Vigyan Varta an International E-Magazine for Science Enthusiasts

www.vigyanvarta.in

Vol. 7, Issue 3

E-ISSN: 2582-9467
Popular Article
Bhawsar et al. (2026)

AI Based Heat Detection Tools

Dr. Nirbhay Bhawsar[1]*, Dr. Pushpa Gautam[2] and Dr. Govindhan K.[3]

Division of Extension Education, Indian Veterinary Research Institute, Bareilly

Corresponding Author
Dr. Nirbhay Bhawsar
Email: drnirbhaybhawsar@gmail.com

OPEN ACCESS

Keywords

AI tools, Estrus, Silent heat, Ovulation, Production

ABSTRACT

Accurate heat detection plays a vital role in maintaining reproductive performance, milk yield, and overall farm income in dairy cattle and buffalo (De Vries, 2006; Lucy, 2001). Conventional observation methods frequently fail to identify estrus correctly, particularly in buffalo where heat signs are less visible, resulting in longer open periods and financial losses (Roelofs *et al*., 2010; Diskin & Sreenan, 2000). AI-based technologies utilize sensors, behavioral monitoring, and data analysis to determine the most suitable time for insemination (Saint-Dizier & Chastant-Maillard, 2012). Studies indicate that these systems significantly enhance detection efficiency, improve pregnancy rates, and contribute to more sustainable dairy production (Roelofs *et al*., 2010; De Vries, 2006).

INTRODUCTION

Heat, also known as estrus, is the natural stage in the reproductive cycle of cows and buffaloes when the female is ready to mate and can become pregnant. This phase occurs because of hormonal changes in the body, especially the rise of estrogen. On average, the estrous cycle repeats every 21 days, while the visible heat period usually lasts 12–18 hours in cows and may extend up to 24 hours in buffaloes. In buffalo, the signs are often mild or silent, which makes detection more difficult. Ovulation takes place shortly after the heat period ends, so correct timing of insemination is very important for successful conception. Detecting heat at the right time helps maintain regular calving intervals and ensures consistent milk production. If heat is missed, the animal remains non-pregnant for a longer time, increasing feeding, labor, and breeding costs. It may also require repeated inseminations and veterinary assistance. Over

Vigyan Varta an International E-Magazine for Science Enthusiasts

www.vigyanvarta.in

Vol. 7, Issue 3

E-ISSN: 2582-9467
Popular Article
Bhawsar et al. (2026)

time, this reduces overall productivity and farm income. Therefore, careful observation and timely heat detection are essential for efficient and profitable dairy farming.

Research in dairy economics shows that every extra day a cow remains open adds financial loss due to delayed calving and reduced lifetime milk yield (De Vries, 2006). International studies estimate that each additional day open can cost between $2–5 per cow per day (De Vries, 2006). In Indian conditions, when we consider feed costs, labor charges, veterinary visits, and artificial insemination expenses, missing even one heat cycle can result in substantial financial loss per animal.

In many Indian dairy farms, heat detection is still based on visual observation. Farmers look for signs like mounting behavior, restlessness, and mucus discharge. However, studies show that visual detection methods often identify only about 50–60% of actual heat cases (Roelofs *et al*., 2010).

High-producing crossbred cows and buffaloes frequently show "silent heat," where visible signs are weak or absent. Mistimed insemination due to incorrect heat detection significantly reduces conception rates (Diskin & Sreenan, 2000). This results in repeated insemination attempts, wasted semen, higher veterinary costs, and longer delays in pregnancy (Lucy, 2001).

National livestock reports in India highlight reproductive disorders and infertility as major constraints affecting dairy productivity (Department of Animal Husbandry and Dairying [DAHD], 2022; Government of India, 2019). Poor heat detection is one of the contributing factors behind delayed conception and reduced productive life.

Scientific evidence confirms that inseminating cows at the wrong time relative to ovulation sharply lowers pregnancy rates (Diskin &

Sreenan, 2000). Over time, these biological losses turn into economic losses — both for individual farmers and for the dairy sector as a whole.

Buffaloes often show weak or silent heat, making it difficult for farmers to observe estrus behavior accurately. This reduced expression is one of the primary reasons for poor reproductive efficiency in buffaloes and missed breeding opportunities. Traditional indicators like mounting behavior, vulval swelling, or mucus discharge are often unreliable in water buffaloes compared to cattle.

Artificial Intelligence-

Artificial Intelligence (AI) is a branch of computer science that focuses on developing machines and systems capable of performing tasks that normally require human intelligence. These tasks include learning from experience, recognizing patterns, understanding language, making decisions, and solving problems.

"Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs." McCarthy, J. (2007)

Artificial Intelligence (AI) in dairy farming refers to the use of advanced computational algorithms, machine learning (ML), computer vision, sensor fusion, and data analytics for precision livestock farming (PLF). AI enables real-time monitoring of animal health, behaviour, productivity, and environmental conditions, promoting increased milk yield, improved animal welfare, reduced costs, and sustainability in dairy systems.

Artificial Intelligence (AI) in heat detection-

Artificial Intelligence (AI) in heat detection refers to the use of smart technologies such as sensors, wearable devices, cameras, and data-analysis software to identify the estrus period

Vigyan Varta an International E-Magazine for Science Enthusiasts

www.vigyanvarta.in

Vol. 7, Issue 3

E-ISSN: 2582-9467
Popular Article
Bhawsar et al. (2026)

in cattle and buffalo automatically and accurately. Traditionally, farmers relied on visual observation of signs like mounting behavior, restlessness, mucus discharge, and reduced feed intake. However, these signs are often missed, especially in buffalo where silent heat is common. AI systems continuously monitor animal activity, rumination, body temperature, and behavioral changes through smart collars, pedometers, ear tags, or camera-based computer vision systems.

How AI Tools Work for Heat Detection-

Artificial Intelligence (AI)–based heat detection systems operate on the principle of **continuous monitoring, data collection, pattern recognition, and predictive analytics**. Instead of depending solely on human observation, these technologies gather large volumes of real-time behavioral and physiological data from animals and analyze them using machine learning algorithms to accurately identify estrus (heat). The system essentially learns what is "normal" for each individual animal and then detects deviations that indicate reproductive activity.

Commonly used AI tools for heat detection-

➢ **Collars / Neck Sensors**

• SCR / Allflex SenseHub

• Stellapps mooON Collar

• Prompt Equipments BOVZ / Smart Collar

• Dairymaster MooMonitor+

• Smartbow (Zoetis)

➢ **Ear Tags / Leg Sensors**

• Allflex Activity Monitoring Ear Tags

• CowManager Ear Sensor

• Nedap CowControl

• GEA CowScout

➢ **Milk / Reproductive Data Systems**

• Afimilk Reproduction Monitoring System

• Heatime (SCR)

• Lely Horizon (integrated reproductive analytics)

➢ **Camera / Computer Vision Based**

• AI Camera Analytics for behavioral detection

• Vision-based estrus detection modules integrated with farm management software

➢ **Temperature / Biosensor Systems**

• smaXtec Bolus System

• Infrared thermal imaging tools (research-based or integrated)

Working principles of different AI tools-

Collars and Neck Sensors

Smart collars are one of the most common tools used in modern dairy farms. These collars contain tiny motion sensors that continuously track the animal's daily activities. When a cow or buffalo comes into heat, she becomes more active, walks more, and may show mounting behavior. The collar records these changes and compares them with the animal's normal routine. If the activity suddenly increases beyond the usual pattern, the system sends an alert to the farmer's mobile phone. Some collars also monitor rumination, which often decreases slightly during heat. In simple terms, the collar works like a 24-hour fitness tracker that detects unusual behavior linked to estrus.

Ear Tags and Leg Sensors

Ear tag–based systems function in a similar way but focus more closely on head and ear

Vigyan Varta an International E-Magazine for Science Enthusiasts

Vigyan Varta
www.vigyanvarta.in

Vol. 7, Issue 3

E-ISSN: 2582-9467
Popular Article
Bhawsar et al. (2026)

movements. These devices are lightweight and attached to the ear, where they monitor feeding behavior, rumination, and physical activity. During heat, animals tend to move their heads more frequently and show restlessness. The system collects this information and uses intelligent software to recognize patterns that signal estrus. Leg-mounted pedometers also measure step count, as walking activity usually increases during heat. By studying these subtle behavioral changes, the system helps farmers identify the correct time for insemination.

Milk and Reproductive Monitoring Systems

Some advanced dairy farms use systems connected directly to automated milking machines. These technologies analyze changes in milk production and milk composition. Hormonal shifts during heat cause progesterone levels to drop, and in certain cases, milk yield may slightly fluctuate. The system combines this milk data with activity information to predict the fertile window. Rather than depending on one sign alone, it uses multiple biological indicators to provide more reliable results. This approach is especially useful in large, technologically advanced dairy farms.

Camera and Computer Vision Systems

Camera-based systems are another emerging technology in heat detection. Cameras installed inside the shed monitor the animals continuously. Artificial intelligence software analyzes video footage to detect mounting behavior, standing heat, tail raising, and unusual social interactions. Instead of a person watching animals all day, the computer does the observation automatically. Using image recognition and deep learning, the system identifies behavior patterns associated with estrus and generates alerts when needed. This method reduces labor requirements and minimizes missed heat cases.

Temperature and Internal Biosensor Systems

Certain tools focus on changes inside the animal's body. For example, bolus sensors placed in the rumen measure core body temperature continuously. A slight increase in temperature often occurs during heat due to hormonal changes. The system detects even small variations and combines them with activity data to improve accuracy. Infrared thermal cameras also work on a similar idea but measure temperature from outside the body. Increased blood flow to reproductive organs during estrus causes minor surface temperature changes, which AI software can detect. These tools are particularly helpful in identifying silent heat.

Instalation cost of heat detection AI tools-

Installing an AI-based heat detection system in dairy farms involves variable costs depending on the type of technology and herd size. For wearable collar or ear-tag systems commonly used in India, the cost generally ranges from ₹8,000 to ₹15,000 per animal for the device, along with additional charges for a base station, software subscription, and maintenance, which may add ₹50,000 to ₹2 lakh depending on farm scale. Advanced integrated systems linked with automated milking or hormonal monitoring can cost even more.

Benefits of heat detection AI tools-

Scientific studies and field research consistently show that implementing AI-based heat detection systems leads to significant improvements in reproductive performance and overall dairy productivity. Activity monitors, sensors, and smart collars have been shown to increase heat detection accuracy to over 80–95%, compared with only 50–60% through visual observation alone (Roelofs *et al*., 2010; Saint-Dizier & Chastant-Maillard, 2012). Improved detection enables timely

Vigyan Varta an International E-Magazine for Science Enthusiasts

E-ISSN: 2582-9467
Popular Article
Bhawsar et al. (2026)

www.vigyanvarta.in

Vol. 7, Issue 3

artificial insemination, resulting in higher conception rates, shorter calving intervals, and increased lifetime milk yield (De Vries, 2006; Lucy, 2001). For example, farms using sensor-based systems have reported reductions in days open by 10–20 days and improved conception success, which directly reduces insemination costs and veterinary interventions. AI systems also help identify silent heats—common in buffaloes—leading to more accurate breeding decisions. Additional research indicates that better heat detection contributes to improved herd fertility, lower culling due to reproductive failure, and increased return on investment over time.

CONCLUSION

Artificial intelligence–enabled heat detection systems have brought a significant improvement in reproductive management in dairy farming. Instead of relying only on human observation, these technologies continuously track animal behavior, movement, rumination, temperature, and sometimes hormonal changes to identify the optimal breeding period. Scientific findings indicate that such systems enhance the accuracy of heat detection, improve conception rates, reduce the number of open days, and help maintain shorter calving intervals. As a result, farmers benefit from better milk production, fewer repeat inseminations, and improved herd fertility.

The importance of these systems is even greater in buffalo, where heat signs are often weak or silent. By detecting subtle biological and behavioral shifts, AI tools minimize the chances of missed estrus. Although the initial cost may be a concern, particularly for small-scale farmers, the long-term economic gains through improved reproductive efficiency

often compensate for the investment. With increasing awareness and technological advancements, AI-based heat detection is gradually becoming a key element of sustainable and profitable dairy farming.

REFERENCES

De Vries, A. (2006). Economic value of pregnancy in dairy cattle. *Journal of Dairy Science, 89*(10), 3876–3885. https://doi.org/10.3168/jds.S0022-0302(06)72430-4

Department of Animal Husbandry and Dairying (DAHD). (2022). *Annual report 2021–22.* Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

Diskin, M. G., & Sreenan, J. M. (2000). Expression and detection of oestrus in cattle. *Reproduction Nutrition Development, 40*(5), 481–491. https://doi.org/10.1051/rnd:2000112

Government of India. (2019). *20th livestock census.* Ministry of Fisheries, Animal Husbandry and Dairying.

Lucy, M. C. (2001). Reproductive loss in high-producing dairy cattle: Where will it end? *Journal of Dairy Science, 84*(6), 1277–1293. https://doi.org/10.3168/jds.S0022-0302(01)70158-0

McCarthy, J. (2007). *What is artificial intelligence?* Stanford University. http://jmc.stanford.edu/articles/whatisai/whatisai.pdf

Roelofs, J., López-Gatius, F., Hunter, R. H. F., van Eerdenburg, F. J. C. M., & Hanzen, C. (2010). When is a cow in estrus? Clinical and practical aspects. *Theriogenology, 74*(3), 327–344. https://doi.org/10.1016/j.theriogenology.2010.02.016

Saint-Dizier, M., & Chastant-Maillard, S. (2012). Towards an automated detection of oestrus in dairy cattle. *Reproduction in Domestic Animals, 47*(6), 1056–1061. https://doi.org/10.1111/j.1439-0531.2011.01971.x.