

Animal welfare practices for bulls

in semen stations

Newton Biswas^{1*}, Kiran Singh¹ and Neeraj Srivastava¹

¹ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly 243 122, Uttar Pradesh

The concept of artificial insemination (AI) has revolutionized the livestock sector. The high-quality semen collected from genetically superior bulls is extended and preserved to artificially impregnate maximum numbers of breedable cows. Rearing bulls separately and solely for superior germplasm became integral to animal husbandry, especially for commercial dairy and meat industries. The set-up established for maintaining bulls for semen collection and processing for AI is known as a semen station. Although the animal husbandry norms ensure adequate treatment for bulls maintained in semen stations as far as their housing, feeding, deworming, vaccination, etc. are concerned, animal welfare standards are merely followed. The purpose of animal welfare is to ensure the humane treatment of animals used for production. It is a proven fact that animal husbandry practices blended with animal welfare concepts not only boost the quantity but also ensure the quality of production. Therefore, adequate stress management, the use of modern technological tools such as artificial intelligence, and behavioural considerations in the context of animal welfare protocols are essential for maintaining highly productive bulls and their long-term quality in the semen stations.

Keywords: Animal welfare standards, Artificial intelligence, Behaviour, Stress management

Artificial insemination (AI) is a popular technique adopted for improving productivity, controlling disease transmission, and improving genetic efficiency in dairy cattle. It offers advantages like reduced bull-cow ratios and injury risk. Breeding bulls are kept in semen stations for routine semen collection; the collected semen is then extended, frozen, and disseminated for AI, reducing the number of sires needed to cover all females and maximizing reproductive efficiency. Semen stations have become essential to modern livestock farming but could not attract as much attention as other animal farming setups in terms of animal welfare practices. Animal welfare norms are adopted in commercial farms to ensure quality production, and animal activist groups are also proactive in ensuring the humane treatment of animals kept for production purposes. Compromised welfare

can lead to issues like sub-fertility, reduced life expectancy, growth issues, body damage, disease, and behavioural anomalies. Bulls in semen stations are as important as the milking cows, but animal welfare practices are largely ignored in semen stations. Therefore, it is high time to implement the prescribed welfare practices for breeding bulls as well. Welfare practices in semen stations can be assured in several ways, such as convenient housing, stress management, improved feeding practices, ethical considerations, and by the use of artificial intelligence tools. This will ensure quality production and a healthy human-animal interaction for ideal farming as well. Animal welfare measures are not only intended to prevent the malpractice of animal husbandry, but their proper implementation can also improve qualitative productivity.

Concept of animal welfare and its importance for breeding bulls in semen stations

According to the Terrestrial Code, laid out by the World Organization for Animal Health (WOAH), animal welfare means 'the physical and mental state of an animal in relation to the conditions in which it lives and dies'. In simple words, it is the protection of the health and well-being of animals.

Implementation of Animal welfare is based on three main principles of research viz:

- Fundamentally understanding the concept of animal welfare
- Development of methods to assess the animal welfare
- Appropriate action to apply animal welfare standards, which is mainly practice oriented.

Welfare standards are divided into three types: resource-based, management-based, and animal-

based. Resource-based requirements set minimum standards for an animal's environment and resources, while management-based requirements describe managers' activities related to animal health, such as pain management and euthanasia protocols. Animal-based requirements specify outcomes, such as health markers, behavioural outcomes, and comfortable movement and lying.

Animal welfare is an approach to minimize the stress exerted by the animal husbandry practices. It is a complex outcome which mainly depends on coordinated action of

three domains. These are:

- Genetic make-up of the animals
- Production system in which they are kept
- Ability of the people to manage these animals in that system

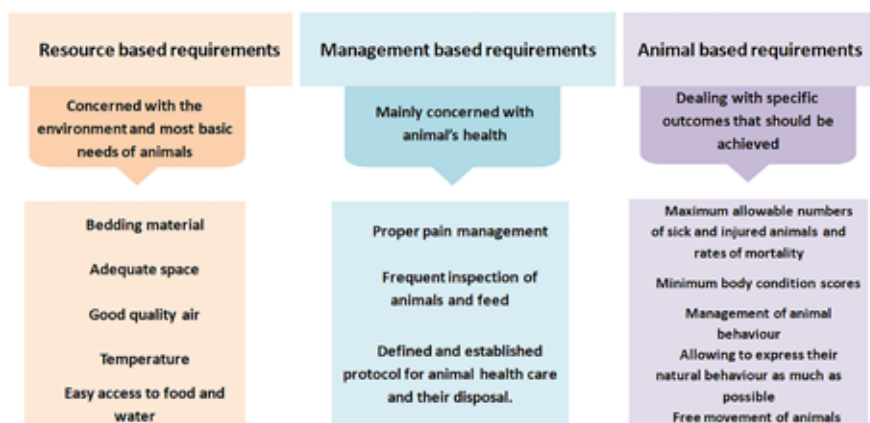
Countries across the world have adopted several animal welfare models for almost all categories of food animals, but breeding bulls maintained in semen stations have received negligible attention as far as animal welfare is concerned. Usually, the animal welfare concept for dairy cows is invariably applied to bulls in the semen stations. The

life of a donor bull, starting from selection to training and subsequent semen donation, is entirely different from their natural behaviour. The bulls in semen stations are subjected to human interactions more than other animals. So, it is important to formulate and focus more on bull welfare for better productivity.

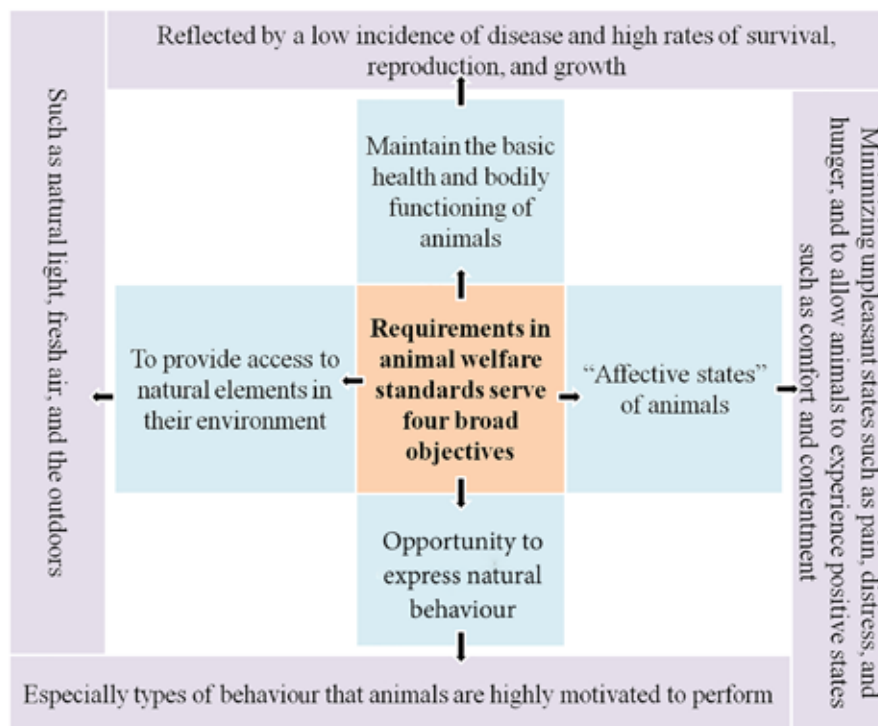
Current scenario of bulls in semen stations

The Central Monitoring Unit of the Government of India has graded 49 out of the 56 semen stations in India during 2019–2020 as A/B. The total number of bulls maintained in those semen stations varies. 'Minimum Standards for Production of Bovine Frozen Semen' formulated by the Department of Animal Husbandry, Government of India, ensures optimum animal husbandry protocols. The prescribed protocols and standards make sure that the animals are taken care of optimally, but they lack certain criteria. These shortcoming plays a major role in lower production of frozen semen straws annually against the target and requirement of straws. As per the National Dairy Development Board (NDDB), India produces about 81 million semen straws per annum, where the number of cows is about 145 million and more than 100 million are breedable. This lacuna reflects the lower production of semen straws in semen stations. Normally, a donor bull should have 2 collections per week and 90 collections (180 ejaculates) per year, but these conditions are hardly fulfilled due to a plethora of circumstances. During winter, although the semen quality is good and bulls remain in optimum conditions to deliver quality semen, it is often noticed that the workers do not turn up due to extreme cold conditions. In winter, managing the environmental conditions like AV temperature, handling of semen outside the water bath, and transportation cause hazardous situations for freezing. In short, low temperatures lead to various problems, and the number of straws falls short of the target. In summers,

Three basic requirements for welfare standards



Source: Cojkic and Morrell (2023)



Requirements in animal welfare standards serve four broad objectives

Source: Cojkic and Morrell (2023)

the temperature is not a big issue, but bulls suffer from heat stress, leading to low-quality ejaculations and subsequent reductions in quantity as well as quality of frozen semen straws.

Can animal welfare practices address the issue?

The concept of semen stations is based on keeping male animals isolated from animals of the opposite sex. Due to the fact that breeding bulls in semen station are different than in natural conditions and that the process of semen collection is not normal reproductive behaviour, requiring close human-animal interaction, there are many critical points in the semen production process that can cause animals to express inappropriate behaviour. Besides, inadequate space and insufficient nutrition can cause health problems that further decrease animal quality of life. Therefore, practices that address and mitigate the welfare concerns are need to be adopted. Routine practices that ensures adequate stress management, proper feeding as well as watering, behaviour management and nullify environmental disturbances can improve the quality semen productions.

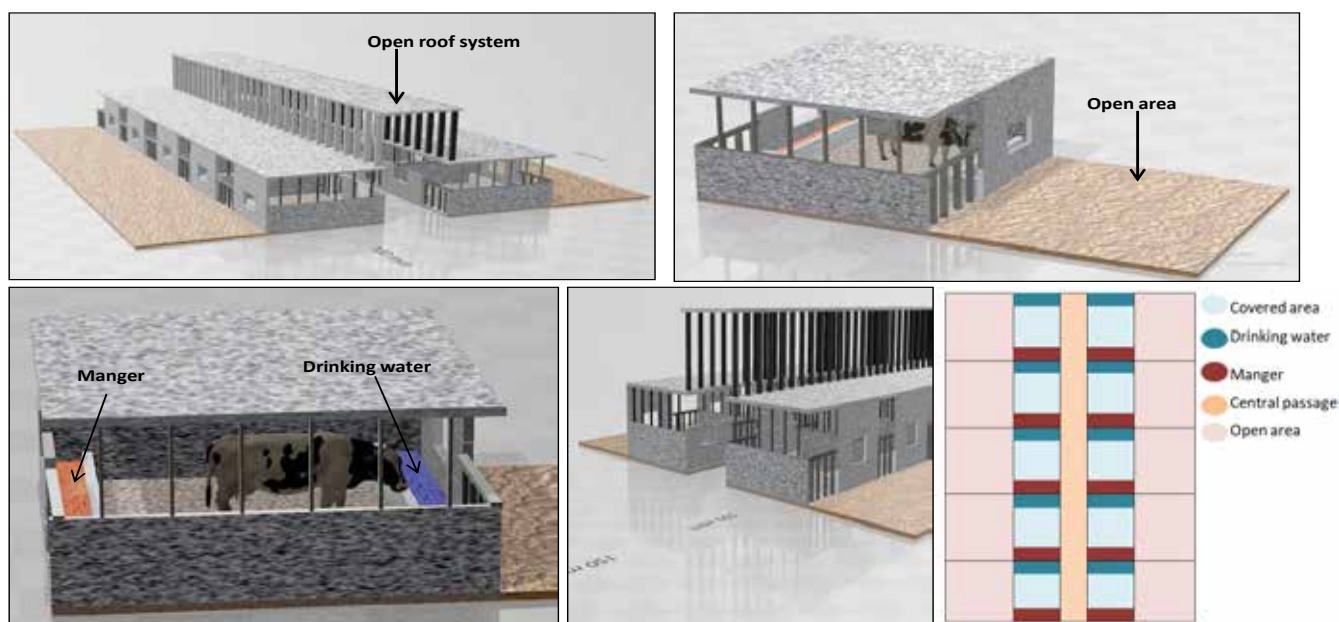
Physiological stress response of animals to compromised animal welfare

The animals experience stress due to extreme environmental conditions beyond their regulatory capacity, such as excessively hot or cold weather. When the animals perceive a situation as unpredictable and uncontrollable, they experience immense stress. There are two broad components of the stress response in an animal's body. These are (1) the hypothalamic-pituitary-adrenal (HPA) axis; and (2) the sympatho-adrenomedullary (SAM) system. The recent concepts suggest that, besides the activation of the HPA axis, a group of hypothalamic neurons and their co-synthesized mediators (neuropeptides) also play a vital role in stress response. These mediators include kisspeptin, neurokinin B, and dynorphin. These neuropeptides regulate the negative effect of cortisol on the reproductive system, which is released due to the activation of the HPA axis. The reproductive function of animals depends on the synthesis and secretion of Gonadotropin-releasing hormone (GnRH) from hypothalamic GnRH neurons. The neuropeptides kisspeptin and neurokinin B have a stimulatory effect on GnRH neurons, while dynorphin has a negative effect. Cortisol released due to the activation

of the HPA axis induced by stress inhibits the synthesis of kisspeptin and neurokinin B and stimulates the synthesis of dynorphin. This leads to the synthesis of GnRH and the subsequent secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), directly affecting the reproductive physiology of animals. The activation of the HPA axis is generally attributed to chronic stress conditions, and the sympatho-adrenomedullary (SAM) system is associated with acute stress conditions. The latter exerts its response by releasing catecholamines (epinephrine, nor-epinephrines). The level and nature of stress are generally determined by measuring cortisol or catecholamine levels in the blood. However, this becomes inappropriate during prolonged and undefined stress conditions such as faulty housing, chronic pain following nose-ringing, dehorning, or tail docking.

Housing of bulls in semen stations

Proper housing is an important welfare requirement. An ideal bull pen should consist of a covered area and an open/loafing area. The dimensions of the covered and open areas should be 7-8 square meters and 12-15 square meters, respectively, for each bull. The covered area should have walls up to



Ideal housing of bulls in semen stations (An open roof system (monitor) for summer season which can be closed during winter and rainy seasons)

half of its height to facilitate free air movement. Height of the covered area of the bull pen should be around 1.5–2 meters more than the bull’s height so as to avoid radiation effects. Cool and potable water should be made available to the bulls around the clock. Cooling systems in the bull pen during the summer months significantly improve the productivity and productive life of the breeding bulls. The floor of the covered area should be non-slippery. Rough concrete flooring is best suited for bull sheds, as concrete flooring also acts as an abrasive surface and helps normalize the wear of the hooves. The bull shed should be surrounded by trees that can provide proper comfort during the summer.

Feeding of bulls in semen stations

The young bulls should be fed optimally to ensure proper growth and development into a potential future sire. From 18 months to 36 months, the bulls should consume 2.5 to 3.0% of their body weight. The grain part should slowly be decreased, and the roughage part should be increased as the bull grows. The young bulls can grow at a rate of 700–800 g per day and attain a body weight of 300 kg at around 12 months of age when fed optimally. During the growth phase, the bulls need growth-promoting rations and should be fed adequate proteins. Thereafter, the ration should be formulated based on maintenance requirements and the frequency of semen collection and breeding. The nutrient requirement of bulls is given in Table 1.

Stress management for bulls in semen stations

Any form of stress, like thermal stress, high humidity, high ambient temperature, high radiation effect, cold and frost, shortage of drinking water, etc., affects the process of spermatogenesis by acting on the hypothalamus-pituitary axis. It causes degradation in the quality of semen. High ambient temperatures reduce the quality and quantity of semen. The ideal testicular temperature for normal

Table 1. Nutrient requirement of bulls

Body weight (Kg)	DCP (Kg)	TDN (Kg)	Carotene (Kg)	Calcium (g)	Phosphorus (g)
<i>Requirement of growing bulls</i>					
100	0.28	1.9	11	13	10
150	0.35	2.6	16	13	12
200	0.40	3.0	21	13	12
300	0.45	4.0	32	13	12
400	0.48	5.0	40	12	12
<i>Requirement of bulls in service</i>					
400	0.38	3.6	45	9	9
500	0.45	4.5	55	11	11
600	0.53	5.4	66	13	13

Source: Shukla, 2020

spermatogenesis should be 4-5°C less than the body temperature, which can be attained if the ambient temperature is 15–21°C. A constantly higher temperature can lead to abnormal spermatogenesis due to testicular degeneration. Therefore, measures to reduce thermal stress should be the top priority in countries like India, where the maximum temperature in summer can go as high as 44–47°C. Particularly, bulls of exotic breeds like HF, Jersey, and buffalo bulls should be housed in pens with cooling systems. The buffalo bulls should also be provided with a wallowing facility.

Behaviour related welfare in bulls of semen stations

Animal welfare issues can manifest in various ways, including increased respiratory rate, decreased feed intake, and aggressive or depressive behaviours. Physiological stress can lead to hormonal imbalance and infertility in bulls, while psychological stress can decrease serum testosterone levels and affect sperm motility and morphology. Good human-animal relationships can positively influence heifers during restraint, leading to decreased heart rate and longer neck stretching durations. However, similar studies have not been conducted for bulls. But there are possibilities to improve bulls’s productivity through good human-animal interaction.

Handlers actively lead bulls during semen collection, and previous positive experiences and a

lack of fear of humans can improve libido. Changes in personnel can negatively affect semen quality or resolve problems. The frequency of semen collection is positively correlated with reaction time and novelty. Management-based semen collection procedures should be reviewed for individual bulls if production goals are not met. False mounting and active restraining are effective sexual preparation methods, but they need to be reduced for bulls with low libido and physical limitations.

Artificial intelligence and its application in animal welfare for bulls

Following the swift progress in artificial intelligence (AI) and sensor technology, a plethora of new opportunities have surfaced in several industries. The field of livestock husbandry, which is frequently ignored in talks of conventional AI, is on the verge of this revolutionary shift. It can be put into practice for better management of bull in semen stations also. Current practices have lot of limitations in monitoring, diagnosing and managing health indicators, behavioural indicators and physiological indicators of breeding bulls. Therefore application of AI tools is a futuristic idea to ensure animal welfare in semen stations and for improvement of production status.

The use of sensor technologies to provide real-time data on environmental, behavioural, and health characteristics is revolutionising precision livestock

production. Wearable sensors, environmental sensors, and imaging technologies are some of these technologies. While ambient sensors keep an eye on things like temperature, humidity, and noise levels, wearable sensors keep an eye on physiological characteristics like body temperature and movement. By analysing an animal's behaviour and physical state, imaging technologies—such as CCTV cameras and 3D imaging systems—

allow for better decision-making and animal welfare. These technologies are essential for improving animal care and managing farms effectively.

CONCLUSION

In conclusion, animal welfare practices for breeding bulls in semen stations are essential for ensuring their well-being and improving productivity. Proper housing, feeding, stress management, and behavioural considerations are

crucial for maintaining bull welfare and enhancing the qualitative productivity of breeding bulls. Appropriate welfare measures for bulls in semen stations have the potential to improve productivity through enhanced animal welfare practices.

*Corresponding author e-mail:
biswasnew12@gmail.com



HANDBOOK OF HORTICULTURE

VOLUME 1 & 2



The Indian Council of Agricultural Research has brought out the Second enlarged and revised edition of the Handbook of Horticulture. Horticultural crops are gaining more and more importance as they have been instrumental in improving the economic condition of the farmer and contributing significantly to the national GDP. This new revised edition has been divided into 2 volumes – Volume 1 contains General Horticulture and Production Technologies (Fruit, Vegetable and Tuber crops) and Volume 2 has Production Technologies (Flower, Plantation, Spices crops and Medicinal and aromatic plants), Plant Protection and Post-harvest Management. The earlier chapters have been thoroughly revised and new chapters have been added. It is hoped that the readers will find this Second edition more useful and informative.

Technical Specifications

Pages : i-xxxiv + 1-682 (Vol. 1)
i-xxiii + 683-1218 (Vol. 2)

Price : Rs 2000/- (Vol.1 & 2) • Postage Rs 200/- • ISBN : 978-81-7164-187-1

Copies available from:

Business Unit

Directorate of Knowledge Management in Agriculture (DKMA)

Indian Council of Agricultural Research

Krishi Anusandhan Bhavan, Pusa, New Delhi 110012

Tele: 011-25843657; e-mail: bmicar@icar.org.in, businessuniticar@gmail.com

