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Review

New approaches in buffalo artificial insemination programs with special reference to India

Inderjeet Singh*, A.K. Balhara

ICAR-Central Institute for Research on Buffaloes, Hisar, Haryana, India

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A B S T R A C T

Buffalo farming has made remarkable progress in productivity mainly because of controlled breeding with artificial insemination (AI) that has proved its worth in breed improvement and breeding managements across the livestock species. Artificial insemination is practiced very little in Europe and East Asian countries with coverage of only 5% buffaloes in Italy, 3.7% in Azerbaijan, 0.3% in Egypt, and 0.1% in Romania although in Bulgaria, 80% buffaloes in large cooperative state farms are subjected to AI. In Turkey, it began in 2002 near Hatay with Italian semen provided by the Food and Agriculture Organization (FAO) Network project. In India, where buffaloes are the most valuable livestock species, research on buffalo specific artificial breeding technologies and adoption of AI by buffalo owners are widely acknowledged. Resultantly, average milk yield of buffaloes in India increased from 3.4 kg in 1992 to 93 to 4.57 kg/day/buffalo in 2009 to 10. In the new millennium, mega projects such as the National Project for Cattle and Buffalo Breeding and the National Dairy Plan were initiated with focus on genetic upgradation of bovine and buffalo population through streamlining AI services and support system in the country. Artificial insemination started in India in the year 1939, and the frozen semen was introduced during late 1960s. During the year 2010 to 11, India produced 63 million bovine frozen semen straws including over one million buffalo semen straws through 49 semen stations. Artificial insemination services are provided through 71,341 AI stations clocking 52 million inseminations with overall conception rate of 35% in bovine and buffalo population. Research is being conducted for improved AI conception rates with synchronization programs and improved frozen-thawed semen quality, and success rates are at par with AI in cattle.

1. Introduction

Buffaloes contribute about 13% to the world milk production with an annual growth rate of 3.5%, compared with over 2.1% for the cow milk production [1]. In India, buffaloes account for about 53% of the total milk produced (Table 1) and 86% of the total exported meat. Buffalo is the target dairy species for sustainable development mainly because of the ability of the species to use low-quality roughage, higher economic returns, and additional advantage as a meat animal in the country, where cow slaughter is largely banned.

Artificial insemination (AI) is the single most important reproductive biotechnology, which has revolutionized animal breeding. This technique is most widely used for dissemination of superior genetic material of outstanding males, progeny testing of males to improve the rate and efficiency of genetic selection, introduction of new genetic materials by import of frozen semen at negligible cost compared to the import of live animals, the use of frozen semen even after the death of bull and control of venereal diseases. For achieving this goal, identification of superior germplasm and its propagation is of utmost importance for breed improvement in livestock.

* Corresponding author. Tel.: +91-9354324903; fax: +91-1662-275004.
E-mail address: inderjeet.dr@gmail.com (I. Singh).

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Table 1
Status of buffaloes in the World, Asia, and India.

Category	Population (million heads)			Milk production (million tonnes)			Meat production (million tonnes)		
	World	Asia	India	World	Asia	India	World	Asia	India
Total bovine (cattle + buffalo)	161.37	682.84	298.40	737.99	276.70	130.60	67.71	17.69	2.58
Total buffalo	193.82	187.86	109.40	102.04	99.22	70.00	3.72	3.32	1.61
Buffaloes as % of total bovine	11.67	27.51	36.66	13.83	35.86	53.60	5.49	18.77	62.40

FAO STAT 2013 [2].

Artificial Insemination gives livestock owners' immense opportunity to introduce proven genetics for accelerated improvements in shortest possible time. Usually, AI programs are implemented in combination with selection programmes, including performance and progeny testing with the estimation of breeding values of the males and by publishing the indexes, allowing farmers to choose the breeding plan for their herds. Considering the socioeconomic condition of owners and resource availability with government state agencies, the productivity of buffaloes in the country has improved substantially. The average milk yield of buffaloes was pegged at 4.6 kg/day/buffalo in 2009 to 10, up from 3.4 kg in 1992 to 93, a success attributable to extensive AI programs launched in the country with active participation of buffalo owners, state and central agencies. A comparative study of the all bovine population has been presented in Table 2.

2. Artificial insemination programs with special reference to buffalo

2.1. World

Borghese (2010) [3] reported that AI is practiced very little in Europe and East Asian countries like Iran and Egypt. He reported that the percent of buffaloes covered by AI programs is only 5% in Italy, 3.7% in Azerbaijan, 0.3% in Egypt, and 0.1% in Romania. In Bulgaria, in the large cooperative state farms, it is used on 80% of the buffaloes. In Turkey, it began in 2002 near Ilikpinar village (Hatay) with Italian semen provided by the FAO Network project. The article states that the diffusion of AI in buffaloes is difficult because of seasonality in this area. Anzar et al., (2003) [4] reported that, in Pakistan, field AI conception rate is 29% and is affected by many factors including those related to farm, animal, semen, and AI technique.

Table 2
Milk production trends in large ruminants of India.

Period	Milk production (million tonnes)			Yield (kg/in-milk animal/day)		
	Indigenous cow	Crossbred cow	Buffalo	Indigenous cow	Crossbred cow	Buffalo
1992–93	16.8	7.6	31.0	1.65	5.57	3.46
2000–01	18.8	14.1	43.4	1.92	6.44	4.05
2009–10	22.5	25.4	59.2	2.14	6.87	4.57

Report of the working group on Animal Husbandry and Dairying, XII Five Year Plan, Govt. of India

2.2. India

Beginning with the first buffalo calf born through AI at the Allahabad Agricultural Institute in 1943, the cattle and buffalo breeding has achieved numerous milestones in India. In the first 5-year plan (1951–56), the Government of India introduced 150 key village centres to improve cattle and buffaloes, which was increased to 400 villages in subsequent plan. This followed introduction of All India Coordinated Research Projects for genetic upgradation of cattle and buffaloes. Constraints for improvement in AI programs in the country include slow progress in bull production and evaluation because of small herd size, no initiative to form breed societies, and ineffective extension network. Most government AI centres were stationary because of deficiency of manpower and transport facility. Toward meeting these challenges, the National Project for Cattle and Buffalo Breeding, initiated in the year 2000, focused on genetic upgradation of their population and streamlining AI services and support system. Twenty-eight states and one union territory participated under this mega project. To produce frozen semen of uniform quality, a Minimum Standard Protocol for semen production has been developed, and the same has been made effective from May 20, 2004. Accordingly, semen freezing laboratories are accredited as "A" or "B" grade laboratories and State Livestock Development Boards are required to use the frozen semen produced only by the "A" grade laboratories. By the end of National Project for Cattle and Buffalo Breeding, bovine and buffalo frozen semen production increased from 22 million straws (1999–2000) to 63 million straws (2010–2011), and the number of inseminations also increased from 18.8 million in 1996 to 97 to 50.7 million in 2010 to 11, including over one million buffalo semen doses, together with an increase from 20% to 35% in overall conception rate (Table 3). The number of A- and B-graded semen stations increased from 27 in 2007 to 08 to 37 in 2011. Presently 44 A- and B-graded semen stations in India are producing around 85 million frozen semen doses, targeting production of around 140 million doses by 2021 to 22. Of these 44 accredited semen station, 17 are also certified with ISO 9001 to 2008, whereas seven semen stations have obtained Hazard Analysis Critical Control Point certification. A network of 71,341 AI stations is instrumental in this achievement.