



An Assessment of dairy farmers livelihoods and dairy breed performance in the Ganjam Dairy Cluster Odisha

Nihar Ranjan Bhuyan¹, Parle Kalyan Chakravarthy², Mehazabeen A³, Ajay Kumar Purusty⁴

¹ ABM Scholar, Department of Agri-Business Management, Centurion University of Technology and Management, Paralakhemundi, Odisha, India

² Associate Professor, School of Management, Centurion University of Technology and Management, Odisha-761211, India

³ Assistant Professor, School of Management, Centurion University of Technology and Management, Odisha, India

⁴ Associate Professor, Department of Agricultural Extension Education, Centurion University of Technology and Management, Paralakhemundi, Odisha, India

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Abstract

Dairy farming is an important livelihood activity in Odisha contributing to household income and livelihood security. The present study assessed the livelihoods of dairy farmers and the performance of major dairy breeds in the Ganjam Dairy Cluster of Odisha. The study covered five blocks, namely Bhanjanagar, Asika, Polasara, Kukudakhandi and Digapahandi and included 135 dairy farmers from 22 villages selected through a multistage sampling procedure. Primary data were collected using a structured and pre-tested interview schedule while secondary information was obtained from relevant government publications reports and literature. Descriptive statistics, cost and return analysis, Benefit–Cost Ratio (BCR), multiple-response analysis, ANOVA, simple linear regression and Henry Garrett Ranking Technique were employed. The results showed that 57.78% of farmers belonged to the 31–50 years age group, while the largest proportion of farmers (40.00%) maintained medium-sized herds of 3–5 animals. The average herd size was 5.46 animals and average milk yield was 7.03 L/day. Jersey was the predominant breed (65.19%), followed by indigenous cattle (39.26%), buffaloes (32.59%) and HF crossbreds (18.52%). The mean monthly dairy income was ₹36,385 and all herd-size categories recorded a BCR greater than one. Feed and fodder constituted the largest share of production cost (52.24%). Regression analysis indicated a positive but statistically non-significant relationship between adoption of improved dairy practices and milk yield ($p = 0.123$). ANOVA revealed significant differences in income across herd-size categories ($F = 1695.14$, $p < 0.001$). Frequent animal diseases, lack of institutional credit and scarcity of green fodder were identified as the major constraints. The study recommends strengthening veterinary services, fodder availability, institutional credit and scientific dairy management to improve dairy productivity profitability and farmers' livelihoods.

Keywords: Dairy farming, dairy farmers, livelihoods, dairy breeds, milk yield, Ganjam Dairy Cluster, profitability, BCR, adoption, constraints

Introduction

Dairy farming is an integral part of Indian agriculture and rural livelihoods, contributing to household income, employment, food security and regular cash flow. In rural farming systems, dairy animals complement crop-based agriculture, while milk sales provide a regular source of income to farm households. Dairy farming is particularly important for small and marginal farmers because it can be integrated with existing farming activities and provide relatively regular returns. However, dairy farmers face several challenges related to feed costs, balanced rations, animal health, breeding services, extension support, management practices and adoption of scientific dairy technologies. Understanding these aspects is important for improving dairy productivity and strengthening the livelihood benefits of the sector. Livelihood assessment of dairy-farming households generally considers socio-economic characteristics, herd size and composition, farming experience, income sources, access to extension services and management practices. Breed composition is also an important determinant of dairy production, as genetic potential interacts with feeding, management and animal-health practices to influence milk productivity and

farm income. Previous studies have shown that socio-economic and management characteristics can influence farmers' adoption of improved practices, productivity, income generation and livelihood outcomes. Statistical techniques such as descriptive analysis, analysis of variance (ANOVA) and regression analysis can be used to examine variations and relationships among important dairy-farming variables, while ranking techniques can help identify the major constraints faced by farmers. The Ganjam Dairy Cluster represents an important dairy-producing region of Odisha, where dairy farming contributes to household livelihood diversification and income generation. However, differences in herd size, breed composition, production practices, resource availability and access to institutional support may result in variations in dairy productivity and livelihood benefits among farmers. A systematic assessment at the cluster level is therefore required to understand the socio-economic and livelihood conditions of dairy farmers and the composition and performance of major dairy breeds. The present study provides an empirical assessment of dairy farmers' livelihoods and dairy production in the Ganjam Dairy Cluster of Odisha, covering Bhanjanagar, Asika, Polasara, Kukudakhandi and Digapahandi blocks. Primary

data were collected from 135 dairy farmers across 22 selected villages using a structured interview schedule. The specific objectives of the study were:

1. To assess the socio-economic characteristics and livelihood dependence of dairy farmers in the Ganjam Dairy Cluster.
2. To analyse the breed composition and selected performance-related characteristics of major dairy breeds reared by farmers in the study area.

The study employs descriptive statistics, analysis of variance (ANOVA), regression analysis, multiple-response analysis and the Henry Garrett Ranking Technique to provide an empirical assessment of dairy farmers' livelihoods, dairy production and major constraints in the study area.

Materials and Methods

The present study was conducted in Ganjam district of Odisha to assess the livelihoods of dairy farmers and the performance of major dairy breeds. The study covered five dairy-intensive blocks, namely Bhanjanagar, Asika, Polasara, Kukudakhundi and Digapahandi, which were selected purposively based on their importance in dairy farming and diversity in production systems. A multistage sampling procedure was adopted, covering 135 dairy farmers from 22 selected villages. The study area was selected purposively, while villages and respondents were selected using a random/proportionate sampling procedure. Both primary and secondary data were used for the study. Primary data were collected through personal interviews using a structured and pre-tested interview schedule. Information was collected on socio-economic characteristics, landholding, herd size, farming experience, breed composition, milk yield, lactation length, disease incidence, feeding and management practices, veterinary care, adoption of improved dairy practices, production costs, income, profitability and constraints. Secondary data were obtained from government publications, *Basic Animal Husbandry Statistics*, departmental reports, journals, books and other relevant sources. Descriptive statistics, cost and return analysis, Benefit–Cost Ratio (BCR), Multiple Response Analysis, Analysis of Variance (ANOVA), Simple Linear Regression and the Henry Garrett Ranking Technique were employed for data analysis. Frequency, percentage, mean and standard deviation were used to describe the socio-economic and production characteristics of the respondents. ANOVA was used to examine differences in income across herd-size categories. Simple linear regression was used to assess the relationship between adoption of improved dairy practices and milk yield. Multiple Response Analysis was used to assess variables involving multiple responses, such as breed composition and other selected dairy practices. The Henry Garrett Ranking Technique was used to identify and prioritise the major constraints faced by dairy farmers.

Selection of Study Area and Sampling

A multistage sampling procedure was adopted for the selection of respondents. The five dairy-intensive blocks, namely Bhanjanagar, Asika, Polasara, Kukudakhundi and Digapahandi were selected purposively based on their importance in dairy farming and diversity in production systems. Subsequently 22 villages were selected from these

blocks using proportionate sampling and 135 dairy farmers were selected randomly from the sampled villages.

Data Collection and Variables

The primary data included information on age, education, landholding, herd size, farming experience, occupation, annual income, breed composition, milk yield, lactation length, disease incidence, feeding management, veterinary care, adoption of improved dairy practices, production costs, income, profitability, and constraints. The study also examined the relationship between socio-economic and management variables and dairy productivity. The dependent and independent variables were defined and measured according to the objectives of the study.

Descriptive Statistical Analysis

Frequency, percentage, mean, and standard deviation were used to summarize the characteristics of the respondents and dairy-production variables.

Mean

The arithmetic mean was used to determine the average value of variables such as milk yield, income, cost, and farming experience.

$$\bar{X} = \frac{\sum X_i}{N}$$

Where

- $\bar{X}$ = Mean value
- X_i = Individual observation
- N = Total number of observations

Standard Deviation

Standard deviation was used to measure the variability of observations around the mean.

$$SD = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N}}$$

Where

- SD = Standard deviation
- X_i = Individual observation
- $\bar{X}$ = Mean of the observations
- N = Total number of observations

The mean and standard deviation were particularly used for variables such as milk yield, income, total cost, and farming experience.

Percentage Analysis

Percentage analysis was used to describe the distribution of respondents across different categories such as age, education, herd size, farming experience, and adoption level.

$$Percentage = \frac{F}{N} \times 100$$

Where

- F = Frequency of respondents in a particular category
- N = Total number of respondents

For example, if 69 out of 135 respondents belong to a particular category:

$$\text{Percentage} = \frac{69}{135} \times 100 = 51.11\%$$

Percentage analysis was also used for variables where respondents could select multiple responses, with the understanding that the combined percentage may exceed 100 per cent in multiple-response questions.

Analysis of Variance (ANOVA)

Analysis of Variance (ANOVA) was used to examine whether significant differences existed between the means of different groups. In the present study, ANOVA was applied to examine differences in income and total cost across different herd-size categories, as well as variations in milk productivity across relevant breed and herd-size groups. The level of significance was considered at 5 per cent ($p < 0.05$).

The F-statistic was calculated as

$$F = \frac{MSB}{MSW}$$

Where

- F = F-ratio
- MSB = Mean Square Between groups
- MSW = Mean Square Within groups

A statistically significant F-value indicates that the group means are not all equal.

Garrett Ranking Technique

The Garrett Ranking Technique was employed to identify and rank the major constraints faced by dairy farmers. Respondents were asked to rank the identified constraints according to their perceived importance. The assigned ranks were converted into percentage positions and subsequently into Garrett scores.

The percentage position was calculated as

$$\text{Percent Position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where

- R_{ij} = Rank given for the i^{th} factor by the j^{th} respondent
- N_j = Total number of factors ranked by the j^{th} respondent

The corresponding Garrett table scores were then used to calculate the mean score for each constraint, and the constraints were arranged according to their resulting scores.

Profitability Analysis

Profit analysis was undertaken to evaluate the economic performance of dairy farming. Profit was calculated as the difference between total income generated from dairy activities and total cost incurred in dairy production.

$$\text{Profit} = \text{Total Income} - \text{Total Cost}$$

Where

- Total Income = Income generated from dairy activities
- Total Cost = Total expenditure incurred in dairy production

A positive value indicates that total income exceeds the total cost of dairy production.

Benefit–Cost Ratio (BCR)

The Benefit–Cost Ratio (BCR) was calculated to assess the economic efficiency and profitability of dairy farming across different herd-size categories.

$$BCR = \frac{\text{Total Income}}{\text{Total Cost}}$$

Where

- Total Income = Total returns generated from dairy activities
- Total Cost = Total cost incurred in dairy production

A BCR greater than one indicates that the total income exceeds the total cost.

Regression Analysis

Regression analysis was used to examine the relationship between dairy technology adoption and milk production. The analysis evaluates the extent to which changes in the independent variable are associated with changes in the dependent variable.

The simple linear regression model was specified as

Where

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

- Y = Milk yield (L/day)
- X = Composite adoption score
- β_0 = Intercept
- β_1 = Regression coefficient
- ε = Error term

The regression coefficient indicates the expected change in the dependent variable associated with a one-unit change in the independent variable.

Multiple Response Analysis

Multiple Response Analysis was used for questions where respondents were permitted to select more than one option. In the present study, it was applied particularly to breed composition and adoption of dairy technologies and management practices.

The percentage of respondents reporting a particular response was calculated as

$$\text{Percentage} = \frac{\text{Frequency of a particular response}}{\text{Total respondents}} \times 100$$

Because respondents could select more than one option, the sum of percentages may exceed 100 per cent.

Analytical Framework

The analytical framework was designed to examine how socio-economic and management characteristics influence dairy-farming performance. Variables such as age, education, farming experience, herd size, and adoption of improved dairy practices were considered in relation to outcomes such as milk yield, income, total cost, profit, and BCR. Descriptive statistics, correlation, regression analysis, ANOVA, economic analysis, multiple-response analysis, and Garrett ranking were used to address the different

objectives of the study.

Results and Discussion

Socio-economic Profile of Respondents

The socio-economic profile describes respondents' age, education, herd size, and farming experience, providing insights into livelihood conditions, decision-making, technology adoption, and dairy productivity in Ganjam district

Table 1: Distribution of Respondents by Age

Sl. No.	Age Category	Age Range (Years)	Frequency (n)	Percentage (%)
1	Young	≤ 30	34	25.19
2	Middle	31 – 50	78	57.78
3	Old	> 50	23	17.04
Total			135	100

The age distribution indicates that 57.78% of dairy farmers are middle-aged (31–50 years), forming the dominant group. Young farmers (≤30 years) constitute 25.19%, suggesting moderate

participation and potential for technology adoption. Farmers above 50 years represent 17.04%, indicating lower participation in intensive dairy operations within the study area overall.

Table 2: Educational profile of the respondents

Sl. No.	Education Level	Frequency (n)	Percentage (%)
1	Illiterate	0	0.00
2	Primary (up to Class V)	32	23.70
3	Secondary (Class IX–X)	36	26.67
4	Higher Secondary (Class XI–XII)	29	21.48
5	Graduate & above	38	28.15
Total		135	100.00

The educational profile shows that 28.15% of respondents are graduates or above, followed by secondary education (26.67%), primary education (23.70%), and higher secondary education

(21.48%). No respondents were illiterate, indicating high literacy levels and greater potential for understanding modern dairy practices, accessing knowledge, and improving productivity and livelihoods.

Table 3: Distribution of Respondents by Herd Size

Sl. No.	Herd Size Category	Number of Farmers	Percentage (%)
1	1–2 animals	33	24.44
2	3–5 animals	54	40.00
3	6–10 animals	36	26.67
4	>10 animals	12	8.89
Total		135	100.00

The distribution of dairy farmers by herd size shows that the largest proportion of respondents (40.00%) maintained 3–5 animals, followed by 26.67% with 6–10 animals and

24.44% with 1–2 animals. Only 8.89% of farmers maintained more than 10 animals. The average herd size was 5.46 animals with a standard deviation of 3.83.

Table 4: Distribution of Respondents by Farming Experience

Sl. No.	Experience Category	Farming Experience (Years)	Frequency (n)	Percentage (%)
1	Low Experience	≤ 5 years	15	11.11
2	Medium Experience	6 – 10 years	75	55.56
3	High Experience	> 10 years	45	33.33
Total			135	100

The farming experience distribution shows that 55.56% of respondents have 6–10 years of experience, followed by 33.33% with over 10 years. Only 11.11% have five years or less. The findings

indicate that most farmers possess moderate to extensive dairy farming experience, supporting established management practices and accumulated practical knowledge.

Milk Yield and Productivity Analysis

Table 5: Average Milk Yield by Herd Size Category

Sl. No.	Herd Size Category	No. of Farmers (n)	Percentage (%)	Average Milk Yield (litres/day)
1	Small (1–2 animals)	33	24.44	5.68
2	Medium (3–5 animals)	54	40.00	6.32
3	Large (6–10 animals)	36	26.67	7.5
4	Very Large (>10 animals)	12	8.89	10.5
Total		135		

Average milk yield increased consistently with herd size, from 5.68 L/day among farmers with 1–2 animals to 10.50 L/day among farmers maintaining more than 10 animals. This indicates higher milk output among larger herd-size categories. However, the observed difference may also reflect variations in breed composition, feeding practices and herd

management.

Income and Cost Analysis

Dairy income reflects financial returns, while costs represent operational expenses; analysing both helps assess profitability, economic sustainability, and financial performance of dairy farming operations.

Table 6: Distribution of Dairy Farmers by Monthly Income Level

Sl. No.	Income Category	Income Range (₹)	Frequency (n)	Percentage (%)
1	Low Income	Below 25,000	46	34.07
2	Medium Income	25,001 – 50,000	60	44.44
3	High Income	50,001 – 80,000	25	18.52
4	Very High Income	Above 80,000	4	2.96
Total			135	100.00

The income distribution shows that 44.44% of farmers fall in the medium-income category, while 34.07% are low-income. High-income farmers account for 18.52%, and very-high-

income farmers 2.96%. Mean income was ₹36,385, indicating moderate earnings with substantial variation associated with herd size, milk production, and management practices.

Table 7: Average Monthly Cost of Dairy Production

Sl. No.	Cost Component	Average cost (₹/month)	Percentage of Total Cost (%)
1	Feed & Fodder	4,639	52.24
2	Labour	1,513	17.03
3	Veterinary Care	931	10.48
4	Breeding/AI	431	4.85
5	Electricity & Water	558	6.29
6	Miscellaneous	809	9.11
	Total Cost	8,880	

The average total cost of dairy production was ₹8,880 per month. Feed and fodder constituted the largest share of total production cost (52.24%), followed by labour (17.03%) and veterinary expenses (10.48%). Breeding and artificial insemination accounted for 4.85%, while electricity and water and miscellaneous expenses accounted for 6.29% and 9.11%, respectively. The findings indicate that feed and

fodder was the major cost component in dairy production.

Profitability and BCR Analysis

Profitability indicates dairy economic viability through net returns after costs, while BCR measures financial efficiency. Values above one indicates profitability. The study compares profitability and BCR across herd-size categories.

Table 8: Profit and BCR across Herd Size Categories

Condition	Category	Mean Income (₹/month)	Mean Cost (₹/ month)	Mean Profit (₹/month)	BCR
1–2	Small	24666.66	5187.88	19478.79	4.75
3–5	Medium	33425.92	9174.07	24251.85	3.64
6–10	Large	62388.88	10705.56	51683.33	5.83
>10	Very Larg	80166.66	11133.33	69033.33	7.20

The profitability analysis revealed that all herd-size categories recorded Benefit–Cost Ratios (BCRs) greater than one, indicating that dairy farming was economically viable across all categories. The BCR was highest among farmers with herds of above 10 animals (7.20), followed by those with 6–10 animals (5.83), 1–2 animals (4.75) and 3–5 animals (3.64). Although the 3–5 animal category recorded

the lowest BCR, all categories remained profitable, with profitability generally increasing with herd size.

Adoption of Impede Practices

Adoption of improved dairy practices enhances productivity, efficiency, and profitability through scientific feeding, better breeding, housing, health monitoring, and improved farm management.

Table 9: Adoption of Selected Improved Dairy Practices among Respondents

Adoption Level	Frequency (n)	Percentage (%)
Low (≤ 2.5)	19	14.07
Medium (2.6–3.2)	69	51.11
High (> 3.2)	47	34.81
Total	135	

The findings revealed that 51.11% of the respondents had a medium level of adoption of improved dairy technologies, while 34.81% had a high level and 14.07% had a low level of adoption. This indicates that adoption was predominantly at a medium level, highlighting the need for strengthened extension support, technical training and improved access to dairy inputs and services to promote wider adoption of improved dairy technologies.

Breed Composition and Performance

Breed composition influences milk production, disease resistance, adaptability, and farm output. The study examined major dairy breeds and their performance in the study area.

Table 10: Breed Composition of Dairy Animals (Multiple Response Analysis)

Sl. NO.	Breed	Frequency (n)	Percentage (%)
1	Jersey	88	65.19
2	Indigenous	53	39.26
3	Buffalo	44	32.59
4	HF Cross	25	18.52
5	Others	20	14.81

The breed composition of dairy animals among the respondents showed that Jersey was the predominant breed (65.19%), followed by indigenous cattle (39.26%) and buffaloes (32.59%). HF crossbreds and other breeds accounted for 18.52% and 14.81%, respectively. The results indicate a diverse breed composition among dairy farmers in the study area.

Table 11: Distribution of Reported Lactation Length among Respondents

Lactation Length (days)	Frequency (n)	Percentage (%)
241–300 days	113	83.70
Above 300 days	22	16.30
Total	135	100.00

The lactation profile shows that 83.70% of animals have lactation periods of 241–300 days, while 16.30% exceed 300 days. The findings indicate predominantly normal lactation durations, highlighting opportunities to improve feeding, breeding, and veterinary management for enhanced productivity and farm returns.

Disease Incidence Analysis

Disease incidence affects dairy productivity, animal health, and farm profitability through reduced milk production and higher veterinary costs. The study examined disease incidence across major dairy breeds to understand disease patterns and their implications for dairy management and productivity in the study area.

Table 12: Disease Incidence by Breed Type

Column	Breed	Total Breed	Disease Count	Disease
1	Jersey	88	75	85.23
2	HF	25	20	80.00
3	Buffalo	44	35	79.55
4	Indigenous	53	40	75.47
5	Other	20	15	75.00

Note: Breed categories were recorded using multiple responses; disease incidence percentages are calculated within each reported breed category.

The disease incidence was highest in Jersey cattle (85.23%), followed by HF cattle (80.00%), buffaloes (79.55%), indigenous cattle (75.47%), and other breeds (75.00%). The findings indicate considerable disease occurrence across breeds, emphasizing vaccination, veterinary care, proper nutrition, hygiene, and improved herd-health management practices for reducing health-related losses.

ANOVA Results (Income across Herd Size Categories)

ANOVA was used to test whether mean income differed significantly across small, medium, large, and very large herd-size groups. The analysis examined whether herd size was associated with significant variation in dairy farmers' income levels and financial returns across different operational scales.

Table 13: Mean Dairy Income across Herd Size Categories

Herd Size Category	Sample Size (n)	Mean Income (₹)	Standard Deviation (₹)
1–2 Animals	33	24,667	924
3–5 Animals	54	33,426	3,093
6–10 Animals	36	62,389	4,311
Above 10 Animals	12	80,167	577

Mean dairy income showed an increasing pattern with herd size. This pattern suggests that larger herds may generate greater marketable milk output and income through increased production capacity. However, income may also be influenced by breed composition, milk productivity, management practices and production costs.

Table 14: ANOVA Results for Income across Herd Size Categories

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F-value	p-value
Between Groups	4.61×10^{10}	3	1.54×10^{10}	1695.14	< 0.001
Within Groups	1.19×10^9	131	9.07×10^6	—	—
Total	4.73×10^{10}	134	—	—	—

Note: df = degrees of freedom; SS = Sum of Squares; MS = Mean Square.

ANOVA revealed a statistically significant difference in mean dairy income across herd-size categories ($F = 1695.14$, $p < 0.001$). The result indicates that income varies significantly across operational herd sizes, supporting the importance of herd scale in dairy-farm income generation.

Hypothesis Testing

At the 5% significance level, the null hypothesis was rejected because $p < 0.001$. Therefore, a statistically significant difference exists in mean dairy income across herd-size categories.

Regression Analysis

The simple linear regression model was specified as $Y = \beta_0 + \beta_1 X + \varepsilon$, where Y represents milk yield (L/day), X represents the composite adoption score, β_0 represents the intercept, β_1 represents the regression coefficient, and ε represents the error term.

Table 15: Regression Results for Adoption of Improved Dairy Technologies and Milk Yield

Variable	Coefficient (β)	Standard Error	t-value	p-value
Intercept (a)	5.12	0.68	7.53	< 0.001
Adoption Score (b)	0.48	0.31	1.55	0.123

Note: Dependent variable = Milk yield (L/day); Independent variable = Adoption score; n = 135; significance level = 5%.

The regression coefficient for adoption of improved dairy technologies was positive ($\beta = 0.48$) but statistically non-significant ($p = 0.123$). This indicates that higher adoption scores were associated with higher milk yield, but the relationship was not statistically significant at the 5% level. Therefore, adoption score alone did not provide sufficient evidence of a significant association with milk yield in the study sample.

Estimated regression equation

$\hat{Y} = 5.12 + 0.48X$

Constraints Analysis (Garrett Ranking)

The Garrett Ranking Technique was used to identify and rank major constraints faced by dairy farmers. Respondents ranked various constraints, which were converted into Garrett scores. Mean scores were then calculated to classify constraints according to their severity, from the most severe to the least severe.

Table 16: Garrett Ranking of Constraints Faced by Dairy Farmers

Rank	Constraint	Mean Garrett Score
1	Frequent animal diseases	41.37
2	Lack of institutional credit	35.16
3	Scarcity of green fodder	30.15
4	Inadequate veterinary services	25.30
5	High cost of feed	21.78
6	Labour shortage	13.03
7	Low / fluctuating milk prices	10.92
8	Poor market access	7.30

Garrett ranking identified frequent animal diseases as the most critical constraint, with the highest mean score of 41.37. Lack of institutional credit ranked second, followed by scarcity of green fodder. These constraints affect dairy productivity, farmers' income, resource access, and opportunities for expanding dairy farming operations.

Conclusion Summary

The study found that dairy farming is an important livelihood activity in the Ganjam Dairy Cluster. Larger herds recorded higher milk yield, income and profitability, with all herd-size categories showing BCR above one. Jersey was the predominant breed, while feed and fodder accounted for the highest production cost. Adoption of improved practices was considerable, although its relationship with milk yield was positive but statistically non-significant. ANOVA confirmed significant income differences across herd-size categories. Major constraints included animal diseases, inadequate institutional credit and green fodder scarcity. Strengthening veterinary services,

fodder availability, institutional credit and scientific dairy management can improve productivity and farmer livelihoods.

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