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**Pratik Ramesh Wankhade**

Research Scholar, Livestock Production Management (LPM), ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

**Hari Om Pandey**

Scientist, LPM, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**Mukesh Singh**

Principal Scientist, LPM, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**AKS Tomar**

Principal Scientist, LPM, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**Cherryl Dimphna Miranda**

Research Scholar, Livestock Production Management (LPM), ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

**Arun Somagond**

Research Scholar, Livestock Production Management (LPM), ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

**Prachurya Biswal**

Research Scholar, Livestock Production Management (LPM), ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

**Med Ram Verma**

Principal Scientist, Division of Livestock Economics, Statistics and Information Technology, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**Gyanendra Kumar Gaur**

Principal Scientist, LPM, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**Triveni Dutt**

Principal Scientist, LPM, ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh, India

**Corresponding Author:**

**Pratik Ramesh Wankhade**

Research Scholar, Livestock Production Management (LPM), ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

## Milking frequency affects consumptive water usage in the parlor

**Pratik Ramesh Wankhade, Hari Om Pandey, Mukesh Singh, AKS Tomar, Cherryl Dimphna Miranda, Arun Somagond, Prachurya Biswal, Med Ram Verma, Gyanendra Kumar Gaur and Triveni Dutt**

### Abstract

Milk production is the water intensive process which demands huge amount of water. Due to changing climatic scenario, it is worthy to understand and quantify the water usage for various activity at the dairy farms. In this study, we measured the consumptive water usage in the milking parlor for crossbred Vrindavani cows which were machine or hand milked. Higher quantity of water usage was recorded for machine milked Vrindavani cows (42 L/animal/day) compared to hand milked cows (28 L/animal/day). Further, computation of water usage based on per kg of milk yield revealed that machine milked cows consumed less water (4.0 L) than hand milked (4.26 L) Vrindavani cows.

**Keywords:** Water usage, milking parlor, organized dairy farm, Vrindavani crossbred cows

### Introduction

India is the largest producer of milk in the world contributing 22% of global milk production (FAO, 2021) [5]. During 2019-20, the country produced about 198.4 MT of milk (PIB, 2021) [10], and such huge quantity of milk production obviously consumes large amount of fresh water. In the dairy farm, large quantities of water are utilized for various production process such as cleaning of animal's sheds and milking parlor, washing of animals, feed and fodder cultivations, drinking purposes, etc. In this context, Boguniewicz-Zablocka *et al.* (2019) [1] reported that 1-10 m<sup>3</sup> of water is required for production of 1 m<sup>3</sup> of milk.

The quantitative information about water usage under current Indian dairy production systems are unavailable due to lack of records about water usage by dairy farmers. On the other hand, on-farm water consumption data is essential for calculation of water footprint which is required to develop water management practices to conserve water use at dairy farms. The cautious water usage is more applicable under the changing global climatic scenario, where incidences of water scarcities due to less rainfall and drought conditions are not uncommon. Indeed, limited studies are available regarding the water uses at milking parlor under different climatic and milking practicing conditions (Krauss *et al.* 2016; Higham *et al.* 2017) [8, 6]. However, no such studies are available in sub-tropical climatic conditions at unorganized and organized dairy farms. Water usage in dairy farms varies with several factors including herd size, milking practices, cleaning practices, milk production, season, etc., Considering the importance of water usage, in this study, we measured the water usage in milking parlor at organized dairy farm during summer season.

### Material and Methods

#### Experimental animals and management

The experiment was conducted at cattle and buffalo farm (CBF), ICAR-IVRI, Izatnagar, Bareilly, Uttar Pradesh (India) which is located in upper gangetic plain agro-ecological region on 28° 22' N latitude and 79° 24' E longitude during summer season. The mean meteorological parameters recorded like temperature, relative humidity, wind speed and precipitation were 31.12±1.30°C, 49.96±4.04%, 1.45±0.12 km/h and 0.62±0.48 mm, respectively during study period from April to June 2019. The experimental procedures were duly approved by Institute Animal Ethical Committee. Total 80 machine milking and 65 hand milking Vrindavani crossbred cows were enrolled for the study. Animals were housed under loose housing system as per BIS (Bureau of Indian Standards) specification. Cows were fed according to NRC (2001) [9] recommendation using institute grown seasonal green fodders like maize, jowar,

oats, bajra, hybrid Napier, and lobia along with dry fodder (wheat straw) and commercially available concentrates.

### Milking management and recording

Vrindavani cows yielding more than 10-12 L/day were milked thrice in a day using machine (M/S DeLaval bucket milking system) and the cows producing less than 10L/day were hand milked twice per day, in a separate milking parlor. The cows were milked at 600 to 900 h, 1200 to 1400 h and 1600 to 1900 h in a day. Daily milk yield was recorded using electronic weighing balance.

### Measurement of consumptive water usage

The floor of milking parlor and equipment's used for milking were washed after each milking with the help of hose pipe of 1.5 mm diameter. We measured the water required for the washing purpose with the help of water meter (M/S Scientific devices Pvt. Ltd., Mumbai, Maharashtra, India) on weekly interval. The washing of animals prior to milking was not included in this study.

### Statistical analysis

General linear model was used to test significance of the differences between Vrindavani machine and hand milking cows for the consumptive water uses in the milking parlor. Data were expressed as Mean  $\pm$  SE and significant differences were considered when  $P < 0.05$ . The statistical analysis was performed using SPSS version 22 software package (SPSS for windows, V22.0; M/s SPSS Inc., Chicago, IL, USA).

## Results and Discussion

### Overall consumptive water usage under different milking system

The consumptive water uses (CWU) in the milking parlor comprised of water used for cleaning the surface of the parlor and washing of milking equipment's after the milking. Significantly ( $P < 0.001$ ) higher CWUs was observed in Vrindavani machine milked cows than hand milked cows (Table 1; Fig 1). It appears that more milking frequency combined with frequent washing of parlor and equipment's could be a reason for more water usage in case of machine milking. Krauss *et al.* (2016)<sup>[8]</sup> reported more water usage for cleaning purpose (34 L/cow/day) in conventional herringbone

milking parlor (HBP) than automatic milking system (AMS; 29 L/cow/day). Lesser quantity of water usage for cleaning purpose under AMS was also reported by Drastig *et al.* (2010)<sup>[3]</sup>. Cleaning methods, type of flooring, soil condition of surfaces due to different weather conditions and knowledge of workers also affects the water consumption at dairy farms.

### Consumptive water usage per kg of milk production

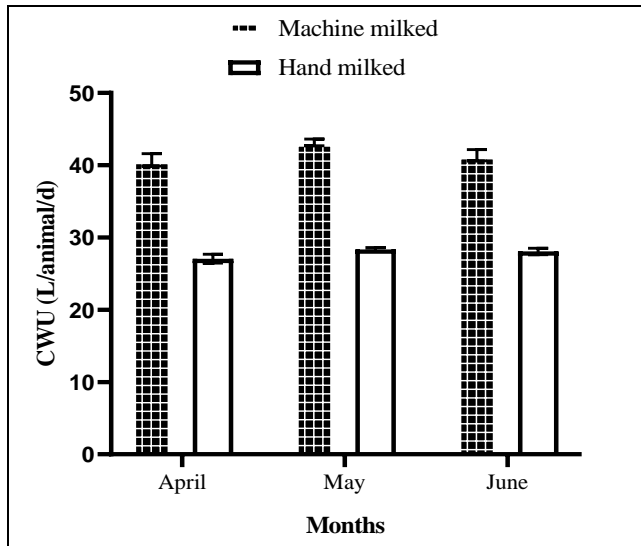
Machine milked cows produced significantly ( $P < 0.001$ ) more milk (10 kg) than hand milked (6 kg) cows during study period (Table1). The CWUs per kg of milk production was more in hand milked cows (4.26 $\pm$ 0.09 L/kg milk) than machine milked cows (4.06 $\pm$ 0.13 L/kg milk). The observed higher trend of water usage in hand milked cows is due to lesser milk production. Compared to our study, lesser quantity of 0.2-0.4 L water use per kg milk was reported in automatic milking system (AMS) which was optimized for low water use and operated with maximum number of cows (Rasmussen and Petersen, 2004; Jensen, 2009)<sup>[11, 7]</sup>. About 22 L/cow/day was estimated by Chapagain and Hoekstra (2003)<sup>[2]</sup> in their calculation of cleaning water demand for livestock production. Whereas, Eide (2002)<sup>[4]</sup> estimated cleaning water demand of 0.3 L/kg of milk in Norway.

The higher amount of CWUs in our study can be attributed due to the smaller number of milking animals, methodology of parlor cleaning and low sensitivity of water conservation at dairy farm. For instance, Krauss *et al.* (2016)<sup>[8]</sup> reported more water usage for cleaning purpose in HBP system (average yield of 25 kg) than AMS (average yield of 36 kg milk). The washing of parlor and equipment's were performed with a high-pressure hose pipe of around 1.5 inches diameter. The parlor was supplied via farms own borewell, due to this reason no costs were incurred for the procurement of water. Taken together it is concluded that larger water demand by machine milked cows due to high milk yield and higher milking frequency can be compensated by overall higher milk production. In addition, monitoring of water usage along with water sensitive dairy workers in the milking parlor is recommended to avoid water wastage. Based on the findings, study for longer duration with greater number of milking animals is needed to estimate annual water consumption at the milking parlor.

**Table 1:** Consumptive water usage (L/animal/d) for cleaning & washing of milking parlor, equipment's and average daily milk yield (kg/d) of Vrindavani cows

Vrindavani cows	April	May	June	Average
<b>Machine milked (N=80)</b>				
Milking parlor	36.34 $\pm$ 0.87 <sup>Ap</sup>	38.47 $\pm$ 0.48 <sup>Aq</sup>	36.76 $\pm$ 0.71 <sup>Ap</sup>	37.19 $\pm$ 0.46 <sup>A</sup>
Equipment's	4.41 $\pm$ 0.09 <sup>Ap</sup>	4.69 $\pm$ 0.06 <sup>Aq</sup>	4.63 $\pm$ 0.08 <sup>Apq</sup>	4.58 $\pm$ 0.05 <sup>A</sup>
Milk yield	10.69 $\pm$ 0.69 <sup>ap</sup>	10.33 $\pm$ 0.76 <sup>ap</sup>	10.09 $\pm$ 0.99 <sup>ap</sup>	10.37 $\pm$ 0.45 <sup>A</sup>
CWU (L/animal/day)	40.75 $\pm$ 0.86 <sup>Ap</sup>	43.16 $\pm$ 0.45 <sup>Ap</sup>	41.39 $\pm$ 0.77 <sup>Ap</sup>	41.77 $\pm$ 0.48 <sup>A</sup>
CWU (L/kg milk)	3.83 $\pm$ 0.18 <sup>ap</sup>	4.21 $\pm$ 0.22 <sup>ap</sup>	4.15 $\pm$ 0.29 <sup>ap</sup>	4.06 $\pm$ 0.13 <sup>a</sup>
<b>Hand milked (N=65)</b>				
Milking parlor	24.53 $\pm$ 0.58 <sup>Bp</sup>	25.58 $\pm$ 0.30 <sup>Bp</sup>	25.22 $\pm$ 0.51 <sup>Bp</sup>	25.11 $\pm$ 0.28 <sup>B</sup>
Equipment's	2.54 $\pm$ 0.09 <sup>Bp</sup>	2.78 $\pm$ 0.05 <sup>Bpq</sup>	2.85 $\pm$ 0.07 <sup>Bq</sup>	2.72 $\pm$ 0.06 <sup>B</sup>
Milk yield	6.26 $\pm$ 0.32 <sup>bp</sup>	6.75 $\pm$ 0.44 <sup>bp</sup>	6.67 $\pm$ 0.31 <sup>bp</sup>	6.56 $\pm$ 0.20 <sup>B</sup>
CWU (L/animal/day)	27.07 $\pm$ 0.62 <sup>Bp</sup>	28.36 $\pm$ 0.25 <sup>Bp</sup>	28.07 $\pm$ 0.45 <sup>Bp</sup>	27.83 $\pm$ 0.30 <sup>B</sup>
CWU (L/kg milk)	4.34 $\pm$ 0.17 <sup>ap</sup>	4.22 $\pm$ 0.19 <sup>ap</sup>	4.21 $\pm$ 0.12 <sup>ap</sup>	4.26 $\pm$ 0.09 <sup>a</sup>

Values are expressed as Means  $\pm$  SE. AB ab Means bearing different superscripts in a column differ significantly (Capital Letter  $P < 0.001$ ; Small letter  $P < 0.05$ ), pqr Means bearing different superscripts in a row differ significantly ( $P < 0.05$ ).



**Fig 1:** Consumptive water usage (L/animal/day) in Vrindavani machine and hand milked cows

### Conflict of Interest

The authors declare no conflicts of interest.

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