Indian Journal of Animal Sciences **89**(9): 1009–1013, September 2019/Article
https://doi.org/10.56093/ijans.v89i9.93784

Estimation of bovine equalizing units in India: A regional perspective

SMITA SIROHI[1], PREM CHAND[2], DEEPAK SHARMA[3] and RAKA SAXENA[4]

ICAR-National Dairy Research Institute, Karnal, Haryana 132 001 India

Received: 19 July 2018; Accepted: 18 February 2019

ABSTRACT

Study was conducted to formulate region specific standard animal units (SAUs) more comprehensively by considering labour utilization as well as size of animals. Both primary as well as secondary data were used in the study. Primary data were collected from 2,700 households from 18 districts of nine states. Conversion coefficients were formulated by aggregating coefficients of bodyweight and labour utilization and giving appropriate weights based on the experts' opinion. We found that the dairy farmers devoted majority of their time on care and maintenance of milch animals in the herd. Heifers got almost equal or even more priority in care and maintenance than the adult male bovines. The intensity of labour utilization in crossbred cow as compared to local adult female was higher. The overall conversion coefficients were higher for crossbred cow. The estimated regional coefficients will be helpful in estimation of costs and returns in not only in dairying but also in other livestock production. Besides the overall SAU, the separate estimation of SAU based on bodyweight and labour utilization pattern will serve the purpose of both social as well as biological research studies, particularly for studies carrying capacity, housing management and overall farm planning.

Key words: Bodyweight, Conversion coefficients, Labour use, Standard animal units

In developing countries where small-holder production system dominates, a livestock-keeper maintains different categories of animals for both milk production as well as draught purpose to sustain his/her income throughout the year. The animals differs in type, age, body weight, sex composition etc. While estimating cost of milk production, some of the items of fixed assets as well as variable items are used jointly in the herd. However, their requirement differs for different categories of animals. Therefore, it becomes necessary to standardise different categories of animals into homogenous animal unit for apportioning the various joint costs incurred by the households. Similarly, the standardization of animal units are also required in the studies on aggregate estimation of feed and fodder requirement and carrying capacity of grazing lands at regional/national level.

The earlier studies on standardisation of livestock/bovine units are largely based on labour utilisation pattern (GoI 1959, CSO 1960, 1961; AERC 1963, Vyas 1971, Yang 1971, Patel *et al.* 1975, Patel and Thumar 1977, Ahuja 1978, Moore 1978, Bal *et al.* 1979, Prabhakaran and Raut 1979, Patel and Kumbhare 1980, Singh *et al.* 1980, Rani 1981 and Kumbhare *et al*. 1983). These coefficients may not be appropriate in all the conditions. Besides the differences in labour use, size of animals is also one of the important factors in determining these coefficients. Further, these coefficients may also vary from region to region due to variation is labour use pattern and size of animals not only across species but also between different breeds of each species.

In the animal equivalent system of FAO, buffaloes and camels, sheep and goats, and horses, donkeys and mules have been grouped together for the purpose of determining animal units in comparison to horse group (horse, donkeys and mules) as one unit. Any statistics collected for Indian Livestock using the animal unit equivalent (AUE) suggested by FAO will be definitely misguiding. Small cattle of northern hills, Bundelkhand, tribal region and most of the coastal areas weighing 150 to 250 kg cannot be equated with Hariyana, Tharparker, Gir etc. of 300 to 500 kg or even higher adult body weight. Under such situation, any estimate and projections for future development based on such estimates will fail to produce the real scenario and will be misguiding (GoI 2011). Kumbhare *et al.* (1983) also accepted that the factors so developed by them are suitable only for the Karnal region and highlighted that such studies need to be carried for other areas as well. In these circumstances, there is a need for developing equalizing coefficients across regions taking both labour utilization and size of animals. Therefore, the present study aims to

Present address: [1]Advisor (smitasirohi@yahoo.com), Embassy of India to EU, Belgium and Luxembourg Brussels. [2]Scientist (prem_mahala@yahoo.com), [4]Principal Scientist (rakasaxena @gmail.com), ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi. [3]PhD Scholar (deepak0533 @gmail.com), SRS of ICAR-NDRI, Bengaluru.

develop the region specific conversion factor for different livestock species.

MATERIALS AND METHODS

Geographical coverage: Considering the differences in regional endowments of animal wealth and species, the stander animal units have been formulated at regional level for five regions of India, viz. northern plains, southern, western, eastern (including north-east) and hills region. The boundaries of the regions were defined based on uniformity in the size of animals as well as based on discussion with experts in the field. The geographical boundaries considered for the study are given in Table 1.

Table 1. Geographical boundaries of the regions used in the study

Region	State
North (Northern Plains)	Punjab, Haryana, Uttar Pradesh, Madhya Pradesh
South	Andhra Pradesh, Tamil Nadu, Kerala, Karnataka
West	Maharashtra, Gujarat, Rajasthan
East (Including north east)	Bihar, Jharkhand, West Bengal, Odisha, Chhattisgarh and all 7 north eastern states
Hills	Jammu and Kashmir, Himachal Pradesh and Uttrakhand

Data and sampling: The study is based on both primary as well as secondary data. Secondary data were used to estimate the SAUs based on bodyweight, while the survey data were used to estimate SAU based on labour utilisation. The information of body weights of cattle and buffalo at different stage of life were collected from Breed Monographs published by National Bureau of Animal Genetic Resources (NBAGR), Karnal, AnGR portal maintained by NBAGR (http://14.139.252.116/agris/breed.aspx), Buffalopedia a portal of buffalo information maintain by Central Institute for Research on Buffalo (CIRB, Undated) and published studies. The number of animals under different categories and breeds were taken for the year 2013 from Department of Animal Husbandry, Dairying and Fisheries, Government of India (GoI, 2015).

Primary data: Primary data were used to workout labour utilisation pattern of dairy animals across different regions. The household level data collected during 2012–13 for all the seasons under the project "Costs and returns in milk production: developing standardized methodology and estimates for various production systems", Department of Animal Husbandry, Dairying and Fishery operated at National Dairy Research Institute and six other centres located across different regions of the country were used for the present study. Under this project, data were collected from 2,700 households from selected 18 districts of nine states (Smita *et al.* 2015).

Analytical framework: The SAUs were calculated using both factors, viz. bodyweight and labour utilization pattern as given below. Let the bodyweight of the i^{th} breed of j^{th} species/ category of animal in k^{th} region is BW_{ijk} and population of i^{th} breed of j^{th} species/ category of animal in k^{th} region is P_{ijk}. Then, the average bodyweight of j^{th} species/ category of bovine animal in k^{th} region is $\overline{BW_{jk}}$ and was calculated as follows.

$$\overline{BW_{jk}} = \frac{\sum_{i=1}^{I} BW_{ijk} P_{ijk}}{P_{jk}}$$

The average bodyweight so obtained for a particular category of animal was divided by weighted average bodyweight of adult female local cow ($\overline{BW\_AFLC_k}$) in the k^{th} region to arrive at SAUs based on bodyweight (SAU_BW_{jk}) for the region, i.e.

$$SAU\_BW_{jk} = \frac{\overline{BW_{jk}}}{\overline{BW\_AFLC_k}}$$

Calculation of SAU based on labour utilization (SAU_LU): Let LU_{jk} is average labour use in hours/per day/ animal for j^{th} species/category of animal in k^{th} region and LU_AFLC_k is the average labour use in hours/per day/ animal for adult female local cow in the region. Then the SAU coefficient for j^{th} category of animal in k^{th} region (SAU_LU_{jk}) was worked out by dividing LU_{jk} by labour use for adult female local cattle (LU_AFLC_k) .

Finally, SAU_BW_{jk} and SAU_LU_{jk} were aggregated to arrive at overall coefficients of SAUs for the regions assigning weights based on expert opinion.

RESULTS AND DISCUSSION

The region-wise results of Standard Animal Units calculated are given here. Besides, aggregate conversion coefficients, the presentation of separate results of SAUs will widen the user base of these estimates. For instance, bodyweight based SAU may be more relevant for researchers/policy makers dealing with estimation of feed balance, management of rangeland/ common property resources while labour use pattern based SAUs may be more useful for researchers dealing with socio-economics aspects of livestock production.

Standard animal unit based on bodyweight: Results of SAUs estimated based on bodyweight are given in Table 2. The perusal of table shows that by and large, the conversion factors of crossbred cow were higher than buffalo and local cow except in northern region where these were in favour of buffalo due to dominance of high weight buffalo breed Murrah in the region. As it is obvious, male bovine were heavier than females irrespective of region and species and hence the conversion coefficients were higher for adult males than the females. SAU conversion factors of crossbred cow and buffalo when compared with local adult female cow ranged from 1.23 (eastern zone) to 1.87 (hill region) in case of crossbred female and from 1.13 (southern region) to 1.74 (hill region) in case of buffalo. Despite of small size of all the animals in the hill region, the higher difference in bodyweight-based conversion factors of adult female with other two categories of bovine is due to even

Table 2. Standard animal unit for different regions in India calculated based on body weight

Region	Category of animals	Adult male	Adult female	Young stock male <1	Young stock female <1	Young stock male ≥1	Young stock female ≥1	Heifer
North	CB	1.64	1.23	0.30	0.30	0.89	0.62	0.85
	LC	1.28	1.00	0.25	0.23	0.70	0.48	0.72
	BU	1.70	1.52	0.34	0.30	0.98	0.61	0.87
South	CB	1.64	1.24	0.29	0.29	0.87	0.62	0.85
	LC	1.27	1.00	0.25	0.22	0.65	0.49	0.75
	BU	1.45	1.13	0.29	0.24	0.80	0.58	0.62
West	CB	1.76	1.23	0.32	0.29	0.95	0.63	0.85
	LC	1.37	1.00	0.26	0.24	0.56	0.53	0.58
	BU	1.61	1.34	0.35	0.31	0.71	0.63	0.77
East	CB	1.71	1.22	0.31	0.29	0.93	0.62	0.84
	LC	1.33	1.00	0.36	0.29	0.69	0.58	0.67
	BU	1.60	1.44	0.31	0.24	0.71	0.62	0.64
Hill	CB	2.26	1.87	0.61	0.55	0.94	1.10	1.19
	LC	1.32	1.00	0.32	0.32	0.52	0.45	0.55
	BU	2.13	1.74	0.48	0.32	0.97	0.74	0.84

CB, Crossbred cow; LC, Local cow; BU, Buffalo.

smaller size of local female cow (average body weight of 155 kg).

The inter-regional variations in the bodyweight-based conversion factor of different bovine species validate the hypothesis and signifies the relevance of regional estimates of SAU. Most of the socio-economic studies for apportioning joint costs, estimation feed and fodder balance, carrying capacity of land/pastures etc. have been either using outdates and coefficients (mostly following SAUs of Kumbhare *et al.* 1983) or have modified by their own without any scientific basis to arrive at standard animal units. While estimating feed consumption pattern in hill region, Pandey (2010) used general formula of Yang (1971) in standardizing animal units but felt that these coefficients are not appropriate and modified conversion coefficient for buffalo equating one buffalo to 1.5 Adult Cattle Unit in consultation with villages of the study area. Therefore, the results of current study are not directly comparable with most of the earlier studies being differences in objectives as well as study area. Moore (1978) calculated Physiological Animal Units (reflecting the body size) based on primary data from Gujarat and Rajasthan. He found the Physiological Animal Units of cow *vis-à-vis* she-buffalo at 0.77 that is close to our SAU conversion coefficient for western region when we compared the coefficient for cow with respect to female buffalo.

Standard animal unit based on labour utilization: Labour cost accounts considerable share in total cost of maintenance of dairy animals. The farmers maintain different types of animals in the herd and maintaining of records of time spent for each animals even on recall basis is almost impossible. Therefore, to work out the labour cost for different types of animals, researchers use SAU conversion coefficients to apportion the join cost items. The SAU conversion coefficients based on labour utilization is given in Table 3. Results shows that dairy farmers devotes major of time on care and maintenance of milch animals. Heifers were cared almost equal or even more than adult male except in northern region. In some of the regions, the labour utilization factor of female young stock and heifers were even higher than milch cow.

The differences in labour use coefficients across different bovine species were relatively narrow in eastern region. This indicates towards the low labour intensive livestock rearing in the region as animals are fed more on grazing. This may also be interpreted in terms of preference of younger animals by dairy farmers. Very low conversion factors of adult male in western region show that male animals are not given proper care. Among the adult female, rearing of crossbred was more labour intensive than buffalo except in hill region. Intensity of labour utilization in crossbred cow as compare to local adult female was higher by 14%, 19%, 30%, 60% and 87% in western, eastern, northern, hill and southern region, respectively.

Overall standard animal units: The overall standard animal units calculated for different regions and different categories of animals are presented in Table 4. The perusal of table shows that the overall conversion coefficients were higher for crossbred cow in all the regions except in northern region where these were in favour of buffaloes. The conversion coefficients estimated in this study were by and large on the higher side as compared to estimated/assumes by most of the earlier studies (CSO 1960; 1961; Rani 1981) due to the reason that most of these studies estimated the coefficient on single aspect either on body weight or labour use. The conversion coefficient of adult female crossbred cow ranged from 1.18 in western region to 1.71 in hill region. Similarly, for adult female buffalo it was ranged from 0.86 in eastern region to 1.7 in hill region. Lower conversion ratios with less inter species and growth stages in the eastern region reflects poor care and management of bovine animals in the region.

Table 3. Standard animal unit for different regions in India calculated based on labour utilization pattern

Region	Category of animals	Adult male	Adult female	Young stock male <1	Young stock female <1	Young stock male ≥1	Young stock female ≥1	Heifer
North	CB	0.95	1.30	0.49	0.49	0.43	0.45	0.73
	LC	0.95	1.00	0.49	0.49	0.43	0.45	0.73
	BU	0.95	1.23	0.49	0.49	0.43	0.45	0.73
South	CB	0.77	1.87	0.21	0.31	0.46	0.46	0.87
	LC	0.77	1.00	0.21	0.31	0.46	0.46	0.87
	BU	0.77	1.31	0.21	0.31	0.46	0.46	0.87
West	CB	0.29	1.14	0.43	0.43	0.29	0.29	0.29
	LC	0.29	1.00	0.43	0.43	0.29	0.29	0.29
	BU	0.29	1.14	0.43	0.43	0.29	0.29	0.29
East	CB	0.64	1.19	0.21	0.21	0.23	0.23	0.63
	LC	0.64	1.00	0.21	0.21	0.23	0.23	0.63
	BU	0.64	0.47	0.21	0.21	0.23	0.23	0.63
Hill	CB	0.97	1.60	0.27	0.83	0.57	1.07	1.26
	LC	0.97	1.00	0.27	0.83	0.57	1.07	1.26
	BU	0.97	1.67	0.27	0.83	0.57	1.07	1.26

CB, Crossbred cow; LC, Local cow; BU, Buffalo.

Table 4. Overall Standard animal unit for different regions in India

Region	Category of animals	Adult male	Adult female	Young stock male <1	Young stock female <1	Young stock male ≥ 1	Young stock female ≥ 1	Heifer
North	CB	1.23	1.27	0.41	0.41	0.61	0.52	0.78
	LC	1.08	1.00	0.39	0.39	0.54	0.46	0.73
	BU	1.25	1.35	0.43	0.41	0.65	0.51	0.79
South	CB	1.12	1.62	0.24	0.30	0.63	0.52	0.86
	LC	0.97	1.00	0.22	0.27	0.54	0.47	0.82
	BU	1.04	1.24	0.24	0.28	0.60	0.51	0.77
West	CB	0.87	1.18	0.39	0.37	0.55	0.42	0.51
	LC	0.72	1.00	0.36	0.35	0.40	0.38	0.40
	BU	0.82	1.22	0.40	0.38	0.46	0.42	0.48
East	CB	1.07	1.2	0.25	0.24	0.51	0.38	0.71
	LC	0.92	1.00	0.27	0.24	0.41	0.37	0.64
	BU	1.02	0.86	0.25	0.23	0.42	0.38	0.63
Hill	CB	1.48	1.71	0.41	0.72	0.71	1.08	1.24
	LC	1.11	1.00	0.29	0.63	0.55	0.82	0.98
	BU	1.43	1.70	0.35	0.63	0.73	0.94	1.09

CB, Crossbred cow; LC, Local cow; BU, Buffalo.

Conclusion and policy implications: The study concludes that the conversion coefficients of crossbred cow were higher than buffalo and local cow. The inter-regional variations in the bodyweight conversion factor of different bovine species w.r.t. local adult female cattle in the region validate the hypothesis and relevance of regional estimates of coefficients. Study further showed that dairy farmers devotes majority of their time on care and maintenance of milch animals than the working animals. Young female breedable animals (Heifers) got almost equal or even more priority in care and maintenance than the adult male bovines. We found that among the adult female, rearing of crossbred was more labour intensive than buffalo. Intensity of labour utilization in crossbred cow as compared to local adult female was higher by 14%, 19%, 30%, 60% and 87% in western, eastern, northern, hill and southern region, respectively. The overall conversion coefficients were higher for crossbred cow in all the regions except in northern region where these were in favour of buffaloes. The estimated regional coefficients will be helpful in estimation of costs and returns in not only in dairying but also in other livestock production. Besides the overall SAU, the separate estimation of SAU based on bodyweight and labour utilization pattern will serve the purpose of both social as well as biological research studies, particularly for studies carrying capacity, housing management and overall farm planning.

REFERENCES

AERC. 1963. *Indian Village Studies*. No. 18. Agro-Economic Research Centre. Sardar Patel University, Vallabh Vidyanagar.

Ahuja K. 1978. *Idle Labour in Village India*. Manohar Publication, New Delhi.

Bal H S, Singh B and Bal H K. 1979. Surplus farm labour in Punjab. *Agriculture Situation in India* **33**: 796.

CIRB. *Buffalo.e-library.* Available at http://www.buffalopedia.cirb. res.in/index. php ? option = com_content & view=article & id=56 & Itemid=61 & lang=en.

CSO. 1960. *National Income Statistics (Proposal for revised series of national income)*. Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

CSO. 1961. *National Accounts Statistics*. Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India.

GoI. 1959. *Studies in Economics of Farm Management in Uttar Pradesh*. Report for 1955–56. Ministry of Food and Agriculture, Government of India, New Delhi.

GoI. 2011. *Animal Husbandry Statistics*. Manual No. CSO M AHBS 2011, Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India. Available at http://www.mospi.gov.in/sites/default/files/publication_reports/Manual%20on%20Animal%20Husbandry%20Statistics.pdf.

GoI. 2015. *Estimated Livestock Population Breed wise: Based on breed survey 2013*. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.

Kumbhare S L, Sharma K N S and Patel R K. 1983. Standardization of bovine units. *Indian Journal of Animal Sciences* **53**(5): 547–50.

Moore M P. 1978. Some micro-economic aspects of livestock economy. *Indian Journal of Agricultural Economics* **33**(1): 67–77.

Pandey R. 2010. *Quantitative Estimation of Livestock Feed from Forest in Uttaranchal Himalayas*. Project Completion Report, Environmental Impact Assessment Division, Indian Council of Forestry Research and Education, Dehradun, Uttarakhand, India.

Patel R K and Kumbhare S L. 1980. Employment for rural women in dairy enterprises. *Indian Dairyman* **32**: 852–54.

Patel R K, Kumar P and Vogee K. 1975. *Economics of crossbred cattle-A case study of the cattle breeding programme of Indo-Swiss Project*, Karnal (Mimeo). National Dairy Research Institute, Karnal.

Patel R L and Thumar B L. 1977. An economic analysis of bullock draught power on Saurashtra farms. *Artha-Vikas* **12**: 45.

Prabhakaran V T and Raut K C. 1979. *Labour Utilization in Maintenance of Bovines and Animal Production (Bikaner area, Rajasthan)* (Mimeo). Indian Agricultural Statistics Research Institute, New Delhi.

Rani U. 1981. 'Role of farm women of weaker section in dairy enterprise.' MSc Dissertation (unpublished), National Dairy Research, Institute, Karnal.

Singh B, Singh R and Bullar B S. 1980. A study into cost of milk production in Punjab. *Financing Agriculture* **11**: 59–61.

Sirohi S, Saxena R, Chauhan A K, Dhaka J P, Sirohi S K, Kumar N, Sharma D, Pal K, Agrawal P, Sharma A, Kumar S, Feroze S M, Burdhan D, Kumar S, Chand P and Fulpagare Y G. 2015. *Costs and Returns in Milk Production: Developing Standardized Methodology and Estimates for Various Dairy Production Systems*. Project report submitted to Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi.

Vyas V S. 1971. *Economics of Dairy Farming in Mehsana District of Gujarat* (Mimeo). Agro-economic research centre, Vallabh Vidyanagar.

Yang W Y. 1971. *Methods of Farm Management Investigation*. FAO Agriculture Development Paper, No. **80**: 59–60.