

## Buffalo calves from the semen of cloned bulls

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Buffalo is the leading farm animal in India's agricultural economy. In 2018–19, the country produced 187.7 million tonnes of milk, of which 49% (91.7 million tonnes) was contributed by buffaloes (Annual report 2019–20, Department of Animal Husbandry, Dairying and Fisheries (DADF), Government of India (GoI); <http://dahd.nic.in>). In addition to a significant share in India's milk production, buffaloes also contribute considerably to the meat industry. Annually, India has been earning more than Rs 20,000 crores (USD 3000 million) through the export of buffalo meat and its products. In 2019–20, the country exported buffalo meat and its products worth Rs 22,668.48 crores (USD 3175.05 million) (data obtained from the Agricultural and Processed Food Products Export Development Authority (APEDA), GoI; <http://apeda.gov.in>). Thus this bovine species is a preferred farm animal to boost India's white (milk) and pink (meat) revolution.

Over the decades, the National Dairy Research Institute (NDRI), Karnal, under

the aegis of the Indian Council of Agricultural Research (ICAR) has been working on genetic improvement of this valuable milch animal species. For faster multiplication of elite germplasm, NDRI has developed a simple, economical and efficient animal cloning technology known as handmade cloning, which has produced over 30 cloned buffaloes in the country<sup>1</sup>. To upgrade the genetic potential of low milk producers and non-descript buffaloes, GoI has proposed to increase the coverage of artificial insemination (AI) from the current 30% to 80–90% by the end of 2025 (National Dairy Plan, DADF, GoI). Therefore, there is a vast requirement for semen from high genetic merit bulls for breeding (as of 2020, India has 55 million breedable female buffaloes).

Due to a severe shortage of elite bulls in the country, semen available from progeny-tested bulls is not sufficient to cover even 5% of the breedable population of livestock. To meet the target of the Government, NDRI has been working to propagate qua-

lity breeding bulls through buffalo cloning technology. Buffalo cloning is an advanced technology that offers to make genetic copies of elite bulls in the shortest possible time. NDRI has produced several cloned breeding bulls, of which two (named Swarn and Rajat) were used to demonstrate the fertility potential of cloned bulls (Figure 1). Scientists at NDRI found that physical semen parameters such as volume, sperm concentration and post-thaw motility are similar to non-cloned bulls. Also, at the molecular level, sperm transcripts, and miRNA regulating spermatogenesis, fertility and early embryonic development are the same between the clones and their parents (unpublished data).

To determine the fertility of the cloned bulls, 20 female buffaloes were inseminated with the semen of the two above-mentioned cloned bulls. Following insemination in female buffaloes, a 65% conception rate was achieved, which is normal in buffaloes. Thirteen healthy calves (six females and seven males) have been produced and further attempts are ongoing to produce more calves. These calves are physiologically normal and growing healthy. Scientists are of the opinion that it is necessary to develop a roadmap to include semen of cloned bulls in classical breeding programmes. Research carried out at NDRI will certainly help technology reach the farmers' doors for enhancing productivity of their animals, which will lead to future sustainable milk production in India.



Swarn



Rajat



Calves born between August and December 2021

**Figure 1.** Healthy buffalo calves produced from the semen of cloned bulls at the ICAR-National Dairy Research Institute, Karnal, India.

1. Selokar, N. L., Saini, M., Palta, P., Chauhan, M. S., Manik, R. S. and Singla, S. K., *Cell. Reprogram.*, 2018, **20**, 89–98.

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