Key constraints in implementation of Artificial Insemination in remote rural area

A. Ranjan[1], G. Sankhala[2], Fatheen Abrar P.N.[1]*, S.K. Roy[3] and S.K. Bishnoi[2]

[1]Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-110012, India
[2]Division of Dairy Extension, ICAR-National Dairy Research Institute, Karnal, Haryana-132001, India
[3]Subject Matter Specialist, ICAR-Krishi Vigyan Kendra Ukhrul, Manipur, India
*Corresponding Author: abrarfatheen@gmail.com

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Abstract

Artificial Insemination (A.I.) is a vital reproductive technology that significantly enhances the genetic potential and productivity of livestock, particularly in regions like Jharkhand, India. Despite its potential, A.I. implementation faces numerous challenges that hinder its effectiveness, particularly in rural areas. This study investigates the key constraints perceived by veterinarians in three districts of Jharkhand viz. Ranchi, Saraikela-Kharsawan, and Ramgarh. Through using the Garret ranking method, the major constraints were identified. The top three constraints were the lack of skilled subordinate staff (69.25), lack of awareness and cooperation of farmers in breeding activities (67.92) and engagement of Vets in other activities (63.83). Other constraints like transport facility limitations for remote areas, lesser concerns like the mishandling of A.I. practices, infertility issues, and inadequate rewards for A.I. technicians were also analysed. The findings highlight the importance of addressing these barriers through targeted interventions, such as training programs for staff, improving infrastructure, and enhancing logistical support. These efforts can significantly improve the success of A.I. programs, thereby boosting livestock productivity in rural India.

Keywords: Artificial Insemination; Veterinarians; Constraints; Livestock; Productivity

Introduction

Artificial Insemination (A.I.) is a crucial reproductive biotechnology widely recognized for its potential to improve the genetic makeup of livestock and enhance productivity in the dairy and animal husbandry sectors. This technology has been successfully implemented in many parts of the world, offering significant advantages such as controlled breeding, enhanced genetic diversity, and prevention of certain diseases (Vishwanath, 2003). In India, A.I. plays a pivotal role in livestock breeding programs, contributing to the growth of the dairy industry and improving livestock productivity (Durrant, 2009). However, the success of A.I. is dependent upon a range of factors, including infrastructure, availability of resources, skilled manpower, and farmer participation (Arrebola *et al*., 2012). Despite its potential, the adoption and implementation of A.I. face significant challenges, particularly in rural and underdeveloped areas (Kemal et al 2024; Kaur & Toor 2024). These challenges stem from various constraints perceived by veterinarians and other stakeholders involved in the process. Factors such as lack of awareness and cooperation from farmers, insufficient financial and infrastructural resources, inadequate transport facilities, and the unavailability of high-quality semen and equipment are common barriers that hinder the successful implementation of A.I. programs (Kumar *et al*., 2021). Veterinarians, who are the primary facilitators of A.I. services, often bear the brunt of these challenges, as they are directly responsible for delivering these services to farmers (Goyal *et al*., 2014).

In Jharkhand, where agriculture and livestock rearing are integral to the rural economy, the implementation of A.I. programs has encountered numerous obstacles. Jharkhand has covered approximately 22.21 lakh animals, performed 27.34 lakh artificial inseminations, and benefited 15.81 lakh farmers under Rastriya Gokul Mission program. Ranchi, Saraikela-Kharsawan, and Ramgarh districts, which are key livestock-rearing regions, present diverse challenges due to their varying geographical, infrastructural, and socio-economic conditions. For understanding the specific constraints faced by veterinarians in these districts which is essential for improving A.I. services and ensuring their effective implementation in this state. This study aimed to identify and analyse the key constraints perceived by veterinarians in the implementation of A.I. across Ranchi, Saraikela-Kharsawan, and Ramgarh. The insemination centres are led by Touring Veterinary Officers (TVO's) and supported by trained paravets. However, detailed information about the average area each AI centre covers and the exact number of sanctioned staff per centre is not readily available. The coverage area and staffing can vary based on regional requirements, livestock population density, and specific operational strategies of each centre. By examining these challenges, the study seeks to provide insights that can inform policies and interventions to enhance the effectiveness of A.I. programs in these regions. The findings can be instrumental in addressing the bottlenecks that hinder the wider adoption of A.I., thereby contributing to the development of the livestock sector in Jharkhand and beyond.

Methodology

Jharkhand state was purposively selected for the study. The average milk production by Jharkhand in the year 2023-24 was 30,25,000 tonnes (Basic Animal Husbandry Statistics, MoFAHD, DAHD, GoI). Based on the coverage of artificial insemination through artificial insemination centres, three districts were selected purposively. Ranchi has a population of 1,073,427 (census 2011), making it the 46th largest urban city in India. It lies at 23°22′N 85°20′E near the Tropic of Cancer. The city has an area of about of 175 km^2, which is situated at an elevation of 651 m above sea level. It is positioned in the southern part of the Chota-Nagpur plateau. It is having the highest number of exotic cattle population (1,20,522) and tenth highest number of indigenous (Desi) cattle population (5,15,880) among all the districts of Jharkhand (20th Livestock Census) with 110 Artificial Insemination centers. It is also having the highest number of exotic female cattle population in milking condition (44,444) (20th Livestock Census). The district Saraikela-Kharsawan is situated between Longitude, East between 85°30'14" & 86°15'24" and Latitude, North between 22°29'26" & 23°09'34". It is having exotic cattle population numbering 6,680 which is one of the lowest in the state of Jharkhand (20th Livestock Census). The district is having indigenous (Desi) cattle population of 2,98,492 (20th among the districts of Jharkhand). Exotic female cattle in milking condition are 3,017 (20th Livestock Census). The district is having 47 established Artificial Insemination centres. Ramgarh (latitude is 23.634380, and the longitude is 85.526421) is having the lowest number of indigenous cattle population (1,05,734) among the districts of Jharkhand with exotic cattle population of 14,234 (20th Livestock Census). The total number of indigenous female cattle in milking condition is also lowest in the district (14,688) (20th Livestock Census). The district is having 35 established Artificial Insemination centres which is also one of the lowest numbers of centres in Jharkhand. From each purposively selected districts, two blocks were selected randomly and from each block, two villages were selected randomly for study. Fifteen farmers and two artificial insemination service professionals were randomly selected from each village for data collection.

Therefore, the total number of respondents selected for the study was 204 (180 farmer respondents and 24 Service Professionals). The data was collected from the respondents by personal interview using a well-structured interview schedule. It was developed in consultation with experts and referring relevant literatures and

previous works. The Garret score, a non-parametric measure, provides a robust means of ranking constraints by converting ranks into percentiles and assigning corresponding scores, was employed to prioritize the constraints

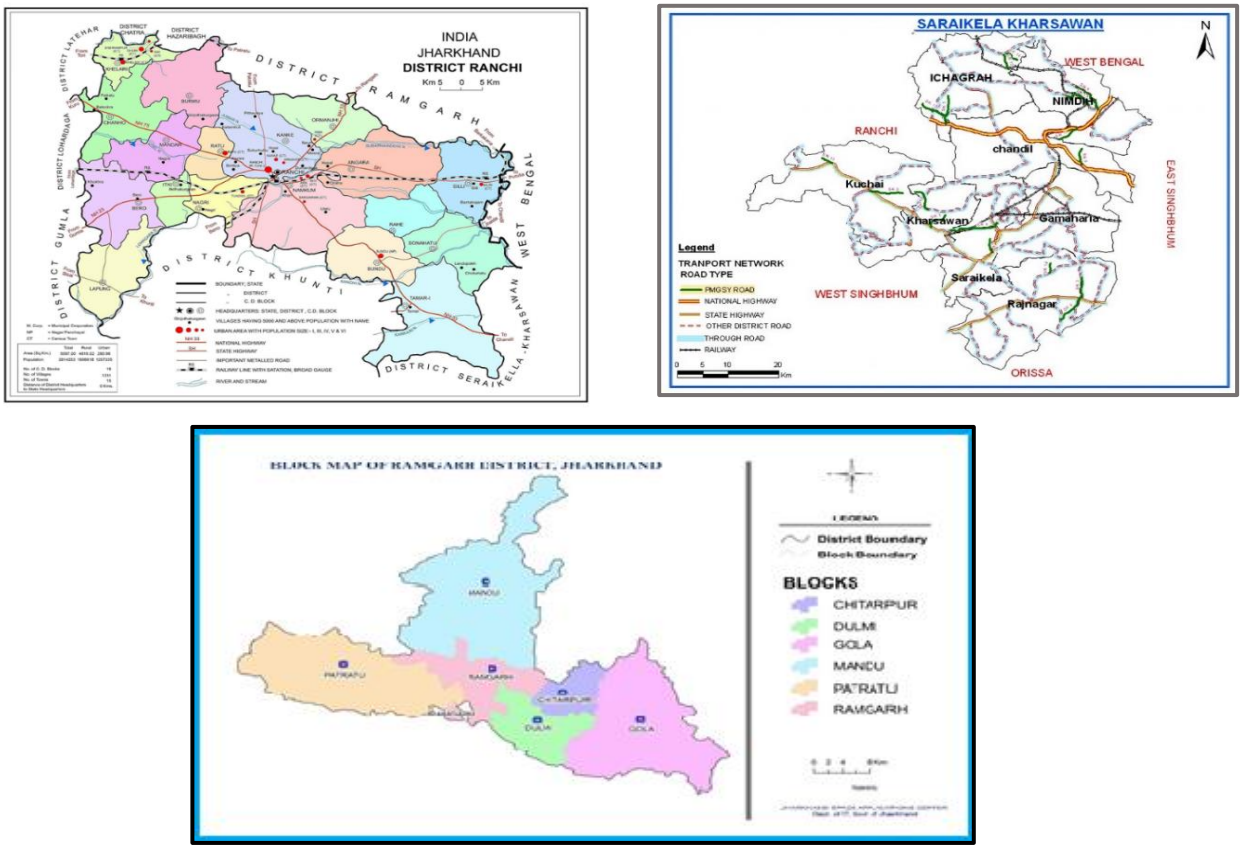

Fig. 1 Map of selected Districts

based on their average scores. It is a statistical tool used to analyse and rank factors based on respondents' preferences. It is widely applied in social sciences research to convert qualitative data into a numerical form for better comparison. The method involves a systematic process where respondents are asked to rank different factors according to their importance. These ranks are then converted into scores using a predefined formula. The percent position (P) of each rank is calculated using the formula:

$$Percent\ Position = \frac{100(Ri - 0.5)}{N}$$

Where:

R_i = Rank given for the i^{th} item

N = Total number of items ranked

The percent position is then matched with Garrett table values to obtain corresponding Garrett scores. Once the scores are assigned, the average Garrett score for each factor is computed by summing all the scores and dividing by the number of respondents. The factors are then arranged in descending order based on their scores, with the highest-scoring factor being the most significant and the lowest-scoring factor the least important. The Garrett Ranking Method is particularly useful because it minimizes subjectivity by converting qualitative judgments into quantitative values, allowing for objective comparisons. It is effective for both small and large sample sizes, making it widely applicable in research and decision-making. This method is frequently used in agricultural extension research to identify key constraints faced by farmers. The Average Garret Score for each constraint were calculated and used to rank the constraints.

Results and Discussion

Constraints perceived by Veterinarians

The table (Table 1) compares constraints faced by Veterinarians across three districts viz Ranchi, Saraikela-Kharsawan, and Ramgarh using the Average Garret Score. All the major constraints perceived by the Veterinarians in implementation artificial insemination were prioritized from first to last based on Average Garret Score.

Lack of Skilled Subordinate Staff for Help during Implementation of A.I.

The most critical constraint with an average Garret Score of 69.25 across all districts is the lack of skilled subordinate staff. This finding underscores the importance of having well-trained personnel to assist veterinarians in conducting A.I. Inadequate staff support can significantly slow down A.I. procedures and reduce the number of animals serviced. When support staff lack proper training, veterinarians are often overburdened with routine tasks, which not only slows down the A.I. process but also reduces the number of animals that can be inseminated in a given period (Panda *et al*., 2022). This limitation directly impacts the success rate of A.I. programs, particularly in regions where veterinarians are responsible for large geographical areas or multiple villages. To address this issue, training programs focused on A.I. techniques should be established for subordinate staff.

Lack of awareness and cooperation of farmers in breeding activities

The lack of farmer awareness and cooperation in breeding activities ranks as second most significant constraint with an average Garret Score of 67.92, particularly in Ramgarh, where it is ranked highest. This finding aligns with previous research, which emphasizes the importance of educating farmers on the benefits of A.I. for improving livestock productivity (Vishwanath, 2003). Farmer reluctance often initiates from a lack of understanding of A.I. processes, which can be mitigated through targeted extension programs designed to raise awareness and increase participation.

Engagement of Veterinarians in Other Activities

The top-ranked constraint in Ranchi and third major issue across the districts with an Average Garret Score of 63.83 is the engagement of veterinarians in non-A.I. activities. The studies suggest that veterinarians, especially in rural areas, are often burdened with multiple responsibilities, reducing the time available for A.I. services (Ashebir *et al*., 2016). This overextension impacts the quality and efficiency of A.I. programs. A more specialized approach, where veterinarians focus solely on reproductive health, could alleviate this problem. Also, by delegating other tasks like vaccinations and routine animal care to trained paraprofessional staff could solve the problem. This division of labour would allow veterinarians to focus more intensively on A.I. services, improving their efficiency and reducing the likelihood of errors.

Infertility Problems

Infertility problems are perceived as a moderate constraint with an average Garret Score of 51.83, which may be related to animal health, nutrition, and management issues (DeJarnette *et al*., 2004). Therefore, veterinary extension services should focus on educating farmers about the importance of balanced diets, proper feeding practices, and the use of nutritional supplements to enhance reproductive health. Additionally, managing reproductive diseases through regular veterinary check-ups, timely diagnosis, and treatment is essential for reducing infertility-related issues. Through vaccination and disease prevention programs Veterinarians can help to control the spread of infections that impair fertility, while targeted reproductive health interventions and can address specific fertility problems in the herd (Budruk, 2023). By providing comprehensive veterinary care that includes reproductive health management, veterinarians can significantly reduce the incidence of infertility, thereby improving the outcomes of A.I. programs.

Lack of High-Quality Equipment for Semen Testing and A.I.

A significant constraint with an Average Garret Score of 50.83 in the pooled ranking, the lack of high-quality equipment for semen testing and A.I. ranked fifth which indicates the need for technological improvements. The low-quality or outdated equipment can lead to inaccurate semen assessments, ultimately reducing fertility rates (Dhangada *et al*., 2024). By upgrading equipment and providing regular maintenance we can likely enhance A.I. success rates which is desirable for genetic improvement of cattle.

Lack of Funds for Implementation of A.I.

The lack of financial resources for A.I. implementation is ranked sixth with an Average Garret Score of 48.00 across the districts. The insufficient funding can restrict the access to essential equipment, semen, and other requirements to implement Artificial Insemination (Woretaw *et al*., 2015). This issue points to the need for increased government or institutional support, possibly through subsidies or grants, to ensure that veterinarians have the resources required for effective A.I. programs.

Lack of Transport Facility for Distant and Remote Areas

The lack of transport facilities with an Average Garret Score of 41.92, ranked as seventh major constraint which indicates challenges in delivering A.I. services to remote areas. The absence of reliable transport infrastructure hampers the timely delivery of A.I. services to farmers, particularly those residing in distant locations. Without efficient transport, the timely delivery of semen and A.I. equipment can be delayed,

Table 1 Constraints perceived by Veterinarians in implementation of A.I

Constraints	Ranchi		Saraikela-Kharsawan		Ramgarh		**Pooled**	
	Avg. Garret Score	Rank	Avg. Garret Score	Rank	Avg. Garret Score	Rank	Avg. Garret Score	Rank
Lack of awareness and cooperation of farmers in breeding activities	25.33	II	17.83	III	24.75	I	67.92	II
Lack of transport facility for distant and remote areas	8.00	X	16.92	V	11.75	X	41.92	VII
Engagement of Vets in other activities	30.75	I	18.50	II	20.25	III	63.83	III
Lack of funds for implementation of A.I	13.92	VII	17.50	IV	16.58	V	48.00	VI
Non-availability of high pedigree & good quality semen	18.50	IV	15.25	VII	16.75	IV	40.83	IX
Lack of high quality equipments for semen testing and A.I	13.25	VIII	15.08	VIII	12.83	VIII	50.83	V
Lack of skilled subordinate staff for help during implementation of A.I	21.92	III	21.00	I	21.50	II	69.25	I
Infertility problems	17.50	V	14.25	IX	15.25	VI	51.83	IV
Mishandling in scientific A.I practices by incompetent/ unskilled A.I inseminator	12.67	IX	15.50	VI	13.50	VII	41.67	VIII
Lack of awards and rewards	14.67	VI	14.17	X	12.83	IX	22.67	X

Box-Violin Plots to compare Garret Scores between districts

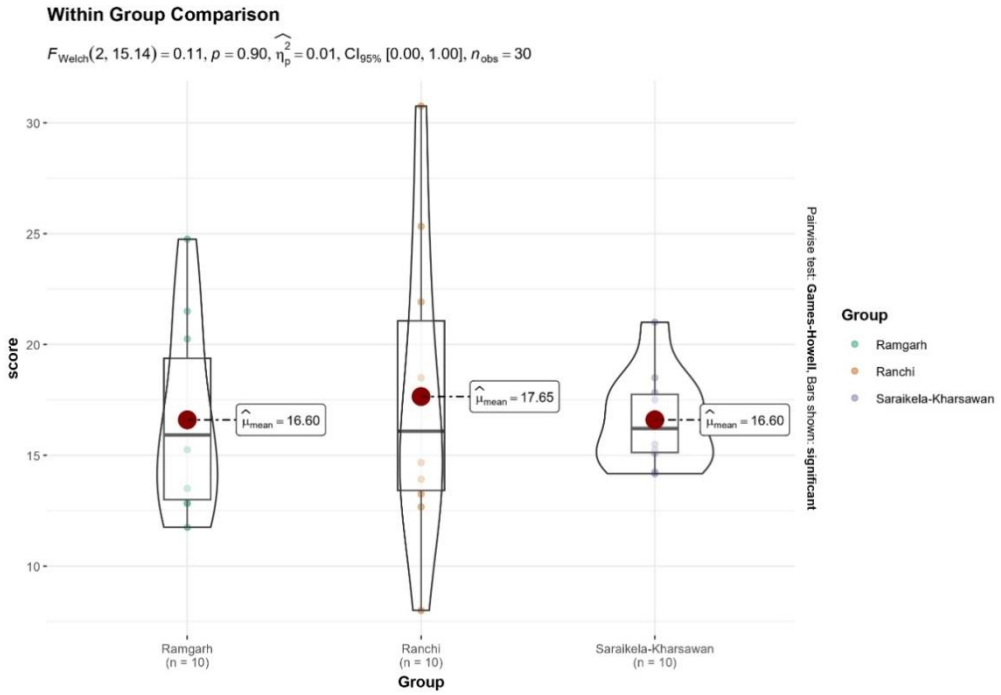

Fig. 2 Violin Plot

reducing the chances of successful insemination, especially when time-sensitive heat detection is critical to reproductive success (Baheriw *et al*., 2013). Furthermore, transportation delays can increase stress on animals during the insemination process, which may lower conception rates. For addressing this issue, it requires improved logistical support, including the provision of mobile veterinary units or dedicated vehicles equipped for A.I. services. Mobile veterinary units have proven effective in other regions by enabling veterinarians and A.I. technicians to deliver reproductive health services directly to farmers, even in the most remote areas. These units can carry the necessary A.I. equipment, frozen semen, and basic medical supplies, allowing veterinarians to

perform multiple inseminations in a single trip. By bringing the service directly to the farmers, mobile units can significantly reduce the time and effort required to access A.I. services.

Mishandling in scientific A.I practices by incompetent/unskilled A.I inseminator

Mishandling in scientific Artificial Insemination (A.I.) practices by incompetent or unskilled A.I. inseminators ranked eighth with an Average Garret Score of 41.67 in the pooled data, highlighting the significant challenge it presents. Improper techniques during A.I. procedures can lead to low conception rates, affecting the overall success of livestock breeding programs. Incorrect handling of A.I. tools, poor semen deposition, or improper timing of insemination can drastically reduce fertility outcomes in livestock, making it a critical issue that needs addressing. To address this challenge, there is an urgent need for continuous training and certification programs for A.I. technicians. The regular training ensures that inseminators are equipped with up-to-date knowledge and skills related to reproductive physiology, A.I. techniques, and the management of A.I. equipment (Grasseni, 2005). This not only enhances the quality of A.I. services but also builds the trust with the farmers, who rely on these technicians for successful livestock breeding for better results.

Non-availability of high pedigree & good quality semen

The availability of high-quality semen is not considered a major issue but remains a concern for veterinarians. With an Average Garret Score of 40.8, it ranked as nineth among the Veterinarians. Poor semen quality can reduce conception rates and the overall success of A.I. By ensuring a stable supply of good-quality semen through effective breeding programs and semen banks could further improve the outcomes of A.I. programs.

Lack of Awards and Rewards

The lack of incentives, such as awards and rewards, ranks lowest among the constraints with an Average Garret Score of 22.67. While this issue may not directly impact A.I. outcomes, recognition programs can boost motivation and improve job satisfaction among veterinarians and A.I. technicians (Kuvaas 2006). When technicians and veterinarians are recognized for their efforts, it creates a positive feedback loop, improving trust and collaboration with the farming community. Farmers, in turn, may be more inclined to participate actively in A.I. programs when they see that their service providers are motivated and appreciated.

ANOVA Results: The graph presents a one-way ANOVA test result comparing the three groups. There is no significant difference in Garret scores among the three districts ($p = 0.90$). The distributions of garret scores are similar across all three districts, with some variation in Ranchi. Although Ranchi has a slightly higher mean score, the difference is not statistically significant. The overlap of distributions suggests that constraints affecting each district might be similar in impact. The violin plot analysis suggests that the constraints affecting A.I. services in Jharkhand are uniform across districts, necessitating state-wide interventions rather than district-specific policies. The solutions should focus on improving human resource capacity, increasing farmer awareness, enhancing transport and cold-chain logistics, ensuring semen quality, and providing incentives to veterinarians. By addressing these challenges comprehensively, Jharkhand can significantly improve A.I. adoption rates, enhance livestock productivity, and contribute to the economic development of rural communities.

Conclusion

For addressing the key constraints faced by veterinarians in implementing Artificial Insemination (A.I.) services in Jharkhand requires a multifaceted approach. For this, enhancing the training and support for subordinate staff, increasing farmer awareness, and reducing the over-engagement of veterinarians in non-A.I. activities are crucial steps in this multifaceted approach. Additionally, improving transport facilities, ensuring a consistent supply of high-quality semen, and upgrading A.I. equipment can significantly enhance service efficiency. The establishment of mobile veterinary units and introducing reward systems for veterinarians and A.I. technicians would further boost motivation and job satisfaction. These measures, collectively, would strengthen A.I. programs, ultimately improving livestock productivity and contributing to rural development in Jharkhand.

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