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NATIONAL DAIRY RESEARCH AND DEVELOPMENT CENTRE
DEPARTMENT OF LIVESTOCK
MINISTRY OF AGRICULTURE & FORESTS
YUSIPANG, THIMPHU






ANNUAL CENTRE REPORT
2018-2019

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Lokey Thapa
NDRDC, Yusipang

FROM THE PROGRAM DIRECTOR'S DESK

This is the 3rd Annual Centre Report of NDRDC Yusipang, published to highlight progress made and challenges faced while implementing National Dairy R&D Program during the fiscal year (FY) 2018-19.

To keep up the momentum of accelerated dairy development, NDRDC as always is playing a pivotal role. During current FY processing of frozen semen is at an all-time high with 30,628 doses produced/cryopreserved (13% increase to 2017-18). In addition 50,693 liters of LN_2 is produced and 35,557 liters (70%) distributed along with required 13,918 doses of semen to AI Outreach Centers.

In search of resilient dairy cattle breed for Bhutan, Progeny Testing Scheme with premium Thai Holstein semen (four sire lines) is continued in three AEZ of Bhutan. Engagement of Community AI Technician (CAIT) of the locality (trained/deployed during this FY) is added intervention for the scheme's success.

To strengthen dairy value chain, expert of this centre imparted training on Good Hygienic Practice and Good Manufacturing Practice for milk and milk products. Livestock staff of Samtse and representative of Yoeseltse Jersey Detshen received Training of Trainers course on dairy product processing and over 168 farmers from Gasa, Haa and six eastern Dzongkhags were trained on product diversification. Besides, breeding experts trained 26 Community AI Technicians (CAIT) from Tsirang, Dagana, Trongsa and Samtse and provided refresher course to 17 CAIT of eastern Dzongkhags. To improve proficiency on artificial breeding, refresher courses were provided to 46 Livestock staff/AI Technicians of western and west central region in two batches.

To reinforce knowledge management, apart from Annual Centre Report, two technical guidebooks developed and four scientific papers published in Bhutan Journal of Animal Science (BJAS).

Despite severe constraints faced owing to aging of pool vehicle to transport LN_2 for sustenance of cattle breeding program; progress made by this centre is noteworthy. Thus in our quest to ensure rural prosperity, however bumpy ride it might be, NDRDC team remains committed to fulfill national aspirations.

Tashi Delek!

(Dr. N.B.Tamang)
PROGRAM DIRECTOR

EXECUTIVE SUMMARY

National Dairy Research & Development Centre (NDRDC), Department of Livestock is gearing to enhance dairy product self-sufficiency through organized and focused approach to Dairy Research and Development (R&D) in the country.

NDRDC is publishing the Annual Report (2018-19) to share success stories and lessons 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 is very vital for success of cattle breeding program in the country. Inputs produced at the centre include liquid nitrogen (LN_2) and frozen semen. During the FY 30,628 doses of semen was produced which is approximately 13% higher than last year. Besides, the centre imported 10,500 doses of Jersey progeny tested semen 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 6 viable embryos from elite donor cows and six of them were transferred to surrogate recipient cows. Similarly, 50,682liters of $LN_2$was produced and 35,557liters were distributed to Dzongkhags. The distribution of LN_2 to AI Outreach Centreshas to be carried out every 45 days to ensure preservation of frozen semen.

To feed the donor bulls and ET cows (44 heads), fodder unit has established around 2.0 acre of improved pasture, renovated 20 acres of existing pasture and conserved 115 MT of winter fodder in the form of hay/silage. Technical manpower support was also provided to Royal cattle herds, Ramtokto, and 8 acres of new pasture was established for the Royal Chipta Farm at Taba.

To improve reproductive efficiency of village herds, estrous synchronization and fixed time AI were conducted. Intotal of 350animals were synchronized. Approximately 86% of the dairy animals responded to treatment. Of the 346 inseminations, 130 AI were with Thai Holstein semen among the Progeny Testing Scheme implemented areas of Samtse (Tading Geog) and Tsirang (Barshong and Sergithang Geogs), and 216 AI were with Jersey semen.

Multiplier herd (Community based Heifer and Bull Production Scheme) to boost heifer/bull production through use of imported semen is expanded and cover over 5,789 HHand5,800 animals in 55 Geogs(cumulative). Artificial Insemination (AI) performance and progeny recorded for the FY was 8,217 AI with progeny record of 2,853(1,250 male and 1,603 female). Cumulative AI done as of 2019 from (1987 – 2019) is 175,426 and progeny record is 56,190.

To improve animal recording system for traceability and herd improvement, National Cattle Information System (NCIS) was expanded in 3 Geogs during the FY. The number of household under NCIS increased to 6,270 from 6,189 an increase of 81 households. The number of animals with NCIS increased to 11,706 an increase of 155 during the fiscal year.

As of now the NCIS is carried out in 118 Geogs and CHBPP in 55 Geogs covering all 20 Dzongkhag.

Research conducted during the FY includes Effect of Dairy Management and Feeding on Income and Milk Production, Compositional Analysis of Market Milk, Butter &*Datshi,*Milk Production of Cattle Breeds in three Agro-Ecological Zones in Western Bhutan and Assessment of Contract Heifer & Bull Production Program in west and west central region. Research on Progeny testing scheme initiated in the 2017 – 2018 was continued and is still ongoing for development of resilient dairy breed for Bhutan covering three Agro-ecological Zone of Tsirang and Samtse.

To strengthen dairy value chain, officials of this centre imparted training on Good Hygienic Practice and Good Manufacturing Practice for milk and milk products. More than 168 farmers of the Gasa, Haa and six eastern Dzongkhag were trained on product diversification. Livestock staff of Samtse and representative of Yoeseltse Jersey Detshen received Training of Trainers course on dairy product processing

During the fiscal year, in support of breed intensification program the Centre conducted refresher courses for 46 AI Technicians (21 from Western and 25 AITs from Western Central regions).Refinement of skills, advancement of knowledge and to keep abreast with latest techniques in cattle reproductive biotechnologies.

NDRDC organized training of 26 Community Artificial Insemination Technician (CAIT) trainings at Tading Geog (10 CAITs) for Samtse Dzongkhag and at Barshong Geog for Tsirang and Dagana Dzongkhag (10 CAITs) and Trongsa Dzongkhag (6 CAITs). Since its inception in 2010, 126CAITs are trained.

The centre published Annual Central Report 2017 – 2018, Training Manual for Artificial Insemination and Reproductive Management and Standard Operating Procedure for Semen Processing Laboratory. These documents can be downloaded by visiting our website (www.moaf.gov.bt).The Centre also published four articles in the Bhutan Journal of Animal Science Volume 3 Issue 1 for communication to clients and scientific community.

Of the Nu. 38.465 M allocated to the centre, a sum of Nu. 37.916 M was gainfully utilized with an achievement of 98.57 percent.

With every passing year, NDRDC remains committed to making consistent efforts to generate and effectively disseminate appropriate technologies/better farming practices and strives to make dairy farming an attractive and prosperous venture.

TABLE OF CONTENTS


ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture and Forests
Department of Livestock
DOL
ARTIFICIAL INSEMINATION REFRESHER COURSE FOR WEST CENTRAL REGION
Organizers: NDRDC, Yusipang, Thimphu
RLDC, Wangdue & Dzongkhag Livestock Sector, Tsirang
Venue: Mendrelgang, Tsirang
Date: 22nd April - 5th May, 2019
Funded by
GEF / LDCF Project, MoAF, Thimphu

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 and Development Centre (NDRDC) 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

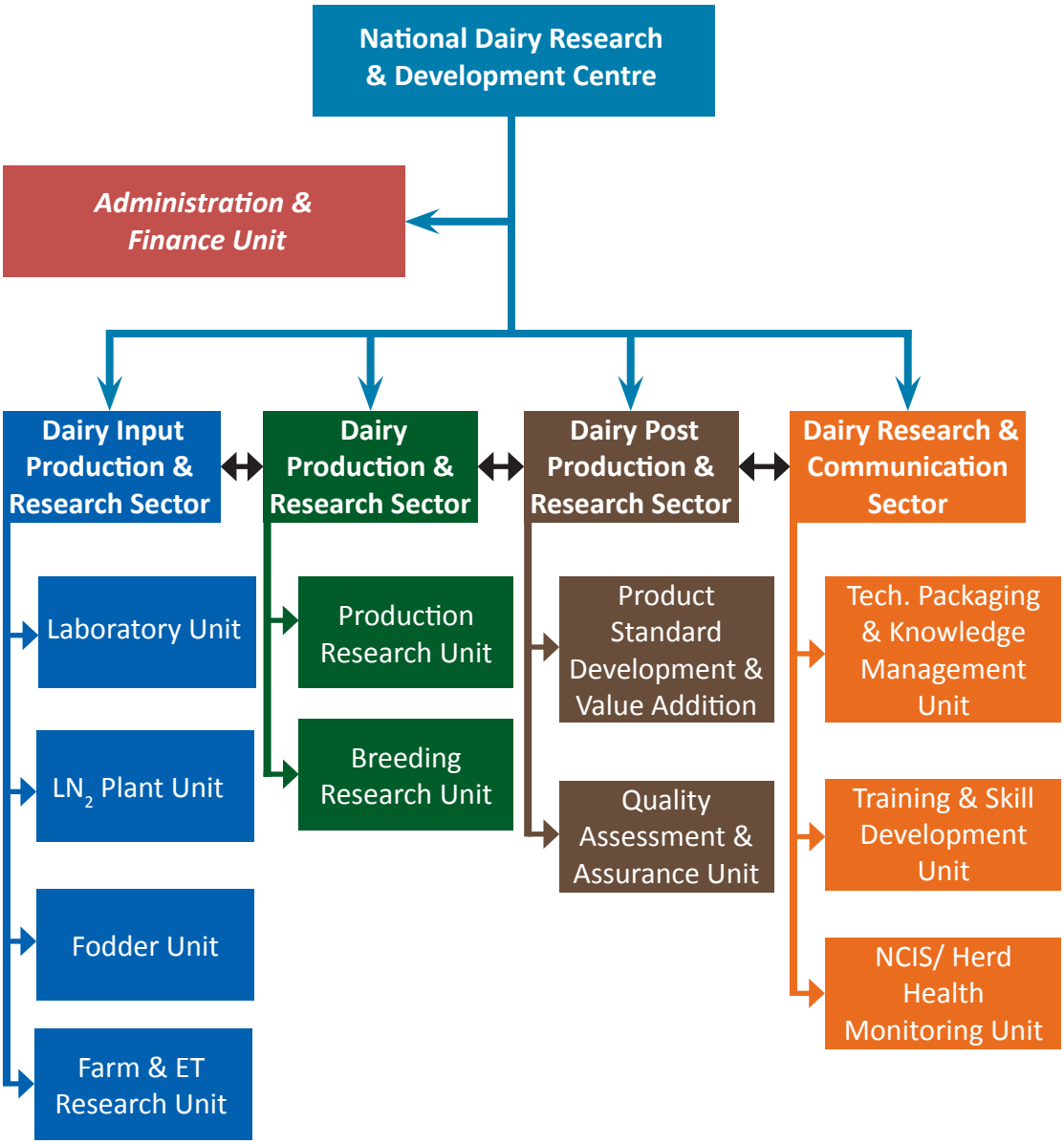
2.4 Mandate

- 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 & DEVELOPMENT SECTOR

4.1.1 Liquid Nitrogen (LN_2) Plant Unit

The Liquid Nitrogen Unit operates a Sterling Cryogenic LN_2 plant with a production capacity of 10 litres per hour. The LN_2 distribution meets the scheduled 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 for 6 Dzongkhags. At Present, the production capacity is 6 – 7 litres per hour. The details of LN_2 produced and distributed to three RLDCs are presented below (Table 1). A total of 15,685 litters was distributed to RLDC, Tsimatsham, 10,024 litters to RLDC Wangdue and 9,848 litters to RLDC Zhemgang totalling to 35,557 litters of total distribution.

Table 1: Liquid Nitrogen produced &distributed

Sl.#	Activities	Quantity (Litres)
1	LN_2 Production	50,693.00
2	LN_2 Distribution	35,557.00
3	LN_2 for Semen Bank refilling	7,302.00
4	LN_2 for S. Processing & freezing	5,232.00
5	LN_2 Evaporation losses	2,048.00

4.1.2 Frozen Semen Processing Laboratory Unit

The laboratory unit produces frozen semen from four cattle breeds (Jersey, Mithun, Nublangand Brown Swiss) and distributes to all AI Outreach Centres in the country. During the fiscal year, a total of 30,628 doses of frozen semen were produced from different donor bulls and 8,630 doses were distributed to various Dzongkhags (**Table 2)**. The production of Jersey semen accounted for 25,306 doses and 7,150 doseswere distributed to various Dzongkhags. Similarly, Semen production from Nublang was 5,322 doses with distribution of 90 doses to various Dzongkhag. There was no production of Mithun because six numbers of young Mithun donor bulls were recently procured and are undergoing training.Around 25.8% of the semen produced was distributed to Dzongkhags through RLDCs during the fiscal year.

Table 2: Locally Produced Frozen Semen & Stock Balance

Species	Opening balance	Production	Distribution	Balance
Jersey	71,006	25,306	7,890	88,422
Mithun	19,128	0	650	18,478
Nublang	23,871	5,322	90	29,053
Brown Swiss Cross	1,772	0	0	1,772
Total	**11,5777**	**30,628**	**8,630**	**137,725**

Besides semen production at NDRDC, the Centre also imports progeny tested semen for maintaining quality of animals at Government nucleus farms and Contract Heifer and Bull Production Program in the country. The centre imported 10,500 doses of Progeny tested frozen bovine semen of different breeds. The details of imported frozen semen is presented in (Tables 3).A total of 5,288 doses of semen were distributed to Dzongkhags and nucleus farms as per their demand.

Table 3: Detail of imported Progeny tested Bovine Frozen Semen

Species	Opening balance	Import	Distribution	Balance
Jersey Conventional	2,477	5,400	3,801	4,076
Jersey (Sex sorted)	1,590	2,400	325	3,665
Brown Swiss	240	300	100	440
Black Angus	350	0	0	350
Tropical Holstein Friesian	1,690	0	302	1,388
Holstein Friesian	512	2,000	610	1,902
Karan Fries	300	0	0	300
Scottish Highland Cattle	0	100	0	100
Buffalo Nilli Ravi	0	300	80	220
Buffalo (Murrah)	70	0	70	0
Total	**7,229**	**10,500**	**5,288**	**12,441**

For implementation of sound breeding program and prevention of inbreeding ,an effective distribution plan for imported semen is designed by the centre(annexure 6) taking into consideration the rule of placing breeding bull/Semen in one place for a maximum of three years to prevent inbreeding.

ET Progress

During the fiscal year, the centre in close collaboration with National Biodiversity Centre (NBC, Serbithang) and National Nublang Breeding Centre (NNBC, Tashiyangphu) carried out Embryo flushing trials in fourteen elite Thrabam donor cows at NDRDC (Yusipang) and NNBF (Tashiyangphu). A total of 23 embryos (5 viable embryos, 5 degraded embryos & 15 UFOs) were recovered and the three viable embryos were successfully cryopreserved. The non-recovery of embryos from most donors could be attributed to factors such as non-responsiveness to hormonal protocols, sub-fertile cows, low Body Condition Score, health status rather than the flushing technique. The ET team has already conducted 24 ET trials and successfully cryopreserved 27 viable embryos from ten elite Thrabum donors as on now. To confirm viability and success rate of the viable embryos, six jersey cross heifers maintained at the Centre were used as recipients and embryo transferred during the fiscal year. However, none of the recipients have conceived.

4.1.3 Fodder Development Unit

4.1.3.1 Pasture development, Renovation & Fodder Conservation

The Fodder development unit has established around two acre of new improved temperate pasture, renovated 20 acres of existing pasture, cultivated 8 acres of fodder maize and conserved around 115 MT winter fodder in the form hay and silage. The unit also procured 4,500 bundles of paddy straw to supplement feed requirement of semen donor bulls and ET animals at the Centre.

4.1.3.2 Activities at Royal Soelbum Herds (Ramtokto)

The Fodder unit provided technical support and man power to Royal cattle herds at Ramtokto, to carry out the pasture/fodder development activities as and when required. The seasonal activities such as, pasture development, renovation, fodder conservation and winter oats cultivation has to be carried out as per the herd

strength. Around five acres of existing pasture has been renovated, cultivated around 10 acres of fodder maize and 5 acres of winter oats and conserved around 65MT maize silage for lean season feeding.

4.1.3.3 Activities at Royal Chipta Farm, Taba

Over eight acres of new improved temperate pasture has been established, two acres of existing pasture renovated and eight acres of previously established pasture top dressed with chemical fertilizer.

Table 4: Detail of pasture development

Unit	New pasture (Acre)	Existing pasture (Acres)	Conserved winter fodder (Metric tons)	Cultivation of fodder maize (Acres)
NDRDC Yusipang	2	20	115	8
Royal Cattle herd Ramtokto	0	5	65	10
Royal Horse Farm, Taba	8	2	0	0

4.1.4 FARM & ET RESEARCH UNIT

The Farm Section maintains a total of 44 animals including elite semen donor bulls and Embryo Transfer donor cows (Thrabum & Jersey cross) (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	7	Nublang	0
Nublang	6	Mithun	4
Mithun	2	ET Donors (Thrabum)	9
Brown Swiss cross	0	ET Donors (Jersey Cross heifer)	9
		Thrabum calf	7

DAIRY PRODUCTION & RESEARCH

4.2 DAIRY PRODUCTION RESEARCH & DEVELOPMENT SECTOR

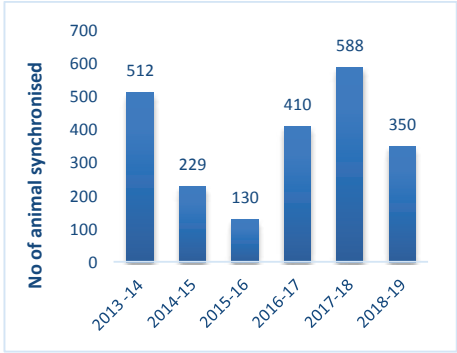
4.2.1. PRODUCTION RESEARCH

Cattle synchronization and Artificial Insemination

During the financial year, NDRDC, Yusipang implemented estrus synchronization in seven Dzongkhags; Tsirang, Samtse, PemaGatshel, Trashigang, Mongar, Lhuntshe& Trongsa (Table 6).A total of 350 animals were synchronized out of 404 animals referred for gynecological examination. The animals examined were the cases referred for infertility investigation and treatment. The response rate to synchronization/ treatment was 86% (Table 6).Of the 349inseminations, 130 AI were with Thai Holstein semen among Progeny Testing Scheme implemented areas of Samtse (Tading Geog) and Tsirang (Barshong and Sergithang Geogs), and 216AI were with semen of Jersey.

Table 6: detail of animals synchronized & AI done

Sl #	Dzongkhag	Animal examined	Synchronized	AI Done
1	Tsirang	119	103	103
2	Samtse	100	81	81
3	Pema Gatshel	49	40	40
4	Trashigang	42	41	41
5	Mongar	55	51	51
6	Lhuntse	21	18	18
7	Trongsa	18	16	15
	Total	**404**	**350**	**349**



4.2.2 ASSESSMENT OFCHBPP IN WEST AND WEST-CENTRAL REGION

The review of Contract Heifer and Bull Production Program (CHBPP) in West and West-central region was conducted during the FY 2018-19. The objectives of the review were to assess;

- the contribution of CHBPP in the regions to breed improvement program in terms of breeding bulls production and supply from the program and compare the performance of CHBPP between sampled Dzongkhags

- the quality of animals by blood level progression in the CHBPP herds to identify cows with high genetic potential for pedigree selection of semen producing bulls
- the productivity of CHBPP animals, socio-economic benefit, and identify constraints and opportunity to improve the CHBPP

The survey covered seven Dzongkhags; Chukha, Samtse and Paro with 7 CHBPPs in western region and Dagana, Tsirang, Punakha and Wangdue with 8 CHBPPs in west-central region. A total of 472 CHBPP households (h/h) were surveyed among 1,129 CHBPP registered members in the surveyed areas, which accounts to overall survey coverage of 42%; with 41% (n=578) in western region and 43% (n=551) in West-central region. The data on procurement and supply of breeding bulls from CHBPP including production and supply of bulls from the National Jersey Breeding Centre (NJBC), Samtse were collected for the review.

Preliminary findings of the review were as follows;

1. There had been almost three folds increase in h/h registered under the program from the inception. But, the increase in Jersey cattle population was two folds only, which may be attributed to limited land holdings of the farmers. However, the average no of Jersey cattle was 4 animals per h/h (n472) marking double fold increase than at the time of inception with 2 animals per h/h (n472).
2. When breed progression among CHBPP herds was assessed for 50-75% exotic blood level(inception) and ≥87.5% in the CHBPP herds, the overall increase in population was observed to be equal in both the categories; 919 to 1,362 nos. in 50-75% and 1 to 452 nos. ≥ 87.5%Progression in breed by blood level was recorded almost double in western region (n=293) than in west-central region (n=159). At Dzongkhag level, the breed progression by blood level was highest in Samtse Dzongkhag, followed by Chukha, Tsirang and Paro.
3. Most of milking cattle in CHBPP herds were found to be in 1st to 4th lactations, which indicates that the CHBPP farmers are educated enough to dispose cattle from their herds as production declines particularly after 6th lactation, and generate revenue through sale of animals.
4. Average daily yield was increasing with the increase in exotic blood inheritance at all level; regional, Dzongkhag and CHBPPs (Table 7).

However, the productivity was higher in western region than in west-central region for blood level ≥87.5% but similarfor other blood levels. At Dzongkhag level, highest production was observed in Chukha Dzongkhag followed by Dagana and Samtse.

Table 7: Milk production by exotic blood inheritance

Region	CHBPP in Dzongkhags	Avg. daily milk production (L) by Jersey blood level				
		50%	62.50%	75%	87.50%	93.75% & above
Western	Samtse	5.9	6.3	8.7	10.7	12.0
	Chukha	6.2	7.0	8.7	12.4	15.3
	Paro	4.5	6.3	8.8	10.7	15.0
	Avg. production	***5.5***	***6.5***	***8.8***	***11.3***	***14.1***
West-central	Dagana	5.5	6.5	8.4	11.0	14.2
	Tsirang	6.2	6.4	8.1	9.8	11.5
	Punakha	4.87	6.40	8.99	9.53	-
	Wangdue	5.63	7.09	8.15	8.83	-
	Avg. production	***5.5***	***6.6***	***8.4***	***9.8***	***12.8***
Overall daily avg. production (L)		**6**	**7**	**9**	**11**	**14**

5. Majority of the animals in CHBPP herds were found to be farm born through AI/ natural services as expressed by CHBPP members (95%, n=451), and 96% of them (n=452) discourages its import from India in future based on the reasons foreseen and/ experienced (who had imported in the past); poor adaptability, high mortality, incursion of exotic diseases, expensive, etc. Thus, the general consensus was to discourage the import of animals from India, and emphasize more on AI facility with strengthened AI services.

6. The services provided to the satisfaction of the CHBPP members as per contract agreement on parameters below are presented (Table 8).
   - ✓ awareness on the contract to the CHBPP members from time to time
   - ✓ ear tag animals born in the program within a months as per NCIS
   - ✓ issue individual bovine register to each animal registered under the program
   - ✓ maintain breeding records of the animals inseminated, and
   - ✓ provide health care facilities to the animals registered under the program on priority

Table 8: Services provided as per HBPP contract agreement

CHBPP surveyed Dzongkhags	Awareness on contract provided		Ear tag animals		Issue individual bovine register		Breeding records in AI register	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Samtse	64	7	66	5	62	9	69	2
Chukha	72	2	67	7	56	18	70	4
Paro	91	0	0	91	51	30	91	0
Western region	***227***	***9***	***133***	***103***	***179***	***57***	***230***	***6***
%	***96***	***4***	***56***	***44***	***76***	***24***	***97.5***	***2.5***
Dagana	59	26	60	25	37	48	68	7
Tsirang	93	2	186	9	76	18	92	3
Punakha	30	0	30	0	30	0	30	0
Wangdue	26	0	0	26	26	0	26	0
West-c region	***208***	***28***	***176***	***60***	***170***	***66***	***226***	***10***
%	***88***	***12***	***75***	***25***	***72***	***28***	***95.8***	***4.2***
G. Total	**435**	**37**	**309**	**163**	**349**	**123**	**456**	**16**
%	**92**	**8**	**65**	**35**	**74**	**26**	**96.6**	**3.4**

On animal health care, 100% expressed receiving the services as desired.
Similarly, the compliance of the CHBPP farmers on points below as per the contract agreement is presented (Table 9).

- ✓ operate the herd as per contract
- ✓ breed animals under CHBPP via AI only
- ✓ maintain milk record once a month on same date in individual bovine register provided
- ✓ sale animals under the programme with information to the CHBPP in-charge

Table 9: Farmers' compliance to HBPP contract agreement

CHBPP surveyed Dzongkhags	Follow contract Agreement			Breeding of animals under CHBPP			Monthly milk recording		Sale animals under CHBPP	
	Fully	*Partially*	*Nil*	*AI*	*Bull*	*AI + bull*	*Yes*	*No*	*With consent*	*Without consent*
Samtse	45	16	10	38	3	30	59	12	56	15
Chukha	51	21	2	67	5	22	64	10	55	19
Paro	0	91	0	0	0	91	0	91	0	91
Western region	**96**	**128**	**12**	**105**	**8**	**143**	**123**	**113**	**111**	**125**
%	**40.7**	**54.2**	**5.1**	**41.0**	**3.1**	**55.9**	**52.1**	**47.9**	**47**	**53**
Dagana	39	36	10	34	10	28	81	4	61	24
Tsirang	47	44	4	87	1	34	77	18	94	1
Punakha	0	*30*	*0*	*0*	*0*	*30*	*0*	*30*	*0*	*30*
Wangdue	0	*25*	*0*	*0*	*0*	*26*	*0*	*26*	*0*	*26*
West-central R.	***86***	***135***	***14***	***121***	***11***	***118***	***158***	***78***	***155***	***81***
%	***36.6***	***57.4***	***6.0***	***48.4***	***4.4***	***47.2***	***66.9***	***33.1***	***65.7***	***34.3***
G. Total	**182**	**263**	**26**	**226**	**19**	**261**	**281**	**191**	**266**	**206**
%	**38.6**	**55.8**	**5.5**	**44.7**	**3.8**	**51.6**	**59.5**	**40.5**	**56.4**	**43.6**

7. For CHBPP farmers, dairy was primary source of income for 76% (n=458). Overall, 61% (n=472) of the h/h surveyed sold fresh milk to MPUs/ MCCs at existing farm gate price, and remaining converted it into butter and cheese and sold in market individually at varying prices. In western region, 86% of the h/h sold fresh milk as there existed market for fresh milk, whereas in west-central region only 35% sold fresh milk indicating limited market for fresh milk. On an average individual farmer earned **Nu. 148,368/annum** through sale of fresh milk and milk products, and excess animals from the herd.
8. Among the h/h surveyed, 49% expressed that they encountered hindrances in smooth implementation of CHBPP such as disposal of bull/ bull calf born in the programme, irregular AI services owing to shortage of AI technicians, repeat breeding from AI, infertility/ anoestrus, etc.
9. CHBPP contributed immensely to the breed improvement program as it complemented the NJBC, Samtse in meeting the demand of jersey breeding bull in the country by 70% annually (Figure 1).

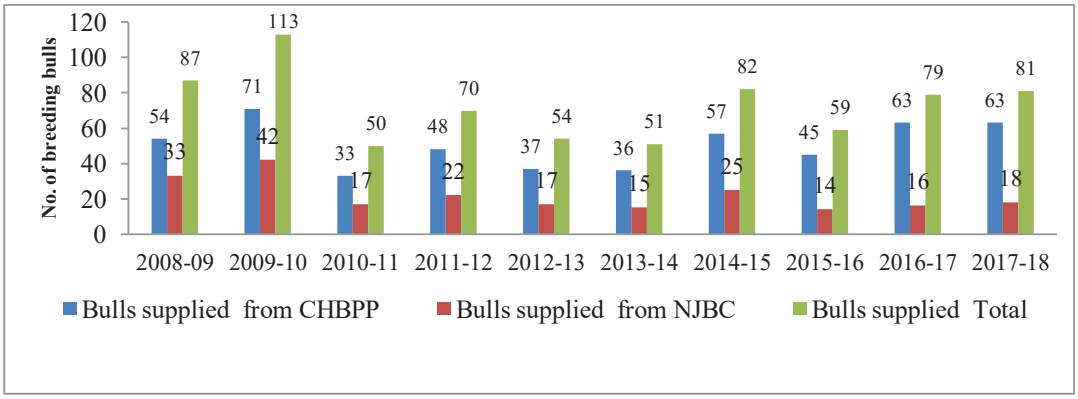


Figure 1: Jersey breeding bull procurement, production and supply to farmers

The review/assessment recommended that:

1. Hnads on training to the farmers of every CHBPP area/ DFG on improved dairy husbandry practices with focus on educating them on heat detection and timing of AI to avoid repeat breeding of inseminated animals as well as use of breeding bulls, and importance of balanced feeding, improved housing for animals and record/book keeping.
2. Dairy being primary source of household income to majority of the farmers, and reproductive problem in the herd is a hindrance, the geog/dzongkhag livestock officials should focus on reproductive management(compile the

cases of infertility; repeat breeders, anoestrus after three months of calving or at breedable time/ age of heifers, and seek assistance from competent agencies under the DoL to correct the assocoiated problems.

3. Assess performance of CAITs, AI Technicians and breedable heifer population in CHBPP areas and select feasible areas for supply of sex-sorted semen to intensify heifer production
4. All progenies born under the program via AI should be ear tagged/registered within a month by concerned Geog Livestock officer and proper records maintained and reported to concerned agencies
5. The individual bovine register for each animal registered under CHBPP be issued to the owner, including those centralized at LECs, and farmers sensitized on usefulness of proper recording And penalty if any for not doing so.
6. The identification of bull mother for production of young sire intended for semen production could be initiated with selection of heifers from high producing dams nearing pureline blood level among CHBPP herds.

Dairy Farmers Groups and Cooperatives

The formation and strengthening of farmers institutions; Dairy Farmers' Groups (DFGs) and Cooperatives is one of the important interventions dairy sector made to sustain and ecel themselves in dairy farming ventures. As of June 2019, there were 196 DFGs with 5,484 members spread across 20 Dzongkhags (Figure 2) and 6 dairy cooperatives with 527 members (Figure 3). The highest number of DFG members is in Trashigang, followed by Samdrup Jongkhar and Bumthang (annexure 1).

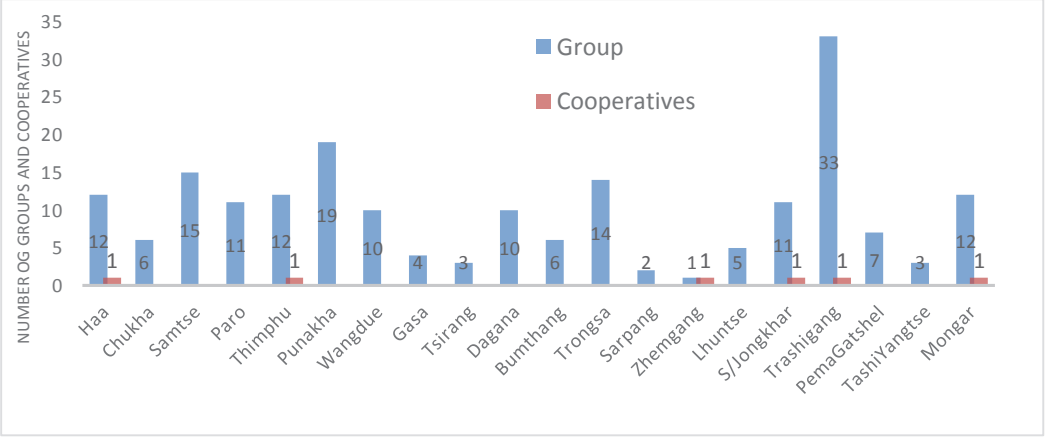


Figure 2: Dzongkhag wise Dairy Farmers and cooperatives Group as of June 2019.

The formation, operation and management of the DFGs are guided by the DFG Bye-law.

The dairy farmers Cooperatives are operational in six Dzongkhags of Haa, Thimphu, Zhemgang Monger, Trashigang and Samdrup Jongkhar with highest membership in Haa, followed by Samdrup Jongkhar and Trashigang (Figure 3).

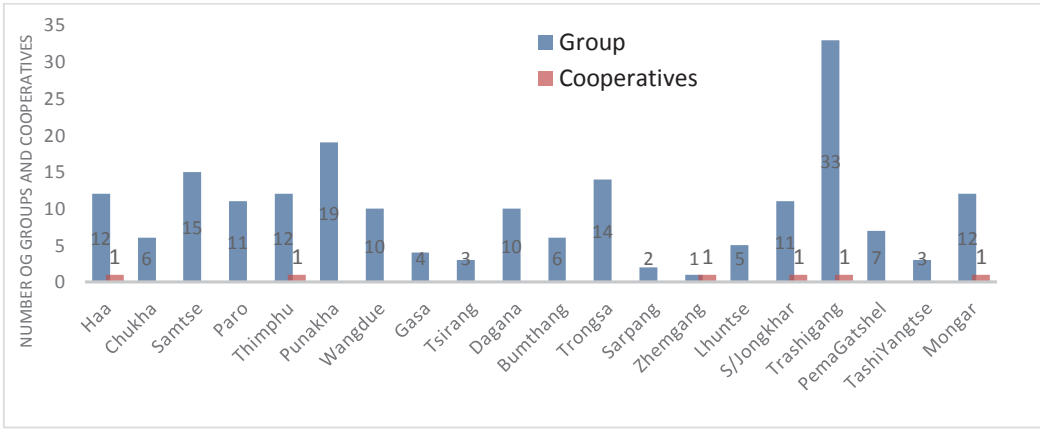


Figure 3: Dzongkhag wise Dairy Farmers and cooperatives member as of June 2019.

During the financial year, these DFGs and DC earned a gross income of **Nu 256.63 M** through sale of milk and dairy products (Figure 4)

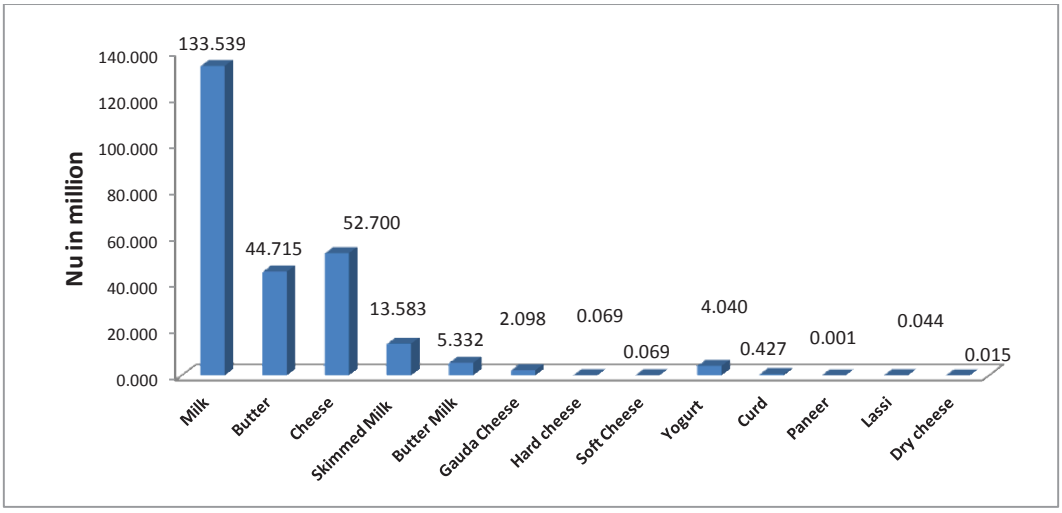


Figure 4: Revenue earned from the sale of fresh milk and milk products by DFG and DFC as of June 2019.

4.2.2 BREEDING RESEARCH UNIT

ARTIFICIAL INSEMINATION PERFORMANCE AND PROGENY RECORD

There are 113 operational Artificial Insemination (AI) Outreach Stations in the country as of June 2019; 34 nos. under RLDC, Tsimatsham(34), RLDC, Wangdue(24),RLDC, Zhemgang(19) and RLDC, Kanglung(39)(Figure 5). Four new AI Outreach Centres (AIOC) were opened in Tading, Namgaycholing and Norgaygang Geogs under Samtse Dzongkhag and Barsong Geog under Tsirang Dzongkhag.

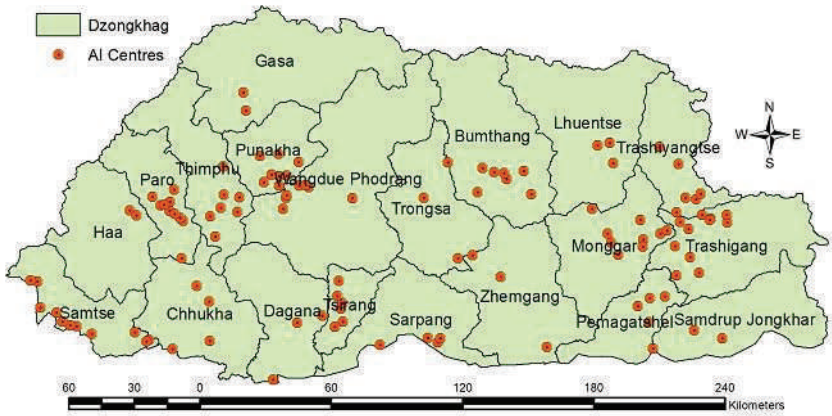


Figure 5:AI Outreach Stations spread across the country

A total of 8,217 AI were performed with progeny record of 2,853 numbers (1,250 male and 1,603 female) indicating the success rate of 34.72%(Table 10). Success rate of 34.72% 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. Cumulative AI report as of 2019 from (1987 – 2019) is 175,426 and progeny record is 56,190.

Table 10: Summary of AI and Progeny record

Region	Total AI	Progeny Record			Average success rate (%)
		Male	*Female*	*Total*	
West	2773	476	546	1022	36.86
West- central	1884	255	339	594	31.53
East-central	1348	171	259	430	31.90
East	2212	348	459	807	36.48
Total	**8217**	**1250**	**1603**	**2853**	**34.72**

Paro, Chukha, Tsirang and Monger with 9 AI/AIOS/month, Bumthang with 8AI/AIOS/month and Samtse, Sarpang, Punakha and Pema Gatshel with 7AI/AIOS/month. Remaining 11 Dzongkhags' average performance was recorded to be below the national average(7AI). Overall 63.71% of AIOS (n=72/113) had performed below the national average (Annexure 3, Figure 6)which warrants close scrutiny in their functioning in 12thFYP from concerned Dzongkhags and RLDCs.

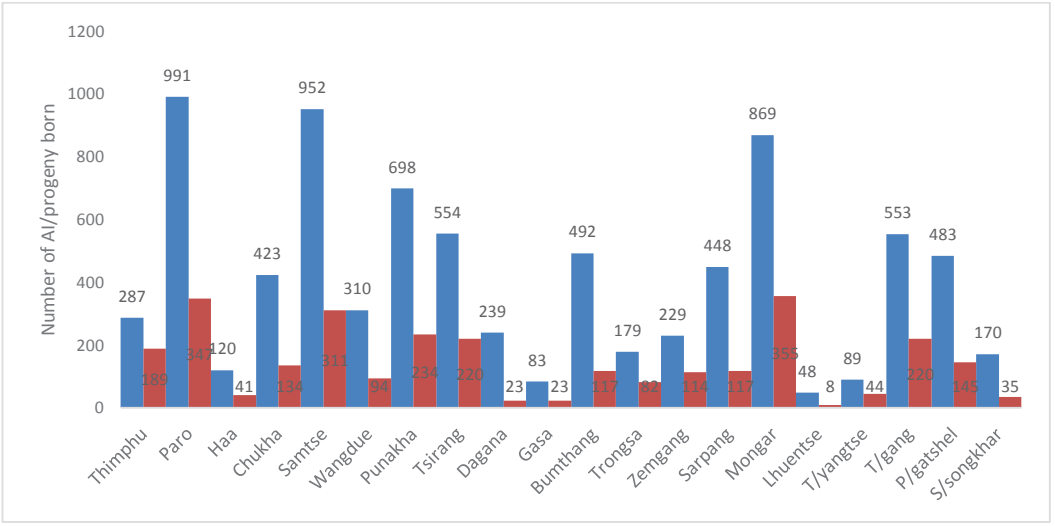


Figure 6: AI done& Progeny born in the country

- 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.

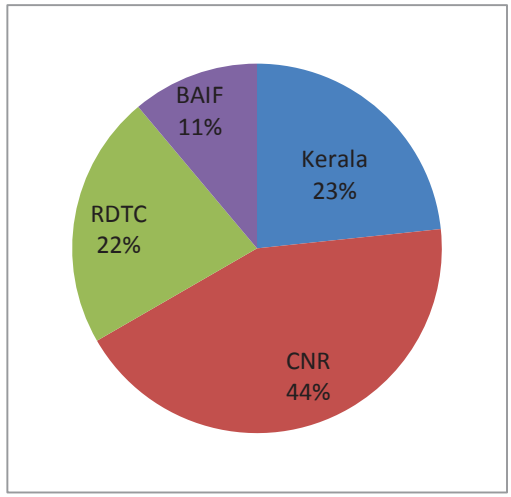
TRAINING NEEDS ASSESSMENT OF ARTIFICIAL INSEMINATION (AI) TECHNICIANS IN THE COUNTRY

NDRDC made an attempt to assess the number of AIOS presently functional vis a vis availability of AI Technicians, their training background to recommend a way forward to enhance their skills to improve delivery of AI services. Assessment revealed that:

- There is serious gap in capacity of staff placed at AI Outreach Centre (AIOS). Fresh diploma graduate are conducting AI, though they lack confidence in carrying out AI (Tshering, 2018). Similarly, Extension agents who were trained in AI at BAIF, Pune, India are also not confident in carrying out AI.

- Further, increased development activities/workload at the Geogs and multi-tasking of Extension Agent are reported to be main reason for lack of focus on AI and dairy cattle recording. Hence, measures to boost confidence of AI technicians and recording needs emphasis.

- Majority of AI Technicians in field are those trained within the country (CNR and RDTC), which together contributes 66% of AI Technicians pool in the country. AI staff was also trained at Mattupatty, Kerala and BAIF, Pune (Figure 1). College of Natural Resources (CNR) diploma holders alone contribute (44%) of AI work force hinting that strengthening of training facilities/curriculum at CNR is essential. Besides, providing regular refresher course to CNR Diploma holder may improve AI services delivery in the field.



DAIRY POST-PRODUCTION & RESEARCH

4.3 DAIRY POST-PRODUCTION RESEARCH & DEVELOPMENT SECTOR

4.3.1 PRODUCT STANDARD DEVELOPMENT AND VALUE ADDITION UNIT

Product Standard Development and Value Addition Unit

1. ***Training on Good Hygiene Practices and Good Manufacturing Practices***

Upon request from The Queens Project Office (QPO), personnel from the Unit proceeded as resource person to conduct training on Food Safety and Hygiene Practices to members of dairy groups from Haa and Paro. The training was conducted at the Haa DVH on the 6th – 7th of April 2019 with focus on Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) for milk and milk products. Resource persons from BAFRA and Technical Advisors from the QPO were also present during the training.

2. ***Product Diversification Training at Samtse***

In coordination with the Dzongkhag Livestock Sector, Samtse, the unit conducted a two days training on yogurt production from the 26th – 27th of November 2019 at the Yoeseltse yogurt plant to Livestock officials, extension agent, and representatives of the Yoeseltse Jersey Detshen farmers group. Training on the importance of milk quality testing such as basic platform testing as well as GMP in the plant was also imparted. Based on the training and observation, the unit made several recommendations including the need for the plant to carry out the milk ring test for presence of *Brucella* before receiving the milk at the plant. Only after the confirmation of absence of *Brucella*spp, should the milk be accepted for yoghurt production. The requirement of a water filtration unit at the plant is also required to ensure supply of potable water. Other minor modification works in the plant and the need for a proper effluent disposal pit was also seen as necessary.

3. *Product Diversification Training for 5 Eastern Dzongkhags*

With request for resource person from the Regional Livestock Development Centre, Kanglung, personnel from the unit conducted trainings on dairy product processing and diversification for youth groups and dairy plant operators in five eastern Dzongkhags. In total 105 farmers were trained (23 in Mongar 23 in Trashigang (Kanglung Dairy Group), and 59 in Samdrup Jongkhar (20 from Gomdar, 39 from Jomotshangkha) and the hands-on-training on platform milk tests and dairy product processing for yogurt, paneer, and lassi was imparted. Besides participants of some Dzongkhags were also provided with refresher course on clean milk productionand importance of producing and supplying clean milk to the processing unit.

4. *Product Diversification Training at Gasa*

The unit in coordination with the Regional Livestock Development Centre, Wangdue conducted training on clean milk production, platform milk tests and manufacture of paneer, and ghee to members of the Yamina Dairy Farmers Group, Khamedgeog, Gasa. A total of 10 participants were provided hands on training with emphasis on good hygiene practices and good manufacturing practices to ensure production of good quality paneer and ghee.

The participants expressed their interest to continue with the production of paneer and ghee as they have a longer shelf life than traditional products. The members, however expressed the need for a onetime support in packaging materials for the products.

5. Product Diversification Training for Haa

Resource persons from the NDRDC conducted training on product diversification for 24 participants including field staff and members of dairy farmers group in the dzongkhag from the 5th – 8th of June 2019. The training location was the erstwhile Haa Valley Cooperative (now defunct) MPU that had been renovated and equipped for production of yogurt, paneer, and cheese, with financial support from the Pro-Bhutan Association and is currently operated by the Eusu Meripuensum Gonor Nyamley Tshodgey. Training focused on clean milk production, handling of dairy equipment and production of yogurt, paneer, and Gouda cheese. The participants were also briefed on the importance of platform milk tests and supplying good quality raw milk with low microbial count to be able to process good quality end products.

Practical demonstration and hands on training on the processing of set yogurt was carried out with emphasis on GMP and GHP followed by the production of paneer using locally available raw materials and production of Gouda Cheese. Participants were reminded on the requirement for supplying good quality raw milk with low microbial count to be able to process good quality Gouda cheese and food safety hazard owing to high microbial load.

Further, experts from the NDRDC made a visit to the Youth Cooperative at Kana village involved in the processing of Caciocavallo cheese and made several recommendations for the group to be better able to maintain GMP and GHP standards.

The results obtained from the samples indicate major contamination of butter and datshi available in the study areas. Contamination would have arisen from unhygienic processing conditions as well as post production contamination of the products due to poor storage conditions. The presence of pathogenic bacteria (*E. coli&Staph. aureus*) and spore forming bacteria such as the *B. cereus* can have major implications on the health of humans arising from food poisoning related illness.

3. Monitoring & Evaluation

The unit carried out monitoring and evaluation of the following milk processing units/milk collection centers at Samtse and Tsirang:

i. Choling Yargay Detshen, Tashicholing, Samtse
ii. Gomtu Dairy Sales Counter & Processing Unit, Gomtu, Samtse
iii. Ugyentse Gonor Tshogpa, Ugyentse, Samtse
iv. Tsirang Gonor Thuenkey Detshen, Tsirang
v. Patshaling MPU, Tsirang

Findings and recommendations from the monitoring and evaluation has been passed on to the respective Dzongkhags.

DAIRY RESEARCH COMMUNICATION

4.4 DAIRY RESEARCH COMMUNICATION SECTOR

4.4.1 TRAINING & SKILL DEVELOPMENT UNIT

Refresher course on artificial insemination conducted for extension staff at Yoseltse, Samtse for western region

Two weeks long refresher course for 21 AI Technicians of western region was held from 10th to 23rdJanuary, 2019 at Yoeseltse, Samtse Dzongkhag was organized by NDRDC, Yusipang with fund support from RD CCRP Project.The AI refresher courses for field AITs is aimed at making AI program more viable, for better performance and improve delivery of AI services.

Photograph with participants and resource person at Samtse Dzongkhag

Refresher course on artificial insemination conducted for extension staff at Mendrelgang Tsirang for west central region

Two weeks long refresher course for AI Technicians was held from 22nd April to 5thMay, 2019 at Mendrelgang, Tsirang Dzongkhag for 25 Livestock staff of West Central region.

Resource person and participant of AI refresher course of West Central region at Tsirang

Refresher course provided opportunity for field staff to get hands on training on latest insemination procedures, thawing of semen, proper loading of AI gun, application of right techniques for AI, proper handling of frozen semen and care / handling of Liquid Nitrogen needed for cryopreservation of frozen semen. The training was organized with fund support from RDCCRP and GEF LDCF Projects.

10TH BATCH OF CAITS TRAINING CONDUCTED, TADING, SAMTSE

Towards providing uninterrupted Artificial Insemination (AI) services to the general public, which is a key component for cattle breed improvement and dairy development in the country, the NDRDC, Yusipang conducted 23 days training on AI for early school leavers who are referred as "Community based AI Technician" (CAIT), from 11th February 2019.

The intervention directly complements the objective of the Department of Livestock (DoL) to enhance public private partnerships to create employment and income generation opportunities in rural areas.

The participants comprised of 6 trainees from Progeny Testing Scheme (PTS) areas in Tading Geog and 4 from other areas of Samtse Dzongkhag. The training was funded by RDCCRP.

11th BATCH OF CAITS TRAINING CONDUCTED AT BARSHONG, TSIRANG

Geared towards providing uninterrupted Artificial Insemination (AI) services to the general public under Public -Private Partnership (PPP) for cattle breed improvement and dairy development in the country, NDRDC Yusipang, conducted another round of 21 days training on AI from 9th-30thApril, 2019. A total of 10 trainees selected by the communities in consultation with the local government were trained. The training was funded by GEF/UNDP project.

12thBATCH OF CAITS TRAINING CONDUCTED AT TRONGSA

A twenty one days Community Artificial Insemination Technician (CAITs) Training was organized by Dzongkhag Administration, Trongsa with technical support from NDRDC, Yusipang. There were 10 participants; 6 were school dropouts and 4 CNR graduates. The training was conducted at Tongtophey, RNR Centre, Langthel Geog Trongsa during May 2019.

The successful candidate were provided set of portable AI equipment as is done in other places to start doing AI on return to their community immediately.

WORKSHOP ON NCIS & CHBPP

Three days training cum workshop was organized on National Cattle Identification system & Contract Heifer and Bull Production Program (NCIS & CHBPP) from 22st to 24rd June 2019 at Thromdoe Veterinary Hospital, Phuentsholing. The training was organized by NDRDC for the staffs of Samtse & Chukha Dzongkhag. A total of 9 staffs from two Dzongkhags participated in the training/workshop. Issues and problem while carrying out NCIS and CHBPP in their Dzongkhags were discussed. Hands on training on the data update on excel sheetwere carried out on the last day and issues on database. The training was funded by GEF LDCF Project.

CHBPP ESTABLISHMENT PROGRAM IN TRONGSA DZONGKHAG

Contract Heifer and Bull Production Program (CHBPP) were established in the three Geogs of Korphu, Langthel and Drakten Geogs of Trongsa Dzongkhag. Dzongkhag and Geog staffs of these three Geogs were trained on the CHBPP, NCIS program, selection of the cattle, bovine register recording, holding Registers recording, and database updates were done so that the expansion program in future can be done independently. Along with the identification system, recording system is being put in place to help in instituting Progeny Testing Scheme in the future.

Training and awareness program was carried for 81 households with 165 number of cattle. In all the Geogs, the training was carried out and following topics were covered as per standard protocol.

- ✓ Terms & conditions of the CHBP Programme.
- ✓ Aims and objectives of establishment of NCIS and CHBPP
- ✓ Selection criteria for CHBPP animals
- ✓ Importance of milk recording and body wt. recording of the CHBPP born calf
- ✓ Importance of heat detection and important heat signs that farmers should be aware of when animal comes in to heat

- ✓ Role and duty of the farmer under CHBPP
- ✓ Agreement among farmers on the payment to Community AI Technician
- ✓ Question and answer session

4.4.2. TECHNOLOGY PACKAGING AND KNOWLEDGE MANAGEMENT

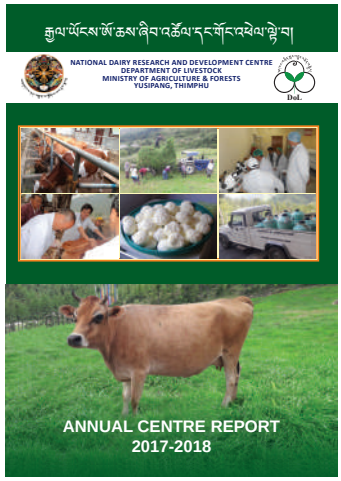
Publication of booklets on:

A total of three report/booklets were published during the fiscal year and are can be downloaded from the centers website(http://www.ndrc.gov.bt/downloads/:

- ✓ Annual Centre Report for 2017 – 2018
- ✓ Training Manual for Artificial Insemination and Reproductive Management
- ✓ Standard Operating Manual (SoP) for Laboratory and Semen processing

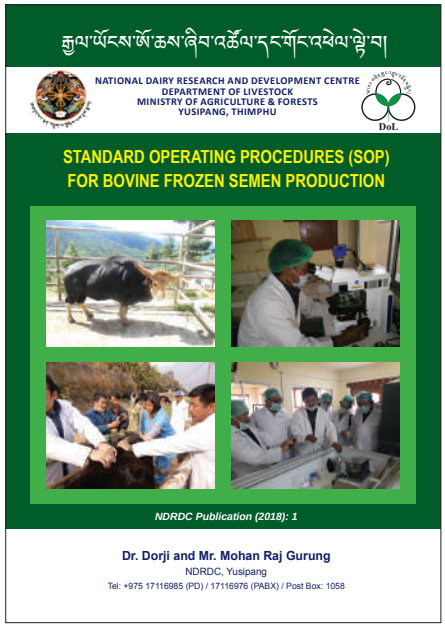
Preparation of Annual Centre Report

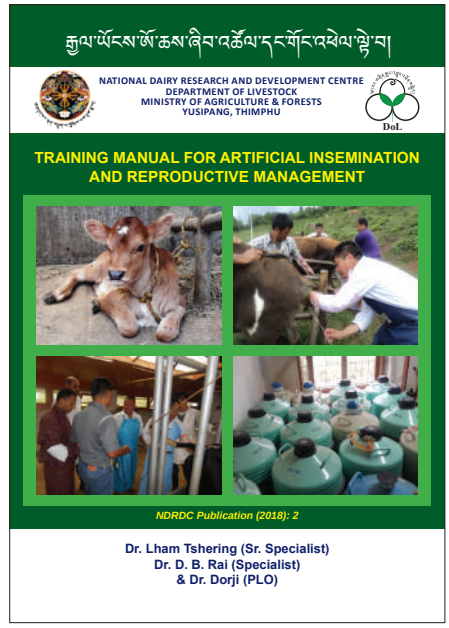
Preparation of the Annual report of the Centre was completed in the end of the July Month 2018 and the final printing and circulation was done in August 2018 to all the stakeholders.



Conduct Review Planning and Workshop

Every Friday of the first week of the month, the review and planning workshop is conducted at the conference hall of the Centre. During the meeting, both review of the past months and planning of the following month is conducted, finalized and approved by the management. In some months, when more than 50% of the technical staffs are out, the meeting is postponed. During the fiscal year of 2018 – 2019, a total of 8 meetings were conducted against the plan meeting of 4 meeting planned.





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 Trongsa Dzongkhag in collaboration with National Dairy Research and Development Centre during the month of April 2019. A total of 81 households and 155 animals were ear tagged in three Geogs of Korphu, Drakten and Langthel. With this expansion program, Trongsa Dzongkhag is fully covered by the NCIS.

The number of household under NCIS increased to 6,270 from 6,189 an increase of 81households. The number of animals with NCIS increased to 11,706 an increase of 155 during the fiscal year. As of now the NCIS is carried out in 118 Geogs and CHBPP in 55 Geogs covering in all 20 Dzongkhags.

5 RESEARCH PAPER PUBLISHED

(Bhutan Journal of Animal Science Volume 3 issue 1)

1. Adoption of Improved Dairy Production Practices by Dairy and Non-Dairy Farmers' Groups. ***Bhutan Journal of Animal Science 2019, 3 [1]: 14-21.***

LOKEY THAPA* | DEKI CHODEN | NAR B. TAMANG

Abstract

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 *Dzongkhags* in Low altitude [Sarpang], Mid-Altitude [Tsirang] and high altitude [Haa]. Ninety-seven were respondents of dairy farmers' groups and 70 were respondents of non-dairy farmers' group. The questionnaire sought information on farmers' knowledge on dairy technology, household profile, feeding practices, dairy husbandry practices, breeding practices and health practices.

Dairy farmers' group respondents had a high level of adoption in feeding practices with 84.92 percent, dairy husbandry practices with 80.15 percent and health care practices with 77.30 percent. However, the non-dairy farmers' group respondents had medium level of adoption of feeding practices with 69.20 percent, dairy husbandry practices with 54.92 respondent and health care practices with 69.87 percent. Breeding practice adoption among dairy farmers' group respondents was medium with 43 percent and non-dairy farmers group respondents with 28 percent. There is a big scope for strengthening the farmers' knowledge on dairy technology adoption among dairy and non-dairy farmers groups, particularly in breeding practices through awareness creation and training of farmers on emerging technologies.

2. Effect of Parity on Milk Yield and Calving Interval of Thrabam Cattle at Nucleus Herd, Tashiyangphu, Bhutan. Bhutan Journal of Animal Science 2019, 3 (1): 22-26.

NAR B TAMANG* | DHAN B RAI | DENDUP | ABI N KOIRALA | SONAM TSHERING

Abstract

A study was carried out to understand the productive and reproductive performances in local *Nublang/Thrabam* cattle managed at the nucleus herd, Tashi yangphu Bhutan. Data on performances were accessed and analyzed from 3794 individual animal records maintained at the farm for 21 years [1997 to 2018]. The record covered 1st to 8th parity for individual animals.

The study found that nucleus herd has a fair balance of young and old stock for regular replacement. Overall average daily milk yield of local *Thrabam*cows [all parity] was 3.54±0.23 kg [n=436] and take-home milk was 2.04±0.23 kg/day excluding 1.5 kg/day estimated to be spared to suckling calves. The average daily milk yield increased from 3.11 kg/day in first parity to 3.78 kg/day in fourth parity. Similarly, average lactation milk yield increased from 708±215 kg in first parity to 889±190 kg in fourth parity. Lactation yield in fourth parity was significantly higher than yields in all other parity. Average lactation length was 230.9±5.4 days [7.7 months] which had little or no improvement with advancing parity. Notably, calving interval has decreased from 16.1±3.6 months [n=173] in 1st/2nd parity to 12.1±1.1 months in 7th/8th parity [n=165], indicating improvement in reproductive efficiency of the nucleus herd.

The study concluded that highest milk yield [daily and lactation yield] of *Thrabam* cattle is in fourth parity with no drastic decline till seventh parity suggesting that cows fit for breeding can be retained in the nucleus herd beyond seventh parity based on their productivity. Further, *Thrabam* being draught purpose breed with short lactation length and low milk yield, it is unlikely to compete in milk production with recognized dairy breeds even if they are rigorously selected. Hence, apart from improvement in milk production, traits for diseases resistance, adaptability/ foraging ability] need to be given equal weightage while selecting this cattle breed.

3. Karan Fries vs. Jersey Cattle in Southern Foothills of Bhutan

NAR B TAMANG1* | DHAN B RAI1 | TASHI DHENDUP2 | ABI N KOIRALA1 | LEKI TSHERING2 | PEMA WANGCHUK2 | MIN P TIMSINA3

Abstract

A study was conducted to evaluate the performances of Karan Fries [KF] and Jersey Pure [JP] dairy cattle breeds managed at the government farm in the sub-tropical environment of Samtse, Bhutan. Quantitative data on production and reproduction were retrieved from 320 individual cow/calf performance records maintained at the farm from July 2014 to March 2018. The qualitative data on adaptability were congregated through key informant's interview. Data was analyzed using standard statistical package Minitab-18. The mean birth weight and monthly weight gain in KF calves was significantly higher than JP. Mean age at first service and age at first calving for JP were found to be 24.6 months and 33.9 months, respectively, which were significantly lesser than KF. Mean daily milk yield [kg] in 1st lactation was significantly higher in JP than KF but there was no yields variation in subsequent lactations. Mean lactation yield [305 days] for KF cows increased to 3823.9 kg in 4thlactation, which was 371 kg higher than JP. However, the difference in milk yield was not statistically significant. Milk production closely associated with season in a year with higher production for both the breeds in winter than in summer owing to better quality fodder in winter.

KF has good foraging ability and is surefooted to survive in the rugged terrain. However, bad temperament and higher quantity forage requirement for animals are the disadvantages. The study concluded that JP breed attains production at younger age and has medium body size requiring lesser fodder intake. Thus, JP and its crosses shall continue to be a breed of choice for the subsistence and semi-commercial dairy farms with limited fodder resources. KF may be recommended in commercial farm with adequate facilities and resources at hand to sustain them.

4. Reproductive Efficiencies of Cows and Heifers Artificially Inseminated with Sex-Sorted and Conventional Semen in Bhutan. *Bhutan Journal of Animal Science 2019, 3 [1]: 37-41.*

DHAN B. RAI* | NAR B. TAMANG | ABI N. KOIRALA

Abstract

The study objective was to compare conception rates and sex of calf at birth from Artificial Insemination [AI] of cows and heifers, using sex-sorted [sexed] and conventional [unsexed] semen. Imported frozen semen from two sire lines for both sexed and conventional semen that had equivalent Post Thaw Motility of 40% was used. Predictors of conception rates and sex of calf at birth were semen type, animal type, insemination sire, number of AI per conception, AI Technician and breed. In total, 422 AI was done in 160 heifers and 130 cows of Jersey pure, Jersey cross and local cattle, of which 151 and 271 were sexed semen and conventional semen, respectively. The conception rates of 44% and 48% were recorded for sexed and unsexed semen, respectively. Although, the conception rate was higher in conventional semen, difference was not statically significant.

Sexed sorted semen gave birth to 89.6% female calves as compared to 51.5% for conventional semen, indicating a strong influence of semen type on birth of female calves. Conception rate was significantly influenced by animal type; cow and heifer and not by other predictors. Conception rate was significantly lower in cows than in heifers. Hence, expensive sexed semen can be recommended for use in first-service heifers than in cows for optimizing conception rates.

5.1.2 Research carried out/completed and due for publication

1. Effect of dairy management and feeding on milk production and income of traditional and improved dairy farmers

LOKEY THAPA, DEKI CHODEN AND N.B. TAMANG

Abstract

A study was conducted to compare the effect of traditional and improved dairy farming practices on household income and to find out the challenges to enhance rural income through dairy farming. The study was carried out in four Dzongkhags, Samtse, Dagana, Trongsa and Samdrup Jongkhar Dzongkhag by random sampling of selecting one Dzongkhag each from a region. Community based questionnaire survey was conducted during December 2018 to February 2019 by visiting each households in the villages.

Structured predesigned questionnaires through interviews were used for data collection consisting of household information, milk production, dairy husbandry management, dairy technology management, feeding management, breeding management and constraint while carrying out livestock farming. Average household milk yield per day of traditional and improved dairy cows were 1.63 ± 0.69 and 7.37 ± 3.22 litters respectively. The monthly household income of the traditional dairy farmers and improved dairy farmers in the study area were Nu. 4167.50 ± 2248.87 and 19586.96 ± 10457.30 respectively. Three fourth percent of the improved dairy farmers meet their household expenses from sale of milk and milk products compared to more than one third by traditional dairy farmers. The main source of income for traditional dairy farming was from the sale of cash crops accounting to 65 percent. It is estimated that if the traditional dairy farming change to improved dairy farming, the average household income is likely to multiply by minimum of three times.

2. Responses of local buffaloes to estrus synchronization and fixed timed artificial insemination (FTAI) in subtropical Bhutan

DORJI* CHUNGSILA & GANGA RAM RAI

Abstract

This study evaluated estrus response and conception rate of local buffaloes under Samtse Dzongkhag using different hormonal estrus synchronization protocols. Since the study was carried out at field level, animals were selected at random; irrespective of parity, breed, milk yield and body weight. Animals were either primiparous or multiparous. Four different estrous synchronization protocols (P1, P2, P3 & P4) were evaluated during two different seasons; seasonal anestrus (March – April) and breeding season (September). Four different groups of animals were maintained for four different protocols, respectively. The efficiency of all the four protocols was evaluated for estrus response rate and conception rate in the four groups. It was observed that there was marked difference in the conception rate when compared between treatments using four different protocols. The percentage of pregnant buffaloes was highest (30.8%) in P3. Similarly, the percentage of pregnant buffaloes resulting on application of P2 was higher (16.6%) when compared with P1 and P4. The objective of this study was to assess the estrus response rate and conception rate in estrous synchronized local buffaloes (using different protocols during two different seasons) at field level. This study is first of its kind in the country. Through this study, we aim to introduce promising exotic dairy buffalo breed (Nili Ravi) using different protocols to upgrade and improve the performance of local buffaloes and manage reproductive waste in the field. The crossbreeding of superior germ plasm with local buffaloes with suitable protocol(s) aims to improve productivity of buffalo hybrid off springs in the country.

3. Milk production of cattle breeds in three agro-ecological zones in western Bhutan

DEKI CHODEN, LOKEY THAPA AND N.B.TAMANG

Abstract

The study was conducted in seven functional Dairy Farmers Groups (DFGs) of Thimphu and Chukha *Dzongkhags* spanning over a year (June 2017 to May 2018) to establish base line information on the milk production of the dairy cows in three different AEZ of western Bhutan. The main objective was to establish facts on milk production of dairy cattle breeds with varying exotic inheritance level, lactation, age and herd type in three Agro-Ecological Zones of western Bhutan and also to compare milk yield of different season and AM&PM milking. Daily milk yield of each individual cow was recorded by the owner for both morning and evening milking in a recording booklet provided to each sample household which was further validated by the concerned researchers. Prevalent dairy breeds in the study area were crossbreds of Jersey (JX), Holstein Friesian (HF) and its crosses. The overall mean DMY was 7.72 ±3.75 litres and days in milk (DIM) was 266.51± 81.03 days. Mean DMY in cool temperate, warm temperate and dry sub tropical agro ecological zones (AEZ) were 5.63±2.14, 6.30±1.94 and 9.07±4.28 litres respectively. Mean DMY of HF pure, HF cross and JX cows were 12.41±3.7, 10.74±5.79 and 6.92±3.07 litres respectively. Cows of exotic inheritance level of 50-75% produced higher mean daily milk yield of 8.44±3.89 l/day than exotic inheritance level of above 75% (7.58±3.66 l/day) and below 50% (5.57±2.2)l/day. Similarly among different herd size, mean DMY of medium size herd (6-10 cows) was highest (11.81±4.79) l/day as compared to very small (1-2), small (3-5),and Large (>10 milking dairy cows) which yielded 6.58±2.94, 6.96±2.98, and 10.2±2.47 l/day respectively. Aspects that determine productivity, such as dairy cattle breed, exotic inheritance level and herd type showed significant difference ($p<0.05$) in daily milk yield (DMY). Yield difference is mainly attributed to management, primarily feeding. This study also found that milk yield/day increased from 1st (6.57±3.67) to 2nd (8.68±3.38) and peaked in 3rd lactation (8.77±4.67). The finding suggests that cows above 11 years of age are not advisable to retain in farmers' field because of its low milk yield. Significant difference in milk yield between AM (4.74±2.19) and PM (3.16±1.59) milking was observed. There was no significant difference in milk yield across seasons although yield in winter (7.42±4.16) and autumn (7.60 ±3.93) were lower than summer (8.07 ±4.51) and spring (7.86±4.49)season. Owing to higher productivity of cows in the lower altitude, it can be deduced that dairy farming is more suitable in such warmer areas. Nonetheless, further studies are needed to establish whether altitude or other management practices affect milk production.

4. Compositional analysis of market milk in Thimphu & Paro

PHUNTSHO T. NORBU*, KINLEY CHOKI AND SONAM YANGCHEN

Abstract

Milk available in the market is not subject to systematic regulations or monitoring for control of quality. The compositional quality of milk is not maintained due to lack of regulations leading to adulteration of milk and supply of poor quality milk to consumers. The study on compositional quality of milk available in the market of Thimphu and Paro revealed deviation and variation in all milk components from expected constituents as well as consistent adulteration with water. Milk available in the market of Thimphu and Paro is found to be of poor quality with unfair trade practices and deception of consumers through sale of inferior quality milk. The centre will continue to undertake studies on milk composition throughout the country and will also undertake to identify the source of adulteration (producers – middlemen – retail outlets) for corrective action to be taken for improving the quality of milk and formulation of standards for milk.

5. Assessment of contract heifer & bull production program in west and west central region for its impact on livelihoods

DHAN B RAI, LOKEY THAPA, ABI N KOIRALA & Nar B. TAMANG

Abstract

A study was conducted to review the Contract Heifer and Bull Production Program (CHBPP) in Chukha, Samtse and Paro under west region and Dagana, Tsirang, Punakha and Wangdue under west central region. Community based questionnaire survey was conducted during May and June 2019 and a total of 472 households were visited and 1129 registered animal records were studied. The study was carried out to find out the contribution of CHBPP to breed improvement, blood level progression to identify cow with high genetic potential for pedigree selection of semen producing bulls and to find out the socio economic benefit of CHBPP farmers. The study have found out that there was threefold increase in the number of household registered, twofold increase in jersey cattle population. The study have also found that milking cattle population among the CHBPP herds were in 1st to 4th lactations indicating that the CHBPP farmers are educated enough to dispose cattle

from their herds during unproductive stages particularly after 6th lactation, and generate revenue through sale of animals at the right time. It was found from the study that recording keeping in the field was poor due to staff shortage and uneducated members. Another constraint expressed by members was disposal of male calves born. In order to improve the CHBPP, there is a need to issue the bovine register to the farmers themselves and train them to start record keeping to get the realistic value in future. There is also the need to develop user friendly data entry which can be immediately done from the field itself.

5.1.3 ONGOING- RESEARCH

1. Implementation of progeny testing scheme: towards development of resilient dairy cattle breed for Bhutan

Expansion of Progeny Testing Scheme in Samtse and Tsirang Dzongkhags

The Progeny Testing Scheme (PTS) in Bhutan was initiated by the centre in 2017 with the development of research protocol, site selection, animal selection and identification, their synchronization and insemination. The site selected for PTS implementation were, as per requirement for testing the Thai Holstein-Friesian (THF) semen in Bhutanese soil having three Agro-Ecological Zones with adequate breedable local cattle population; Tading geog under Samtse Dzongkhag, Barshong and Sergithang geogs under Tsirang Dzongkhag. The long term objectives of the scheme are to;

- ✓ identify superior young sires for semen production and future crossbreeding,
- ✓ facilitate steady genetic progress in cattle population for milk, fat/ protein yield and environmental adaptation including disease resistance,
- ✓ test and identify resilient dairy breed with appropriate combination of local and exotic inheritance level for its resilience to climate change

The expansion of the scheme was undertaken in Nov. 2018 at Tading Geog, Samtse and in Dec. 2018 at Barshong and Sergithang Geog, Tsirang. During the expansion phase, synchronization and insemination of additional animals in the areas were carried out for inclusion in the PTS, including the follow-up on the 1st phase PTS activities and identification (ear tagging) and body weight recording of calves born out of 1st phase PTS.

A total of 145 animals were examined (Table 12). The breedable animals, after gynecological examination were either synchronized using TRIU-B and/ GnRH/ PGF2 depending on ovarian status of the animals upon per-rectal examination. The response to synchronization using TRIU-B was 82.3% (n=98/119). Overall, **102 Thrabum** animals;48 in Tading, 32 in Barsong and 22 in Sergithang, were inseminated using THF semen as per mating planning PTS protocol.

RESEARCH PAPERS DUE FOR PUBLICATION

- ✓ Milk Production of Cattle Breeds in Three Agro-Ecological Zones in Western Bhutan
- ✓ Review of Contract Heifer & Bull Production Program in west and west central region
- ✓ Effect of Dairy Management and Feeding on Income and Milk Production
- ✓ Compositional Analysis of Market Milk, Butter & Datshi

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. Sonam Zangpo	Driver I	General
8	Mr. Pema Tenzin	Driver III	General
9	Mr. Samten	Power Tiller Driver	General

II Dairy Research Communication Sector

Sl. #	Name	Designation	Sector
1	Mr. Lokey Thapa	Sr.LPO	Research Communication Sector
2	Mr. Yuraj Giri	Sr.ES II	Research Communication Sector

III Dairy Production Research Sector

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

IV Dairy Inputs Production & Research Sector

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

V Dairy Post Production Research Sector

Sl. #	Name	Designation	Sector
1	Mr. Phuntsho T Norbu	Dy. CLPO	Research Post Production
2	Mrs. Kinley Choki	Sr.LPO	Research Post Production
3	Ms. Sonam Zangmo	Dairy Officer	Research Post Production

6. Accounts and Administration

ASSET DECLRATION

As mandated to carry out the Assert Declaration of the individual staffs of the Centre, 100% of the staff assert were declared before the deadline of March 2018.

Financial Progress

		National Livestock Breeding Programme			
Act	**Fic**	**Obc**	**Title**	**Budget**	**Expenditure**
001			Personnel Emoluments		
	0001	01.01	Pay And Allowances	8.945	8.603
		02.01	Other Personnel Emoluments	1.456	1.348
		24.03	Contributions - Provident Fund	0.787	0.697
			Total Of Fic 0001	11.188	10.648
			Operation & Management Services		
1	0001	11.01	Travel – In-Country	2.073	2.073
		12.01	Utilities -Telephones, Telex, Fax, E-Mail, Internet	0.363	0.363
		12.02	Utilities -Telegram, Wireless Transmission, Postage	0.015	0.015
		12.03	Utilities - Electricity, Water, Sewerage	0.444	0.444
		14.01	S & M - Office Supplies, Printing, Publications	0.100	0.100
		14.06	S & M - Uniforms, Extension Kits, Linens	0.170	0.170
		14.07	S & M - Text Books, Library Books, Ports Item	0.021	0.021
		15.01	Maintenance Of Property - Buildings	0.060	0.060
		15.02	Maintenance Of Property - Vehicles	1.428	1.428
		15.03	Maintenance Of Property - Roads		
		15.05	Maintenance Of Property - Equipment	0.020	0.020
		15.07	Maintenance Of Property - Computers	0.051	0.051
		15.09	Maintenance Of Property - Water Supply, Sewerage	0.034	0.034
		17.01	Op. Exp. - Advertising	0.060	0.059
		17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling	0.003	0.003
		18.01	Hospitality & Entertainment	0.030	0.030
		25.01	Retirement Benefits	2.805	2.800

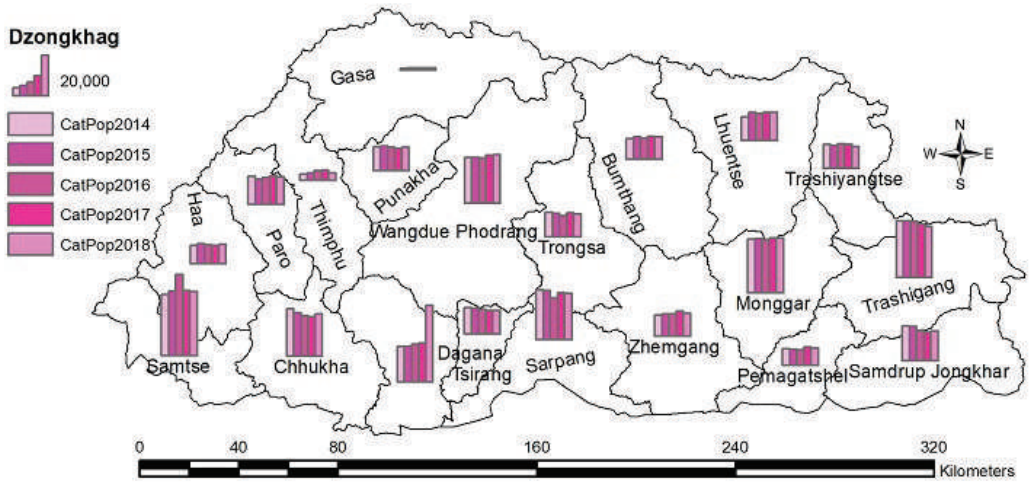
			Total Of Fic 0001	**7.677**	**7.670**
			Production & Distribution Of Liquid Nitrogen (Ln2)		
002	0001	11.01	Travel – In Country	0.200	0.200
		12.03	Utilities - Electricity, Water, Sewerage	0.240	0.240
		14.02	S & M - Medicines & Laboratory Consumables	0.050	0.050
		15.05	Maintenance Of Property - Equipment	0.210	0.210
		17.06	Op. Exp. - Items For Processing/Manufacturing	0.240	0.240
		52.07	Plant & Equipt. - Hospital/Lab. Equipment	1.000	1.000
			Total Of Fic 0001	**1.940**	**1.939**
			Production & Distribution Of Frozen Semen		
	0001	11.01	Travel – Incountry	0.200	0.200
		14.02	S & M - Medicines & Laboratory Consumables	1.044	1.044
			Total Of Fic 0001	**1.244**	**1.244**
			Semen / Embryo Production		
	0001	14.05	S & M - Animal Feeds	0.672	0.672
		17.06	Op. Exp. - Items For Processing/Manufacturing	0.130	0.130
			Total Of Fic 0001	0.802	0.802
			Research & Support For Embryo Transfer Technology		
	0001	14.02	S & M - Medicines & Laboratory Consumables		
			Total Of Fic 0001		
			Research And Package Technology To Enhance Production		
	1000	14.01	S & M - Office Supplies, Printing, Publications	0.010	0.010
			Total Of Fic 0001	0.010	0.010
			Pasture And Fodder Production For Farm Animals		
	0001	14.03	S & M - Fertilizers, Chemicals, Manures, Innoculants	0.098	0.098
		14.04	S & M - Seeds, Seedlings	0.019	0.019
		15.06	Maintenance Of Property - Plantations	0.094	0.094
			Total Of Fic 0001	**0.211**	**0.211**
			Intensification Of Dairy Breed Improvement		
	4599		Rural Development And Climate Change Response Programme		

		52.06	Plant &Equipt. - Livestock	0.340	0.340
			Total Of Fic 4599	**0.340**	**0.340**
			Breed Improvement And Progeny Testing Scheme		
	4599		Rural Development And Climate Change Response Programme		
		45.01	Training - Human Resource Development	0.960	0.960
			Total Of Fic 4599	**0.960**	**0.960**
			Capacity Building For Diary Breeding Services		
	4599		Rural Development And Climate Change Response Programme		
		45.02	Training - Others	1.200	1.200
			Total Of Fic 4599	1.200	1.200
			Bio-Security Fencing Of Semen Lab		
	4599		Rural Development And Climate Change Response Programme		
		51.08	Exp. On Structure - Others	0.500	0.500
			Total Of Fic 4599	**0.500**	**0.500**
Procurement Of Progeny Tested Bovine Frozen Semen					
	4599		Rural Development And Climate Change Response Programme		
		52.06	Plant &Equipt. - Livestock	2.000	2.000
			Total Of Fic 4599	**2.000**	**2.000**
			Establishment Of Ln2 Plant		
	4599		Rural Development And Climate Change Response Programme		
		51.08	Exp. On Structure - Others	5.000	5.000 *
			Total Of Fic 4599	**5.000**	**0.714**
003			Dairy Production Research Services		
			Conduct Priority Dairy Production Researches		
	0001	11.01	Travel – In Country	0.100	0.100
		14.01	S & M - Office Supplies, Printing, Publications		
		17.08	Op. Exp. – In Country Meetings And Celebrations	0.040	0.040
			Total Of Fic 0001	0.140	0.140
	0001	14.02	S & M - Medicines & Laboratory Consumables	0.030	0.030
		17.08	Op. Exp. – In Country Meetings And Celebrations	0.020	0.020

			Total Of Fic 0001	**0.050**	**0.050**
	4620		Enhancing Sustainability And Climate Resilience Of Forest And Agriculture Landscape And Community Livelihoods In Bhutan		
		14.02	S & M - Medicines & Laboratory Consumables	3.000	3.000
		45.02	Training – Others	1.635	1.635
			Total Of Fic 4620	**4.635**	**4.635**
005			Research Communication Services		
			Technology Packaging And Popularization		
	0001	11.01	Travel – In Country	0.375	0.375
		14.01	S & M - Office Supplies, Printing, Publications	0.058	0.058
		17.08	Op. Exp. – In Country Meetings And Celebrations	0.05	0.05
		17.09	Op. Exp. - Survey/Census	0.135	0.134
			Total Of Fic 0001	**0.568**	**0.567**
			Grand Total	**38.465**	**37.916**

Fund utilized is (37.916/38.465 *100) = 98.57 percent

**Fund transferred to RLDC Zhemgang vide their request letter No. 2(2)RLDC/ADMZG/2018-2019/456 dated 20/1/2019 from RD, RLDC Zhemgang. RDCCRP Budget 51.08 for construction of LN2 plant*



7 VISITORS AT NDRDC

7.1 HON'BLE LYONPO'S VISIT

The Hon'ble Lyonpo Yeshey Penjor, Minister for the Ministry of Agriculture and Forests visited different offices in Yusipang under the Ministry of Agriculture & Forests on 21st November 2018. During the familiarization visit, the heads of the Programs made presentation on Centres achievements and 12th FYP in Conference Hall, Agriculture Research & Development Centre, Yusipang. Issues and challenges that the Centres faced to cater the need of the farming communities were also briefed and discussed. Hon'ble Lyonpo made a visit to National Dairy Research & Development Centre, Semen Processing and Embryo Transfer Laboratory and Liquid Nitrogen Plant of NDRDC.

7.2 VICE MINISTEROF CHINA VISITED NDRDC, YUSIPANG

HE Mr. Ma Yoxiang, Vice Minister and Animal Husbandry Commissioner for Agriculture and Rural Affairs of China and his 5 members' delegates visited NDRDC Yusipang on 25 May 2019. The delegates discussed dairy development activities in Bhutan and Visited Semen Processing lab of the centre.

8 DEPARTURES AND NEW ARRIVALS

8.1. DEPARTURE

Dr. Lham Tshering Sr Specialist superannuates

Dr. Lham Tshering, Sr. Specialist (Animal Reproduction), National Dairy Research and Development Centre (NDRDC), Yusipang superannuated on 1st October 2018 after 32 years to dedicated service to Livestock Sector Development in the country.

Dr. Lham hails from Trong, Zhemgang. He holds Bachelor of Veterinary Science & Animal Husbandry degree from Trichur, Kerala and Masters of Veterinary Science degree from Paris, France.

Dr. Lham started his carrier in Civil Service in early 1987 as Head of Jersey Crossbreeding Farm at Wangchutaba. Later in the year, it was renamed as National Artificial Insemination Program to implement organized Cattle Breeding Program in the country. The centre was upgraded in 1990 to National Artificial Insemination

Program and Semen Processing Centre (NAIP&SPC). Frozen bovine semen could be processed and made available within the country to be self-reliant the input required to promote dairy breed improvement program.

With his timeless efforts, in 1995 NAIP &SPC under his leadership could collect and process frozen semen from Mithun (*Bos frontalis*), a semi wild bovine species. This was a technological break-through which made Bhutan first country in the world to do this. Much needed Mithun semen could then be availed by needy farmers of Bhutan.

His pioneering work in dairy breed improvement has helped the dairy sector in Bhutan to reach a new height. The country now boasts to have 109 Artificial Insemination (AI) outreach centers in all 20 Dzongkhags. This is augmented with Contract Heifer and Bull Production Program initiated in 2000 that eased Government farm on supply of breeding bulls to farmers. As of date, the program is implemented in 55 Geogs. To mitigate shortage of Artificial Insemination Technician, training of Community Artificial Insemination Technician (CAIT) commenced in 2010. So far 99 CAIT were trained and deployed to reach AI services to farmer's door steps.

The consistent efforts made by Dr Lham on dairy breed improvement, country milk production have reached to 50,250MT by 2017. This has enabled rural farmers to earn a gross income of Nu.2.26 Billion (@Nu 45/kg of milk) of which AI program contributes estimated Nu.1.06 Billion (48%) annually. This is a huge contribution to propel socio-economic development of the country forward and boost national economy.

Equally, Dr Lham has contributed immensely in building knowledge base on dairy sector through publication of scientific papers in Journals and also developed booklets/manuals/leaflet on improved animal breeding and management practices for sharing of knowledge.

NDRDC (erstwhile NAIP & SPC), Department of Livestock and livestock fraternity greatly value contribution made by Dr. Lham Tshering. Footprints left and milestones set during his over three decades of carrier in the Civil Service; no doubt open a new chapter in the history of Diary Sector Development in the Country.

The NDRDC family extends our heartiest congratulations and Tashi Delek on his retirement, and for successfully completing 32 memorable years in service to the nation. Wishing him and his family a fulfilling and a peaceful retirement life

2. MOHAN RAJ GURUNG SR. SUPERVISOR SUPERANNUATES

Mohan Raj Gurung, **Sr. Livestock Supervisor II**. EID No. 8405020,CID # 11201001890, , National Dairy Research and Development Centre (NDRDC), Yusipang superannuated on 14 May 2019 after 35 years to dedicated service to Livestock Sector Development in the country.

Mohan Raj Gurung is from Norgaygang under Samtse Dzongkhag. He completes his Diploma in Veterinary Science & Animal Husbandry from Royal Veterinary Institute, Serbithang in March 1984. He was appointed as Asstt. Farm Manager in National Horse Breeding Program in Bumthang in May 1984. It was good opportunity and foundation of my profession to work with experienced farm management and Swiss Experts and have work for 14 years. He was transferred to National Artificial Insemination & Semen Processing Centre, Wangchutaba.

There were limited staff in the centre and taken care of the farm animals and Semen Processing Laboratory when he first joined the then NAIP & SPC in 1997. During his service, Centre have initiated trials and launched Mithun Semen Production in 1997 which was the technological break-through and Bhutan become the first country in the world. Much needed Mithun semen could then be availed by needy farmers of Bhutan. During his stay in the centre, has undergone short term courses: Artificial Insemination & Reproductive Management (2002) at NAIP, Bhutan (Certificate), Frozen Semen Production Techniques from UCEAR, France (2003) and certificate in Embryo Transfer Technology from DLD, Thailand (2013). These short term trainings has been a great privilege for the reward bestowed on me in my profession.

The semen Processing Laboratory under NAIP had basic semen processing equipment, however, after shifting to Yusipang the Laboratory have been the State of Art and have all the required modernized Semen Processing Equipment. During my 21 years of service years at Yusipang, the centre is producing Frozen Bovine Semen from Nublang, Jersey, Brown Swiss breeds and sufficient to meet the AI inputs requirements of 113 AI Centres in the country for breed improvement program in the country.

The NDRDC family extends our heartiest congratulations and Tashi Delek on his retirement, and for successfully completing 35 memorable years in service to the nation. Wishing him and his family a fulfilling and a peaceful retirement life

3. UGYEN DORJI, ESP RESIGNS AFTER 30 YEARS OF SERVICE.

Ugyen Dorji, Farm Attendant Working in NDRDC, Yusipang hailing from Mossi village, Lumang Geog under Tashigang Dzongkhag have resigned from service. He first started his service as Farm Attendant from National Artificial Insemination & Semen Processing Centre, Wangchutaba in July 1989. He was separated from the service with effect from 30th June 2019 after completion of the contract period.

NDRDC family and the Livestock fraternity wish all of them a very healthy and happy retired life.

8.2 NEW FACES OF NDRDC

Ms. Sonam Zangmo joins NDRDC

Ms. Sonam Zangmo, Dairy Officer joined the NDRDC family after completing her B.Sc Animal Science from College of Natural Resources and successfully getting through the Royal Civil Service Examination conducted in 2018. Before she joined the Centre, she was working in National Centre for Animal Nutrition Bumthang. She will work as Dairy Officer under Dairy Post Production & Development Sector.

Mr. Sonam Zangpo joins NDRDC

Mr. Sonam Zangpo, Driver joined the NDRDC family after getting transferred from the office of Ministry of Agriculture & Forests. He was working as Driver of the Hon'ble Lyonpo before he joined the Centre

9 TRAINING/WORKSHOP ATTENDED

1. Meeting of Animal Production and Health Commission for (APHCA)

The Dr. N.B.Tamang, Program Director, NDRDC attended the 41st session/meeting of Animal Production and Health Commission for Asia and Pacific (APHCA) at Changmai from 12-14 November 2018.The meeting discussed the past activities and prepared work plan and budget for coming year. Besides, participants were given opportunity to attend International Symposium of Veterinary Epidemiology and Economics (ISVEE) 2018 for two days on sidelines of the meeting

2.Study visit on Dairy Breeding, Reproduction and Dairy Production Thailand

Upon invitation by Director General, Department of Livestock Development (DLD), MoAC, Thailand, eight officials from NDRDC/RLDC/Dzongkhags attended week long study visit to Thailand from 22 – 29March, 2019. The visit included field trips, experience sharing on animal breeding, reproductive biotechnology, dairy development and research. The visit shared experience and knowledge on Dairy Research and development between the two countries and fostered technical collaborations. Besides, participants got insight of advances on gene technology, dairy breeding/ reproduction including use of ultrasound technique in early pregnancy diagnosis, data management, progeny testing.

3. Dairy processing and quality management

Ms Deki Choden, Sr. LPO attended the training on Dairy Processing and Quality Management from 1st to 8th October 2018 in Maejo University, Chaingmai, Thailand. A total of 9 members from different offices of Department of Livestock attended the training. The training was a mixture of lecture followed by practical-hands on training in (dairy product processing & laboratory) and study visits to Government institutions as well as and farmers' field in farms and dairy processing. The training was funded by by EUCTCP.

4. Training on milking to Potential

Ms Deki Choden, Sr LPO attended the Milking to Potential from 13th to 31 May 2019. A total of 32 participants from 15 different countries attended the training organized by Wageningen Centre for Development Innovation (WCDI), Wageningen University & Research and funded by Orange Knowledge Programme (OKP). The course was very relevant and centres on an approach to achieve sustainable and successful dairy sector development. The central framework consists of five steps in order to finally identify and implement interventions to achieve the objectives. The course was mixture of lectures, field excursions to analyze the dairy sector and apply lessons learnt in building our (participant's) own case enables us to examine dilemmas in dairy development in the host country.

5. Advance Training on Embryo

Mr. Mohan Raj Gurung &Yuvraj Giri, Sr Livestock Supervisor II attended one week training at Maejo University, Chaing Mai, Thailand from 4th to 10th November 2018. The training was on Advance Training on Embryo Transfer. The training was both theory and practical and covered practical examination ovaries, foetus and other organs using ultrasound for cows and goats. Better and shorter protocol for synchronization and multiple ovulation and transferring of embryo in quality recipient cows. The training was useful and was funded by EU TCP

6 Training on Embryo Cryopreservation technology

Mr. Thinley Dorji, LPO attended 4 weeks training on Embryo Cryopreservation technology from 19th November to 17th December in Maejo University, Chiangmai, Bangkok. The training was both theory and practical and covered Estrous synchronization and control of ovulation, Artificial insemination in cattle, Embryo flushing, freezing and transferring and Bovine semen processing. This training opportunity have given good hands-on experience on embryo cryopreservation technology, artificial insemination in cattle and bovine semen processing. The training was funded by EU TCP

7 Advance office Management and Administration

Mr. Pema Dorji, Adm of NDRDC attended the short term training on Advance office Management & Administration at Maejo University Changmai, Thaland with effect from 12 -25 March 2018 through EUTCP project. Training covered the topics like Understanding Collaborative Intelligence, Understanding Virtual Teams, Leadership Decision Making for Collaboration and Choosing the Right Technologies. The above said training was very relevant as per his job responsibilities and training has benefited him a lot in carrying out his task in efficient way.

10 STAFF DIRECTORY

Dr.N.B.Tamang
Specialist Head/Program Director

Phuntsho T. Norbu
Head (DPPRS)

Dr. D.B Rai
Specialist III (DPRS)

Pema Dorji
Asst. Adm (A&FS)

Lokey Thapa
Sr. LPO

Dr Dorji
Head (DIPRS)

Kinley Choki
Sr. LPO

Deki Choden
Sr. LPO

Jigme Tenzin
Accountant

Yuraj Giri
LO

Thinley
LPO

Sonam Zangmo
DO

Abi N. Koirala
LO

Nima
Lab Assistant

Narapati Chapagai
Electrical Technician

Phub Dorji
Asst. Engineer

Chungsila
LPS

Kanti Ram Chhetri
LPS, Pasture

Sonam Zangpo
Driver

Durga Chhetri
Driver

Pema Tenzin
Driver

Domzang
Driver

Samten
Power Tiller Operator

Annexure 1: Dairy Farmers Groups

Dairy Farmer Groups (DFG) as of June 2019		
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
Wangdue	10	363
Zhemgang	3	70
	196	**5,484**

Dairy Farmer Cooperative as of June 2019	
Dzongkhag	**Members**
Haa	121
Mongar	43
Samdrup Jongkhar	103
Thimphu	82
Trashigang	50
Zhemgang	**128**
Total	**527**

ANNEXURE 2: SYNCHRONIZATION DETAIL

Dzongkhag/ Central Farms	Geog	Animals examined	Animals synchronized	Animals responded	A.I performed
Tsirang	Sergithang	43	31	22	22
	Barshong	62	58	43	53
	Mendrelgang	14	14	13	14
	Sub - Total	***119***	***103***	***78***	***89***
Samtse	Tading	83	64	56	63
	Yoeseltse	17	17	15	17
	Sub - Total	100	81	71	80
Pemagatsel	Shumar	49	40	38	40
	Sub - Total	49	40	38	40
Trashigang	Kanglung	19	18	17	18
	Pam	23	23	20	23
	Sub - Total	42	41	37	41
Monggar	Ngatshang	30	28	25	28
	Chaskar	17	15	14	15
	Doyok	8	8	8	8
	Sub - Total	55	51	47	51
Lhuntse	Menbi	21	18	17	17
	Sub - Total	21	18	17	17
Trongsa	Korphu	6	6	6	6
	Langthel	12	12	9	9
	Sub - Total	18	18	15	15
Grand Total		**404**	**352**	**303**	**333**

ANNEXURE 3:

A. AI CENTRES & PROGENY BORN RECORD

Year		2018- 2019				Success rate (%)	Avg. AI (nos)
Dzongkhags	*AIOS (Active)*	*AI Done*	*Progeny (P)*				
			M	*F*	*Total progeny*		
Thimphu	DVH Ramtokto	151	69	50	119	78.8	12.6
	Khasadrapchu	10	0	0	0	0.0	0.8
	Kawang	10	0	0	0	0.0	0.8
	Genekha	15	0	0	0	0.0	1.3
	Tshaluna/Bjemina	82	29	27	56	68.3	6.8
	NDRC, Yusipang	19	3	11	14	73.7	1.6
Sub-Total	**5**	287	101	88	189	**65.9**	**4.8**
Paro	DVH Wangchang	459	44	72	116	25.3	38.3
	Tshentog	56	0	12	12	21.4	4.7
	Lamgong	33	12	9	21	63.6	2.8
	Shari	58	25	49	74	127.6	4.8
	Dawakha	81	8	5	13	16.0	6.8
	Shaba	49	9	12	21	42.9	4.1
	Luni	65	18	10	28	43.1	5.4
	Dogar	0	0	0	0	0.0	0.0
	Doteng	87	33	26	59	67.8	7.3
	Naja	103	1	2	3	2.9	8.6
Sub-Total	**9**	991	150	197	347	**35.0**	**9.2**
Haa	DVH Tshelungkha	40	6	2	8	20.0	3.3
	Bjee/Yangthang	0	0	0	0	0.0	0.0
	Katsho	80	15	18	33	41.3	6.7
Sub-Total	**2**	120	21	20	41	**34.2**	**5.0**
Chukha	DVHTsimasham	0	0	0	0	0	0.0
	Bongo/Drala	66	20	22	42	63.6	5.5
	Sampheling	208	4	9	13	6.3	17.3
	Phuntsholing	91	13	24	37	40.7	7.6
	CRC - Wangkha	58	18	24	42	72.4	4.8
Sub-Total	**4**	423	55	79	134	**31.7**	**8.8**
Samtse	DVH Samtse	61	19	15	34	55.7	5.1
	Changmari	55	10	7	17	30.9	4.6
	Chargarey	10	4	0	4	40.0	0.8

	Ugyentse	175	21	36	57	32.6	14.6
	Yoseltse	102	36	38	74	72.5	8.5
	Tashicholing	128	13	9	22	17.2	10.7
	Dophuchen	39	8	9	17	43.6	3.3
	Tendu	52	8	6	14	26.9	4.3
	LEC- Phuntshopelri	8	0	2	2	0.0	0.7
	LEC- Buduney	104	6	8	14	13.5	8.7
	LEC- Tading	150	6	11	17	11.3	12.5
	NJBC- Samtse	68	18	21	39	57.4	5.7
Sub-Total	**12**	952	149	162	311	**32.7**	**6.6**
Wangdue	DVH Petakarpo	91	6	15	21	23.1	7.6
	Gaselo/Gumina	130	15	17	32	24.6	10.8
	Phobjikha	33	11	11	22	66.7	2.8
	Sephu	10	0	0	0	0.0	0.8
	Phangyul/ Katikha	9	2	4	6	66.7	0.8
	Bjena	29	4	3	7	24.1	2.4
	Nysho/Samtegang	8	0	0	0	0.0	0.7
	Rubesa	0	2	4	6	0.0	0.0
Sub-Total	**7**	310	40	54	94	**30.3**	**3.7**
Punakha	DVH Punakha	224	35	41	76	33.9	18.7
	Samdingkha	158	29	28	57	36.1	13.2
	Talo	74	12	8	20	27.0	6.2
	Thinlaygang/Toeb	39	0	1	1	2.6	3.3
	Kabjesa	149	26	34	60	40.3	12.4
	Baap	19	2	6	8	42.1	1.6
	LEC –Shengana	29	2	10	12	41.4	2.4
	LEC -Limbukha/	6	0	0	0	0.0	0.5
Sub-Total	**8**	698	106	128	234	**33.5**	**7.3**
Tsirang	DVH Damphu	198	42	71	113	57.1	16.5
	LEC- Gosarling	95	10	27	37	38.9	7.9
	LEC- Mendrelgang	54	8	11	19	35.2	4.5
	Tsirangtoe	61	12	12	24	39.3	5.1
	LEC- Barsong	85	7	9	16	**18.8**	**7.1**
	LEC- Sergithang	61	7	4	11	**18.0**	**5.1**
Sub-Total	**5**	554	86	134	220	**39.7**	**9.2**
Dagana	Dagapela	91	1	0	1	1.1	7.6

	Drujegang	89	9	7	16	18.0	7.4
	Lhamoizingkha	47	3	3	6	12.8	3.9
	LEC- Tsangkha	12	0	0	0	0.0	1.0
Sub-Total	**4**	239	13	10	23	**9.6**	**5.0**
Gasa	DVH Gasa	26	5	2	7	26.9	2.2
	Damji	57	5	11	16	28.1	4.8
Sub-Total	**2**	83	10	13	23	**27.7**	**3.5**
Bumthang	DVH Bumthang	169	10	22	32	18.9	14.1
	Thangbi	0	0	0	0	0.0	0.0
	Chumey	46	8	11	19	41.3	3.8
	Mesithang	83	20	8	28	33.7	6.9
	Wobthang	28	1	3	4	14.3	2.3
	Ura	0	0	0	0	0.0	0.0
	BS Farm - Bumthang	166	12	22	34	20.5	13.8
Sub-Total	**5**	492	51	66	117	**23.8**	**8.2**
Trongsa	DVH Sherabling	14	3	8	11	78.6	1.2
	Kuengarabten	30	7	5	12	40.0	2.5
	Langthel	6	0	0	0	0.0	0.5
	Tangsibji/Trashiling	115	25	34	59	51.3	9.6
	Nimsong	14	0	0	0	0.0	1.2
Sub-Total	**4**	179	35	47	82	**45.8**	**3.7**
Zhemgang	DVH Trong	149	31	58	89	59.7	12.4
	Panbang	38	5	2	7	18.4	3.2
	Buli	12	4	6	10	83.3	1.0
	Pantang	16	2	5	7	43.8	1.3
	LEC- Tingtibi	14	1	0	1	7.1	1.2
Sub-Total	**5**	229	43	71	114	**49.8**	**3.8**
Sarpang	DVH Sarpang	81	5	5	10	12.3	6.8
	LEC - Gelephu	286	33	58	91	31.8	23.8
	LEC - Dekiling	47	4	10	14	29.8	3.9
	LEC- Chuzagang	12	0	2	2	16.7	1.0
	LEC- Sersong	22	0	0	0	0.0	1.8
Sub-Total	**5**	448	42	75	117	**26.1**	**7.5**
Monger	DVH Monger	220	35	63	98	44.5	18.3
	Chali	0	0	0	0	0.0	0.0
	Ngatshang	156	38	44	82	52.6	13.0

	Sherimuhung	0	0	0	0	0.0	0.0
	Chaskhar	442	65	82	147	33.3	36.8
	Drametse	1	1	4	5	500.0	0.1
	Tsakaling	16	0	0	0	0.0	1.3
	Lingmethang	0	0	0	0	0.0	0.0
	Drepong	34	8	13	21	61.8	2.8
	Tsamang	0	2	0	2	0.0	0.0
	Narang	0	0	0	0	0.0	0.0
Sub-Total	**8**	869	149	206	355	**40.9**	**9.1**
Lhuntshe	DVH Gangzore	16	1	2	3	18.8	1.3
	Tangmachu	0	0	0	0	0.0	0.0
	Khoma	27	3	2	5	18.5	2.3
	Menji	5	0	0	0	0.0	0.4
Sub-Total	**3**	48	4	4	8	**16.7**	**1.3**
Tashiyangtse	DVH T/Yangtse	36	4	7	11	30.6	3.0
	Khamdang	41	5	6	11	26.8	3.4
	Bumdeyling	1	0	0	0	0.0	0.1
	Tongshang	3	7	9	16	533.3	0.3
	Jamkhar	8	6	0	6	75.0	0.7
Sub-Total	**5**	89	22	22	44	**49.4**	**1.5**
Trashigang	DVH Samkhar	163	16	17	33	20.2	13.6
	Radhi	19	4	5	9	47.4	1.6
	Bartsham	58	15	26	41	70.7	4.8
	Yangneer	67	10	9	19	28.4	5.6
	Kanglung	124	17	19	36	29.0	10.3
	Khaling	20	5	2	7	35.0	1.7
	Bikhar	23	0	16	16	69.6	1.9
	Phongmay	6	0	4	4	66.7	0.5
	RNR-EC Bidung	24	4	4	8	33.3	2.0
	RNR-Changmay	38	14	23	37	97.4	3.2
	Lumang	11	4	6	10	90.9	0.9
Sub-Total	**11**	553	89	131	220	**39.8**	**4.2**
Pemagatshel	DVH Shumar	73	9	12	21	28.8	6.1
	Zobel	28	8	16	24	85.7	2.3
	Tshebar	27	0	0	0	0.0	2.3
	Nangkhor	75	5	13	18	24.0	6.3
	Yurung	34	14	16	30	88.2	2.8

	Tshelingkhor	10	5	2	7	70.0	0.8
	LEC- Nanong	79	9	9	18	22.8	6.6
	CAIT- Norbugang	65	5	1	6	9.2	5.4
	CAIT Nganglam	92	11	10	21	22.8	7.7
Sub-Total	**6**	483	66	79	145	**30.0**	**5.4**
S/Jongkhar	Deothang	102	13	12	25	24.5	8.5
	Orong	59	5	5	10	16.9	4.9
	Phuntshothang	0	0	0	0	0.0	0.0
	LEC- Martshala	0	0	0	0	0.0	0.0
	Gomdar	9	0	0	0	0.0	0.8
Sub-Total	**3**	170	18	17	35	20.6	4.7

B. AI PERFORMANCE AND COVERAGE IN 11TH FIVE YEAR PLAN FIRST YEAR OF 12TH PLAN

Financial Year	AI performed (Number)	Progeny (Number)	AI Success rate (Percent)	Milking cattle * (numbers)	AI Coverage (Percent)
2013-14	9,358	3,511	37.5	44,971	18.3
2014-15	8,455	3,626	42.9	45,808	20.4
2015-16	7,679	2,516	32.8	48,295	17.5
2016-17	7,159	2,456	34.3	49,255	15.6
2017-18	7,705	2,657	34.5	52,236	13.7
2018-19	**8,217**	**2,853**	**34.72**	**56,586**	**12.17**
Average	**8,096**	**2,937**	**36.12**	**49,525**	**16.36**

*** Milking cattle population as per Livestock statistics (2012-2018), which excludes Mithun cross**

ANNEXURE 4: CHBPP IMPLEMENTED DZONGKHAGS & GEOGS

Sl #	Dzongkhag	CHBPP Geog
1	Bumthang	Chokhor & Tang
2	Trongsa	Tangsibjee, Korphu, Langthel, Drekten & 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	TashiYangtse	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, NajaDogar & Hungreal
18	Haa	Bjee
19	Chukha	Darla, Sampheling & Phuentsholing
20	Samtse	Samtse, Ugyentse, Yoseltse & chengmari

ANNEXURE 5: DISTRIBUTION PLAN FOR LOCAL SEMEN PRODUCTION

Sl #	Bull NBIN	Dam	Sire no (name)	Grang 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, Pemagatsel, 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)*

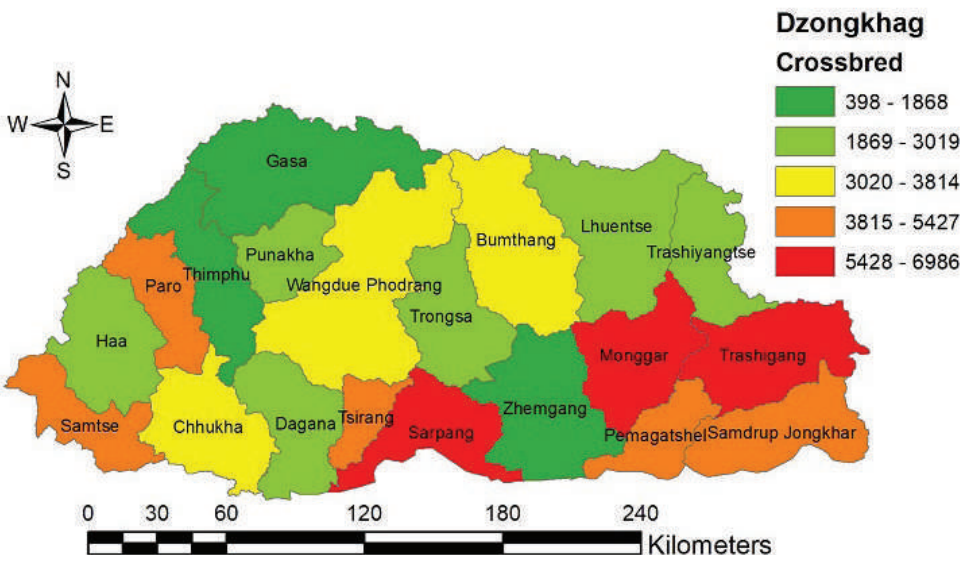
ANNEXURE 6: DISTRIBUTION PLAN FOR PROGENY TESTED SEMEN (JERSEY)

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			

RLDC Kanglung	Unit	1st qtr			2nd qtr			3rd qtr			4th qtr			Overall Total		
Summary		Produced	Sold	Gross income	Produced	Sold	Gross income	Produced	Sold	Gross Income	Produced	Sold	Gross Income	Produced	Sold	Gross Income
Milk	litre	952236	437340	17571799.2	516818	262920	10671012.5	593129	290030	10304630.3	916146	479407	20692101.25	2978330	1469697	59239543.2
Butter	kg	11359.8	12578.8	3643260	13057.3	13666.6	3906357.5	14588.5	13321.5	3717095	16153	2821.5	4365421	55158.54	42388.3	15632133.5
Cheese	ball	75552	73141.8	6451675	161934	174514	5934025	166758	161260	8926028	195048	107985	6534781	599291.8	516900.8	27846509
Butter milk	litre	15724.5	10048.5	298720	5541	4733	148314	4947	4059	117920	2910	2910	160345	29122.5	21750.5	725299
Yogurt	(200 ml cup)	10659	10659	532950	13207	13207	556210	13597	13597	458795	13349	13726	440715	50812	51189	1988670
Curd	litre										2854	2854	70920	2854	2854	70920
Lassi	litre				560	560	14000	570	570	14250	257	257	6425	1387	1387	34675
Skimmed milk	kg	1788	1788	53640	1310	1310	39300	2830.5	2830.5	138525	150	150	2760	6078.5	6078.5	234225
Hard cheese	kg	1031	1031	15465										1031	1031	15465
Sub Total																105787439.7
RLDC Wangdue		Produced	Sold	Gross income	Produced	Sold	Gross income	Produced	Sold	Gross Income	Produced	Sold	Gross Income	Produced	Sold	Gross Income
Milk	litre	98308.3	67177.3	3190997.6	109154	47554.5	2312392.5	115547	73853	3816142.8	134562	88589	3236217.5	457571.3	277173.8	12555750.4
Butter	kg	10722.4	7575	2596870	5637.23	4788.3	932800	5397.1	4696	1668797.5	5962.3	5324.6	1699315	27718.98	22383.9	6897782.5
Cheese	ball	68817.7	62763.7	2380165.2	47146.1	42159.4	590192.5	26986	23480	1739114	64562	49170	2020733.8	207511.3	177573.1	6730205.5
Gouda cheese	kg	210.7	120.949	58055.52				57.728	57.728	27709.44	122.2	35.6	17088	390.628	214.277	102852.96
Hard cheese	kg	526.4	20.6	11330				104	104	57200	67	67	36850	697.4	191.6	105380
Soft Cheese (Kg)	kg	113.9	139.216	62647.2							141.7	25.8	11610	255.6	165.016	74257.2
Lassi	(250 ml cup)	152	152	7600							235	235	11750	387	387	19350
Yogurt (200 ml cup)	kg	38983	38983	1364405	30717.9	30718	1075130				56156	56156	1965460	125856.9	125857	4404995
Curd (Litres)		5385	5385	297460	7649	7649	437100				6149	6149	375935	19182.5	19183	1110495
Sub Total																32001068.56
RLDC Tshimasham		Produced	Sold	Gross income	Produced	Sold	Gross income	Produced	Sold	Gross Income	Produced	Sold	Gross Income	Produced	Sold	Gross Income
Milk	litre	1315039	961946	38600142	1315039	898191	41305072.5							2630079	1860137	79905214.5
Butter	kg	23382	22568	6644100	23382	22568	6596500							46764	45136	13240600
Cheese	ball	6815754	253842	8281990	161682	164288	8281990							6977436	418129.5	16563980
Butter milk	litre	19499	15299	520465	89805	114489	4008956							109304	129788	4529421
Sub Total																114239215.5
RLDC Zhemgang		Produced	Sold	Gross income	Produced	Sold	Gross income	Produced	Sold	Gross Income	Produced	Sold	Gross Income	Produced	Sold	Gross Income
Milk	litre	-	-	-	-	-	-	-	-	-	-	-	-	858262.4	194915.2	8079691.4
Butter	kg	-	-	-	-	-	-	-	-	-	-	-	-	46099.4	45859.25	15941905.63
Cheese	ball	-	-	-	-	-	-	-	-	-	-	-	-	223082	222569	10704768.5
Skimmed Milk	litre	-	-	-	-	-	-	-	-	-	-	-	-	324306.5	324306.5	13351820
Butter Milk	litre	-	-	-	-	-	-	-	-	-	-	-	-	13725.4	13725.4	230022.5
Gauda Cheese (Kg)	kg	-	-	-	-	-	-	-	-	-	-	-	-	2874	2874	2011800
Yogurt (Cup)	(250 ml cup)	-	-	-	-	-	-	-	-	-	-	-	-	38064	38034	823335
Curd	litre	-	-	-	-	-	-	-	-	-	-	-	-	4319.5	4319.5	129585
Paneer	kg	-	-	-	-	-	-	-	-	-	-	-	-	2.8	2.8	980
Sub Total																51273908.03
Grand Total																303301631.8
Note; 1. RLDC Zhemgang submitted at once all 4 qtrs. 2. RLDC Tshimasham submitted only 2 qtrs 3. RLDC kanglung and Wangdue submiitted all qtrs																303.3016318 303.3 milion


Dzongkhag
Crossbred
398 - 1868
1869 - 3019
3020 - 3814
3815 - 5427
5428 - 6986
N
W
E
S
Gasa
Punakha
Thimphu
Paro
Haa
Wangdue Phodrang
Bumthang
Lhuentse
Trashiyangtse
Trongsa
Monggar
Trashigang
Zhemgang
Samtse
Chhukha
Dagana
Tsirang
Sarpang
Pemagatshel
Samdrup Jongkhar
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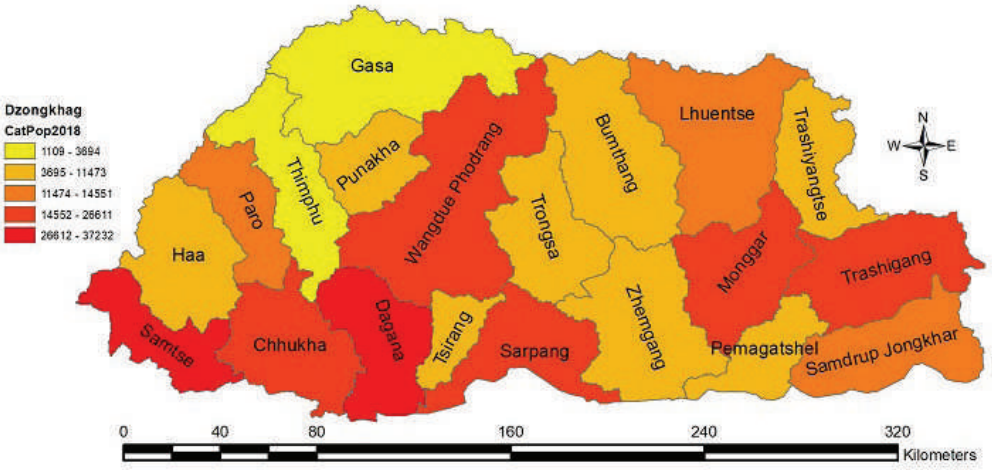
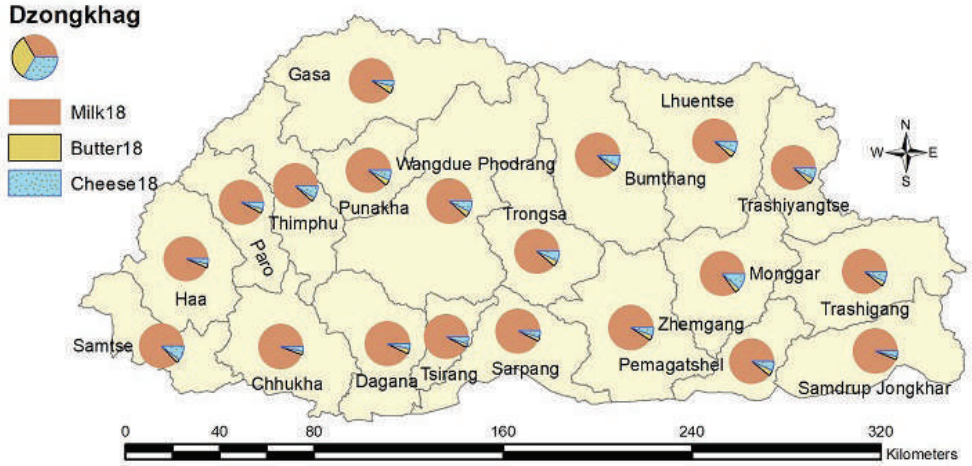
Kilometers


Dzongkhag
CatPop2018
1109 - 3694
3695 - 11473
11474 - 14551
14552 - 26611
26612 - 37232
N
W
E
S
Gasa
Punakha
Thimphu
Paro
Haa
Wangdue Phodrang
Bumthang
Lhuentse
Trashiyangtse
Trongsa
Monggar
Trashigang
Zhemgang
Samtse
Chhukha
Dagana
Tsirang
Sarpang
Pemagatshel
Samdrup Jongkhar
0 40 80 160 240 320
Kilometers


Dzongkhag
Milk18
Butter18
Cheese18
N
W
E
S
Gasa
Lhuentse
Wangdue Phodrang
Bumthang
Punakha
Thimphu
Trongsa
Trashiyangtse
Paro
Monggar
Haa
Trashigang
Zhemgang
Samtse
Chhukha
Dagana
Tsirang
Sarpang
Pemagatshel
Samdrup Jongkhar
0 40 80 160 240 320
Kilometers

SEXED SEMEN: IS IT A REALITY IN BHUTAN?

What is sexed semen?

Semen having X or Y bearing sperm to produce progenies of a desired sex either female or male (with about 80-90% accuracy) is known as sexed semen. Sex sorting technology was developed by the United States Department of Agriculture (USDA) researchers in Livermore, California, and Beltsville, Maryland. The technology was patented as "Beltsville Sperm sexing technology". The commercialization of sexed semen started in United States in 2001 with a license granted to Sexing Technologies (ST), Texas. At present, ST commercially produces sex sorted semen in many countries of Europe, USA, Canada, Mexico, Brazil, China, Japan and other countries.

How Sexed Semen is produced?

- Among several methods for semen sexing, flow cytometry based sorting has emerged as most efficient with purity of more than 90%.
- X-chromosome (female) contains about 3.8% more DNA than the Y-chromosome (male) in cattle. This difference in DNA content is used to sort the X- from the Y- bearing sperm. Sperm sorting procedure is as follows:
- Dilute sperm to a very low concentration and stain them with a fluorescent dye and send through the flow-cytometer
- As sperm pass through the internal laser beam, larger X chromosome, emit slightly more light than Y male sperm
- Laser detectors measure the amount of fluorescence and assign positive or negative charges to each droplet containing a single sperm(Figure 1).

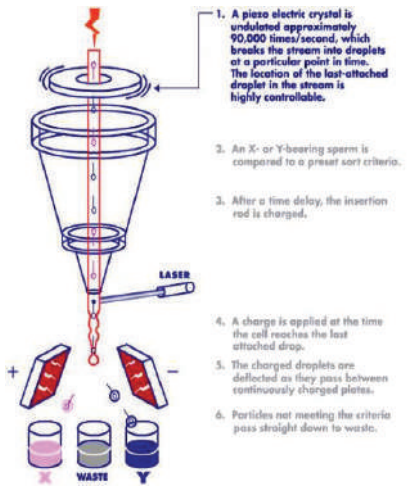


Figure 1.Sex sorting using flow cytometry (Courtesy: Sexing Technologies, USA

Advantages of using sexed semen

- Producing mostly female calves helps the farmers to save resources that would have been shared with unwanted males.
- Production of more female calves: increase supply of replacement heifers
- Opportunity to sell surplus heifers to other farmers/farms
- Speed up genetic improvement through:
  - ❖ Increasing efficiency of progeny testing Scheme(PTS)
  - ❖ Increasing efficiency of embryo transfer and In Vitro Fertilization(IVF) schemes

Limitations of using sexed semen

- High cost of sex sorting machine (USD 250,000 or Nu17.5M per Machine(University of Florida, USA, 2018)
- Low sorting efficiency and speed
- Require highly skilled person to operate sex sorting machines
- Damage to the sperm due to shear force, electrostatic charge & droplet formation ·

Implementation limitations

- High cost of sexed semen $23 or Nu.1600/ dose compared to $4.7 or Nu.329/ dose for imported conventional semen
- Sperm concentration of sexed semen ranges between 2-4 million/dose whereas it is 20 million/dose in conventional semen. Accordingly, conception rate with sex sorted semen is 10-15% less than the conventional semen. This factor is critical considering low AI coverage in Bhutan (about 17%) owing to difficult terrain

Sexed semen availability and field trials in Bhutan

Sexed semen is not produced in Bhutan due to high investment cost. It is imported regularly from western countries. Trials were conducted in a random samples of animals at Govt. as well as village farms. Conception rate with sex-sorted semen is 49% in heifers and 37.5% in cows (NDRDC, 2018). Sex ratio is about 92% (female) in Govt. farms.

Recommendations for use of sexed semen in Bhutan

Sexed semen has low sperm numbers per dose and compromises sperm viability. Hence, considering their high fertility rate of heifers, it is recommended that sexed semen should be used only in virgin heifers for better conception rate.

NATIONAL DAIRY RESEARCH & DEVELOPMENT CENTRE
DEPARTMENT OF LIVESTOCK
MINISTRY OF AGRICULTURE AND FORESTS
YUSIPANG, THIMPHU, BHUTAN, POST BOX: 1058
17116985 (Direct), 17116986 (Lab), 17116976 (PABX)
www.ndrc.gov.bt