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Association of various farm management parameters with milk yield

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Abstract
The profitability of any dairy farm depends on their milk production performances. Hence, to determine the association of milk productivity with various farm management parameters, the data was collected from randomly selected 44 dairy farms regarding all the aspects of management *viz.* production, reproduction, feeding, housing, health and miscellaneous management activities. The result revealed that out of 26 parameters, 19 parameters was found to have significant association with milk productivity (L/SAU/day). The number of days open/calving conception interval and labour utilization efficiency/labour productivity (Rs./kg) was found to have significantly negative association, while, overall pregnancy rate (%), first service conception rate (%), peak milk yield (L), herd average (L), culling/adult mortality rate (%), pregnant non-pregnant ratio, milch dry ratio, regularity in deworming and faecal examination, better forage concentrate ratio, presence of adequate stocking capacity, irrigation facilities, automation in milking, higher degree of farm automation, loose housing system with proper waste disposal system along with environmental controlled dairy housing was found to have significantly positive association with milk productivity. Hence, it could be expected that improvement in these management parameters is supposed to improve the milk productivity of a dairy farm.

Keywords: Profitability, productivity, improvement and farm management parameters

Introduction
The profitability/productivity of any dairy farm largely depends on the management practices employed for running the farms. The production performances of dairy farm indicates the income and profitability, whereas, reproduction performances decides the future existence of that farm. However, there exists the highly complex and diverse relationships among different parameters along with the overall profitability of a dairy farm (Ostergaard *et al.*, 2000) [17]. Each of these parameters have their own importance in successful dairy production, moreover, some parameters are positively correlated with each other, whereas, other parameters showed negative correlation with various traits. Hence, the livestock managers need insight into the potential impact of management decisions on technical performance and economic results (Morvits *et al.*, 1997) [14] and to decide which parameters had to be considered for improving the milk productivity and which had to be discarded. Hence, the present investigation has been designed to determine the association of various farm management parameters with milk yield.

Materials and Method
For present investigation, data from randomly selected 44 dairy farms was collected using pretested questionnaire. The various parameters covering maximum possible aspects of management *viz.* production, reproduction, culling, health management practices, feeding management practices, housing management parameters and other miscellaneous management parameters was taken into the consideration. These 26 parameters were peak milk yield (L), lactation persistency (%), cattle buffalo ratio, milch dry ratio, herd average, presence of automation in milk collection, pregnant non-pregnant ratio, service period/calving conception interval, overall pregnancy rate (%), first service conception rate (%),culling/adult mortality rate (%), calf mortality rate (%), regularity in vaccination, deworming, faecal examination, mastitis rate (%), presence of adequate stocking capacity, on farm forage production, availability of irrigation facilities, forage concentrate ratio, presence of loose/conventional housing, proper waste disposal system, waste utilization in dairy farms and environmental controlled dairy housing, labour productivity/utilization efficiency and degree of farm automation.

To nullify the effect of species and breed on milk productivity, the standard animal unit (SAU) was calculated as per the method reported by Sirohi *et al.*, 2019 [20]. The correlation between wet average/milk productivity (L/SAU/day) with different management parameters was calculated using MS excel software for windows.

Results and Discussion

Table 1: Correlation of different parameters with wet average/farm productivity (L/SAU/day)

S. No.	Parameter	Correlation
1	No. of days open/Calving conception interval	-0.41**
2	Overall pregnancy rate (%)	0.45**
3	First service conception rate (%)	0.41**
4	Peak milk yield average (L)	0.98**
5	Lactation persistency (%)	0.22
6	Herd average (L)	0.98**
7	Culling/adult mortality rate (%)	0.51**
8	Calf mortality rate (%)	-0.26
9	Fodder/ALU (kg)	-0.16
10	Fodder/Season (kg)	-0.14
11	Labor productivity/Utilisation efficiency (Rs./kg)	-0.36*
12	Mastitis rate (%)	0.06
13	Pregnant non-pregnant ratio	0.56**
14	Cattle buffalo ratio	-0.14
15	Milch dry ratio	0.55**
16	Regularity in deworming	0.38*
17	Regularity in faecal examination	0.81**
18	Stocking capacity	0.55**
19	Irrigation facilities	0.54**
20	Forage concentrate ratio	0.81**
21	Automation in milking	0.79**
22	Degree of farm automation	0.80**
23	Waste disposal system	0.43**
24	Waste disposal utilization	0.10
25	Housing system (Loose/Conventional)	0.58**
26	Presence of environmental controlled dairy housing system	0.81**

Note: *$P < 0.05$, **$P < 0.01$

As shown in Table-1, the correlation of number of days open/calving conception interval was found to be negatively and significantly associated ($P \leq 0.01$) with milk productivity of dairy farms. Anan and Soller, 2010 had also reported negative association with number of days open and 305 days milk yield. Such association might be due to the fact that the average production of each cow per day will reduce, since, the cows spends relatively greater time duration in late lactation, during which the milk yields are comparatively lower (Nemeckova *et al.*, 2015) [15].

The correlation of overall pregnancy rate was found to have significantly positive relationship ($P \leq 0.01$) with per day milk yield, which means that better pregnancy rate improves the milk productivity of animals. It may be due to the fact that animal will comparatively spends greater duration on the early part of lactation curve, when the milk production is higher and the cost of feed is comparatively less that the earnings from the milk production (Lormore, 2018) [11].

The first service conception rate was found to have significantly positive correlation with the per day milk yield ($P \leq 0.01$). The farms with high production was supposed to have better heat detection capacity, semen quality and breeding techniques, thereby improving the rate of conception at first service (Krpalkova *et al.*, 2016) [9]. Moreover, higher first service conception rate reduces the number of services per conception and number of days open/calving conception interval, which in turn improves the milk productivity of animals.

The higher peak milk yield improves the milk productivity of animals. Since, each unit increase in peak milk yield increases the 300 days total yield by 200 units (Moran, 2009; Anon, 2021) [13,21], thereby, improving the productivity of a dairy farm. Similar observations were also reported by Lean *et al.*, 1989 [10] and Oliveira *et al.*, 2020 [16].

The herd average depends on the ratio of lactating and non-lactating animals in a farm. Since, the farms with better efficiency of milk production had better milch dry ratio, which in turn reflects the better herd average of a farm. This may be one of the reasons for significantly positive correlation ($P \leq 0.01$) between herd averages with productivity of a farm.

The farms with high milk production tend to have higher culling/adult mortality rate in their dairy farms. The rate of culling, either voluntary or involuntary in a dairy farm largely depends on the balance between the production and fertility traits of the animal. The high productivity of animals may worsen the health status (mastitis, lameness and various other metabolic disorders) and fertility of an animal (Horvath *et al.,* 2017) [8], which may be one of the reasons for significantly positive correlation ($P \leq 0.01$) between culling/adult mortality rate with productivity of a farm.

The correlation of labour productivity/utilization efficiency with milk productivity was found to be statistically significant and negative ($P \leq 0.05$), which means that improvement in the production of milk along with utilizing less amount of labour, will significantly improve the milk productivity of a dairy farm. Since, the labour cost is the second most incurring cost for running any dairy farm (Erickson and Kalscheur, 2020) [5], which means that if the labour had been utilized in much better way to get higher amount of outputs in the form of milk, the productivity of such farms can be increased.

The adequate pregnancy ratio in a dairy farm was significantly associated ($P \leq 0.01$). with milk productivity, which may be due to the fact that overall production of milk

get increased, as such animals spends more time at the front part of the lactation curve, during which the feed cost per unit production of milk is much lower at this duration (Lormore, 2018) [11]. Moreover, the failure to achieve the optimum pregnant non-pregnant ratio decreases the number of calves born per cow, thereby affecting the milk productivity of a farm.

The drying off of animals-calving-initiation of new lactation are the series of transitional events that occurs in a well-managed dairy farms. Such sequential event is necessary to maintain the sustainable productivity and profitability of farms. This may be one of the reasons for significantly positive correlation of milch dry ratio with milk productivity of a farm. This finding was in corroboration with Gadariya *et al.,* 2018 [6] had also observed maximum performance in optimum size and milch dry composition of Gir herd.

The regularity in deworming not only promotes the feed utilization capacity of farm animals but also improves there health status, thereby, improving both the quantity and quality of milk. Whereas, routine faecal examination is useful to diagnose the health condition of animal, hence the prevention of animals from diseases and maintaining them in healthy condition. These might be some of the reasons for significantly positive correlation of these parameters with milk productivity of a farm. Shrestha *et al.*, 2020 [19], had also observed the positive effect of deworming on milk productivity of animals.

The adequate stocking capacity assures the continuous and adequate supply of feeds and fodders to the animals, whereas, presence of irrigation facilities in a dairy farm assures the continuous supply of water for fodder production besides it's usage for drinking, cleaning of animals and housing. These may be some of the reasons for improvement of animal's productivity of a dairy farm.

The forage concentrate ratio was found to impart significantly positive association ($P \leq 0.01$) with milk productivity of animals, which might be due to the fact that adequate forage concentrate ratio ensures the proper supply of all macro and micronutrients that are vital for maintaining the proper health, production and reproduction of animal. Moreover, the animals having adequate fiber content in diet had better eating rate, dry matter intake and milk yield with lesser rumination time along with better rate of lipid metabolism (Shi *et al.*, 2018; Meir *et al.*, 2021) [18, 12].

The improvement in automation of dairy farms is supposed to improve the efficiency of labour utilization, thereby improving the overall health, care and management of animals. This may be one of the reasons for significantly positive impact on milk productivity. This finding was in agreement with Tse *et al.*, 2018 [21], who reported average increase of 2% to 25% in milk yield in case of automated milking systems as compared to that conventional milking system. Moreover, Bhavya *et al.*, 2018 [4], had also reported improvement in the production due to the mechanization and automation of dairy farms.

The improvement in the waste disposal system was found to significantly improve the per day milk production of dairy farm. The proper waste disposal system is supposed to be associated with welfare, environmental and health concerns of the dairy animals (Grossi *et al.*, 2019) [19]. Hence, the presence of proper waste disposal system was reflected in the form of better productivity by animals.

The behavior and welfare of dairy cows is affected by the physical environment they are housed in (Wang *et al.*, 2016) [22]. The housing condition which provides the freedom of expression was supposed to be associated with welfare of dairy animals. Such welfare condition leads to lower levels of aggression, better heat detection and improved levels of lying/resting time, which was reflected in the form of optimum production, reproduction and health status of dairy animals. Moreover, the cows on loose housing systems had lower incidences of hoof pathologies and mastitis (Arnott *et al.*, 2017) [2]. These may be some of the reasons for positive association ($P \leq 0.01$) of milk productivity of animals with loose and environmental controlled dairy housing system.

Conclusions
The production performance of dairy animals depends on the management practices followed in the farm. Out of 26 parameters that covers almost all the aspects of management, 19 parameters *viz.* the number of days open/calving conception interval, overall pregnancy rate (%), first service conception rate (%), peak milk yield (L), herd average (L), culling/adult mortality rate (%), labour productivity/use efficiency (Rs./kg), pregnant non-pregnant ratio, milch dry ratio, regularity in deworming and faecal examination, better forage concentrate ratio, presence of adequate stocking capacity, irrigation facilities, automation in milking, higher degree of farm automation, loose housing system with proper waste disposal system along with environmental controlled dairy housing was found to have significant association with milk productivity. Hence, the due consideration given to improve these parameters is supposed to increase the milk productivity of dairy farm.

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