An International Multidisciplinary Journal
अनन्यशास्त्रम्
(A Unique Treatise of Knowledge)
ISSN:3049-3927 (Online)

ANANYAŚĀSTRAM:
An International Multidisciplinary Journal
(A Unique Treatise of Knowledge)
Peer-Reviewed | Refereed | Open Access Journal
DOI: https://doi.org/10.64328/aimjv01i030041

Volume: 01 | Issue: 03 | December: 2025
Research Article

Statistical Study on Sustainable Dairy Practices in Rural Maharashtra: A Case Analysis under NEP 2020

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Abstract

This interdisciplinary research and real-world applications to improve India's agricultural and rural economy. In this framework, we study and demonstrate study of Milk Production as case study carrying out in some villages of Pandharpur and Mangalwedha talukas. This study analyses the dynamics of dairy production using statistical tools and sustainable practices. Milk production, a dynamic sector of agriculture, not only contributes significantly to food safety and nutritional health but also supports rural livelihoods and economic growth for the country.

The primary data was collected to study cost structures, productivity and sustainability factors in dairy farming from milk producers. The analysis is carried out to study relationships between variables such as animal maintenance, feedstuff type, hygiene practices and milk yield. The statistical methodology is applied in terms of exploratory data analysis, descriptive statistics and testing of hypothesis. The study findings shown that low margins produced by majority of producers after covering cost related to maintenance and small proportion of producers are reported high profits. The results are shown that there are significant associations between sustainable practices such as regular washing of cattle and the providing of wet fodder and increased milk production and productivity. Furthermore, the study emphasized that there are equal levels of profit both

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buffalo's milk and cow's milk provided by maintenance and nourishing strategies influenced on overall revenues.

Addition with NEP 2020, this case study exhibits how statistical analysis can provide actionable insights for researchers, farmers and policymakers. By aligning training with challenges with practical agriculture, the study supports for data-driven decision-making to enhance profitability, sustainability and resilience in India's dairy farming.

Keywords: Sustainable Dairy Practices, Chi-Square test & NEP 2020.

Introduction

A milk production farming is the one of the major parts of faming which helps in feeding large number of populations .it means we have raised animals like cow, buffalo, goat, sheep etc. and properly maintaining their cleanness and feeding good quality of food to get good quality of milk and also yogurt, cheese and butter etc.

Milk has all the essential nutrient like calcium, protein, healthy fats, and vitamin which help our body grow and make it strong. It has direct impact on muscle building and making bone strong. The also has provide large number of job opportunity. However, milk production also faces challenges such as climate change, disease management, and ethical concerns related to animal welfare. Sustainable practices, including organic farming and eco-friendly production methods, are being increasingly adopted to ensure long-term viability.

Background: Importance of dairy production in India's rural economy.

Nutritional Value:

Milk is a rich in essential vitamin and nutrients calcium, protein, vitamins like A, D, and B12, and minerals. It builds strong bones, increases muscle growth, and overall health, making it an important dietary staple for people of all ages.

Economic Contribution:

The dairy industry provides employment to millions of farmers, workers, and businesses worldwide. From dairy farming to milk processing and distribution, it is a key contributor to national economies.

Food Security:

Milk and dairy products offer an affordable and accessible source of nutrition, helping to combat malnutrition and support growing populations.

Cultural and Traditional Significance:

Milk holds cultural and religious importance in many societies. It is used in traditional recipes, religious rituals, and celebrations across different cultures.

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Versatile Ingredient:

Milk is a base for many food products such as cheese, yogurt, butter, and ice cream. It is widely used in cooking, baking, and beverage production.

Relevance:

Role of dairy in food security, nutrition, and rural employment.

The process of milk production begins with the proper care and feeding of dairy animals to ensure high-quality and sustainable yield. Modern dairy farming utilizes advanced technologies, including automated milking systems, genetic selection, and improved feed management, to enhance production efficiency.

Research Gap

Limited local statistical evidence on sustainable dairy practices.

Limited study on profitability of small town cow and buffalo milk businesses

Lack research which use quantitative approach

Lack of scientific proof research with factual result of impact of daily practices on milk production and profit margin

Lack study on improvement local milk farmer businesses.

Objective of the Study:

- To check whether the milk production is profit making production.
- To check whether how gain more profit from the milk production.
- To check whether the cow's milk is more profitable or buffalo's milk.
- To check whether who to spend more cost to maintain the buffalo or the cow.

Review of Literature

Singh and Sharma (2021) conducted a research on how the statistical analysis can help farmer of Maharashtra in understanding which factors has impact on milk production and quality of milk. This study showed that factors like animal cleaning, type of food given to animals and proper management of maintenance cost has heavy impact on profit margin. When animal is feeds proper nutritious food and kept clean it directly increases the quality of milk and it production. The study found that importance of data-driven decision making in rural dairy sectors to make farming more scientific.

The National Dairy Development Board (NDDB, 2023), in its report on "Sustainability in the Indian Dairy Sector," stressed the role of resource-efficient practices such as balanced ration feeding, water conservation,

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and manure recycling. The board recommended promoting sustainable dairy entrepreneurship through capacity building and financial support for small and marginal farmers

Adoption of recommended dairy farming practices by farmers in Maharashtra under Kamdhenu Dattak Gram Yojana (Kad Sanjay Vasant et al.) This study examines the extent of adoption of recommended dairy-farming practices (breeding, feeding, health, general management, waste management) among beneficiaries and non-beneficiaries of the Kamdhenu Dattak Gram Yojana in Pune & Nashik divisions of Maharashtra. The authors find that beneficiaries had a significantly higher overall adoption index (75.31 vs 66.75 for non-beneficiaries) and note that waste-management practices had the lowest adoption levels. This is directly relevant for understanding sustainable practice uptake in rural Maharashtra's dairy sector.

Dairy development through natural resource management:

it is an story of how an small village in Phand, Hiware Bazar case, Maharashtra successfully developed itself. The case study analyses how an small village likeairy development through natural resource management: a success story of drought prone village in India (Phand, Hiware Bazar case, Maharashtra). The paper analyses a case study of village Hiware Bazar in the drought-prone Ahmednagar district of Maharashtra, showing how community watershed management revitalised allied agriculture and dairy farming, shifting about 70% of families into dairy as a commercial enterprise. The study highlights how natural-resource management (water availability) enabled sustainable dairy development, offering a model of sustainable dairy practices under rural constraints. While not explicitly framed under education policy (NEP 2020) it provides strong contextual evidence for rural-dairy sustainability in Maharashtra.

Socio-Economic Status of Dairy Farmers and Their Constraints in Adoption of Improved Dairy Management Practices (Chinchmalatpure Umesh R., Akola, Maharashtra). This exploratory study on dairy farmers in Akola district (Maharashtra) examines socio-economic status and constraints in adopting improved dairy management practices among farmers with more than four mulch animals and five years' experience. It reports that a large proportion of farmers fall in middle-age, low educational attainment (eight–high school), and face barriers to adoption of improved management practices—useful for your statistical study on sustainable dairy practice adoption in rural Maharashtra.

Research Methodology

Data Collection:

As there are lots of milk producers in Solapur city but we have selected some villages in Pandharpur taluka and some in Mangalwedha, taluka for our data collection. We have collected primary data using some simple questions.

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Results / Findings

Descriptive Analysis:

Histogram:

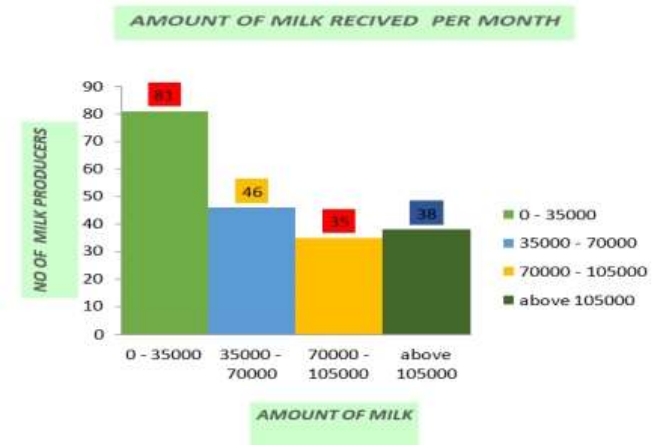

Fig. 1 Amount of milk received per months

Interpretation:

The diagram shows that the number of milk producers earning high profit after recovering all maintenance costs is small. The number of milk producers earning low profit after recovering all maintenance costs is large. Overall, milk production is mainly contributed by small farmers with limited large-scale production.

Pie Chart:

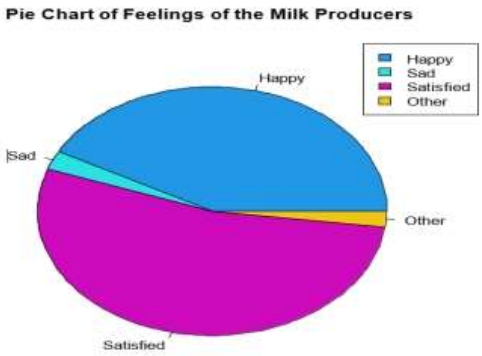

Fig .3 Feelings of the milk Producers

Interpretation:

The pie chart explains the most milk producers are satisfied or happy with their production and work conditions, indicating a generally positive attitude among them.

Simple Bar Diagram:

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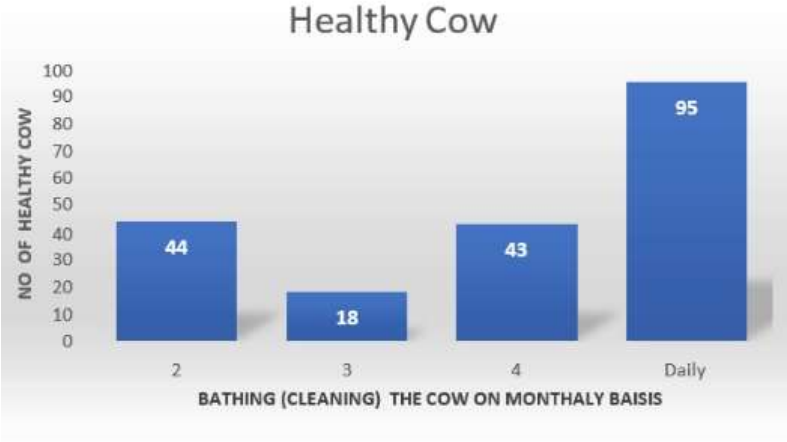

Fig. 4 Number of healthy Cows monthly basis

Interpretation:

If cows or buffaloes are washed daily, the cows or buffaloes will stay healthy and hospital expenses will be reduced. If cows or buffaloes are not washed once a month or never, they will fall ill and hospital expenses will increase.

Simple Bar Diagram:

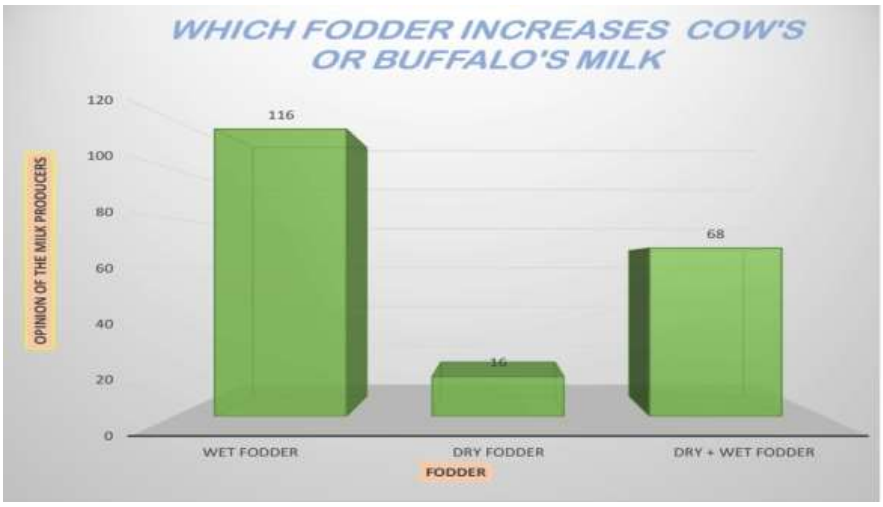

Fig 5.Opinion of milk producers Foder wise

Interpretation:

The illustration of above show that if cows and buffaloes are fed wet fodder, their milk production increases. If cows and buffaloes are fed dry fodder, their milk does not increase as much as when fed wet fodder, so it suggest that we can use mixed fodder like wet and dry combine for better milk production increase.

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Simple Bar Diagram:

Fig. 6 Profit Gain in months of milk producers

Interpretation:

A bar diagram shows that one of the Milk productions is profit making business but it depends on how they do their job.in simple terms the higher milk production directly correlate to higher production. The chart suggests that there is good scope in this business of milk farming.

Multiple bar Diagram:

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Fig. 5 Milk Profit for buffalo and Cow.

Inferential Analysis:

Present Chi-square result:

By using formula: $(Oi – Ei)^2 / Ei$

Hypothesis:

H_0: There is no relationship between washing the cow and increases in milk

H_1: There is relationship between washing the cow and increases in milk

1. Table of observed value:

	Group \ Classes	2	3	4	daily	Total
YES	Obs. Frequency(Oi)	28	6	28	11	73
	Exp. Frequency(ei)	16.06	6.57	15.695	34.675	73
NO	Obs. Frequency(Oi)	16	12	15	84	127
	Exp. Frequency(ei)	27.94	11.43	27.305	60.325	127
Total	Oi	44	18	43	95	200
	ei	44	18	43	95	200

2. Calculation table of X^2

By using formula: $(Oi – Ei)^2 / Ei$

Group \ Classes	2	3	4	daily	Total
Yes, milk increases and also fat& S N F	8.876936	0.049452	9.647214	16.16455	34.73815
No, it doesn't matter	5.102491	0.028425	5.545249	9.291432	19.9676

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Total	13.97943	0.077877	15.19246	25.45598	54.70575

Calculation:

Calculated value of X^2 = 54.70575

Tabulated value of X^2= 7.815

Here Calculated value of X^2>Tabulated value of X^2

Thus, we reject H0 at 5% level of significance

Result: There is relationship between washing the cow and increases in milk

Hypothesis:

H_0: There is no relationship between fodder and growth in milk (cow/buffalo)

H_1: There is relationship between fodder and growth in milk (cow/buffalo)

1. Table of observed value:

Group \ Classes		0 – 10	10 – 20	20 – 30	above 30	TOTAL
Obs. Val	Cattle feed, corn flakes, dry & wet fodder, sugar cane	32	67	23	0	122
	Cattle feed, corn flakes, dry fodder, sugar cane, silage	1	50	2	0	53
	Cattle feed, corn flakes, sugar cane, dry & wet fodder, silage.	9	12	3	0	24
	Other	0	1	0	0	1
Exp. Val	Cattle feed, corn flakes, dry & wet fodder, sugar cane	25.62	79.3	17.08	0	122

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	Cattle feed, corn flakes, dry fodder, sugar cane, silage	11.13	34.45	7.42	0	53
	Cattle feed, corn flakes, sugar cane, dry & wet fodder, silage.	5.04	15.6	3.36	0	24
	Other	0.21	0.65	0.14	0	1
Total	Obs. Val	42	130	28	0	200
	Exp. Val	42	130	28	0	200

2. Calculation table of X^2

By using formula: $(Oi - Ei)^2 / Ei$

	0 – 10	b) 10 – 20	c) 20 – 30	d) above 30	TOTAL
Cattle feed, corn flakes, dry & wet fodder, sugar cane	1.568784	1.907818	2.051897	0	5.528499
Cattle feed, corn flakes, dry fodder, sugar cane, silage	9.219847	7.01894	3.959084	0	20.19787
Cattle feed, corn flakes, sugar cane, dry & wet fodder, silage.	3.111429	0.830769	0.038571	0	3.980769
Other	0.21	0.188462	0.14	0	0.538462

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TOTAL	14.11006	9.945989	6.189552	0	30.2456

Calculation:

Calculated value of X^2 = 30.2456

Tabulated value of X^2= 16.919

Here Calculated value of X^2> Tabulated value of X^2

Thus, we reject H0 at 5% level of significance

Result: There is relationship between fodder and growth in milk (cow/buffalo)

Hypothesis:

H_0: Profit from milk is independent of choice of doing this profession

H_1: Profit from milk is dependent of choice of doing this profession

1. Table of observed value:

		0 – 10000	10000 – 20000	20000– 30000	above 30000	Total
Obs. Val	Because you love doing this business	19	22	12	16	69
	Because of ideas given by friends or relatives	1	2	1	1	5
	As there is more income	15	11	6	8	40
	Addition to agriculture	19	23	21	23	86
Exp. Val	Because you love doing this business					

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Because you love doing this business					
	18.63	20.01	13.8	16.56	69
Because of ideas given by friends or relatives					
	1.35	1.45	1	1.2	5
As there is more income					
	10.8	11.6	8	9.6	40
Addition to agriculture					
	23.22	24.94	17.2	20.64	86
Obs. Val	54	58	40	48	200
Exp. Val	54	58	40	48	200

2.Calculation table of X^2

	a) 0 – 10000	b) 10000 – 20000	c) 20000 – 30000	d) above 30000	Total
Because you love doing this business	0.007348	0.197906	0.234783	0.018937	0.458974
Because of ideas given by friends or relatives	0.090741	0.208621	0	0.033333	0.332695
As there is more income	1.633333	0.031034	0.5	0.266667	2.431034
Addition to agriculture	0.766942	0.150906	0.839535	0.269845	2.027228
Total	2.498364	0.588467	1.574318	0.588782	5.249931

Calculation:

Calculated value of X^2= 5.249931

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Tabulated value of X^2 =16.919

Here Calculated value of X^2< Tabulated value of X^2

Thus, we accept H0 at 5% level of significance

Result: Profit from milk is independent of choice of doing this profession

Hypothesis:

H_0: There is no relationship between provide of dry and wet fodder with profit get from this business per month

H_1: There is relationship between provide of dry and wet fodder with profit get from this business per month

1.Table of observed value:

		0 – 10000	10000 – 20000	20000 – 30000	above 30000	Total
Obs. Val	Selling whole fodder	1	1	0	0	2
	Whole fodder homemade	31	28	9	6	74
	Half sold half homemade	22	29	31	42	124
	Other	0	0	0	0	0
Exp. Val	Selling whole fodder	0.54	0.58	0.4	0.48	2
	Whole fodder homemade	19.98	21.46	14.8	17.76	74
	Half sold half homemade	33.48	35.96	24.8	29.76	124
	Other	0	0	0	0	0
Total	Obs. Val	54	58	40	48	200
	Exp. Val	54	58	40	48	200

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2. Calculation table of X^2

By using formula: $(Oi - Ei)^2 / Ei$

	a)0 – 10000	b) 10000 – 20000	c) 20000 – 30000	d) above 30000	Total
Selling whole fodder	0.391852	0.304138	0.4	0.48	1.57599
Whole fodder homemade	6..078098	1.993085	2.272973	7.787027	12.05309
Half sold half homemade	3.936392	1.34097	1.55	5.034194	11.86156
Other	0	0	0	0	0
Total	4.328244	3.638193	4.222973	13.301221	25.49063

Calculation:

Calculated value of X^2= 25.49063

Tabulated value of X^2= 16.919

Here Calculated value of X^2> Tabulated value of X^2

Thus, we reject H0 at 5% level of significance

Result: There is relationship between provide of dry and wet fodder with profit get from this business per month

Discussion / Analysis :

The study showed that daily practices such as washing cow, proper fodder use, and well maintain good hygiene management practices has direct effect on milk productivity and milk quality

The test like chi-square test found strong relationship between washing animals frequency and increased in milk production meaning it prove that cleaning animal has direct impact on both quality and quantity of milk

The study also state that the type of fodder means type of food like mixture of both dry and wet food result in good quality of milk yield.

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This study state that sustainability dairy practice and management result beneficial in both environmentally and economically approach

Conclusion

This study found that the milk production profitable business Most farmer reported modest profit in milk production business indicating room improvement The data reveal that both cow and buffalo producers achieve more profit by proper management and cost maintenance. The farmer also reported that the buffalo milk yield give slightly high profit than cow milk. The study found that performing Sustainable practices result in improvement of yield, quality of milk, reduce health costs.

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