestock development on scientific lines. Considering the importance of such studies, almost all the developed countries and some developing countries undertake studies on cost of production of important livestock products on a regular basis as in the case of other commodities. In India, the production units are organized farms and rural households, the latter contributing the major share. The method of working out the production cost for some of the important livestock products like milk, wool, poultry and egg has been evolved by IASRI based on a series of methodological investigations following cost accounting approach. For example, the procedure of estimation of cost of production of milk is given in detail by Panse *et al.* (1963). The overall cost includes the components on feed, paid labour, family labour, depreciation on animals, miscellaneous recurring expenditure and depreciation on capital investment. From the gross cost, the income from sources other than milk, mainly dung is subtracted to secure the net cost of production. Utilizing the data collected in these investigations, some ancillary studies have been carried out, which are considered to be important and useful for planners, development agencies and research workers. Realizing the importance of cost studies, the TCD have emphasized that the states should take up the study on cost of production of milk in the first instance. The efforts should be pursued till the goal is reached. The States might be reluctant to undertake the study in view of the expenditure involved, but they may be convinced that the initial cost would be overcome after obtaining the input-output in quantitative terms and the cost structure. The methodological surveys have shown that cost on feed and labour account for 70 to 85% of production cost. Once the survey is conducted for two consecutive years in a given area, it would be necessary only to secure seasonal prices of feed and fodder, labour wage rates, market rates of milk and dung for the next few years so as to work out in an appropriate manner the index of cost of production, utilizing the quantities of physical inputs and outputs estimated from detailed enquiry. Such methodology to work out the index of cost of production has been developed by the IASRI. The index will provide

the relative increase or decrease in the production cost as well as the prevailing market rate. After a reasonable period say 5 or 6 years, when the structure of enterprise may be considered to have undergone a change, it would be desirable to repeat the detailed enquiry for another period of two years. The details of the survey methodology, analysis etc. can be seen from the available reports.

As mentioned earlier, data collected for a specific objective are also useful in getting some indicators of progress and for guidance in other developmental work. A few such cases are discussed.

Feed resources/ availability/ requirement

It is essential to assess feed resources, supply and utilization of quantity and quality of feed stuffs as well as the nutritional requirements of animals for targeted increase in production through feeding and the measures required to provide better nutrition. The crucial necessity is also to build up proper reserves against bad years, which come frequently and more or less in constant cycle, otherwise all efforts towards better breeding to enhance production will not be fruitful with or without crossbreeding. Moreover, it is necessary to achieve a good balance between feed production and feed requirement. This requires construction of Feed Balance Sheet which will help in knowing the shortage or surplus of feed supply. The goal is to obtain estimates of feed requirement/ utilization on one side and feed availability/ resources on the other.

The feeds of livestock consist of :

- Green fodder (pasture grasses, green forage/silage crops, certain types of tree leaves and shrubs etc.)
- Dry roughages (harvested by products like straw and chaff of cereals and pulses, hay which include dry leguminous and non leguminous grasses etc.)
- Concentrates (primary cereals and pulses, by-products of cereals, oilseeds, oil cakes etc.)
- Compound feeds and additives prepared and supplied as balanced rations for some category of animals and also feed minerals

The estimation of production of various constituents of feeds is far from satisfactory. For estimating total feed resources, it is necessary to have data on:

- total production of grains, oilseeds etc.
- the proportion of cereals, pulses and other crops utilized as animal feed
- extraction rates to assess indigenous production of by-products like bran, oilcakes etc.
- the amount of straw, hay and silage available
- quantity of nutrients available through grazing and from pastures
- the amount of nutrients available from by-products like blood meal, fish meal, butter milk and skimed milk
- the quantum of animal feed imported as well as exported

The straw to grain ratio, percentage of bran and husk accruing from paddy and wheat, extraction rates of cake from oilseeds, percentage of allowance for seed, feed and wastage etc. would play a crucial role in working out the contribution of agricultural commodities for livestock feeds. Since production of grain is estimated regularly, the estimates of by-products can be obtained utilizing the grain to straw ratios. However, these ratios need to be worked out periodically for crops grown in different agro-climatic regions. As an example, the extent of variation of ratios for different crops in different regions are shown in Table 3.

Mostly estimates are worked out based on scanty data or on certain assumptions. Sometimes certain proportions of by-products of human food for livestock consumption are earmarked. It is stated that about one per cent of the total production of cereals and 3 per cent of pulses are kept for livestock consumption. Further, brans, husks which would be available are worked out by assuming conversion factor such as 5% for rice bran, 15% for wheat bran, 25% for rice husk, 15% for other husks, 2:1 ratio for straw to grain in the case of paddy and wheat, 8:1 ratio for jowar and millets and 3:1 ratio for gram. Seed to lint ratio is taken as 2:1 and extraction rate of cake from cotton seed as 20%. These assumptions are accepted and used since few decades. To what extent, these assumptions are valid now need to be studied based on reliable data through surveys.

Estimation of area under pastures and herbage available through grazing can be obtained through sample surveys, the methodology of which is provided by IASRI. Alternatively where the area under grassland is recorded in land records, the estimates of average yield of pastures per hectare may be obtained through sample

Table 3. Estimation of straw (x) to grain ratio (x : 1)

Region	Paddy		Wheat		Jowar		Bajra	
	HYV	Local	HYV	Local	HYV	Local	HYV	Local
a. North & North-western	1.5	1.9	1.3	1.7	NA	NA	4.0	4.9
b. Eastern & North-eastern	1.4	1.6	1.4	1.6	*	*	*	*
c. Southern	2.4	3.1	2.2	3.0	4.2	6.0	3.5	4.7
d. Central	2.0	2.6	1.8	2.2	4.5	6.2	4.5	5.2
All India	1.7	2.2	1.4	1.7	4.4	6.1	4.2	5.0

Source: Agricultural Situation in India (1982).

NA: Not available

* Ratio not worked out as contribution of these regions to the total production was negligible.

(a) Haryana, Punjab, U.P., Rajasthan, J & K, H.P. and Delhi

(b) Bihar, West Bengal, Orissa, Assam, Manipur, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Mizoram and Pondicherry

(c) Andhra Pradesh, Karnataka, Kerala and Tamil Nadu

(d) Maharashtra, Gujarat and Madhya Pradesh

surveys. Similarly, since area under fodder crops are recorded under land utilization statistics, the average yield of cultivated fodder may be estimated utilizing the technique already available.

In most of the developed countries, the animals are fed according to their requirements. In the developing countries, however, the animals are fed by farmers according to their means and resources. Only in farms, animals are fed as per their requirements. For estimating the feed consumption, it is necessary to conduct sample surveys.

During the 2nd and 3rd Plan Period, IARS (now IASRI) used to conduct sample surveys for estimation of milk yield of cows and buffaloes as well as feed fed to animals in typical tracts of the country. Now the states are conducting the surveys to estimate the milk production but information on quantum of feed given to animals is not recorded. It is suggested that TCD may persuade states to collect data on feed fed to animals in a household in addition to recording milk yield. From surveys on cost of production of livestock products, if conducted in different regions, the data would provide adequate information in working out not only feed intake but also the nutritional status of animals. Data on availability and utilization of swill and kitchen refuse and household rubbish which are considered as important source of feed for pigs and poultry are hardly available.

The ingredients of livestock feed i.e. greens, dry fodder and concentrates provide different amounts, per unit quantity, the dry matter, protein as measured by digestible crude protein (DCP) and energy as measured by total digestible nutrients (TDN). Knowledge of the nutritive values of feedstuffs available in a region will be extremely useful in working out their availability and requirements for any improvement programme. In the cost of production surveys, the quantity of feed fed to animals are recorded and these would provide the amount of DCP and TDN available to animals and thus their nutritional status.

Nutritive values of feedstuffs and fodder can also be known by working out Nutritive Ratio.The Nutritive Ratio (NR) is calculated as:

$$NR = \frac{DNN}{DCP} \quad \text{where DNN} = \text{TDN} - \text{DCP}$$

Protein rich feedstuffs are referred to as possessing narrow nutritive ratio, and low protein feedstuffs as having wide nutritive ratio. Since TDN includes DCP, this difference can be considered as an intake and termed as DNN i.e. digestible non-nitrogenous nutrients. A few examples are cited in Table 4. Two sets of NR values are worked out: one based on DCP and TDN available to animals and the other as per requirement. The NR based on feed availability is found to be much higher than that based on requirement. This is mainly due to overfeeding of roughages containing more TDN, and less of greens and concentrates which provide DCP. Balanced feed can make the NR values closer to each other.

Table 4. Nutritive ratio from availability and requirement of feed

Area/Region	Category of Animal	Feed Available		Feed Required	
		DNN (kg.)	NR	DNN (kg.)	NR
Hisar district (Haryana)	Cow in milk	4.353	14.09	2.871	9.06
	Dry cow	3.292	21.80	2.163	10.98
	Bullock	4.536	17.93	3.160	8.10
	Buffalo in milk	6.700	13.54	5.388	8.29
	Dry buffalo	4.660	22.19	3.378	10.30
24 Paraganas & Nadia district (West Bengal)	Crossbred cow in milk	3.708	11.10	2.409	8.89
	Dry cow	3.078	17.90	1.907	11.02
	Bullock	3.144	23.64	1.580	7.18
	Nondescript cow in milk	2.934	19.69	1.783	9.05
	Dry cow	2.711	26.58	1.421	10.22
	Bullock	3.059	24.28	1.927	7.33
Dhulia region (Maharashtra)	Buffalo in milk	5.107	8.08	5.418	8.85
Krishna delta area (Andhra Pradesh)	Buffalo in milk	4.187	35.18	2.410	8.67
	Dry buffalo	3.349	74.42	1.644	10.54

The nutritional requirements for cows and buffaloes can be obtained by studying feed-milk relationship. Suitable production functions need to be fitted utilizing available data on milk yield, DCP and DNN. In the conventional method of feeding, a fixed quantity of nutrient is given for every kg. of milk irrespective of the level of production. However, limited study indicated that at lower levels of milk yield, the nutritional requirements may be less and at higher levels, the requirements may be more than those prescribed by the nutritionists. It would be desirable to undertake more studies based on data from different regions in the country.

Another important concept in animal nutrition statistics is the digestibility coefficient, which is the percentage of the quantity of a nutrient actually digested by animal (determined by an intake – faecal output analysis) to the available quantity of nutrient (e.g. protein) in the feedstuff.

CATTLE EQUIVALENT

Cattle Equivalent Scale is prepared on the basis of body weight of different species of animals or feed-intake or may be on some other factors. This scale can be used on many situations. The one prepared based on body weight can be of use in obtaining total meat production; feed requirements of animals, carrying capacity of grasslands and pastures etc. The scale prepared based on feed-intake may be used for feed availability/ consumption, apportion of constituents of feed among different categories of animals etc. While preparing National Income Statistics, cattle equivalence scale of livestock feed has been prepared by CSO for service-animals as well as non-service animals. However, the equivalent scale prepared on any basis should not be used for all the regions as there is wide variation due to different breeds and their body weight as well as quantum of feed intake. As an example, the scales prepared based on these two factors (body-weight and feed-intake) in two different areas are given in Table 5. The survey to

Table 5. Cattle equivalent, Hisar (1963-66)

Category of animals	Based on body weight		Based on feed intake	
	Cattle	Buffalo	Cattle	Buffalo
In milk	0.97	1.80	1.24	1.77
Dry	1.00*	1.80	1.00**	1.36
Heifer	0.87	1.33	0.85	1.00
Bullock	1.17	-	1.33	-
Young Stock : Female< 1 year	0.20	0.30	0.30	0.32
1 – 2 years	0.50	0.67	0.56	0.65
2 – 3 years	0.73	1.03	0.71	0.84
: Male < 1 year	0.27	0.23	0.35	0.32
1 – 2 years	0.50	0.43	0.68	0.57
2 – 3 years	0.77	-	0.96	-

* Body weight : 300 kg ≡ 1 unit ** Feed intake : 12.509 kg ≡ 1 unit

Cattle equivalent, West Bengal (1977-80)

Category of animals	Based on body weight		Based on feed intake	
	Crossbred	Nondescript	Crossbred	Nondescript
In milk	1.21	1.00	1.32	1.09
Dry	1.37	1.00*	1.11	1.00**
Heifer	0.92	0.79	0.93	0.83
Adult Males	0.95	1.16	1.18	1.11
Young Stock : Female < 1 year	0.26	0.24	0.29	0.24
1 – 2 years	0.47	0.42	0.60	0.47
2 – 2 ½ years	0.68	0.55	0.74	0.63
2 ½ – 3 years	0.79	0.74	0.78	0.71
: Male < 1 year	0.24	0.21	0.24	0.25
1 – 2 years	0.42	0.39	0.49	0.45
2 – 2 ½ years	0.55	0.50	0.64	0.56
2 ½ – 3 years	0.68	0.60	0.72	0.66

* Body weight : 260 kg ≡ 1 unit ** Feed intake : 7.717 kg ≡ 1 unit

study the economics of rearing calves and maintenance of adult animals in rural areas of Hisar (Haryana) and districts of 24 Parganas and Nadia in West Bengal was undertaken by IASRI. The body weight of animals in the selected stalls was obtained taking body measurements and using Minnesota formula

$$W = 0.02768 \ \frac{LG^2}{300}$$

where W is the body weight in kg., L is the length in cms. and G is the girth in cms. of an animal.

In these areas, the feed intake by each category of animals was recorded by actual weighment. The cattle equivalent scales have been prepared separately on the basis of these two factors. These can be used suitably.

ESTIMATION OF DUNG QUANTITY

The estimates of wet dung production are reported in FAO year book and Tata Energy Research Institute year book. It is stated that there is a collection loss of 40% in the case of cattle dung and 20% in the case of buffalo dung. However, the method of collection of data

and about assumptions, nothing is mentioned. The quantity of dung excreted at night for some categories of cattle and buffaloes are given in the ICAR Handbook of Manures and Fertilizers. Here again the method of collection is not indicated. It is likely that some government farms might have supplied the information. The estimates need to be examined carefully.

The methodological surveys were conducted by IASRI for estimation of cost of production of milk as well as for rearing calves in different areas. The enumerators weighted dung of cattle and buffaloes in the selected households in three seasons. These estimates were required to work out the component of cost i.e. income from sources other than milk, mostly dung. The value of dung is given in each report. As an example, the quantity of dung produced for each category of bovines in a rural area of Tamil Nadu is mentioned in the survey report for estimation of cost of production of milk and reproduced in Table 6. Higher quantity of dung per animal in rural areas was due to the fact that animals are fed very high quantity of roughages mainly paddy straw as compared to urban and suburban areas. Assuming that the results would be a representative for the state (Tamil Nadu) as a whole, the total production of dung can be obtained utilizing the number of cattle and buffaloes in the state. If similar surveys are carried out in other states, the data can be utilized to get total production of dung in the states and for the country as a whole.

Table 6. Quantity of dung (kg.) per animal per day in former Madras state

Category of animal	Urban	Suburban	Rural
Cow	5.72	5.08	10.07
Buffalo	6.67	7.80	10.25
Cow calf	2.04	2.49	4.76
Buffalo calf	2.22	2.95	4.94
Other adults	5.03	5.67	10.30

WOMEN LABOUR INPUT

Labour is an important component in knowing the economics of livestock keeping. Participation of women particularly in rural areas for various activities in Animal Husbandry operations is indispensable. Quantitative estimates of women labour in these activities are hardly available in spite of the fact that recommendations are made in various national and international forums to take necessary steps to secure adequate and reliable data. Livestock keeping is one enterprise, which can provide gainful employment to rural women in their own households throughout the year.

Studies undertaken by IASRI in the methodological surveys for estimation of cost of production of milk and other livestock products in different rural areas have provided some data on input of women labour. The results are available in the relevant reports. A compiled information on the subject is given in the Journal of the Society (Raut (2004)). Of the total time utilized in various activities for livestock keeping, women contributed about 25% to 35% and remaining by men and children. Women labour input (assuming 8 hours of work per day as norm) was 84 to 92 days in the rural areas of Haryana, West Bengal, Tamil Nadu and Rajasthan; 100 days in Maharashtra and 76 days in Andhra Pradesh. These estimates are excluding time utilized by women for taking animals for grazing. Woman-time utilized was comparatively more in landless households and small holdings maintaining animals. As the size of holding increased, household women labour decreased.

Since livestock keeping is a labour intensive effort uniformly distributed throughout the year and women participation is an essential part, their contribution needs to be measured quantitatively. Since dairy enterprise has gained momentum after functioning of cooperatives in various parts of the country women's role is dominant factor and as such more data on input of women labour is required. If cost of production of milk and other livestock products are taken up by the states as emphasized by TDC, the desired data would be available.

MILK CONSUMPTION/AVAILABILITY

Per capita availability of milk is reported considering the total milk production and human population. India is the largest milk producer globally with 94 million tonnes. The per capita availability is about 255 gms per day, against the WHO norm of 350 gms. However, it is more important to know about per capita consumption of milk. It is observed that in a household all the members do not take milk due to various reasons, mainly financial constraint. Rural population feels that they may gain nutritionally by providing and consuming more milk but increased income from milk marketing will enable them to increase

Table 7. Per capita consumption/ availability of milk

Type of Household	Average no. of persons in a household		Percentage of people consuming milk		Milk consumption per day (gms)		Per capita availability of milk (gms)	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
(a) Gudiyatham Taluk of North Arcot District of Tamil Nadu								
Milk – producer (31.3%)	3.5	2.4	31.4	31.7	109	204	36	68
Non-milk producer (68.7%)	2.9	2.1	20.7	19.0	91	136	18	27
(b) Krishna Delta Area of Andhra Pradesh								
Milk – producer (44.5%)	2.7	2.8	88.6	86.4	82	87	72	75
Non-milk producer (55.5%)	2.4	2.2	9.5	7.6	58	64	5	5

expenditure on their food items and thus improving their nutritional intake.

During the methodological survey for estimation of cost of production of milk, data on pattern of consumption of milk were collected from both milk-producer and non-milk producer households in rural area of Gudiyatham taluk of North Arcot district of former Madras State as well as in the rural areas of Krishna delta area of Andhra Pradesh (Table 7). The findings may not be of recent years, but these can be taken as the results of benchmark surveys and compared with repeat surveys, if carried out to reveal the changes and thereby the extent of development.

Two out of six members in a milk producer household and one out of five members in a non-milk producer household take milk. As is to be expected, more people from milk producer class take milk than the non-milk producer class. There is wide gap between the amount of consumption and availability. When the availability figures are reported, the real picture is not revealed. The present situation, if there is any change, can be known only if a repeat survey is undertaken in the area. In Krishna delta area, less than 10% of persons in non-milk producer households used to take milk. The quantity consumed per adult and child in both milk-producer and non-milk producer households are less than 100 gm.

MANAGEMENT

It is well known that scientific breeding, improved feeding and proper management can enhance productivity of an animal/ bird. Studies have been made to know the extent of improvement through breeding and feeding. However, very little is known quantitatively the influence of management. Without proper management, the animal's potential will never be realized. Study to assess the influence of management even under farm conditions have not been made, perhaps due to the fact that animals are maintained in farms under uniform conditions and no variation is introduced within a farm.

Management practices or conditions can be classified into three broad groups viz. housing conditions, feeding practices and other management practices. Some suggestions have been made on housing conditions for dairy cows in western countries. However, these observations are hardly applicable under Indian conditions. A housing system should function to provide a healthy comfortable environment for maximal production; comply with sanitary conditions; provide safe desirable working conditions for operator; and to integrate housing with feeding and waste handling system. Similarly there are some indicators for feeding practices. A modest attempt was made by Raut (1975) suggesting measurement techniques for different indicators of management. It is not necessary, rather

impracticable, to collect data in all parts of the country because such a coverage will be prohibitively costly, laborious', unduly time consuming and operational difficulties involved in training the staff likely to be engaged for collection of data. Sample surveys planned for the purpose in typical areas representative of the regions may serve the purpose. The sample area needs to cover the entire gamut of variability in management practices. Appropriate designs to conduct qualitative-cum-quantitative experiments need to be developed to measure the components of management and their influence on production in farms. After working out the relative importance of various management factors and contributions towards production, suitable management index can be prepared. These indices can serve as guidelines for future improvement programmes on management.

CONCLUSIONS

- While the states may continue the crossbreeding programme to enhance production, it should be kept in mind that the well known recognized breeds of cattle and buffaloes in the region are not eliminated.
- Sound basic data are essential as a foundation for policy making and there is thus a need to collect and analyse more information on current and potential feed resources, particularly of grasslands, forage crops and agro-industrial wastages as well as on the utilization of these resources in different regions and under different farming systems.
- The TCD may persuade the states to undertake studies on cost of production of important livestock products in selected areas representative of the region. The available data may also be utilized for ancillary studies (either by the states or by IASRI and ISAS), particularly on the indicators of progress and useful for planners and developmental agencies.
- Suitable measurement techniques for different indicators of management need to be evolved and the extent of their influence on production obtained through planned experiments as well as well designed sample surveys.
- Adequate funds may be provided at the Centre and states to undertake research in the field of livestock sector which has great potential in generating more employment and enhancing national income.

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