



Impact of Artificial Insemination on Milk Productivity: A Spatial Analysis of Kolhapur District, Maharashtra

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Abstract:

Artificial insemination (AI) has emerged as a crucial technological intervention in improving livestock productivity and enhancing milk production in rural India. The present study examines the relationship between artificial insemination practices and milk production in Kolhapur District of Maharashtra. Using secondary data related to annual artificial insemination targets, success rates, and total milk collection across twelve tahsils, the study analyzes spatial variations and assesses the effectiveness of AI programs. The findings reveal a positive correlation between higher success rates of artificial insemination and increased milk production, highlighting the importance of scientific breeding methods for sustainable dairy development.

Keywords: Artificial Insemination, Milk Production, Dairy Development, Livestock Management

Introduction:

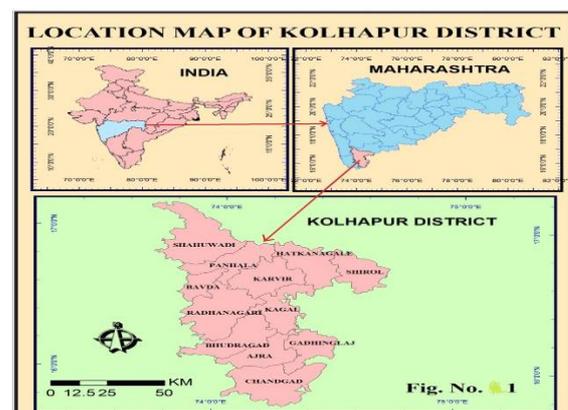
India is the largest producer of milk in the world, and dairy farming plays a significant role in the rural economy. Artificial insemination has become one of the most important tools for genetic improvement of cattle and buffaloes. It helps in increasing milk yield, improving breed quality, and reducing the spread of diseases.

Kolhapur district, located in the south-western part of Maharashtra, is well known for its cooperative dairy movement. The district has diverse geographical conditions ranging from plains to hilly and forested regions, which influence livestock rearing practices. This study attempts to analyze the impact of artificial insemination on milk production across different tahsils of Kolhapur district.

Study Region:

Kolhapur district is the most developed district of Southern-western part of Maharashtra. The absolute location of district is 15° 43' to 17° 17' North Latitude and 73° 40' and 74° 42' East

Longitude. It is surrounded by Sangli district to its North and East, Belgaum district of Karnataka to its South and Sindhudurg district to the West. The Sahyadri ranges to the west and Warana River to the North forms the natural boundaries. The geographical area of districts is 7685 square kilometres, For the administrative purpose the district is divided into 12 Tehsils. The population of the study region is 38, 76, 001 persons, according to 2011 census. The district experiences moderate to high rainfall and has fertile soil, which supports fodder cultivation and dairy farming.



Objectives Of The Study:

1. To analyze the tahsil-wise distribution of artificial insemination targets in Kolhapur district.
2. To study the success rate of artificial insemination across different tahsils.
3. To examine the relationship between artificial insemination success rate and milk production.

Data Source and Methodology:

This study utilizes **secondary data** for the year **2024–25**, obtained from official records of the **District Dairy Development Officer** and the **Department of Animal Husbandry, Kolhapur**. Tahsil-level data covering all twelve tahsils of Kolhapur district were analyzed. The dataset includes annual artificial insemination targets, artificial insemination success rates (%), and total milk collection (thousand liters).

A **quantitative analytical framework** was employed. Descriptive statistics and comparative analysis were used to examine spatial variations in artificial insemination performance. The relationship between artificial insemination success rate and milk production was assessed using **Pearson’s correlation coefficient**, while **simple linear regression analysis** was applied to evaluate the influence of artificial insemination success on milk

production. Graphical representations were used to support interpretation and enhance clarity.

Analysis And Interpretation:

1.Artificial Insemination Targets: The total annual target for artificial insemination in Kolhapur district is **606,262**. Karvir tahsil records the highest target (110,687), followed by Hatkanangale (71,373) and Kagal (65,737). Gaganbavda tahsil has the lowest target (6,686), mainly due to its hilly terrain and forest cover.

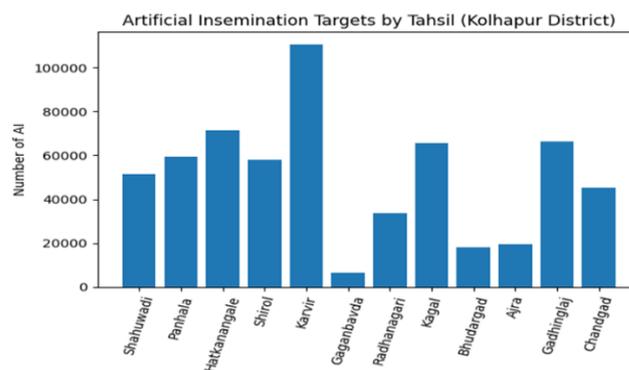


Figure 2: Artificial Insemination Targets by Tahsil

This bar chart shows tahsil-wise annual targets for artificial insemination in Kolhapur district. Karvir tahsil has the highest AI target, indicating better infrastructure and higher livestock population. Gaganbavda has the lowest target due to hilly terrain and forest cover. Plain tahsils such as Hatkanangale, Kagal, and Gadhinglaj show relatively higher targets.

Table No-1: Taluka-wise progress of artificial insemination and milk production (2024-25)

Sr. No.	Tahsils	Annual target for artificial insemination (Number)	Success rate of artificial insemination (Percentage)	Total milk collection ('000 liters)
1	Shahuwadi	51292	19	48640
2	Panhala	59571	15	98314
3	Hatkanangale	71373	18	75800
4	Shirol	57826	16	100756
5	Karvir	110687	26	115600
6	Gaganbavda	6686	10	4950
7	Radhanagari	33754	14	58635
8	Kagal	65737	29	75850
9	Bhudargad	18230	20	26800

10	Ajra	19385	24	30200
11	Gadhinglaj	66431	21	46450
12	Chandgad	45290	16	43500
	Total	606262		725495

Source: District Dairy Development Officer, Kolhapur, District Deputy Commissioner, Animal Husbandry, Kolhapur.

2.Success Rate of Artificial Insemination: This chart represents the percentage success rate of artificial insemination across tahsils. Kagal tahsil records the highest success rate (29%), followed by Karvir (26%) and Ajra (24%). Gaganbavda shows the lowest success rate (10%), reflecting limited accessibility and veterinary services, and traditional livestock practices.

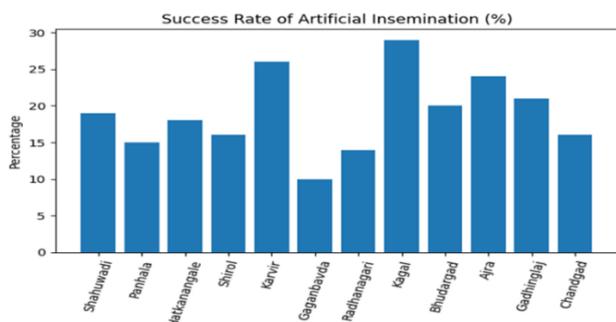


Figure 3: Success Rate of Artificial Insemination (%)

3.Milk Production Pattern: The total milk collection in Kolhapur district is **725,495 thousand liters**. Karvir tahsil contributes the highest milk production (115,600 thousand liters), followed by Shirol (100,756 thousand liters) and Panhala (98,314 thousand liters). Tahsils with higher AI success rates generally show higher milk production, confirming the effectiveness of scientific breeding practices.

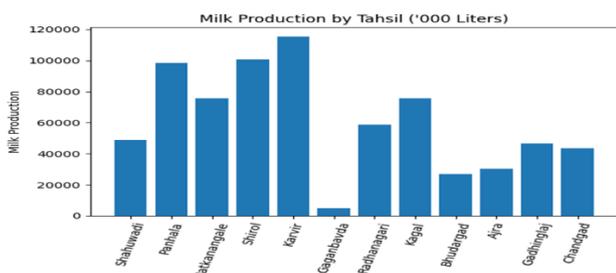


Figure 4: Milk Production by Tahsil

4.Relationship between Artificial Insemination and Milk Production: This scatter graph shows the relationship between artificial insemination success rate and milk production. A positive correlation is clearly visible. Tahsils with higher AI success rates generally produce more milk, proving that artificial insemination plays a vital role in improving dairy productivity.

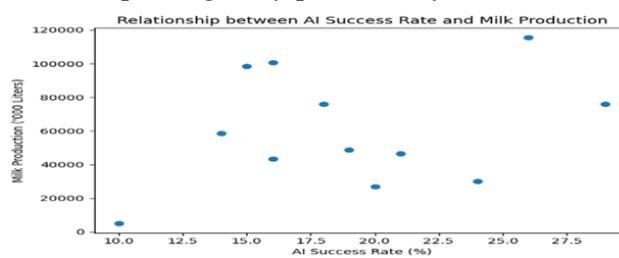


Figure 5: Relationship between AI Success Rate and Milk Production

Statistical Correlation Analysis:

The **Pearson’s correlation coefficient** was calculated to measure the relationship between **artificial insemination success rate (%)** and **milk production ('000 liters)** across the tahsils of Kolhapur district.

Correlation Value

$$r = 0.30$$

The calculated Pearson correlation coefficient (**r = 0.30**) indicates a **moderate positive correlation** between the success rate of artificial insemination and milk production in Kolhapur district. This implies that tahsils with higher artificial insemination success rates generally tend to have higher milk production. However, the relationship is not very strong, suggesting that milk production is also influenced by other factors such as fodder availability, breed

quality, veterinary infrastructure, farmer awareness, and climatic conditions

Findings:

- Artificial insemination targets and success rates vary significantly across tahsils.
- Higher AI success rates contribute to increased milk production.
- Plain and agriculturally developed tahsils perform better than hilly and forested regions.
- Infrastructure, veterinary services, and farmer awareness influence AI success.

Suggestions:

1. Strengthening veterinary infrastructure in hilly tahsils like Gaganbavda and Chandgad
2. Conducting farmer awareness programs on the benefits of artificial insemination
3. Improving access to quality semen and trained technicians
4. Promoting fodder development and balanced cattle feed

Conclusion:

The present study highlights the significant role of artificial insemination in enhancing milk production in Kolhapur district. Tahsil-level analysis reveals notable spatial variations in artificial insemination targets,

success rates, and milk productivity, largely influenced by geographical conditions, veterinary infrastructure, and dairy development levels. A moderate positive correlation between artificial insemination success rate and milk production confirms the effectiveness of scientific breeding practices in improving dairy output. However, the regression results indicate that artificial insemination alone does not fully explain variations in milk production, emphasizing the influence of complementary factors such as fodder availability, breed quality, and farmer awareness. Strengthening artificial insemination services, particularly in hilly and underdeveloped tahsils, along with integrated dairy support systems, can contribute to sustainable milk production and rural livelihood enhancement in the district.

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5. News on milk procurement growth from Kolhapur's primary dairy cooperative