

Factors Influencing Effective Artificial Insemination Services Delivery in Selected Districts of Bhutan

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Abstract

To understand the factors effecting Artificial Insemination (AI) service delivery, functional AI centers in the five selected districts were visited; AI records assessed and discussion held with Technicians individually on challenges and opportunities in delivery of AI services. Information obtained was validated through focused group discussion at the district level. AI beneficiaries were also interviewed at random to get their views on uptake of AI services. Findings suggest that though 60% of districts exceeded national average AI success rate, but only 20% of sampled districts engaging Community AI Technicians achieved significantly higher number of AI/year and AI success rate ($p < 0.007$) than national average. Among four limiting factors for success of AI success: farmer factor-not observing cows in heat is ranked the highest (42%) followed by animal factor: poor health of animal (31%), Technician's skill factor (15%) while 12% is linked to deterioration of semen quality while handling it. Scattered village, migratory herd, inadequate mobility and multitasking of extension staff lowered AI performances. Lesser awareness of farmers on AI and distance from AI service centre lowered technology uptake. The study concludes that motivation of AI Technician with performance-based incentives; awareness of farmers on AI Technology, engagement of Community Technicians can improve AI service delivery.

Keywords: Artificial Insemination; Service Delivery; Factors; Challenges; Opportunities

Abbreviations: DVH: District Veterinary Hospital; LEC: Livestock Extension Centre; NDRDC: National Dairy Research and Development Centre; CAIT: Community AI Technician; CHBPP: Contract Heifer and Bull Production Program.

Introduction

Artificial Insemination (AI) is the first Assisted Reproductive Technology applied to cattle world-wide. Wide spread use of AI is to facilitate sires with genetic merit to increase the rate of genetic gain in livestock populations. Over 150 million cattle are artificially inseminated annually across the globe [1]. AI continued to be popular because its application is

simple, economical and successful.

In Bhutan, the National Artificial Insemination Program in cattle was initiated in 1987. AI service centres are now expanded nationwide with 130 AI centres equipped with required facilities and inputs. This intervention has resulted in marked shift in composition of dairy herd in favour of crossbred cattle with positive outcome on enhanced milk production and livelihoods of farming communities in Bhutan [2]. Efforts are under way to intensify AI services using in-country produced, imported progeny tested (sexed and conventional semen) for wider AI coverage to increase cattle population with higher inheritance of dairy

breed characteristics. Nevertheless, AI coverage of breed able female population (both crossbred and local cattle) at the national level is low about 12% [3]. AI coverage is low due to difficult farming environment and scattered human settlement NDRDC 2019, [3]. The national average success rate based on number of progeny born is about 36.1% and average AI performed annually is 75AI /AI Centre Rai DB, et al. [4]. Though AI is one of the viable technologies that have been used for genetic improvement in Bhutan, there was little empirical information about major factors affecting effectiveness of AI service delivery and adoption of technology by farming communities. Hence, comprehensive assessment of limiting and challenging

Factors influencing transfer of AI technology to farmers was carried out with the following objectives:

- Assess AI performance/effectiveness of AI service delivery in five selected districts
- Identity limiting/ challenging factors for AI service delivery and opportunities to enhance uptake of AI services

Materials and Method

Study Area

Five out of 20 districts in Bhutan (Gasa, Punakha, Wangdue, Dagana, Tsirang) with 31 out of 120 functional AI centers (26%) were identified to assess AI performance (Figure 1).

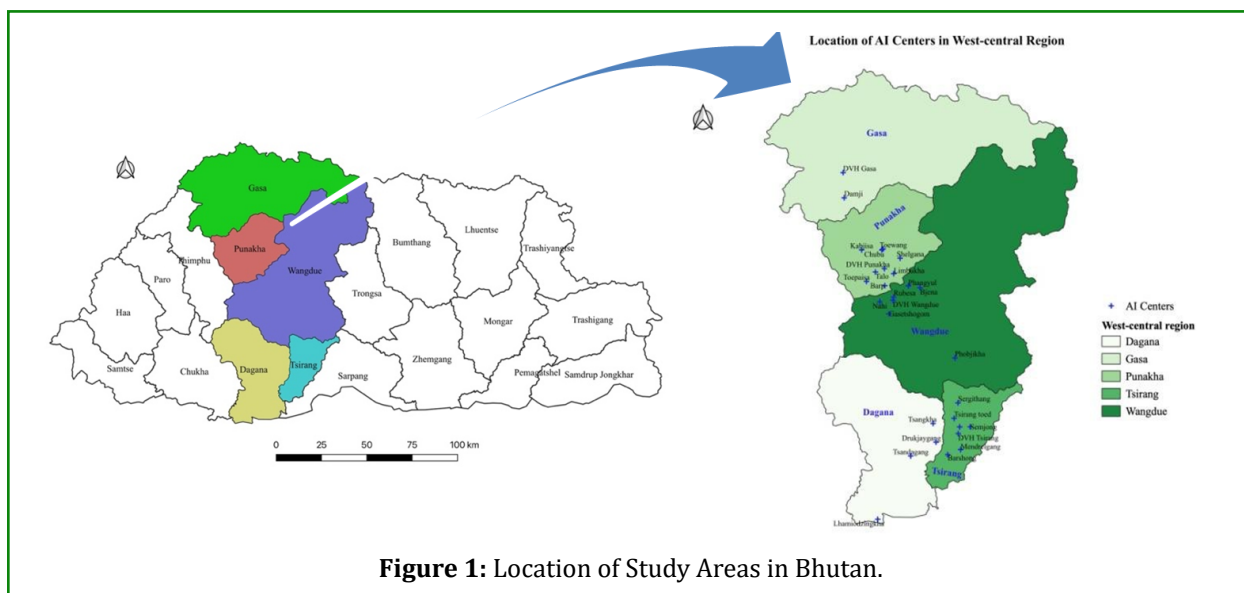


Figure 1: Location of Study Areas in Bhutan.

Data Collection Method

Quantitative data

- Assessment of AI records

Records of AI events (2020-2022) of all 31 functional AI

centers visited Table 1 were compiled for performance assessment. Data were validated with records available with National Dairy Research and Development Centre (NDRDC) at Yusipang.

Sl No	Districts	No of AI Centre	Location of LEC with AI facility
1	Gasa	2	DVH Gasa, LEC Khamed (Damji)
2	Punakha	9	DVH Punakha, LEC Toedwang, Talo, Tobesa (Thinleygang), Kabjisa, Barp, Shengana, Limbukha & Chubu
3	Wangdue	8	DVH Wangdue, LEC Gaselo, Phobjikha, Rubesa, Phangyul, Bjena, Nyisho (Samtegang) & Nahi
4	Tsirang	7	DVH Tsirang, LEC- Gosarling, Mendrelgang, Barsong, Sergithang, Tsirangtoe & Semjong
5	Dagana	5	LEC Tshendagang, Tashidin, Drujegang, Lamoizingkha & Tsangkha

Note: 29 LEC with AI out of 31 visited

Table 1: AI Centre Identified for Assessment of AI Services.

Qualitative Data

1. Assessment of limiting and challenging factor of AI Technician in delivery of services

The qualitative data were collected through face-to-face discussion with concerned AI Technician on:

- Location specific field constraints/challenges impeding service delivery
- Probing four key limiting factors (Farmers factor, Animal factor, Technician factor and Semen factor) during the individual and group meetings
- Completeness of recording AI events by AI Technician upon scrutiny of individual AI register: very good-complete record including follow up on repeat heat, pregnancy and calving done, good- AI event was maintained and AI follow up partially done and poor-either proper record was maintained nor AI events follow up is done.

2. Beneficiary's (farmer) views on AI services: Few farmers both far and near the AI center were randomly selected for face-to-face informal discussion to understand their perception/views on ease of availing of AI services.

3. Focused group discussion at District level: Focused group discussion was held at district level with relevant staff to validate data/information on location specific constraints and opportunities on delivery of AI services

Data Analysis

- Quantitative data on AI done and progeny born were compiled and one sample t-test was performed using software SPSS version 18 to test the significance level of AI performed and success rate (progeny born) in the districts visited, compared with national average AI performed and success rate as test value
- Qualitative data were entered in excel sheet and answers falling into similar pattern were sorted, percentage derived, and analyzed using descriptive statistics

Results and Discussion

AI performances in Selected Districts

AI success rate when compared with national average success rate of 36.1% and amount of AI/centre/year of 75 Rai DB, et al. [4] shows that Wangdue, Tsirang, Gasa districts exceeded national average success rate whereas in terms of number of AI/Centre/Year only Punakha and Tsirang exceeded it. Overall, only Tsirang district had significantly higher AI performance (for both AI number/year and AI Success rate) than the national averages. On the contrary, Dagana had significantly lower AI and AI Success rate than the national average (Table 2).

Districts	AI done (no)	AI/ Yr/ AI Centre	p-Value	Progeny born (no)	Success rate (%)	p-Value
Punakha	751±93	95±11	0.000	245±50	32.8±6.5	0.145
Wangdue	388±142	52±23	0.011	157±77	39.5±9.1	0.254
Tsirang	487±116	113±35	0.007	215±68	44.5±10	0.029
Dagana	196±83	52±21	0.007	52±27	27.4±12.5	0.054
Gasa	64±24	32±11	0.000	26±15	37.6±14.6	0.747

Table 2: Average Annual AI Performances in Selected Districts.

Higher success rate in Tsirang is attributed to engagement of Community AI Technician (CAIT) as well as involvement of retired livestock professional (with AI skills) to provide mobile AI services on payment basis at the Geogs (sub-districts). However, with multiple roles of single Extension Staff in a Geog and absence of active CAIT to support, AI services delivery in other districts are affected which warrants a closer look. Yemane, et al. [5] supported the view that the extension system should emphasize scaling out of best practices and encourage participation of the private sector in wider adoption of AI technology for better results.

Limiting Factors and Field Challenges and Opportunities for Effective AI Service Delivery

Limiting Factors Associated with AI Success: Four key limiting factors (Farmers factor, Animal factor, Technician factor and Semen factor) were probed with focus group of AI Technicians and District officials (n=39) to understand its

influence on AI success rate (Figure 2).

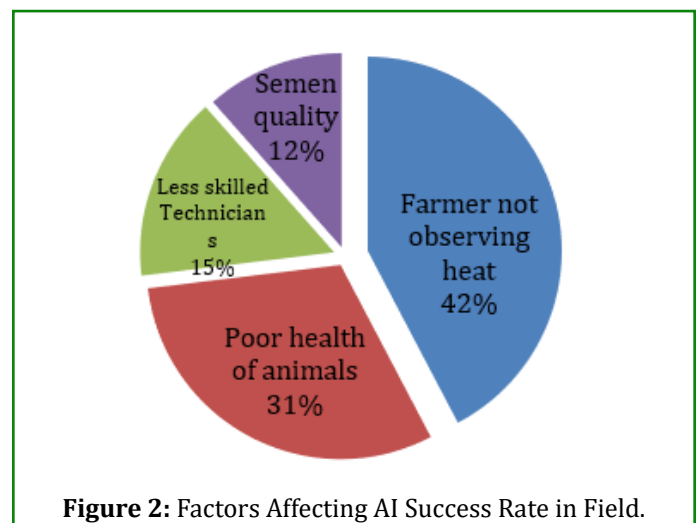


Figure 2: Factors Affecting AI Success Rate in Field.

1. **Farmer Factor:** Focused group discussion revealed that farmers owing to busy farming schedule do not closely observe their animals in heat and inform the AI technician for timely inseminations. Many a time farmer bring animal to AI Centre in late heat, when cervix of animal has already closed. Since farmers have travelled quite a distance with animals to reach the centre, the AI Technician is obliged to inseminate despite knowing that animal do not conceive. Farmer's cooperation to observe the animals in heat and bring the animals for insemination on time is crucial for success of AI.
2. **Animal Factor:** Energy and protein are the limiting factors affecting health and body condition of animals in the villages of Bhutan. Poor reproductive health/reproductive disorders leading to pus discharge during heat and abortion in third trimester after insemination was reported by some AI Centre. Traditional practices of not attending to retained placenta cases by farmers are suggested to have led infection of reproductive tract affecting success rate. Research have shown that inducing heat in animals with Body Condition Score of <2.4 (scale of 1-5), do not usually conceive even when animals show clear heat signs due to unovulatory heat Tamang, et al. [6]. Advocacy to provide adequate feed and fodder both in quantity and quality to encourage normal growth, production, reproduction and post-partum care of animals would improve animal performance.
3. **Technicians Factor (skilled, dependable AI Technicians):** Inadequate skills to perform AI by freshly appointed staff from training institute has resulted in lower AI success rate. Training provided by College of Natural resources in Bhutan is reported to be inadequate for field Livestock Supervisors to perform the AI services efficiently. Mathewos, et al. [7] also documented major constraints associated with AI service in Ethiopia and found that conception failure owing to wrong timing of insemination, unavailability of skilled artificial insemination technicians and dystocia. However, staff who received refresher courses could provide AI services confidently. Hence, periodic re-training and up-skilling of field AI staff is a necessity.
4. **Semen Factor:** Discussion with AI Technicians revealed that improper semen handling while transferring from one semen bank to another in the field could deteriorate semen quality affecting conception rate. Quality semen is an important element in all breeding programs and semen analysis for sperm quality in imperative as in other developed countries. The semen analysis using Computer-assisted semen analysis (CASA) and Flow cytometry (CF) are two standout technologies developed to accurately and objectively analyze sperm quality

Zuidema, et al. [8]. Hence, timely analysing semen along-with proper semen handling, storage and usage are essential for higher success rate.

Challenging factor associated with effective AI service delivery

Challenges faced by AI Technicians

- **Logistic challenges Vs low AI coverage:** Scattered and far-flung villages with human settlements away from AI Centre have resulted in low AI coverage as reported by at least 31% AI Technicians (n=9). AI services are dependent on availability of transportation facilities to reach services to farmers on time. Even if AI Technicians have their own transport, the farm roads condition cannot be accessed and used during rainy season which hinders effective AI services delivery. Limited provision for transport and mobility of staff and inactive or non-availability of Community AI Technician to support AI Services delivered by Government Technicians is the bottle neck (Figure 3).

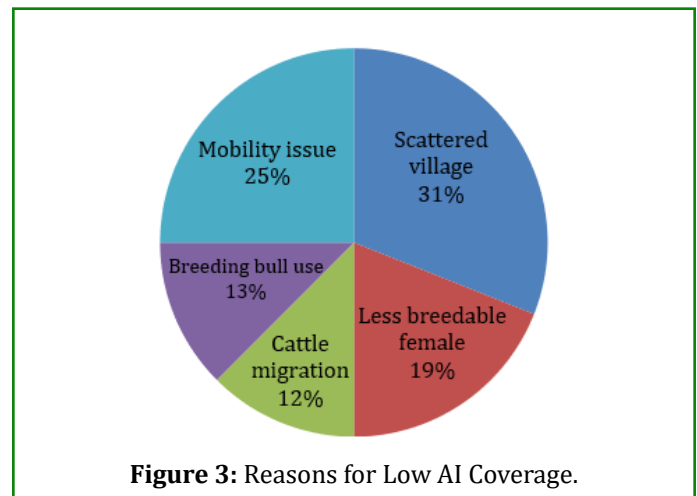


Figure 3: Reasons for Low AI Coverage.

Unless transportation facilities and farm road conditions are improved, AI coverage is likely to remain low in remote Geogs.

- **Multitasking of Geog Extension Staff:** The single staff available at the Geog Livestock Centre is multi-tasked with various developmental tasks in hand and AI services are one of many tasks. AI being a time bound activity; majority 100% of staff reported that engagement in another assigned task for months often hampered the AI services delivery. Similarly, Mathewos, et al. [7] reported AI service interruptions during both regular working hours and weekends and holidays that impeded AI service delivery in Ethiopia and suggest technician-related scarcity should be resolved.
- **Limited motivation of staff to record AI events:**

Recording of AI events is very important for successful artificial insemination. However only 41% AI Technicians (n=12) keep very good records with following-up of all the AI events including record of semen used and its stock balance, repeat heat in 21 days cycle, pregnancy, calving and recording of calves born. While 52% (n=15) maintain records of most events but follow-up is incomplete, 7% (n=2) are careless without good record maintained nor follows up the AI events (Figure 4).

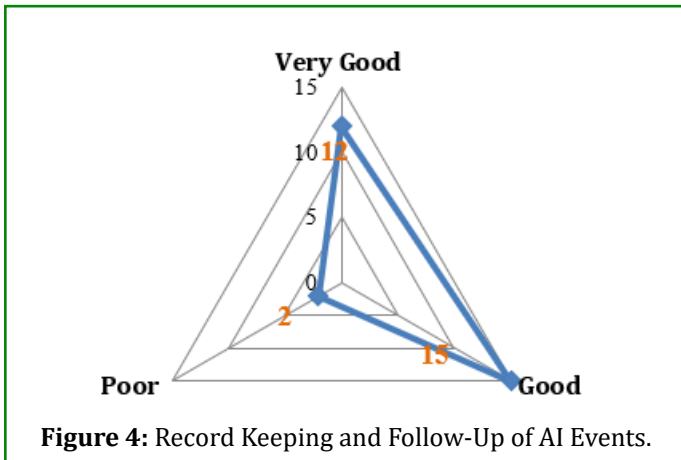


Figure 4: Record Keeping and Follow-Up of AI Events.

Reasons cited by AI Technicians for minimal or no follow-ups are lack of time, no incentives such as very limited travel allowance and cost involved while making calls to each farmer. Keeping records according to Azab AI [9] are time and material investment that are equally important as input provided for successful artificial insemination services. Jan, et al. [10] mentioned that reliable recording of AI event is crucial for accurate pedigrees, opportunities for genetic analyses of all traits, selection for female with higher fertility that offers opportunities for village herd improvement. But Tshering, et al. [2] reported that lack of proper recording in Bhutan, the number of progenies born is underestimated by 14.2%. Reinforcing recording of AI events therefore is prerequisite.

Associated Reasons for Lesser Adoption of AI Technology by Farmers

- **Distance of farming households from the AI centre:** Assessment of village-wise records of memberships to Contract Heifer and Bull Production Program (CHBPP) at Kabesa, Punakha that offers AI services with imported frozen semen confirms that farther the distance of hamlets/villages from the AI centre, lesser is the number of farmers enrolling into the program. Farmers who are away from the AI centre and with limited means reported that due to distance, it is difficult to walk the animals to the nearest AI centre. However, in the periphery of urban town, farmers keep mostly high yielding crossbred cows and come forward to avail

AI service on their own arranging transport to pick and drop AI service providers. This implies that these farmers are more aware on benefit of AI in peri-urban areas in contrary to lesser acceptance at the rural areas. Studies elsewhere have also found that AI adoption rates remain poor due to inadequate services providers, the long distances between farms and providers besides poor infrastructure such as roads Mwanyumba, et al. [11]. Further, around the urban dairy hubs of Kenya, farmers keeping exotic cattle derived high utility from AI and were willing to pay more for AI services Omondi, et al. [12].

- **Farmers awareness and perception on AI services:** It was revealed that rural farmers have limited awareness on usefulness of AI services despite repeated advocacy provided by livestock extension staff. Farmers perceive that conception with AI is lower than natural mating with breeding bulls. Similarly, farmer's perception on AI studied in Indonesia Adnyana, et al. [13] revealed that higher acceptance of AI services was in areas with bull scarcity and high price of crossbred calf whereas lesser acceptance in other area is perceived to be due to low AI conception rates. Besides, inadequate support to address the challenges faced by farmers result in low adoption of AI services. In Bhutan, Wangchuk, et al. [3] reported that inadequate knowledge of the beneficiary farmers on detection of estrus led to wrong time of reporting for AI that resulted in poor conception rates. Hence, to increase the success of AI, policy support from the local and central government to reduce access to bulls unfit for breeding and farmer's education on AI is likely to improve AI success rate.

Further 56% (n=15) of farmers interviewed reasoned that birth of male calves with AI dishearten them while 44% have no issue on calf gender. Male calves are less preferred by farmers because it is not strong for draught purpose and has limited utility. Hence, male calves/bulls are often are less cared and are left free to stray causing public nuisance. In similar studies, Devon, et al. [14] reported that male calves received less milk compared with females and males were fed with unsalable milk as cost of feeding and price premium received for male calves dictates the level of care provided. Use of sexed semen with 89.6% female Rai, et al. [15] birth is suggested to encourage more farmers to avail AI services and has to be advocated at least in peri-urban areas across the country.

- **Decreasing Number of Breedable Females:** High altitude areas of Khatoe at Gasa district have limited number of breedable female cattle whereas Tobesa Geog in Punakha where agriculture activity is prominent, limited number of cattle is kept for manure and rest sold to farmers in other districts. Similarly, Barsong Geog in Tsirang,

farmers sold away less productive local cattle and farmers in Bjena Geog Wangdue still practice traditional cattle migration practices. These situations reportedly led to decrease in breedable female cattle population and resultant lesser AI coverage.

Opportunities to Enhance AI Service Delivery

Improving Knowledge, Skill and Diligence of AI Technicians: Applying correct AI technique is critical for higher AI success rate. A maximum 69% (n=20) of the AI Technicians are observed to acquired knowledge and skills and have attended refresher course organized by government agencies. About 21% (n=6) reported that they have basic AI skills and upgrading skills on use latest equipment and facilities is necessary whereas 7% (n=3) reported that lack of AI skill hampered service delivery and AI refresher/crash course would be necessary for them to deliver services effectively.

Diligence to deliver service is shown by majority (52%) of AI Technicians (n=15) indicated by proper techniques being applied and proactiveness in providing AI services even in weekends, holidays and before/after the office hours (morning/ evening) without hesitation.

However, family obligation of some Technicians, compelling them to stay away from Livestock Extension Centres hindered AI service delivery during off hours. Similarly, AI service interruptions both during regular working hours and weekends and holidays are reported by Mathewos, et al [7]. Hence opportunity exists whereby motivation of AI Technicians providing opportunity of upgrade knowledge and skills, provision for adequate gears to perform field duty, recognition of excellent AI performers and placement of right staff at right place can bring positive outcomes.

Engagement of Community AI Technicians: Engagement of CAIT and retired livestock staff with AI skills has been instrumental in improving AI coverage. For instance, Tsirang with good number of active CAITs providing mobile AI services facilitated to boost AI performances and it stands as highest performer among five districts (study area). Wangchuk, et al. [3] supplemented the view that CAITs engaged in eastern Bhutan achieved higher AI success rate of 43% than the national average of 36.1% Tamang, et al. [4] and is contributing to breed improvement and milk production. Experience from Bangladesh also reveal that though demand for the AI services has been increasing existing institutional arrangement is not able to provide the needed AI services especially to the remote areas and farmers' access to such services have to be improved through various alternative means Uddin, et al. [16]. Hence, skilling and engagement of CAIT in all Geogs with AI centre is thought to be expanded

as an alternative institutional arrangement to improve AI coverage and related benefits.

Advocacy of Beneficiaries/Farmers: The farmers in the peri-urban areas are more aware on benefit of AI in contrary of lesser acceptance at the rural areas. Hence, steps have to be taken for continuous advocacy on benefits of availing AI services and maintaining of quality animals in rural areas. Studies also have found that in urban dairy hubs in Kenya, farmers are more aware on keeping quality exotic cattle and avail AI service facilities paying services charges where required Omondi, et al. [12].

Clustering of Underperforming AI Centers: Over 17% of AI centers grossly underperformed (<6AI/Centre/Month) with some centers performing only few AI in a year though expensive inputs [Semen and Liquid Nitrogen (LN2)] are provided to the centre regularly at an interval of 45 days. To reduce wastage of inputs, clustering of underperforming AI centre with the nearest best performing AI centers to avail inputs, may be necessary [17].

Conclusion

The study concludes that owing to involvement of CAIT as an extra hand in delivery of mobile AI services. The performance of some district is exceeding the national average (AI done and progeny born) which needs to be pursued in other districts too.

Among four important factors affecting AI effectiveness, farmers' factor: limited knowledge and time available with them is hindering the effectiveness of services delivered. This combined with animal factor: poor health of animal; together constitute overriding limiting factor which needs to be mitigated.

Despite challenges faced in delivering of AI services owing to difficult mountain farming environment and having to attend multiple tasks, majority Government AI Technicians/ Extension staff are performing the task with diligence. Providing performance-based incentives could motivate AI Technicians to perform better. Besides, continuous advocacy to farmers on AI Technology application is necessary. To curtail underutilization of expensive inputs in field, piloting of cluster approach for resource efficient AI services delivery may be piloted.

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