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Adoption of Artificial Insemination Among Large Ruminants in Arid Western Rajasthan, India

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ABSTRACT

This study estimated the adoption rate of Artificial Insemination (AI) among large ruminants based on primary data collected from 200 farm households in Jodhpur district from 2019 to 2022. The composition of cow and buffalo population was 74 and 26 per cent in the study villages. 56 per cent farmers in cows and 13 per cent in buffaloes adopted AI with a success rate of conception after first insemination of 31 per cent in cows and 22 per cent in buffaloes. AI cost ranged from Rs. 400-800/- and Rs. 500-1000/- per insemination in cows and buffaloes respectively. Breeding cost through pedigreed bull was comparable to insemination in both cows and buffaloes. Subsistence mode of livestock rearing and natural grazing on community pastures were the main reasons for low adoption rate of AI. Farmers ensured that their buffaloes were sired only through pedigreed bulls. Since, pedigreed bulls were not available in all villages, their availability in villages or at the selected farmers on payment basis is required for genetic improvement of cattle.

INTRODUCTION

Livestock is an integral component of agriculture, livelihoods and culture in arid and semi-arid regions of India. Rajasthan has about 10.60 per cent of the livestock of the country making it second highest number of livestock population in India. It ranks second (7.23%) and third (12.47%) of the country's cattle and buffalo population respectively. Jodhpur district has the maximum number of livestock population in Rajasthan (20th livestock census, 2019). Cattle, buffalo, sheep and goat are the major livestock reared in Jodhpur district. Livestock was part of farming systems of 98 per cent farm households in Jodhpur district. Cows and buffaloes were reared by 87 and 29 per cent households (Manjunatha, 2021). Livestock is the second most significant contributor of farm income in arid regions and its significance increased during low rainfall and drought years (Manjunatha et al., 2019a; Manjunatha et al., 2019b & Manjunatha et al., 2021). The livestock enterprise has gradually shifted from subsistence to commercial mode.

Adoption of scientific technologies plays a crucial role in enhancing the production and efficiency of livestock enterprise. According to Chander et al., (2010), the low productivity and quality of products in India's livestock and dairy sector persist as a major problem. Artificial Insemination (AI) is one of the important technologies for enhancing the genetic superiority and production performance of the livestock. However, the adoption of AI is low in India especially in arid regions. Genetic progress requires widespread use of artificial insemination and the use of high-quality semen from genetically superior bulls (Dixit et al., 2016). Lack of a mandatory system of animal identification and data retrieval, weak control of AI technicians, and problems with timely AI delivery are some of the main issues with the existing AI delivery system (Gupta et al., 2017). In this context, the current study sought to estimate the adoption of AI among large ruminants

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in western Rajasthan and the challenges that livestock keepers faced in adoption of this technology.

METHODOLOGY

Jodhpur district in the Indian state of Rajasthan was chosen specifically for the research and participants were chosen using a multi-stage stratified random selection technique. Four tehsils in Jodhpur district and one village per tehsil namely Bisalpur (Mandore tehsil), Balarwa (Tinwri tehsil), Bankliya (Pipar tehsil) and Dantiwada (Mandore tehsil) were selected to represent different farming systems practiced in the region (Table 1). The total sample size was 200 farm households, with 50 selected from each of the four villages randomly. Primary data were collected between May 2019 and June 2022 using personal interview technique through a well-structured interview schedule developed and validated specifically for the study.

The study used a survey and case study approach. The primary data were analysed using frequency, percentage and means. Respondents were asked to rank various constraints affecting adoption of artificial insemination using Garrett ranking technique and this ranking was then used to a scoring method to determine an actual numerical value with standard formula:

$$\text{Percent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where, R_{ij} = Rank given for the i^{th} variable by j^{th} respondent; and N_j = Number of variables ranked by j^{th} respondent. In the study N_j = 7.

With the help of Garrett's table, the percent position estimated was converted into scores. For each factor, the scores of each individual are added and total value of scores and mean values of score is calculated. The factor having highest mean value is considered to be the most important factor.

RESULTS AND DISCUSSION

Livestock population in study villages

Brief information pertaining to livestock rearing in the study villages is provided in Table 1. The cattle population was higher than the buffalo population in each village. *Tharparkar, Rathi, Nagauri* and *Kankrej* breeds of cows and Graded *Murrah, Surti* and *Meshana* breeds of buffaloes were dominantly found in the study villages. The composition of cow and buffalo population ranged from 70-83 per cent and 17-30 per cent, respectively in the study villages. Dairy or milk collection center was found in all the villages within the distance of 4-6 kms. Public veterinary hospital was present only in Bisalpur and farmers in other villages had to travel 5-10 kms to avail public veterinary services. These services were also availed by the livestock keepers from private veterinary service providers on payment basis (minimum of Rs. 100-150 per visit). The high cost of insemination was also highlighted as a limitation of the artificial insemination technique in a study from Kerala by Gowda & Samanta (2002). Therefore, in majority of the cases livestock keepers follow the traditional methods of healing the sick animals. In addition, 12 per cent of respondents relied on traditional healers to treat their sick animals, as found by Jarial et al., (2015). It is necessary to raise awareness among dairy farmers about the commercial viability and profitability of dairy farming and make them successful in the region (Gupta et al., 2020).

Extent of livestock keeping

Cow rearing was practiced by 86-100 per cent farmers in the study villages (Table 2). The number of households rearing buffaloes varied from 16 per cent in Dantiwada to 64 per cent in Bisalpur. In Bankliya and Dantiwada villages every household reared cows, but only 44 and 16 percent households kept buffaloes respectively. Buffaloes were reared by farmers having assured irrigation facilities (tubewells). These farmers cultivated fodder crops (lucerne and fodder bajra) for feeding buffaloes.

Adoption of artificial insemination

Adoption of AI was high (56%) among the households rearing cows since there was no pedigreed bull available in these villages for natural breeding. Rest of the households resorted to natural breeding for their cows through non-descript stray bulls present in the village/ livestock herd. Only 12.5 per cent buffalo rearing families adopted AI and rest of the farmers availed the services of pedigreed bulls reared specifically for breeding purpose by few farmers in the same or nearby villages on payment basis. It indicated that though adoption of AI was low in buffaloes, all

Table 2. Number of farm households rearing cows and buffaloes

Village	Cow	Buffalo
Bisalpur	43	32
Balarwa	46	30
Bankliya	50	22
Dantiwada	50	8
Total	189	92

Table 1. Demographic and livestock information of the study villages

Village	Number of Households	Livestock Population 2019-2020*		Distance from Jodhpur city (kms)	Location of nearest public veterinary hospital (Distance in kms)
		Cattle	Buffalo		
Bisalpur	1012	1880	760	34	Same village
Balarwa	815	2970	1110	38	Tinwri (7)
Bankliya	410	1030	440	53	Bhujkala (10)
Dantiwada	565	1540	310	37	Dangiyawas (5)
Total	2802	7420	2620	-	-

Note: *Includes livestock of all age groups

Table 3. Number of farm households that adopted artificial insemination vis-à-vis natural breeding in livestock (2019-20)

Method of breeding	Species	Number of households*				Total
		Bisalpur	Balarwa	Bankliya	Dantiwada	
Artificial insemination	Cows	20	27	31	34	112
	Buffaloes	0	12	13	0	25
Natural breeding	Cows	30	23	19	16	88
	Buffaloes	50	38	37	50	175

Note: *Farm household that has adopted AI at least once in at least one cow/buffalo in 2019-20.

buffalo rearing farmers took care in getting their buffaloes sired only through pedigreed bull. AI in cows was practiced in all villages whereas it was practiced only in two villages for buffaloes. Only 16.23 and 6.26 per cent of total cows and buffaloes respectively were treated with AI upon detection of oestrus in the year 2019-20 in the study villages. The success rate of conception after first AI was found to be 31 and 22 per cent in cows and buffaloes respectively. The cost of AI per animal per time was Rs. 400-800 for cows and Rs. 500-1000 for buffaloes. Since the success rate is low, livestock keepers had to go for more number of AI (3-5 times) to achieve a higher success rate, thus increasing the average cost of AI to Rs. 800-1000/- animal.

Reasons for low adoption of artificial insemination

The adoption of AI among cows and buffaloes was found to be low in all the study villages. The adoption rate of AI varied among the villages and farmers. The adoption was low among majority of the farmers who reared livestock under traditional farming systems as part of agriculture. These farmers still practiced free grazing of cattle (both male and female livestocks together) which increased the chance of natural breeding in the herd. Under such conditions, detecting the heat at the right time is also difficult leading to low success rate of AI. Farmers who had commercial dairy farms with large herd size (average herd size of >20) invariably adopted AI and the success rate in such organized farms was high. They availed services from public and private veterinarians or para-veterinary staff in getting AI done at their own farms. The adoption of AI was also higher among farmers who reared livestock for sale of milk in the market though the average herd size was small (<5 animals). High cost of AI service due to the need to undergo AI repeatedly for the same animal in some cases is another major constraint. The biggest problems in the livestock breeding industry are inbreeding, low birth rates, and a lack of skilled workers (Hamdani, 2013; Lawrence et al., 2015 & Ibrahim

Table 4. Number of livestock sired with artificial insemination (2019-20)

Parameter	Species	Bisalpur	Balarwa	Bankliya	Dantiwada	Total
Number of livestock*	Cows	43	130	80	48	301
	Buffaloes	0	17	24	0	41
AI success rate at first attempt	Cows	14	39	28	15	96
	Buffaloes	0	4	5	0	9
Cost of AI (Rs./dose)	Cows	400-800	400-800	400-800	400-800	-
	Buffaloes	Not practised	500-1000	500-1000	Not practised	-
Cost of service of breeding bull (Rs./animal/service)	Cows	Stray animals	Stray animals	Stray animals	400-600	-
	Buffaloes	Villagers collectively bought pedigreed Murrah bull	500-1000	500-1000	1000	-

Note: *Represents all cows/buffaloes eligible for breeding (either through AI or natural breeding) in a given year. Based on the discussion with livestock experts, it was assumed that out of every four female large ruminants (cow/buffalo) in the village, one was calf, one was heifer and two were adults. Out of two adult female animals, one animal was considered eligible for breeding in a given year. Therefore, the number of cows/buffaloes eligible for breeding was equivalent to one-fourth of the cow/buffalo population in the village (Table 1).

Table 5. Reasons for low adoption of artificial insemination

S.No.	Constraint	Mean Score	Rank
1	Rearing of livestock under subsistence agriculture mode (Practice of natural grazing on community pastures in arid region)	57.16	I
2	Failure to detect heat of cow/ buffalo at right period (especially under natural grazing conditions)	56.95	II
3	Improper timing of insemination after oestrus detection	49.59	III
4	Lack of expertise of AI technicians	45.21	IV
5	High cost of AI (due to low rate of conception under AI vis-à-vis natural breeding)	44.76	V
6	Poor veterinary infrastructure (including facilities for storage of frozen semen)	43.72	VI
7	Poor post AI management like management of livestock stress including their handling, nutrition, temperature, etc.	41.38	VII

et al., 2014). The proper timing of insemination after oestrus detection is not taken into consideration in many cases. Lack of expertise or skill of technicians in performing AI leads to low success rate of AI services. Livestock keepers perceive that a lack of qualified professionals and paraprofessionals is a significant barrier to making full use of livestock services (Ravikumar & Chander, 2011). Limitations in artificial insemination (AI) technician capacity and IVF procedure also contribute significantly to low birth rates (Samsuddin et al., 1997). The need to train AI technicians in this regard plays an important role. Majority of the livestock keepers believed that the success rate of conception under AI was low as compared to natural breeding in the region. Few farmers held a misconception that the calves conceived through AI are usually unhealthy and there was early emergence of horns among calves. Study conducted by Verma (2020) reported that farmer's belief on village quack and hesitations to contact veterinary officers were among the serious constraints. According to Saharia (1990), veterinarians in Assam similarly cite being misled by quacks as one of their biggest challenges. Due to several factors such as difficulties in access and use of technology and low success rate, such misconception is prevailing among some of the livestock keepers. Mass-media can be used to greatly improve milk farming, but first we need to identify the political repercussions of systematically organising massive awareness campaigns (Gupta et al., 2021). Poor infrastructure to store the frozen semen and poor AI follow up are other major constraints for low adoption of AI services in the region. After insemination, the embryo is most vulnerable to heat stress on days 4 or 5, just before the maternal to zygotic transition, as observed by George & Robin (2020). In cattle, shipping after the embryo has entered the uterus can have a harmful effect up to 60 days following insemination. Since the embryo is completely reliant on the secretions from the uterine lining for survival before it attaches around day 20, abrupt dietary changes are most likely to have an effect on the embryo's chances of survival before this time. Adoption of any technology requires that farmers are fully convinced about the benefits of the technology. The livestock sector in the western Rajasthan is shifting from subsistence to the commercial enterprise and the adoption of AI is expected to increase in future. Therefore, lot of scope exists for extension system to address the knowledge, skill and attitudinal gaps in dissemination of this proven technology. There is a statistically significant positive relationship between the amount of extension contact and the speed with which a technology is adopted (Singh et al., 2021). The private players may play a great role in partnering with public veterinary service providers in increasing the adoption by bridging infrastructure gaps.

CONCLUSION

Number of farmers that adopted Artificial Insemination (AI) in Jodhpur district was 56 per cent in cows and 13 per cent in buffaloes. Success rate of conception after first insemination was 31 per cent in cows and 22 per cent in buffaloes respectively. Farmers ensured that their buffaloes were sired through pedigreed breeding bulls in the absence of AI facilities. However, pedigreed breeding bulls were not maintained by the farmers for breeding of cows since it is a very costly affair. With the gradual shift from subsistence farming to commercial agriculture, cows are being neglected by the farmers. Therefore, farmers have to be incentivized in keeping pedigreed breeding bulls for enhancing the genetic superiority of the well-known cattle breeds of this arid region.

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