Malpractices and Challenges in Artificial Insemination Programs vis-à-vis Measures to Improve Conception Rate in Rural India

Abhishek Kumar*[1], Komal[2] and Kaushlendra Singh[3]

[1]*Assistant Professor, Veterinary Clinical Complex (VGO), COVAS, Kishanganj*
[2]*Assistant Professor, Veterinary Clinical Complex (Veterinary Biochemistry), COVAS, Kishanganj*
[3]*Assistant Professor, Veterinary Parasitology, COVAS, Kishanganj*

Corresponding Author
Abhishek Kumar
Email: abhiawadhesarita@gmail.com

OPEN ACCESS

Keywords

Artificial Insemination; Semen Straw Thawing; Conception Rate; Semen Quality; Cattle Breeding; Livestock Reproductive Management

How to cite this article:

Kumar, A., Komal. and Singh, K. 2026. Malpractices and Challenges in Artificial Insemination Programs vis-à-vis Measures to Improve Conception Rate in Rural India. *Vigyan Varta* 7 (07): 45-52.

ABSTRACT

Artificial insemination (AI) has become an indispensable reproductive biotechnology for genetic improvement, enhanced milk production, and sustainable livestock development in India. Despite its widespread adoption, the effectiveness of AI programs is often compromised by several operational, technical, and infrastructural challenges, particularly in rural areas. Common malpractices such as the use of poor-quality semen, improper semen handling, inadequate hygiene, lack of follow-up services, involvement of untrained technicians, and non-transparent pricing mechanisms adversely affect conception rates and livestock productivity. Negligence in AI service delivery and exploitation of farmers through misinformation regarding semen quality and breeding procedures further undermine the success of breeding programs. Among the various factors influencing AI outcomes, improper thawing and handling of frozen semen straws remain critical causes of reduced sperm viability and fertility. Inadequate cold-chain infrastructure, transportation constraints, shortage of skilled personnel, and limited farmer awareness exacerbate these problems under field conditions. Addressing these challenges requires strengthening quality control systems, improving technician training, ensuring transparency in semen sourcing and service

delivery, enhancing farmer education, and adopting scientifically validated reproductive management practices. Such interventions can significantly improve conception rates, genetic progress, and the overall effectiveness of AI programs in India.

INTRODUCTION

India possesses the world's largest bovine population, and the livestock sector contributes significantly to agricultural growth, nutritional security, and rural livelihoods. Artificial insemination (AI) has emerged as a key reproductive technology for accelerating genetic improvement and enhancing dairy productivity through the dissemination of superior germplasm. Over the years, government-led breeding initiatives have expanded AI services across rural India to improve reproductive efficiency and livestock performance. However, despite considerable progress, conception rates achieved under field conditions often remain below expected levels due to multiple technical, managerial, and infrastructural constraints (Rauthan and Negi, 2022).

The success of AI programs depends on maintaining semen quality throughout cryopreservation, storage, transportation, thawing, and insemination. Frozen semen is stored at ultra-low temperatures in liquid nitrogen, and any deviation from recommended handling procedures can adversely affect sperm viability and fertilizing capacity. Cryopreservation-induced stress can alter sperm structure and function, making spermatozoa particularly vulnerable during the thawing process (Upadhyay *et al*., 2021). Recent studies have further demonstrated that cryopreservation may influence the expression of fertility-associated genes, highlighting the importance of proper semen handling and storage protocols in preserving reproductive potential (Ebenezer Samuel King *et al*., 2022). Research conducted under Indian conditions has shown that adherence to recommended thawing temperatures and handling procedures can significantly improve post-thaw semen quality and fertility outcomes (Pawshe *et al*., 2017).

In addition to technical challenges, negligence and malpractices in AI service delivery have become important concerns, particularly in rural areas where veterinary infrastructure and monitoring mechanisms are limited. Farmers often encounter problems such as the use of low-quality or improperly stored semen, inadequate hygiene during insemination, absence of post-service follow-up, and services provided by inadequately trained personnel. Improper thawing practices, including warming semen straws using body heat, exposing straws to ambient temperatures for extended periods, and using contaminated water during thawing, are frequently reported under field conditions and can substantially reduce conception rates. Furthermore, lack of transparency in semen sourcing, inflated service costs through intermediaries, and insufficient information provided to livestock owners may result in farmer exploitation and economic losses.

To address these challenges, government agencies and livestock development organizations have emphasized the need for stricter regulatory oversight, technician certification, continuous skill development programs, and standardized quality assurance systems. Educating farmers about semen quality, recommended handling procedures, and verification of technician credentials can improve transparency and reduce the risk of exploitation. In addition, factors such as balanced nutrition, reproductive health management, accurate heat detection,

environmental management, and access to quality genetic material play important roles in determining fertility outcomes. Therefore, a comprehensive approach involving scientific semen handling, capacity building, farmer awareness, and strengthened extension services is essential for improving conception rates and ensuring the long-term success of AI programs in India.

Malpractices in AI Programs

Some reported malpractices include:

1. **Poor Quality Semen**: Some breeders use low-quality semen for insemination. This can reduce conception rates and result in weaker progeny, affecting the overall productivity of cattle. Farmers pay more for what they believe to be of superior breed causing economic losses.
2. **Unqualified Technicians**: Untrained or unlicensed individuals performing AI procedures are a common issue. This not only reduces success rates but also risks harming the animals. Without proper training, technicians may mishandle equipment or incorrectly perform the procedure, leading to infections or injuries in cattle.
3. **Unsanitary Conditions**: AI requires a sterile environment, but in many rural areas, poor hygiene standards prevail. The equipment is sometimes not cleaned or sterilized properly, increasing the risk of infections and disease transmission in animals.
4. **Lack of Follow-Up and Aftercare**: Aftercare is essential to ensure that the AI procedure was successful. Many AI providers fail to offer follow-up services, which can lead to complications for the animals and poor reproductive outcomes.
5. **Excessive Prices and Middlemen**: Due to a lack of transparency in pricing and middlemen inflating costs, farmers often pay more than necessary for AI services. This financial strain can be burdensome for smaller-scale farmers who rely on accurate pricing for sustainability.

Challenges in AI Programs

Handling semen straws in India, particularly in rural and agricultural contexts, presents a set of logistical, infrastructural, and technological challenges. These challenges impact the effectiveness of artificial insemination (AI) programs for livestock, which are crucial for improving breeding and milk production in India. Here are some key issues:

1. Lack of Cold Chain Infrastructure

- **Challenge**: Semen straws require consistent refrigeration at very low temperatures, typically stored in liquid nitrogen at -196°C, to maintain their viability. Many rural areas lack reliable cold chain infrastructure, including storage facilities, and transport systems, making it difficult to keep semen viable over long distances.
- **Impact**: Without consistent cold storage, semen quality deteriorates, reducing conception rates and leading to wastage.

2. Transportation and Accessibility Issues

- **Challenge**: Delivering semen straws to remote villages is challenging due to inadequate roads and transportation infrastructure. Specialized containers for liquid nitrogen storage are needed, and frequent transportation disruptions can compromise the semen's quality.

- **Impact**: Limited access to semen straws means fewer farmers can benefit from AI, hampering breeding efforts in areas that need genetic improvements in livestock.

3. Training and Skilled Personnel Shortage

- **Challenge**: AI requires skilled personnel trained in handling semen straws, proper insemination techniques, and reproductive management. There is often a shortage of such trained personnel in rural India, and those available may lack updated training or resources.
- **Impact**: Improper handling of semen straws can lead to contamination or thawing, making AI attempts ineffective and frustrating for farmers.

4. Awareness and Cultural Challenges

- **Challenge**: In many parts of India, farmers lack awareness of the benefits of AI or may be hesitant to adopt new reproductive technologies. Additionally, cultural beliefs around animal breeding can sometimes create resistance to AI.
- **Impact**: Farmers may not take advantage of AI even when available, which slows down genetic improvement efforts and reduces the efficiency of livestock farming.

5. Financial Constraints

- **Challenge**: Setting up AI facilities, maintaining cold chain infrastructure, and hiring skilled personnel all require significant financial investment. Many rural AI centers operate on limited budgets and struggle to maintain consistent services.
- **Impact**: Low funding can lead to inconsistent AI services, reduced access for farmers, and difficulty in scaling AI programs across regions.

6. Quality Control and Monitoring

- **Challenge**: Ensuring that semen straws maintain their quality from production to insemination is challenging, especially in the absence of standardized monitoring systems. Quality testing, labelling, and monitoring can be limited or inconsistent.
- **Impact**: Farmers may use semen of low viability or improper genetic traits, which compromises breeding goals and productivity outcomes.

7. Environmental and Climatic Challenges

- **Challenge**: In some parts of India, high ambient temperatures and humidity can make maintaining appropriate temperatures for liquid nitrogen challenging without adequate storage facilities.
- **Impact**: High temperatures increase the risk of thawing and degrade semen quality, making the entire process less effective.

8. Limited Access to High-Quality Genetic Material

- **Challenge**: There may be limited availability of semen from high-quality, genetically superior bulls, especially in remote areas. Local AI centres may not have consistent access to high-demand genetic lines.
- **Impact**: Without access to improved genetics, the effectiveness of AI in enhancing livestock productivity is reduced.

Addressing these challenges requires a coordinated approach that includes strengthening cold chain infrastructure, providing training, raising awareness, and increasing funding for AI programs, particularly in rural India.

Thawing semen straws is most exploited step and is critical to ensure optimal sperm viability and fertility. Many field workers may not have adequate training in AI techniques, including proper thawing methods. Inexperienced personnel might misinterpret the thawing protocols leading to improper handling. Rubbing the straw under palms or putting in armpits are unavoidable practices encountered under field conditions. Using water that is too cold or contaminated instead of properly heated water, dirty or non-sterile containers for thawing straws increases the risk of contamination. Addressing the exploitation related to the thawing of semen straws in India requires a multi-faceted approach that includes training, enhancing farmer education, implementing stricter regulations, and promoting access to quality resources. Adopting best practices ensures that the sperm maintains its viability, leading to higher chances of successful conception. By adhering to these practices, farmers and AI technicians can enhance the efficiency of breeding programs, contributing to improved livestock genetics and productivity.

Considerations during Thawing

Temperature Control: Maintaining an optimal temperature is critical. Too high a temperature can damage sperm; while too low can result in poor motility. Prepare a clean water bath with a temperature of 35-37°C (95-98.6°F). It's important to maintain this temperature throughout the thawing process.

Time Management: When semen straws are removed from a liquid nitrogen container, they will undergo a rapid temperature increase due to exposure to warmer air and surfaces. The extent of this temperature change will vary based on factors like exposure time, surface area, and insulation properties of the goblet. For optimal results in sperm viability, it is crucial to minimize exposure time. Thawing straws for too long or too short a time can lead to reduced motility and viability of the sperm cells. Remove the semen straw from the storage tank (liquid nitrogen), wave for one time in air quickly to minimize exposure to ambient temperatures. Immediately, submerge the straw in the water bath for approximately 30-60 seconds. The exact time may vary based on the type of semen and manufacturer recommendations. Ensure that the entire straw is submerged in water.

Handling: Wipe the straw with cotton or tissue paper and cut through laboratory seal at 90° angle with straw cutter or scissor. Minimize exposure to cold air and avoid any physical shocks to the straw (e.g., dropping or jarring) in order to protect the spermatozoa.

Field Condition Considerations

- **Environmental Factors:** Ensure that the storage tanks are protected from direct sunlight and extreme temperatures. Position them in shaded areas to maintain a stable temperature.
- **Training of Personnel:** Ensure that the AI personnel are adequately trained in handling and using semen straws, including thawing, insemination, and record-keeping practices.
- **Regular Monitoring:** Conduct regular checks on the condition of liquid nitrogen tanks, including levels and overall integrity to prevent any potential failures.

Quality Control

- **Semen Quality Assessment:** Before use, ensure the semen quality is assessed (e.g., motility, concentration) to determine viability. Only use semen that meets the required standards for AI.
- **Post-Insemination Monitoring:** Monitor the health of the animals post-insemination for signs of successful

conception and manage any potential complications.

Best Practices

- **Training:** AI technicians involved in the thawing process are trained to understand the importance of sperm quality. Failure to maintain liquid nitrogen levels adequately for storing semen straws compromise the quality of the semen prior to thawing. Transportation of semen straws without proper thermal insulation leads to thawing before reaching the destination. Ensure that the container is securely closed and monitor the liquid nitrogen level regularly during transit to prevent thawing.
- **Transparency and Consent:** Farmers often face high costs for quality semen straws. This can lead to exploitation if suppliers take advantage of farmers' lack of knowledge about alternative options. Smallholder farmers may have limited access to high-quality semen, leading to reliance on lower-quality options that could affect their livestock's health and productivity. Therefore, in artificial insemination programs, the process should be transparent, and farmers should be well-informed about the practices involved, including the sourcing and handling of semen.
- **Equipment:** Always use calibrated and maintained equipment to ensure accurate temperature readings. Use Personal Protective Equipment (PPE) like gloves and face protecting mask when handling semen straws to prevent exposure to liquid nitrogen and contamination.
- **Documentation:** Maintain accurate records of insemination dates, bull details, and conception rates for future reference and management. Tracking the success rates of insemination attempts can improve the semen handling practices.

Measures to Improve Conception Rate

Improving the conception rate in Indian cattle is crucial for enhancing dairy production, and supporting farmers' livelihoods. Collaboration among stakeholders, including farmers, veterinarians, and researchers, is essential for the successful outcome. Here are several measures that can be adopted to achieve this:

Nutritional Management

- **Balanced Diet:** Provide a well-balanced diet rich in proteins, vitamins, and minerals. Nutritional deficiencies can lead to poor reproductive performance.
- **Supplementation:** Use trace chelated minerals and vitamin supplements (vitamin A, C and E) especially in the pre- and post-partum periods to support reproductive health.

Health Management

- **Regular Veterinary Check-ups:** Schedule regular health check-ups to monitor and treat reproductive diseases and implement vaccination programs to prevent reproductive diseases.
- **Hygiene Practices:** Ensure proper sanitation in housing and milking areas to reduce disease transmission.

Heat Detection and Breeding Management

- **Accurate Heat Detection:** Employ trained personnel or technology (like pedometers or heat detection collars) to accurately identify estrus signs.
- **Use of Low-Cost Heat Synchronization Programs**

❖ **Hormonal Synchronization**: Some simple hormonal treatments can help

synchronize estrus, allowing for a more predictable breeding season. Farmers can collaborate with veterinarians for affordable hormone protocols.

❖ **Education on Synchronization Benefits**: Raising awareness about the effectiveness of timed breeding through synchronization can improve AI success and increase conception rates.

- **Use of Superior Semen:** Implement artificial insemination using high-quality, genetically superior bull semen to enhance genetic traits and improve overall performance. Where AI is not possible in remote areas, natural mating through genetically proven bulls is preferable.

Genetic Improvement

- **Selective Breeding:** Focus on breeding cattle that exhibit strong reproductive performance traits, such as shorter calving intervals and higher fertility rates.
- **Crossbreeding:** Consider crossbreeding indigenous breeds with high-yielding exotic breeds to improve overall reproductive efficiency and productivity.

Environmental Management

- **Comfortable Housing:** Provide adequate space, ventilation, and comfort in housing to reduce stress, which can adversely affect reproduction.
- **Temperature Control:** Implement measures to manage heat stress during peak temperatures, such as providing shade, misting, or cooling systems.

Training and Awareness

- **Farmer Education:** Conduct training programs for AI technicians and livestock farmers on best practices in cattle management, nutrition, and reproductive health.
- **Extension Services:** Strengthen agricultural extension services to ensure farmers receive timely information and support. NGOs that work in rural areas can provide valuable extension services, including training, AI services, and health camps for cattle, to support breeding efforts.

Record Keeping and Data Analysis

- **Maintain Accurate Records:** Keep detailed records of breeding, health, and production to identify trends and areas for improvement.
- **Use of Technology:** Leverage technology for data analysis and to monitor cattle performance, which can help in breeding and management decisions.

Financial Support and Resources

- **Access to Credit:** Provide farmers with access to credit facilities to invest in better breeding, nutrition, and health care.
- **Subsidies for Inputs:** Many state governments in India provide subsidies and schemes to support AI and livestock improvement. Offer government subsidies for veterinary services, feed, and breeding programs to make them more accessible.

Collaboration with Research Institutions

- **Adopt Research Findings:** Collaborate with agricultural universities and research institutions to adopt the latest research findings in cattle reproduction.
- **Field Trials:** Encourage field trials to evaluate new breeding techniques or nutritional strategies in real-world settings.

- Implementing these strategies in rural India requires a combined effort involving training, access to affordable resources, and ongoing support from government and community organizations. By focusing on accessible and low-cost solutions, rural farmers can improve conception rate, which in turn contributes to better productivity and profitability.

CONCLUSION

Artificial insemination remains one of the most effective tools for genetic improvement and productivity enhancement in Indian cattle. However, the full benefits of AI programs can only be realized when semen quality is maintained throughout the storage, transportation, thawing, and insemination process and when services are delivered in a transparent and technically competent manner. Malpractices such as the use of inferior-quality semen, improper thawing techniques, poor hygiene, inadequate follow-up services, and engagement of untrained personnel continue to limit conception rates and reduce farmer confidence in AI programs. Additionally, negligence in service delivery, lack of transparency, and exploitation of farmers through misinformation or excessive charges further undermine the effectiveness of livestock breeding initiatives.

Improving reproductive performance requires strengthening cold-chain infrastructure, implementing rigorous quality control measures, ensuring certification and regular training of AI technicians, and promoting awareness among livestock owners regarding recommended breeding practices. Farmer education on semen quality, insemination procedures, and technician credentials can help minimize exploitation and encourage informed decision-making. Furthermore, improved nutrition, disease control, reproductive health monitoring, accurate heat detection, and systematic record keeping are essential components of successful breeding programs. A coordinated effort involving farmers, veterinarians, researchers, extension agencies, and policymakers is necessary to promote ethical, efficient, and scientifically sound AI services. Such measures will contribute to higher conception rates, enhanced genetic improvement, increased milk production, and sustainable livestock development in India.

REFERENCES

Ebenezer Samuel King, J. P., Sinha, M. K., Kumaresan, A., Nag, P., Das Gupta, M., Arul Prakash, M., ... and Datta, T. K. (2022). Cryopreservation process alters the expression of genes involved in pathways associated with the fertility of bull spermatozoa. Frontiers in Genetics, 13, 1025004.

Pawshe, M., Becha, B. B., Unnikrishnan, M. P., Harshan, H. M., and ghosh, K. A. (2017). Bovine semen thawed at 28ºC or 37ºC can be used for AI till 90 min post-thaw. Indian Journal of Animal Reproduction, 38, 2.

Rauthan, A., and Negi, A. (2022). Artificial insemination in cattle. Int. J. Vet. Sci. Anim. Husb, 7(1), 5-8.

Upadhyay, V. R., Ramesh, V., Dewry, R. K., Kumar, G., Raval, K., and Patoliya, P. (2021). Implications of cryopreservation on structural and functional attributes of bovine spermatozoa: An overview. Andrologia, 53(8), e14154.