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

DoL

ANNUAL CENTRE REPORT
2020-2021

Suggested Citation:
Annual Centre Report 2020– 2021. National Dairy Research & Development Centre, Department of Livestock, MoAF, Yusipang, Thimphu, Bhutan

Published By:
NDRDC, Yusipang
Department of Livestock, MoAF

Editors:
Program Director & Sector Heads, NDRDC

Layout and design:
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FROM THE PROGRAM DIRECTOR'S DESK

This is the 5th Annual Centre Report of NDRDC Yusipang, published to highlight progress and challenges while implementing National Dairy Research &Development Program during the fiscal year (FY) 2020-21.

During this FY, NDRDC Yusipang Sexed Semen Technology (SST) well tested in field is released by HE Sanam Lyonpo, MoAF on 3rd July 2021 along with user guidelines. This technology release is very timely in view of growing demand of heifers and need for such technology to accelerate dairy heifer production across the country. To facilitate the program over 7290 doses of sexed semen (including 4290 doses for eastern region) and 5300 doses of conventional semen from abroad to speed-up breed intensification program.

During the FY 6269 Artificial Inseminations (AI) were performed nationwide with success rate of 38.3%. The Progeny Testing Scheme (PTS) in Bhutan, initiated in 2017 using Holstein-Friesian (THF) Semen is progressing well. With the performance assessment of THF (F1 female) progenies, promising sires and bull-dam is being identified; contemporary young bulls will be selected for semen processing.

To facilitate setting of product standards, samples of local dairy products is tested to facilitate initiation of quality based milk pricing system in near future. Besides, Training of Trainers (TOT) for the extension officials yak dairy products development and dissemination standards as per Bhutan Standards (BSB) specification to extension officials. Additionally, seven BAFRA officials trained on main dairy products processing to assist them in implementing products testing and inspection.

To enhance application of climate smart farming practices 30 cubic meter Biogas Plant was set up at NDRDC, donor bull shed renovated with footbath and other bio-security features and manure management slurry pits widen and fenced. To match with the time, Ultrasound machines were procured to advance early pregnancy diagnosis techniques and infertility management. Staff of the Centre were also acquainted to use the ultra sound technology

Geared towards providing uninterrupted AI services, 26 Community AI Technicians were trained in three batches. This intervention complements the employment and income generation opportunities in rural areas. Besides, refresher course imparted to 15 staff on how to perform AI in Yaks and hands on training on bovine semen processing staff was also imparted to staff of highland Dzongkhags.

During FY, the Centre published Annual Centre Report, three technical guidebooks/Standard Operating Procedure and contributed five scientific papers to Bhutan Journal of Animal Science Vol: 5 (issue 1) to keep the momentum of research alive.

Despite challenges faced due to on- going COVID-19 crisis, NDRDC managed to deliver the required research and development services to the best of the capacity and will continue with same vigor in days ahead.

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 (2020-21) to share success stories and lessons learnt while implementing Dairy R&D activities during the FY.

Dairy input (liquid nitrogen (LN_2) and frozen semen) production and distribution is very crucial for success of cattle breeding program in the country. During the FY 20,627 doses of frozen semen and 35,937 liters of LN_2 was produced for distribution to Dzongkhags and Govt. farms.

To maintain the health of donor bulls and ET cows (49 heads including calves), fodder unit has established around 3.0 acres of improved pasture, renovated 15acres of existing pasture and conserved 210 MT of winter fodder (silage). Technical manpower support was also provided to Royal cattle herds, Ramtokto, and Royal Chipta Farm at Taba to maintain pasture.

Heifer Production Scheme (HPS) using sexed semen was initiated during this FY to intensify heifer production adopting a cluster village approach. The technology was officially relased on 3rd July 2020 by HE Lyonpo, MoAF. The Scheme is implemented in 17 Dzongkhags, covering 33 cluster villages and will be expanded to all potential geogs.

During the FY seven additional AI centers were opened, which make a total of 120 functional AI centers in the country. During the FY, 6269 Artificial Inseminations (AI) were performed nationwide with success rate of 38.3%.

To set local dairy products standards, samples are tested from various locations which will facilitate to initiate of quality based milk pricing system in near future. To build capacity on products processing. Extension officials from Yak priority areas were trained as trainers; information on dairy products standards as per Bhutan Standards (BSB) specification disseminated. Additionally, seven BAFRA officials were trained on main dairy products processing to assist them in implementing products testing and inspection.

Geared towards providing uninterrupted AI services, 26 Community AI Technicians were trained in three batches. This intervention complements the self-employment and income generation opportunities of youth in rural areas. Besides refresher course on AI in Yaks and hands on training on bovine semen processing staff was also imparted to staff of highland Dzongkhags.

During FY, the Centre published Annual Centre Report, four technical manual/guidelines and contributed five scientific papers to Bhutan Journal of Animal Science Vol: 5(issue1).

Along with substantial physical progress made, overall financial progress made in this FY was satisfactory. Out of the Nu. 35.088 M allocated to the Centre, Nu. 35.064 M was gainfully utilized, giving financial achievement percent of 99.93%.

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BACKGROUND

As part of the institutional strengthening strategy of the Department of Livestock, the erstwhile National Livestock Breeding Programme had been renamed as the National Dairy Development Centre (NDDC) with the 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 reorganised as the National Dairy Research and Development Centre (NDRDC) with the mandate to carry out need based action research for dairy development in the country. The centre is located at Yusipang, 14 km 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(Liquid Nitrogen and Frozen semen) for breed improvement. For faster genetic gain in indigenous and exotic cattle breed, research on the use of progeny tested sexed semen is popularized and embryo transfer technology is initiated.

PROGRAM PROFILE

Vision

- To be the Centre of Excellence/Knowledge Hub on dairy to ensure livelihoods security of farming communities

Mission

- Enhance productivity of dairy cattle for improved National Food and Nutrition Security
- Develop and strengthen innovative Research and Development(R&D) programs
- Provide coherent mechanisms to efficiently generate and disseminate knowledge and technologies on dairy farming

Mandates

- Serve as the apex arm of department of livestock for dairy research and development in the country
- Co-ordinate and conduct need based dairy research to establish knowledge and generate technologies in support of dairy development in the country
- Meet demand for high quality specialized inputs (*frozen semen and Liquid Nitrogen*) to accelerate dairy breed improvement in the country
- Package and transfer appropriate technologies and good practices to the end users
- Conduct trainings to impart skills on specialized field of dairy breeding and management

Major functions

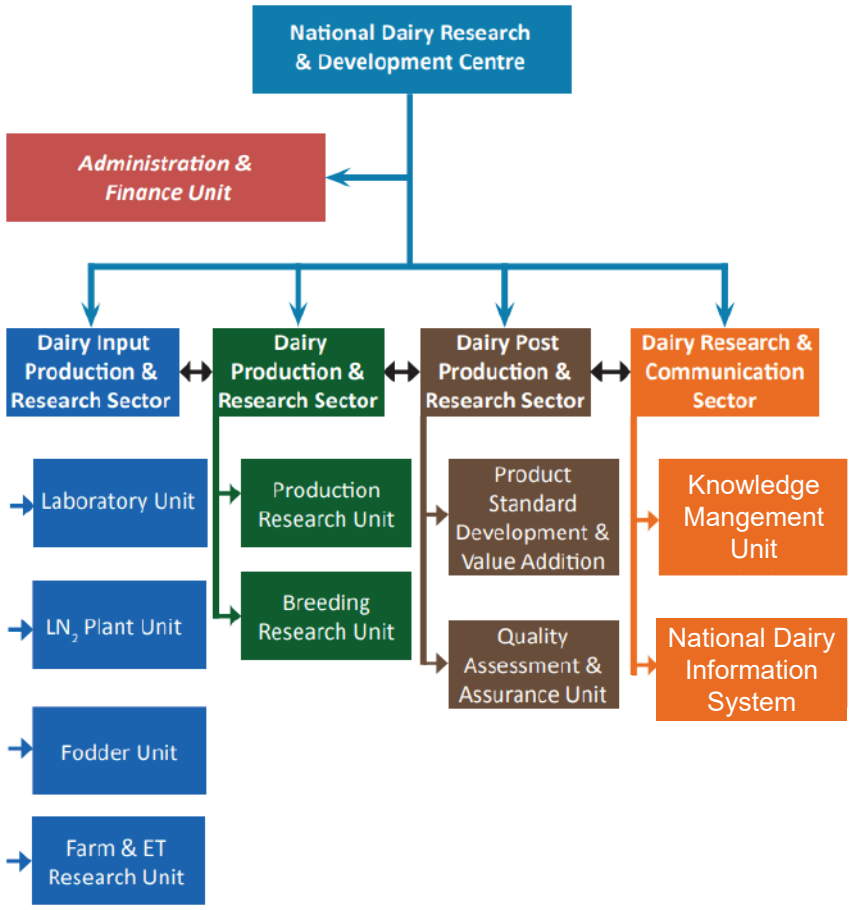
- Conduct need based research to trigger dairy development
- Produce or procure high quality specialized breeding inputs needed for breed improvement
- Develop Standard Operating Procedures, Good Manufacturing Practices and Better Farming Methods to enhance dairy production, dairy product development and value addition
- Manage National Dairy Information System- to captures real time data for a decision support system

- Prepare annual work plan and budget and manage performance of the center
- Create platform to coordinate and effectively implement Research and Development (R&D) activities
- Coordinate with National (NJBC/NNBC)and Regional Cattle Breeding Centers (RCBC) and other cattle farms and provide expertise to upheld technical efficiency of farms operation
- Support the Department of Livestock to formulate policies, strategies and guidelines
- Liaise with national and international agencies for technical collaboration for exchange of knowhow

Organizational setup

NDRDC has four sectors supported by Management & Directions Services to implement National Dairy Research & Development Program

3. Organizational Setup



INPUT PRODUCTION RESEARCH & DEVELOPMENT

DAIRY INPUT PRODUCTION RESEARCH & DEVELOPMENT SECTOR

Liquid Nitrogen (LN_2) production and distribution

The sole Liquid Nitrogen Plant with a production capacity reduced to 6litres/hr has to meet LN2 demand of three region (Western, West Central and East Central regions) while the LN_2 Plant at RLDC, Kanglung caters LN_2 needs of Eastern region. A total of 35937 litres of LN_2 was produced during the FY and 23445 litres was distributed to field (Table 1). The LN_2 production/distribution is disrupted due to the major break down of the plant's chiller unit. With budget support from NHRDC (Bumthang) and LRED (DoL) non-functioning parts of the water chiller unit was replaced during the FY. Further, due to the continuing Covid-19 pandemic situation, the Service Engineer from the contract Firm, Kolkata India could not visit to carry out regular servicing to resolve issues related with the Plant.

Table 1. Liquid Nitrogen produced &distributed

Sl	Activities	Quantity (Litres)
1	LN2 Production	35937
2	LN2 Distribution	23445
3	LN2 for Semen Bank refilling	7193
4	LN2 for S. Processing & freezing	3783
5	LN2 Evaporation losses	1886

Bovine Frozen Semen processing & distribution

The Semen Processing Unit produces frozen semen from three breeds of cattle (Jersey, Mithun and Nublang) and distributes to all AI Centres in the country. During the fiscal year, a total of 20627 doses of frozen semen were produced from different donor bulls. Over 5000 doses (24.2 % of pedigree selected semen produced) is distributed to various Dzongkhags during the FY (Table 2).

Table 2. Pedigree selected Frozen Semen Produced, Distributed & Stock Balance

Species	Opening balance	Production	Distribution	Balance
Jersey	101518	18862	4340	116040
Mithun	17738	1405	630	18513
Nublang	29,053	360	30	29383
Brown Swiss Cross	1772	0	0	1772
Total	**150081**	**20627**	**5000**	**165708**

The Centre also imported 5650 doses of Progeny tested (PT) / Genomic selected (GS) frozen bovine semen of different cattle breeds from Ms. Cogent Breeding Ltd., UK of which 3000 doses are sex sorted Jersey, 150 doses sex sorted HF and 2500 doses conventional Jersey semen. The details of imported frozen semen are presented in (Table 3). A total of 10961 doses (5000 pedigree selected, 4976 imported conventional semen & 985 sex sorted) were distributed to Dzongkhags and nucleus farms as per their demand.

Table 3. Detail of imported Progeny tested Bovine Frozen Semen

Species	Opening Balance	Imported	Distribution	Balance
Jersey Conventional	4917	5300	6652	3565
Jersey (Sex sorted)	7834	6790	4735	9889
Brown Swiss	313	0	70	243
Black Angus	350	0	0	350
Tropical Holstein Friesian	1228	0	300	928
Holstein Friesian (Conventional)	2147	0	739	1408
Holstein Friesian (Sex sorted)	600	650	540	710
Karan Fries	300	0	0	300
Scottish Highland Cattle	97	0	0	97
Buffalo Nilli Ravi	215	0	15	200
Buffalo (Murrah)	0	0	0	0
Total	**18001**	**12740**	**13051**	**17690**

Besides NDRDC facilitated procurement of PT/GS bovine semen for RLDC (Kanglung), Chukha, Pemagatsel, Zhemgang Dzongkhags and BLDCL from their approved budget. Over 7090 doses (4290 sex sorted & 2800 conventional) semen doses procured for them from USA. In total, 13051 doses of semen was distributed during the FY (Tables 2 & 3 above) (*Refer Appendix 1 for more details*).

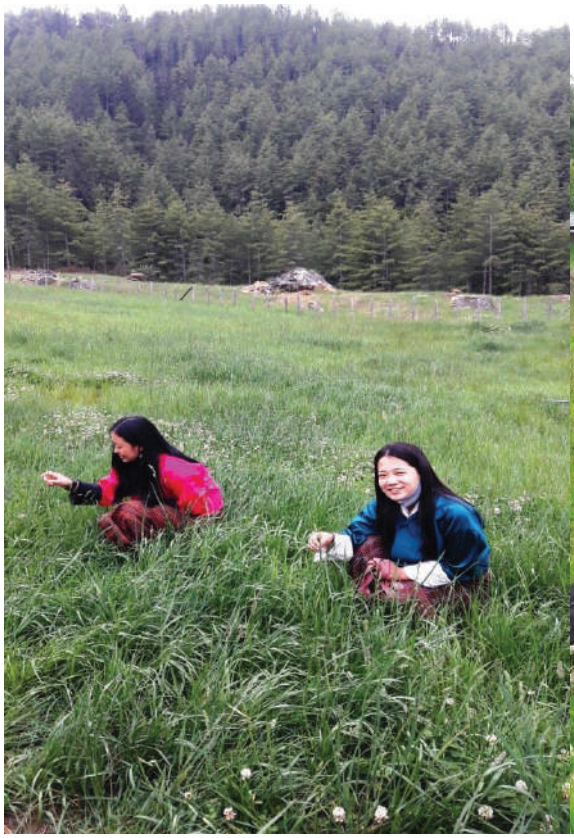
Animal nutrition and fodder conservation

Fodder unit besides managing pastures at NDRDC, provides technical supports on pasture development to Royal Dairy Herd in Ramtokto and Royal Chipta Farm at Taba.

The detail of pasture developed, renovated and winter fodder conserved is given in Table 4.

Table 4. Detail of pasture development

Unit	New pasture established (Acres)	Existing pasture renovated (Acres)	Conserved winter fodder (MT)	Cultivation of fodder maize (Acres)
NDRDC Yusipang	2	10	130	8
Royal Cattle herd Ramtokto	0.5	3	80	10
Royal Chipta Farm, Taba	0.5	2	-	-
Total	3	15	210	18



Farm Management & Embryo Transfer (ET) Research

Animal strength in the farm

The Farm Unit maintains elite semen donor bulls and Embryo Transfer donor cows (Thrabam & Jersey cross) cattle. There are 51 animals in the farm (table 5). Out of the total animals, 14 are adult donor bulls of three breeds and 5 are young bulls and 19 are ET Donor cows (Table 5)

Table 5: Detail of cattle maintained in the farm and mortality

Cattle Type	Nos.	Cattle Type	Numbers	
Semen Donor Bulls	18	ET cow/heifer/calves	33	
Jersey pure	4	Jersey cross calves	2	
Nublang	9	Nublang calves	9	
Mithun	5	ET Donors (Thrabum)	10	ET donor cows
Brown Swiss cross	0	ET Donors (Jersey X)	9	
		Thrabum Heifer	3	

ET/Embryo Flushing trials

During the fiscal year, the Centre carried out 5 Embryo flushing trials in fifteen (8 Thrabam and 7 JX) elite ET donor cows maintained at the Centre. A total of 30 embryos (5 degraded embryos, 10 two to eight cell stage embryos & 15 UFOs) were recovered. However, no viable embryos could be recovered for cryopreservation. The non-recovery of viable embryos from donors could be attributed to factors such as non-responsiveness to hormonal protocols due to use of expired hormones for super ovulation of donors, sub-fertile cows, low Body Condition Score, health status rather than the flushing technique.

The Centre planned to conduct embryo flushing programs in the field in close collaboration with National Biodiversity Centre (NBC) Serbithang) and National Nublang Breeding Farm (NNBF, Tashiyangphu). However, the planned programs could not be executed due to budget constraints in procuring specialized hormones used in ET protocols and the current Covid-19 pandemic situation.

Animal Health, Mortality and Farm Bio-security

Vaccination and deworming

Regular and timely vaccination and deworming were carried out for the 100% elite Semen donor bulls and ET animals maintained at the Farm Unit of the Centre. Further, the Centre carried out schedule vaccination and deworming of all animals (100%) maintained at Royal Soelbum herd, Ramtokto. The details of the vaccination and deworming carried out are in Tables 6 to 8.

Table 6. Vaccination record at Farm Unit, NDRDC, Yusipang

Breed	No. of animals	Sex	Vaccine type	Vaccination date
Pure Jersey	7	M	H.S & B.Q	20/08/2020
Nublang/ Siri	3	M	H.S & B.Q	20/08/2020
Mithun	5	M	H.S & B.Q	20/08/2020
Thrabum	19	F	H.S & B.Q	20/08/2020
Jersey Cross	9	F	H.S & B.Q	20/08/2020
Pure Jersey	7	M	FMD	02/11/2020
Nublang/ Siri	3	M	FMD	02/11/2020
Mithun	5	M	FMD	02/11/2020
Thrabum	19	F	FMD	02/11/2020
Jersey Cross	9	F	FMD	02/11/2020
Pure Jersey	7	M	FMD	14/04/2021
Nublang/ Siri	9	M	FMD	14/04/2021
Mithun	5	M	FMD	14/04/2021
Thrabum	19	F	FMD	14/04/2021
Jersey Cross	10	F	FMD	14/04/2021

Table 7. Vaccination record at Royal Soelbam Herd Ramtokto

Breed	No. of Cattle	Vaccination type	Vaccination Date
Pure Jersey	30	H.S & B.Q	10/9/2020 & 30/04/2020
Pure Jersey	30	FMD	03/11/2020
Pure Jersey	43	FMD	15/04/2021

Table 8. Deworming done at Farm Unit, NDRDC, Yusipang

	No. of Cattle	Sex	Deworming medicine used	Dewormed against	Deworming Date
Pure Jersey	7	M	Albendazole		12/8/2020
Nublang	3	M	Albendazole		12/8/2020
Mithun	5	M	Albendazole		12/8/2020
Thrabum	19	F	Albendazole		12/8/2020
Jersey Cross	9	F	Albendazole		12/8/2020
Pure Jersey	7	M	Albendazole	Internal parasites	21/04/2021
Nublang/ Siri	9	M	Albendazole		21/04/2021
Mithun	5	M	Albendazole		21/04/2021
Thrabum	19	F	Albendazole		21/04/2021
Jersey Cross	10	F	Albendazole		21/04/2021

Table 9. Deworming done at Royal Soelbum Herd, Ramtokto

Breed	No. of Cattle	Sex	Deworming medicine used	Deworming against	Deworming Date
Pure Jersey	14	F	Albendazole	Roundworm	4/2/2021
	6	M	Fenbendazole	Roundworm	4/2/2021



Medicine usage

Medicines are essential for ensuring animal welfare and preventing zoonotic diseases along with protecting our food supply. Medicines at the farm were judiciously used and indented as per the need and budget availability. The centre received medicines on 30 November, 2020 and 22May, 2021 from the Central store, Phuntsholing. There are no expired drugs at present in the centre


Following are the major group of drugs that were used in our Centre in 2020-2021(Table 10)

Table 10. Percentage of medicine used

Sl	Drugs group	Volume used (%)	Balance (%)	Used where	Remarks
1	Antimicrobial	80%	20%	NDRDC, Royal Soebum Herd Ramtokto	20% left form present stock (2nd batch)
2	Anthelmntics	90%	10%	-do-	10% from first batch
3	Analgesics	60%	40%	-do-	40% from 2nd batch
4	Antiprozoal	50%	50%	-do-	50% from 2nd batch
5	Hormones	50%	50%	-do-	50% from 2nd batch
6	Minerals &vitamins	50%	50%	-do-	50% from 2nd batch
7	Ectoparasites	50%	50%	-do-	50% from 2nd batch

Vaccines and vaccination

Vaccines are regarded as the most important medicine. Therefore, timely usage of vaccine helps in prevention of diseases at the farm to a great extent. Moreover, it plays a vital role in the cure of the diseases. FMD vaccination was done biannually with BQ vaccination done once a year. The Centre procured vaccines from NCAH as per the necessity and animal heads in the Centre.

The Centre used 100% vaccines that were procured at the NDRDC farm and Royal Herd, Ramtokto (Table 11)

Table 11. Percentage of vaccine used

Sl.	Name of vaccine	Received date	No. of doses	Remarks
1	FMD	10/10/2020	200	100% used in NDRDC, Royal Soebum herd, Ramtokto
2	FMD	11/04/2021	200	100% used
3	BQ/HS	26/05/2021	200	100% used

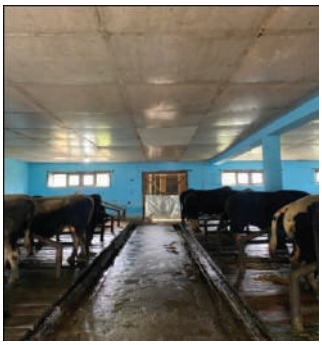
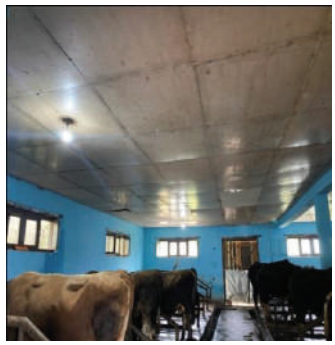
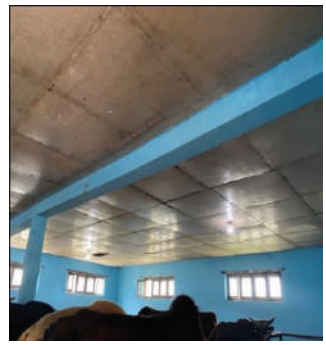
Herd mortality

During the FY only one young bull died. Herd mortality percent is 2.12%. The average herd strength for 2021 and 2019-20 is 47 animals.

Bio-security compliance

The farm is renovated, all lights, floor, railing reconstructed. Foot bath constructed at the entrance and is filled with pp solution 1%. The solution is changed twice in a week. Cleanliness of farm is maintained with attendants briefed on routine activities and critical aspects of farm bio-security. The routine activities were carried out with regular monitoring. Following activities were carried at the farm for bio-security measures at the farm:

i. The donor ***bull shed was renovated*** with installation of new roof and maintenance of ceiling along with the light. Floor and drainage was also maintained in the needy areas of the shed.

ii. The ***foot bath*** was constructed in front of each animal shed and the attendants were advised to fill with disinfectants to change the solution twice a week (1 % pp solution).



iii. ***Sign boards*** with labeling both in Dzongkha and English was put up for the medicine and feed store and a general store for the sheds were identified and maintained.

iv. ***Manure pit*** for each animal sheds were widened and deepened for proper management of manure. The dung are put in pit and covered for decomposition and application in pasture field.

v. ***Biogas plant (30 cubic meter capacities)*** was constructed for environment friendly manure management and mitigates Green House Gas (methane) emission. The biogas generated is to be used for heating and cooking.




DAIRY PRODUCTION RESEARCH & DEVELOPMENT

DAIRY PRODUCTION RESEARCH & DEVELOPMENT SECTOR

Overview

Dairy production is gaining steady momentum over the years. Annual milk production increased from 29,625MT (2012) to 57,546.8MT (2019). Gross income generated by farmers (if all milk is sold @Nu 40/kg) is Nu.2.30B annually. Per capita milk availability increased from 113gm (2012) to 206.6gm /day in 2020 (MoAF 2020_RNR Strategy 2040). Milk self-sufficiency increased from 63% in 2012 to 93% in 2020.

The target set for milk production by end of 12th FYP (2022 – 23) is 56,300 MT to achieve 91% self-sufficiency in domestic milk production, but expectations are to produce milk and milk products beyond 12th FYP target. Therefore, dairy production and breed improvement programs are further intensified in 12th FYP with focus on application of sexed semen technology under Heifer Production Scheme (HPS), training and deployment of Community based AI Technicians (CAIT), providing AI refresher courses to livestock field staff and establishment of AI centres wherever feasible. Beside, for sustainability of dairy production system, farmers' institutions such as Dairy Farmers Groups (DFGs) and Cooperatives (DFCs) are being strengthened and Progeny Testing Scheme (PTS) is pursued for development of climate resilient dairy cattle breed for Bhutan in long run.

Dairy Breeding Research

Progeny Testing Scheme implementation

The Progeny Testing Scheme (PTS) in Bhutan was initiated in 2017 using tropical Thai Hostein-Friesian (THF) Semen in Samtse and Tsirang Dzongkhags. Three geogs were selected; Tading in Samtse and Barshong and Sergithang in Tsirang, and categorized into three agro-ecological zones (AEZ) according to altitude, temperature and rainfall. A total of 568 animals were selected and identified initially from the areas. The THF semen of four sire-lines was distributed equally in all PTS areas. The Scheme was implemented in phase-wise manner, inseminating the selected animals in induced heat (1st & 2nd phases) and in natural heat by the Community AI Technicians (CAITs) later. Review of coverage of PTS was done twice in a year with reporting done in half yearly basis (***gist of report in Appendix 2***)

The AI success rate obtained from insemination in induced heat was 18.1% (n=431); 14.1% (n=298) with 48 hr. protocol in 1st phase and 27.1% (n=133) with 52 hr. protocol in 2nd phase, and 48.3% (n=176) in natural heat. The overall AI success rate obtained was 21.2% (n=581); resulting in total birth of 123 progenies; 66 males and 57 females.

The uptake of PTS was recorded very poor despite of training and deployment of CAITs. The AI services provided by the CAITs were disrupted due to non-remuneration by the beneficiaries and shortage of LN_2 owing to frequent breakdown of LN_2 plant at Yusipang. Hence, there is a need to establish LN_2 plants in each RLDCs with replacement of old LN_2 plants, and devise a mechanism to incentivize the CAITs for overall success of AI program in the country. The birth of more male progenies from the THF bulls is discouraging to the farmers and the success of the Scheme is questioned. Nevertheless, with the performance assessment of THF F1 female progenies, bull-dam

will be selected that will aid in selection of THF bulls for future semen production from the breed in the country.

Sexed Semen Technology popularization

Over 2800 dairy cows and regnant heifers were sourced from India and supplied to dairy farmers in 11th FYP (NDRDC, 2018) as the demand exceeded the in-house production of heifers. However, the initiative was confronted with challenges of exotic diseases incursion into the country, despite of strict quarantine measures in place, and poor adaptability of imported animals in new farming environment. Thus the sourcing and supply of dairy cattle was risky and not sustainable. As an alternative measure to fast track dairy sector development, sexed semen was imported and usage trial (on-station and on-farm) was conducted from August 2014 to March 2018. The trial resulted in AI success rate of 44.4%, with female birth assurance of 89.6% (Rai et al., 2019). With the promising result obtained during the trial the **"Heifer Production Scheme"** was initiated through application of sexed semen technology in 12th FYP. The technology was officially launched on 3rd July 2020 by the Hon'ble Minister, MoAF.

During the FY 2020-21, a total of 1441 AI were performed using sexed semen and recorded progeny born of 613; 68 male and 545 female leading to 88.9% female birth (detail in annex 3). The AI success rate recorded was 42.3% which could be attributed to supply of sexed semen in best performing AI centres with fluent AI technicians. It has been planned to reach the Scheme in 72 AI centres among CHBPPs/ DFGs by end of 12 FYP, considering breedable Jersey and HF heifers' population, to cover 60% of total AI centres in the country (120 AICs in 2020-21).

AI PERFORMANCE AND PROGENY RECORD

In the year 2020-21 seven no additional AI centres were opened and remained a total of 120 AI centres in the country. During the FY, a total of 6269 AI were performed and recorded 2403 progenies (924 male and 1479 female) marking AI success rate of 38.3% (Table 12, *Refer details in Annexure 4a & 4b*). The birth of male progenies is 38.5% and that of female is 61.5%.

Table 12. Summary of AI and Progeny record (July 2020 – March 2021)

Region	Dzongkhag	AI performed (no)	Progeny recorded			AI success rate (%)
			Male	Female	Total	
Western	Thimphu	161	29	63	92	57.1
	Paro	475	70	101	171	36.0
	Had	80	12	27	39	48.8
	Chukha	285	43	90	133	46.7
	Samtse	506	97	120	217	42.9
	Total	***1507***	***251***	***401***	***652***	***43.3***
West Central	Gasa	75	20	17	37	49.3
	Punakha	652	66	116	182	27.9
	Wangdue	195	37	50	87	44.6
	Tsirang	513	76	196	272	53.0
	Dagana	148	14	30	44	29.7
	Total	***1583***	***213***	***409***	***622***	***39.3***

East Central	Bumthang	249	40	62	102	41.0
	Trongsa	284	72	94	166	58.5
	Zhemgang	98	22	13	35	35.7
	Sarpang	220	20	39	59	26.8
	Total	***851***	***154***	***208***	***362***	***42.5***
Eastern	Lhuntshe	82	9	9	18	22.0
	Monggar	845	107	145	252	29.8
	Trashiyangtshe	103	18	18	36	35.0
	Trashigang	467	95	162	257	55.0
	Pemagatshel	448	53	57	110	24.6
	Samdrupjongkhar	383	24	70	94	24.5
	Total	***2328***	***306***	***461***	***767***	***32.9***
	Grand Total	**6269**	**924**	**1479**	**2403**	**38.3**

Cumulative AI performed as of March 2021 (from 1987) is 187,577 (181,308+6269) and progeny born recorded is 60,486 (58083 +2403).

During the financial year, there were 120 AI centres and average AI performed was 5.8AI/month/centre. The highest performance was recorded for LEC, Chaskar with 43AI/month, followed by DVH, Damphu with 26 AI/month and by DHV, Punakha with 24 AI/month (Annexure 5). On analysis of the report, following observations were made;

- the no of AI centre and average AI performance was same as in FY 2019-20
- the AI success rate has increased from 33.1% (FY 2019-20) to 38.3% during this financial year, which could be attributed to providing of AI refresher courses to the field staff AI Technicians over the past few years
- there was not a single Dzongkhag where all AI centre in the Dzongkhag had AI performance above the national average of 5.8AI/month during the reporting year
- majority of AI centre (64%, n=77/120) had performed below the national average, which warrants close scrutiny in their functioning from concerned Dzongkhags and RLDCs.

Overall, to boost dairy production via AI services, more emphasis should be given on training and deployment of CAIT, improve skills of existing AI technicians via AI refresher courses, relocate or close under-performing AICs and take joint ownership of the AI programme by the concerned stake holders at all levels.

Reproductive waste management

Animals that do not reproduce within the stipulated/ expected time or age are not always infertile but they may be posed with reproductive disorders owing to various reasons; embryonic mortality, cystic ovaries, persistent CL or non development of follicles on ovaries, etc. leading to repeat breeding, irregular heat or no heat signs at all.

During the financial year 2020-21, the Reproduction experts from NDRDC, Yusipang attended animals presented with infertility and reproductive disorders during the visit in the areas. A total of 300 animals were actually presented for examination; pregnancy diagnosis as well as infertility, and treatment (Table 13). The animals were synchronized for estrus using Controlled Intra-vaginal drug Delivery Release – Bovine (CIDRB) and treated against infertility or reproductive disorders

employing hormonal drugs such as GnRH and/ PGF2α depending on the ovarian status of the animal upon per-rectal examination. However, the success of such interventions is determined by the diagnostic precision of reproductive status by the examining veterinarian and health status of the animal.

Table 13. Animals presented for gynecological investigation, treatment of infertility and AI

Dzongkhag	Geog/ Area	Animal examined	Treated for reproductive Disorders*/estrus synchronized**	Responded to treatment & AI done
Bumthang	Tang	102	31**	29
Samtse	Tading	43	14*	10
Tsirang	Semjong	17	10*	8
Pemagatshel		30	24**	20
Chukha	Chapcha	5	4*	3
	Gangtey/	19	18**	18
Wangdue	Gogona			
	Rubesa/ Jala	52	48**	48
Thimphu	Mewang/	32	22*	18
	Tshaluna			
Total		**300**	**171**	**154**

Overall, 90% of animals that were treated for reproductive disorders/ estrus synchronized had responded to treatment/ synchronization and AI done subsequently, which concludes that the diagnosis and treatment measures adopted were very effective.

Community AI Technician training

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, the National Dairy Research & Development Centre (NDRDC), Yusipang, in collaboration with concerned Regional Livestock Development Centres (RLDC) and Dzongkhag Livestock Sectors conducted training on AI for early school leavers, who are referred as "***Community based AI Technician" (CAIT).*** The training was conducted for 28 days at different occasions during the financial year.

A total of 26 CAITs were trained during the FY 2020-21 in three batches; four at Bumthang, nine at Tsirang; 3 from Dagana and 6 from Tsirang, and thirteen at Pemagatshel. The intervention

directly complements the objective of the Department of Livestock (DoL) to enhance employment and income generation opportunities in rural areas.

Impact Assessment of Breed Intensification Program on breed improvement and livelihood security of dairy farmers in Tsirang Dzongkhag

Overview

To assess the impact of breed intensification programme a review was conducted in Tsirang Dzongkhag among the Contract Heifer and Bull Production Program (CHBPP) in 2019-20 and the information was updated and validated in March 2021. For the review, structured questionnaire was used to assess the impact of CHBPP in Tsirang Dzongkhag; Kilkhorthang, Gosarling and Rangthangling Geogs.

Objectives

- Assess impact of breed intensification on quality of animals by blood level progression in the CHBPP herds
- Assess the productivity of CHBPP animals, socio-economic benefit, and identify constraints and opportunity to improve the breed intensification program

Data collection and review

Random sample of households involved in CHBPP were selected for data collection, ensuring minimum coverage of 25% of existing households in the programme. The household covered in selected CHBPP is presented in table 14.

Table 14. CHBPP areas surveyed and coverage in Tsirang Dzongkhag

Study areas	Year of inception	h/h registered during inception	H/h registered as of March 2021 (nos)	H/h covered during the survey (nos)
Kilkhorthang	2008	34	134	42 (31.3%)
Gosarling	2008	16	89	29 (32.6%)
Rangthangling	2008	25	75	24 (32.0%)
Total		75	298	95 (31.9%)

Salient findings

The CHBPP at Kilkhorthang, Rangthangling and Gosarling under Tsirang Dzongkhag was started in the year 2008. Since inception there had been nearly three folds increase in number of h/h registered under the program. Jersey cattle population has also increased by almost 2.3 times (n=357/156) in Tsirang Dzongkhag since the inception of the program (Table 15)

Table 15. Cattle population dynamics in the surveyed areas, Tsirang

CHBPP areas surveyed	Jersey category according to exotic blood level (%)	Initial Jersey cattle selected among surveyed h/h(Nos)	Existing Jersey cattle of surveyed h/h (Nos)	Milking cattle (nos)
Kilkhorthang	Crossbred;< 93.75	77	169	62
	93.75 & above	0	0	2
Gosarling	Crossbred;< 93.75	43	110	37
	93.75 & above	0	0	6
Rangthangling	Crossbred;< 93.75	36	78	27
	93.75 & above	0	0	1
Total		156	357	135

When assessed the population of milking cattle in the surveyed areas, most of them were found in 1st to 4th lactations, when animals were at productive stage. This indicates that the CHBPP farmers are educated enough to dispose cattle from their herds during unproductive stages of lactation particularly after 6th lactation, and generate revenue at the same time. The CHBPP farmers among the h/h surveyed generated revenue of **Nu. 6.02 M** through sale of 224 animals in 11 years with average income generation of **Nu. 5,760/annum/household** (n=95) in Tsirang Dzongkhag through sale of animals only.

When milk production level of CHBPP animals was assessed, the average daily production stands at 6.1L, 6.1L, 8.1L, 9.7L and 11.7L for jersey of 50%, 62.5%, 75%, 87.5% and 93.75% and above respectively. The daily productivity was found increasing by blood level as intended.

Among the CHBPP h/h surveyed, majority of the members (59%, n=95) expressed that there are adequate market for fresh milk and however, some of them processed into butter and cheese. With the survey, the existing farm gate price (Nu. 38.5) and market price (Nu. 50) for fresh milk were same in all CHBPP areas.
If all milk produced on daily basis is sold as fresh the farmers would generate income of **Nu. 15M** through sale of milk annually by CHBPP farmers in Tsirang, which accounts to **Nu. 157,447/household/annum**

Of the 2800 animals imported in the country during 11th FYP only nine households had imported one each HF cross cows in entire Tsirang Dzongkhag. Overall, 90% of CHBPP farmers (n=95) are self content with in-house production through AI services This indicates that there is positive impact of breed intensification program on availability of quality replacement stock.

The assessment concluded that implementation of CHBPP was found to be successful in Tsirang Dzongkhag. The majority animals in the CHBPP herds were farm born which is a positive impact of the breed intensification program as the increase in no. of crossbred animals in the CHBPP herd. Besides, the Programme had provided the soci-economic benefit to beneficiaries with the income generation support on an average of Nu 157,447/member/ annum through sale of milk only.

However, smooth implementation of the programme was constrained by difficulties in maintenance of breeding records, milk production records and disposal of male calves born out of conventional semen in the program. CHBPP in Tsirang Dzongkhag is now provided with sexed semen under Heifer Production Scheme, which is expected further strengthen the program with more heifer joining the herd and issue of male calf birth and disposal problem greatly addressed (*For detailed report please refer to appendix 3*)

Dairy Production Research

Farmers Institution

The dairy farmers are supported in group with establishment of milk collection centre, milk processing unit and dairy sales counter for fresh milk marketing, dairy product processing and dairy product marketing group respectively, as it is difficult provide support at individual level. The approach encouraged the farmers to come together and function in group led by elected members of Chairperson, Secretary and/ Treasurer in each group. These groups are referred here as "**Farmers' Institution**"; Groups at village and geog level, Cooperatives at Dzongkhag level, Federation at regional level and Union/ Board at national level. The layer of institutions at various levels will complement the sustainability of dairy production system. Further, in order to boost dairy production in the country, dairy enterprises will be established wherever feasible according to guidelines for its establishment.

As of June 2021, there are 242 Dairy Farmers Groups & Cooperatives (DFG&C); 224 Dairy Farmers Groups and 18 Dairy Cooperatives operated as groups, with an average of 28 members per group or cooperative, based on the OGTP report compiled on annual basis. Distribution of DFG&C was highest in eastern region followed by western region (Figure 1).

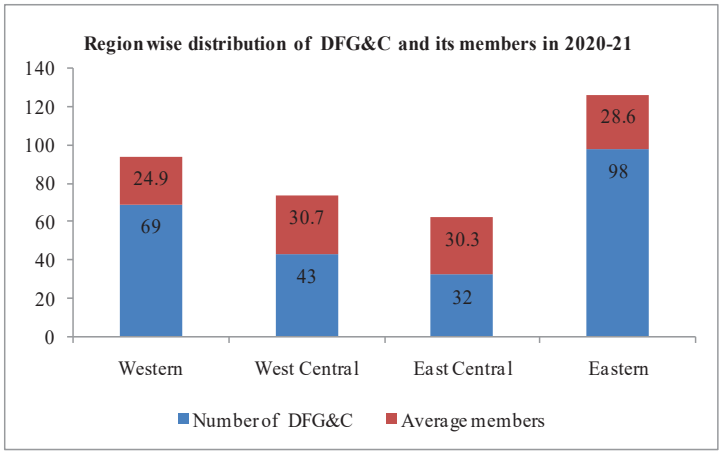


Figure 1. Region wise distribution of DFG&C and its members in 2020-21

Among the group, 192 groups were involved in milk production, processing and marketing whereas remaining 50 groups were left unreported which could be owing to dried off (non-milking) animal in their herd at the time of data compilation. Nevertheless, during the reporting year, the DFG&C had produced on an average of 8.6 – 10.8 l/day/ member and contributed in the

production of 11,191.1 MT (n=192) – 14,105.5 MT of milk (n=242), which accounts to 19.4% - 24.5% of total milk production in the country**.**

Development of Dairy Production Manual

The dairy farmers have good quality crossbred cattle now but milk production potential of these breeds could not be tapped fully owing to following attributes:

- Inadequate feeding, management and housing facilities that compromise the comfort, welfare and production of animals.
- Poor adoption of good health management practices
- Inadequate uptake of systematic breeding and reproductive management practices

Therefore, "Dairy Production Manual" [***NDRDC (15), 2021***] has been developed to address the above attributes covering the relevant topics (*The manual is edited by NDRDC Technical team and is ready for printing and distribution).*

The manual shall provide overall guidelines for dairy cattle management; proper breeding and reproduction, selection of good quality animals, feeding, housing and health care, under Bhutanese environment. The manual is intended for use by dairy farmers and Livestock Extension Agents to enhance dairy productivity and farm income.

Guidelines for Establishment, Operation and Management of Dairy Enterprise in Bhutan

The guidelines [NDRDC publication (17), 2021] is developed to facilitate and empower Bhutanese dairy farmers to operate dairy farming on business mode as "Dairy Enterprise" geared towards environment friendly operation for sustainable socio-economic development, while investing in dairy sector for achieving self-sufficiency in dairy products in the country (*Refer to Appendix 4 for detailed guidelines*).

DAIRY POST-PRODUCTION RESEARCH & DEVELOPMENT

DAIRY POST-PRODUCTION RESEARCH SECTOR

Product Standard Development and Value Addition

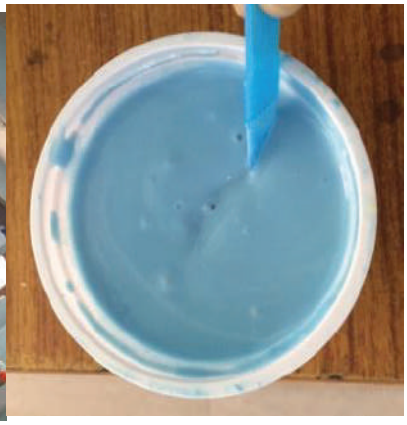
Post Production Technology Transferred

i. Training of Trainers

The sector in collaboration with the Livestock Research and Extension Division DoL conducted a Training of Trainers (TOT) for the extension officials from Thimphu, Wangduephodrang, Paro, Gasa, Haa and personnel from Yak Farm (Haa and NHRDC, Bumthang) for duration of 7 days. The training was focused on Dairy Product Diversification with theoretical and practical hands on training on product manufacture with the aim to address pertinent marketing issues faced by herders and to enhance proper product processing and marketing value chain.

ii. Training of Dairy Plant Technicians

Following request from the Thimphu Dzongkhag Livestock Office, the sector conducted training of technicians of the Thimphu Dairy Plant, Babesa on theoretical, and hands-on-training practical application of platform milk tests, good manufacturing practices and dairy product processing. The trainees were provided with practical sessions on processing of dairy products such as flavoured set yoghurt, drinking yoghurt and flavored stirred yoghurt. The training was aimed at enhancing the knowledge and skills on platform milk tests, dairy product processing of the participants for production of quality products.

Dairy Products Standards (Bhutan Standards Bureau (BSB) Specifications) Disseminated

The Centre along with training of personnel also disseminated dairy products standards as per BSB specification to extension officials from Thimphu, Wangduephodrang, Paro, Gasa, Haa and personnel from Yak Farm (Haa and NHRDC, Bumthang) and technicians of the Thimphu Dairy Plant, Babesa. Furthermore, the sector was also involved in the development of Scheme of Testing and Inspection (STI) as per BSB standards and training and dissemination of the BSB standards to BAFRA personnel as outlined below:

i. **Development of Draft Scheme of Testing and Inspection (STI)**

Personnel from the sector participated in the development of STIs under the Cottage and Small Industries CSI Flagship program. The program was initiated to facilitate market access of agro-based CSI products, food business licensing and product certification for butter, cheese and Paneer in collaboration with BAFRA, MoAF. The STI were developed as per BSB standards and will be the basis for the implementation of the National Standards by the CSIs for self monitoring and internal controls and audit by the certification body.


ii. Training of BAFRA Personnel (BSB Standards)

As part of the Cottage and Small Industries (CSI) Flagship Program on enhancing market access of CSI products, BAFRA submitted a request for training of 7 BAFRA officials on the manufacture of Paneer, Datshi and Butter as per BSB standards. Following the request, the sector carried out 3 day training on Milk processing technologies and Milk testing to further enhance the participant's practical knowledge. The knowledge and skills gained during the training is expected to assist the BAFRA officials in implementing the requirements of the Scheme of Testing and Inspection with respect to Butter, Cheese and Paneer for obtaining product certification by the Milk Processing Plants as per National standards.

Capacity Building

Personnel from the sector were nominated to attend following virtual capacity development programs organized by BAFRA and DAMC. Participation in the virtual trainings is as follows:

i. Training Program on HACCP

Personnel from the centre was nominated and selected to attend training program on HACCP for eventual participation as Trainers and Counselors for the implementation of HACCP in selected Agro Based Small and Medium Enterprises (SME). The training course was facilitated by BAFRA and funded by the EU – Bhutan Trade Support Project and held "**Virtually"** with active participation in facilitating assigned local SMEs to obtain HACCP certification.

ii. Training on Effective Participation in Codex Works

Personnel from the centre attended a 2 day program on Effective Participation in Codex Works organized by BARFA. The aim of the meeting was to strengthen the function of National Codex Structure through effective engagement of all stakeholders in Codex activities and standard setting process. Furthermore, it was also intended to improve scientific and technical capacity of national experts to contribute to the scientific basis of Codex and promotion of sub-regional cooperation.

iii. **Virtual Training for Value Chain Analysis and Small Business Development**

Personnel from the centre attended 8 days **"Virtual Training"** course for Value Chain Analysis and Small Business Development organized by the Department of Agricultural Marketing and Cooperatives and the Maastricht School of Management, The Netherlands. The overall objective of the virtual training was to help participants understand the dynamics of value chain and what is needed to connect agro based small and medium enterprises and clusters to value chains.

Dairy Infrastructure Monitoring

The sector conducted monitoring of the Tamshing Gonor Gongphel Chuethuen Detshen and Chumey Gonor Lothen Detshen, Bumthang to assess the overall functioning of the MPUs in terms of following Good Manufacturing Practices and plant hygiene. Compositional analysis of milk supplied to the MPUs was assessed and the mean results are presented in Table 16.

Table 16. Compositional analysis of milk supplied to the MPUs

Parameters	Tamshing GGCD	Chumey GLD
Fat (%)	4.48	4.73
Protein (%)	3.01	2.80
SNF (%)	8.21	7.66
Density	28.40	26.03
Lactose (%)	4.52	4.21
Salt/Minerals (%)	0.68	0.63
Added Water (%)	1.01	5.76
Freezing Point (°C)	-0.530	-0.490

The monitoring and evaluation report inclusive of the findings and recommendations have been shared to the Livestock Sector Bumthang.

Quality Assessment and Assurance

Procurement of Dairy Equipment (RDCCRP Funding)

The sector received a fund support of Nu. 4.450M from the RDCCRP for procurement of dairy and laboratory equipment for use in the two sections of the laboratory. Essential equipment to be used for the chemical/physical and microbial analysis of milk and milk products at the NDRDC in-house laboratory were procured. The laboratory is equipped with water filtration system, ultra pure water filter for laboratory use, laboratory climate control system, materials for microbial analysis as well as milk analyzers and somatic cell counter. Equipment for use by MCCs and MPUs for the implementation of Quality Based Milk Payment System (Milk Analyzer, MBRT test, Platform Milk Test) was also procured.

Research on Milk Quality in Thimphu Dzongkhag

Following approval provided by the Livestock Technical Advisory Committee (LTAC), DoL the sector initiated research into the composition and microbial parameters of milk in Thimphu Dzongkhag. The analysis is being carried out for institution of Quality Based Milk Payment System (QBMPS) as the current practice of payment for milk is based on volume supplied irrespective of the compositional and microbial quality of the milk procured. This system of payment is vulnerable to adulteration of milk to increase volume by the addition of water and other adulterants. There are no measures to ensure the production and supply of hygienic and good

quality milk that could have serious public health implications. The institution of a QBMP system is expected to address these challenges and eventually ensure the supply of hygienic and good quality milk and milk products to consumers.

Thimphu Dzongkhag was selected as the pilot area as majority of raw milk and milk products from various dzongkhags are marketed in Thimphu and also taking into consideration the CoVID 19 travel restrictions. The research areas were identified in consultation with the Dzongkhag Livestock Office, Thimphu Dzongkhag based on current operational status of the dairy groups and supply of milk to Thimphu town. A total of 7 locations (Tshaluna, Gyenekha, Kasadrupchu, Begena, Hangkawog, Dazhi and Yusipang) were selected.

Preliminary analysis showed high microbial load in the raw milk samples ranging from 10^3-10^8 cfu/ml. Compositional analysis of milk showed prevalence of water adulteration and somatic cell count ranged from 127,000-163,000 cells/ml.

Microbiological and Moisture analysis of Local butter and *datshi*

As part of ongoing research into the microbial and moisture analysis of local butter and *datshi*(local cottage cheese*),* personnel from the sector were involved in the collection of samples from Bumthang Dzongkhag. The samples were submitted to National Food Testing Laboratory, BARFA, Yusipang for moisture and microbial analysis.

Compositional Analysis of Raw milk

As part of the ongoing research on the compositional quality of milk from different dzongkhags, the sector analyzed milk samples from Trongsa and Bumthang Dzongkhags. A total of 40 raw milk samples from each Dzongkhag were analyzed using the Lactoscan Farm Eco milk analyzer with average results obtained presented in Table 17.

Table 17. Compositional Analysis of Raw Milk

Parameters	Trongsa	Bumthang
Fat (%)	5.63	4.57
Protein (%)	2.93	2.93
SNF (%)	8.10	8.00
Density	26.48	27.51
Lactose (%)	4.42	4.41
Salt/Minerals (%)	0.72	0.66
Added Water (%)	0.77	2.79
Freezing Point (°C)	-0.527	-0.513

From the total samples analyzed, water adulteration was detected in 20% and 55% of the samples from Trongsa and Bumthang respectively.

Attended TC 02 Food and Agriculture Technical Committee, Bhutan Standards Bureau meeting as representative from the DoL.

Personnel from the sector was involved in the Bhutan Standards Bureau TC 02 Food and Agriculture Technical Committee as a representative from the DoL, MoAF. The committee is involved in the drafting and review of standards pertaining to the food and agriculture sectors.

Dairy Research Communication

DAIRY RESEARCH COMMUNICATION SECTOR

Training and Skill Development

Training on application of Ultrasound Technology

In house training of staff of NDRDC on use of ultrasound technology for pregnancy diagnosis and detection of reproductive disorders was conducted on 22 June 2021 to all interested staff of NDRDC with trainer from IMV France.


Refresher course on Artificial Insemination (AI) in Yaks

Two weeks refresher course on Artificial Insemination (AI) in Yaks successfully conducted at Integrated Yak Farm, Haa. Fifteen participants from Bumthang, Thimphu, Gasa, Paro and Haa of (highland dzongkhags) and staff of National Highland Research & Development Centre (NHRDC), Bumthang attended the refresher course. AI training in yaks is the first of its kind conducted in the country.


Hands-on training on bovine semen processing

Seven staff of NHRDC was provided hands on training on semen processing including bull management, semen collection, processing and cryo-preservation.

Knowledge Management

Research conducted/ papers published in Bhutan J of Animal Sc Vol. 5, Issue 1.

Five research activities were completed in this FY and five papers (highest number each year) is contributed by NDRDC to Bhutan Journal of Animal Science to keep the momentum of research alive. The papers published in 2021 are:

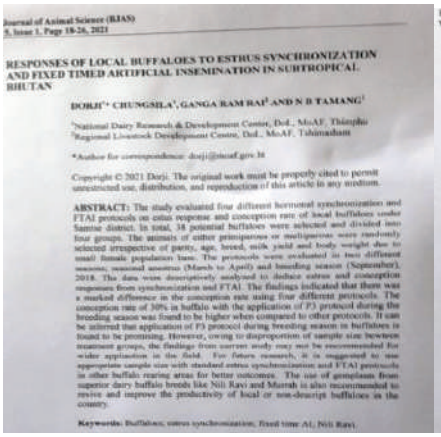
i. *Compositional Quality of Milk sold at urban sales outlet*
PHUNTSHO T NORBU* AND KINLEY CHOKI

ii. *Assessment of Non-Genetic Factors affecting the Quality of Bovine Semen Production under Bhutanese environment:*
DHAN B RAI* AND DORJI

iii. *Determining Cost of Milk Production in Bhutan*
DEKI CHODEN*, LOKEY THAPA, NAR B TAMANG AND DHAN B RAI

iv. *Microbial qualities of traditionally produced butter and cheese*
KINLEY CHOKI*, SONAM ZANGMO AND PHUNTSHO T. NORBU

v. *Responses of Local Buffaloes to Estrous Synchronization and Fixed Timed Artificial Insemination in subtropical Bhutan:*
DORJI* CHUNGSILA, GANGA RAM RAI AND NB TAMANG



Journal of Animal Science (BJAS)
5, Issue 1, Page 18-26, 2021

RESPONSES OF LOCAL BUFFALOES TO ESTRUS SYNCHRONIZATION AND FIXED TIMED ARTIFICIAL INSEMINATION IN SUBTROPICAL BHUTAN

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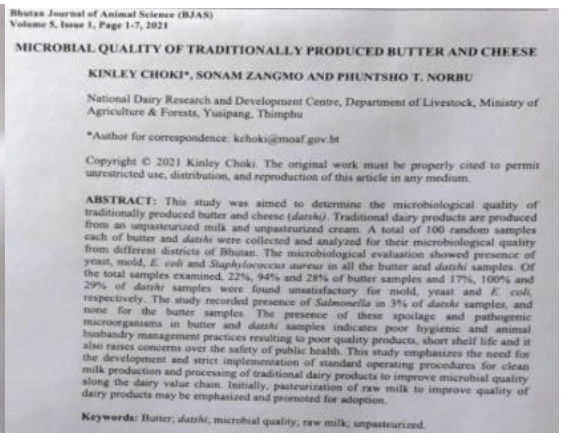
ABSTRACT: The study evaluated four different hormonal synchronization and FTAI protocols on estrus response and conception rate of local buffaloes under Samtse district. In total, 38 potential buffaloes were selected and divided into four groups. The animals of either primiparous or multiparous were randomly selected irrespective of parity, age, breed, milk yield and body weight due to small female population base. The protocols were evaluated in two different seasons; seasonal anestrus (March to April) and breeding season (September), 2018. The data were descriptively analyzed to deduce estrus and conception responses from synchronization and FTAI. The findings indicated that there was a marked difference in the conception rate using four different protocols. The conception rate of 30% in buffalo with the application of P3 protocol during the breeding season was found to be higher when compared to other protocols. It can be inferred that application of P3 protocol during breeding season in buffaloes is found to be promising. However, owing to disproportion of sample size between treatment groups, the findings from current study may not be recommended for wider application in the field. For future research, it is suggested to use appropriate sample size with standard estrus synchronization and FTAI protocols in other buffalo rearing areas for better outcomes. The use of germplasm from superior dairy buffalo breeds like Nili Ravi and Murrah is also recommended to revive and improve the productivity of local or non-descript buffaloes in the country.

Keywords: Buffaloes; estrus synchronization; fixed time AI; Nili Ravi.



Bhutan Journal of Animal Science (BJAS)
Volume 5, Issue 1, Page 1-7, 2021

MICROBIAL QUALITY OF TRADITIONALLY PRODUCED BUTTER AND CHEESE

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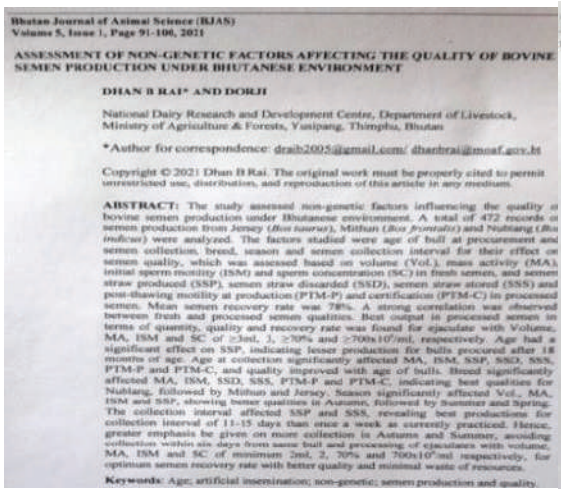
ABSTRACT: This study was aimed to determine the microbiological quality of traditionally produced butter and cheese (*datshi*). Traditional dairy products are produced from an unpasteurized milk and unpasteurized cream. A total of 100 random samples each of butter and *datshi* were collected and analyzed for their microbiological quality from different districts of Bhutan. The microbiological evaluation showed presence of yeast, mold, *E. coli* and *Staphylococcus aureus* in all the butter and *datshi* samples. Of the total samples examined, 22%, 94% and 28% of butter samples and 17%, 100% and 29% of *datshi* samples were found unsatisfactory for mold, yeast and *E. coli*, respectively. The study recorded presence of *Salmonella* in 3% of *datshi* samples, and none for the butter samples. The presence of these spoilage and pathogenic microorganisms in butter and *datshi* samples indicates poor hygienic and animal husbandry management practices resulting to poor quality products, short shelf life and it also raises concerns over the safety of public health. This study emphasizes the need for the development and strict implementation of standard operating procedures for clean milk production and processing of traditional dairy products to improve microbial quality along the dairy value chain. Initially, pasteurization of raw milk to improve quality of dairy products may be emphasized and promoted for adoption.

Keywords: Butter; *datshi*; microbial quality; raw milk; unpasteurized.



Bhutan Journal of Animal Science (BJAS)
Volume 5, Issue 1, Page 91-100, 2021

ASSESSMENT OF NON-GENETIC FACTORS AFFECTING THE QUALITY OF BOVINE SEMEN PRODUCTION UNDER BHUTANESE ENVIRONMENT

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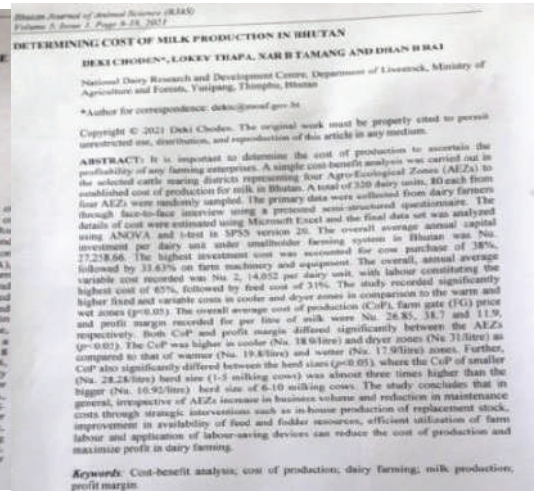
ABSTRACT: The study assessed non-genetic factors influencing the quality of bovine semen production under Bhutanese environment. A total of 472 records of semen production from Jersey (*Bos taurus*), Mithun (*Bos frontalis*) and Nubtang (*Bos indicus*) were analyzed. The factors studied were age of bull at procurement and semen collection, breed, season and semen collection interval for their effect on semen quality, which was assessed based on volume (Vol.), mass activity (MA), initial sperm motility (ISM) and sperm concentration (SC) in fresh semen, and semen straw produced (SSP), semen straw discarded (SSD), semen straw stored (SSS) and post-thawing motility at production (PTM-P) and certification (PTM-C) in processed semen. Mean semen recovery rate was 78%. A strong correlation was observed between fresh and processed semen qualities. Best output in processed semen in terms of quantity, quality and recovery rate was found for ejaculate with Volume, MA, ISM and SC of ≥3ml, 3, ≥70% and ≥700x10⁶/ml, respectively. Age had a significant effect on SSP, indicating lesser production for bulls procured after 18 months of age. Age at collection significantly affected MA, ISM, SSP, SSD, SSS, PTM-P and PTM-C, and quality improved with age of bulls. Breed significantly affected MA, ISM, SSD, SSS, PTM-P and PTM-C, indicating best qualities for Nubtang, followed by Mithun and Jersey. Season significantly affected Vol., MA, ISM and SSP, showing better qualities in Autumn, followed by Summer and Spring. The collection interval affected SSP and SSS, revealing best productions for collection interval of 11-15 days than once a week as currently practiced. Hence, greater emphasis be given on more collection in Autumn and Summer, avoiding collection within six days from same bull and processing of ejaculates with volume, MA, ISM and SC of minimum 2ml, 2, 70% and 700x10⁶/ml respectively, for optimum semen recovery rate with better quality and minimal waste of resources.

Keywords: Age; artificial insemination; non-genetic; semen production and quality.



DETERMINING COST OF MILK PRODUCTION IN BHUTAN

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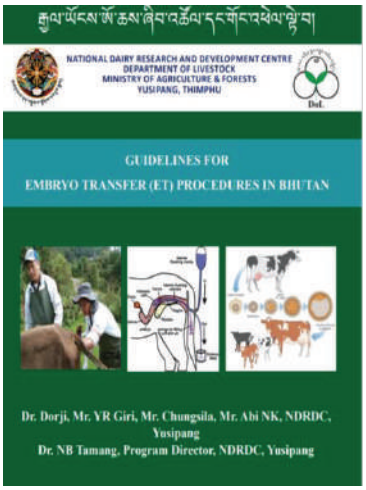
ABSTRACT: It is important to determine the cost of production to ascertain the profitability of any farming enterprises. A simple cost-benefit analysis was carried out in the selected cattle rearing districts representing four Agro-Ecological Zones (AEZs) to established cost of production for milk in Bhutan. A total of 320 dairy units, 80 each from four AEZs were randomly sampled. The primary data were collected from dairy farmers through face-to-face interview using a pretested semi-structured questionnaire. The details of cost were estimated using Microsoft Excel and the final data set was analyzed using ANOVA and t-test in SPSS version 20. The overall average annual capital investment per dairy unit under smallholder farming system in Bhutan was Nu. 27,258.66. The highest investment cost was accounted for cow purchase of 38%, followed by 33.63% on farm machinery and equipment. The overall, annual average variable cost recorded was Nu. 2, 14,052 per dairy unit, with labour constituting the highest cost of 85%, followed by feed cost of 31%. The study recorded significantly higher fixed and variable costs in cooler and dryer zones in comparison to the warm and wet zones ($p<0.05$). The overall average cost of production (CoP), farm gate (FG) price and profit margin recorded for per litre of milk were Nu. 26.85, 38.7 and 11.9, respectively. Both CoP and profit margin differed significantly between the AEZs ($p<0.05$). The CoP was higher in cooler (Nu. 18.9/litre) and dryer zones (Nu 31/litre) as compared to that of warmer (Nu. 19.8/litre) and wetter (Nu. 17.9/litre) zones. Further, CoP also significantly differed between the herd sizes ($p<0.05$), where the CoP of smaller (Nu. 28.28/litre) herd size (1-5 milking cows) was almost three times higher than the bigger (Nu. 10.92/litre) herd size of 6-10 milking cows. The study concludes that in general, irrespective of AEZs increase in business volume and reduction in maintenance costs through strategic interventions such as in-house production of replacement stock, improvement in availability of feed and fodder resources, efficient utilization of farm labour and application of labour-saving devices can reduce the cost of production and maximize profit in dairy farming.

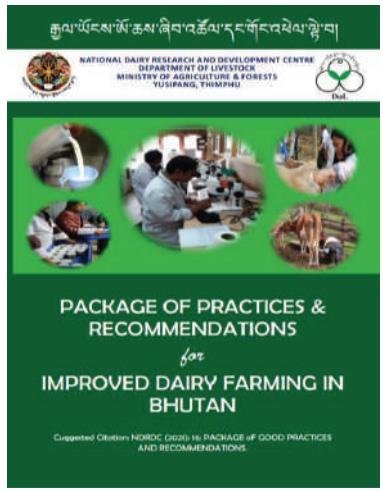
Keywords: Cost-benefit analysis; cost of production; dairy farming; milk production; profit margin

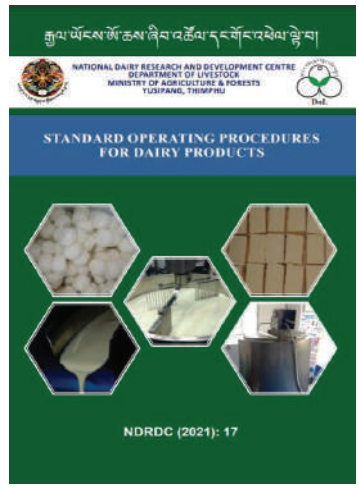
Extension and Technology Transfer

Four Extension and Technology transfer materials were published including Package of Good Practices and Recommendation for published research was prepared with14 brochures (gist of research finding two pages each) , Dairy Production Manual for use by extension staff, Standard Operating Procedure (SoP) for dairy products and SoP for Embryo transfer were also developed, printed for dissemination of technologies and best practices/ technology transfer. A total of four report/booklets were published during the fiscal year:

i. Annual Centre Report for 2019 – 2020
ii. Standard Operating Procedure for processing of Dairy Products
iii. Guidelines / SoP on Embryo Transfer Technology
iv. Dairy Production Manual prepared and submitted to DoL HQ
v. Guidelines for Establishment, Operation and Management of Dairy Enterprise in Bhutan(Draft)





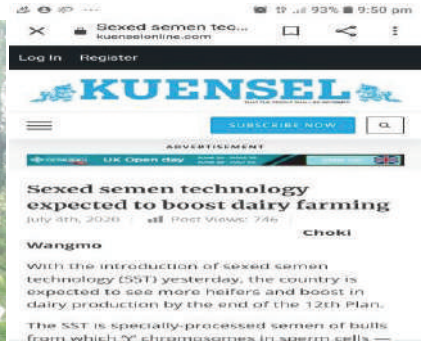


Release of Sex sorted Semen Technology for nation-wide application

The sex semen technology was successfully launched by HE Minister, MoAF for national wide application along with guidelines. The Centre also conducted series of consultative /sensitization meetings with Dzongkhags (DLOs and Extension staff) and Managers of Government dairy farms in the recent past on heifer production (applying sexed semen technology).

Samtse

Chukha



Pema Gatshel **Bumthang**

Picture story of sensitization on sex semen technology application

Animal registered under NCIS

During the FY 1480 ear tags were printed and distributed to dzongkhags and Government farms as per their requirement to implement National Cattle Identification System (NCIS) via ear tagging and recording (Table 18) The laser printing machine broke down and still under repair, hence the numbers were manually written on plastic ear tags.

Table 18. Total number of eartag distributed for National Cattle identification System

Sl.	Name of agency	Date	Allocation number		Total (no)	Remarks
1	NNBF, T/yangphu	5/10/2020	1506000001	1506000150	150	
2	BLDC, Samrang	16/12/2020	1109900049	1109900099	50	
3	Brownswiss farm	2/2/2021	101899999	101900099	100	
4	Sertsam Farm	12/5/2021	602900030	602900130	100	
5	Punakha Dzongkhag	1/6/2021	NA	NA	100	
6	Sergithang	23/05/2021	1810005001	1810005070	70	
7	Barshong	23/05/2021	1801001001	1801001070	70	
8	Saling geog	21/01/2021	712012001	712012079	79	
9	Ramjar	21/01/2021	1604004001	1604004079	86	
10	Kanglung	21/01/2021	1503004001	1503004112	112	
11	Minjey	21/01/2021	607007001	607007152	152	
12	Menbi	21/01/2021	605006001	605006092	92	
13	Orong	21/01/2021	1106003001	1106003140	140	
14	Deothang	21/01/2021	1101002001	1101002139	139	
15	NDRDC, Yusipang	15/3/2021	1401899999	1401900009	10	
16	Royal Soebum	15/2/2021	1401799999	1401800029	30	
				Total	**1480**	

The number of household under NCIS increased to 7750 from 6,270 in previous year. The number of animals with NCIS increased to 13,186, an increase of 1480 during the fiscal year. As of now the NCIS is carried out in 118 Geogs and CHBPP in 55 Geogs of all 20 Dzongkhags.

National Dairy Information System

National Dairy Research and Development Centre, Yusipang in collaboration with Information & Communication Technology Division, Ministry of Agriculture Forests and Department of Information Technology & Telecom under the Ministry of Information and Communication have developed the National Dairy Information System with mobile Apps. The system is a web based database system developed under Government to Citizen Project (G2C) which keep records of all the data and information related to dairy development in the country. The system enables data entry at Geog level by Geog extension offices and government farms and report produced for Geog, Dzongkhags, Regional and at National levels. Through this online system, it is expected that all the cattle in the country are registered, breeding and AI carried out are captured instantly through mobile apps, updates of production and post-production products produced by groups and cooperatives information are available online monthly.

The database have three modules as follow:

i. Cattle Identification and Registration
ii. Breeding and Artificial Insemination
iii. Groups, Cooperatives and Post Production

With this database functional, it is expected that reports on dairy development in the country are available to all the relevant stakeholders, meet the government objectives to go paperless and also reduce the reporting layers and time taken to process paper to reach at commodity Centres and at the Department.

General: Operation and Management/Direction services

Reporting, Asset declaration and correspondences in Dzongkha

Under operation and management all reports including annual report are submitted as scheduled. Meetings were held regularly atleast once in three months to discuss plans and programs of the centre. Asset declaration was done per timeline by all staff and over 20 correspondences were done in Dzongkha to increase proficiency in National Language.

Budget utilization

Annual budget utilization is Nu. 35.064 Million out of allocated Nu. 35.088 Million with the achievement percentage of **99.93%**, which is excellent as per guidelines (*For details refer to Annex 2*). Capital budget were used in semen procurement, equipment purchase, renovation of animal shed and construction of biogas plant (30CuM).

Revenue generation

NDRDC is mandated to produce and supply LN2 and frozen semen which as per the existing policy is provided free of cost. As mostly donor bulls and bull calves are maintained for semen production and cows used for ET research, revenue generated is mostly from sale of small volume of milk and sale of culled animals if any. During the FY, against the target of Nu. 20,000 the revenue generated was 117,368 (including sale of 1 bull worth 12,000) as more animals had calf at foot (*For Details refer Appendix 5*).

ANNEXURES:

Annex 1: Staff strength

Sl.	Name	Designation	Sector
I	**Administration & Management**		
1	Dr. N. B Tamang	Program Director	Management Direction services
2	Mr.Jigme Tenzin	Acct. Asst IV	Management Direction services
3	Mr. Pema Dorji	Adm. Asst II	Management Direction services
5	Mr. Durga Chhetri	Driver I	Management Direction services
6	Mr. Domzang	Driver II	Management Direction services
7	Mr. Sonam Zangpo	Driver I	Management Direction services
8	Mr. Pema Tenzin	Driver III	Management Direction services
9	Mr Samten	Power Tiller Driver	Management Direction services
II	**Dairy Research Communication Sector**		
1	Mr.Lokey Thapa	Dy. CLPO	Dairy Research Communication
2	Mr.Yuraj Giri	Sr.ES II	Dairy Research Communication
3	Ms Tashi Pemo	LPO	Dairy Research Communication
III	**Dairy Production Research Sector**		
1	Dr.D.B Rai	Specialist III	Dairy Pdn Research Sector
2	Ms. Deki Choden	Dy. CLPO	Dairy Pdn Research Sector
3	Mr.Abi Narayan Koirala	Sr. LPS II	Dairy Pdn Research Sector
IV	**Dairy Inputs Production & Research Sector**		
1	Dr. Dorji	PLHO	Inputs Pdn Research Sector
2	Mr Thinley Dorji	LPO	Inputs Pdn Research Sector
3	Mr.Phub Dorji	Asst. Engineer II	Inputs Pdn Research Sector
4	Mrs. Yudon	Sr. LPS	Inputs Pdn Research Sector
5	Mr. Chungsila	LPS I	Inputs Pdn Research Sector
6	Mr.Narapati Chapagai	Technician II	Inputs Pdn Research Sector
7	Mr. Kanti Ram Chhetri	LPS III	Inputs Pdn Research Sector
8	Mr. Nima	Lab Asst. I	Inputs Pdn Research Sector
V	**Dairy Post Production Research Sector**		
1	Mr. Phuntsho T Norbu	PLO	Research Post Production
2	Ms. Kinley Choki	Dy. CLPO	Research Post Production
3	Ms. Sonam Zangmo	Dairy Officer	Research Post Production

Annex 2. Budget and expenditure 2020-21

ADMINISTRATIVE UNIT:

FIELD OFFICE:

204.01 MINISTRY OF AGRICULTURE & FORESTS
03 DEPARTMENT OF LIVESTOCK
11 NATIONAL LIVESTOCK BREEDING PROGRAMME

(Nu. in Millions)

PRG	SPRG	ACT	SACT	FIC	OBC	TITLE	BUDGET	EXPENDITURE	BALANCE	%
045						LIVESTOCK SERVICES				
	026					LIVESTOCK PRODUCTION SERVICES				
		001				DIRECTION SERVICES				
			01			PERSONAL EMOLUMENT				
				0001		RGOB Financing				
					01.01	Pay and Allowances	11.273	11.270	0.003	0.03
					02.01	Other Personnel Emoluments	2.631	2.617	0.014	0.53
					11.03	Travel - (LTC/Leave Travel Concession)	0.539	0.539	0.000	0.08
					24.03	Contributions - Provident Fund	1.589	1.583	0.006	0.36
					25.01	Retirement Benefits	0.044	0.044	0.000	1.05
						TOTAL OF FIC 0001	**16.076**	**16.053**	**0.023**	
						TOTAL OF SAct 01	**16.076**	**16.053**	**0.023**	
			02			OPERATION AND MANAGMENT SERVICES				
				0001		RGOB Financing				
					12.01	Utilities -Telephones, Telex, Fax, E-mail, Internet	0.150	0.150	0.000	0.01
					12.02	Utilities -Telegram, Wireless Transmission, Postage				
					12.03	Utilities - Electricity, Water, Sewerage	0.148	0.148		
					14.01	S & M - Office Supplies, Printing, Publications	0.024	0.024		
					14.06	S & M - Uniforms, Extension Kits, Linens	0.055	0.055		
					15.01	Maintenance of Property - Buildings	0.015	0.015		
					15.02	Maintenance of Property - Vehicles	0.770	0.770		
					15.05	Maintenance of Property - Equipment	0.009	0.009		
					15.07	Maintenance of Property - Computers	0.011	0.011		
					15.09	Maintenance of Property - Water supply, Sewerage, Playfield	0.005	0.005		
					17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling Charges, Bank Charges				
					18.01	Hospitality & Entertainment	0.039	0.039		
						TOTAL OF FIC 0001	**1.226**	**1.226**	**0.000**	
						TOTAL OF SAct 02	**1.226**	**1.226**	**0.000**	
			03			PROVIDE ADMINISTRATION SERVICES AND STAFF MOBILITY				
				0001		RGOB Financing				
					11.01	Travel – Incountry	0.915	0.915		
						TOTAL OF FIC 0001	**0.915**	**0.915**		
						TOTAL OF SAct 03	**0.915**	**0.915**		
						TOTAL OF Act 001	**18.217**	**18.194**	**0.023**	
		002				INPUT PRODUCTION & RESEARCH FOR BREED IMPROVEMENT SERVICES				
			01			SCHEDULE PRODUCTION & DISTRIBUTION OF LIQUID NITROGEN (LN2)				
				0001		RGOB Financing				
					12.03	Utilities - Electricity, Water, Sewerage	0.235	0.235		
					12.05	Utilities – Fuelwood	0.005	0.005		
					14.02	S & M - Medicines & Laboratory Consumables				
					15.05	Maintenance of Property - Equipment	0.124	0.124	0.000	0.18

					52.07	Plant & Equipt. - Hospital/Lab. Equipment	0.100	0.100		
						TOTAL OF FIC 0001	**0.464**	**0.464**	**0.000**	
						TOTAL OF SAct 01	**0.464**	**0.464**	**0.000**	
			02			SCHEDUEL PRODUCTION AND DISTRIBUTION OF FROZEN SEMEN				
				0001		RGOB Financing				
					14.02	S & M - Medicines & Laboratory Consumables	0.100	0.100	0.000	0.05
						TOTAL OF FIC 0001	**0.100**	**0.100**	**0.000**	
				4599		Rural Development and Climate Change Response Programme				
					52.06	Plant & Equipt. - Livestock	5.500	5.500		
						TOTAL OF FIC 4599	**5.500**	**5.500**		

PRG	SPRG	ACT	SACT	FIC	OBC	TITLE	BUDGET	EXPENDITURE	BALANCE	%
						TOTAL OF SAct 02	**5.600**	**5.600**	**0.000**	
			03			QUALITY DONOR ANIMAL MAINTAINED FOR SEMEN / EMBRYO PRODUCTION				
				0001		RGOB Financing				
					14.05	S & M - Animal Feeds	0.240	0.240		
					15.05	Maintenance of Property - Equipment	0.012	0.012		
					17.06	Op. Exp. - Items for Processing/Manufacturing	0.082	0.082		
					51.07	Exp. on Structure - Plantations	1.070	1.070	0.000	0.03
						TOTAL OF FIC 0001	**1.404**	**1.404**	**0.000**	
						TOTAL OF SAct 03	**1.404**	**1.404**	**0.000**	
			06			PASTURE AND FODDER PRODUCTION FOR FARM ANIMALS				
				0001		RGOB Financing				
					14.03	S & M - Fertilizers, Chemicals, Manures, Innoculants	0.046	0.046		
					14.04	S & M - Seeds, Seedlings	0.010	0.010	0.000	0.86
					51.07	Exp. on Structure - Plantations	0.150	0.150	0.000	0.12
						TOTAL OF FIC 0001	**0.206**	**0.206**	**0.000**	
						TOTAL OF SAct 06	**0.206**	**0.206**	**0.000**	
						TOTAL OF Act 002	**7.674**	**7.673**	**0.001**	
		004				DAIRY POST PRODUCTION RESEARCH SERVICES				
			01			COORDINATE AND CONDUCT DAIRY POST PRODUCTION RESEARCH AND TECHNOLOGY PACKAGING				
				0001		RGOB Financing				
					14.02	S & M - Medicines & Laboratory Consumables	0.024	0.024		
						TOTAL OF FIC 0001	**0.024**	**0.024**		
				4599		Rural Development and Climate Change Response Programme				
					52.07	Plant & Equipt. - Hospital/Lab. Equipment	4.000	4.000		
					52.08	Plant & Equipt. - General Tools, Instruments	0.450	0.450		
						TOTAL OF FIC 4599	**4.450**	**4.450**		
						TOTAL OF SAct 01	**4.474**	**4.474**		
						TOTAL OF Act 004	**4.474**	**4.474**		
		005				RESEARCH COMMUNICATION SERVICES				
			01			TECHNOLOGY PACKAGING AND POPULARIZATION				
				0001		RGOB Financing				
					12.01	Utilities -Telephones, Telex, Fax, E-mail, Internet	0.001	0.002	-0.001	-50.00
					14.01	S & M - Office Supplies, Printing, Publications	0.012	0.011	0.001	4.46
					17.08	Op. Exp. - Incountry Meetings and Celebrations	0.015	0.015		
						TOTAL OF FIC 0001	**0.028**	**0.028**	**0.000**	

						TOTAL OF SAct 01	**0.028**	**0.028**	**0.000**	
						TOTAL OF Act 005	**0.028**	**0.028**	**0.000**	
		006				GOI SUPPORT TO LIVESTOCK DEVELOPMENT PROJECT				
			01			REPLACEMENT OF OLD LN2 PLANT AT NDRC				
				5190		Livestock Enterprise Development in Bhutan				
					52.06	Plant & Equipt. - Livestock				
						TOTAL OF FIC 5190				
						TOTAL OF SAct 01				
			02			BIO SECURITY FENCING AND RENOVATION OF SEMEN LAB OR LN2 PLANT BUILDING				
				5190		Livestock Enterprise Development in Bhutan				
					51.08	Exp. on Structure - Others	1.000	1.000		
						TOTAL OF FIC 5190	**1.000**	**1.000**		
						TOTAL OF SAct 02	**1.000**	**1.000**		
			03			MANURE MANAGEMENT FACILITIES AND MINI BIOGAS PLANT				
				5190		Livestock Enterprise Development in Bhutan				
					52.06	Plant & Equipt. - Livestock	1.000	1.000		
						TOTAL OF FIC 5190	**1.000**	**1.000**		
						TOTAL OF SAct 03	**1.000**	**1.000**		

PRG	SPRG	ACT	SACT	FIC	OBC	TITLE	BUDGET	EXPENDITURE	BALANCE	%
			04			PROCUREMENT OF ULTRASOUND AND AI TEACHING AND LEARNING AID EQUIPMENT				
				5190		Livestock Enterprise Development in Bhutan				
					52.06	Plant & Equipt. - Livestock	2.000	2.000		
						TOTAL OF FIC 5190	**2.000**	**2.000**		
						TOTAL OF SAct 04	**2.000**	**2.000**		
			05			TRAIN AND DEPLOY OF 20 CAITS				
				5190		Livestock Enterprise Development in Bhutan				
					45.02	Training – Others	0.350	0.350		
						TOTAL OF FIC 5190	**0.350**	**0.350**		
						TOTAL OF SAct 05	**0.350**	**0.350**		
			06			PROCUREMENT OF FARM EQUIPMENT AND AGRICULTURAL MACHINERY				
				5190		Livestock Enterprise Development in Bhutan				
					52.06	Plant & Equipt. - Livestock	0.345	0.345		
						TOTAL OF FIC 5190	***0.345***	***0.345***		
						TOTAL OF SAct 06	***0.345***	***0.345***		
						TOTAL OF Act 006	***4.695***	***4.695***		
						TOTAL OF SPrg 026	***35.088***	***35.064***	***0.024***	
						TOTAL OF Prg 045	***35.088***	***35.064***	***0.024***	
						TOTAL OF FO 11	***35.088***	***35.064***	***0.024***	
						TOTAL OF Dept 03	***35.088***	***35.064***	***0.024***	
						TOTAL OF AU 204.01	***35.088***	***35.064***	***0.024***	
						GRAND TOTAL	***35.088***	***35.064***	***0.024***	

Fund utilized IN 2020-21 is (35.064/35.064 *100) = 99.93% (Reference: EPEMS printout NDRDC, Yusipang)

Annex 3: Progress on application of Sex Semen Technology

Sl no	Dzongkhag	CHBPP/ DFG/Geog	Sensitization	AI Initiation	AI done as of 30/6/20	Progeny born as of 30/6/2020		AI done (July '20 June 2021)	Progeny born from July '20 to June 21		Total AI till 25 June 2021	Total Progeny born as of 25 June 2021	
						M	**F**		**M**	**F**		**M**	**F**
1	Chukha	Darla	Aug. 2019-20	Aug-19	81	0	0	41	3	42	122	3	42
2	Samtse	Ugyentshe	Aug. 2019-20	Sep-19	0	0	0	45	0	5	45	0	5
		Yoseltse	Aug. 2019-20	Sep-19	74	0	0	43	2	28	117	2	28
3	Thimphu	Tshaluna	Sept.2019-20	Oct-19	65	0	0	52	9	41	117	9	41
4	Paro	Wangchang/Shari	Sept.2019-20	Oct-19	75	0	0	35	3	30	110	3	30
5	Haa	Katsho	June 2019-20	Jun-20	16	0	0	47	11	23	63	11	23
6	Punakha	Guma	Oct. 2019-20	Jan-20	52	0	0	44	3	27	96	3	27
7	Wangdue	Tshogom	Oct. 2019-20	Mar-20	25	0	0	28	1	12	53	1	12
8	Tsirang	Kilkhorthang	Nov. 2019-20	Nov-19	120	0	0	123	5	69	243	5	69
		Gosarling	July 2020-21	Jul-20	11	0	0	11	1	5	22	1	5
9	Dagana	Tsendagang/Gozhi	Jan. 2019-20	Mar-20	27	0	0	22	1	11	49	1	11
10	Trongsa	Tangsibji	Dec. 2019-20	Jan-20	49	0	0	31	2	32	80	2	32
11	Mongar	Monggar	Dec. 2019-20	Dec-19	56	0	0	46	2	35	102	2	35
		Chaskhar	May 2019-20	May 20	29	0	0	129	0	9	158	0	9
		Yadi –Ngatshang	May 2019-20	May 20	33	0	0	45	1	8	78	1	8
12	Lhuentse	LEC- Menji	June 2019-20	Jun-20	2	0	0	17	0	1	19	0	1
		LEC Menbi (Tangmachu)	June 2019-20	Jun-20	8	0	0	27	0	2	35	0	2
13	Trashigang	DVH- T/gang (Pam)	Dec. 2019-20	Dec-19	46	0	0	50	3	35	96	3	35
		LEC- Kanglung	May 2019-20	May 20	5	0	0	60	0	8	65	0	8
14	T/yangtse	Jachephu –Yangtse	June 2019-20	Jun-20	5	0	0	17	0	0	22	0	0
15	P/gatshel	DVH- Shumar	June 2019-20	Jun-20	6	0	0	44	0	3	50	0	3
		Nanong (Wongchelo)	June 2019-20	Jun-20	12	0	0	47	0	9	59	0	9
		Khar (Petingma)	June 2019-20	Jun-20	2	0	0	26	0	8	28	0	8
		Norbugang (Menchu+Nganglam)	June 2019-20	Jun-20				17	1	5	17	1	5
		Nangkhor	Sept. 2020-21	Sep-20				39	0	3	39	0	3
		Zobel (Ngangmalang +Tshelingore)	Sept. 2020-21	Sep-20				25	0	2	25	0	2
16	S/jongkhar	Deothang	Dec. 2019-20	Jan-20	31	0	0	41	4	18	72	4	18
		Orong	June 2019-20	Jun-20	9	0	0	39	2	12	48	2	12
17	Central units	RCBC, Wangkha		Jul-19	37	1	9	39	1	10	76	2	19
		RCBC, Bumthang		Jul-19	74	1	6	49	3	17	123	4	23
		BLDCL, Samrang		Jul-19	140	17	49	162	10	35	302	27	84
	Total				**1090**	**19**	**64**	**1441**	**68**	**545**	**2531**	**87**	**609**
	Total Progeny born					**83**			**613**			**696**	
	Female birth percentage (%)							**77.1**		**88.9**			**87.5**

Annex 4a: AI performance and success rate 2020-2021

Region	Dzongkhag	AI Centre	Total AI	Male	Female	Total Progeny	AI success rate (%)	Avg. AI/ month
Western	Thimphu	DVH - Ramtokto T/phu	53	11	14	25	47.2	5.9
		LEC Kawang	8	0	0	0	0.0	0.9
		LEC Genekha	5	0	0	0	0.0	0.6
		LEC Tshaluna	64	17	41	58	90.6	7.1
		NDRC, Yusipang	31	1	8	9	29.0	3.4
	Dzo. Total	***5***	*161*	*29*	*63*	*92*	*57.1*	*3.6*
	Paro	DVH Wangchang, Paro	117	16	27	43	36.8	13.0
		LEC Tshentog	13	4	4	8	61.5	1.4
		LEC Lamgong	45	16	18	34	75.6	5.0
		LEC Shari	48	2	10	12	25.0	5.3
		LEC Dogar (Dawakha)	67	10	6	16	23.9	7.4
		LEC Shaba	39	5	3	8	20.5	4.3
		LEC Luni	48	0	6	6	12.5	5.3
		LEC Doteng	49	17	20	37	75.5	5.4
		LEC Naja	49	0	0	0	0.0	5.4
	Dzo. Total	***9***	*475*	*70*	*94*	*164*	*34.5*	*5.9*
	Haa	DVH Tshelungkha	5	1	1	2	40.0	0.6
		LEC Katsho	75	11	26	37	49.3	8.3
	Dzo. Total	***2***	*80*	*12*	*27*	*39*	*48.8*	*4.4*
	Chukha	DVH Tsimasham + Chapcha	22	2	5	7	31.8	2.4
		LEC Darla	106	16	47	63	59.4	11.8
		LEC Sampheling	48	3	3	6	12.5	5.3
		LEC Phuntsholing	86	21	32	53	61.6	9.6
		CRC – Wangkha	23	1	10	11	47.8	2.6
	Dzo. Total	***5***	*285*	*43*	*97*	*140*	*49.1*	*6.3*
	Samtse	DVHSamtse	16	3	3	6	37.5	1.8
		LEC Ch-mari/Norbugang	38	7	4	11	28.9	4.2
		LEC Charga/Sangacholing	15	6	6	12	80.0	1.7
		LEC Ugyentse	70	23	27	50	71.4	7.8
		LEC Yoesheltse	72	17	41	58	80.6	8.0
		LEC Sipsu/ Tashicholing	18	7	7	14	77.8	2.0
		LEC Dorokha/Dophuchen	18	3	0	3	16.7	2.0
		LEC Tendu	21	9	10	19	90.5	2.3
		LEC Buduney – Samtse	12	5	4	9	75.0	1.3
		LEC- Tading	105	6	9	15	14.3	11.7
		LEC Norgaygang/ Bara	18	4	3	7	38.9	2.0
		LEC Namgaycholing	15	4	4	8	53.3	1.7
		NJBC- Samtse	88	3	2	5	5.7	9.8
	Dzo. Total	***13***	*506*	*97*	*120*	*217*	*42.9*	*4.3*
	Total	**34**	**1507**	**251**	**401**	**652**	**43.3**	**4.9**
West central	Gasa	DVH Gasa	35	8	9	17	48.6	3.9
		LEC Damji	40	12	8	20	50.0	4.4
	Dzo. Total	***2***	*75*	*20*	*17*	*37*	*49.3*	*4.2*
	Punakha	DVH Punakha	216	26	43	69	31.9	24.0
		LEC Samdingkha	127	26	30	56	44.1	14.1
		LEC Talo	44	1	7	8	18.2	4.9
		LEC Thinlaygang/Toepaisa	31	0	2	2	6.5	3.4
		LEC Kabjisa	98	5	14	19	19.4	10.9

		LEC Barp	41	3	3	6	14.6	4.6
		LEC –Shengana	42	1	2	3	7.1	4.7
		LEC -Lingmukha (Tshochasa)	53	4	15	19	35.8	5.9
	Dzo. total	***8***	*652*	*66*	*116*	*182*	*27.9*	*9.1*
	Wangdue	DVH Petakarpo	43	22	16	38	88.4	4.8
		LEC Gaselo/Gumina	101	4	17	21	20.8	11.2
		LEC Phobjikha	6	3	1	4	66.7	0.7
		LEC Rubesa	13	5	6	11	84.6	1.4
		LEC Phangyul (Katikha)	6	0	3	3	50.0	0.7
		LEC Bjena	26	3	7	10	38.5	2.9
	Dzo. total	***6***	*195*	*37*	*50*	*87*	*44.6*	*3.6*
	Tsirang	DVH Damphu	237	30	113	143	60.3	26.3
		LEC- Gosarling	87	14	45	59	67.8	9.7
		LEC- Mendrelgang	41	5	5	10	24.4	4.6
		LEC- Barsong	27	18	19	37	137.0	3.0
		LEC- Sergithang	71	5	8	13	18.3	7.9
		LEC Tsirangtoe	50	4	6	10	20.0	5.6
	Dzo. total	***6***	*513*	*76*	*196*	*272*	*53.0*	*9.5*
	Dagana	LEC Tshendagang	70	5	19	24	34.3	7.8
		LEC Drujegang	52	9	9	18	34.6	5.8
		LEC Lhamoizingkha	22	0	2	2	9.1	2.4
		LEC Tsangkha	4	0	0	0	0.0	0.4
	Dzo. Total	***4***	*148*	*14*	*30*	*44*	*29.7*	*4.1*
	Total	**26**	**1583**	**213**	**409**	**622**	**39.3**	**6.8**
East Central	Bumthang	DVH Bumthang	61	17	26	43	70.5	6.8
		LEC Chokhor (Thangbi)	24	0	0	0	0.0	2.7
		LEC Chumey	8	1	1	2	25.0	0.9
		LEC Tang/ Wobthang	60	11	5	16	26.7	6.7
		BS Farm – Bumthang	96	11	30	41	42.7	10.7
	Dzo. total	***5***	*249*	*40*	*62*	*102*	*41.0*	*5.5*
	Trongsa	DVH Sherabling	12	3	2	5	41.7	1.3
		LEC Kuengarabten	84	25	6	31	36.9	9.3
		LEC Langthel/Bayling	47	15	15	30	63.8	5.2
		LEC Tangsibji	106	24	55	79	74.5	11.8
		LEC Bemji	25	4	10	14	56.0	2.8
		CAIT Korphu/Nimsong	10	1	6	7	70.0	1.1
	Dzo. total	***6***	*284*	*72*	*94*	*166*	*58.5*	*6.3*
	Zhemgang	DVH Trong Z/gang	72	14	7	21	29.2	8.0
		LEC Panbhang - Ngangla	7	2	3	5	71.4	0.8
		LEC Buli – Nangkhar	0	0	0	0	#DIV/0!	0.0
		LEC Pantang - Phangkhar	10	3	1	4	40.0	1.1
		LEC Tingtibi – Trong	9	3	2	5	55.6	1.0
	Dzo. total	***5***	*98*	*22*	*13*	*35*	*35.7*	*2.2*
	Sarpang	DVH Sarpang	52	5	8	13	25.0	5.8
		LEC – Gelephu	108	8	26	34	31.5	12.0
		LEC – Dekiling	27	4	1	5	18.5	3.0
		LEC- Chuzargang	9	1	1	2	22.2	1.0
		LEC- Sersong	24	2	3	5	20.8	2.7
	Dzo. total	***5***	*220*	*20*	*39*	*59*	*26.8*	*4.9*
	Total	**21**	851	154	208	362	42.5	5.0

	Lhuntshe	DVH Gangzur	4	0	0	0	0.0	0.4
		LEC Khoma	9	1	2	3	33.3	1.0
		LEC Menbi	42	3	4	7	16.7	4.7
		LEC Minjey	27	5	3	8	29.6	3.0
		NPHPC Sertsham-Jarey	0	0	0	0	#DIV/0!	0.0
	Dzo. total	***5***	*82*	*9*	*9*	*18*	*22.0*	*1.8*
	Mongger	DVH Monger	163	22	47	69	42.3	18.1
		LEC Chali	24	8	11	19	79.2	2.7
		LEC Ngatshang	165	16	24	40	24.2	18.3
		LEC Chaskhar	383	30	40	70	18.3	42.6
		LEC Tshakaling	20	0	2	2	10.0	2.2
		LEC Lingmithang	69	14	6	20	29.0	7.7
		LEC Depong	13	12	6	18	138.5	1.4
		LEC Tsamang	8	5	9	14	175.0	0.9
	Dzo. total	***8***	*845*	*107*	*145*	*252*	*29.8*	*11.7*
	Tashiyangtse	DVH T/Yangtse	45	7	4	11	24.4	5.0
		LEC Khamdang	24	3	3	6	25.0	2.7
		LEC Bumdeyling	17	0	0	0	0.0	1.9
		LEC Tongmajangsa	9	0	0	0	0.0	1.0
		LEC Jamkhar	8	8	11	19	237.5	0.9
	Dzo. total	***5***	*103*	*18*	*18*	*36*	*35.0*	*2.3*
Eastern	Trashigang	DVH T/gang	91	18	44	62	68.1	10.1
		LEC Radhi	26	6	4	10	38.5	2.9
		LEC Bartsham	63	12	19	31	49.2	7.0
		LEC Yangnyer	67	21	45	66	98.5	7.4
		LEC Kanglung	121	16	27	43	35.5	13.4
		LEC Khaling	25	8	8	16	64.0	2.8
		LEC Bikhar –Samkhar	31	6	7	13	41.9	3.4
		LEC Phongmaed	9	1	0	1	11.1	1.0
		LEC Bidung	18	6	4	10	55.6	2.0
		RNR-Changmay/Songphu	16	1	4	5	31.3	1.8
	Dzo. total	***10***	*467*	*95*	*162*	*257*	*55.0*	*5.2*
	Pemagatshel	DVH P/gatshel	66	12	19	31	47.0	7.3
		LEC Khar (Petingma)	26	6	4	10	38.5	2.9
		LEC Nangkhor (Shumar)	36	6	6	12	33.3	4.0
		LEC Yurung	25	5	3	8	32.0	2.8
		LEC Zobel (Tshelingore + Nangmalang)	33	1	1	2	6.1	3.7
		LEC-Nanong (Wangchelo)	136	0	2	2	1.5	15.1
		LEC Norbugang (Nganglham+ Menchu)	126	23	22	45	35.7	14.0
	Dzo. total	*7*	*448*	*53*	*57*	*110*	*24.6*	*7.1*
	S/Jongkhar	LEC Deothang	83	14	35	49	59.0	9.2
		LEC Phuntshothang	2	0	0	0	0.0	0.2
		LEC Orong	63	0	0	0	0.0	7.0
		BLDCL Samrang	235	10	35	45	19.1	26.1
	Dzo. total	*4*	*383*	*24*	*70*	*94*	*24.5*	*10.6*
	Total	**39**	**2328**	**306**	**461**	**767**	**32.9**	**6.6**
	G. Total	**120**	**6269**	**924**	**1479**	**2403**	**38.3**	**5.8**

Table 4b: Summary of AI and Progeny record (July 2020 to March 2021)

Region	July -September 20 (QI)				
	Total AI	Progeny Record			Average success rate (%)
		Male	*Female*	*Total*	
West	527	59	122	181	34.3
West-central	522	69	119	188	36.0
East-central	273	44	55	99	36.3
East	783	90	135	225	28.7
Total	**2105**	**262**	**431**	**693**	**32.9**

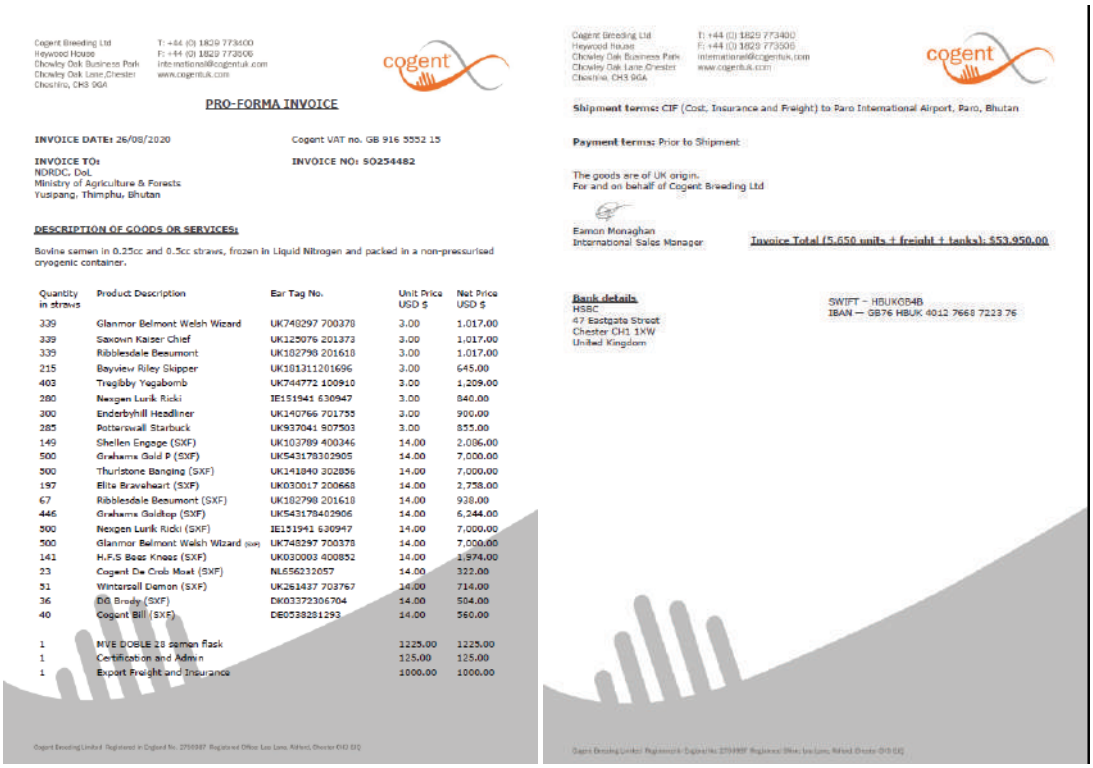
Region	October -December 20 (QII)				
	Total AI	Progeny Record			Average success rate (%)
West		*Male*	*Female*	*Total*	
West-central	492	84	122	206	41.9
East-central	498	76	134	210	42.2
East	295	39	67	106	35.9
Total	710	104	155	259	36.5
	1995	**303**	**478**	**781**	**39.1**

Overall Total (July 2020-March 2021)				
Total AI	Progeny Record			Average success rate (%)
	Male	*Female*	*Total*	
492	84	122	206	**41.9**
498	76	134	210	**42.2**
295	39	67	106	**35.9**
710	104	155	259	**36.5**
1995	**303**	**478**	**781**	**39.1**

Region	January - March 21 (QIII)				
	Total AI	Progeny Record			Average success rate (%)
West		*Male*	*Female*	*Total*	
West-central	488	108	157	265	54.3
East-central	563	68	156	224	39.8
East	283	71	86	157	55.5
Total	835	112	171	283	33.9
	2169	**359**	**570**	**929**	**42.8**

Note: 4th quarter April -June Not submitted yet by RLDCs

Appendix 1: Procurement of Genomic Selected/Progeny Tested Conventional and Sexed Semen



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international@cogentuk.com
www.cogentuk.com

PRO-FORMA INVOICE

INVOICE DATE: 26/08/2020

Cogent VAT no. GB 916 5552 15

INVOICE TO:
NDRDC, DoL
Ministry of Agriculture & Forests
Yusipang, Thimphu, Bhutan

INVOICE NO: SO254482

DESCRIPTION OF GOODS OR SERVICES:

Bovine semen in 0.25cc and 0.5cc straws, frozen in Liquid Nitrogen and packed in a non-pressurised cryogenic container.

Quantity in straws	Product Description	Ear Tag No.	Unit Price USD $	Net Price USD $
339	Glanmor Belmont Welsh Wizard	UK748297 700378	3.00	1,017.00
339	Saxown Kaiser Chief	UK125076 201373	3.00	1,017.00
339	Ribblesdale Beaumont	UK102798 201618	3.00	1,017.00
215	Bayview Riley Skipper	UK101311201696	3.00	645.00
403	Treglisby Yogabomb	UK744772 100910	3.00	1,209.00
280	Nexgen Lurik Ricki	IE151941 630947	3.00	840.00
300	Enderbyhill Headliner	UK140766 701755	3.00	900.00
285	Potterswall Starbuck	UK937041 907503	3.00	855.00
149	Shellen Engage (SXF)	UK103789 400346	14.00	2,086.00
500	Grahams Gold P (SXF)	UK543178302905	14.00	7,000.00
500	Thurlstone Banging (SXF)	UK141840 302856	14.00	7,000.00
197	Elite Braveheart (SXF)	UK030017 200668	14.00	2,758.00
67	Ribblesdale Beaumont (SXF)	UK102798 201618	14.00	938.00
446	Grahams Goldtop (SXF)	UK543178402906	14.00	6,244.00
500	Nexgen Lurik Ricki (SXF)	IE151941 630947	14.00	7,000.00
500	Glanmor Belmont Welsh Wizard (SXF)	UK748297 700378	14.00	7,000.00
141	H.F.S Bees Knees (SXF)	UK030003 400852	14.00	1,974.00
23	Cogent De Crab Moat (SXF)	NL656232057	14.00	322.00
51	Wintersell Demon (SXF)	UK261437 703767	14.00	714.00
36	DG Brady (SXF)	DK03372306704	14.00	504.00
40	Cogent Bill (SXF)	DE0538281293	14.00	560.00
1	MVE DOBLE 28 semen flask		1225.00	1225.00
1	Certification and Admin		125.00	125.00
1	Export Freight and Insurance		1000.00	1000.00

Cogent Breeding Ltd
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Cheshire, CH3 9GA

T: +44 (0) 1829 773400
F: +44 (0) 1829 773506
international@cogentuk.com
www.cogentuk.com

Shipment terms: CIF (Cost, Insurance and Freight) to Paro International Airport, Paro, Bhutan

Payment terms: Prior to Shipment

The goods are of UK origin.
For and on behalf of Cogent Breeding Ltd

Eamon Monaghan
International Sales Manager

Invoice Total (5,650 units + freight + tanks): $53,950.00

Bank details
HSBC
47 Eastgate Street
Chester CH1 1XW
United Kingdom

SWIFT – HBUKGB4B
IBAN — GB76 HBUK 4012 7668 7223 76

[illegible]

ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture and Forests
Department of Livestock
NATIONAL DAIRY RESEARCH & DEVELOPMENT CENTRE
YUSIPANG, THIMPHU

NDRDC/TECH- 27/2020-21/36 — 7th September, 2020

NOTE SHEET

Sub: **Approval for Import of Progeny Tested / Genomic tested Frozen Bovine Semen**

This is to apprise Dasho that NDRDC, Yusipang is mandated to procure Progeny tested (PT) / Genomic selected (GS) conventional and sexed frozen bovine semen from abroad for use in Government Nucleus Farms, Contact breeders (CHBPP) and selected progressive potential dairy areas. The Centre has asked Proforma Invoices of PT / GS frozen bovine semen from world recognized Companies / Firms. Accordingly, we have received Performa Invoices from four recognized Firms Viz. Ms. Cogent Breeding Ltd (Cogent, UK), Ms. World Wide Sires Ltd (WWS, USA), ST Genetics (USA) and Viking Genetics (Vikings, Denmark). Based on the Proforma invoices received, the Centre proposes to procure the consignments from Ms. Cogent Breeding Ltd., United Kingdom since they offered the lowest rate (US$ 53950) while other Firm viz. Ms. WWS, Ms. ST Genetics and Ms. Viking Genetics have quoted US$ 55641.2, US$ 55725 and Euro 64111, respectively inclusive of freight, container, insurance and other charges. Further, Sires selected from Cogent are of unique pedigrees (different bloodlines) with proven genetics and performance parameters.

The Centre proposes import of **5650 doses (2500 doses Conventional Jersey, 3000 doses sex sorted Jersey and 150 doses sex sorted HF)** of PT / GS frozen semen amounting to around **Nu. 5.00 M** including freight, insurance, bank transfer and other charges. The budget for the same will be met from the approved budget of the Centre under object code 52.06 Plant & Equipt - Livestock (fund support received from RD CCRP Project). The budget balance after semen import will be used for fuelling utility vehicles and meet other expenses related to schedule distribution of LN2 and AI inputs to AI Centres. The import and use of PT / GS semen will create wider genetic base, shorten generation interval and guarantee production of superior offspring to enhance production potential of our cattle population. Therefore, we would like to request Dasho to kindly accord approval for import of 5650 doses of PT / GS bovine frozen semen from Ms. Cogent Breeding Ltd., UK.

Attached: Comparative Statement, Proforma Invoices from different Firms' & other related documents

Submitted for Dasho's kind approval please

Specialist (Advisor)
DoL

Chief
LPD, DoL

Dr. NB Tamang
Program Director

Chief
RED, DoL

HON'BLE DIRECTOR
Department of Livestock, MOAF

Director
Department of Livestock
Ministry of Agriculture & Forests

[illegible]

ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture and Forests
Bhutan Agriculture and Food Regulatory Authority (BAFRA)
Tashichodzong, Thimphu: Bhutan

BAFRA/[illegible] — October 9, 2020.

IMPORT PERMIT OF FROZEN SEMEN FOR ARTIFICIAL INSEMINATION

Permission is hereby granted to ***Dr. NB Tamang Program Director***, National Dairy Research Development Centre (Yusipang) NDRDC DOL, MoAF, Thimphu, Bhutan to import ***5650 doses*** (Five thousand six hundred and fifty only) of ***Frozen Semen*** into Bhutan from "M/s ***Cogent Breeding Ltd. Chester, CH3 9 GA, United Kingdom(UK)***.

Sl. No	Particulars	Trade mark/ Name	Company/Producer	Description of the supply/package	Qty: No. of straws
1.	*Progeny tested jersey semen*	*Sex sorted frozen bovine semen*	*Cogent Breeding Ltd. Chester, CH3 9 GA, United Kingdom (UK)*	*container*	5650 doses

PROVIDED THAT the following conditions are met:

The frozen semen is accompanied by a health certificate of donor bulls certified by the Government Veterinarian In-charge of the area stating that:

1. [illegible]
2. [illegible]
 - [illegible]
 - [illegible]
 - [illegible]
 - [illegible]
 - [illegible]
 - [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. The consignment enters Bhutan at Paro Airport and is immediately presented to the [illegible] Officials for inspection.

THIS PERMIT IS VALID FOR A PERIOD OF (30) DAYS FROM THE DATE OF ISSUE.

Prakash Tamang
[illegible]
Sr. Regulatory & Quarantine Officer
BAFRA

[illegible] SUBJECT TO CANCELLATION AT THE DISCRETION OF THE DIRECTOR GENERAL, BHUTAN AGRICULTURE AND FOOD REGULATORY AUTHORITY, MINISTRY OF AGRICULTURE AND FORESTS, THIMPHU BHUTAN.

BHUTAN AGRICULTURE AND FOOD REGULATORY AUTHORITY
ROYAL GOVERNMENT OF BHUTAN ★ MINISTRY OF AGRICULTURE & FORESTS

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Appendix 2: Half yearly Gist of Report on Implementation of Progeny Testing Scheme in Tading geog, Samtse Dzongkhag *(report submitted by mail on, 27 July 2020)*

Introduction

The Progeny Testing Scheme (PTS) in Samtse Dzongkhag was implemented at Tading geog as per protocol of the Scheme. The 1st and 2nd phases of PTS were executed in Dec. 2017 and Nov. 2018 respectively. The follow-up action of the earlier PTS implemented in the Dzongkhag was executed from 13-18 July 2020, during which identification of the progenies born out of 2nd phase PTS and its body weight recording including progenies of 1st phase were carried out as required under the protocol.

Field activities

- ***Follow-up on AI and progeny born from 1st and 2nd phases of PTS***

All animals included in the PTS were identified via ear-tagging as per National Cattle Information System (NCIS) including progenies. The progenies born of 1st phase implementation were identified in 2nd phase implementation and the progenies born of 2nd phase were identified during the trip and AI success rate was calculated. The two phases of PTS were implemented via synchronization using TRIU-B and insemination on induced heat. During 1st phase of PTS, inseminations were carried out 48 hr post removal of the synchronizing devise as recommended in *Bos Taurus* breed. With the poor result obtained from the 48hr protocol (11.1% AI success rate), inseminations during the 2nd phase were carried out 52hr post removal of the synchronizing gadget. The AI success rate achieved with the 52 hr protocol was 27.7%, resulting in two folds higher success rate than in 1st phase (Table 1). Overall AI success rate achieved via synchronization and insemination in induced heat was 19.4%, whereas it was 34.5% in natural heat (Table 1).

Table 1: Progeny born and AI success rate in PTS areas of Tading geog, Samtse

PTS Implementation	Total AI	Progeny born			AI success rate (%)	Remarks
		Male	*Female*	*Total*		
1st phase	153	6	11	17*	**11.1**	AI in induced heat at 48hr. post removal of synchronizing device
2nd phase	47	5	8	13	**27.7**	AI in induced heat at 52hr. post removal of synchronizing device
	113****	12	8	20** + 19***	**34.5**	AI in natural heat by CAITs
	313	**23**	**27**	**50 +**		

** 1 male progeny from 1st phase died,** progeny born recorded, *** found pregnant on PD*

***** includes 2AI of Karan Fries in HF crosses & 8 AI of Jersey pure in Jersey cross by LEA & CAITs*

Beside, the no of AI and progeny born by THF bulls were also worked out. The overall AI success rate obtained with THF bulls was very poor, particularly *Push* and *Puzzle* when compared to *Pound* and *Popular*, which may be attributed to poor response of farmers and animals quality itself in the areas. The lower AI success rate for Push and Puzzle is directly proportional to its low post-thaw motility. The THF bulls' insemination has led to birth of more female progenies in Tading geog (54%). However, only 27 female progenies were born so far; 11 from 1st phase PTS and 16 from 2nd phase PTS (Table 2). With such result it is difficult to continue the Scheme as intended and planned.

Table 2: AI and progeny born by THF bulls in Tading geog

	1st phase			2nd phase			Total				
THF Bulls	***No. of AI***	***Progeny***		***No. of AI***	***Progeny***		***No. of AI***	***Progeny***			***AI success rate (%)***
		M	***F***		***M***	***F***		***M***	***F***	***Total***	
Push	41	1	3	47	3	3	88	4	6	10	11.4
Puzzle	47	3	3	27	0	0	74	3	3	6	8.1
Pound	29	1	3	36	5	6	65	6	9	15	23.1
Popular	36	1	2	40	9	7	76	10	9	19	25.0
Total	**153**	**6**	**11**	**150**	**17**	**16**	**303**	**23**	**27**	**50***	**22**

* additional 19 animals were found pregnant on PD (table 1)

Conclusion

The uptake of PTS in Tading geog, Samtse was very poor despite of training and deployment of CAITs for insemination of animals in natural heat. The mobile AI services were crippled owing to shortage of LN2 due to frequent breakdown of LN2 plant at Yusipang which has surpassed its functional guarantee of 10 years and warrants its immediate replacement. The insemination of animals in induced heat via synchronization using exogenous hormones was not encouraging; though 52 hr. protocol (2nd phase) resulted in better AI success rate than 48 hr protocol (1st phase), as compared to the success of insemination in natural heat. Nevertheless, synchronization had helped in regularization of normal heat cycles in local cattle which otherwise the animals would continue to remain as unproductive/ feeding burden to the farmers. The progenies born from 1st and 2nd phases of PTS with THF bulls in Tading geog were 54% females (n=50). The average daily weight gain for the THF crossbred progenies of 290 gm was encouraging as the progenies from 1st phase PTS have reached breedable weight at the age of 21-22 months.

Team Members

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II: Half Yearly Consolidated Report (Gist) on implementation of Progeny Testing Scheme in Samtse and Tsirang Dzongkhags. (report submitted by mail on, 16 Dec. 2020)

Introduction

During 11th FYP, the Royal Govt. has accorded approval to introduce high yielding dairy cattle breed like Holstein-Friesian (HF) in the country, along with stimulus package support to the farmers and import of HF frozen semen. At the same time, the Dairy Promotion Organization (DPO), Thailand had gifted 2000 doses of tropical Thai Holstein-Friesian (THF) semen to Bhutan in 2016. In view of systematic utilization of the donated semen, Progeny Testing Scheme (PTS) was initiated with a research protocol in place.

The scheme was implemented in Samtse and Tsirang Dzongkhags using the THF semen of four different sire-lines with first initiation in Dec. 2017. As per protocol for the scheme, three geogs were selected; Tading geog in Samtse Dzongkhag and Barshong and Sergithang geogs in Tsirang Dzongkhag. The selection of the geogs and areas was based on availability of sizeable base population of local cattle, similarity of agro-ecological zones and farming environment and accessibility of PTS operation site for smooth implementation, monitoring and recording.

The scheme was implemented in phase wise manner. Initially local breedable cattle were selected and identified as per National Cattle Identification System (NCIS). The selected animals were synchronized and/ treated for reproductive disorders (infertility) using exogenous hormones and other drugs. The animals that responded to synchronization/ treatment were inseminated with the THF semen in first and second phases. Later, for better uptake of the scheme, the Community AI Technicians (CAITs) were trained and deployed in 2019; six in Tading geog, four in Bashong geog and three in Sergithang geog, for insemination of animals in natural heat. The progenies born under the scheme were ear-tagged, body weight measured and included in the scheme during successive follow-up actions.

Implementation of Progeny Testing Scheme

The scheme was implemented in phase-wise manner. The first two phases of PTS were implemented via synchronization and/ treatment of selected animals. Later, the selected animals were inseminated in natural heat by CAITs and staff AI Technicians.

Insemination in induced heat and AI success rate

The selected animals were subjected to per-rectal examination for assessment of pregnancy, ovarian status and reproductive disorders at the time of implementation. A total of 431 animals were inseminated in induced heat via synchronization using exogenous hormones. The device used for synchronization was TRIU-B impregnated with progesterone hormone (1.9gm) and used other hormonal drugs such as Gonadotropin Releasing hormone (GnRH- Receptal) and Prostaglandin (PGF2α- Lutylase) based on ovarian status of the animals. The animals responded to synchronization and treatments were inseminated on exhibition of heat signs.

During 1st phase of PTS, 298 inseminations were carried out following 48 hr protocol, as recommended for *Bos Taurus* breed, post removal of the synchronizing devise. The inseminated animals were followed-up for progeny born. The AI success rate achieved was 14.1% (Table 2). With the poor AI success rate obtained from the 48hr protocol in 1st phase, the 2nd phase implementation was carried out, almost a year later, following 52hr post removal of the synchronizing gadget. A total of 133 AI were performed and recorded AI success rate of 27.1% (Table 2). However, the AI success rate achieved was still low.

Table 2: Synchronization and AI success rate with different protocol in the PTS areas/ geogs

PTS area/ geog	1st phase (AI on 48 hr. protocol)					2nd phase (AI on 52 hr protocol)					Total AI (no)	Total Progeny (no)	AI success rate (%)
	Total AI	*M*	*F*	*Calves Born*	*AI success rate (%)*	*Total AI*	*M*	*F*	*Calves Born*	*AI success rate (%)*			
Barshong	74	6	8	14	**18.9**	64	13	4	17	**26.6**	138	31	**22.5**
Sergithang	71	7	4	11	**15.5**	22	3	3	6	**27.3**	93	17	**18.3**
Tading	153	6	11	17	**11.1**	47	5	8	13	**27.7**	200	30	**15.0**
Total	**298**	**19**	**23**	**42**	**14.1**	**133**	**21**	**15**	**36**	**27.1**	**431**	**78**	**18.1%**

The overall AI success rate achieved through insemination in induced heat via synchronization/ treatment was 18.1% (Table 2), which was very poor. The synchronization and insemination of local cattle in induced heat just helped in regularization of normal heat cycles and successfully bred by breeding bulls in subsequent heat, which otherwise the animals would continue to remain unproductive/ feeding burden to the farmers.

Insemination in natural heat and AI success rate

In order to accelerate the uptake of the Scheme, CAITs were trained and deployed in the PTS areas from March 2019 in Tading and April 2019 in Barshong and Sergithang for insemination of animals in natural heat. A total of 176 AI were performed in natural heat and recorded conception rate of 48.3% (Table 3). With the findings, it is conclusive that AI in local cattle is recommended in natural heat only.

Table 3: AI in natural heat and Conception rate in the PTS geogs

PTS geogs	Total AI	Progeny born and pregnant on PD				Conception rate (%)	Remarks
		Male	Female	Pregnant	Total		
Barshong	38*	3	3	17	23	44.7	AI from April 2019 till Jan. 2020
Sergithang	35*	8	5	10	23	65.7	
Tading	103**	12	8	19	39	37.9	AI from March 2019 till June 2020
Total	**176**	**23**	**16**	**46**	**85**	**48.3**	

*includes 8 AI of Jersey pure in Jersey cross cows

**2 AI of Karan Fries in HF crosses & 8 AI of Jersey pure in Jersey cross by LEA & CAITs

The AI services were provided based on the agreement between the service provider (CAIT) and the beneficiaries (communities) that the beneficiaries would remunerate for the services provided. However, during the review of the Scheme in 2020, it was observed that most of the CAITs deployed in the PTS areas had stopped performing AI owing to nonpayment of agreed service charge by the beneficiaries and lack of provision to remunerate the CAITs by the Govt.

Hence, the success of the scheme is questioned, which is further precipitated by untimely supply of adequate liquid nitrogen (LN_2) owing to frequent breakdowns of LN_2 plant at Yusipang.

Insemination, Progeny born and AI success rate by AEZs

A total of 581 inseminations were done using the semen of THF bulls; 221 AI in dry sub-tropical zone, 282 AI in humid-subtropical zone and 78 AI in wet sub-tropical zone. The overall AI success rate achieved was 21.2%.

Conclusion and Recommendations

The uptake of PTS was recorded very poor despite of training and deployment of CAITs who provide mobile AI services. The services provided by the CAITs were disrupted due to non remuneration by the beneficiaries and shortage of LN_2 owing to frequent breakdown of LN_2 plant at Yusipang that had surpassed functional warranty of 10 years. Hence, there is a need to establish LN_2 plants in each RLDCs with replacement of old LN_2 plants, and devise a mechanism to incentivize the CAITs for overall success of AI program in the country. The AI success rate achieved in the PTS areas through insemination of animals in induced heat was relatively poor (18.1%) as compared to insemination in natural heat (48.3%). Therefore, AI in local cattle is recommended only in natural heat. However, if local cattle in anestrous state have to be synchronized for advantage of normal heat cycle regularization, 52 hr. protocol is recommended as it resulted in two folds higher AI success rate than 48 hr protocol.

The female progenies born from 1st phase PTS implementation have attained breed-able age and weight for which the Geog Livestock In-charges are advised to take note of the **"Breeding Strategies for THF progenies born in the PTS areas"**, and accordingly guide the CAITs while inseminating the progenies to avoid inbreeding. All events of breeding, reproduction and milk production of THF F1 generation in the PTS areas needs to be recorded. The birth of 54% male progenies from THF bulls in the PTS areas was discouraging to the farmers and thus continuity of the Scheme is questioned. Therefore, another progeny Testing Scheme using the semen of pedigree selected bulls of Jersey breed is recommended for initiation in viable areas.

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Appendix 3: Impact Assessment of Breeding Intensification Program on Breed Improvement and Livelihood in Tsirang Dzongkhag

Introduction

Jersey as principal dairy cattle breed was introduced in the country in first Five Year Plan with the establishment of National Jersey Breeding Centre (NJBC) at Samtse. The breed was propagated in the country through supply of Jersey breeding bulls; both pure and crosses, and crossing with local cattle (*Thrabam*) population. In order to complement the breeding programme, Artificial Insemination (AI) programme in the country was introduced in 1987. Later, further to intensify the breeding programme the Contract Heifer & Bull Production Programme (CHBPP) for Jersey was initiated in 2001, wherein imported progeny tested frozen semen was used. The intervention greatly enhanced the breed improvement programme and productivity of crossbred cattle thereby contributing in improvement of farmers' livelihood. However, no review was conducted to assess the impact of breed intensification programme. Therefore, a review was conducted in Tsirang Dzongkhag among the CHBPP in 2019-20, to assess its impact on breed Improvement programme and livelihood of CHBPP farmers. For the review, structured questionnaire was used to assess the impact of CHBPP in Tsirang Dzongkhag; Kilkhorthang, Gosarling and Rangthangling Geogs, and the information was updated and validated in March 2021.

Objectives

- Assess the quality of animals by blood level progression in the CHBPP herds
- Assess the productivity of CHBPP animals, socio-economic benefit, and identify constraints and opportunity to improve the CHBPP

Data collection and Review

The data were collected randomly from the CHBPP farmers, ensuring minimum coverage of 25% of existing households in the programme. The data collected from the CHBPP farmers were presented in table 1.

Table1: CHBPP areas surveyed and coverage in Tsirang Dzongkhag

CHBPP areas surveyed	Year of inception	H/h registered during inception	H/h registered as of March 2021 (nos)	H/h covered during the survey (nos)
Kilkhorthang	2008	34	134	42 (31.3%)
Gosarling	2008	16	89	29 (32.6%)
Rangthangling	2008	25	75	24 (32.0%)
Total		**75**	**298**	**95 (31.9%)**

The CHBPP at Kilkhorthang, Rangthangling and Gosarling under Tsirang Dzongkhag was started in the year 2008. There have been nearly 3 folds increased in no of h/h registered under the programme now from the inception time. The survey coverage for the review was 31 – 33 % in the areas (Table 1).

In the surveyed areas, the Jersey cattle population has increased now to almost 2.3 times (n=357/156) in Tsirang Dzongkhag from the year of inception of the programme (table 2), showing the availability of 2 milking cows per household (357/169).

Table 2: CHBPP cattle population dynamics in the surveyed areas, Tsirang

CHBPP areas surveyed	Jersey category according to exotic blood level (%)	Jersey cattle (nos) selected initially among surveyed h/h	Jersey cattle (nos) existing under the surveyed h/h	Milking cattle (nos)
Kilkhorthang	Crossbred;< 93.75	77	169	62
	93.75 & above	0	0	2
Gosarling	Crossbred;< 93.75	43	110	37
	93.75 & above	0	0	6
Rangthangling	Crossbred;< 93.75	36	78	27
	93.75 & above	0	0	1
Total		**156**	**357**	**135**

When assessed the population of milking cattle in the surveyed areas, most of them were found in 1st to 4th lactations, when animals were at productive stage (table 3). This indicates that the CHBPP farmers are educated enough to dispose cattle from their herds during unproductive stages of lactation particularly after 6th lactation, and generate revenue at the same time (table 4)

Table 3: Milking cattle population by lactation no. among the CHBPP areas, Tsirang

CHBPP areas surveyed	Milking cattle population by lactation no										Total
	L-1	*L-2*	*L-3*	*L-4*	*L-5*	*L-6*	*L-7*	*L-8*	*L-9*	*L-10*	
Kilkhorthang	20	12	12	13	3	3	0	1	0	0	64
Gosarling	16	9	8	5	3	1	0	0	1	0	43
Rangthangling	11	4	2	6	1	2	2	0	0	0	28
Total	**47**	**25**	**22**	**24**	**7**	**6**	**2**	**1**	**1**	**0**	**135**

The CHBPP farmers among the h/h surveyed generated revenue of **Nu. 6.02 M** through sale of 224 animals in 11 years (table 4). This leads to average income generation of **Nu. 5,760/annum/household** (n=95) in Tsirang Dzongkhag through sale of animals only.

Table 4: Sale of animals from CHBPP and revenue generation (Inception to May 2019)

CHBPP areas surveyed	Animals sold to the Program (nos)	Animals sold outside the Program (nos)	Total revenue generated through sale of animals (Nu)
Kilkhorthang	72	64	3,298,000.00
Gosarling	26	23	178,3400.00

Rangthangling	17	22	938,500.00
Total	**115**	**109**	**6,019,900.00**

When milk production level of CHBPP animals was assessed categorically based on the exotic blood inheritance taking average of daily yield for all lactations recorded, the average daily production stands at 6.1L, 6.1L, 8.1L, 9.7L and 11.7L for jersey of 50%, 62.5%, 75%, 87.5% and 93.75% and above respectively in Tsirang Dzongkhag (Table 5). The daily productivity was found increasing by blood level as intended. However, statistical analysis for production differences will be applied at later period for all categories of exotic blood level.

Table 5: Milk production by exotic blood inheritance of CHBPP cows in Tsirang Dzongkhag

CHBPP areas surveyed	Exotic blood level (%)	Milking cattle (nos)	Total daily yield (L)	Avg. daily production (L/day)
Kilkhorthang	50	23	137.5	6.0
	62.5	1	7	7.0
	75	32	268.6	8.4
	87.5	6	65.5	10.9
	93.75 & above	2	25	12.5
Sub-total		***64***	***503.6***	***7.9***
Gosarling	50	9	57.8	6.4
	62.5	0	0	0
	75	18	135.4	7.5
	87.5	10	95.5	9.6
	93.75 & above	6	71.1	11.9
Sub-total		***43***	***359.8***	***8.4***
Rangthangling	50	13	79.5	6.1
	62.5	3	17.5	5.8
	75	7	58	8.3
	87.5	4	36	9.0
	93.75 & above	1	10	10.0
Sub-total		***28***	***201***	***7.2***
Total	**50**	**45**	**274.8**	**6.1**
	62.5	**4**	**24.5**	**6.1**
	75	**57**	**462**	**8.1**
	87.5	**20**	**194**	**9.7**
	93.75 & above	**9**	**106.1**	**11.7**

		135	**1064.4**	**7.9**

Among the CHBPP h/h surveyed, majority of the members (59%, n=95) expressed that there are adequate market for fresh milk and however, some of them processed into butter and cheese (table 7). With the survey, the existing farm gate price (Nu. 38.5) and market price (Nu. 50) for fresh milk were same in all CHBPP areas. If all milk produced on daily basis is sold as fresh the farmers would generate income of **Nu. 15M** through sale of milk annually by CHBPP farmers in Tsirang, which accounts to **Nu. 157,447/household/annum** (Table 6).

Table 6: Sale of milk and income generation

CHBPP areas surveyed	Members surveyed	Daily milk production (L)	Farm gate price (Nu)	Revenue/ Day (Nu)	Revenue/ Year (Nu)	Revenue/yr/ member (Nu)
Kilkhorthang	42	503.6 (n=64)	38.5	19,388.6	7,076,839.0	168,496.2
Gosarling	29	359.8 (n=43)	38.5	13,852.3	5,056,089.5	174,347.9
Rangthangling	24	201.0 (n=28)	38.5	7,738.5	2,824,552.5	117,689.7
Total	**95**	**1064.4 (n=135)**	**38.5**	**40,979.4**	**14,957,481.0**	**157,447.2**

In order to boost dairy production in 11FYP, the Royal Govt. had supported the import of over 2800 animals but the data on sources of animals in the CHBPP herds in Tsirang revealed that only 9 households had imported one each HF cross cows in entire Tsirang Dzongkhag. Overall, 90% of CHBPP farmers (n=95) discouraged the import of animals as the import of animals was seen as expensive affair coupled with poor adaptability and high mortality of imported animals, and the farmers emphasized more on in-house production through AI services for quality; adaptability and productivity. This indicates that there is positive impact of breeding intensification programme on breed improvement. Further, 82% of the CHBPP farmers (n=95) expressed that the programme was very much beneficial in terms of herd improvement and income generation. The data revealed that dairy farming remained as 1st, 2nd and 3rd sources of income for 76%, 21% and 3% of the CHBPP farmers (n=95) in Tsirang Dzongkhag. In terms of feeding and housing of CHBPP animals 71% of the farmers feed commercial concentrate and 67% of them (n=95) had permanent cattle sheds.

While CHBPP was initiated, the farmers had to sign a contract agreement whereby that the member would breed the registered animals through AI only, maintain breeding records, maintain one day milk record of each milking animal on a particular date every month for 10 months and sale the registered animals with prior information to the geog livestock Staff. Whereas, the livestock sector shall provide awareness of the programme from time to time, provide AI services with imported semen, ear-tag the progeny born in the programme, provide individual bovine register for recording of animal information and other events and provide health care services.

The data revealed that the majority of the CHBPP members had complied with the contract agreement (Table 7). However, only 81% had carried out recording of milk as required and 8% had availed both AI and breeding bull in the event when repeated from AI.

Table 7: Farmers' compliance to CHBPP contract agreement

CHBPP areas surveyed	Breeding of CHBPP animals		Maintain breeding records		Monthly milk Recording		Compliance on sale of animals from CHBPP	
	AI	AI + bull	Yes	No	Yes	No	Fully	Partially/ nil
Kilkhorthang	42	1	41	1	32	10	42	0
Gosarling	23	6	28	1	23	6	29	0
Rangthangling	22	1	23	1	22	2	23	1
Total	**87**	**8**	**92**	**3**	**77**	**18**	**94**	**1**

According to the contract, services were provided adequately by the livestock sector (Table 8).

Table 8: Services provided as per HBPP contract agreement

CHBPP areas surveyed	Awareness on the contract programme		Ear tag animals as per NCIS		Issue individual bovine register		Provide health care facilities	
	Received	Not received	Yes	No	Yes	No	Yes	No
Kilkhorthang	42	0	38	4	31	11	42	0
Gosarling	28	1	26	3	26	3	29	0
Rangthangling	23	1	22	2	21	3	24	0
Total	**93**	**2**	**86**	**9**	**78**	**17**	**95**	**0**

Conclusion

The implementation of CHBPP was found to be successful in Tsirang Dzongkhag. The majority animals in the CHBPP herds were farm born which is a positive impact of the breeding intensification programme as the increase in no. of crossbred animals in the CHBPP herds, after selling of 224 excess cross-bred animals in the herd, was 2.3 times from inception of the programme in 2008 which could be attributed to keen interest of the members in the programme. Beside, the Programme had provided the social benefit to the community over and above the income generation support on an average of Nu 157,447/member/ annum through sale of milk only. However, smooth implementation of the programme was constrained by difficulties in maintenance of breeding records, milk production records and disposal of male calves born out of conventional semen in the programme. Nevertheless, the CHBPP in Tsirang Dzongkhag is supported with supply of sexed semen under Heifer Production Scheme, which is expected to tackle the issue of male calf birth and disposal and strengthen the programme further as there is high demand for dairy heifers nationwide.

Appendix 4: GUIDELINES FOR ESTABLISHMENT, OPERATION AND MANAGEMENT OF DAIRY ENTERPRISE IN BHUTAN

Scope

Bhutanese dairy farmers shall be facilitated to operate dairy farming on business mode as "Dairy Enterprise" for environment friendly operation and sustainable socio-economic development while investing in dairy sector towards achieving overwhelming demand of heifers in the country. The Enterprise can be taken up by an individual or a group of individuals in own registered land or on leased land.

1. Eligibility

1.1 Any Bhutanese above 18 years of age and having capacity to maintain required no. breedable crossbred cows and heifers (min. 50% exotic blood inheritance: Jersey and Holstein-Friesian) at all times individually or in a group to produce 10 marketable heifers annually.

1.2 An individual having undergone Comprehensive Entrepreneurship Course (40 days training) or at least Basic Entrepreneurship Course (30 days training) provided by competent agency shall be given preference.

2. Registration

2.1 The eligible proponent(s) upon fulfillment of the requirements outlined below, verified by the Dzongkhag Livestock Sector, shall be registered with the National Dairy Research & Development Centre (NDRDC), Department of Livestock (DoL).

2.2 The NDRDC, DoL shall issue Certificate with registration no. for the Entrepreneurship [*Yr. of registration (4 digits), Dzo. Code (2 digits), Geog code (2 digits) & Sl no (2 digits)]*.

2.3 Individual household(s) that qualify for membership under Dairy Eenterprise shall register their animals via ear-tagging or any other suitable identification medium applying National Cattle Identification System under the umbrella of National Dairy Information System (NDIS).

3. Criteria for selection of potential proponent(s)

3.1 Youth or individual(s) with keen interest on dairy farming.

3.2 Farmers with existing stock of animals as required, land (preferably dry), water and other basic resources/ facilities.

3.3 Experience in dairy farming and interest to expand existing farm to enterprise mode.

3.4 Members of dairy groups interested to diversify business through heifer production.

3.5 Consent from the local extension agent (LEA) and local government (LG).

3.6 Matrix ranking shall be applied while selecting the potential proponents as in the format below;

Matrix ranking (100 score)

Proponent(s)	Interest (20)	Experience (20)	Animal (15)	Land/ water (15)	LEA/ LG Consent (15)	Finance (15)	Total Score	Remarks
Example: A							80	Selected
B							60	Selected
C							40	not selected

4. General requirements

4.1 ***Operation type***

The proponent(s) shall specify the whether the operation is at individual level or in a group.

4.2 ***Business proposal***

The proponent(s) shall submit business proposal (Annexure 1) indicating the location of enterprise, scale of operation, employment generation, marketing and management plan in the project proposal.

4.3 ***Clearances***

4.3.1 The proponent shall obtain all necessary clearances where necessary from the respective competent authority.

4.3.2 The proponent shall obtain lease agreement document if the enterprise is established/ proposed for establishment in leased land.

4.4 ***Socio-economic development***

4.4.1 The Enterprise shall gear towards income and employment generation.

4.4.2 The Enterprise shall pay taxes to the Royal Govt. where applicable.

5. Technical requirements

5.1 ***Animal housing***

Animal shed(s) shall be of permanent type and constructed as per specification provided by the National Dairy Research and Development Centre (NDRDC), Yusipang or requirement based on agro-climatic condition in view of animal welfare and management ease.

5.2 ***Animal feeding***

The farmer(s) shall adopt stall feeding practices with zero forest grazing. Feed and fodder requirement shall be calculated on Dry Matter (DM) basis @ 2.5kg DM for 100kg live body weight as per standard outlined in Dairy Production Manual, 2021(15). Farmer(s) may adopt

other appropriate technologies in case the pasture development area is not sufficient, and ensure access to clean water *ad-libitum.*

5.3 ***Hygiene and sanitation***

The animal(s) and animal shed(s) shall be kept clean all time. While milking the animals standard operating procedure (SoP) for clean milk production shall be followed strictly as highlighted in Dairy Production Manual, 2021 (15).

5.4 ***Farm bio-security***

Visit to animal farm(s) shall be restricted to visitors or unauthorized personnel, which may be notified by means of a sign board at the entry point to the farm premises as highlighted in Dairy Production Manual, 2021 (15).

5.5 ***Manure management***

The provision of slurry pit connected to the animal shed(s) is mandatory to reduce methane gas emission from free flowing urine and dung in the environment. Adoption of bio-gas technology is encouraged.

6. Operation and Management of Enterprise

6.1 ***General***

6.1.1 The proponent(s) shall have basic knowledge on dairy management (produce certificate from any recognized institution viz. RDTC, Zemgang).

6.1.2 The enterprise shall make arrangement for uninterrupted AI services.

6.1.3 The enterprise shall be operated as per technical requirements in sl. no. 4.

6.1.4 The transportation of live animals for establishment/ operation of dairy enterprise shall adhere to Standard for Transport of Animals prescribed under Bhutan Standards, Bhutan Standard Bureau.

6.2 ***Marketing of live animals***

6.2.1 The Enterprise shall identify market and carryout marketing of animals on its own.

6.2.2 While selling heifers from the enterprise, priority shall be provided to the local community.

6.2.3 When transportation of live animals is involved in marketing, the enterprise shall respect 6.1.4 section of this guideline.

6.3 ***Record keeping***

6.3.1 The enterprise shall maintain physical and financial records of the enterprise including animal stock inventory, health and breeding records.

6.3.2 The records should be analyzed periodically for decision support system.

7. Breeding support and facilities

7.1 The enterprises shall be supported with AI services to promote the enterprise.

7.2 The Enterprise shall be provided with sexed semen of Jersey and Holstein-Friesian.

7.3 The usage of sexed semen shall be in accordance with the Heifer Production Scheme implementation modalities.

8. Credit facilities

8.1 The Dzongkhag Livestock Sector shall give priority to the potential proponents in availing loan liaising with financial institutions for establishment of dairy enterprise or expansion of the business.

9. Progress reporting

9.1 The Geog and Dzongkhag livestock sectors shall follow the reporting channel and frequency as approved by the DoL until NDIS is launched officially.

9.2 The performance of the enterprise shall be reported through NDIS, wherein information shall be updated by the Geog Livestock Officer as per their areas of intervention.

10. Monitoring and Evaluation

10.1 The geog livestock officer shall monitor the regular functioning of the Enterprise and provide technical backstopping where required.

10.2 The NDRDC in collaboration with Dzongkhag livestock sector and RLDC shall monitor and evaluate the Enterprise on annual basis.

Tashi delek

Annexure 1: BUSINESS PROPOSAL

(Establishment, Operation and Management of Dairy Enterprise)

1. Details of proponent(s)

   1.1 Identity: Name: ……., CID #: ……

   1.2 Address: Village:……, Gewog: ……., Dzongkhag: …….

2. Location: …….. *.(Where the enterprise is proposed for establishment)*

3. Scale of operation: …… (proposed no. of cattle heads in the enterprise).

4. Operation type: …….. (*Individual/ Group of Individuals*)

5. Prepare detail project report (DPR) on operation and management of the enterprise including proper feasibility study, infrastructure and equipment, animal stock, feed & fodder resources, human resource and detail financial analysis.

Appendix 5: Revenue generation receipt

REVENUE ACCOUNTING SYSTEM
COLLECTION SUMMARY
Manager, National Livestock breeding centre, Wangchutaba (Thimphu)

.d 2020-11-16 to 2021-06-29 Print Date: 29/06/2021

GL HEAD CODE	GL HEAD DETAILS	AMOUNT
131110082	Other Fees and Charges -Live Stock	105,368.00
132110008	BULL SALE	12,000.00
	TOTAL REVENUE:	117,368.00

(CASHIER)

Asst. Accountant
National Dairy Research Centre
Yusipang : Thimphu

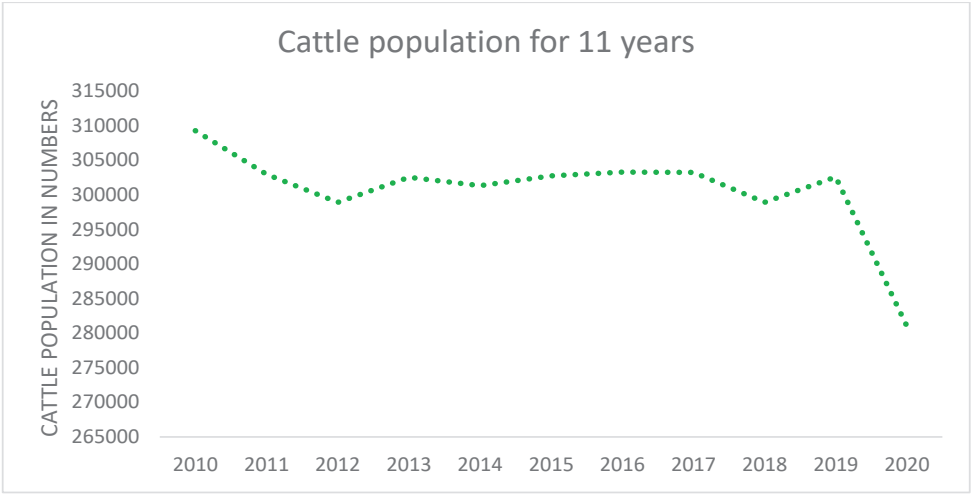
(CONTROLLING OFFICER)

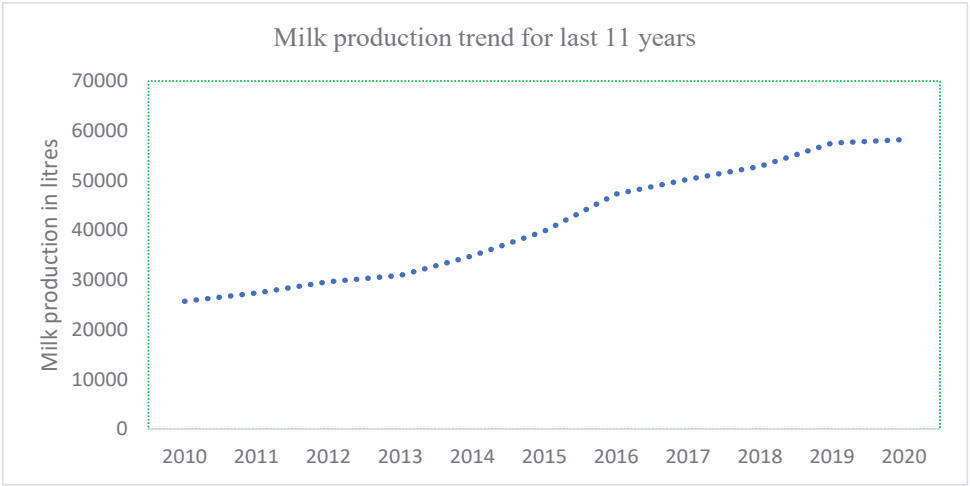
Appendix 6: Annual Asset Declaration (Hardcopy attached)

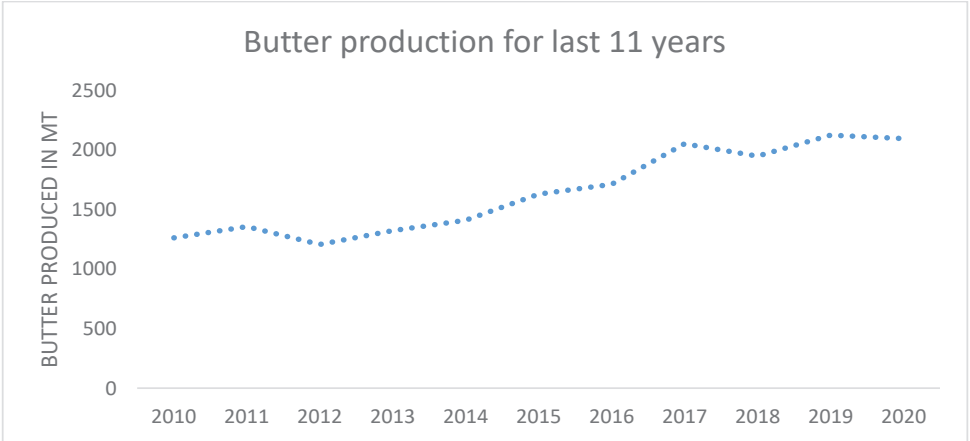
Appendix 7: Report on AI Refresher Course Done (Hardcopy attached)

Appendix 8: Correspondences in Dzongkha (Hardcopy attached)

Appendix 9: Minutes of Staff Meeting (Hardcopy attached)


Cattle population for 11 years
CATTLE POPULATION IN NUMBERS
315000
310000
305000
300000
295000
290000
285000
280000
275000
270000
265000
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020


Milk production trend for last 11 years
Milk production in litres
70000
60000
50000
40000
30000
20000
10000
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

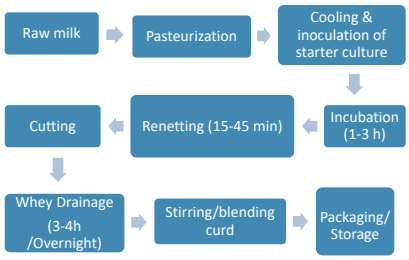

Butter production for last 11 years
BUTTER PRODUCED IN MT
2500
2000
1500
1000
500
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

QUARG

INTRODUCTION

Quarg (or Quark) is an acid coagulated fresh unripened variety of cheese generally made from pasteurized skim milk with addition of lactic acid starter culture and small amount of rennet. Quarg can also be made from partially skim milk or whole milk. It contains high moisture content of 82%w/w and has a shelf life of 6-10 days when stored under refrigeration condition.

PRODUCTION PROCESS



APPLICATIONS/END USE

The mild flavor and smooth texture of Quarg compliments various dishes.

- Can be substituted in place of sour cream, cottage or ricotta or cream cheese
- Serves as a flavor carrier
- Can be blended with seasoning to be used as toppings or as a dip
- Used as a filling in variety of pasta dishes
- Adds viscosity to variety of products, can be blended with sauce and dressing
- Due to high moisture content can be baked cakes and brownies keeping the product moist




CHARACTERISTICS

Quarg is similar to that of yogurt and cottage cheese with the following characteristics:

- Unripened, fresh, and very smooth in texture unlike cottage cheese (distinct curd)
- Mildy acidic in flavor in comparison to yogurt
- Milky white in color or slightly yellowish
- There should not be appearance of water or whey
- No bacteriological deterioration, over acidification, or bitter flavor during storage

NUTRITIONAL BENEFITS

Quarg is of high nutritional value.

- High content of **milk protein**
  - Protein is an important building block of bones, muscles, cartilage, skin, and blood
- High content of **minerals and vitamins**
  - Mostly rich in calcium helps to keep teeth and bone healthy.
  - Vitamin A (great for eyesight) and vitamin B which helps support our nervous systems.
- Contains various **essential amino acids**
  - Vital for body functioning such protein synthesis, tissue repair and nutrient absorption
- **Gut friendly**
  - Helps in improving and maintaining a healthy gut/digestive environment.

QUALITY CONTROL

In order to maintain quality Quarg must be produced with utmost care.:

- Raw milk should be of high quality with low microbial load. Thus, ensure clean milk production at the farm level
- Ensure cold chain facility at all levels starting from the farm, at manufacturing, marketing and at retail level
- Quality control and quality assurance during manufacturing processes should be ensured (Good Manufacturing Practices and Good Hygienic Practices)

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