

Assessment of survey method for estimating annual milk production

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ARTICLE HISTORY

Received: 25/11/16

Peer reviewed: 01-12/12/16

Received in revised form: 23/1/2/16

Accepted: 01/01/17

KEYWORDS

Breed
Cattle
Jersey cross
Livestock
Milk production
Sample survey

ABSTRACT

The study objective was to evaluate the method of probability sample surveys for estimating annual milk production. Field survey was conducted in Samdrup Jongkhar *dzongkhag* (district) from September-November 2016. Field sampling included 1058 households from total households of 2257 with milking cattle. Questionnaires were used to interview respondents of 11 *gewogs* (block). Planning Analysis tool was used for estimating milking cattle population growth and milk production. Results showed that majority of dairy cattle in production were Jersey cross, followed by *Thrabum* and *Jatsham*. Milk yield of Jersey cross was highest round the year with peak in summer between May and August. Maximum milk production in the *dzongkhag* was contributed by this breed. Total milk production estimated for Samdrup Jongkhar for 2016 was 3,662MT. The error margin of estimate was within the 5% level suggesting that the estimate was reasonably accurate. Thus, the systematic sample survey of households could address ambiguity in annual livestock census for which data was usually collected in lean season (November-December). However, for improving its reliability, the method needs re-validation in other representative *dzongkhags* through appropriate sampling design and data collection. The study concluded that the estimate derived is within 95% confidence level indicating that quality of data collected by extension staff during the annual census and surveys were good. The results also suggest that there are opportunities to enhance milk production in the study *gewogs*.

INTRODUCTION

The annual livestock census is data collected on livestock number (population) and products. The census report published by the Department of Livestock (DoL) is the result of complete enumeration of households carried out by *Gewog* (block) Livestock Extension Officers in 205 *gewogs* using a set of structured questionnaires developed by DoL. The enumeration is monitored by *Dzongkhag* (district) Livestock Officer. Preliminary data processing of livestock census starts at individual *gewog* level and by last week of December all compiled data from *gewogs* and *dzongkhags* reaches DoL. Outputs and a report are available by March in the following year.

To overcome specific problems such as time and money required to collect data from all households and explore opportunities to strengthen and bring improvements in livestock statistics, a pilot survey on estimation of milk production was first implemented in Haa *dzongkhag* in 2014. The study recommended carrying out similar surveys in representative *dzongkhags* of three other regions to re-confirm milk production estimate across four regions of the country. Hence, this study is a follow-up to provide precise operational and technical details on a pilot sample survey on milk production. The survey was conducted by DoL in Samdrup Jongkhar *dzongkhag* from September to November 2016. The survey undertaken is within the framework of Food and Agriculture Organization (FAO) of United Nations's global

strategy to improve agricultural and rural statistics. The objectives of the study were to derive average yield and lactation length of different cattle types, estimate milk production during three different seasons of the year, evaluate the use of probability sample surveys to estimate milk production for the year, and explore the potential use of sample surveys for estimation of milk production in the *dzongkhags/gewogs* using the household data from the previous year.

MATERIALS AND METHOD

Sampling frame

The overall sample size at the *dzongkhag* level is 30% (1058 out of 3529 households). However, drawing a sample of 30% from 3529 households would have decreased considerably the reliability of the estimates mainly due to inclusion of households without milking animals. Hence, the population domain for the survey was chosen as 2257 households with milking cattle, a suitable frame available with DoL (DoL 2015). Of the total households with milking cattle, 1058 households (47%) were selected for the sample survey. This approach was adopted for increasing the efficiency of a sampling design.

Sample size

The number of households drawn in a *gewog* was proportional to the number of milking animals in the *gewog*. For example, in the case of Deothang *gewog*, the number of sampled households was $=121/2257 \times 1058 = 57$. This allocation assumed that higher the number of milking animals in a *gewog*, more is the milk production. The summarised sampling framework and sample size are presented in Table 1. The survey covered all 11 *gewogs*. In each *gewog*, “a circular systematic sample of households” was drawn from the total size to ensure that every household has equal chance to be selected.

Two types of questionnaires (*gewog* and household level) were designed for the survey. The questionnaires were pre-tested in the field. The *gewog* questionnaire captured data that were not likely to vary within the same *gewog*. Household questionnaire, on the other hand, was prepared to collect data that could be reported accurately at the household level (FAO 2015). Fourteen *dzongkhag* and *gewog* staff were trained on survey methods and data collection in September 2016. An instruction manual for precise recording of details was also provided.

Process of estimation of milk production for 2016

The planning analysis tool and formula prescribed by Parker (2002) were applied to estimate the trend in annual cattle population growth. Out of 2,257 households with milking cattle in 2015, 1,058 households sampled were subtracted. The remaining households with estimated number of milking cattle in 2016 were multiplied with the respective lactation length and average daily yield to estimate milk production of non-sampled households. The milk production estimate of non-sampled households was added to milk production of sampled households to generate total milk production estimate of Samdrup Jongkhar *dzongkhag* for 2016. For calculating milking cattle population growth rates (straight line method) the following formula was used:

$$PR = \frac{V_{\text{present}} - V_{\text{past}}}{V_{\text{past}}} \times 100$$

(Source: University of Oregon, USA)

Where: PR = Percent Rate; V_{present} = Present or Future Value; V_{past} = Past or Present Value. The annual percentage growth rate is the percent growth divided by N (number of years).

Data analysis

Data was entered in Microsoft Access, processed in Excel and analysed in SPSS version 20.

Table 1 Summarized sampling framework and sample size. hh-household.

Sl. No	<i>Gewog</i>	Total hh with Cattle (2015)	hh with Milking Cattle 2015	Sampled hh for survey	Quotient for Random Start Number(RSN)
1	Deothang	155	121	57	2
2	Gomdar	374	352	165	2
3	Langchenphu	224	147	69	2
4	Lauri	277	199	93	2
5	Martshala	561	315	148	2
6	Orong	483	243	114	2
7	Pemathang	248	196	92	2
8	Phuentshothang	651	261	122	2
9	Samrang	22	19	9	2
10	serthig	220	152	71	2
11	Wangphu	314	252	118	2
12	Total	3529	2257	1058	

RESULTS AND DISCUSSION

Lactation Length

The average lactation period was longest (280 days) for Pure Jersey cows (Figure 1). Very consistent lactation length (260-265 days) was found for other three local breeds (*Jaba*, *Deothra* and *Yangkum*). The lactation length was slightly lower (253-254 days) for *Thrabam* and *Jatsham*. However, the lactation length reported for Jersey cross was 241 days (8 months) which is lower than the standard lactation length of 305 days (10 months) for *Bos taurus* cattle breeds (Chamberlain 1989). This could have probably resulted from absence of written record and inaccurate or improper recollection of lactation length by interviewees in such recall method.

Dairy cattle in production

Vast majority of dairy cattle in production in October 2016 were Jersey cross, followed by *Thrabum* and *Jatsham* (Figure 2). It indicates that Jersey cross are consistent milkers that can contribute to farmers' income and family nutrition. The majority of respondents fed willow tree leaves as fresh fodder, and few conserved it as hay and bag silage for winter feeding.

Average milk yield during three different seasons

Milk yield of cattle was highest in summer (May to August). Among all cattle types, Jersey cross gave the highest average milk yield of 6.73 litres per day. Milk production from Jersey cross was also highest for all seasons, indicating that maximum milk contribution for the *dzongkhag* is from this breed of cattle. The average milk yield of local cattle types (*Jatsham*, *Deobum*, *Deothram*, *Thrabam* and *Jaba*) was 2.0 to 2.6 litres per day (Table 2).

Total milk production estimate for Samdrup Jongkhar

The total milk production in Samdrup Jongkhar in 2016 was estimated at 3,662MT, of which the highest production of 542MT was from Martshala *gewog*, and the lowest production of 17MT was from Samrang *gewog* (Figure 3). The total milk produced in summer (May to August) accounted 42% of the total milk production. Milk production was lowest in September to December (28%) (Figure 4). Amongst dairy cattle, over half (56%) of milk production in September-December was estimated from Jersey cross cattle. Additional

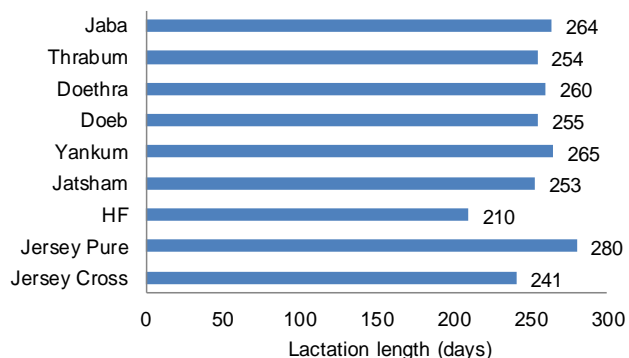


Figure 1 Lactation period by type of dairy cattle (days).

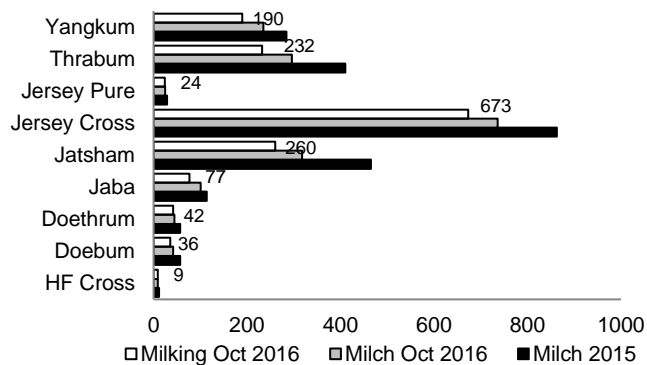


Figure 2 Estimated number of milking dairy cattle in October 2016.

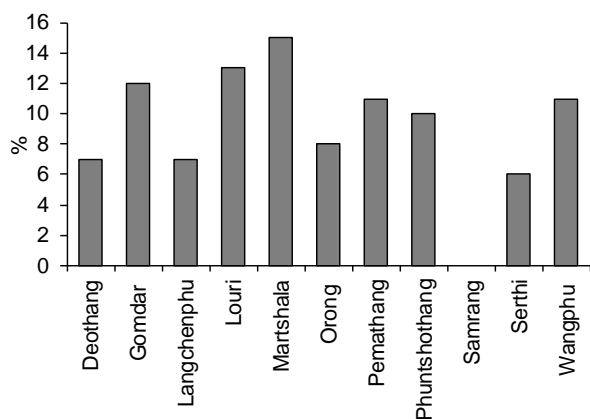


Figure 3 Share of milk production (MT) by gewog in 2016.

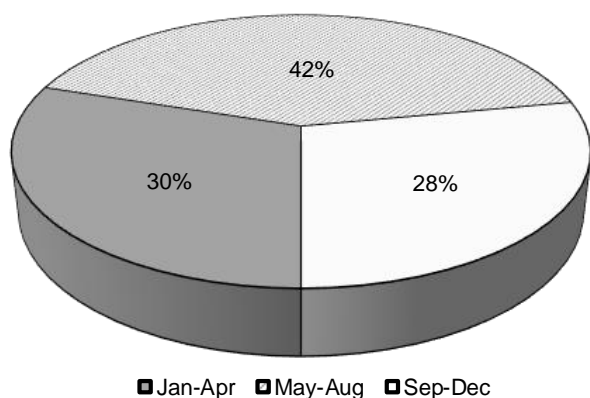


Figure 4 Share of milk production (MT) by season in 2016.

23% of the total milk production in the same period was from *Thrabum* and *Jatsham* (Table 3).

Gewog-wise share of milk production is presented in Figure 5. Based on the volume of annual milk produced, the production level of *gewogs* could be categorised into three types: Category 1- production less than 250MT, Category 2- production between 250 to 450MT, and Category 3- production above 450MT. The survey result showed that *Martshala*, *Louri* and *Gomdar* were the highest milk producing *gewogs* (>450MT), whereas *Samrang*, *Langchenphu* and *Serthi* *gewogs* produced less than 250MT milk annually. The milk production from the *gewog*, however, depended on milking cattle population in the *gewog*. The highest milk production in

Table 2 Average milk yield of cattle types during three different seasons. SD=Standard Deviation.

Milking animal type	Milk yield (litres day ⁻¹)			Mean	SD
	Jan-Apr	May-Aug	Sep-Dec		
<i>Doebum</i>	1.25	2.00	2.00	1.75	0.35
<i>Doethram</i>	1.67	2.67	3.00	2.44	0.57
Holstein Friesian	4.50	6.25	4.25	5.00	0.89
<i>Jaba</i>	1.33	2.50	1.33	1.72	0.55
<i>Jatsham</i>	2.30	2.60	1.90	2.27	0.29
Jersey Cross	4.82	6.73	4.27	5.27	1.05
Jersey Pure	4.00	6.00	4.00	4.67	0.94
<i>Thrabum</i>	1.56	2.44	1.67	1.89	0.40
<i>Yangkum</i>	1.90	2.60	1.70	2.07	0.39

Table 3 Milk production by cattle breed in Sept-Dec in Samdrup Jongkhar.

Livestock breed	Sept- Dec 2016 (kg)	Share (%)
Jersey cross	576,991	56
Jersey pure	19,787	2
HF cross	16,363	2
<i>Jatsha-Jatsham</i>	124,662	12
<i>Yanku-Yangkum</i>	79,588	8
<i>Doeb-Doebum</i>	63,070	6
<i>Doethra-Doethrum</i>	20,280	2
<i>Nublang-Thrabum</i>	109,643	11
<i>Jaba</i>	19,360	2
Total	1,029,743	100

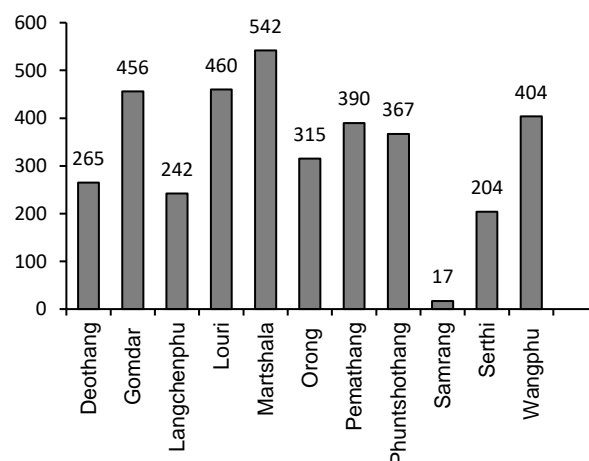


Figure 5 Milk production (MT) in gewogs.

Martshala is attributed to the number of milking dairy cattle (315) in the *gewog* (DoL 2015).

Sample survey milk production estimate for 2016

The milk production estimate for 2016 ranged from 3,604 to 3,720MT. The survey examined the Standard Error (SE) and Relative Standard Error (RSE) for the estimate (Table 4). The error margin of estimate was within 5% level. RSE up to 5% is an indication of very high quality data (FAO 2015). Hence, the estimate of milk production is reasonably accurate at 95% confidence level. It also confirms that the quality of data collected by livestock staff during livestock census and surveys are good. To derive total milk production, the seasonal estimates for productive dairy cattle (milking animal, milk production) based on recalls and forecasts may not be statistically reliable. Thus, there is a need to improve the survey design by broadening in-country experience and making necessary progressive adjustments over time.

Table 4 Milk production estimation with margin of error.

<i>Gewog</i>	hh with cattle (2015)	hh with milking cattle (2015)	Sampled hh with milking cattle (current survey)	Estimated milk production 2016 (MT)	Estimated SE (MT)	% Standard Error (RSE ⁶)
Dewathang	155	121	57	265	9.5	3.6
Gomdar	374	352	165	456	12.4	2.7
Langchenphu	224	147	69	242	6.4	2.6
Lauri	277	199	93	460	6.8	1.5
Martshala	561	315	148	542	14.0	2.6
Orong	483	243	114	315	12.8	4.1
Pemathang	248	196	92	390	8.4	2.2
Phuentshothang	651	261	122	367	11.8	3.2
Samrang	22	19	9	17	0.5	2.9
Serthi	220	152	71	204	4.4	2.2
Wangphu	314	252	118	404	8.4	2.1
Total	3529	2257	1058	3,662	-	-

⁶Relative Standard Error (RSE) of an estimate is its Standard Error (SE) expressed as percentage of its estimated value. RSE up to 5% is an indication of very high quality data

CONCLUSIONS

The annual milk production estimate for Samdrup Jongkhar in 2016 is between 3,604 to 3,720MT. The estimate is reasonably accurate. However, efforts should be continued to improve it further through proper orientation and training of staff on data collection, controlling non-sampling errors for fast changing indicators, policies, and strategies. The milk production estimate has to be validated through appropriate sampling design and data collection methods for improving its reliability. The milk production sample survey is recommended for two more representative *dzongkhags* in west-central and east-central regions in 2017 and 2018 to validate the method; provide hands-on-training to field staff, and gain experience.

The annual survey has no provision to record seasonal variation in milk production. Season, livestock type, and management practices can play a major role in household milk production. The annual survey during early winter might underestimate the total milk production in a year. Hence, some adjustments are required in gathering more representative data considering the influence of environment on milk production. Adjustments are also required in the reporting frequency on milk production and other aspects based on emerging needs. The milk production enhancement opportunities exist for Lauri, Martshala and Gomdar Geogs, thus, potential of these

gewogs needs to be tapped through proper planning and programming.

ACKNOWLEDGEMENTS

The Department of Livestock gratefully acknowledges the generous fund support of FAO to carry out the survey and sharing a report of the first pilot sample survey in Haa. The DoL team also acknowledges guidance from Director General, DoL and support from DLO and his staff of Samdrup Jongkhar to carry out the survey.

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