NATIONAL DAIRY RESEARCH CENTRE

DEPARTMENT OF LIVESTOCK, MoAF
YUSIPANG






ANNUAL CENTRE REPORT
2017 - 2018

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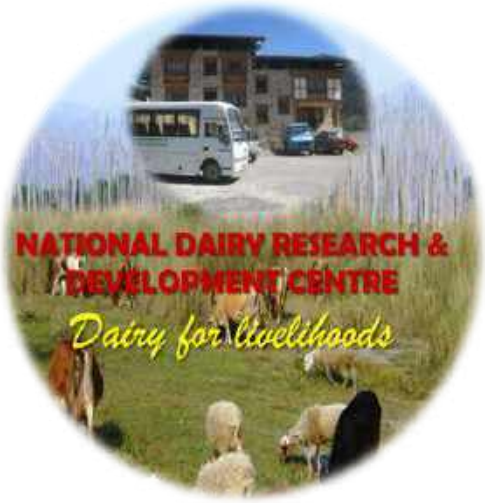

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FROM THE PROGRAM DIRECTOR'S DESK

This is the second Annual Centre Report of NDRDC Yusipang, published to highlight progress made and challenges faced while implementing R&D activities during the fiscal year (FY) 2017-18.

This FY marked a new era in modern biotechnology, enabling the centre to successfully superovulate, flush, grade and cryopreserve 24 viable embryos from elite donors (*Thrabam* cattle). Six of them are transferred to surrogate recipient on a trial basis. Processing of bovine frozen semen and LN_2 is all time high (by local standard) with 27,182 doses produced and cryopreserved (increase by 54% over the previous year). In addition 41,631 liters of LN_2 produced and 30,672 liters distributed to Dzongkhags through RLDCs.

In search for resilient breed of dairy cattle for Bhutan, Progeny Testing Scheme has been initiated for the first time. Three Agro-ecological Zone is covered with premium Thai Holstein semen (four sire lines) received from Dairy Promotion Organization of Thailand on gratis. Artificial Insemination in buffaloes is tried with Nilli Ravi Buffalo semen received from SAARC Centre Dhaka. First ever buffalo AI progeny is born during the FY and many are due.

For organized dairy value chain and to address marketing problem of milk, the centre actively participated and provided expertise to commission Yoghurt plant at Mongar, Paro and Sarpang and trained farmers on good manufacturing practices. To acquaint Regional Breeding focal officers on safe handling of liquid nitrogen and frozen semen, three days hands on training was provided to them. Besides, to reach cattle breeding technology closer to farmers' door steps, experts of this centre trained 54 additional Community AI Technician during the FY in collaboration with RLDCs and Dzongkhags.

With consistent efforts of this centre with fullest support from all agencies/stakeholders and more importantly dairy farmers, annual milk production to reach 50,250 MT (2017) in the country which is an increase of 70% over the 2012 baseline of 29,625 MT. Milk self-sufficiency increased from 63% and (2012) to 81% (2017) and per capita milk availability increased from 113gm (2012) to 187gm (2017). Annually gross income generated by farmers through dairy farming is estimated at Nu.2.26 Billion of which AI program constitutes about 48%.

This centre however is not without challenges, severe constraints to transport LN_2 to sustain breeding program had been a hinderances. Frequent breakdown of old Balero is affecting public services delivery which warrants generosity of policy makers to support the genuine cause.

In the knowledge management front, one ACR, two technical guidebooks and three scientific articles published. A website of NDRC (*www. ndrc.gov.bt*) was launched to provide a platform for information sharing.

Despite challenges faced, very good progress have been made which would not have been possible without guidance from Ministry/Department and support from RLDC, Dzongkhags and Govt. farms. Therefore, NDRDC and team would remain grateful for their helping hand for now and for the future too.
Tashi Delek!

(Dr. N.B.Tamang)
PROGRAM DIRECTOR

EXECUTIVE SUMMARY

National Dairy Research & Development Centre (ND-RDC), Department of Livestock is gearing to enhance dairy product self-sufficiency in 11th Five Year Plan (FYP) through organized and focused approach to Dairy Research and Development (R&D) in the country.

NDRC is publishing the Annual Report (2017-18) to share success stories and lesson learnt while implementing Dairy R&D activities, in its mission to fulfill the aspiration of Royal Government of Bhutan to achieve economic self reliance.

Dairy input production and distribution, very vital for success of cattle breeding program in the country. Inputs produced at the centre include liquid nitrogen (LN2) and frozen semen. During the FY 27,182 doses of semen was produced which over 54% higher than last year. Besides, the centre imported 5200 doses of Jersey progeny tested semen from abroad to enable farmers to have wide access to improved germplasm. Further, for faster genetic gain in cattle, Embryo Transfer (ET) trials were successfully conducted. The ET team super ovulated, flushed, graded and cryopreserved 24 viable embryos from elite donor cows and six of them were transferred to surrogate recipient cows. Similarly, 41,631 liters of LN_2 produced, 30,672 liters were distributed to Dzongkhags. The LN_2 has to be distributed to AI Outreach Centre every 45 days to preserve frozen semen.

To maintain the health of donor bulls and ET cows (40 heads), fodder unit has established around 2.0 acre of improved pasture, renovated 25 acres of existing pasture and conserved 95 MT of winter fodder in the form of hay/silage. Technical manpower support is also provided to Royal cattle herds, Ramtokto, Royal Soelbam herd, Chubachu and established eight acres new pasture for Royal Chipta Farm at Taba.

To improve reproductive efficiency of village herds, estrous synchronization and fixed time AI were conducted. In total of 588 animals were synchronized (17were buffalos). Approximately 86% of the dairy animals responded to treatment. To intensify cattle breeding program, imported sex sorted semen and progeny tested semen use was intensified in potential areas for production of dairy heifers. AI success rate with sex-sorted semen is 49% in heifers (n=26) and 37.5% in cows (n=15) hinting that sex sorted semen can be best used for inseminating heifers.

Multiplier herd (Community based Heifer and Bull Production Scheme) to boost heifer/bull production through use of imported semen is expanded and cover over 5789 HH, 5800 animals in 55 geogs (cumulative). Artificial Insemination (AI) performance and progeny recorded for the FY was 7705 AI with progeny record of 2657 (1199 male and 1458 female). AI done as of 2017 (1987 – 2017) is 1, 67,209 and progeny record is 53,337.

To improve animal recording system for traceability and herd improvement, National Cattle Information WSystem (NCIS) was expanded in 13 geogs during the FY. Total household under NCIS increased to 6,189 an increase of 400 households than last year. The number of animals with NCIS increased to 11,551. As of now the NCIS is carried out in 115 Geogs in the country.

Research conducted during the FY includes assessment of performances of Karan Fries (KF) and Jersey Pure (JP) cattle at NJBC, Performance of Nublang nucleus herd at NNBF. Farmer's knowledge on improved dairy technology in dairy farmers and non farmers group documented. Milk production recordings of cattle types under different management system are completed. Progeny Testing Scheme was initiated for the first time for development of resilient dairy breed for Bhutan covering three Agro-ecological Zone of Tsirang and Samtse.

Dairy post-production research facilitated training and capacity building of livestock field staffs and the farmers' group members on dairy product processing, adopting good manufacturing practices. Besides, possibility of product diversification for Yak milk in Laya geog is studied and expertise provided to commission Yogurt Plant at Sarpang, Paro and Mongar.

Equally the centre organized training/workshop and skills development for the field staff. Three days training on Handling of Liquid Nitrogen (LN2) and Frozen Bovine Semen was carried out to the breeding focal officers of four Regional Livestock Development Centers (RLDCs) and Govt. farms. The Centre also provided expertise to train Community Artificial Insemination Technician (CAIT). Additional 54 CAIT were trained in this FY. Since its inception in 2010, 99 CAITs are trained facilitated by this centre.

The centre published annual report and technical guidebooks and journal articles to communicate to clients and scientific community. The centre also officially launched the website (*www.ndrc.gov.bt*) on 11th October 2017. The website has been developed recognizing the growing emphasis of going paperless in delivery of information via use of ICT in a cost-effective manner. The website provides a platform for information sharing, exchange of knowledge and keeps abreast on the technologies generated in dairy sector.

During the FY 2017-18, out of Nu. 20.289 million allocated to this centre, a sum of Nu. 20.082 million was gainfully utilized giving a achievement of 99.23%.

With every passing year, NDRC will remain committed to make consistent effort to generate and effectively disseminate appropriate technologies/better farming practices and strive to leave footprints behind so as to make dairy farming an attractive and prosperous venture.

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1. BACKGROUND

As part of the institutional strengthening strategy of the Department of Livestock, the erstwhile National Livestock Breeding Programme had been reinstituted as the National Dairy Development Centre (NDDC) with the additional mandate to serve as the technical authority for the planning, coordinating, implementing, monitoring and evaluation of dairy development activities of the country. However, with the organizational development exercise conducted by the RCSC, the NDDC has been renamed the National Dairy Research Centre with the mandate for need based dairy research for dairy development in the country. The centre is located at Yusipang, 14 kms away from Thimphu.

The major focus of dairy research consists of consolidation and strengthening breed improvement programs, dairy product diversification, strengthening dairy post harvest technologies and production of high quality specialized inputs for breed improvement. For faster genetic gain in indigenous and exotic cattle breed research on the use of progeny tested sex sorted frozen semen and embryo transfer technology is also initiated.

2. PROFILE OF THE NATIONAL DAIRY RESEARCH CENTRE

2.1 VISION

- Generate knowledge through quality research that supports dairy development thereby contributing to sustainable economy of dairy farmers

2.2 MISSION

- Improve food and nutritional security through research to enhance productivity of dairy products.
- Develop and strengthen innovative dairy research programs that align well with government plans and priorities to ensure equitable socio- economic development
- Provide coherent mechanisms to efficiently disseminate knowledge and technologies to the end user

2.3 DEVELOPMENT OBJECTIVES

- Produce high yielding dairy cattle for sustainable green economy
- Promote income generation capacities of dairy farmers by creating employment opportunities
- Facilitate private sector investments in dairy enterprise

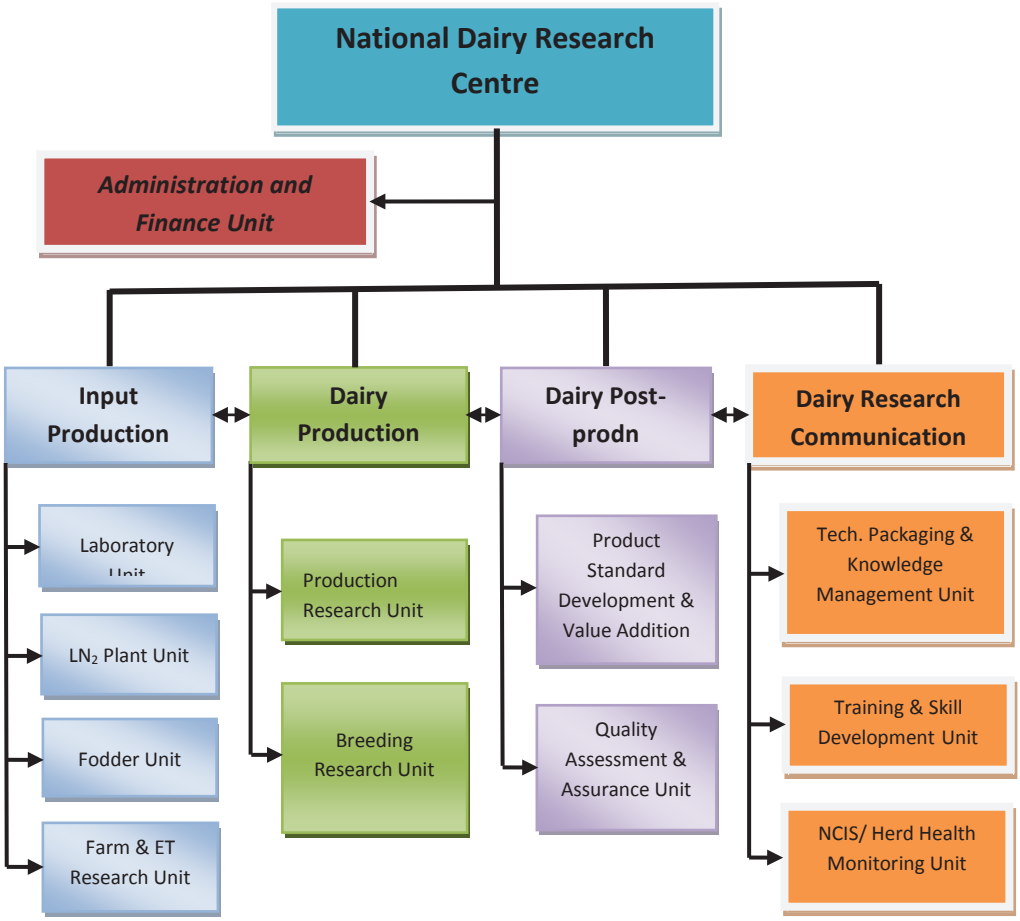
2.4 MANDATE

- Co-ordinate and conduct need based dairy research and establish sound technical information and technology for dairy development in the country
- Produce and meet demand for high quality specialized inputs to accelerate dairy breed improvement in the country
- Package and transfer technologies generated through research to the end users

2.5 Major Functions

- Develop and execute screening mechanism to standardize research proposals for its soundness, relevance and benefits to the country
- Coordinate and conduct need based research for dairy development in the country
- Conduct needs analysis based on published research findings for introduction of new dairy breeds in the country
- Develop and disseminate Standard Operating Procedures & Good Manufacturing Practices to enhance dairy production and post production
- Produce and or procure high quality specialized breeding inputs to meet the demand for breed improvement
- Manage database of National Cattle Identification System (NCIS), Contract Breeding Program, AI and Dairy Technology as tool for research and development.
- Prepare annual budget, targets and performance management for the center
- Coordinate and conduct meetings and stakeholder workshops
- Support the Research and Extension Division, DoL in formulation of policies, strategies and guidelines
- Liaise with national and international agencies for technical collaboration

3. Organizational Setup



DAIRY INPUTS PRODUCTION & RESEARCH

4. PROGRESS AND ACHIEVEMENTS

4.1 INPUT PRODUCTION RESEARCH SECTOR

4.1.1 LIQUID NITROGEN (LN_2) PLANT UNIT

The Liquid Nitrogen Plant Unit operates a Sterling Cryogenic LN_2 plant with a production capacity of 10 litres per hour. The LN_2 distribution meets the schedule supply of AI Centres in the Western, West Central and East Central regions (covering 14 Dzongkhags), while the LN_2 Plant at Kanglung, Trashigang caters to the distribution of LN_2 for the eastern region (6 Dzongkhags). At Present, the production capacity is 6 – 7 litres per hour. The details of the LN_2 produced and distributed during the FY are presented below (Table 1).

Table 1: Liquid Nitrogen produced & distributed

Sl	Activities	Qty (Litres)
1	LN2 Production	41631.5
2	LN2 Distribution	30672.2
3	LN2 for Semen Bank refilling	6238.85
4	LN2 for S. Processing & freezing	2716.45
5	LN2 Evaporation losses	2004.00

4.1.2 FROZEN SEMEN PROCESSING LABORATORY UNIT

The laboratory unit produces frozen semen from four cattle breeds (Jersey, Mithun, Nublang & Brown Swiss) and distributes to all AI Centres in the country. During the fiscal year, a total of 27,182 doses of frozen semen were produced from different donor bulls and distributed 6,275 doses to various Dzongkhags (Table 2). The production of Jersey semen accounted for 17,773 doses with distribution of 5,400 doses. Similarly, Semen production from Nublang was 9409 doses and distributed 100 doses to the Dzongkhag. There was no production of Mithun and Brown Swiss semen during the fiscal year as there was no demand from the field. Local semen distribution plan is attached for sound breeding and to prevent inbreeding as annexure 5

Table 2: Locally Produced Frozen Semen & Stock Balance

Species	Opening balance	Production	Distribution	Balance
Jersey	58633	17773	5400	71006
Mithun	20003	0	875	19128
Nublang	14512	9409	100	23871
Brown Swiss Cross	1822	0	50	1772
Total	**94970**	**27182**	**6275**	**115777**

In addition progeny tested semen is imported for use in Government nucleus farms and contract breeders (CHBPP). The details of imported frozen semen are shown in (Tables 3). This year the centres imported only Jersey conventional semen of 5200 doses. A total of 5,968 doses of semen were distributed to Dzongkhags and central programs during the FY.

Table 3: Detail of imported Progeny Tested Bovine Frozen Semen

Species	Opening balance	Import	Distribution	Balance
Jersey Conventional	1601	5200	4324	2477
Jersey (Sex sorted)	1780	0	190	1590
Brown Swiss	380	0	140	240
Black Angus	350	0	0	350
Tropical Holstein Friesian	2000	0	310	1690
Holstein Friesian	1436	0	924	512
Karan Fries	300	0	0	300
Buffalo (Nilli Ravi)	150	0	80	70
Total	**7997**	**5200**	**5968**	**7229**

For the sound breeding program and to prevent the inbreeding the distribution plan for imported semen is designed and is attached as annexure 6. There is standing rule of placing the breeding bull/Semen from particular in one place for not maximum of three years to prevent the inbreeding within the family.

For faster genetic gain in cattle, the Centre has initiated Embryo Transfer (ET) Technology in the country. The initiative was made with technical support from the Department of Livestock Development (DLD, Thailand) under the Joint Agriculture Working Group (JAWG) agreement between the Ministry of Agriculture and Forests (MoAF), Royal Government of Bhutan and the Ministry of Agriculture and Cooperatives (MoAC), Royal Government of Thailand.

During the fiscal year, the centre in close collaboration with National Biodiversity Centre (NBC, Serbithang) and National Nublang Breeding Farm (NNBF, Tashiyangphu) carried out Embryo flushing trials in elite Thrabam donor cows at NDRC (Yusipang) and NNBF (Tashiyangphu). As per observation, most donor cows responded well to 192 mg doses of Follicle Stimulating Hormones (FSH) treatment for super ovulation. Flushing as per the standard procedures in donor cows was carried out with embryo searching under stereo microscopes. During the fiscal year, the ET team successfully collected and cryopreserved 24 viable embryos and gaining useful experience / skills in the process. Since ET procedures involves highly specialized technique and skills; the ET team needs to refine their skills and knowledge from time to time.

4.1.3 Fodder Development Unit

4.1.3.1 Pasture development, Renovation & Fodder Conservation

The Fodder unit has established around 2.0 acre of new improved temperate pasture, renovated 25 acres of existing pasture and conserved 95 MT of winter fodder in the form of hay and silage (grass & maize) along with the procurement of 9150 bundles of paddy straw. The unit also procured and planted 785 willow branches as live fencing around new paddock table 4.

4.1.3.2 Activities at Ramtokto, Taba & Chubachu

The unit also provides technical support and manpower to Royal cattle herds at Ramtokto, Royal Soelbam herd Chubachu and Royal Chipta Farm establishment at Taba, to carry out the pasture/fodder development activities as and when required. The seasonal activities include pasture development, renovation, fodder conservation and winter oats cultivation to suffice the herds strength maintained. During the financial year around 10 acres of existing pasture was

renovated at Ramtokto, cultivated around 5acres of fodder maize and 5 acres of winter oats and conserved 65 MT of winter fodder in the form of maize silage to supplement with others forages. Likewise, the similar activities was carryout at Royal Chipta Farm Taba includes development of 8 acres new pasture, paddock fencing, construction of news stable and staff quarter(Table 4).

Table 4: Detail of pasture development

Unit	New pasture established (Acre)	existing pasture renovated (Acres)	Conserved winter fodder (Metric tons)	Cultivation of fodder maize
NDRC Yusipang	2	25	95	8
Royal Cattle herd Ramtokto	0	10	65	10
Royal Chipta Farm Taba	8	0	0	0
Total	**10**	**35**	**160**	**18**

4.1.4 FARM & ET RESEARCH UNIT

The Farm Section maintains elite semen donor bulls and Embryo Transfer donor cows (Thrabum & Jersey X) cattle. There are a total of 44 animals in the farm which is detailed in (Table 5).

Table 5: Detail of cattle maintained in the farm

Cattle Type	Numbers	Cattle Type	Numbers
Semen Donor bulls	***15***	**Young / future donors**	**29**
Jersey pure	9	Nublang	0
Nublang	5	Mithun	1
Mithun	1	ET Donors (Thrabum)	14
Brown Swiss cross	0	ET Donors (Jersey Cross heifer)	10
		Thrabum calf	4

DAIRY PRODUCTION RESEARCH

4.2 DAIRY PRODUCTION RESEARCH SECTOR

4.2.1. PRODUCTION RESEARCH

Cattle synchronization and Artificial Insemination

Estrous synchronization is a technique of treating female cattle of breedable age which are not in normal estrous cycle or in anoestrus state and bringing them in heat at desired time frame (36 to 96 hours). It is achieved via use of one or more hormonal drugs depending on the ovarian status of the animal upon per-rectal examination. The success of synchronization is determined by the diagnostic precision of reproductive status by the examining veterinarian. There are different synchronizing agents such as progesterone injections or a Progesterone Releasing Intra-vaginal Device (PRID), GnRH, PGF2α, etc. Estrus synchronization has major advantages in making artificial insemination more practical, cost effective and economically profitable.

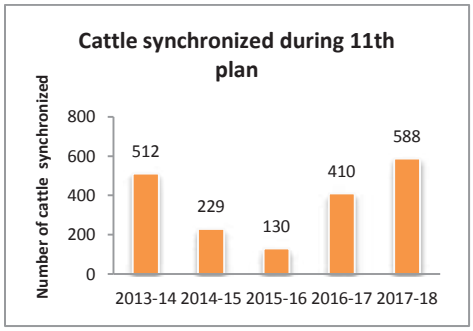
During the FY 2017 - 2018, NDRC teams implemented estrus synchronization in cows/ heifers with anestrous and infertility cases to reduce reproductive waste. It covered five Dzongkhags; Paro, Wangdue, Tsirang, Sarpang and Samtse, and central farms (Table 6).

A total of 588 animals were synchronized out of 861 animals referred for gynecological examination; Paro (n=40/61), Wangdue (n=57/79), Tsirang (n=187/258), Sarpang (n=10/26), Samtse (n=165/206); Trongsa (n=38/61) and Central farms (n74/153). Of the 588 animals synchronized, 17 were buffalos. The animals examined in Dzongkhags were the cases referred for infertility investigation and treatment, whereas the cases at central farms were presented for pregnancy diagnosis.

Of the 529 AI done, 298 were Thai Holstein semen, 203 were progeny tested semen, 11 were sex sorted semen and 17 were Nilli Ravi buffalo semen used (Table 6). Approximately 86% of the dairy animals responded to different hormonal synchronization and came on heat in 2017-2018.

Table 6: detail of animals synchronized & AI done

Sl. #	Dzongkhag	Animal examined	Synchronized	AI Done
1	Paro	61	40	31
2	Wangdue	79	57	55
3	Tsirang	258	187	190
4	Sarpang	26	10	7
5	Samtse	206	165	164
6	Government Farms	153	74	65
7	Samtse Dzongkhag (Buffalo)	17	17	17
	Trongsa	61	38	0
8	**Total**	**861**	**588**	**529**



Trial use of sex sorted and progeny tested frozen semen in Tsirang, Sarpang and Samdrup Jongkhar Dzongkhags

The center initiated the use of sex-sorted semen and progeny tested frozen semen in potential areas in field on a pilot scale in 2017, as focused approach for production of dairy heifers. The usage of sex-sorted semen was limited to Govt. dairy nucleus farms only and progeny tested frozen semen in nucleus and multiplier herds in the past. The initiative was basically to supplement the ever increasing demand of dairy animals in the country. The intervention was

undertaken in Tsirang and Sarpang Dzongkhags in the month of March-April 2017, and in Samdrup Jongkhar in May 2017, which was reviewed in the month of Nov. 2017.

The intervention was made via synchronization of breedable animals (cows and heifers) that were presented for infertility and/ anoestrus problem. During the programme implementation, a total of 44 AI was carried out in Tsirang Dzongkhag; 26 AI with Sex-sorted semen and 18 AI with Progeny tested semen, 39 AI in Sarpang Dzongkhag; 28 AI using Sex-sorted frozen semen and 11 AI with Progeny tested frozen semen, and 40 AI in Samdrup Jongkhar; 39 with sex-sorted semen and 1 AI with progeny tested semen (Table 7).

The use of sex-sorted frozen semen was not limited to virgin heifers only, but also in cows and other heifers exhibiting clear heat signs at the time of insemination.

Table 7: Success rate of Sex-sorted and Progeny tested semen in cows and heifers

Dzongkhag	Animal Category	Different Semen used	AI done (number)	Pregnant (numbers)	Success rate Percent
Tsirang	Heifer	Sex-sorted	15	8	53.3
		Progeny tested	10	4	40.0
	Cow	Sex-sorted	11	4	36.4
		Progeny tested	8	5	62.5
Sarpang	Heifer	Sex-sorted	11	5	45.45
		Progeny tested	3	2	66.7
	Cow	Sex-sorted	17	6	35.3
		Progeny tested	8	6	75.0
S/Jongkhar	Heifer	Sex-sorted	27	13	48.1
		Progeny tested	1	0	0
	Cow	Sex-sorted	12	5	41.7
		Progeny tested	0	0	0
Grand Total			123	58	45.0

The AI success rate with confirmed pregnancy was 47.7% in Tsirang Dzongkhag, 48.7% in Sarpang Dzongkhag and 45% in Samdrup Jongkhar Dzongkhag

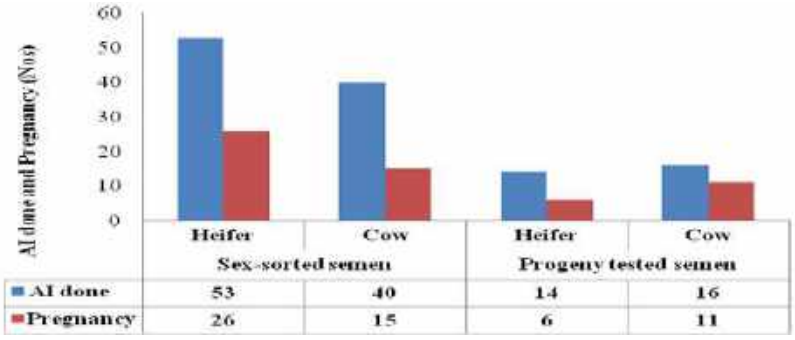


Figure 2: AI Success rate in Cow and Heifer with Sex-sorted semen and Progeny tested frozen semen

The overall AI success rate was 47.1% (n=58/123) for both type of semen; 44% for sex-sorted semen (n=41/93) and 56.7% for progeny tested semen (n=17/30). By category of animals, the AI success rate with sex-sorted semen is 49% in heifers (n=26/53) and 37.5% in cows (n=15/40) figure 2.

The trial use of this semen indicates that the use of sex-sorted semen in cows may not be recommended owing to low success rate. However, the AI sample size is too low to deduce the conclusion and provide recommendations. Therefore, more AI with sex-sorted semen needs to be carried out in potential areas in field to concretize the findings.

Sourcing and supply of Dairy Cattle

In total, 598 cattle were sourced and supplied of which 125 was sourced from outside the country and 473 from within figure 3. The out country sourcing was done by Dzongkhags and projects as per the project agreements. Punakha, Dagana, Sarpang and Trongsa Dzongkhags have not sourced the dairy cattle.

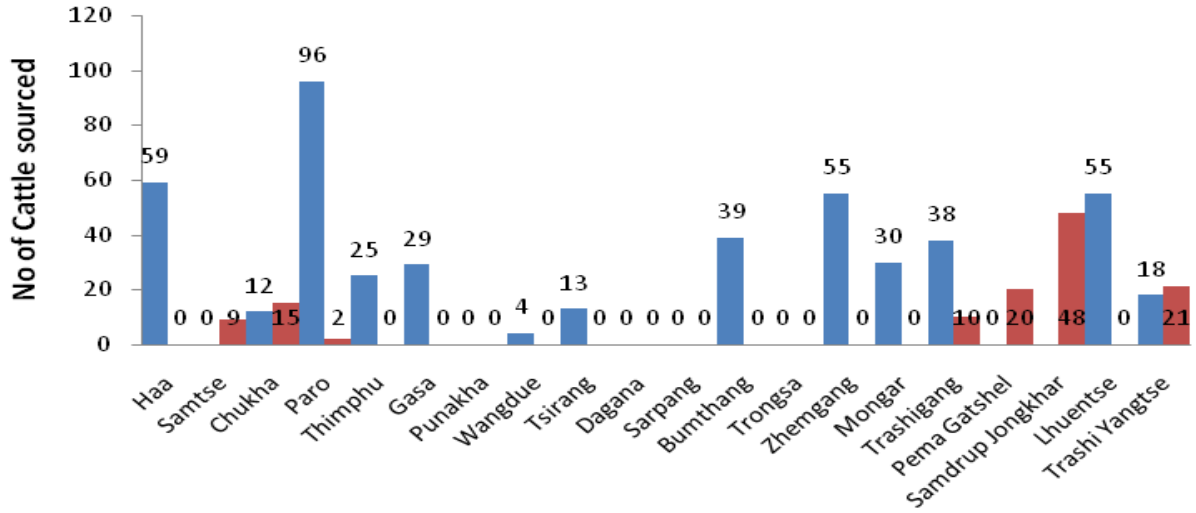


Figure 3: Dzongkhag wise summary of Dairy cattle sourced and supplied

About 79% of the cattle were purchased within the country and 21% from outside the country figure 4. Paro Dzongkhag sourced the highest number of animals followed by Haa, Zhemgang and Lhuntse.

At regional level, eastern region procured the highest number (40%) followed by Western region (36.5%). The interior regions, West-Central (8%) and East-Central (16%) sourced almost equal numbers of animals.

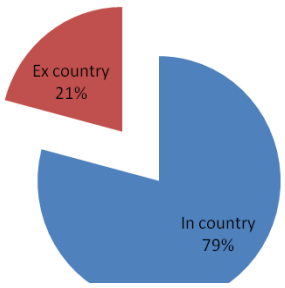


Figure 4: Cattle purchased by source

During the 11th plan, a total of 3256 dairy cows were purchased out of which 1201 were purchased within the country while 2055 were purchased from India. About 63% of the animals were purchased from India and 37% of the animals purchased within the Dzongkhags.

When compared by region, 50% was procured by Eastern region followed by 25% western region 13% by east central with and 12% by west central with figure 5. During the 11th plan all the Dzongkhags have procured dairy cows.

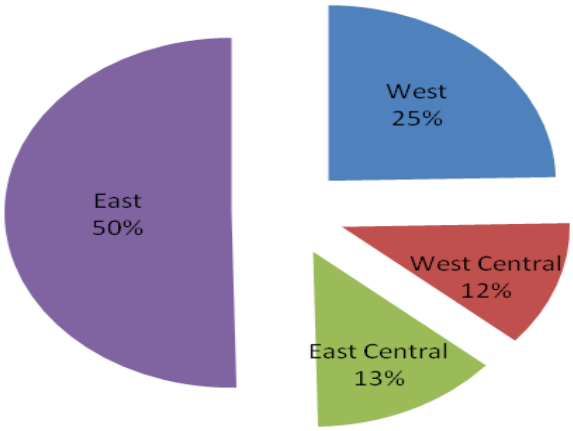


Figure 5: Cattle purchased in 11th plan

Dairy Farmers Groups and Cooperatives

The formation and strengthening of farmers institutions; Dairy Farmers' Groups (DFGs) and Cooperatives was one of the important interventions made in the dairy sector. As of June 2017, there were 196 DFGs with 5,484 members. The maximum groups were formed in Tashigang, followed by Punakha and Samtse. The highest number of DFG members is in Tashigang, followed by Samdrup Jongkhar and Bumthang annexure 1.

The formation, operation and management of the DFGs are guided by the DFG Bye-law, which was officially released at the Annual Livestock Conference 2017. Each DFG is managed by the office bearers; Chairperson, Group Secretary and Treasurer, with payment made to the office bearers from the group savings of the respective DFGs as their monthly salary. Thus, it is an employment generating opportunity in rural areas.

The dairy farmers Cooperatives are operational in five Dzongkhags of Haa, Thimphu, Mongar, Tashigang and Samdrup Jongkhar with highest membership in Haa, followed by Samdrup Jongkhar and Tashigang (annexure 2).

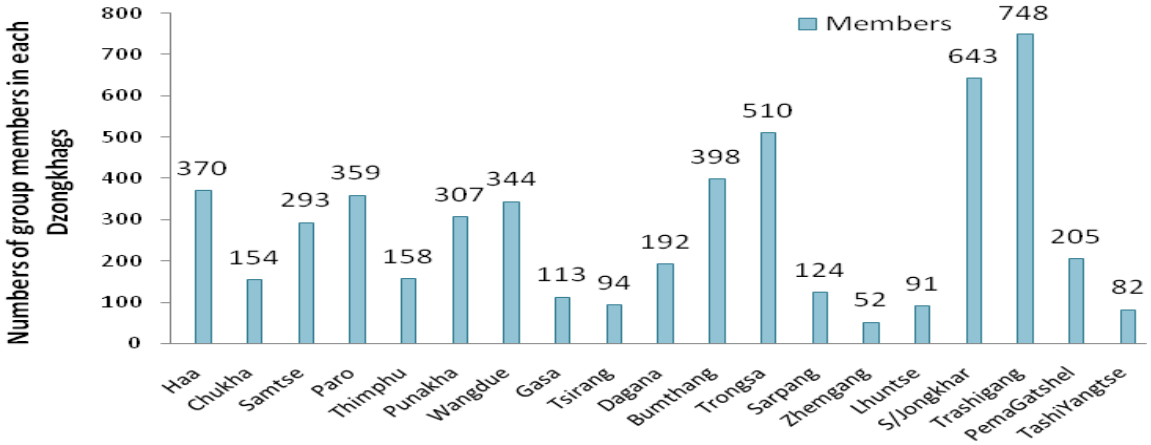


Figure 6: Number of Group members in Each Dzongkhags as of June 2018

4.2.2 BREEDING RESEARCH ARTIFICIAL INSEMINATION PERFORMANCE AND PROGENY RECORD

There are 109 operational Artificial Insemination (AI) Outreach Stations in the country as of June 2018 (RLDC Tsimatsham – 31, RLDC - 23, RLDC Zhemgang – 19 and RLDC Kanglung - 36) as presented in figure 7. Three AI Centres were opened this year; two AI centres opened in Chuzagang & Shershong Geog under Sarpang Dzongkhag and other was Toetsho Geog under Tashi Yangtse Dzongkhag.

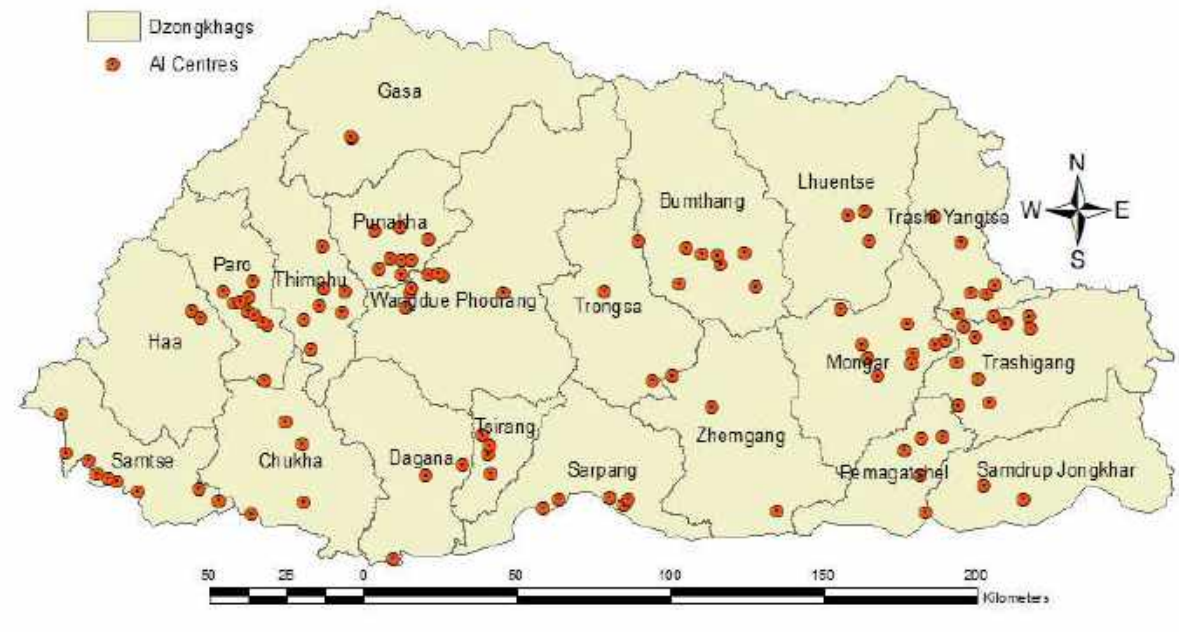


Figure 7: AI Outreach Stations spread across the country

During the FY 2017 -18, a total of 7705 AI were performed with progeny record of 2657 numbers (1199 male and 1458 female) indicating the success rate of 35.2% as presented in (Table 8). Success rate is lower than national average as some of the progenies are yet to be born as the inseminations were done on the second half of the fiscal year.

Table 8: Summary of AI and Progeny record

Region	Total AI	Progeny Record			Average success rate (%)
		Male	*Female*	*Total*	
West	2487	432	540	972	39.08
West- central	1628	239	304	543	33.35
East-central	1014	228	261	489	48.22
East	2578	300	353	653	25.32
Total	7705	1199	1458	2657	34.48

The Dzongkhags which performed above national average of 6AI/AIOS/month during the reporting year were Samtse, Sarpang and Pema Gatshel with the national average, Thimphu, Punakha and Samdrup Jongkhar with 7AI/AIOS/month, Paro with 8AI/AIOS/month, Chukha with 9AI/AIOS/month, Tsirang with 11AI/AIOS/month, and Mongar with 12AI/AIOS/month figure 8. Remaining 10 Dzongkhags' average performance was recorded to be below the national average. However, some AIOS of these 10 Dzongkhags had performance record of above the national average, and similarly some AIOS of the above average performing Dzongkhags had below national average performance as well. Thus, overall 66% of AIOS (n=72/109) had performed below the national average of 6AI/month during the reporting year annexure 3, which warrants close scrutiny in their functioning in 12FYP from concerned Dzongkhags and RLDCs.

The average AI performance in 2017-18 was 6AI/AIOS/month, with cumulative record of 7705 AI by 109 AIOS, against the minimum recommended number of 7AI/AIOS/month. There were 66 AIOS which performed below the national average during the year for which closer attention of the concerned Dzongkhags and the RLDCs are required.

The AI success rate recorded during the financial year was 35%, which is lower than the average success of 37% in 11FYP. This could be attributed to either poor follow-up on progeny born by the concerned staff owing to lack of dedicated staff for AI or poor AI skills or multi-tasking responsibilities of AI technicians.

Therefore, to boost dairy production via AI services, more emphasis need to be given on training and deployment of CAIT, improve skills of existing AI technicians, relocate or close under-performing AIOS and take joint ownership of the AI programme by the concerned stake holders at all levels; national, regional, Dzongkhag and extension

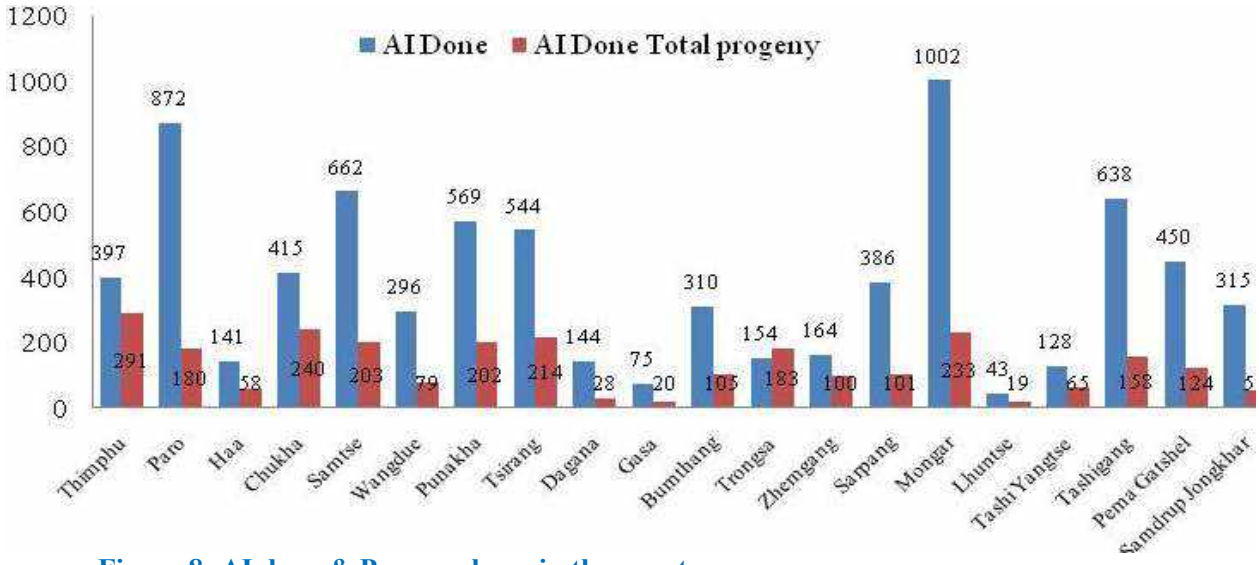


Figure 8: AI done & Progeny born in the country

During 11FYP, a total of 40,356 AI and 14,766 progenies were recorded, making an annual average of 8107AI and 2990 progeny record annually, which accounts to overall AI success rate of 37% (Table 9). The highest no of AI was recorded in 2013-14 (9358) which correlates with highest no of progeny born record in 2014-15. Accordingly, when AI coverage of each year was equated with the no of milking cattle in the subsequent year after nine months of gestation, it accounts to only 17% during the plan period. It indicates that remaining 83% of milking cattle were served by breeding bulls (certified/scrub).

Table 9: AI performance and coverage in 11th Five Year Plan

Financial Year	AI performed (Number)	Progeny (Number)	AI Success rate (Percent)	Milking cattle * (numbers)	AI Coverage (Percent)
2013-14	9358	3511	37.5	44971	18.3
2014-15	8455	3626	42.9	45808	20.4
2015-16	7679	2516	32.8	48295	17.5
2016-17	7159	2456	34.3	49255	15.6
2017-18	7705	2657	34.5	52236	13.7
Average	**8101**	**2990**	**37**	**240565**	**17.1**

* Milking cattle population as per Livestock statistics (2012-2017), which excludes Mithun cross

The AI coverage equated based on milking cattle population under cross breeding programme had decreased by about 2% each year since 2014-15. The AI coverage was 14% in 2017-18 against the average coverage of 17% in 11th FYP.

Cumulative AI report as of 2017 from (1987 – 2017) is 16,7209 and progeny record is 53,337.

DAIRY POST-PRODUCTION RESEARCH

4.3 DAIRY POST-PRODUCTION RESEARCH SECTOR

4.3.1 PRODUCT STANDARD DEVELOPMENT AND VALUE ADDITION UNIT

Product Standard Development and Value Addition Unit

The National Dairy Research Centre in collaboration with Dzongkhag Livestock Sector, Mongar organized three days training from 5th January 2017 at Traling, Mongar to the Livestock field staffs and the farmers' group members on Yoghurt processing and packaging. Redaza dairy farmers group, provided 200-250 liters of milk for yogurt production and hands on training and demonstration were provided to all trainees including the group members.

Assessment of product diversification for Yak milk in Laya Geog.

A team comprising the members from the NDRC, RLDC Wangdue and the BS Farm carried out a consultative meeting with the Dzongkhag Livestock Office, Gasa to assess the possibility of product diversification for Yak milk in Laya geog. The team discussed the possibility of promoting the production of Gouda cheese using yak milk but field realities suggested that this would not be possible due to very scattered herds, limited milk production, lack of permanent settlement, proper infrastructure, lack of electricity and the limited availability of water and fire wood. Due to the limited scope for diversification of dairy products, the team recommends that equipment for production of hygienic milk be supplied to the herders to encourage production of good quality milk.

Installation and Commission of Yogurt Plant in Sarpang Dzongkhag

The installation and commissioning of the Yogurt Plant at Dolkohola, Dekiling Geog under Sarpang was done during on 3rd week of March 2018 in collaboration with the Sarpang Dzongkhag Livestock Sector, RLP, Zhemgang and the RLDC, Zhemgang. The plant was established to address marketing constraints faced due to the limited market for fresh milk, butter and datshi.

With the establishment of the yogurt plant it provides the group with an alternative source for milk intake with the plant having a production capacity of 500 liters. The plant has the capacity to produce 2,500 cups of 200ml yogurt in one batch and should the intake of

milk increase in the future, the plant can work two batches to produce yogurt from 1000 liters of milk. With this production capacity, the plant has the potential to generate an income of Nu. 62,500 per batch of production.

The Sector also has carried out farmers' trainings in several Dzongkhags with the view of promoting good manufacturing practices by the members of the dairy farmers groups as well as conducting training and trials on product diversification.

DAIRY RESEARCH COMMUNICATION

4.4 DAIRY RESEARCH COMMUNICATION SECTOR

4.4.1 TRAINING & SKILL DEVELOPMENT UNIT

TRAINING ON HANDLING OF LIQUID NITROGEN AND FROZEN BOVINE SEMEN

Three days familiarization training on Handling of Liquid Nitrogen (LN2) and Frozen Bovine Semen was carried out to the breeding focal officers of four Regional Livestock Development Centres (RLDCs) and Research Farms (NNBF, Tashiyangphu & RCRF, Wangkha). The familiarization training was attended by 8 breeding focal officer and was conducted from 4th to 6th October, 2017 at NDRC, Yusipang. During the training both theoretical and practical sessions were conducted with more emphasis on hands on training. The training program help in orienting the concerned officers on proper handling for specialized AI inputs which are critical for taking up the ownership and responsibility on schedule supply from distribution of AI inputs by RLDCs to Dzongkhags and Geogs.

Resource person and participants of LN2 & Frozen Bovine Semen handling training participants

TECHNICAL SUPPORT FROM NDRC YUSIPANG FOR CAIT TRAINING

In the FY 2017-18, an additional 54 CAIT were trained. Cumulative since the start of CAIT (in 2010) is 99. The details of training conducted are also follows:

1) CAIT TRAINING CHUKHA

Community Artificial Insemination Technician (CAIT) was conducted by Dzongkhag Administration, Chukha from January 6-26 January 2018. A total of 10 (2 from Geling, 2 from Darla, 3 from Sampheling and 3 from Phuentsholing) CAIT were trained. These trained CAITs will provide doorstep mobile Artificial Insemination to their community. The training was

technically supported by National Dairy Research Centre, Regional Livestock Development Centre, Tsimasham. Both theoretical and practical technical training was imparted with the participants involving all the nitty-gritty of the AI program

Resource person and participants of CAIT Training Chukha Dzongkhag

TECHNICAL SUPPORT FROM NDRC YUSIPANG FOR CAIT TRAINING

2) CAIT TRAINING KANGLUNG

Community Artificial Insemination Technician (CAIT) training was conducted by Regional Livestock Development Centre, Kanglung from 22nd May to 18th June 2017. A total of 27 (Mongar 3, Tashigang 4, Tashi Yangtse 2, Pema Gatshel 6 and Samdrup Jongkhar 12) CAIT were trained for a period of month. These CAIT provides mobile Artificial Insemination services to the community and fill the gap of the shortage of AI technician as the only livestock staffs placed have to cater the technical supports to the Geogs in many area. The training was technically supported by National Dairy Research Centre, Yusipang with financial support from CARLEP. All the participants have successful passed the examination carried on both practical and theory examination.

Resource person and participants of CAIT Training RLDC Kanglung

TECHNICAL SUPPORT FROM NDRC YUSIPANG FOR CAIT TRAINING

3) CAIT TRAINING KANGLUNG

Community Artificial Insemination Technician (CAIT) training was conducted by Regional Livestock Development Centre, Kanglung from 29th May to 4th July 2018. A total of 17 (Tashigang 5, Pema Gatshel 6, Lhuntse 1 and Samdrup Jongkhar 5) CAIT were trained. The training was technically supported by National Dairy Research Centre, Regional Livestock Development Centre, Kanglung and four eastern Dzongkhags and financially supported by CARLEP. Once the training is completed these CAIT will provides mobile Artificial Insemination services to the community and fill the gap of the AI technician. All the participants have successful passed the examination carried on both practical and theory examination. In total, 54 additional CAIT were trained in the FY 2017-18.

Resource person and participants of CAIT Training RLDC Kanglung

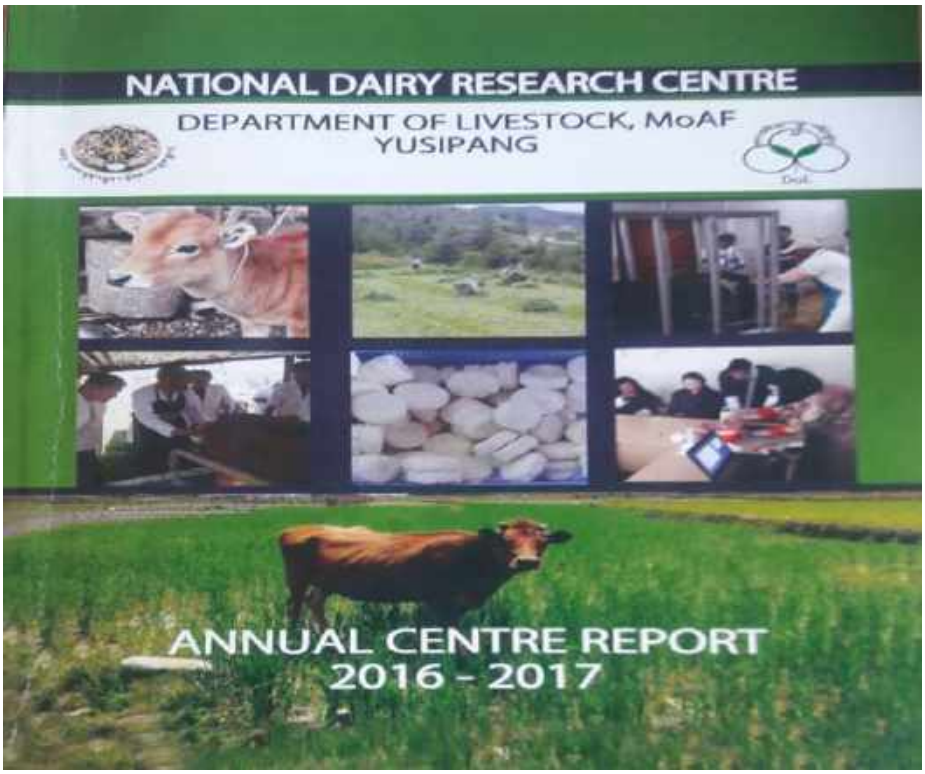
4.4.2. TECHNOLOGY PACKAGING AND KNOWLEDGE MANAGEMENT

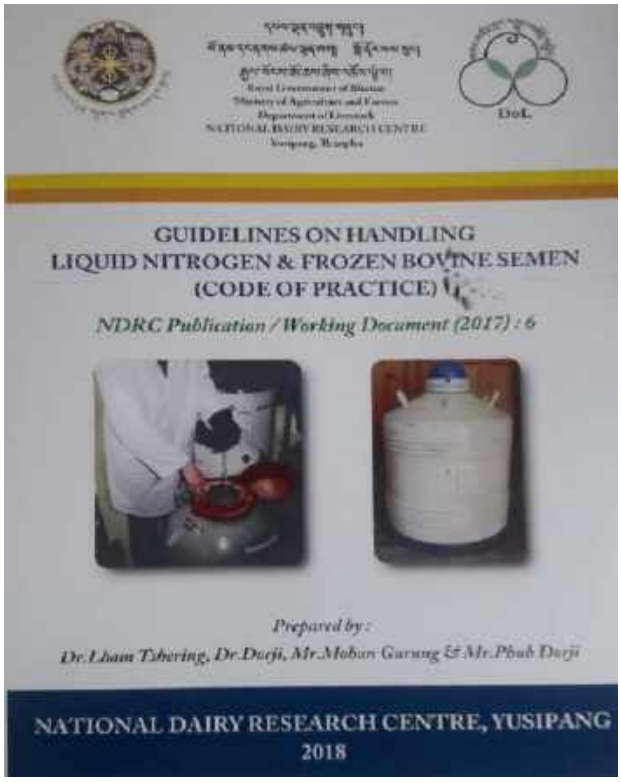
Publication of booklets on:

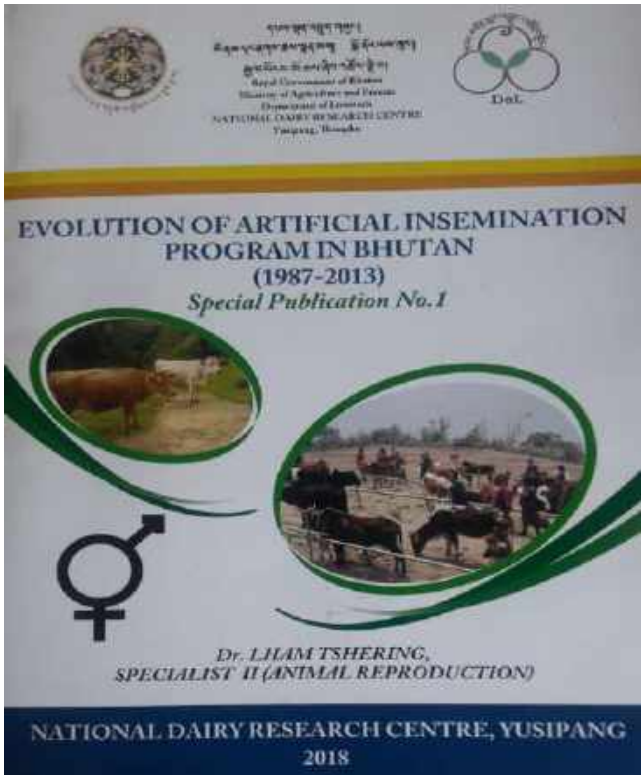
A total of three report/booklets were published during the fiscal year and are the following

- ✓ Annual Centre Report for 2016 – 2017
- ✓ Evolution of Artificial Insemination Program in Bhutan
- ✓ Guidelines on handling Liquid Nitrogen & Frozen Bovine Semen (Code of Practices)

It is hoped that the above released booklets will help all the stakeholders and enhance the livestock production. These books can be downloaded by visiting at: http://www.ndrc.gov.bt/downloads/


NATIONAL DAIRY RESEARCH CENTRE
DEPARTMENT OF LIVESTOCK, MoAF
YUSIPANG
ANNUAL CENTRE REPORT
2016 - 2017


GUIDELINES ON HANDLING
LIQUID NITROGEN & FROZEN BOVINE SEMEN
(CODE OF PRACTICE)
NDRC Publication / Working Document (2017) : 6
Prepared by :
Dr. Lham Tshering, Dr. Dorji, Mr. Mohan Gurung & Mr. Phub Dorji
NATIONAL DAIRY RESEARCH CENTRE, YUSIPANG
2018


EVOLUTION OF ARTIFICIAL INSEMINATION
PROGRAM IN BHUTAN
(1987-2013)
Special Publication No.1
Dr. LHAM TSHERING,
SPECIALIST II (ANIMAL REPRODUCTION)
NATIONAL DAIRY RESEARCH CENTRE, YUSIPANG
2018

NATIONAL DAIRY RESEARCH CENTRE LAUNCHED OFFICIAL WEBSITE

Dr. Tashi Samdup, Director General, Department of Livestock has officially launched the website of National Dairy Research Centre, Yusipang on 11th October 2107. The website has been developed recognizing the growing emphasis of going paperless in delivery of information via use of Information and Communication Technology in a cost-effective manner. The website provides a platform for information sharing, exchange of knowledge and keeps abreast on the technologies generated in dairy sector. Interested individuals or stakeholders can have access to the uploaded information such as Guidelines, Standard Operating Procedures, Reports, Journal articles and news of NDRC in the website (*www.ndrc.gov.bt*).

A total of 12 news and announcements and 4 advertisement and tenders were uploaded the office website and the different stakeholders are accessing the information as seen by number of visiting the website.

The Department of Information Technology and Telecom, Ministry of Information and Communications organised the National Website Competition and the 5th National Website Competition was held on 1st June 2018. The actual evaluations took place from 17th October 2017 to 31st March 2018. A total of 135 websites were registered for the competition. The management is pleased to keep in record that NDRC website stood 81st position from 135 competitiors**.**

Paper published in RNR Newsletters and Sanam Drupdrey, Ministry of Agriculture & Forests

Yogurt Production in Sarpang Dzongkhag

4.4.3 NCIS/ HERD HEALTH MONITORING

National Cattle Identification and Information System (NCIS)

National Cattle Information System (NCIS) Expansion programs were carried out in the following Dzongkhags by the team from National Dairy Research Centre in collaboration with respective Regional Livestock Development Centers (RLDCs) and Dzongkhags. Two Dzongkhags of Paro and Mongar Dzongkhags only carried out the implemented of NCIS program in 13 geogs.

The number of household under NCIS increased to 6189 from 5789 an increase of 400 households. The number of animals with NCIS increased to 11551 an increase of 1027 during the fiscal year. As of now the NCIS is carried out in 115 Geogs and CHBPP in 55 Geogs covering in all 20 Dzongkhag. The detail of Dzongkhags and Geogs where NCIS are carried out is given in annexure 4.

Review of performance s of Community based AI Technicians

The concept of Community Based AI Technician (CAIT) was initiated by National Dairy Research Centre (NDRC), Yusipang in 2010. The training of the CAIT aims to ease the shortage of AI Technicians in the field to provide AI services to the farmers and generate employment opportunities for early school leavers. The Centre in collaboration with RLDCs and Dzongkhags identify and train CAITs in dairy potential areas.

The first batch of community based AI technicians (CAIT) was trained during November 2010 at RTDC Zhemgang. A total of 45 CAIT's were trained till June 2017. A total of 54 CAIT were trained during the 2017 – 2018. Since its inception in 2010 till date, 99 CAITs (nine batches) were trained

CAIT's under Western region:

A total of 3085 inseminations were carried out of which 609 progenies were recorded by CAIT under western region as of June 2018 (Table 10). The Chukha Dzongkhag has 20 CAIT trained of which 50% are providing AI services to their community,15% of the trained CAIT's has not performed even a single AI and 35% has stopped providing after sometime. Among the four Dzongkhags, Chukha Dzongkhag has not provided free AI services wherever there is trained CAIT's. In other Dzongkhags especially Samtse the extension agents were providing free AI services even when there is CAIT's in that locality. Free AI service is provided by our extension agents, the CAIT's are not called to carryout AI and thus affected their CAIT performance. CAIT's under Chukha Dzongkhag are performing better than other three Dzongkhags.

Table 10: AI performance by CAIT's Dzongkhag wise under Western Region

Sl. No.	Dzongkhag	Total number of insemination	progenies recorded	CAIT trained	No. of CAIT's still providing AI services
1	Paro	287	23	3	1
2	Thimphu	50	20	2	Nil
3	Chukha	1983	416	10	5
4	Samtse	740	150	5	4
	Total	**3060**	**609**	**20**	**10**

CAIT's under West Central Region:

A total of 73 inseminations were carried out of which 30 progenies were recorded by CAIT under west central region as of June 2018 table 10. Five CAITs were trained of which all have stopped performing AI in the Dzongkhag. Compare to Dagana CAIT's under Tsirang Dzongkhag has performed better. No CAIT training is initiated in Gasa, Punakha & Wangdue Dzongkhags under this region. It is clear that the performance of CAIT's under western central region in terms of both the number of inseminations and follow up on the progenies born is poor (Table 11).

Table 11: AI performance by CAIT's Dzongkhag wise under West Central Region:

Sl. No.	Dzongkhag	Total number of insemination	progenies recorded	CAIT trained	No. of CAIT's still providing AI services
1	Tsirang	28	17	2	Nil
2	Dagana	45	13	3	1
3	**Total**	**73**	**30**	**5**	**1**

CAIT's under East Central region.

A total of 786 inseminations were carried out of which 113 progenies were recorded by CAIT in Bumthang Dzongkhag under east central region as of June 2018 (Table 12). One of the CAIT attached to Tang Community farm have performed 736 AI and 112 progeny born. Similarly, 42 AI and one progeny born were performed in Bumthang Dzongkhag. Seven CAITs were trained of which only two CAIT from Bumthang Dzongkhag is performing AI services. All the four CAIT under Trongsa and Bumthang Dzongkhag have not carried out any AI or services to the Dzongkhags.

Table 12: AI performance by CAIT's Dzongkhag wise under West Central Region:

Sl. No.	Dzongkhag	Total number of insemination	progenies recorded	CAIT trained	No. of CAIT's still providing AI services
1	Bumthang	778	113	3	2
2	Trongsa	5	0	2	Nil
3	Zhemgang	3	0	2	Nil
	Total	786	113	7	2

CAIT's under Eastern region

A total of 786 inseminations were carried out and 70 progenies were recorded by CAIT's of eastern region. The overall performance both in terms of number of inseminations and progenies recorded is not satisfactory (Table 13). Of the 39 CAITs trained 21 of which have stopped performing AI in their Dzongkhags. Pema Gatshel followed by Mongar and Samdrup Jongkhar Dzongkhags are performing better based on the progeny born. Trashigang & Tashi Yangtse Dzongkhags have no progeny born from AI done by CAITs.

Table 13: AI performance by CAIT's Dzongkhag wise under Eastern Region

Sl. No.	Dzongkhag	Total number of insemination	progenies recorded	CAIT trained	No. of CAIT's still providing AI services
1	Mongar	169	12	7	3
2	Trashigang	20	0	5	2
3	Tashiyangtse	0	0	2	2
4	Pemagatshel	341	47	8	5
5	Samdrup Jongkhar	256	11	17	9
	Total	**786**	**70**	**39**	**21**

AI performance by CAIT's region wise

A total of only 4705 inseminations were carried out of which 822 progenies were born since the start of CAIT's program from 2010 (table 14). The overall performance both in terms of number of inseminations and progenies recorded is not satisfactory. Furthermore out of 71 CAIT's trained till 7th batch only 34 CAIT's (48%) are providing AI services which is very questionable for the sustainability of CAIT's program in the country.

Table 14: AI performance by CAIT's region wise

Sl. No.	Region	Total Insemination.	Total progenies born	Total No. of CAIT's trained	CAIT providing AI services.
1	Western	3060	609	20	10
2	West Central	73	30	5	1
3	East Central	786	113	7	2
4	Eastern	786	70	39	21
	Total	**4705**	**822**	**71** **(excludes recently trained CAIT)**	**34**

General observations:

1. Non performance and discontinuation to perform by CAIT is a serious issue and as such sustainability of CAIT's is a big question.
2. No contract is signed in most geogs between CAIT's after completion of training and beneficiaries on the number of years the CAIT will provide AI services to the communities including penalties to be levied to the CAIT's on breach of contract.
3. AI register not properly filled-no mention of bull name/number, frozen semen inventory are not filled properly.
4. Separate AI register not maintained for AI services provided for frozen semen of different breeds.
5. No separate AI register maintained for AI performed by extension agents and CAIT.
6. An extension agent providing free AI services in places where there is CAIT's thus affecting their AI performance.
7. The payment system for CAIT's varies from Dzongkhag to Dzongkhag and there is no payment made by the communities for the progenies born to the CAIT's in most Dzongkhags under review.
8. The follow up on the progenies born by CAIT's is very poor and this is attributed to nonpayment by communities to CAIT's for the progenies born.
9. There is no proper follow up from the geog in-charges on the performance of CAIT's.
10. Progenies born through AI by CAIT's in some geogs are not ear tagged.
11. There is no problem with the supply of AI inputs to the CAIT's.

Recommendations:

1. A contract needs to be signed between CAIT's and beneficiaries on the number of years the CAIT will provide AI services to the communities immediately after their training to have legal backing.
2. There is a need to include payment for progenies born apart from AI services during contract signing.
3. AI register provided is to be filled up properly especially on the frozen semen used column.
4. Separate AI register to be maintained for the AI services provided for frozen semen of Different breeds.
5. Separate AI register to be maintained for free AI services provided by Extension agents.
6. The extension agents shall avoid providing free AI services as far as possible wherever there is CAIT's trained.
7. There should be proper monitoring from the geog in-charges of the CAIT's in their respective geogs especially with regard to number of AI and follow up on progenies born.
8. The geog in-charge should verify the progeny born through AI by CAIT's and should ear tag the progenies by giving National Bovine Identification Number (NBIN).
9. Regular monitoring of CAIT's from respective RLDC and Dzongkhag breeding focal persons to ensure proper filling of AI register and follow up on progenies born.
10. Regular refresher course on AI to be provided to all CAIT's on regular basis to improve their skills and keep abreast of the changing technology.

11. For those CAIT's who has not performed even a single AI after training there should be a mechanism to make them refund the cost incurred for their training.
12. Training of new CAIT's shall be done only after formal agreement between CAIT's and beneficiaries for their service and remuneration are executed properly involving other stakeholders like local government.

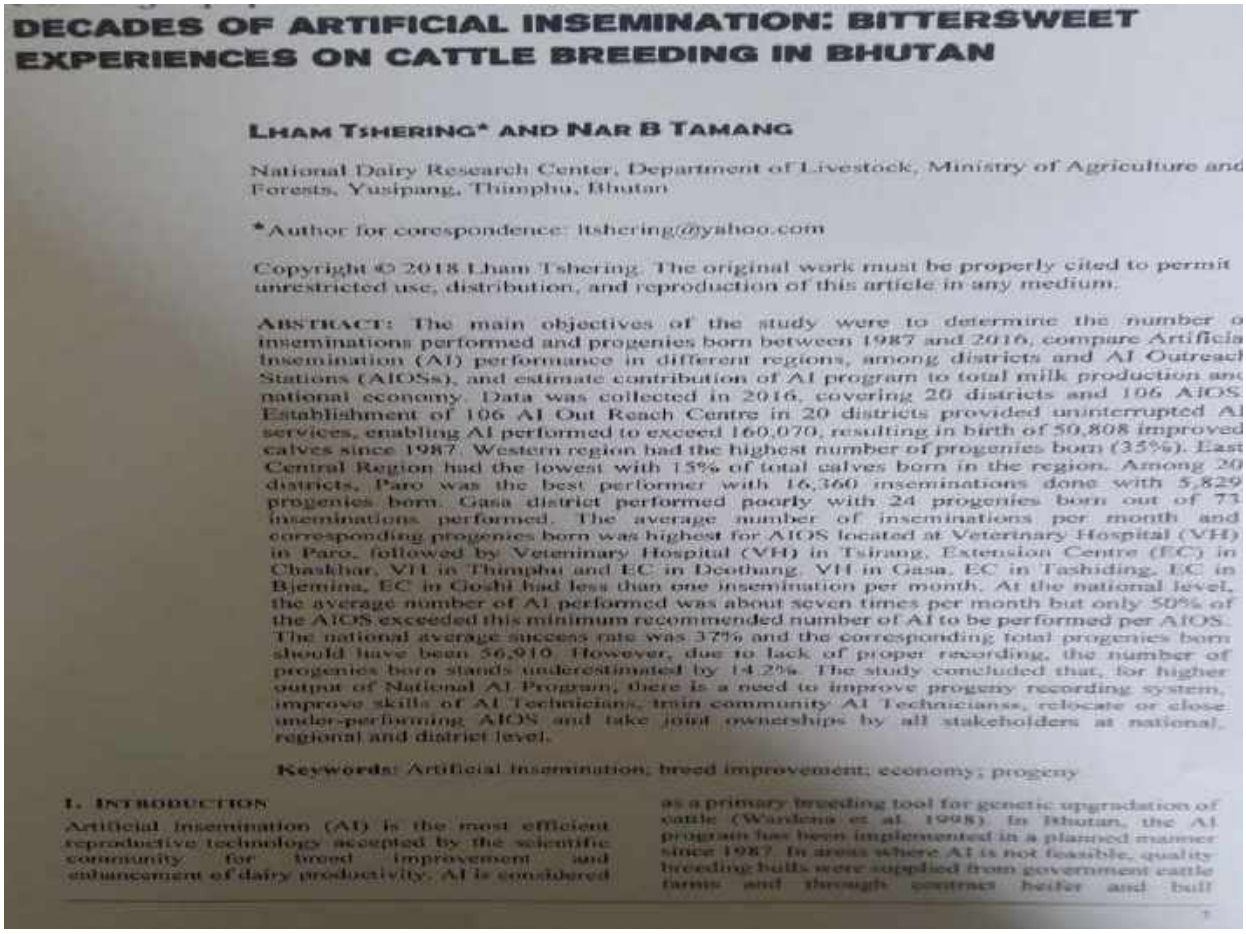
A glimpse of CAIT's AI progenies born

20 . RESEARCH ACTIVITIES

The erstwhile NLBP / NDDC was renamed as National Dairy Research Centre (NDRC) based on recommendation of Organization Development Exercise of RCSC. The Center is entrusted as an apex body to oversee and conduct Dairy Research in the country as well as to produce specialized dairy breeding inputs. Based on the change in mandates the Centre has carried out the research activities as follows:

5.1 DAIRY PRODUCTION RESEARCH

5.1.1 PUBLISHED



DECADES OF ARTIFICIAL INSEMINATION: BITTERSWEET EXPERIENCES ON CATTLE BREEDING IN BHUTAN

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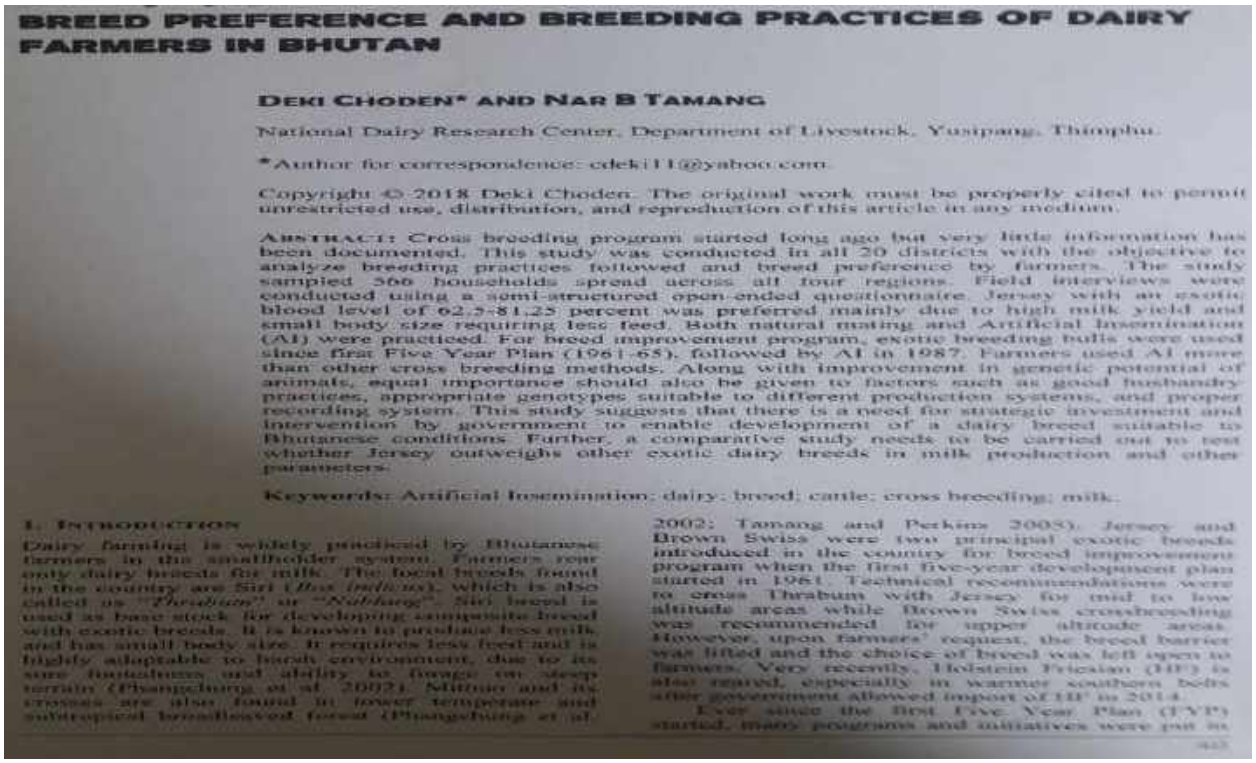
ABSTRACT: The main objectives of the study were to determine the number of inseminations performed and progenies born between 1987 and 2016, compare Artificial Insemination (AI) performance in different regions, among districts and AI Outreach Stations (AIOSs), and estimate contribution of AI program to total milk production and national economy. Data was collected in 2016, covering 20 districts and 106 AIOS. Establishment of 106 AI Out Reach Centre in 20 districts provided uninterrupted AI services, enabling AI performed to exceed 160,070, resulting in birth of 50,808 improved calves since 1987. Western region had the highest number of progenies born (35%). East Central Region had the lowest with 15% of total calves born in the region. Among 20 districts, Paro was the best performer with 16,360 inseminations done with 5,829 progenies born. Gasa district performed poorly with 24 progenies born out of 71 inseminations performed. The average number of inseminations per month and corresponding progenies born was highest for AIOS located at Veterinary Hospital (VH) in Paro, followed by Veterinary Hospital (VH) in Tsirang, Extension Centre (EC) in Chaskhar, VH in Thimphu and EC in Deothang. VH in Gasa, EC in Tashiding, EC in Bjemina, EC in Goshi had less than one insemination per month. At the national level, the average number of AI performed was about seven times per month but only 50% of the AIOS exceeded this minimum recommended number of AI to be performed per AIOS. The national average success rate was 37% and the corresponding total progenies born should have been 56,910. However, due to lack of proper recording, the number of progenies born stands underestimated by 14.2%. The study concluded that, for higher output of National AI Program, there is a need to improve progeny recording system, improve skills of AI Technicians, train community AI Technicianss, relocate or close under-performing AIOS and take joint ownerships by all stakeholders at national, regional and district level.

Keywords: Artificial Insemination; breed improvement; economy; progeny

1. INTRODUCTION

Artificial Insemination (AI) is the most efficient reproductive technology accepted by the scientific community for breed improvement and enhancement of dairy productivity. AI is considered as a primary breeding tool for genetic upgradation of cattle (Wardeha et al. 1998). In Bhutan, the AI program has been implemented in a planned manner since 1987. In areas where AI is not feasible, quality breeding bulls were supplied from government cattle farms and through contract heifer and bull



BREED PREFERENCE AND BREEDING PRACTICES OF DAIRY FARMERS IN BHUTAN

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ABSTRACT: Cross breeding program started long ago but very little information has been documented. This study was conducted in all 20 districts with the objective to analyze breeding practices followed and breed preference by farmers. The study sampled 366 households spread across all four regions. Field interviews were conducted using a semi-structured open-ended questionnaire. Jersey with an exotic blood level of 62.5-81.25 percent was preferred mainly due to high milk yield and small body size requiring less feed. Both natural mating and Artificial Insemination (AI) were practiced. For breed improvement program, exotic breeding bulls were used since first Five Year Plan (1961-65), followed by AI in 1987. Farmers used AI more than other cross breeding methods. Along with improvement in genetic potential of animals, equal importance should also be given to factors such as good husbandry practices, appropriate genotypes suitable to different production systems, and proper recording system. This study suggests that there is a need for strategic investment and intervention by government to enable development of a dairy breed suitable to Bhutanese conditions. Further, a comparative study needs to be carried out to test whether Jersey outweighs other exotic dairy breeds in milk production and other parameters.

Keywords: Artificial Insemination; dairy; breed; cattle; cross breeding; milk.

1. INTRODUCTION

Dairy farming is widely practiced by Bhutanese farmers in the smallholder system. Farmers rear only dairy breeds for milk. The local breeds found in the country are Siri (*Bos indicus*), which is also called as "*Paraibum*" or "*Nublang*". Siri breed is used as base stock for developing composite breed with exotic breeds. It is known to produce less milk and has small body size. It requires less feed and is highly adaptable to harsh environment, due to its sure footedness and ability to forage on steep terrain (Phuntsho et al. 2002). Mithun and its crosses are also found in lower temperate and subtropical broadleaved forest (Phuntsho et al. 2002; Tamang and Perkins 2005). Jersey and Brown Swiss were two principal exotic breeds introduced in the country for breed improvement program when the first five-year development plan started in 1961. Technical recommendations were to cross Thrabum with Jersey for mid to low altitude areas while Brown Swiss crossbreeding was recommended for upper altitude areas. However, upon farmers' request, the breed barrier was lifted and the choice of breed was left open to farmers. Very recently, Holstein Friesian (HF) is also reared, especially in warmer southern belts after government allowed import of HF in 2014.

Ever since the first Five Year Plan (FYP) started, many programs and initiatives were put in

5.1.2 COMPLETED

PERFORMANCE EVALUATION OF KARAN FRIES IN COMPARISION TO JERSEY (PURE) DAIRY CATTLE MANAGED IN THE SUB-TROPICAL ENVIRONMENT OF BHUTAN

Evaluation was conducted to understand the performances of Karan Fries (KF) and Jersey Pure (JP) dairy cattle breeds managed at the same government farm in the sub-tropical environment of Bhutan. Quantitative data on production and reproduction are retrieved from over 320 individual cow/calf performance records maintained at the farm covering a period between July2014-March 2018 and qualitative data on adaptability are gathered through key informant's interview. Data was analyzed using statistical package Minitab-18 and SPSS-20.

Evaluation revealed that mean birth weight and monthly weight gain in KF calves is significantly higher than JP ($p<0.004$). Mean age at first service/first calving of 24.6± 4.7 (months) and 33.9±4.2 (months) for JP which is significantly lesser than KF ($p<0.001$). Thus JP is likely to calve at younger age benefiting smallholder farmers to get early returns to their investment.

Mean daily milk yield (kg) in 1st lactation is significantly higher in JP than KF ($p<0.006$) but there is no yields variation in subsequent lactations. Mean lactation yield (305 days) for KF cows increased to 3823.9 kg in 4th lactation, which is 371 kg higher than JP, difference in yield is not statistically significant. Further, study found that milk production is dependent on season of a year ($p<0.000$). Milk production declined in both the breeds during summer possibly due to heat stress and poor quality fodder.

Good foraging ability and surefootedness are positive attributes of KF to survive in the mountain environment of Bhutan. However, bad temperament, higher quantity of forage requirement for the animals are the disadvantages.

Though KF is relatively resistant to common disease than JP, introduction of infected KF into the JP nucleus herd triggered outbreak of brucellosis. From 2014-18, both the breeds endured abortion storm because of this disease resulting in loss of calves as well as milk.

The study concluded that JP breed come into production at younger age, has medium body size requiring lesser fodder intake. Hence JP and its crosses may continue to remain a breed of choice for the subsistence and semi-commercial farmers with limited fodder resources while KF may find place in more commercial farm with adequate facilities and resources to sustain them.

Incursion of Brucellosis though import of KF has reduced the scarce Jersey gene pool at the JP nucleus farm hence mixing of imported breed into nucleus herd should be done with outmost caution in the future.

Status of the study is completed and the scientific paper on review of KF and JP(in detail) is ready for publication in the coming issue of BJAS.

PERFORMANCE ASSESSMENT OF NUBLANG NULCEUS HERD AT NATIONAL NUBLANG BREEDING FARM, TASHIYANGPHU

Performance of Nublang nucleus herd at National Nublang Breeding Farm (NNBF) Tashiyangphu was assessed to understand their productive/reproductive performance of the herd and identify key challenges for further improvement of the breed.

The review accessed from 3794 individual animal records (1st to 8th lactations) maintained at the farm from 1997 to 2018 for analysis. Informal discussion was held with stakeholders to recognize the challenges faced and their perspective about the future of the nucleus herd.

Review found that the farm maintains a fair balance of young and old stock for regular replacement. Practice also is in place for regular culling of less productive animals as required for herd improvement. The animals are managed in Kikuyu based pasture. Overall average daily milk yield of cows in all lactations was 3.54 ±0.23 kg (n=436) and take home milk was 2.04± 0.23 kg/day after allotting about 1.5kg/day to calves for their nutrition.

Highest lactation yield of cows at the farm was 889kg (n=47) and calculated 305days lactation yield was 1093kg in 4th lactation which is significantly higher than yields of all other lactations ($p<0.000$). Lactation length (overall average) was 219±18 days (7.3months).

Notably, calving interval or inter calving period has progressively decreased from first 16.1 ±3.6 months (n=173) between 1st/2ndlactation to12.1 ±1.1 months 7th/8th lactation (n=165). This is very encouraging because is an indication of improvement in reproductive efficiency of a herd. Length of lactation however, had little or no improvement over the years, which could be due to genetic limitation of the breed.

Major challenges faced by NNBF include induction of other breeds of cattle to the Nublang herd affecting management and productivity of Nublang nucleus herd. Besides, non replacement of crucial human resource needed by the farm is issues that need attention.

Review concluded highest overall average lactation milk yield of Nublang/Thrabam cattle in 5th lactation with no drastic decline in milk yield till 7th lactation is suggestive that some cows in the herd that are fit and producing above the herd average can be retained up to 7th lactation or beyond based on their productivity.

Nublang cows being a draught /dual purpose breed with short lactation length and low lactation yield, it is unlikely to compete for milk production with recognized dairy breeds even if they are rigorously selected. Hence, besides improvement in milk production, other traits such as diseases resistance, adaptability, and foraging ability should be given equal weightage during selection.

To pursue pure line breeding of Nublang/Thrabam herd, mixing of other breeds of cattle be discouraged in the future to enable NNBF to continue focusing on improvement of Nublang nucleus herd for sustainable future use. This should be augmented with proper breeding strategies and doable mechanism to record vital farm data to assist in decision support system.

REVIEW OF REGIONAL CATTLE RESEARCH FARM, WANGKHA

Introduction

The erstwhile Calf Rearing Center (CRC), Wangkha is upgraded to Regional Cattle Research Farm (RCRF) with a mandate to support conducting dairy research and also produce crossbred heifers in the country. Accordingly farm initiated to hold cattle of various breeds such as Jersey pure, Jersey cross, Karan Fries and local cattle since February 2016 for the said purpose. A review of the farm was conducted in 2018 to assess the current status and future needs of the farm.

Farm resources

The RCRF has a total area of 113 acres and is holding 112 heads of cattle. The pasture was dominated by kikuyu grass with few acreage of Napier grass and Ficus roxburgii fodder trees.

Breeding and reproduction

It was observed that most of the animals were mated using breeding bulls owing to absence of AI technician in the farm. For research purpose, 100 doses each of Jersey pure sex-sorted semen and progeny tested semen were supplied to the farm from NDDC, Yusipang in Feb. 2014 for use in heifers along with insemination protocol. Insemination was carried out by the Farm Manager himself as AI technician.

A total of 88 AI was done: 35 AI with sex-sorted semen and 53 AI with progeny tested frozen semen, in procured jersey heifers. With the sex-sorted semen, 19 progenies born: 16 female calves and 3 male calves(84% for female). The AI success rate for the sex-sorted semen was 54% (n=19/35), and 52% (n=28/53) for the conventional progeny tested frozen semen. The average age at first service was 31 months (n=88, and age at 1st calving was 42 months (n=47).

The animals with reproductive anomalies were subjected for corrective measures. Most of the animals were found healthy with body condition score of 2.5 - 3.5 (scale of 1 - 5).

Milk production

Milk production in the farm was started from Feb. 2016 with animals retained in the farm after supplying to the farmers of their choice. Total milk produced in the farm were 5,223l,

35,531land 34,039l in 2015-16, 2016-17 and 2017-18 respectively. All animals were in first lactation 1st lactation. Average milk production of existing 28 cows in the farm were assessed breed wise, stands at 5.8l/day for Jersey pure and HF, 5.2l/day for Jersey cross, 6.5l/day for Karan Fries and 3.8l/day for local (Siri) cows.

Animal procurement and supply
During the 11th FYP, the farm had procured a total of 208 heifers from 2013-2017, and supplied 162 animals; pregnant heifers and milking cows to the members of Dairy Farmers Groups.

Conclusion and recommendations
Milk production record is incomplete and sample size was small to deduce any conclusion.

The trial use of sex sorted semen in virgin heifers was promising with success rate of 54% and female birth rate of 84% is encouraging. Hence, apart from research on dairy cattle, focusing on producing Jersey cross heifers using sex sorted semen is recommended.

The farm consists of mixture of breeds, but with the growing demand for Jersey cross heifers by farming community, more focus may be given to Jersey cross heifer production, slowly thinning out stock of other breeds from the farm.

The AI component in pre-requisite for genetic improvement. Therefore, training of support staff of the farm on AI or placement of fluent AI technician in the farm is crucial.

5.1.3 ONGOING

IMPLEMENTATION OF PROGENY TESTING SCHEME: TOWARDS DEVELOPMENT OF RESILIENT DAIRY CATTLE BREED FOR BHUTAN

To start with PTS semen of four premium (best of the best) sire lines of Thai Holstein provided by Dairy Promotion Organization (DPO) Thailand in August 2017 is used. For organised and systematic breeding, proper breeding goal and breeding design/plan have been framed in close consultation with breeding experts within the country as well as from DPO and Kasarsat University, Thailand. To kick start, systematic breeding for unbiased prediction of sire superiority, testing of sires in different agro-ecological zones(AEZ): Samtse and Tsirang (wet, humid and dry subtropical zone). AEZ identified based on set criteria. The areas and coverage will be expanded as number of animals of desired quality increases and with field experience gained. The objectives of the schemes are:

Short-term

- Utilize Thai Holstein semen to increase crossbred population in targeted geog/Dzongkhags
- Increase household milk production by area farmers for home consumption/sale
- Promote participatory development through formation of Holstein Cattle Breeding Village
- Control inbreeding by injecting fresh bloodline in the free grazing herd

Long-term

- Identify superior young sires for semen production and future crossbreeding
- Facilitate steady genetic progress in cattle population for milk yield and environmental adaptation
- Test and identify resilient dairy breed with appropriate combination of local and exotic inheritance level for its resilience to climate change in a longer-run.

PTS site selection criteria

Representative geogs in three agro-ecological zone based on altitude and farming environment
Select PTS operation site with sizeable base population of local cattle
Accessibility to PTS operation site for smooth implementation, monitoring and recording

Overall pts operation modalities

- Initially 2000 doses of Thai Holstein Semen (four sire lines) provided by DPO, Thailand was used for Artificial Insemination (AI)
- Mostly local cattle (Thrabam) was selected for the scheme for herd improvement in the targeted areas
- All selected cows/heifers were ear-tagged with NBIN[1], inseminated and all events of artificial insemination, pregnancy and calving shall be recorded
- All daughters born shall be ear-tagged, and proper record kept with clear mention of blood level, breed and body weight shall be recorded on a monthly basis.
- Daughters on reaching serviceable age shall be inseminated with progeny tested semen (Thai HF semen of other sire line) and will be followed up for pregnancy and calving. All data related to AI, pregnancy and calving will be captured.
- Milk production of the daughters that calved shall be recorded once a month for one lactation period.
- Breeding values of bulls put under test shall be estimated based on daughter's performance
- The top sidelines (top 20%) selected shall be used for nominated mating of elite cows to produce sire of superior animals, and full sibs bull of the highest producing cows will be identified for semen production for use in successive generation (repeating PTS cycle).

Status of study

Mating scheme wherein mating selected dams at tests site is designed that needs monitoring for proper implementation. This includes equitable allocation of semen of the four sire lines (Table 15.Each selected sites were visited again by NDRC team from late November 2017 to January, 2018 breed able females were synchronized with suitable hormones to bring the animal to heat and mobile AI services was provided by NDRC team to inseminate cows in heat.

[1] *National Bovine Identification Number*

Over 298 AI were carried out by highly skilled AI staff supervised by Animal Reproduction / Breeding Specialist of NDRC to ensure higher success rate, supported by Extension staff of concerned Dzongkhag.

Table 15: Detail of sire used under Progent Testing Scheme

Dzongkhag/Geog/Chiwog/Village	THF Sire lines used under PTS				
	Push (C 5008)	Puzzle (C 5009)	Pound (C 4908)	Popular (C 4902)	Geog Total
Total Tading, Samtse	41	47	29	36	153
Total Barsong Tsirang	20	19	23	12	74
Total Sergithang	16	19	16	20	71
Grand Total (Total AI from all sire lines)	77	85	68	68	298

THF = Thai Holstein Friesian
PTS = Progeny Testing Scheme

Total 298 insemination done, expected conception rate is 50%=149, of which 50% female= 74, 10% mortality/ still birth, abortion=7), 67 female, will be on recording from October-November 2018 roughly 17 female progenies per sire line.

In total, **232 households** were involved in the scheme with insemination of **298 animals** using THF semen; 111 households with 153 animal insemination in Tading geog, Samtse, 65 households with 74 animal insemination in Barsong geog and 56 households with 71 animal inseminations in Sergithang geog, Tsirang. It was found that Tading geog, Samtse has all 3 AEZs (wet, humid and dry sub-tropical) where as Tsirang has only 2 AEZs (humid and dry sub-tropical) based on the zoning criteria. However, each AEZ will be considered as on contemporary group. Beside, the distribution of bulls in AEZs will be made uniform during the expansion time/ 2nd phase of implementation.

COMPARISON OF MILK PRODUCTION OF CATTLE BREEDS IN THREE AGRO-ECOLOGICAL ZONES OF BHUTAN

Time series data of livestock census show variations in livestock number as well as production in a number of Geogs. In order to bring improvement in the livestock statistics pilot surveys on estimation of milk production was first implemented by IMS DoL in Haa and Samdrup Jongkhar with support from FAO. The surveys had reference period of one year for milk production. Recall methods was applied to missing fill up data sets for seasonal production variation. In order to have more precise recording of milk production data, a more detailed real time data on milk production of different breeds, lactation stage, parity and season in three agro-ecological zones is implemented with the objective to:

- Establish facts about seasonal milk production variations of different cattle breeds in three agro-ecological zones
- Strengthen milk recording system in the farmers' organization in the country

Status of the study: This study is being carried out in Darla, Sampheling and Phuentsholing Geogs of Chukha Dzongkhag and Kawang and Mewang Geogs of Thimphu Dzongkhag

representing three agro-ecological zones, Cool Temperate, Warm Temperate and Dry sub-tropical. Dairy Farmers Groups (DFGs) members of these two Dzongkhag falling under these zones that have milking cows were purposively sampled for recording milk yield of dairy cows in four different seasons of the year: Spring (March, April, May); Summer (June, July, August); Autumn (September, October, November) and Winter (December, January, February).

So far three seasons recording is completed and the final data collection will be carried out in August and data analysis and paper writing will be completed by December 2018 and published in forth coming issue of Bhutan Journal Animal Science.

5. 2 DAIRY INPUT PRODUCTION RESEARCH

5.2 COMPLETED

ESTRUS SYNCHRONIZATION & FTAI IN LOCAL BUFFALOES IN BHUTAN USING PROGENY TESTED NILLI RAVI BUFFALO BREED FROZEN SEMEN

Buffalo (*Bubalus bubalis*) plays an important role in the world's production of animal protein, especially in third world countries. However, in Bhutan, buffalo farming is in declining trend and buffalo population has drastically reduced to around 700 heads (DoL, 2016). Lack of suitable breeds, unavailability of breeding bull and AI facilities for buffaloes are some of the constraints faced. In order to revive buffalo farming and improve local buffalo to augment milk production in the country, introduction of quality germ plasma from promising dairy buffalo through AI in buffaloes is initiated for the first time in the country availing 200 doses progeny tested frozen semen of Nilli Ravi buffalo breed (received from SAARC Agriculture Centre, Dhaka) was used for estrus synchronization and Fixed Time Artificial Insemination (FTAI) in local buffaloes in Bhutan.

A technical team from National Diary Research Centre (NDRC, Yusipang) carried out trials on estrus synchronization and AI in local buffaloes in Tashicholing/Sipsu, Namgaycholing and Dophuchen geogs under Samtse and Phuentenchu geog under Tsirang Dzongkhags. Buffaloes referred for examination were per rectally examined to confirm pregnancy, reproductive status and reproductive aliments. A total of 40 breedable buffaloes were estrus synchronized and inseminated; 38 in Samtse and 2 in Tsirang.

The response rate to the estrus synchronization was 100% and AI done accordingly though heat signs exhibited were not as prominent as in cattle. The overall conception rate confirmed through per rectal examination was only 20% (n=8/40). The conception rate is observed to be relatively lower in buffalo than in cattle (55% reported in the same report for progeny tested semen). The attributing factors for this low conception rate in buffalos could be that buffalos are seasonal breeder and use of different protocols for induction of heat.



First AI buffalo calf born sired by progeny tested frozen semen of Nilli Ravi buffalo breed & estrus synchronized & FAIT in Buffaloes under Samtse district, Bhutan.

The scientific paper on the subject, with detail trial on different protocols, is ready for publication in forth coming issue of BJAS.

5.3.1 ONGOING

NUBLANG EMBRYO TRANSFER (ET) TECHNOLOGY TRIAL

The reproductive technology used in Bhutan so far for cattle breed improvement is limited to Artificial Insemination (AI) which was introduced in 1987. To further advance the cattle breeding techniques, Embryo Transfer (ET) technology which can greatly increase the number of offspring that a genetically superior female can produce is being tried. Application of ET in the country will also complement the conservation initiatives of our native cattle breed (*Nublang*) and offer a new era in research and development in the area of animal reproduction.

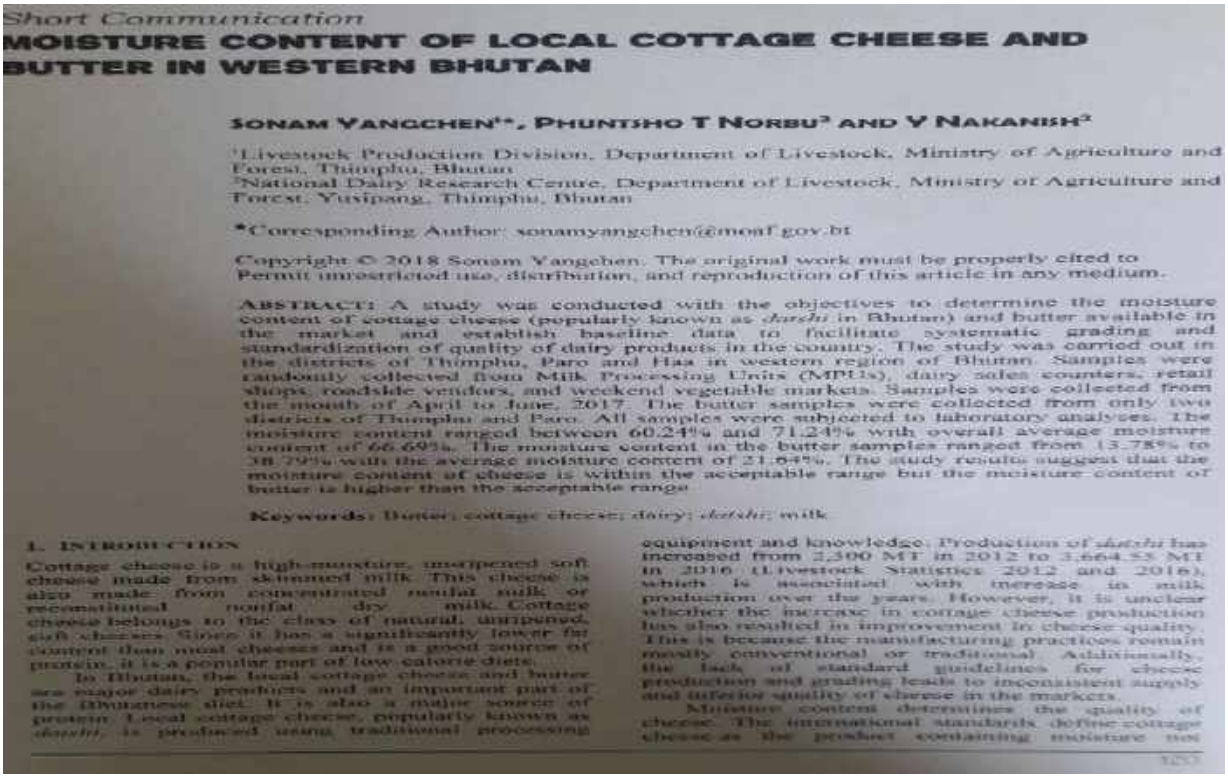
Thus with the inherent benefits of ET technology, it is application of highly skilled ET technology (**Super ovulation, embryo flushing, collection, grading and cryopreservation**) is tried both at NDRC Yusipang and NNBF Tashiyangphu with the following objective:

- ✪ Initiate application of ET technology to exploit genetic potential and decrease generation
- ✪ inter val of high yielding elite Nublang cows
- ✪ Select best Nublang cows through selective breeding for fast genetic gain in our native cattle breed

Status of trial: Five embryo flushing trails **(Super ovulation, embryo flushing, collection, grading and cryopreservation)** at NDRC with 14 elite donor cows and two flushing trial at NNBF could harvest and successfully cryopreserved **24 high quality viable embryo** for future transfer to recipients.

5.3 DAIRY POST-PRODUCTION RESEARCH

PUBLISHED



Short Communication

MOISTURE CONTENT OF LOCAL COTTAGE CHEESE AND BUTTER IN WESTERN BHUTAN

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ABSTRACT: A study was conducted with the objectives to determine the moisture content of cottage cheese (popularly known as *datshi* in Bhutan) and butter available in the market and establish baseline data to facilitate systematic grading and standardization of quality of dairy products in the country. The study was carried out in the districts of Thimphu, Paro and Haa in western region of Bhutan. Samples were randomly collected from Milk Processing Units (MPUs), dairy sales counters, retail shops, roadside vendors, and weekend vegetable markets. Samples were collected from the month of April to June, 2017. The butter samples were collected from only two districts of Thimphu and Paro. All samples were subjected to laboratory analyses. The moisture content ranged between 60.24% and 71.24% with overall average moisture content of 66.69%. The moisture content in the butter samples ranged from 13.78% to 38.79% with the average moisture content of 21.64%. The study results suggest that the moisture content of cheese is within the acceptable range but the moisture content of butter is higher than the acceptable range

Keywords: Butter; cottage cheese; dairy; *datshi*; milk

1. INTRODUCTION

Cottage cheese is a high-moisture, unripened soft cheese made from skimmed milk. This cheese is also made from concentrated partial milk or reconstituted nonfat dry milk. Cottage cheese belongs to the class of 'natural, unripened, soft cheeses. Since it has a significantly lower fat content than most cheeses and is a good source of protein, it is a popular part of low calorie diets.

In Bhutan, the local cottage cheese and butter are major dairy products and an important part of the Bhutanese diet. It is also a major source of protein. Local cottage cheese, popularly known as *datshi*, is produced using traditional processing equipment and knowledge. Production of *datshi* has increased from 2,300 MT in 2012 to 3,664.55 MT in 2016 (Livestock Statistics 2012 and 2016), which is associated with increase in milk production over the years. However, it is unclear whether the increase in cottage cheese production has also resulted in improvement in cheese quality. This is because the manufacturing practices remain mostly conventional or traditional. Additionally, the lack of standard guidelines for cheese production and grading leads to inconsistent supply and inferior quality of cheese in the markets.

Moisture content determines the quality of cheese. The international standards define cottage cheese as the product containing moisture not

1253

5.3.3 ONGOING

DETERMINATION OF MOISTURE CONTENT AND MICROBIAL CONTENT OF LOCAL COTTAGE CHEESE (DATSHI)

The growth in popularity of dairy farming and the increase in the number of dairy farmers groups throughout the country have seen increasing amount of datshi becoming available in the market. However, the increase in production has not been associated with any improvements in the manufacturing practices for production of datshi. Additionally, the lack of standard guidelines for production and grading of finished product is leading to the supply of inconsistent quality products to the market. Moreover, a detail analysis of datshi has not been conducted to document and compare the compositional parameters with international standards. Hence with the objectives to:

- Document the average moisture content of datshi available in the market
- Document the microbial content of datshi available in market
- Serve as a baseline data for compositional standard setting of datshi for systematic grading of *datshi* in the country

Study status

Determination of moisture content of datshi is undertaken using the conventional oven drying method. Microbial analysis is carried out as per standards for organisms. Sampling and testing is on-going. So far sampling is completed from Paro, Thimphu, Punakha and Wangdue and results available. The trials will be expanded to other Dzongkhags in future

Compositional analysis of raw milk available in marketing outlets of Thimphu and Paro

As there is no systematic regulation or monitoring mechanism in place for the sale of raw liquid milk, the compositional quality of milk is not maintained for the consumers with variations in compositional quality and adulteration with water being common practice. The use of water as an adulterant to increase the volume of milk sold can pose a risk to human health through the use of contaminated and unclean water leading to the rapid deterioration of milk quality as well as the reduction of milk solids.

No study to determine the compositional quality of raw milk available in the market has been carried out and the objective of this study is to address the lack of information and quantitative data. Through this study, initial information on the compositional quality of milk will be made available for future reference and corrective measures to be implemented in case of adulteration.

Study status

Determination of raw milk composition is undertaken using the lactoscan MCCW and the portable milk analyzer available in the field. Sampling and testing for Thimphu and Paro Dzongkhag has been completed and report generation is in process. The trials will be expanded to other Dzongkhags in the new financial year.

DETERMINATION OF MOISTURE CONTENT AND MICROBIAL CONTENT OF LOCAL BUTTER

The growth in popularity of dairy farming and the increase in the number of dairy farmers groups throughout the country have seen increasing amount of butter becoming available in the market. However, the increase in production has not been associated with any improvements in the manufacturing practices for production of butter. Additionally, the lack of standard guidelines for production and grading of finished product is leading to the supply of inconsistent quality products to the market. Moreover, a detail analysis of local butter has not been conducted to document and compare the compositional parameters with international standards. Hence with the objectives to:

- Document the average moisture content of butter available in the market
- Document the microbial content of local butter available in market
- Serve as a baseline data for compositional standard setting of local butter for systematic grading of butter in the country

Study status

Determination of moisture content of butter is undertaken using the conventional oven drying method. Sampling for microbial organisms is carried our as per standards for organisms. Sampling and testing is on-going. So far sampling is completed from Paro, Thimphu, Punakha and Wangdue and results available. The trials will be expanded to other Dzongkhags in future.

5.4 RESEARCH COMMUNICATION AND TECHNOLOGY TRANSFER

5.4.2 COMPLETED

FARMERS KNOWLEDGE ON IMPROVED DAIRY TECHNOLOGY IN DAIRY FARMERS AND NON FARMERS GROUP

A study was conducted to understand the farmers' knowledge on adoption of dairy technologies comparing dairy farmers groups (DFG) and non dairy group members. Over 167 farmers were interviewed in three Dzongkhag*s*; Low altitudes Sarpang, Mid-Altitude, Tsirang and high altitude Haa of which 97 were member of dairy farmers groups and 70 were from non dairy farmer group. The questionnaire sought information of farmers' knowledge on dairy technology on household profile, feeding practices, dairy husbandry practices, breeding practices and health practices.

Dairy farmers' group members have high level of adoption in feeding practices (84.92%), dairy husbandry practices (80.15%) and health care practices (77.30%). However, non dairy farmers' group members have medium level of adoption in feeding practices (69.20%), dairy husbandry practices (54.92%), and health care practices (69.87%). Breeding practice adoption in dairy farmers' group members is medium (43%) and non dairy farmers' group members is low (28%). There is large scope for the strengthening the farmer knowledge on dairy technology adoption among dairy farmers groups and non dairy farmers group particularly in breeding practices through awareness creation and training of farmers on emerging technologies.

6 Staff Strength

I Administration & Management

Sl. #	Name	Designation	Sector
1	Dr. N. B Tamang	Program Director	General
2	Mr.Jigme Tenzin	Acct. Asst IV	General
3	Mr. Pema Dorji	Adm. Asst II	General
5	Mr. Durga Chhetri	Driver I	General
6	Mr. Domzang	Driver II	General
7	Mr. Tandin Wangchuk	Driver III	General
8	Mr. Pema Tenzin	Driver III	General
9	Mr Samten	Power Tiller Operater	General

II Dairy Research Communication Sector

Sl. #	Name	Designation	Sector
1	Dr. Lham Tshering	Specialist II	Dairy Research Communication
2	Mr. Lokey Thapa	Sr.LPO	Dairy Research Communication
3	Mr.Yuraj Giri	Sr.ES II	Dairy Research Communication

III Dairy Production Research Sector

Sl. #	Name	Designation	Sector
1	Dr. D.B Rai	Specialist III	Dairy Production Research
2	Mrs. Deki Choden	Sr.LPO	Dairy Production Research
3	Mr.Abi Narayan koirala	Sr. LPS II	Dairy Production Research

IV Dairy Inputs Production & Research Sector

Sl. #	Name	Designation	Sector
1	Dr. Dorji	PLO	Inputs Production Research
2	Thinley Dorji	LPO	Inputs Production Research
3	Mr. Mohan Raj Gurung	Sr. LPS II	Inputs Production Research
4	Mr. Phub Dorji	Asst. Engineer II	Inputs Production Research
5	Mr. Chungsila	LPS I	Inputs Production Research
6	Mr. Narapati Chapagai	Technician II	Inputs Production Research
7	Mr. Kanti Ram Chhetri	LPS III	Inputs Production Research
8	Mr. Nima	Lab Asst I	Inputs Production Research

V Dairy Post Production Research Sector

Sl. #	Name	Designation	Sector
1	Mr. Phuntsho T Norbu	Dy. CLPO	Post Production Research
2	Mrs. Kinley Choki	Sr.LPO	Post Production Research
3	Miss. Yuka Nakanishi	JOCV	Post Production Research

7 FINANCIAL PROGRESS

ACT	FIC	OBC	TITLE		
01			**OPERATION AND MANAGEMENT SERVICES**		
	0001		**RGOB Financing**	**BUDGET**	**EXPENDITURE**
		01.01	Pay and Allowances	8.591	8.578
		02.01	Other Personnel Emoluments	1.325	1.246
		11.01	Travel – In country	3.004	3.004
		12.01	Utilities -Telephones, Telex, Fax, E-mail, Internet	0.221	0.218
		12.02	Utilities -Telegram, Wireless Transmission, Postage	0.020	0.020
		12.03	Utilities - Electricity, Water, Sewerage	0.303	0.303
		14.01	S & M - Office Supplies, Printing, Publications	0.100	0.100
		14.06	S & M - Uniforms, Extension Kits, Linens	0.020	0.019
		14.07	S & M - Text Books, Library Books, Stationeries & Sports Items	0.010	0.010
		15.01	Maintenance of Property – Buildings	0.046	0.046
		15.02	Maintenance of Property – Vehicles	1.419	1.419
		15.03	Maintenance of Property – Roads	0.025	0.025
		15.05	Maintenance of Property – Equipment	0.050	0.050
		15.07	Maintenance of Property – Computers	0.037	0.037
		15.09	Maintenance of Property - Water supply, Sewerage, Playfield	0.020	0.020
		17.01	Op. Exp. – Advertising	0.050	0.048
		17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling bank charges	0.010	0.004
		17.08	Op. Exp. – In country Meetings and Celebrations	0.050	0.050
		24.03	Contributions - Provident Fund	0.713	0.705
		25.01	Retirement Benefits	0.049	0.048
			TOTAL OF FIC 0001	**16.063**	**15.950**
			INPUT PRODUCTION AND RESEARCH FOR BREED IMPROVEMENT		
02			**SCHEDULE PRODUCTION & DISTRIBUTION OF LIQUID NITROGEN**		
	0001		RGOB Financing		
		11.01	Travel – In country	0.200	0.200
		12.03	Utilities - Electricity, Water, Sewerage	0.200	0.200
		12.05	Utilities – Fuel wood	0.001	0.001
		14.02	S & M - Medicines & Laboratory Consumables	0.036	0.036
		15.05	Maintenance of Property – Equipment	0.210	0.210
		17.06	Op. Exp. - Items for Processing/Manufacturing	0.373	0.372
		52.07	Plant & Equipment. - Hospital/Lab. Equipment	0.100	0.099
			TOTAL OF FIC 0001	**1.120**	**1.118**
02			SCHEDULE PRODUCTION & DISTRIBUTION OF FROZEN SEMEM		
	0001		RGOB Financing		
		14.02	S & M - Medicines & Laboratory Consumables	1.588	1.588
		15.05	Maintenance of Property – Equipment	0.030	0.030
		45.02	Training – Others	0.100	0.070

		52.07	Plant & Equipment. - Hospital/Lab. Equipment	0.300	0.266
			TOTAL OF FIC 0001	**2.018**	**1.954**
02			**ANIMALS MAINTAINED FOR SEMEN EMBRYO PRODN**		
	0001		RGOB Financing		
		14.03	S & M - Fertilizers, Chemicals, Manures, Inoculants	0.050	0.049
		14.04	S & M - Seeds, Seedlings	0.021	0.021
		14.05	S & M - Animal Feeds	0.500	0.500
		17.06	Op. Exp. - Items for Processing/Manufacturing	0.130	0.130
		52.06	Plant & Equipment. – Livestock	0.070	0.044
			TOTAL OF FIC 0001	**0.771**	**0.744**
02			**PROFESSIONAL SERVICE SUPPORT ET TECHNOLOGY**		
	0001		RGOB Financing		
		14.01	S & M - Office Supplies, Printing, Publications	0.022	0.022
			TOTAL OF FIC 0001	**0.022**	**0.022**
			DAIRY PRODUCTION RESEARCH SERVICES		
	0001		RGOB Financing		
		11.01	Travel – In country	0.050	0.049
		14.01	S & M - Office Supplies, Printing, Publications	0.010	0.010
		14.02	S & M - Medicines & Laboratory Consumables	0.027	0.027
		17.08	Op. Exp. – In country Meetings and Celebrations	0.027	0.027
			TOTAL OF FIC 0001	**0.114**	**0.113**
3			**DAIRY POST PRODUCTION RESEARCH SERVICES**		
	0001		RGOB Financing		
		11.01	Travel – In country		
		14.01	S & M - Office Supplies, Printing, Publications		
		14.02	S & M - Medicines & Laboratory Consumables	0.030	0.030
		17.08	Op. Exp. – In country Meetings and Celebrations	0.001	0.001
			TOTAL OF FIC 0001	**0.031**	**0.031**
			RESEARCH COMMUNICATION SERVICES		
4	0001		RGOB Financing		
		11.01	Travel – In country	0.050	0.049
		14.01	S & M - Office Supplies, Printing, Publications	0.025	0.025
		17.08	Op. Exp. – In country Meetings and Celebrations	0.025	0.025
		17.09	Op. Exp. - Survey/Census	0.050	0.050
			TOTAL OF FIC 0001	**0.150**	**0.149**
			TOTAL OF Programs	**20.289**	**20.082**

8. VISITORS TO NDRC

8.1 DELEGATES FROM DLD THAILAND

Five officials from Department of Livestock Development (DLD) Thailand led by Mr. Tossaporn Srisakdi, Deputy Director General visited National Dairy Research Center, Yusipang on 23rd August 2017. The team visited the Semen Processing and Embryo Transfer (ET) laboratory to see the ongoing activities being carried out. Later the team had a meeting with the technical staffs from the center where they discussed on future collaboration and Research works. The meeting also discussed about new projects and further collaboration on Embryo Transfer, breed improvement program and training's related to dairy processing and value addition.

8.2 HON'BLE LYONPO'S VISIT

Hon'ble Lyonpo, Minister, Ministry of Agriculture & Forests visited National Dairy Research Centre, Yusipang on 11th July 2017 for the review of the activities that are being undertaken by the Centre. He met with the staffs and discussed the issues related on the Dairy Research of the center.

8.3 VISIT OF DIRECTOR GENERAL KOREAN INTERNATIONAL COOPERATION AGENCY

Korean International Cooperation Agency (KOICA) led by Mr. Seok Wong Yang, Director General of the World Friends Planning and Coordination Department visited National Dairy Research Centre, Yusipang on 4th July 2017. Discussion was held on the issues related to the international volunteer program and the JICA side briefed the delegates on how JICA has been implementing the JOCV and Senior Volunteer program in Bhutan. According to the KOICA team, the first Korean volunteer will be arriving by the end of December 2017. KOICA member also met with Ms. Yuka Nakanishi, JOCV who is working at NDRC as advisor on livestock and dairy product development.

8.4 Visit of Resident Coordinator, JICA

Resident Coordinator from Japan International Cooperation Agency visited the National Dairy Research Centre, Yusipang on 26th November 2017. During the meeting with technical staffs of the centre, progress and achievement of the attached JOCV was discussed. The contribution made by the Volunteer Ms Yuka Nakanishi in the field of dairy technology was very satisfying as expected.

During the meeting discussion was also made to explore the opportunity on Embryo Transfer Sr Volunteer from Japan as the Center is embarking on the Embryo transfer technology to boost the cattle breeding program and enhance dairy production in the country.

8.5 Staff in and out: Farewell Yuka

Ms Yuka Nakanishi, completes two year of her service at NDRC, Yusipang

Ms. Yuka Nakanishi, JOCV volunteer was attached with the Dairy Post Production Research Sector, National Dairy Research Centre for the past two years. During her tenure with the DPPRS she was involved in the training of farmers and extension agents of various Dzongkhags in clean milk production, platform milk tests and yogurt production. She was also involved in the design of packaging materials for various yogurt plants along with designs for butter and cheese packaging materials.

Additionally, she has also provided designs for cover pages of various publications for other sectors of the NDRC as well as designing cover pages for the Annual Centre Report and brochures of the centre. On her completion of two years tenure, the centre organized a small farewell party for her with the NDRC family wishing her a successful life ahead.

9. WORKSHOP ABROAD BY NDRC OFFICIALS

9.1 DAIRY GENETICS TECHNICAL WORKING GROUP MEETING

A holistic dairy animal breeding guidelines needs to be developed for Asia to maximize productivity of dairy breeds, including fitness and adaptive traits. This will guide member countries to design simple, yet effective long-term dairy breeding strategies / models that are consistent with breeding goals of each country. Such guidelines that capture all aspects of breeding program including breeding design, information management, monitoring and evaluation, institution and capacity building, required policy and legislation will enable timely assessment of outcome and impact of dairy genetic improvement program.

Hence, Technical Working Group Meeting on Dairy Genetics was held from 22-24 May 2018 at Anand, India brought together 14 animal breeding experts from 11 Asian Countries including

Bhutan to agree on how to develop a guideline for sustainable dairy breeding for low-input production systems in Asia.

Meeting agreed that a diary breeding guidelines have to be developed with the following objectives:

- Enable member countries to devise pragmatic dairy breeding program for continuous genetic improvement of dairy breeds
- Guide member countries to improve productivity of individual animals in a herd without compromising with its adaptability to adverse environment
- Foster building of institution and develop institutional linkage for exchange of Germplasm, share knowledge, experience and expertise
- Support member countries to work out minimum parameters that needs to be recorded to manage animal breeding information system
- Help members countries to develop enabling policy and legislation in support of dairy breed improvement program

Meeting was hosted by Dairy Farming Promotion Organization (DPO), Thailand, FAO RAP Bangkok/Dairy Asia Platform and National Dairy Development Board of India, Anand.

9.2 RINDERPEST TABLE TOP EXERCISE FOR ASIA IN SRI LANKA

Dr. Lham Tshering, Animal Reproduction Specialist II, attended the Regional Table top exercise in Asia at Colombo, Sri Lanka from 13th to 15th March 2018. The Tabletop Exercise of Asian countries were focus on a simulated outbreak of Rinderpest in Asia and involve key personnel discussing a simulated scenario. Exercise on the use of current plans, policies, training and procedures were discussed among the member countries as it was the draft plan. The group discussions were mainly focused on the emergency management cycle for Rinderpest to Prepare, Prevent, Detect, Respond and Recovery from the draft Global Rinderpest Action Plan.

The official declarations of global freedom from Rinderpest were made during the Food and Agriculture Organization of the United Nations (FAO) conference and the World Organization for Animal Health (OIE) in 2011. The Global Rinderpest Action Plan(GRAP) prepared jointly by FAO and OIE aims to ensure continued global freedom from Rinderpest by outlining the actions that should be taken in the event of a Rinderpest outbreak, and is the global operational plan that compliments all other international, contingency plans.

Bhutan has no National Contingency plan for Rinderpest in place and as such a national contingency plan for Rinderpest is to be prepared by the focal agency on Animal health based on the Global Rinderpest Action Plan. The table top exercise was attended by 12 Asian countries of Bangladesh, Bhutan, China, India, Japan, Kazaskthan, Mongolia, Pakistan, Republic of Korea, Russian federation, Sri Lanka and Vietnam.

10. STAFF DIRECTORY

ANNEXURE 1: DAIRY FARMERS GROUPS

Dairy Farmer Groups (DFG) as of June 2017		
Dzongkhag	**No. DFG**	**DFG Members**
Bumthang	6	398
Chukha	6	153
Dagana	10	192
Gasa	4	113
Haa	12	370
Lhuentse	6	91
Mongar	12	247
Paro	11	359
Pemagatshel	7	303
Punakha	19	307
Samdrup Jongkhar	10	643
Samtse	15	328
Sarpang	2	124
Thimphu	12	158
Trashigang	33	748
Trashiyangtse	3	82
Trongsa	10	346
Tsirang	3	94
Wangduephodrang	10	363
Zhemgang	3	70
	196	**5,489**

Dairy Farmer Cooperative as of June 2017	
Dzongkhag	**Members**
Haa	141
Mongar	45
Samdrup Jongkhar	97
Thimphu	110
Trashigang	50
	443

ANNEXURE 2: ESTROUS SYNCRONIZATION DETAILS

Sl. no.	Geog	Animals examined (no.)	Animals synchronized (no.)	A.I performed (no.)	Dzongkhag Unit
1	Dogar	9	9	6	Paro
2	Luni	15	6	6	
3	Naja	24	17	9	
4	Shapa	6	5	5	
5	Shari	7	3	5	
	Sub-total	***61***	***40***	***31***	
6	Daga	43	31	31	Wangdue
7	Phangyul	36	26	24	
	Sub-total	***79***	***57***	***55***	
8	Kikorthang	33	21	15	Tsirang
9	Gosaling	9	5	4	
10	Tsholingkhar	1	1	1	
11	Rangthangling	7	5	3	
12	Mendrelgang	8	5	3	
13	Phuentenchu	4	2	2	
	Sub-total	***62***	***39***	***28***	
14	Sergithang	93	72	79 (7 NH*)	
15	Barshong	103	76	83 (7 NH*)	
	Sub-total	*196*	*148*	*162 (14 NH*)*	
16	Gelephu	7	4	3	Sarpang
17	Dekiling	8	1	1	
18	Gakiling	9	5	3	
	Sub-total	***24***	***10***	***7***	
19	Tading	206	157	164 (7 NH*)	Samtse
20	Tang/Wabtang	35	11	16	Central farms
21	BS Farm	91	36	25	
22	CRC Wangkha	17	13	14	
23	NDRC, Yusipang	10	10	10	
24	Soelbum herd, Lhuentse	36	25	20	
	Sub-total	***189***	***95***	***85***	
	Total	**817**	**546**	**532**	

ANNEXURE 3: AI CENTRES & PROGENY BORN RECORD

Dzongkhags	***AIOS (Active)***	***AI***	***Progeny (P)***			**Success rate * (%)**	**Avg. AI (nos)**
			M	***F***	***Total progeny***		
Thimphu	DVH Ramtokto	141	99	94	193	136.9	11.8
	Khasadrapchu	61	10	9	19	31.1	5.1
	Kawang	19	1	2	3	15.8	1.6
	Genekha	6	7	14	21	350.0	0.5
	Tshaluna/Bjemina	98	19	18	37	37.8	8.2
	NDRC, Yusipang	72	5	13	18	25.0	6.0
Sub-Total	**5**	397	141	150	291	**73.3**	**6.6**
Paro	DVH Wangchang	317	16	26	42	13.2	26.4
	Tshentog	37	3	3	6	16.2	3.1
	Lamgong	6	0	0	0	0.0	0.5
	Shari	136	15	15	30	22.1	11.3
	Dawakha	41	0	4	4	9.8	3.4

	Shaba	99	14	18	32	32.3	8.3
	Luni	91	11	14	25	27.5	7.6
	Dogar (suspended)	0	0	0	0	0.0	0.0
	Doteng	79	21	20	41	51.9	6.6
	Naja	66	0	0	0	0.0	5.5
Sub-Total	**9**	872	80	100	180	**20.6**	**8.1**
Haa	DVH Tshelungkha	39	18	15	33	84.6	3.3
	Bjee/Yangthang	0	0	0	0	0.0	0.0
	Katsho	102	9	16	25	24.5	8.5
Sub-Total	**3**	141	27	31	58	**41.1**	**3.9**
Chukha	DVHTsimasham	3	0	0	0	0.0	0.3
	Bongo/Drala	73	16	16	32	43.8	6.1
	Sampheling	210	54	96	150	71.4	17.5
	Phuntsholing	68	12	20	32	47.1	5.7
	CRC - Wangkha	61	13	13	26	42.6	5.1
Sub-Total	**4**	415	95	145	240	**57.8**	**8.6**
Samtse	DVH Samtse	43	5	39	44	102.3	3.6
	Changmari/Norbugang	24	6	7	13	54.2	2.0
	Chargarey/Sangachholing	9	1	2	3	33.3	0.8
	Ugyentse	35	13	10	23	65.7	2.9
	Yoseltse	67	25	16	41	61.2	5.6
	Tashicholing	70	10	11	21	30.0	5.8
	Dophuchen	32	0	2	2	6.3	2.7
	Tendu	18	8	4	12	66.7	1.5
	LEC- Gomtu/ Phuntshopelri	0	0	0	0	0.0	0.0
	LEC- Buduney	50	2	2	4	8.0	4.2
	Tading	164	0	0	0	0.0	13.7
	NJBC- Samtse	150	19	21	40	26.7	12.5
Sub-Total	**10**	662	89	114	203	**30.7**	**5.5**
Wangdue	DVH Petakarpo	75	9	11	20	26.7	6.3
	Gaselo/Gumina	126	15	17	32	25.4	10.5
	Phobjikha	44	9	11	20	45.5	3.7
	Sephu (suspended)	0	0	0	0	0.0	0.0
	Phangyul/ Katikha	38	2	5	7	18.4	3.2
	Bjena	5	0	0	0	0.0	0.4
	Nysho/Samtegang	8	0	0	0	0.0	0.7
Sub-Total	**6**	296	35	44	79	**26.7**	**4.1**
Punakha	DVHPunakha	146	26	34	60	41.1	12.2
	Samdingkha	132	27	23	50	37.9	11.0
	Talo	47	3	6	9	19.1	3.9
	Thinlaygang/Toeb	54	1	7	8	14.8	4.5
	Kabjesa	124	19	23	42	33.9	10.3
	Baap	12	2	0	2	16.7	1.0
	LEC -Shengana	35	6	7	13	37.1	2.9
	CNR, Lobesa	19	12	6	18	94.7	1.6
Sub-Total	**7**	569	96	106	202	**35.5**	**6.8**
Tsirang	DVH Damphu	179	43	75	118	65.9	14.9
	LEC- Gosarling	111	19	35	54	48.6	9.3
	LEC- Mendrelgang	47	10	15	25	53.2	3.9
	Tsirangtoe	45	8	9	17	37.8	3.8
	Barsong	83	0	0	0	**0.0**	**6.9**
	Sergithang	79	0	0	0	**0.0**	**6.6**
Sub-Total	**4**	544	80	134	214	**39.3**	**11.3**
Dagana	Dagapela	45	1	0	1	2.2	3.8
	Drujegang	49	14	10	24	49.0	4.1
	Lhamoizingkha	47	0	1	1	2.1	3.9
	LEC- Tsangkha	3	1	1	2	66.7	0.3
Sub-Total	**4**	144	16	12	28	**19.4**	**3.0**
Gasa	DVH Gasa	30	2	2	4	13.3	2.5
	Damji	45	10	6	16	35.6	3.8
Sub-Total	**2**	75	12	8	20	**26.7**	**3.1**
Bumthang	DVH Bumthang	23	5	3	8	34.8	1.9
	Thangbi	17	1	2	3	17.6	1.4
	Chumey	29	4	6	10	34.5	2.4
	Mesithang	166	27	15	42	25.3	13.8
	Ura	3	0	0	0	0.0	0.3
	BS Farm - Bumthang	72	17	25	42	58.3	6.0
Sub-Total	**5**	310	54	51	105	**33.9**	**5.2**
Trongsa	DVH Sherabling	32	52	15	67	209.4	2.7
	Kuengarabten	33	9	11	20	60.6	2.8

	Langthel (suspended)	0	0	0	0	0.0	0.0
	Tangsibji/Trashiling	89	42	54	96	107.9	7.4
	Nimsong	0	0	0	0	0.0	0.0
Sub-Total	**4**	154	103	80	183	**118.8**	**3.2**
Zhemgang	DVH Trong	78	20	42	62	79.5	6.5
	Panbang	40	7	2	9	22.5	3.3
	Buli	19	0	13	13	68.4	1.6
	Pantang	14	0	6	6	42.9	1.2
	LEC- Tingtibi	13	4	6	10	76.9	1.1
Sub-Total	**5**	164	31	69	100	**61.0**	**2.7**
Sarpang	DVH Sarpang	24	2	3	5	20.8	2.0
	LEC - Gelephu	245	30	51	81	33.1	20.4
	LEC - Dekiling	78	8	7	15	19.2	6.5
	LEC- Chuzagang	37	0	0	0	0.0	3.1
	LEC- Sersong	2	0	0	0	0.0	0.2
Sub-Total	**5**	386	40	61	101	**26.2**	**6.4**
Monger	DVH Monger	246	24	17	41	16.7	20.5
	Chali	0	1	1	2	0.0	0.0
	Ngatshang	232	30	25	55	23.7	19.3
	Sherimuhung (suspended)	0	0	0	0	0.0	0.0
	Chaskhar	451	55	47	102	22.6	37.6
	Drametse	5	2	2	4	80.0	0.4
	Thangrong (suspended)	0	0	0	0	0.0	0.0
	Drepong	41	12	7	19	46.3	3.4
	Tsamang	27	10	0	10	37.0	2.3
	Narang (suspended)	0	0	0	0	0.0	0.0
Sub-Total	**7**	1002	134	99	233	**23.3**	**11.9**
Lhuntshe	DVH Gangzore	26	6	6	12	46.2	2.2
	Tangmachu (suspended)	0	0	0	0	0.0	0.0
	Khoma	12	2	2	4	33.3	1.0
	Menji	5	2	1	3	60.0	0.4
Sub-Total	**3**	43	10	9	19	**44.2**	**1.2**
Tashiyangtse	DVH T/Yangtse	35	11	20	31	88.6	2.9
	Khamdang	77	7	8	15	19.5	6.4
	Bumdeyling	2	0	0	0	0.0	0.2
	Tongshang	8	8	8	16	200.0	0.7
	Jamkhar	6	2	1	3	50.0	0.5
Sub-Total	**5**	128	28	37	65	**50.8**	**2.1**
Trashigang	DVH Samkhar	125	15	18	33	26.4	10.4
	Radhi	33	0	0	0	0.0	2.8
	Bartsham	82	9	21	30	36.6	6.8
	Yangneer	95	12	9	21	22.1	7.9
	Kanglung	117	17	11	28	23.9	9.8
	Khaling	52	4	4	8	15.4	4.3
	Bikhar	16	1	5	6	37.5	1.3
	Phongmay	20	0	0	0	0.0	1.7
	RNR-EC Bidung	36	0	0	0	0.0	3.0
	RNR-Changmay	51	14	15	29	56.9	4.3
	Lumang	11	1	2	3	27.3	0.9
Sub-Total	**11**	638	73	85	158	**24.8**	**4.8**
Pemagatshel	DVH Shumar	105	12	15	27	25.7	8.8
	Zobel	16	2	2	4	25.0	1.3
	Tshebar	3	3	3	6	200.0	0.3
	Nangkhor	140	16	26	42	30.0	11.7
	Yurung	69	20	23	43	62.3	5.8
	Tshelingkhor	13	2	0	2	15.4	1.1
	LEC- Nanong (new CAIT)	68	0	0	0	0.0	5.7
	CAIT- Norbugang (new CAIT)	36	0	0	0	0.0	3.0
Sub-Total	**6**	450	55	69	124	**27.6**	**6.3**
S/Jongkhar	Deothang	155	6	11	17	11.0	12.9
	Orong	62	14	23	37	59.7	5.2
	Phuntshothang	36	0	0	0	0.0	3.0
	LEC- Martshala (suspended)	9	0	0	0	0.0	0.8
	Gomdar	53	0	0	0	0.0	4.4
Sub-Total	**4**	315	20	34	54	17.1	6.6
Grand Total	**109**	7705	1219	1438	2657	**34.5**	**5.9**

ANNEXURE 4: CHBPP IMPLEMENTED DZONGKHAGS & GEOGS

Sl #	Dzongkhag	CHBPP Geog
1	Bumthang	Chokhor & Tang
2	Trongsa	Tangsibjee & Nubi
3	Zhemgang	Trong, Nangkhor & Buli
4	Sarpang	Dekiling, Gelephu, Sompangkha & Gakiling
5	Lhuntse	Menbi and Menji
6	Mongar	Chaskhar, Tsamang, Mongar & Ngatshang
7	Tashigang	Shamkhar & Kanglung
8	Tashi Yangtse	Yangtse
9	Pemagatshel	Shumar, Yurung
10	Samdrup Jongkhar	Dewathang, Orong & Shamkhar
11	Gasa	Goenkhatoe
12	Punakha	Baap & Guma
13	Wangdue	Gasetshogom & Gasetshowom
14	Tsirang	Gosaling, Kikorthang, Rangthangling & Tsholingkhar
15	Dagana	Gaserling, Goshi, Tashiding, Lhamoizingkha & Tshendagang
16	Thimphu	Chang & Mewang
17	Paro	Shari, Shari, Lamgong, Luni, Shapa Wangchang, Naja Dogar & Hungreal
18	Haa	Bjee
19	Chukha	Darla, Sampheling & Phuentsholing
20	Samtse	Samtse, Ugyentse, Yoseltse & chengmari

ANNEXURE 6: DISTRIBUTION PLAN FOR LOCALLY PRODUCED SEMEN

Sl #	Bull NBIN	Dam	Sire no (name)	Grand sire (maternal)	Grand sire (paternal)	Distribution Plan (2012 - 15)	Distribution Plan (2015 -18)	Distribution Plan (2018 - 2021)
1	**14001067 (Stock nil)**	3513	185 (from Orrisa)					
2	**14001092**	3437/6	94438	Royals Greem Ella 76	Tinopai Dantes Pet SJ3	**West Central**	**Eastern**	
4	**12000262 (Stock nil)**	12000076	111480263	Molly Brook Berretta Flyer	Mason Boomer Sonner berretta	**Western**	**West Central (2015 - 2016)**	
3	**14001091**	10	66547	MVF Bold Venture Danial	Bold Venture	**Eastern**	**West Central (2017 - 2018)**	
5	**12000276 (Stock nil)**	12000083	111249864	Barbs MBSB Decio	Mason Boomer Sonner berretta	**East Central**		
6	**12000401**	12000054	112251008	Schultz Brook Hallmark	Molly Brook Brass Major		**Western**	**Eastern**
7	**01000295 (Stock nil)**	01000130	112084376	H & B Alf Pargon ET	Comfort Royal Alf ET		**East Central (2015-2016)**	
8	**12000359**	12000054	112251008	Schultz Brook Hallmark	Molly Brook Brass Major		**East Central (2017-2018)**	**West Central**
9	**12000454**	12000384	112990549	Long Distance Barber Barkly	WF/L&M Duncan ET			**East Central**
10	**12000457**	12000147	111249864	Barbs MBSB Decio	Mason Boomer Sonner berretta			**Western**

Note

1. Eastern: RLDC, Kanglung (Lhuntse, Mongar, Pema Gatsel, S/Jongkhar, Trashigang, Trashiyangtse)
2. East Central: RLDC, Zhemgang (Bumthang, Sarpang, Trongsa, Zhemgang)
3. West Central: RLDC, Wangdue (Dagana, Gasa, Punakha, Tsirang, Wangdue)
4. Western: RLDC, Tshimasham (Chukha, Haa, Paro, Samtse, Thimphu)

ANNEXURE 6: DISTRIBUTION PLAN FOR PROGENY TESTED SEMEN (JERSEY)

DISTRIBUTION PLAN FOR IMPORTED PROGENY TESTED SEMEN (JERSEY)(2012-2021)

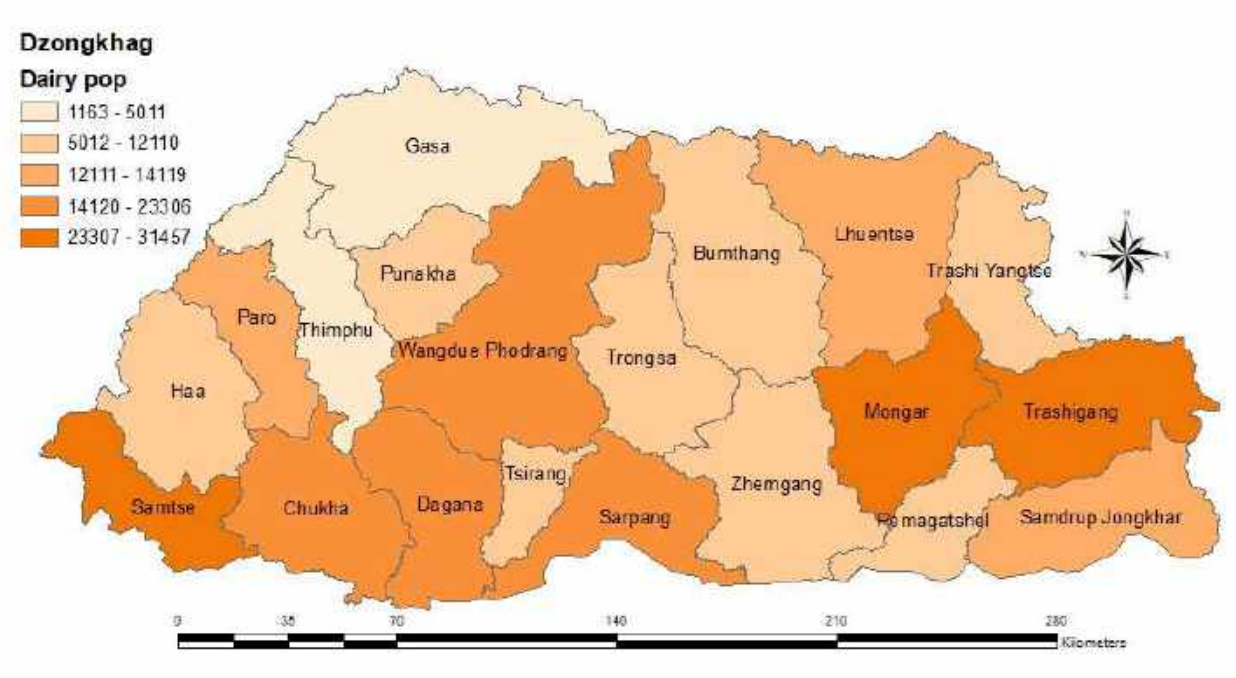
Sl #	Bull #	Bull code	Bull name	Distribution Plan (2012 - 2015)	Distribution Plan (2015 - 2018)	Distribution Plan (2018 - 2021)
1	112894928	014JE00408	FOREST GLEN VD JADES JIMMIE-ET	Eastern		
2	115969078	14JE00524	SR BLUEPRINT PLAN	East Central + Blood line B (NJBC)		
3	114245720	007JE00821	MAACK DAIRY SPECTACULAR -ET	Blood line C (NJBC)		
4	115479838	007JE00968	DUTCH HOLLOW GAVIN -ET	Western		
5	115547683	007JE00988	SUN VALLY JEWELER ARROW-ET	West Central + Blood line A (NJBC)		
6	UK103789 300352	J2215	SHELLEN PRECISION		Western	
7	UK927007 143183	J2216	LAGANGREEN ROY BOY		East Central + Blood line B (NJBC)	
8	UK283178 400661	J2072	PARKPLACE FLAGSHIP ET		West Central + Blood line A (NJBC)	
9	UK103789 400346	J2214	SHELLEN ENGAGE		Eastern + Blood line C (NJBC)	
10	UK030003 400852	J2276	HOME FARM STUARTS BEES KNEES		Eastern	
	C541	007JE01267	SUNSET CANYON DEPUTY-ET			EAST CENTRAL
	C564	007JE01335	SUNSET CANYON JORDACHE-ET			NJBC (Bloodline A)
	4544	007JE01219	DUTCH HOLLOW OLIVER-P			NJBC (Bloodline B)
	G650	007JE01184	GLYNN HEADLINE NEWS-ET			NJBC (Bloodline C)
	C428	007JE01150	SUNSET CANYON DIGNITARY-ET			WESTERN
	440	007JE01342	RIVER VALLEY SALINA SPEED			
	D1503	007JE01337	DP PARKER			EAST CENTRAL
	4369	007JE01173	DUTCH HOLLOW PRESCOTT {6}-ET			EASTERN
	1045	014JE00568	TOLLENAARS HEADLINE LOU-ET			WEST CENTRAL
	79422	014JE00650	JX FARIA BROTHERS CHEEZ {3}-ET			

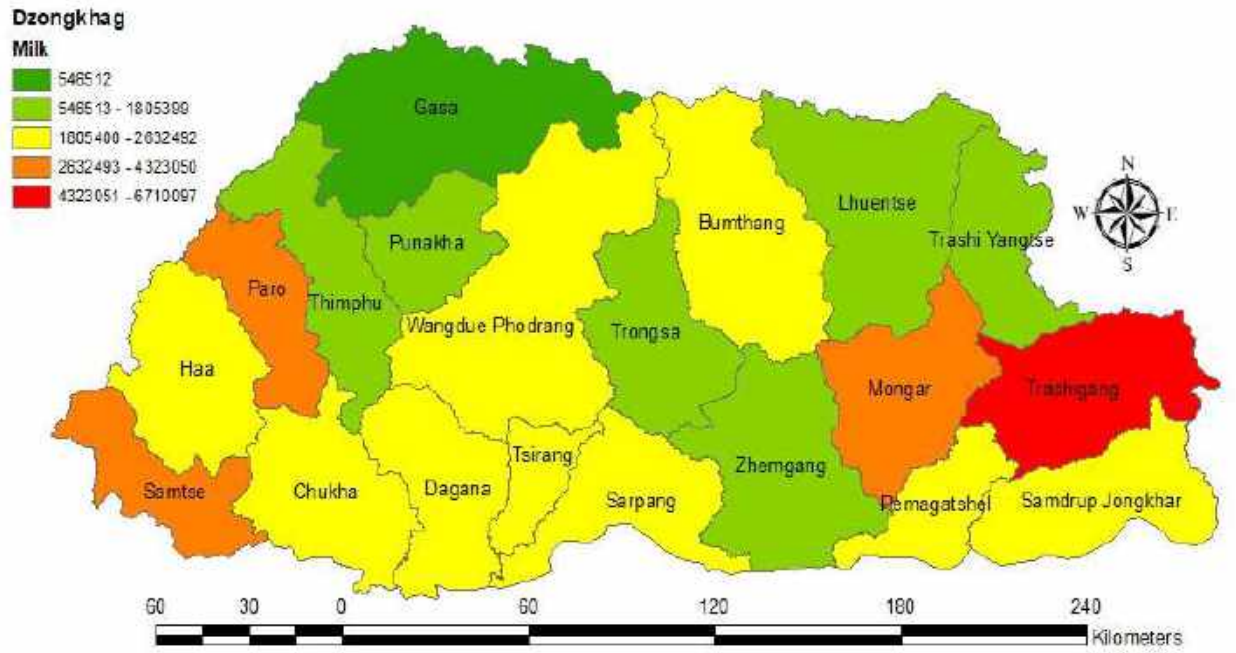
Note

1. Eastern: RLDC, Kanglung (Lhuntse, Mongar, Pema Gatsel, S/Jongkhar, Trashigang, Trashiyangtse),
2. East Central: RLDC, Zhemgang (Bumthang, Sarpang, Trongsa, Zhemgang)
3. West Central: RLDC, Wangdue (Dagana, Gasa, Punakha, Tsirang, Wangdue)

Average price/ dose of imported Progeny Tested Semen US$4.7, Imported Sex Sorted Semen US$23

Map showing Cattle Population of 2017





YOGURT

YOGURT

Yogurt is a dairy product produced by the fermentation of milk using selective bacterial cultures. The bacteria used for the production of yogurt is known as yogurt cultures that ferments lactose into lactic acid and acts upon the milk proteins to produce the characteristic yogurt flavor and texture.

RAW MATERIALS REQUIRED

- Milk of very good quality (low acidity and low microbial count)
- Yogurt cultures (*Streptococcus thermophilus and Lactobacillus delbrueckii subsp. bulgaricus*)
- Skim milk powder or whey protein powder

Yogurt cultures

Skim milk powder

EQUIPMENTS REQUIRED

Yogurt vat

Cream separator

- Yogurt vat (heating up to 90 - 95°C)
- Cream separator
- Incubation chamber
- Cold storage
- Yogurt cups and lids

CONSTRAINTS FOR PRODUCTION

- Poor quality raw milk (high numbers of microbes)
- Contamination with bacteriophage
- Poor hygiene of production personnel
- Lack of good manufacturing practices
- Milk with antibiotic/antibiotic residues
- Poor hygiene in plant
- Post production contamination of product
- Poor HACCP control in plant

DETAILED MANUFACTURING PROCESS

Selection of Raw Materials

The raw milk selected for the product must support good growth of the culture and should be fresh, have normal milk composition, be free from mastitis and other diseases, be free from antibiotics and other inhibitors, be free from off-flavours and have low bacterial count. It is important to conduct all necessary platform tests on the milk supplied and to reject milk that fails the platform tests.

Standardization and pre-treatments

Standardization of milk to meet requirements for fat and SNF (Solids-not-fat) will have to be carried out by the manufacturer. Ideally, good quality set yogurt is obtained from milk having 13-15% total solids. Milk fat contributes to flavour and richness of the product. About 3% fat is sufficient to have good quality product, while SNF can be increased to 10-12% by supplementation with skim milk powder.

It is important to select ingredients of the highest quality to avoid contamination of milk and ensure a good end product.

Homogenization

Homogenization of the milk at 100 Kg/cm2 at 60-70 °C can be carried out as an optional step and is useful to provide uniform mixing of all raw materials, reduce the problem of fat separation in curd and improve gel stability.

However, the homogenizer and the interconnecting pipes can be an additional source of contamination if it is not properly cleaned it may add to the total micro flora of the milk.

Homogenizer

Heat treatment

The heat treatment destroys pathogenic microbes and makes the milk safe for human consumption and is considered as the critical control point (CCP) in HACCP program for yogurt. It is therefore important to ensure that after heat treatment, the milk should not get contaminated by extraneous microorganism. Milk for yogurt manufacture must be heated to and held at one of the following time temperature combinations: 80°C for 30 minutes or 85°C for 20 minutes or 90°C for 10 minutes or 95°C for 5 minutes

This high heat treatment is also useful for supporting good growth of the culture as it destroys other competing micro flora giving free ground for the starters to proliferate. It also inactivates natural inhibitory substances in milk, produces some growth stimulating agents for starters and denatures whey proteins to improve gel stability

Inoculation

After heating, the milk is cooled to the incubation temperature of 42-45°C for addition of starter culture. Inoculation of starter culture should be carried out as fast as possible to prevent the growth of unwanted microbes. The inoculated milk should be uniformly mixed prior to filling in containers.

The milk is inoculated with active yogurt cultures comprised of *Streptococcus thermophilus and Lactobacillus delbrueckii subsp. bulgaricus* at the rate of 2% (v/v) of milk. Usually both the cultures are added in equal proportion (1% each).

Filling in retail packs

The inoculated milk is filled in retail containers before incubation. The packing material must efficiently be treated, sanitized to minimize contamination as risk of mould and bacterial spores decreases shelf-life.

Incubation

Incubation temperature should be kept 42 - 45°C. The period of incubation varies between 3 - 6 hours depending upon the rate of acid production by the culture in the milk. However, the best end point to stop fermentation is just after the milk sets. Setting takes place at about 0.6% acidity and the remaining acidity required in the product can develop while cooling. During incubation, the milk is very sensitive to mechanical disturbances and other changes. Hence, it should not be disturbed.

Cooling

As soon as the curd sets or desired acidity in the product is achieved, it must be cooled. Cooling is done to reduce the rate of multiplication of starter cultures and stop their growth at the end of cooling. This is essential to avoid over acidification in the product.

The rate of cooling affects the quality characteristics of the product and should be decided according to the per cent lactic acid expected in the final product. Rapid cooling may lead to more contraction of gel and separate more whey, while too slow cooling may sour the product. In yogurt, two stage cooling is preferred, i.e. in first stage cooling from 42°C to 20°C and in the second stage from 20°C to 5°C in cold store.

Storage

The yogurt must be stored at less than 5°C to ensure growth inhibition of starters and non-starter microorganism. Temperature fluctuations or temperature increases during storage will promote the growth of culture as well other microorganisms and will make the product sour or produce other defects. Hence, maintenance of temperature during storage is very important. The distribution of the finished product should always be through cold-chain facilities.

A good quality yogurt has shelf-life of 2-3 weeks at 5°C.

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