ICAR-NRCY

ANNUAL REPORT

2020

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ICAR-National Research Centre on Yak
(ISO 9001:2015 certified)
Dirang-790 101, West Kameng District
Arunachal Pradesh, India
Website: https://nrcy.icar.gov.in

ANNUAL REPORT

2020

MILESTONES

1989: ICAR-National Research Centre on Yak established at Dirang, Arunachal Pradesh.

1995: Experimental yak farm at Nyukmadung (2750 meter above mean sea level and 31 km away from Dirang) become functional.

1998: ARIS Cell established and institute website launched.

2004: Small scale yak milk and wool processing unit for demonstration and training started.

Institute organized a National Con-ference on "Sustainable Yak Husbandry".

2005: MISMO, first Embryo Transfer Technology (ETT) yak calf in world born.

Cryopreservation of yak semen stand-ardized. Artificial Insemination with frozen semen started.

2006: Institute's scientist received prestigious 'Fakhruddin Ali Ahmed Award (Animal Science)' and 'Jawaharlal Nehru Award'.

First yak calf born through Artificial Insemination.

2007: First KVK under ICAR-NRCY inaugurated at Lohit district of Arunachal Pradesh. First Yak x Cattle hybrid calf born through AI.

2008: Scientists received prestigious 'CSIR Award for Science & Technology Innovations for Rural Development 2007'.

2009: Institute organized an International Conference on "Yak Husbandry: Chal-lenges & Strategies".

2010: A novel product on yak milk i.e. dietary fibre enhanced low fat paneer (Designer Paneer) has been selected in the top ten ICAR technologies in the North-East during 2nd North-East Agri-Expo held at Dimapur.

2011: Institute's Scientist received prestigious 'Fakhruddin Ali Ahmed Award'.

2012: Ultra sounded guided trans-vaginal Ovum pick up technique for oocyte retrieval for in vitro production of yak embryos standardized.

2013: NORAGYAL, first IVF calf born. The first Yak Mela organized.

2014: Interface meeting conducted at Leh, Jammu & Kashmir to sustainable yak husbandry at Ladakh

2016: Fourth Interface meeting conducted at ICAR-NRC on Yak, Dirang on "Holistic approaches to sustain livelihood of yak rearers through scientific intervention in India"

2017: MoA with local tribal youth for yak-jute blended fabric technique. Implement the techniques of "Ensiling of forages" to mitigate winter feed crisis in highland animals

2018: Registered First Yak Breed for Arunachal Pradesh as "Arunachali" with A. Number INDIA_YAK_2300_ARUNACHALI_16001.

Organized Workshop on "Yak Resource Towards Doubling Farmer's Income".

2019: Fifth Interface meeting organized Sixth Yak Mela'2019 organized

2020: Developed Cheddar style-yak milk cheese having up to four months of storing ability

MANDATE

1. Identification, conservation, charact-erization and evaluation of yak germplasm
2. Improvement of yak for draught and milk

MISSION

Conservation and propagation of novel yak genetic resource and improvement of yak husbandry in India through scientific interventions

VISION

Conservation and improvement of yak for higher productivity and profitability through innovative research.

भाकृअनुप
ICAR

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(ISO 9001:2015 Certified Institue)
Dirang - 790 101, Arunachal Pradesh, INDIA
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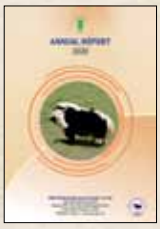

A *Female Arunachali* yak (Front)

Yak herd grazing in summer pasture (Back)

The achievement and activities presented in this Annual Report cover the period from January'2020 to December'2020 and based on inputs from various sections. This report includes unpublished data, which would form the basis of different scientific papers in due course. The materials contained in this report therefore may not be used without prior permission of this institute.

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Preface

The ICAR-National Research Centre on Yak (NRCY), the only premier institute in the country, is dedicated to work exclusively for conservation and improvement of yaks in the country through research, and technological support to the yak rearers for enhancing their socio-economic status. It is my immense pleasure to present the Annual Report of the institute for the year 2020.

The inherent qualities of yaks to produce milk, meat, hide and hair, along with its utility for much needed transportation at the high altitude make them '***most important treasure animals of highlanders***'; the value addition of yak products essentially make these animals potential resources for improving income generation at high altitude. However, decline in yak population in the country (24.67% over Livestock Census Report of 2012) becomes a major issue for all concerned. As such, necessitated the institute to develop strategy for yak rearing states, particularly in Leh-Ladakh and Sikkim in collaboration with sister ICAR institutes and Animal Husbandry and Veterinary Departments of respective Union Territory and the State, for improvement of yak production in the light of strategic actions taken by the institute in ***Arunachal Pradesh which has resulted in 71.22 % increase in yak population*** over the 2012 census report. Pertinent actions have been taken. However, the crisis due to COVID-19 Pandemic coupled with other constraints retarded the desired progress; yet continuing the mandated journey of the institute towards overall improvement of yaks in the country.

The hard-working staff with small scientific manpower of ICAR-NRC on Yak, has accomplished targeted researches and performed commendable services for the farmers during this period. The targeted research works on different aspects of yak production and improvement under 06 institute funded projects, 01 collaborative project with ICAR-IIMR, 01 project sponsored by GBP Institute of Himalayan Environment and Development on 'Capacity building and awareness programme on conservation of yaks in the state of Arunachal Pradesh, 02 AICRPs – one on 'Application of Plastic in Yak Husbandry' & another on 'FMD' and 01 DST funded project on 'Himalayan Agriculture under National Mission on Sustaining Himalayan Ecosystems' have been accomplished. Notable progress has been made in activities pertaining to 'Maize production potentiality for sustainable livestock production in substitution of normal maize with QPM in the concentrate ration', 'Awareness and monitoring of Foot and Mouth Disease (FMD)', '*Ex-situ* conservation of yak germ plasm and its reproduction with preparation of semen samples in best found tris extender & cryopreservation of such 1230 semen straws for A.I. and superovulation study in yak', 'Development of value added cheese from yak milk with effectiveness of storing yak milk cheese up to four months with

optimum sensory attributes, and 'Assessment of thermo-adaptability in Yaks housed in CGI roofed shelters with evidence of heat stress when housed inside during summer months at an altitude of 2750 m above msl under semi-intensive system of rearing'. Also, research progress has been made on 'effect of weaning age on yak calves performance', 'detection of anthelmintic resistance in GI nematodes of high altitude animals', and 'Nutrients profiling for the milk of Arunachali yak'. Attempting to materialize the Hon'ble Prime Minister's vision for '***Atmanirbhar Bharat***' the institute extensively carried out various skill development and capacity building programmes viz. value addition of animal products, processing of yak milk and wool/fibre, scientific rearing of highland animals to women & unemployed youths for better earning from their livestock keeping all preventive measures of COVID-19 pandemics. One of such trainee has already started his small milk processing start-up. It is worth mentioning that during the reported period, the institute made all possible efforts to support the yak farmers of North Sikkim, particularly with feeds & Complete Feed Blocks (CFBs) for sustenance of their animals during winter food crisis which has received applaud from the Animal Husbandry & Veterinary department of Sikkim Government. It gives me pleasure to admire and congratulate the three scientists and a technical officer of this institute who received awards/recognitions for their scientific contributions from esteemed institute/organizations.

I take the opportunity to put on record our gratitude to Dr. Trilochan Mohapatra, Secretary, DARE, Govt. of India and Director General, ICAR, for his constant support and encouragement towards development of this institute. I sincerely extend my thanks to Dr. B.N. Tripathi, DDG (AS), ICAR for his valuable advice and guidance. I am equally thankful to Dr. Ashok Kumar, ADG (AH), Dr. Amrish Tyagi, ADG (ANP) & Dr. V.K. Saxena, ADG (AP&B), for their help, support and cooperation towards accomplishing various tasks of the institute on time. Hearty thanks are also extended to Dr. Rajan Gupta, Pr. Scientist (AN&P), Dr. Vineet Bhasin, Pr. Scientist (AP&B), Dr. (Mrs.) Jyoti Misri, Pr. Scientist (AH), and other officials of ICAR Headquarters for their constant guidance, help and support. Lastly, I express my immense thanks to all the scientists, technical officers and staff of the institute for their dedicated service & contributions towards overall development of the institute. I congratulate the entire editorial board for doing excellent exercise to meticulously prepare the ICAR-NRC on Yak Annual Report: 2020, and sincerely wish that this report would best serve the purposes for which ICAR-NRC on Yak was established, and would help all concerned working for yak husbandry practices in the country.

At the end, I heartily congratulate Dr. Mihir Sarkar, regular Director of this prestigious institute of ICAR, and wish everyone involved in the development of ICAR-NRC on Yak 'work with positive attitude and best of luck'.

Thanks & regards.

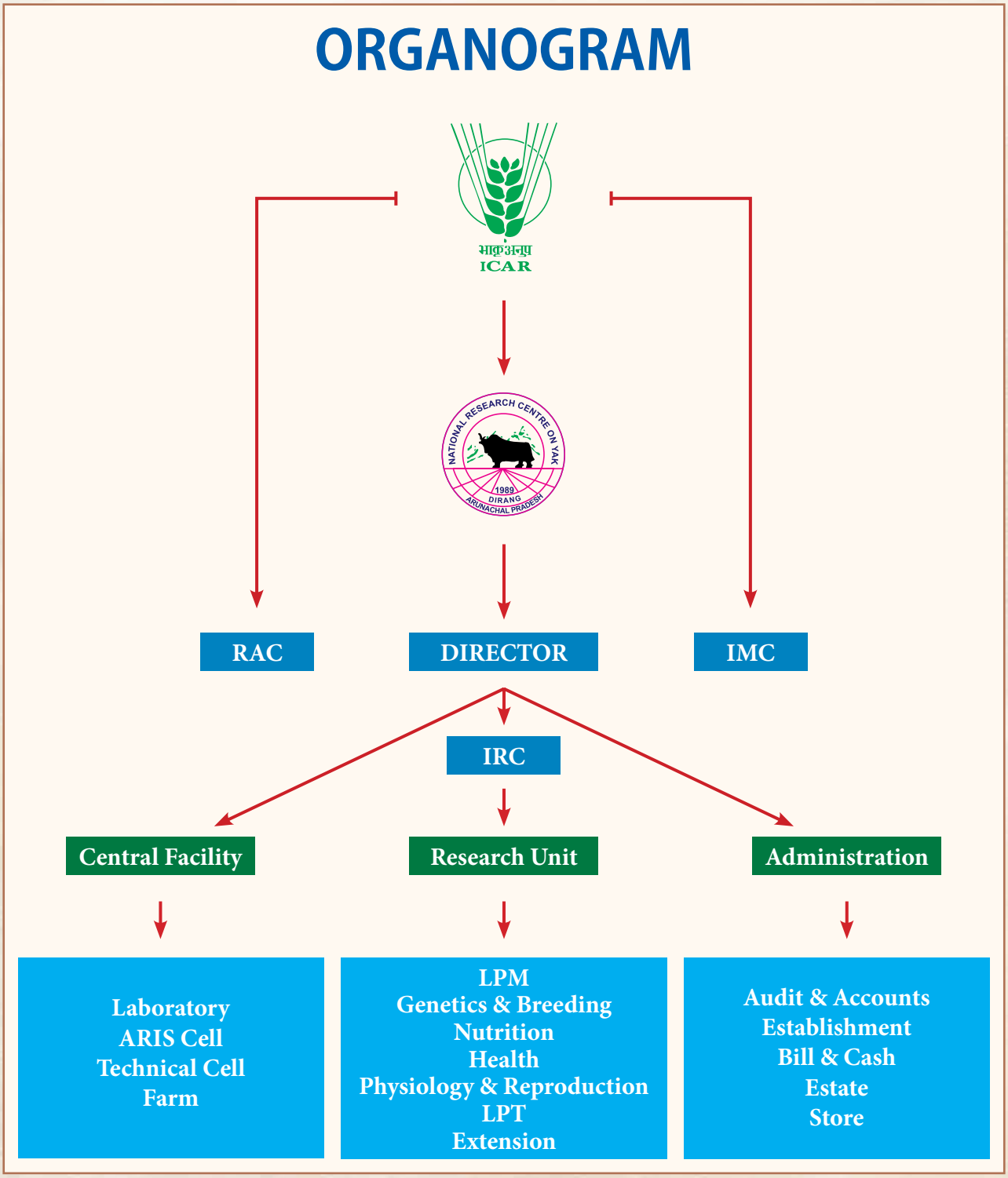
Jai Hind !

(P. Chakravarty)
Director (Acting)

CONTENTS

Organizational set up

The Director, ICAR-NRC on Yak, exercises full authority for research strategy formulation and administration. Institute Management Committee (IMC), Research Advisory Committee (RAC) and other functional committees constituted by ICAR provide advices to the Director for smooth, efficient and improved functioning of the institute. For day-to-day administration and smooth running of the institute, a team of scientists, technical, administrative and supporting staffs assist the Director. The present structure of management of the institute is presented below:



EXECUTIVE SUMMARY

ICAR-National Research Centre on Yak is the premier research organization exclusively engaged in research and development of yak (*Poephagus grunniens* L). Institute was established in 1989 at Dirang, West Kameng district of Arunachal Pradesh to make an in-depth study on traditional yak rearing and to formulate future plans, strategies and programs for overall improvements and sustainable development of yak husbandry in the country.

ORGANIZATIONAL STRUCTURE

The Director is the highest authority for research strategy formulation and administration with the help of Institute Management Committee (IMC), Research Advisory Committee (RAC), Institute Research Committee (IRC) and other functional committees constituted by the ICAR. Research and development activities are mainly done through different scientific section like Animal Genetics &Breeding, Animal Nutrition, Animal Physiology and Reproduction, Livestock Production & Management, Animal Health, Livestock Product Technology and Veterinary Extension Education. The institute has infrastructure consisting of central facilities like Nyukmadung yak farm, Library, Central Laboratory, Central Instrumentation Facility, AKMU Cell, Estate and Maintenance Section etc. Administrative functions *viz*., purchase, establishment, store etc. is looked after by the Administrative Officer, where, finance section is under the Assistant Finance & Account Officer. Institute has present strength of Director, 06 scientists, 05 technical, 08 administrative and 15 skilled supporting staff as on 31st December'2020.

BUDGET OUTLAY

The financial outlays of the Institute in terms of actual expenditure and budget sanctioned for the financial year 2020-21 was Rs. 8, 93, 03, 307.00

RESEARCH ACHIEVEMENT

Effect of weaning age and starter protein levels on performance of yak calves

Sucking without restricted milk feeding from dams by calves, leads to frequent digestive disturbances in calves due to overfeeding. Besides, this system of yak raising is economically less viable. It also extends the calving intervals, although records in this regards in yak is very scanty. Therefore, the study performed on effect of weaning age and dietary protein levels in calf starter, revealed that the weaning of yak calves at 2-3 months age supplemented with high protein calf starter is beneficial for profitable yak rearing under semi-intensive system at high altitude.

Maize production potentiality for sustainable livestock production

Production potentiality of maize carried out through cultivation of six varieties of maize in different altitude and found out-standing growth for African Tall (fodder variety) and Dirang local (grain variety) in mid altitude (Dirang, 4500 ft above msl); however, the productivity in other varieties viz. sweet corn, QPM (Shaktiman & HQPM-1) and baby corn were comparatively low irrespective of altitude. Complete substitution of normal maize with QPM in the concentrate ration of yaks indicated beneficial effects in both growing and lactating yaks.

Awareness and monitoring of Foot and Mouth Disease (FMD)

A total of 323 animals were vaccinated (277 yaks, 3 hybrids and 70 cattle were vaccinated) in different yak tracts of Arunachal Pradesh. For screening of FMD virus, total 89 serum samples, including 39 yak, 29 yak-cattle hybrids and 21 cattle samples, were collected from different pastures and farm of Arunachal Pradesh.

Detection of anthelmintics resistance in GI nematodes of high altitude animals

Internal parasites in yaks are one of the major health problems in both free ranged and farmed yaks. Considering its economic importance detection of anthelmintic resistance in GI nematodes of yak with other high-altitude ruminants was studied and found no resistance against benzimidazole in GI nematodes of yak, yak cattle hybrids and cattle irrespective of their managemental system. Different anthelmentics showed 100% efficacy on faecal egg count reduction test (FECRT).

Ex-situ conservation of yak germplasm and its reproduction

Fresh sperm ejaculates from fertile yaks were collected and evaluated for its concentration, motility and morphology. Evaluation of the cryopreserved yak semen found to be the best in Tris extender containing Vitamin E alone or in combination with Vitamin C. During this report period a total of 1230 semen straw were prepared, evaluated and preserved at -196^{0}C in liquid nitrogen for future use. Superovulation of yaks with a combination of FSH and LH (Stimufol®), and PMSG (Folligon®) alone, were found effective for superovulation and recovery of yak embryos with the best results by the use of Folligon (@ 1500 IU) for *Arunachali* yaks.

Assessment of Thermo-adaptability in Yaks housed in CGI roofed shelters:

Heat tolerance tests, based on changes in physiological responses of the animals in relation to its surrounding microclimate indicated that yaks experience heat stress when housed inside a CGI roofed animal shelter during summer months at an altitude of 2750m above msl under semi-intensive system of rearing.

Development of value added cheese from yak milk

Cheddar style-yak milk cheese from yak milk was prepared with standardized procedure and stored at 7±1°C for 150 days. Cheese samples were evaluated for physicochemical, antioxidant activity, textural, microbial and sensorial changes at defined interval during storage. Physicochemical, microbiological, and texture parameters of yak milk cheese affected with ageing of cheese. The antioxidant activity enhanced significantly with the advancement of storage period. Sensory evaluation indicated that all the sensory attributes improved with the storage period. Yak milk cheese could be stored up to four months with optimum sensory attributes.

Nutrients profiling for the milk of Arunachali yak

The nutrient composition and physicochemical properties of *Arunachali yak* milk reared under farm conditions were evaluated for exploring the prospects of product diversification through their value addition. It was observed 15.63-19.63% total solids with 5.29-8.73% fat, 3.45-4.27% protein and 0.64-0.82% ash. The pH, titratable acidity (% lactic acid) and density (g/cm^3) of yak milk ranged 6.47-6.63, 0.128-0.161 and 27.9-37.1, respectively. The Fat, solid non fat and protein of yak milk was significantly ($p<0.05$) higher than yak-cow hybrid and cow milk. It was also revealed the Ghee produced from the yak-cow hybrid milk was richer in MUFA and PUFA, while yak ghee showed higher level of saturated fatty acids.

TRANSFER OF TECHNOLOGY

- **Support to Highland Livestock Farmers during COVID Pandemic:** The Institute has provided concentrate animal feed, complete feed blocks, mineral mixtures, essential veterinary medicines and also logistic support to the 86 yak and other highland livestock farmers affected due to restriction imposed on movement in their migratory routes towards highland pastures to contain the spread of COVID 19 in West Kameng, Arunachal Pradesh.
- Keeping all preventive measures of COVID-19 pandemics the institute extensively carried out various skill development programmes viz. value addition of animal products, processing of yak milk and wool/fibre, scientific rearing of highland animals to women & unemployed youths for better earning from their livestock.

All these programme were the effort towards Prime Minister's vision for '*Atmanirbhar Bharat*" through capacity building programmes of the tribal communities of Arunachal Pradesh. One of such trainee has already started his small **milk processing start-up**.

- ICAR-NRC on Yak has organized various collaborative programmes with TSP supports in the form of animal feed, mineral mixture, basic veterinary medicines and other utility items for promotion of highland animal farming. Most of these programmes were carried out in association with Dirang Employees Worker's Society (DEWS), Krishi Vigyan Kendras of West Kameng district of Arunachal Pradesh; Department of Animal Husbandry and Veterinary, Govt. of Arunachal Pradesh and Sikkim for benefiting the farming community of both Arunachal Pradesh and Sikkim.
- Institute has also carried out various animal health-cum-vaccination camps for enhancing their livestock productivity through raising of healthy animal.
- To popularize and showcase the technologies developed by the institute, ICAR-NRC on Yak participated in different exhibitions, kisan mela, farmer's fair etc and put up stalls to display the technologies to attract the public towards yak rearing.

PUBLICATIONS AND PRESENTATIONS

- A total of 03 (three) research papers have been published during the year. All the papers have been published in foreign peer reviewed journals.
- Other major publications of the institute include training manuals, extension folders/ leaflets, ITMU news bulletin, Annual report 2019 etc. Besides these the institute compiled and published the Strategic Document for Yak Breeding in Sikkim in collaboration with Department of Animal Husbandry, Veterinary and Fisheries, Govt. of Sikkim.

OTHER ACHIEVEMENTS

- Institute generated revenue of Rs. **19, 55, 779.00** from the sale of the yak products, surplus unproductive yaks and other sources.

01

INTRODUCTION

Brief History

The Indian Council of Agricultural Research (ICAR) established the ICAR-National Research Centre on Yak (NRCY) at Dirang in West Kameng district of Arunachal Pradesh in 1989 to make an in-depth study on traditional yak rearing and to formulate future plans, strategies and programs for overall improvement and sustainable development of yak husbandry in the country. The institute was initially started in the premises of Regional Temperate Fodder Station, Department Animal Husbandry and Veterinary, Government of Arunachal Pradesh, Dirang. In 1995, this institute got its own campus and started its activity. Subsequently on 19th April, 2009 laboratory-cum-office building of NRCY was inaugurated with initiation of its full fledged activity in its Dirang campus. The institute experimental yak farm is located at Nyukmadung (2750 m above msl) at a distance of 31 km from Dirang.

Mandate

- Identification, conservation, characterization and evaluation of yak germplasm.
- Improvement of yak for draught and milk.

Objectives

- Establishment of nucleus herd(s) of yak.
- To develop and frame conservation strategy of yak and to take up research on *ex-situ* and *in-situ* conservation of yak genetic resources in a collaborative mode.
- To conduct research on different aspects of yak improvement in terms of production, productivity, health and quality improvement of products.
- To conduct research on scientific utility of yak crossbreds being traditionally carried out by people of mid-altitude areas to frame a strategy on crossbreeding with cattle.
- To act as one stop station for yak related information and technology accessing.

Past Achievements

Since its inception in 1989, ICAR-NRCY has been conducting research on various aspects of yak health and production. Scientists of this institute contributed in yak research through innovative works in the areas like non-invasive approach to detect male infertility and sterility, energy budgeting of yak, molecular characterization of yak pathogens, highland pasture development, yak nutrition, toxicological finger printing of yak tracts of India, augmentation of fertility in yaks, reproductive biotechnology and value addition of yak products.

Salient achievements on yak research since initiation of the institute has been summarised below:

Yak Nutrition

- Exotic grasses (*Phleum pratense*, *Dactylis glomerata*, *Lolium perenne*, *Trifolium pretense* and *T. repense* introduced in yak tracts.
- Fifty one varieties of fodder species received from FAO were tested in different altitude and seed setting was found reasonable for *Dactylis*, *Vicia* and *Agrostis* spp.

- Three varieties of *Salix* were found to be suitable in this region which was imported from Jammu and was found to be palatable for yaks.
- Soil samples collected from fourteen yak rearing pockets revealed that 71.43% soil were deficient in copper. This result was helpful to develop Area Specific Mineral Mixture which is very much important for yak production, reproduction and health.
- Different locally available forages were evaluated for their chemical composition and mineral profiles which was further recommended for feeding of yaks.
- Area Specific Mineral Mixture for yak had been prepared with zinc, copper, cobalt and manganese in the ratio of 40:20:2:1 which has helped to increase production.
- Locally available tree fodders fed to the yaks were collected from West Kameng district of Arunachal Pradesh and chemical composition was worked out. Protein content of Phrengpa (*Quercus walliasehiana*) was the highest among eight different species of tree leaves. The lowest cellulose content was observed in Zimbu (*Lingustrum myrsinites*) and was the highest in Baggar (*Berberis* spp.) leaves.
- The substantial reduction of body weights in growing and lactating yaks during severe winter can be compensated through supplementation of Complete Feed Blocks.
- Different types of low cost Complete Feed Blocks (CFBs) were prepared using locally available crop residues and tree leaves and fed to the yaks. On feeding CFB, optimum gain in body weight in growing calves and milk production in lactating yaks were recorded during winter months when yaks come down to lower altitude. Besides, the institute developed farmer's friendly low cost manual feed block making machines in association with IIT, Guwahati.

- Comparative study on different types of silages viz. Maize, Napier, salix as sole or in combinations with or without additives prepared in polybags and found economically beneficial in maize as Sole silage in both

growing and lactating yaks. Besides, maize silage with supplementation of concentrate was recorded best feeding regime for both growing and lactating yaks in winter.

- Varieties of maize showed potentiality to grow in different altitude of Arunachal Pradesh with out-standing growth in African Tall (fodder varieties) and Dirang local (grain variety) at mid altitude (Dirang, 4500 ft above msl) in comparision to other varieties like Baby corn, Sweet Corn, QPM etc.

Yak Genetics and Breeding

- Different horn types encountered in the yaks of Arunachal Pradesh documented for the first time.
- Phenotypic characterization of yak in five categories i.e. Common, Bisonian, Bare Back, Hairy forehead and White yaks.
- Phenotypically differentiated five types of yaks were found to be genetically similar which was demonstrated by DNA fingerprinting.
- The basic Karyogram of yak was 60 and all the 29 pairs of autosomes were found to be acrocentric. The large ones were distinguishable from smaller ones; however, decrease in size was so gradual that further sub-classification was difficult.
- Seasonal variation in the body weight changes was estimated and it has been observed that when there is rise in environmental temperature above 15°C, animals suffered from heat stress along with loss of body weight.
- A reliable molecular technique has been developed to identify male mediated introgression based on mutation in SRY gene which helped to identify paternal origin of yak hybrid.
- Sequence information and allele mining of FASN gene has been done for the first time in Indian yak.
- Two different single stranded conformation polymorphism (SSCP) types of toll like receptor 2 (TLR2) were identified on the basis of band sharing index. Presence of polymorphism in these relatively conserved domains of genome seems to be significant because earlier studies revealed that Indian yaks showed considerable monomorphism in other candidate gene loci.
- The first global report of male specific genes in yak has been identified by DNA amplification. These genes may be used as a valid bio-marker to distinguish tissues of male and female genotypes of yaks, especially for yak-cattle-hybrid.
- Among the growth traits, body weight at 6 months of age would be the best criteria of selection for desired body in yaks.
- Expression studies of male specific genes (MSY) indicated that out of 12 MSY genes, 10 were predominantly expressed in testis which has been deduced on the basis of RT-PCR using RNA from different tissue panels. This was documented in the Two years achievements of the Ministry of Agriculture and Farmers welfare, Govt. of India.
- Yaks of Arunachal Pradesh have been successfully registered as a breed called "*Arunachali*" with accession number INDIA_YAK_2300_ARUNACHALI_16001.

- Micro-RNA specific forward primer and adopter specific universal reverse primer designed from miR-Based technology was used to deduce underlying mechanism of sub fertility in male yaks. Based on expression level mir19a, 19b, 23a, 23b, 1248, and 1468 was found highly expressed in yak sperm.

Yak Physiology & Reproduction

- For e*x-situ* conservation of yak the technique of frozen semen production and artificial insemination (AI) was standardised.
- First yak calf born through ETT: one female calf named **MISMO** took birth from a recipient female yak cow on 27th June, 2005. This success indicated the prospect of implementing ETT in *ex-situ* conservation of yaks.
- Heatsynch protocol could induce oestrus and synchronisation of ovulation in anoestrous yak which addressed the potentiality of the technique to fixed time for Artificial Insemination.
- The modified Thermal Humid Index (THI) was developed to identify climatic comfort zone of yaks and it was established that at THI values of 52 or less yaks were comfortable without thermal stress; THI values of more than 52indicated that yaks were under thermal stress.
- Developed and validated sensitive enzyme immunoassay for estimation of protein and steroid hormones which was helpful for reproductive management.
- Ovsynch protocol have been standardised for oestrous synchronization and fixed-time A.I. in yak.

- Two male calves were born to oestrus synchronised female yaks using progesterone impregnated vaginal sponge followed by artificial insemination.
- Ante partum administration of vitamin E and selenium in yaks exhibited reduced time of placental expulsion, calving abnormalities, increased neonatal birth weight and reduced calf mortality compared to untreated group.
- Ultrasound guided ovum pick up (OPU) has been standardized in yaks and percentage recovery of good (A and B category) oocytes was 59.09 and 22.73, respectively, with an average oocytes recovery of 1.47 per yak. Maturation of oocytes (both A and B category) was found to be 71.43% with subsequent *in vitro* fertilization rate of 42%, using *in vitro* capacitated yak frozen sperm, which gave cleavage up to the stage of morulae and blastocysts. Embryos were further cryopreserved and subsequently were transferred to suitable recipients.
- The first yak calf born through IVF named ***NORGYAL*** (Ratnaraj) on July 15, 2013 with a birth weight of 19 kg. This success proved the effectiveness of IVF in *ex-situ* conservation of the yak.
- A competitive enzyme immunoassay has been standardized for detection of progesterone in blood plasma of yak. Detection limit of the assay was 0.4 ng/ml during commencement of estrous. This primary binding assay can also measure upto 12.5 ng/ml blood progesterone during luteal phase of estrous and during pregnancy.
- To understand the follicular and ovarian response in female yaks two different treatments of porcine FSH (pFSH), folltropin-V was administered in two different doses and further evaluated by real-time transrectal ultrasonography. It was observed that the superovulatory treatments of pFSH have stimulated the growth of small (3.0 mm to 5.0 mm diameter) follicles to preovulatory size of ^{3}7.5 mm with overall increase of ovary size by 1.4 to 2.9 fold. However, there were no dose dependent variations in the superovulatory response in terms of preovulatory follicle size and number.
- Heat tolerance tests, based changes in physiological responses of the animals in relation to its surrounding microclimate indicated that yaks experience heat stress when housed inside a CGI roofed animal shelter during summer months at an altitude

of 2750m above msl under semi-intensive system of rearing.

- Evaluation of the cryopreserved yak semen found to be the best in with Tris extender containing vitamin E alone or in combination with Vitamin C.
- Superovulation of yaks with a combination of FSH and LH (Stimufol®), and PMSG (Folligon®) alone, were found effective for superovulation and recovery of yak embryos.

Yak Health

- Alkaloid containing poisonous plant like *Senecio crysanthomoides* was identified by the scientists having fatal effect on yak. This plant poisoning was a major problem in this region.
- Effect of colostral immunity under experimental condition was explored through biochemical mining for the first time.
- Centre has also contributed to a national project by providing database on yak health and has been documented in *India Admas Epitrak* Software. This has helped to formulate national policy to control diseases.
- Pathway of *Senecio* poisoning was explored through studies of its pro-inflammatory, oxidative and pro-apoptotic signalling. The experimentation was done on murine macrophage cell line.
- Molecular detection of *Babesia bigemina* standardised and was useful for detection of organism under field conditions.
- First global report of cutaneous papillomatosis in yak has been confirmed through DNA sequence information of proviral partial gene for capsid protein.
- To identify abiotic stress factors among yak population, environmental samples were analysed for arsenic in soil-plant-animal continuum. Average arsenic concentration in water in various spots of West Kameng district of Arunachal Pradesh were below permissible limit as per national standard (50 ppb) but higher than that of WHO standard (10 ppb).
- Evaluation of disease status of yak was correlated with seasonal prevalence, type of disease syndrome and rearing system as well. The maximum mortality of yak was recorded during winter season followed by autumn, winter and spring. Amongst the identified causes of mortality, respiratory disorders were the most predominant cause of calf mortality followed by digestive disorders.
- Biotic factors responsible for morbidity of yak have been identified as brucellosis, IBR and FMD. Out of three diseases, brucellosis and IBR have been identified as abortion causing organisms in yak.
- On the basis of AB-ELISA this was found that seroprevalence of Bovine Herpes Virus-1 (BoHV-1) was 12.3% both in yaks and yak cattle hybrids. Further, out of 46 DNA samples only one sample exhibited positive reaction for the presence of pathogen when specific sense and antisense primers were used to amplify glycoprotein antigen of BoHV-1.
- Molecular signature of *Toxocara canis*, *Toxocara cati* and *Toxocara vitulorum* collected from different geographical locations and host assemblages was done for the first time in India. *Toxocara vitulorum* was collected from cattle, yak and mithun of West Bengal, Arunachal Pradesh and Nagaland, respectively. Isolated parasites were initially identified morphologically before proceeding for molecular characterization. ATP synthase subunit 6 (*atp*6) gene had a 598 bp stretch which contained both the punctuation codons but was unique in its characteristics due to presence of abbreviated stop codon (T). On the basis of phylogenetic analysis of *atp*6, 12S and transcribed spacer sequences, three species could be clustered in three different groups. Number of preferred and non-preferred codons also varied in between three species of *Toxocara* of Indian origin. *Atp*6 gene had abundance in guanine (G) and thymine (T) bases which has been also described as unique characteristic for Neodermata. Restriction profile of transcribed sequences, 5.8S gene and a small fragment of 28S gene could differentiate Indian isolates of *Toxocara* in two different clades.
- Methanolic extracts of *Zanthoxylum* spp.,

Artemesias pp. and aqueous extracts of tobacco showed total repellence to all the leeches and result was comparable with the standard drug. Methanolic extract of *Solanum* also showed very good protection but at lower concentration it did not show protection.

Yak Production and Management

- As a pack animal, yaks have the potential to carry load up to 35% of their body weight and can walk at a stretch with a speed of 4-6 km/h. After carrying load body temperature was increased but there was no difference in body temperature among the animals carried varying percentage of loads. From this observation this may be concluded that, different percentage of load within a limit, has no effect on body temperature of yak.

Yak Products Technology

- Polymorphic chemical composition of yak hair was confirmed for the first time which was not described earlier.
- Structure of yak hair has been described as interrupted medulla with long flattened cells and air gap in between. This feature is helpful to prepare yak wool products like carpet and caps.
- Sausage, a value added product, was prepared from yak meat by incorporating pork meat and fat (yak meat 60%, pork 20% and pork fat 20%). The product had an overall acceptability of 8 out 9 point hedonic scale in terms of flavour, texture, juiciness and tenderness as judged by a trained panellist. The product showed a good market potential in the local areas.
- Dietary fibre enhanced low fat paneer has been developed from yak milk. Value added yak milk products like vitamin C enriched whey beverage, value added yak wool products like carpet, doormat, blended cap has also been developed.
- Yak coarse fibres have utilized for making valuable products like chamer, jacket, coat, carpet etc and the farmers were demonstrated on the technologies for value addition of their yak hair products.
- Ripened yak cheese developed by the institute is a semi hard cheese prepared by processing yak milk. It is off-white in colour and has a characteristic sharp flavour. This cheese have unique characteristic taste, flavor, texture and ease of storage and transportation.
- The nutrient composition and physicochemical properties of *Arunachali yak* milk reared under farm conditions were evaluated for exploring the prospects of product diversification through their value addition.

Veterinary Extension Education with TSP supports

- A psychometric scale to measure the socio-economic status of the highlanders developed and standardised.
- Benefit-cost analysis of the yak based livestock production system assessed and found the yak rearing is a profitable venture with B:C ratio of 4.34:1.
- Methodology for farmers' led participatory assessment of ethno-veterinary practices was standardised. Assessment of ethno-veterinary practices against ephemeral fever of yak was

done and root of *Thalictrum foliosum* was found as the most effective.

- Technologies developed at ICAR-NRC on Yak viz. preparation of complete feed block, specially design concentrate mixture, ensiling, urea molasses enrichment of poor quality roughages etc. has successfully demonstrated among the yak rearing community with distribution of basic amenities under Tribal Sub Plan (TSP) of the institute.

Statement showing the total number of employees at ICAR-NRC on Yak and its campuses / stations and number of S. C. and S. T. category employees (as on 31.12.2020)

Class of posts	No. of sanctioned posts	No. of employees in position	No. of S.C. category employees	No. of S.T. category employees	No. of O.B.C. category employees	No. of PHs in position
SCIENTIFIC						
Scientist	11	04	--	02	--	--
Sr. Scientist	03	02	--	--	--	--
Pr. Scientist	01	01	--	--	--	--
R.M.P./Director	01	Filled by a Principal Scientist as Director (Acting)	--	--	--	--
TECHNICAL						
Category - I	03	03	-	02	--	--
Category – II	01	01 (filled by Driver cum Mechanic)	01	--	--	--
Category – III (STO to CTO)	03	01	--	--	--	--
ADMINISTRATIVE						
A.O	01	--	--	--	--	--
A.A.O	01	01	--	01	--	--
AF&AO	01	01	--	--	--	--
Assistant	04	01	--	--	01	--
UDC	01	01	--	--	--	--
LDC	02	02	--	01	01	--
P.S.	01	01	--	--	01	--
P.A.	01	01	--	01	--	--
Steno Grade III	01	01	--	01	--	--
Skilled Support Staff	15	14	01	12	01	--

STATEMENT OF EXPENDITURE DURING 2020 W.E. F. 1st JANUARY to 31st DECEMBER'2020

(A) EXPENDITURE STATEMENT DURING 2020:

(A) GRANT IN AID - (CAPITAL)	
Equipments	17, 20, 531.00
Information Technology	13, 02, 998.00
Library Books & Journals	11, 680.00
Livestock	2, 00, 000.00
Furniture & Fixture	4, 87, 678.00
TSP (Equipments)	1, 88, 000.00
TSP (Livestock)	5, 88, 000.00
Equipments	17, 20, 531.00
Information Technology	13, 02, 998.00
Library Books & Journals	11, 680.00
Livestock	2, 00, 000.00
Furniture & Fixture	4, 87, 678.00
TSP (Equipments)	1, 88, 000.00
TSP (Livestock)	5, 88, 000.00
Total (A)	44, 98, 887.00
(B) GRANT IN AID - (SALARIES)	
Establishment Charges	3, 77, 15, 000.00
Total (B)	3, 77, 15, 000.00
(C) GRANT IN AID - (GENERAL)	
Pension	5, 56, 680.00
Travelling Allowance	11, 26, 701.00
Research Expenses	70, 81, 991.00
Operational Expenses	10, 32, 932.00
Minor Works	57, 419.00
Others (excluding TA)	2, 27, 48, 525.00
HRD	10, 030.00
Other Misc.	1, 44, 75, 142.00
Total (C)	4, 70, 89, 420.00
TOTAL (A+B+C)	**8, 93, 03, 307.00**

(b) SCHEME-WISE EXPENDITURE DURING 2020 (PLAN & EXTERNAL FUNDED):

Schemes financed from Plan Budget of Council:-	Expenditure Amount (₹)
(A) PLAN SCHEME:	
1. NAIF (ITMU)	1, 00, 000.00
2. AICRP on PET	7, 09, 548.00
3. ICAR-IIMR funded project on Maize Production	5, 37, 169.00
TOTAL (A)	**13, 46, 717.00**
(B) EXTERNAL FUNDED	
1. GB Pant Institute of Himalayan Environment & Development, Almora	4, 19, 000.00
TOTAL (B)	4, 19, 000.00
GRAND TOTAL (A+B)	**17, 65, 717.00**

REVENUE GENERATION DURING 2020:

(A) Head	Revenue Generated (₹)
1. Sale proceeds of farm produces	7,03,508.00
2. Sale of Livestock	6,71,555.00
3. Sale of Guest house	2,69,300.00
4. Licence fees/rents	1,73,920.00
5. Revenue of tender fees	21,929.00
6. Revenue of generator charges	51,667.00
7. Training registration fees	11,100.00
8. Misc (Others like tender fees)	17,000.00
9. Auditorium charges	43,000.00
TOTAL	**19, 55, 779.00**

RESEARCH ACHIEVEMENTS

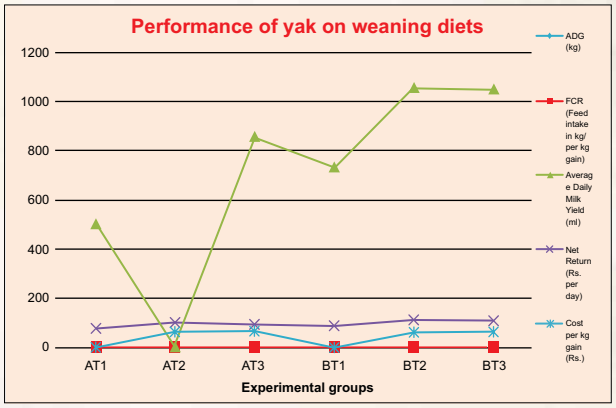
THEME : NUTRITIONAL INTERVENTION

Effect of weaning age and starter protein levels on post weaning performance of yak calves

Sucking without restricted milk feeding from dams by calves, leads to frequent digestive disturbances in calves due to overfeeding. Besides, this system of yak raising is economically less viable. It also extends the calving intervals, although records in this regards in yak is very scanty. Therefore, the study performed on effect of weaning age and dietary protein levels in calf starter, using a total of 30 growing yak calves of uniform age and body weights (22.25±0.24kg at 1-2 months and 32.15±0.21kg at 2-3 months age). The calves were randomly divided in to six groups of 5 calves in each and allowed to feed individually after 1-2 minutes suckling with or without *ad libitum* quantity of Calf Starter (CS) with free grazing for at least 3-4 hours every day. The different experimental treatments were as follows-

Dietary treatments/Age⇒ ⇩	**Yak Calves (1-2 months)**	**Yak Calves (2-3 months)**
Feeding calves without Calf Starter	AT_1	BT_1
Feeding calves with Calf Starter-1 (CP-24 and TDN-68-70%)	AT_2	BT_2
Feeding calves with Calf Starter-2 (CP-20 and TDN-68-70%)	AT_3	BT_3

The study indicated the performances of yak calves in terms of average daily gain (ADG) and feed efficiencies with their dam's milk yields was highest (345g/day and 1.90 with dam's milk yields 1057.8 ml/day) in group BT_2 that's weaned at 2-3 months



fed with *ad libitum* Calf Starter-1 containing 24% CP level. The net returns calculated on the basis of feed cost for ADG in yak calves along with their dam's milk yields calculated as per existing rate of Rs. 32.81/kg, 200/kg and 60/litre, respectively was found highest in group-BT_2 (Rs. 110.99 per day), followed by BT_3 (Rs. 109.22) indicating suitable weaning method for yak was the separation of yak calves at 2-3 months with supplementation of Calf Starter containing CP 24%. The samples of blood collected from all experimental calves at initial and final day of the experiment were found no significant differences amongst the groups as well as in between the pre and post weaned collections. It was concluded, weaning of yak calves at 2-3 month age is beneficial for profitable yak rearing for highland yak farmers.

ICAR-IIMR collaborating project on "Maize production potentiality in NEH region for sustainable livestock production"

The maize farmers in North Eastern Himalayan Region (NEHR) of India, in spite of being the second most important crop after rice facing lots of problems including crop diseases, lower yield etc. that directly puts the farmers in financial losses. Lack of scientific knowledge and restriction of these farmers on growing this crop with the traditional methodologies using the conventional

genotypes of maize are the main reason for this and keeping these in mind the institute implemented the project to provide scientific know how on the methods of sowing, different types of maize varieties, soil treatment, field geometry, use of chemical fertilizers, and use of modern technology in the maize production. Accordingly the farmers were provided scientific knowledges on maize production supporting with different varieties of maize seeds, fertilizers, pesticides and agricultural tools for scientific maize cultivation.

Besides, the institute also cultivated six varieties of maize in its two campuses namely Dirang and Nyukmadung situated at altitude of 5500 ft above msl and 9000 ft above msl, receptively. It was observed out-standing growth of the African Tall as well as the Dirang local varieties in Dirang campus; however, the productivity in other varieties viz. sweet corn, QPM (Shaktiman & HQPM-1) and baby corn were comparatively low. It was also observed all the varieties perform very poor in higher altitude i.e. Nyukmadung.

The grain produced from Shaktiman variety of quality protein maize (QPM) was utilized for feeding trial replacing normal maize in the concentrate ration of both growing and lactating yaks. The study was conducted at Nyukmadung farm of ICAR-National Research Centre on Yak, West Kameng district of Arunachal Pradesh. Both, the experiment were conducted for 112 days using ten growing and ten lactating yaks of uniform age, body weights and parity (lactating); and were randomly divided into two groups of five animals in each. The normal maize part of the control ration (50%) was completely replaced with QPM and fed to the treatment groups for a period of 112 days followed by a digestion trial of 7 days collection. The study revealed the followings-

- Complete substitution of normal maize with QPM in the concentrate mixture of growing yaks shows beneficial effects in growth, feed efficiency, nutrient digestibility and plane of nutrition.
- Incorporation of QPM in the concentrate mixture have no significant effect on their performances in terms of milk yields, nutrient digestibility and plane of nutrition in lactating yaks.
- QPM have no any adverse effect in health statuses of both growing and lactating yaks.

It can be concluded that normal maize can completely be replace with QPM in the diets of growing and lactating yaks without any adverse effect on their health.

THEME : YAK HEALTH MANAGEMENT

Detection of anthelmintics resistance in GI nematodes of yak and other high altitude ruminants

Internal parasites in yaks are one of the major health problems in both free ranged and farmed yaks. It is considered to be the most economically important constraint in yak rearing as often times it causes mortality in young yak calves. Yak rearers rely on anthelmintic drugs to minimise the parasite burden and to maintain performance of the animals. The extensive use of anthelmintics for the control of helminth infections on grazing livestock has resulted in the development of resistance against anthelmintics in parasite that has become a major practical problem in many countries. To detect development of anthelmintic resistance in GI nematodes of yak under filed and farm condition, and in other high-altitude ruminants that often co-graze same pasture with yaks on the nature pastures of Arunachal Pradesh the present study was undertaken. The most widely used *in-vivo* method for detecting and monitoring of anthelmintic resistance suitable for all types of anthelmintics and recommended

by World Association for the Advancement of Veterinary Parasitology (WAAVP), faecal egg count reduction test (FECRT) was used in the present study. In addition, egg hatch assay (EHA), in-vitro tests also recommended by WAAVP for evaluation of benzimidazole resistance was used to detection of level of resistance against benzimidazole.

No resistance was detected against benzimidazole in GI nematodes of yak, yak cattle hybrids and cattle irrespective of the system of management, and all the drugs showed 100% efficacy on FECRT. Development of resistance was not detected against Fenbendazole in free ranging pasture grazed sheep flocks. But, the results of FECRT of sheep under farm condition showed development of resistance against Fenbendazole and Albendazole. The development of resistance against Benzimidazole was further confirmed by EHA with calculated EC 50 was >0.5 µg/ml.

AICRP on Foot and Mouth Disease

Under the project during January to December 2020, total 323 animals were vaccinated (277 yaks, 3 hybrids and 70 cattle were vaccinated). For screening of FMD virus, total 89 serum samples, including 39 yak, 29 yak-cattle hybrids and 21 cattle samples, were collected from different pastures and farms around West Kameng district of Arunachal Pradesh. Three FMD awareness and vaccination programmes were organised at different yak tracts of Arunachal Pradesh.

THEME : CONSERVATION OF YAK GERMPLASM

Ex-situ conservation of yak germplasm and its reproduction

- **Improved cryopreserved yak semen:** Fresh sperm ejaculates from fertile yaks were collected and evaluated for its concentration, motility and morphology. The cryopreserved yak semen were found to be the best in its quality, when extended with Tris extender containing vitamin E alone or in combination with Vitamin C. Study on the seasonal effect of yak semen it was observed autumn is the best season for fresh yak semen for maintaining its good qualities. During this report period

a total of 1230 semen straw were prepared, evaluated and preserved at -1960C in liquid nitrogen for future use.

- **Multiple Ovulation and Embryo Transfer (MOET):** A total of twenty four female yaks were selected and superovulated with a combination of FSH and LH (Stimufol®), and PMSG (Folligon®) alone, respectively. All these treatments were found effective for superovulation and embryo recovery. However, use of Folligon (@ 1500 IU) comparatively seems to be more effective for *Arunachali* yak.

THEME : STRESS PHYSIOLOGY

Assessment of Thermo-adaptability in Yaks housed in CGI roofed shelters:

Yak is a remarkable livestock of high altitude areas of Himalayan and Trans-Himalayan region of India and neighbouring countries viz., China, Bhutan, Nepal, Pakistan, Kazakhstan and Mongolia. It can survival and perform under extreme cold, hypoxic and low nutrition conditions. It is well adapted to the harsh cold climatic conditions owing to unique physiological and anatomical features. However, yak cannot tolerate the environmental heat load beyond 15°C mean ambient temperature due to less developed heat dissipation mechanisms. To

cope with the rising temperature in summer, yaks are traditionally raised on high altitude pastures under transhumance system of livestock rearing. Rising ambient temperature due to global warming in natural habitat of yak and hardship associated with traditional yak rearing, demand sedentarization of traditional yak husbandry in future with suitable animal housing and management system.

An effort was made to assess the microclimate (temperature and relative humidity) changes inside the animal shed roofed with corrugated galvanised iron (CGI) sheets during a sunny summer day located at an altitude of 2700m above mean sea level. It was observed that the temperature of inner side of the rooftop started rising with the increasing intensity of solar radiations, as a consequence temperature inside the animal shed also raised to the discomfort level of housed yaks (≥15°C), between 10.00 to 14.00 h (Figure 1)

To assess the thermo-adaptability of yaks housed inside CGI roofed animal shelter, heat tolerance tests were evaluated based on microclimate inside the shed and respective changes in physiological responses of the animals. Thermal adaptability was determined by Temperature Humidity Index (THI), Dairy Search Index (DSI), and Benezra's Thermal Comfort Index (BTCI).

Therefore, physiological responses in term of variations in respiration rate (RR; breaths/min), pulse rate (PR; beats/min) and rectal temperature (RT; °F) were recorded during noon and evening hours of a sunny summer day to assess thermo adaptive capability of housed yaks. Earlier, Krishnan et al 2009 defined that yaks are comfortable when THI value is below 52, however, they experience heat stress beyond 52 THI value. Whereas, BCTI values ≤2.0 represents a high degree of adaptability of the animal to the environment. An increase in DSI from '1' indicates the decreased thermal adaptability.

The results of present findings as tabulated in Table 1., indicated that yaks housed in CGI roofed animal shelter had reduced thermal adaptability and were experiencing heat stress during a sunny summer day at an altitude of 2750 m above msl.

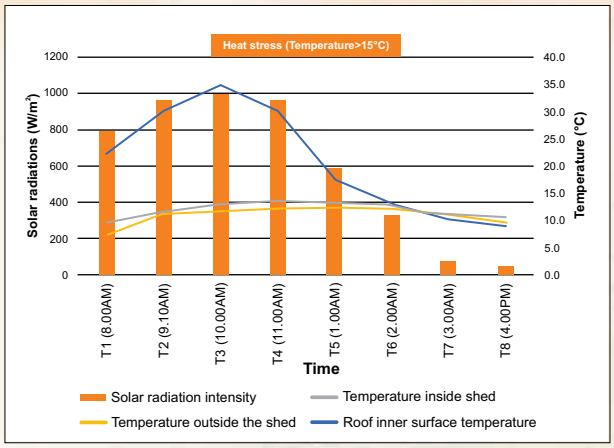


Figure 1: Variations in meteorological variables and microclimate inside the CGI roofed animal shed during a sunny summer day located at an altitude of 2700 m above msl in Arunachal Pradesh

Therefore, a suitable animal shelter is required to protect the yaks from radiant heat load during summer under semi-intensive system of rearing.

Table 1: Variation in microclimate inside the CGI roofed animal shelter and corresponding thermo-adaptability based on physiological responses of housed yak during the month of October 2020.

Parameters	Noon (value in range)	Evening (value in range)
Surface temperature of inner side of rooftop (°C)	27.8 (22.5-33.4)	13.2 (12.4-14.0)
Relative humidity (%)	48.4 (47.1-49.7)	67.3 (59.4-74.9)
Temperature (°C)	19.7 (19.2-20.0)	16.3 (15.0-17.4)
Temperature humidity index (THI)	64.7 (64.0-65.1)	60.6 (58.8-62.4)
Physiological variables		
RR (breaths/min)	36.13±13.08	43.5±25.19
PR (beats/min)	62.88±6.30	62.56±4.28
RT (°F)	101.41±0.67	101.95±0.78
BTCI	2.58 (1.88-3.62)	2.91 (1.7-4.95)
DSI	1.1 (1.0-1.3)	1.2 (1.0-1.6)

THEME : YAK PRODUCT TECHNOLOGY

Development of value added cheese from yak milk

Yak is one of the few species of which the rennet coagulated cheese making characteristics of its milk are still not well established. To make yak cheese production as a viable commercial enterprise, the cheddar style-yak milk cheese from yak milk was prepared with standardized procedure and stored at 7±1°C for 150 days. Cheese samples were evaluated for physicochemical, antioxidant activity, textural, microbial and sensorial changes at defined interval during storage. With the increase in storage duration, values of fat, protein, ash, salt, pH, titratable acidity, soluble protein, ripening index, tyrosine value, total free fatty acids, peroxide value, antioxidant activity (2,2-diphenyl-1-picryl-hydrazyl, 2,2-azinobis-(3-ethylbenzothiazoline-6-sulphonic acid and reducing power assay) and yeast and mould count increased significantly ($p<0.05$) whereas, moisture content and textural attributes decreased significantly ($p<0.05$) over the storage period of 150 days. Sensorial changes like colour and appearance, flavour, body and texture and overall acceptability followed increasing trend up to day 105^{th}, thereafter decreased till the end of storage. Results showed that all the physicochemical, microbiological, and texture parameters of yak milk cheese affected with the ageing of cheese. The antioxidant activity enhanced significantly with the advancement of storage period. Sensory evaluation indicated that all the sensory attributes improved with the storage period. Therefore, yak milk cheese could be stored up to four months with optimum sensory attributes.

Nutrients profiling for the milk of Arunachali yak

Yak milk reported to be more nutritious than milk of other bovines; however, there is limited data available on nutrient composition of yak milk from India. Therefore, the nutrient composition and physicochemical properties of milk of *Arunachali* yak, reared under farm conditions were evaluated for exploring the prospects of product diversification through value addition towards wider consumer acceptability. It contains 15.63-19.63% total solids with 5.29-8.73% fat, 3.45-4.27% protein and 0.64-0.82% ash. The pH, titratable acidity (% lactic acid) and density (g/cm^3) of yak milk ranged 6.47-6.63, 0.128-0.161 and 27.9-37.1, respectively. In another study, a physicochemical characterization of ghee derived from the milk of *Arunachali* yak, yak-cow hybrid (*dzomo*) and cow reared under semi-intensive conditions was performed. The ghee samples were analyzed for its physicochemical parameters; colour profile analysis, fatty acid composition and fourier transform infrared (FTIR) characteristics. The Fat, solid non fat and protein of yak milk was significantly ($p<0.05$) higher than yak-cow hybrid and cow milk. Results revealed that the colour profile and various physicochemical properties such as yield, moisture, specific gravity, saponification value, free fatty acid, cholesterol and vitamin A showed significant variation ($p<0.05$) in ghee samples. Ghee produced from the yak-cow hybrid milk was richer in MUFA and PUFA, while yak ghee showed higher level of saturated fatty acids. In FTIR, the characteristic intensity of the absorption peaks in the region of 650 to 4000 cm^{-1} was taken. They are nearly comparable, and no differences were detected. These results obtained from the present study would be aiding to an increase in information about physicochemical characterization of ghee from these three genotypes of foot hills of the Himalayas.

TRANSFER OF TECHNOLOGY

CAPACITY BUILDING PROGRAMMES:

Three days training cum technology demonstration programme on "*Scientific rearing of highland animals*"

Keeping all preventive measures of COVID-19 pandemics a three days training programme was organized during 28 to 30th September'2020 at Dirang. A total of 21 tribal livestock farmers coming from the adjoining villages like Yewang village, Jyotinagar, Sangti, Phudung, Rungkhung etc of Dirang locality were participated in the programme. The farmers were briefed on scientific feeding, breeding and reproductive and health management with Hands-on-Practices of different aspects of highland animal farming. Besides, they were also trained on hygienic maintenance for clean milk and value addition of milk products for better earning from livestock rearing. All the participated farmers were awarded certificates and supported with basic amenities for livestock farming like concentrate feed, nylon pipe, vegetable crate, solar light, chelated mineral mixtures with and some basic veterinary medicines including anthemantics, anti-diarrhoeas, tick-out etc under TSP of the institute. Besides, eighteen farmers were also received manual chaff cutter machine for processing of their forages for better feeding of their animals.

Three days training on "Quality control and processing of yak milk"

Three days training programme on "Quality control and processing of yak milk" was organized under TSP from July 21- 23, 2020 at ICAR-NRC on Yak, Dirang. Thirteen (13) tribal youth from different villages under Dirang Sub-division participated in this training programme. The focus of the training was to provide hands-on training about hygiene and quality control measure to the participants to ensure clean milk production and processing especially during Covid-19 pandemic. The training comprised lectures on pre- and post-milking hygienic measures to ensure healthy animals as well as safe milk for consumers. The participants were given extensive training on processing of various value-added yak milk products like cream, *ghee, dahi, lassi, srikhand, kalakand, khoa, rosogulla, gulab jamun, paneer*, whey drinks, etc. This programme was an initial effort towards Prime Minister's vision for '*Atmanirbhar Bharat*" through capacity building of the tribal communities.

Three days training on "Processing of coarse fibres of yaks"

The programme was organized under Tribal Sub Plan of the institute during 4 to 6th August'2020 at ICAR-NRC on Yak, Dirang. Developing skill among tribal youth on tailoring, carpet making and other yak coarse fibre products was the

theme of the training. Eleven (11) tribal youth from Sangti, Thembang, Namshu, Jyotinagar and Yewang villages under Dirang Sub-division participated in this training programme. The participants were exposed to various yak fibre products developed by the institute and then allowed to choose a particular product they were interested in learning and were given hands-on training to develop specific skill accordingly. For the encouragement of the trainees, the products prepared by each participant were evaluated and the best three products were awarded.

Collaborative programmes and TSP activities:

With the support of GBP Institute of Himalayan Environment & Development (GBPIHED), Almora

The downing yak population in the country is a serious concern among the stake holders of the country and keeping this in view, the project on capacity building programmes for improvement of yak population and their productivity in Arunachal Pradesh was implemented by

GBPIHED and carried out some capacity building programmes for the yak rearers in Tawang, Namshu and Thimbu villages covering 219 yak rearers of Arunachal Pradesh on scientific yak rearing to achieve more productivity and profitability from their yaks. Besides, some awareness programmes was also planned for the younger generations to motivate them towards yak conservation. Through these training the farmers acquired knowledge on scientific rearing of yaks and owned the technologies like Chamar making from yak hair and Ghee and Paneer makings using yak milk. Thereby they improved their income generation and livelihood status of the farmers. The impacts of the programmes reflected as an increase of 71.22% of yak population in Arunachal Pradesh though the overall India's yak population decreased to fifty eight thousand in 2019 as per the 20th Livestock Census'2019 (24.67%) over previous records of 19th Livestock Census'2012.

Awareness cum vaccination camp under AICRP on FMD:

Three FMD awareness and vaccination programmes were organized at different yak tracts of Arunachal Pradesh.

With State AH & Veterinary Department, Arunachal Government:

- ICAR-National Research Centre on Yak in collaboration with the Department of Animal Husbandry, Veterinary and Dairy Development, Govt. of Arunachal Pradesh conducted an "***Awareness programme on scientific feeding and management of***

***highland farmers*"** keeping all preventive measures of COVID-19 pandemics on 20-06-2020 at Dirang. A total of 45 tribal livestock farmers coming from the adjoining villages like Yewang village, Jyotinagar, Sangti, Thembang, Rungkhung etc of Dirang locality were participated in the programme.

- Conducted an **"*Awareness camp on scientific feeding and management of highland animals*"** at Marshing village under Kalaktang circle of West Kameng district on 16th February'2020. During this programme, a total of 49 tribal livestock farmers coming from Marshing, Domkho, Sanglem etc villages were participated gathered knowledge on scientific feeding, breeding and reproductive and health management of different highland animals. Besides, farmers were also briefed on hygienic aspects of clean milk production and their value addition and supported with basic amenities like Raincoat, Mineral mixtures, concentrate yak feed, salt along with some basic veterinary medicines like anthemantics, antidiarrhoeas, tick-out etc in presences of the village heads and Ex-ZPM, Sanglem village.
- Conducted an awareness programme *on* "***Scientific feeding and management of highland animals***" at Namshu village under Dirang circle of West Kameng district on 7th February'2020 for a total of 100 tribal livestock farmers coming from Namshu, Thembang, Panchavati, Munnacamp, Pangma etc. Farmers were also brief on scientific rearing of highland animals with their hygienic maintenance for clean milk production and value addition of their products with TSP supports in the form of Raincoat, Mineral mixtures, concentrate yak feed, salt along with some basic veterinary medicines like anthemantics, antidiarrhoeas, tick-out etc.
- The institute conducted **"*Training cum technology demonstration programme with TSP support*"** for tribal livestock farmers at Thimbu village under Jang circle of Tawang district situated at about 12,500 ft above msl on 27th January'2020. After their winter spent at high altitude the yak farmers brings their animals towards this area for grazing, but they need to complete with other livestock. Hence, to support these tribal yak farmers the team ICAR-NRCY on yak has taken this step in collaboration of state AH & Veterinary department for control and treatment measures against some common diseases occurs in yak. A total of 50 tribal yak/yak cattle hybrid farmers coming from Thimbu, Jang and Mago area were participated in

this programme and gathered knowledge on scientific feeding, breeding and reproductive and health management of different highland animals with TSP supports in the form of tarpaulin, PP rope, Gumboots, Mineral mixtures, concentrate yak feed, salt along with some basic veterinary medicines like anthemantics, antidiarrhoeas, tick-out etc.

With Dirang Employees Workers Society, Dirang, Arunachal Pradesh:

The institute conducted one collaborative programme with Dirang Employees Welfare Society (DEWS) on 02-08-2020 at Naga GG under Dirang circle situated at 13,000 above msl in presence of District Commissioner, Bomdila, Sri Karma Leki with 20 officials of district Head Quarter, Bomdila. In this occasion seventy (70)

numbers of beneficiaries were provided with concentrate yak feed, common salts, complete feed blocks chelated mineral mixtures and some basic veterinary medicines like anthemantics, antidiarrhoeas, tick-out etc for their animals under TSP of the institute. Besides, 30 beneficiaries were also given manual cream separator for processing their milk produced in through their yaks in the field condition. Similar programme along with distribution of inputs for the support of tribal yak farmers who were affected by the restrictions to pass through their natural migratory path were also organized by ICAR-NRC on Yak ICAR-National Research Centre on Yak in collaboration with and Dirang Employees Welfare Society (DEWS) at various alpine and sub alpine pastures of West Kameng and Tawang districts of Arunachal

Pradesh namely in Bangajang on 27th August'2020 and in Sela on 2nd July'2020. Inputs like concentrate feed, common salt, chelated mineral mixture and veterinary medicines were provided the tribal farmers attended in the programme.

With Krishi Vigyan Kendra, Government of Arunachal Pradesh:

ICAR-National Research Centre on Yak, Dirang in collaboration with Krishi Vigyan Kendra, Tawang and Animal Husbandry, Veterinary and Dairy Development, Tawang, Arunachal Pradesh conducted a "***Training cum technology demonstration programme with TSP support at Tawang***" Krishi Vigyan Kendra, Tawang during 17-19th February'2020. During this programme, a total of 69 tribal livestock farmers coming from 4 Killo, Seecu, Cheybe, Gyagongpa, Chayprong, Limelo, Kitpi, Myomadung, Shyobasti, Khirmu etc under Tawang circle were acquired knowledge on scientificrearing of highland animals with hygienic aspects of clean milk production and value addition of their products. The partiocipated farmers were provided with Gumboots, Polypropelene rope, concentrate yak feed, common salt, mineral mixtures with some basic veterinary medicines

like anthemantics, antidiarrhoeas, tick-out etc under TSP of the institute. on this occasion Dr. A. K. Mishra and Dr. S. K. Niranjan, Principal Scientists of ICAR-NBGR, Karanal, Haryana acting as Guest of Honours appreciated the efforts of ICAR-NRC on Yak, Dirang.

Institute TSP activities

An awareness cum yak health camp was organized on 11th December'2020 in Bishum Phudung under Dirang circle wherein 49 yak/yak cattle hybrids were vaccinated against FMD, HS and BQ. Treatment of some affected animals and

input support such as concentrate animal feed, common salts and basic veterinary medicines like antiseptics ointments, anti-diarroheals, ant-

helmintics, mineral mixtures, healing sprays and health tonics etc from TSP funds were provided to the participated 100 tribal farmers.

- A series of "*Yak Health Camp*" were conducted in different villages viz. Mandala, Khorong, Khagoksa and Lubrang under TSP of the institute. The tribal farmers associated with yak rearing were supplemented with some basic veterinary medicines during the COVID-19 pandemics through district administration.

Technology showcased, demonstrated and popularized

- Showcased the technologies of ICAR - NRC on Yak, Dirang through exhibition at St. Lopon Stadium Dirang during Republic Day celebration on 26th January, 2020. Sri Toko Babu, ADC cum Chief Guest of the programme while inaugurating the stall appreciated the yak products of the institute.
- Showcased the technologies of ICAR - NRC on Yak, Dirang through exhibition at St. Lopon Stadium, Dirang and Buddha stadium, Bomdila during 73rd Independence Day celebration on August 15, 2020.
- Institute technologies were showcased during Pusa Krishi Vigyan Mela'2020 held at New Delhi during 1-3rd March'2020. Hon'ble Union Minister of Agriculture and Farmer's Welfare graced the occasion as chief guest.
- Showcased the available technologies like feed and fodder conservation for mitigation of winter feed crisis like silage & CFB preparation, processing and preparation of yak products from milk and wool etc and were also demonstrated the techniques during different training programme organized during the report period.

AWARDS AND RECOGNITIONS

Dr. Mokhtar Hussain, is awarded PhD Degree from College of Vetrinary Science, Assam Agricultural University, Khanapara, Guwahati-22, in his thesis entitled "*Differential Expression of Certain Fertility marker Genes in Yak Semen and their association with Yak Embryo production*" under the discipline of Animal Reproduction, Gynaecology and Obstetrics.

Dr. Joken Bam was awarded by the Additional Deputy Commissioner, Dirang, Govt. of Arunachal Pradesh for her remarkable services to the citizenry of Dirang during Covid-19 pandemic as a Quarantine Facility Centre Management Team.

Dr. Tarun Pal Singh received *"Certificate of Appreciation"* for valuable contribution in service of scientific community as "Member of Scientific Advisory Board" of International Journal of Livestock Research for the year 2020-21.

Dr. Dinamani Medhi, received *"Certificate of Appreciation"* for valuable contribution in service of scientific community as "Member of Scientific Advisory Board" of International Journal of Livestock Research for the year 2020-21.

LINKAGE AND COLLABORATION IN INDIA AND ABROAD INCLUDING EXTERNAL FUNDED PROJECTS

All India Co-ordinated Research Project

Sl. No.	Title of the Project	Name of the PI and Associates	Date of start	Sanctioned Funds (lakh)	Location
1.	Application of Plastic in Yak Husbandry	Vijay Paul (PI) Joken Bam Dinamani Medhi Navnath Indore (ICAR-CIPHET)	April 01, 2015	7.10 (2020-21)	ICAR-NRCY
2.	PD on FMD–AICRP Collaborating centre, ICAR-NRCY	Joken Bam (PI)	December 01, 2014	Nil (2020-21)	ICAR-NRCY
DST					
3.	Task Force on Himalayan Agriculture under National Mission on Sustaining Himalayan Ecosystems	P. Chakravarty (PI) Dinamani Medhi Vijay Paul Joken Bam	2015-20	ICAR-CAZRI 6,27,017 Including ICAR-RC for NEH, Barapani 35,08,239/-	ICAR-NRCY with ICAR-CAZRI, Jodhpur & ICAR-RC for NER, Barapani
GBP Institute of Himalayan Environment and Development, Almora, Uttarakhand					
4.	Capacity building and awareness programme on conservation of yaks in the state of Arunachal Pradesh	Dinamani Medhi (PI) Vijay Paul	March 28, 2018	4,19,000/-	ICAR-NRCY
Collaborating project with ICAR-IIMR, Ludhiana					
5.	ICAR-IIMR project on "*Maize production in NEH region for sustainable livestock production*"	Dinamani Medhi (PI) Vijay Paul Tarun Pal Singh	December 12, 2018	5,37,169/-	ICAR-NRCY collaborated with ICAR-IIMR, Ludhiana
DBT					
6.	Socio-economic upliftment of yak rearing communities in Northeastern region by capacity building and technological interventions	Vijay Paul (PI) Joken Bam Dinamani Medhi Rafiqul Islam (ICAR-NRC on Pig)	December, 18 2019	33,76,370/-	ICAR-NRCY

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LIST OF PUBLICATIONS

Research Papers

- Das Parth Partim, Begum Safeeda Sultana, Choudhury Manasee, Medhi Dinamani, Paul Vijay and Das Pranab Jyoti (2020). Characterizing miRNA and mse-ts RNA in fertile and sub-fertile yak bull spermatozoa from Arunachal Pradesh. *Journal of Genetics*, **99**: 88-95.
- M. Hussain, K. Ahmed, P. Chakravarty, V. Paul , B.C. Deka, S.S. Begum , D. Bhuyan, P. Borah, S. Tamuly, D. Medhi and P.M. Barua. (2020). Super ovulation and embryo production response in oestrus-synchronized Arunachali yak. Reproduction, Fertility and Development 33(2):182-183.
- Kirchner B., Buschmann D., Paul V., Pfaffl M.W. 2020. Postprandial transfer of colostral extracellular vesicles and their protein and miRNA cargo in neonatal calves. *PLoS One*, 15(2): e0229606.

Book Chapters

- Aswathy C., Raj A., Rakshit S., Kar P., Mepfhuo K., Ramya H.R., Sontakki B.S. and Nagashree K. (2020). *Institutional linkages and community partnerships for climate resilient agriculture*. In: Ch. Srinivasarao *et al.,* (Eds). Climate Change and Indian Agriculture: Challenges and Adaptation Strategies, ICAR-National Academy of Agricultural Research Management, Hyderabad, Telangana, India. Pp - 569-583.
- Punetha M., Pathak A., Choudhary S.S., Sharma M., Yasotha T., Arul S. and Kumar B.G. (2020). *Climate change versus livestock health: impact, mitigation and adaptation*. In: Ch. Srinivasarao *et al.*, (Eds). Climate Change and Indian Agriculture: Challenges and Adaptation Strategies, ICAR-National Academy of Agricultural Research Management, Hyderabad, Telangana, India. pp-431-448.

Invited Paper/ Lead Paper:

- Chakravarty P. (2020). Invited paper on "Physiological Spectrum to Augment Livestock Production in Enigmatic COVID-19 scenario" in National Webinar organised by Department of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22 on 25 September, 2020.
- Chakravarty P. (2020). Invited paper on "*Applied technologies for sustainable yak population*" presented in Regional Workshop cum Exhibition on Yak Rearing in the Himalaya Strengthening Yak Network in Transboundary Landscapes for Social-Ecological Resilience of Highland Communities during November 25-26, 2020 organised by Regional Centre Sikkim, G.B. Pant National Institute of Himalayan Environment in collaboration with Department of Animal Husbandry and Veterinary Services, Government of Sikkim and Internal Centre for Integrated Mountain Development, Nepal.
- Chakravarty P. (2020). Invited paper on "Potential of yak milk" in the Brainstorming session on Potential of Non-bovine Milk organised by National Academy of Agricultural Sciences, New Delhi, India held on June 29, 2020.

Technical/Popular Articles published:

- तरुण पाल सिंह, जोकन बाम, दिनमणि मेधी, पृथ्वीराज चक्रवती और विजय पॉल. (2020). याकपालन से आजीविका और पोषण सुरक्षा, खेती, 73(4): 65–69.

Leaflets/Folders published:

- Medhi D., Singh T.P., Paul V. and Chakravarty P. (2020). *Potentiality of sweet corn and baby corn production in Arunachal Pradesh* (Yak Production/Folder-/2019-20/05), Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.

- Medhi D., Paul V., Bam J., Singh T.P. and Chakravarty P. (2020). *Preparation of Maize silage for mitigation of winter feed scarcity in highland animals* (Yak Production/ Folder-/2019-20/04). Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.
- Medhi D., Hussain M. and Ringu T. (2020). *Importance of Maize cultivation* (Yak Production/Folder/2020-21/01). Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.
- Singh T.P., Bam J. and Paul V. (2020). स्वच्छ दुध उत्पादन और याक चरवाहों की यक्ति गत स्वच्छता (Yak Production/Folder/ 2020-21/01) निदेशक, आईसीएआर–राष्ट्रीय याक अनुसंधान केंद्र, दिरांग–790101, पश्चिम कामेंग, अरुणाचल प्रदेश द्वारा प्रकाशित।
- तरुण पाल सिंह, जोकेन बाम, जुवर डेली, विजय पॉल, दिनमणी मेधी और मिहिर सरकार (2020), मुंहपका–खुरपका रोग ''इलाज से बेहतर है बचाव'' Yak Health/Folder/ 2020-21/01), निदेशक, आईसीएआर–राष्ट्रीय याक अनुसंधान केंद्र, दिरांग–790101, पश्चिम कामेंग, अरुणाचल प्रदेश द्वारा प्रकाशित।
- Hussain M., Paul V., Medhi D., Bam J., Chakravarty P. and Sarkar M. (2020). *Anoestrus and Repeat Breeding in Highland Animals: Causes and Management* (Yak Production/Folder/2020-21/02) Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.
- Hussain M., Bam J., Paul V., Medhi D., Chakravarty P. and Sarkar M. (2020). *Common Diseases of Arunachali yaks: Causes and Management* (Yak Health/Folder/2020-21/03). Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.
- Singh T.P., Bam J., Paul V. and Chatterjee G. (2020). क्रीम (मलाई) प्रिथकिकरन कर्ने की बिधि और सिद्धत (Yak Production/Folder/2019-20/02) Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.

Institute's Other Publications:

- Singh T.P., Bam J. and Paul V. (2020). *ITMU News Bulletin* (ITMU News/2019-2020/Vol. 06) (English Eds). Published by ICAR-National Research Centre on Yak, Dirang-790101, Arunachal Pradesh.
- Annual Report 2019.

LIST OF INSTITUTE FUNDED RESEARCH PROJECTS (2020)

Sl. No.	Title of the projects	Name of the PI/ Associates	Year	
			Start	Completion
1.	Effect of weaning age and starter protein levels on post weaning performance of yak calves.	D. Medhi (PI) V. Paul (Associate)	May, 2017	May, 2020
2.	Ex-situ conservation of yak germplasm	P. Chakravarty (PI) V. Paul (Associate) M. Hussain (Associate)	June, 2017	May, 2020
3.	Detection of anthelmintics resistance in GI nematodes of yak and other high altitude ruminants.	J. Bam (PI) V. Paul (Associate)	June, 2017	May, 2020
4.	Identification of circulating microRNA (miRNA) in Bovine herpesvirus - 1 (BHV - 1) infection/ Infectious Bovine Rhinotracheitis in Yak.	*J. Doley (PI) P. J. Das (Associate) V. Paul (Associate)	June, 2017	May, 2020
5.	Development of value added cheese from yak milk	T. P. Singh (PI) Joken Bam (Associate) D. Medhi (Associate)	June'2018	May'2020
6.	Nutrients profiling for the milk of Arunachali yak	T. P. Singh (PI) Joken Bam (Associate)	October'2019	September'2021

**Dr. Juwar Doley transferred from this institute to ICAR-NRC on pig, Rani, Guwahati on November 30, 2019*

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MEETINGS OF INSTITUTE MANAGEMENT COMMITTEE, RAC, IRC, QRT ETC. WITH SIGNIFICANT DECISIONS

COMPOSITION OF THE RESEARCH ADVISORY COMMITTEE FOR THE INSTITUTE (w.e.f. 05.03.2019)

Position	Status	Names and Designation
71A(a) 1 An eminent scientist from outside the ICAR system nominated by DG, ICAR	Chairman	**Prof. V. K. Taneja** Former VC, GADVASU, Ludhiana, B-2020, Chinar CGHS Ltd., Plot No. 3. Sector 18A Dwarka, New Delhi-110078
71A(a) 2 4-5 external members (including retired scientists of ICAR) representing the major areas of research & development programme of the institute nominated by DG, ICAR	Member	**Dr. B. S. Prakash** Former ADG (AN & P) Indian Council of Agricultural Research Krishi Bhawan, New Delhi-110001 **Dr. A. Chakravarti** Former Director of Research AAU, CVSc, Khanapara, Guwahati-781022 **Dr. A. S. Bawa** Former Director Defence Food Research Laboratory 103 Begonia, Sankalp Central Park Jawa Main Road, Yadavgiri Mysore-570020, Karnataka **Dr. A. K. Mathur** Former Principal Scientist ICAR-Central Institute for Research on Cattle D-6A, WHO Colony, Mawana Road Meerut, UP-250001
71A(a) 3 Director of the Institute	Member	Director, ICAR-NRC on Yak
71A(a) 4 ADG, concerned with the Institute/ nominated scientist	Member	ADG (AN&P), ICAR, New Delhi

71A(a) 5 Two persons representing /rural interests on the Management Committee of the Institute in terms of Rule 66(a) 5 for the period of their membership of the Management Committee	Member	**Sri Lobsang Tsering** Namshu Village, PO/PS - Dirang Dist. West Kameng, Arunachal Pradesh **Sri Lobsang Tsewang Komu** Munna Camp, PO/PS - Dirang Dist. West Kameng, Arunachal Pradesh
71A(a) 6 One Sr. level Scientist of the concerned Institute nominated by the Director of the Institute	Member Secretary	**Dr. Vijay Paul**, Principal Scientist, ICAR-NRC on Yak, Dirang, Dist.-West Kameng, Arunachal Pradesh

COMPOSITION OF INSTITUTE MANAGEMENT COMMITTEE

Rule No. 66 (a) 1 Director of the Institute	**Chairman**	**Director, ICAR- NRC on Yak, Dirang**
Rule No. 66 (a) 2 A representative of the State Government in which the Institute is located nominated by the President (Valid up to 02.11.2019)	Member	**Dr. Hano Tama**, Deputy Director, Regional Sheep Breeding Farm, Govt. of Arunachal Pradesh, Sangti, West Kameng, Arunachal Pradesh. (*Transferred as DAH & VO*) **Communicated to Council**
Rule No. 66 (a) 3 A representative of any other State Government concerned with the research in the Institute, nominated by the President (Valid up to 02.11.19)	Member	**Dr. NirmalBaruah**, Professor, Department of Poultry Science, College of Veterinary Science, Khanapara, Guwahati
Rule No. 66 (a) 4 A representative of the Agricultural University having jurisdiction over the area, nominated by the President (Valid up to 02.11.19)	Member	**Prof. R. K. Talukdar**, Department of Extension Education, Assam Agricultural University, Jorhat, Assam
Rule No 66 (a) 5 Two non official persons representing agricultural/rural interests, to be nominated by the President	Member	**Sri Lobsang Tsering** Namshu Village, PO/PS - Dirang Dist. West Kameng, Arunachal Pradesh **Sri Lobsang Tsewang Komu** Munna Camp, PO/PS - Dirang Dist. West Kameng, Arunachal Pradesh

Rule No. 66(a) 6 Scientist of Council's Institutes to be nominated by the Director General (Valid up to19.07.2020)	Member	**Dr. M. K. Ghosh**, Pr. Scientist, ERS, ICAR-NDRI, Kalyani, Kolkata **Dr. Ram GopalLaha**, Pr. Scientist, ICAR-Research Complex for NEH Region, Barapani. **Dr. ShantanuBanik**, Pr. Scientist, ICAR-NRC on Pig, Rani, Guwahati **Dr. Mihir Sarkar**, Pr. Scientist, ICAR-IVRI, Izatnagar, Uttar Pradesh
Rule No 66 (a) 7 A representative from the council nominated by the Director General (Valid up to 19.07.2020)	Member	**ADG (AN&P),** ICAR HQ New Delhi
Rule No 66 (a) 8 The Financial Adviser of the Council or Department of Agricultural Research and Education or the Accounts Officer of the same or another Institute, nominated by the President (Valid up to 02.11.19)	Member	**Finance & Accounts Officer**, ICAR-CRIJAFT, Barrackpore, West Bengal
Rule No.66(a) 9 Administrative Officer of the Institute	Member-Secretary	**AO**, ICAR-NRC on Yak, Dirang

COMPOSITION OF INSTITUTE ANIMAL ETHIC COMMITTEE (IAEC)

Name	Status
Dr. P. Chakravarty Director, ICAR- NRC on Yak, Dirang	Chairman
Dr. P. Chattopadhyay	Main Nominee, CPCSEA
Dr. Varun Tyagi	Scientist from outside the institute
Mr. Suresh Chandra Pathak	Socially aware nominee
Dr. Dinamani Medhi	Scientist In-Charge Animal House Facility
-do-	Member Secretary, IAEC

COMPOSITION OF INSTITUTE TECHNOLOGY MANAGEMENT COMMITTEE (ITMC)

Name	Status
Dr. P. Chakravarty Director, ICAR- NRC on Yak, Dirang	Chairman
Dr. Vijay Paul	Member
Dr. Joken Bam	Member
Dr. R. Thomas	External Member
Dr. T. P. Singh	Member Secretary

SIGNIFICANT DECISIONS OF VARIOUS COMMITTEES

23rd Institute Management Committee (IMC) meeting

The 23rd meeting of Institute Management Committee was held on 2nd March, 2020 at ICAR-NRC on Pig to cut short the time and expenses of IMC members of the institute. Dr. P. Chakravarty, Director (Acting) chaired the meeting and welcomed all the members. He presented the ATR on the recommendations of 22nd IMC meeting and appraised the house about the progress made by the institute under different activities. He also discussed status of different projects being implemented by the institute. All the members appreciated the activities taken up by the institute for uplifment of yak husbandry in the country. Some of the major recommendations proposed were:

- Transfer of technologies of the institute in collaboration with KVK and department of AH and Veterinary, Arunachal Pradesh
- Necessary steps for commercialization of yak products
- Allocation of land for Indian Institute of Geomagnetism, Shillong for installation of Broad Band Seismograph in Nyukmadung farm premises
- Strongly recommended for filling up of all the vacant posts of the Institute by the Council

Institute Research Committee (IRC) meeting

The IRC meeting was held on 10th December, 2020 at ICAR-NRC on Yak, Dirang under the chairmanship of Dr. P. Chakravarty, Director (Acting). Dr. Rajan Gupta, Principal Scientist cum DDG's nominee (AN & P), ICAR HQ, Dr. Juwar Doley, Scientist (Animal Biotechnology) and Dr. Taruna Pal Singh, Scientist (LPT) attended the IRC through Video Conferencing due to nationwide lockdown for Covid 19 pandemic. The chairman welcomed Dr. Rajan Gupta and presented a brief profile cum measures undertaken during peak lockdown periods in the institute. After the introductory note a total of four recently concluded projects, two ongoing projects and two new projects were thoroughly discussed and recommendations were made. The two new projects entitled "*Assessment of biological and immunological responses to heat stress in yaks*" and "*A study on the factors influencing the pastoral yak rearing system in North East India*" submitted by Dr. S. S. Choudhary, Scientist (Veterinary Medicine) and Dr. Khriengunuo Mepfhuo, Scientist (Agril. Extension), respectively were also approved. IRC also discussed different externally funded projects undertaking by the scientists and appreciated the progress of the projects. After the deliberation of all the projects, the chairman and DDG's nominee appreciated the effort of all the scientists for carrying out the quality research work in such a remotely located centre.

Institutional Animal Ethics Committee (IAEC) Meeting

Keeping all preventive measures of Covid-19 pandemics two meetings of Institute Animal Ethic Committee with CPCSEA nominees were held on 16-05-2020 and 30-12-2020, respectively through Video Conferencing. Dr. D. Medhi, Member Secretary of the IAEC briefed the profile of the institute with ATR as per proceeding of past meeting held on 05/07/2019. He also presented the herd profile of the experimental yak farm of the institute situated at Nyukmadung with the

breeding, feeding, reproductive and health care management of the animals in the farm. He also described the ongoing activities with various research projects undergoing in the institute.

After thorough discussions the CPCSEA nominee appreciated the institute's animal house facility for its well management taking care of animal welfare aspects and the scientific merits of experimentation for the facilities available both in animal house and the institute.

Virtual Pre-Interface meeting of the institute:

A virtual Pre-Interface Meeting of ICAR-NRC on Yak, Dirang on "Yak Rearing in India" with Animal Husbandry (AHD) Departments and Krishi Vigyan Kendras (KVKs) of all yak rearing States of India was organized through video conferencing on 17th August 2020 at 10.30AM under the Chairmanship of Dr. P. Chakravarty, Director (Acting), ICAR-NRC on Yak, Dirang, Arunachal Pradesh. In total 40 participants from different organizations like ICAR-National Research Centre on Yak, Animal Husbandry departments and KVKs of yak rearing regions of Ladakh, Himachal Pradesh, Sikkim and Arunachal Pradesh attended the meeting. Dr Vijay Paul, Principal Scientist and in-charge, PME briefed the background and purpose for virtually organizing the meeting under the prevalent circumstances of COVID -19 outbreak in the country.

The Chairman, Dr. P. Chakravarty, Director (Acting), ICAR-NRC on Yak, Dirang in his opening remarks conveyed his heartfelt greetings to all the delegates joining in the meeting and highlighted the importance of the yak as a unique animal solely supporting the livelihood of highland communities of our Country. He also asked for joint efforts of the Institute and field departments to overcome the constraints associated with yak rearing in the Country for overall improvement of yak population in the country and their productivity. He mentioned that the Institute technologies like Complete Feed Block is boon for preparedness for avoiding tragic mortality associated with winter starvation citing the example of the natural calamity of unprecedented heavy snowfall in North Sikkim during 2018-19 which claimed the mortality of more than 500 yaks. He also informed the participants about the planning for expansion of outreach activity of the Institute in all yak rearing states viz., Leh-Ladakh, Sikkim, Himachal Pradesh with the help of Animal husbandry department for increasing the animal productivity and livelihood security of yak farmers. Therefore, the Institute has arranged for this pre-interface meeting with the objective to have inputs and suggestions from the animal husbandry departments and Krishi Vigyan Kendras, who are working at field and aware on ground realities.

Thereafter, a brief presentation on *"Technologies & Achievements of ICAR-NRC on Yak"* was presented by Dr. Vijay Paul. The focus of the presentation was on the role of Institute technologies in addressing the issues of yak rearing in India highlighting the following points:

- Sedentarization of yak at different approachable pastures to address the transhumance associated problems of yak rearing.
- Breed characterization of Indian yak population in collaborative mode.
- Nutritional interventions to overcome the winter feed crisis, the Institute has developed Complete Feed Blocks (CFB) based on local feed resources, and silage making for feeding animals during winter scarcity, was highlighted for further implementation at field level.
- *Development of pastureland*: Institute has tested suitable temperate grasses need to be tested for propagation in cold arid region of Ladakh and Himachal Pradesh along with the water harvesting and saving technologies.

- *Conservation of yak germplasm*: Institute has developed technologies like cryopreservation of yak semen, artificial insemination (AI), estrus synchronization, multiple ovulation and embryo transfer (MOET), and *in-vitro* embryo production (Ovum pick up, IVF). Artificial insemination has been successfully implemented at Institute farm with the conception rate of above 60%. To implement AI in field, Institute has made efforts by supplying frozen semen straws to Ladakh, Sikkim and Arunachal Pradesh. Hence, AI with estrus synchronization in yak can be adopted to upgrade the germplasm and check the inbreeding in yaks of different states.
- *Value of addition of yak products with linkage to entrepreneur/industry*: The Institute developed the processing technologies of yak milk for making paneer (dietary fibre enriched low fat), *ghee*, *churpi* and ripen cheese. In recent past, a new area of venture has been opened for utilizing under used coarse yak fibre by blending with jute for fabric making through the joint efforts of Institute and ICAR-NINFET (erstwhile ICAR-NIRJAFT), Kolkata. This fabric is being used for making various products like jackets, five covers, bags, wall hangings, purse, toilet bags etc.
- Alternative purpose of yak viz., packability, riding, trekking etc. Yak is a sure-footed animal and can carry up to 35% load of their body weight in hill terrains, hence can be used in various ecotourism activities like riding and trekking etc.
- *Trainings*: Institute is regularly organizing training for different stakeholders on yak rearing, management and product processing. Some training programme are focused for the local youths and ladies especially on yak product processing to make them self-reliant in line of Govt. AtmaNirbhar Bharat Abhiyan.
- *Yak breeding farms*: It was suggested to open or upgrade their existing yak breeding farms in all yak rearing states and also make strong collaboration with ICAR-NRC on Yak for setting up the facilities/infra structure for pasture development, CFB making, yak semen collection, cryopreservation and AI, and yak product processing.
- Linkages may be established with the textile and handicrafts, and tourism departments for encouraging yak based Entrepreneurship among the local for sustainable development of yak husbandry.

In subsequent open discussion with inputs from the participants following points was arises:

AHD of Himachal Pradesh requested the following assistance from the Institute to promote yak husbandry the state:

- Technology transfer to Himachal Pradesh especially the Artificial Insemination (AI) and fodder conservation.
- Capacity building of Veterinary Officers on Yak Husbandry and Management.
- Frozen yak semen straws to Himachal Pradesh.
- Technological support for implementation of Complete Feed Block technology to meet the winter fodder requirements for yaks of Himachal Pradesh.
- Training of yak farmers on yak milk and fibre products.

AHD and KVKs of Ladakh suggested the possible measures to promote yak husbandry in the region like:

- To encourage and motivate yak farmers, they should be provided free ration for keeping and increasing their animals number which will initially ensure their income and subsequently could turn out a sustained source of sole livelihood.

- To save the declining yak population, the yak breeders should be encouraged through ensured free supply of animal feed and feed supplements, to prevent an abrupt decease in yak population.
- Feed resource management and pasture development techniques need to be implemented for fulfilling the fodder requirements of their livestock.
- Field studies on pertinent issues like inbreeding, poor reproductive and productivity efficiency of yaks in Ladakh region need to be taken up, beside adopting the reproductive techniques like estrus synchronization and artificial insemination.
- More initiatives need to be taken on value addition in yak products like milk, wool etc. Hence, a small processing unit for yak fibre and milk products should be setup in Ladakh for promoting their branding and commercialization.
- Encouraging tribal youth for entrepreneurship through yak husbandry and IP protection of locally made yak products for branding and better economic returns to the farmers are the other options for sustainable development of yak husbandry.
- The Institute was requested to supply frozen yak semen to avoid/reduce inbreeding.

Dr. Karma T. Bhutia, Additional Director, Mangan AHD, Govt of Sikkim appreciated the post-disaster mitigation efforts made by ICAR-NRC on Yak to help the affected yak farmers by providing immediate relief aids in form of complete feed block, yak feed, health booster and essential veterinary medicines etc. The Complete Feed Block Technology which proved as a boon for the affected yaks during the disaster at Muguthang area in North Sikkim was appreciated by the farmers and the department. Dr. Bhutia, also appreciated for 250 semen doses of *Arunachali* yak provided by ICAR-NRC on yak to the state for initiating artificial insemination in yaks. He also informed the participants that under collaborative efforts of the Institute and AH department the AI was performed in three yaks reared at their yak breeding farm and one of them was confirmed pregnant on pregnancy diagnosis. He also expressed his view on sedentarization of yak and highlighted the importance of yak rearing under traditional migratory system as an integral part of the culture and tradition of the pastoral communities of rearing this unique animal for their livelihood. Yak milk and meat products are by virtue rich in flavour, taste and composition due to grazing on high altitude mountain grasses. A few other points were also discussed for the improvement of yak husbandry in Sikkim.

- *Preparedness for meeting winter fodder requirements through CFBs*: Installation of a Mini CFB machine in Sikkim in collaboration with ICAR-NRC on Yak for preparation of CFB locally to mitigate winter feed scarcity.
- Capacity building of locals on yak product processing.
- Pasture development programmes in collaboration with the Ministry of Defence should be taken up for promotion of yak rearing.
- Artificial insemination is being introduced in Sikkim for up-gradation of field yaks, hence need to be intensified.

The following issues were raised and discussed regarding yak rearing in Arunachal Pradesh:

- Decreasing and degrading pasture land, winter fodder scarcity, grazing tax and inbreeding are the concerns of yak herders of Arunachal Pradesh.
- Calf mortality in pastures during migration due to harsh climate and poor temporary infrastructure (shelters) in the high mountains. Makeshift animal shelters at strategic locations for protection of young animals during migration with nail-set huts for the yak herders can reduce the calf mortality and ease the lifestyle of herders.
- Encourage yak farmers for a sedentary system of yak rearing at different pastures connected with roads.
- Proposal for issuing a separate beneficiary card (similar to PM Kisan card) for yak farmers to

aid right farmers associated with the hardships of yak farming with direct benefits, basic inputs and amenities.

- Awareness and collaborative animal health care programmes could be taken up with Animal husbandry and KVKs on deworming in yak calves to prevent calf mortality and animal vaccination against FMD-HS-BQ.
- Fodder cultivation techniques with suitable grasses should be provided to the livestock farmers.
- Suitable breeding policy may be designed and taken up for yaks keeping in view their inherent features of adaptability to harsh climate and productive parameters.
- The following issues were emerged out of the threadbare discussion during this virtual meeting:
- Degrading pastures and shrinking grazing land for the yaks due to overstocking, infrastructure development across the border areas and occupation of good pastures for other activities relevant to national security.
- Up-scaling and implementation of the Institute fodder production and conservation technologies i.e., pasture development, complete feed blocks and silage making in poly bags to mitigate the fodder crisis.
- Implementation of Artificial insemination and estrus synchronization in yaks for addressing the inbreeding issues along with bull exchange programme at field.
- Capacity building of farmers and other stakeholders on yak rearing and management, yak product processing and value addition to promote yak husbandry throughout the country.

It was finally recommended for implementation of a strong networking and collaboration with all the A.H. & Vety. Departments and KVKs of all yak rearing states and ICAR-NRC on Yak for dissemination of technologies from time to time.

09

PARTICIPATION OF THE SCIENTISTS AND STAFF IN CONFERENCE, WORKSHOP, SYMPOSIUM, TRAINING, MEETING ETC. IN INDIA AND ABROAD

International

Sl. No.	Name of the Symposium/Seminar/Workshop/Training/Meeting	Participating Scientist & Staff
1.	Webinar in respect to "*World Milk Day'2020*" organized by ICAR-National Dairy Resaerch Institute, Karnal, Haryana on 1st June'2020	P Chakravarty
2.	Ten days training programme on '*Livestock Methane Emission: Assessment, Impact and Amelioration Strategies*' organized by International Livestock Research Institute (ILRI), Nairobi in collaboration with ICAR-NIANP, Bengaluru during 2nd to 12th November' 2020.	D Medhi
3.	Regional workshop cum exhibition on "*Yak rearing in Himalaya-Strengthening yak network in transboundary landscapes for socio-ecological resilience of the highland community*" during 25-26th November'2020 organized by GBP National Institute of Himalayan Environment (NIHE), Sikkim in collaboration with Department of AH, Livestock, Fisheries & Vety. services, Sikkim and International Centre for Integrated Mountain Development, Nepal .	P Chakravarty V Paul D Medhi
4.	Webinar Series on "*Emerging trends in Extension and Social Sciences Research*" jointly organized by Multi-technology testing Centre & Vocational Training Centre, College of Fisheries, CAU, Imphal, ICAR-NAARM, Hyderabad, and ICAR-CTCRI, Kerala, during 10th to 16th June 2020.	K Mepfhuo
5.	Webinar on "ET/IVF/OPU in Bovine" jointly organized by Department of ARGO, Nagpur Veterinary College, MAFSU, Nagpur - 44001 with ISSAR (Maharashtra Chapter) and IMV, India on 18.09.2020.	M Hussain
6.	Webinar on "*Alphavision: A Vedioptic tool to improve the Reproductive efficiency of Cattle herds*" jointly organized by Department of ARGO, Nagpur Veterinary College, MAFSU, Nagpur - 44001 with ISSAR (Maharashtra Chapter) and IMV, India on 17.09.2020.	M Hussain
7.	Webinar on "*Iron Metabolism and its disorders: From Anemia to Hemochromatosis*" organized by Department of Veterinary Biochemistry, College of Veterinary Science & Animal Husbandry, DUVASU, Mathura(UP) on 31.08.2020.	M Hussain

National

Sl. No.	Name of the Symposium/Seminar/Workshop/Training/Meeting/ Agri-Fair	Participating Scientist & Staff
1.	Pusa Krishi Vigyan Mela'2020 held at ICAR-IARI, New Delhi from 1 to 3rd March'2020	D Medhi P Namje
2.	Online conference of Directors held on 01/04/2020 at ICAR, HQ, New Delhi	P Chakravarty V Paul D Medhi N Khochilu G Srivastava
3.	National Webinar on "*Awareness and use of CeRA resources through J-gate discovery platform on 25th June*'2020 organized by Nehru Library, CCS Haryana Agricultural University, Hisar in collaboration with Consortium for e-resource for Agriculture-CeRA-DKMA-ICAR-New Delhi and Informatics Publishing Limited, Bengalore	D Medhi
4.	National Webinar on "*Physiological Spectrum to augment livestock production in enigmatic Covid-19 scenario*" organized by Department of Veterinary Physiology, College of Veterinary Sciences, Khanapara, Guwahati-22, Assam on 25th Septemebr'2020	D Medhi M Hussain
5.	National Webinar on "*Livestock- A driving force for food security and self sufficiency during post Covid phase*" organized by Department of Livestock Production and Management, CVSc, Khanapara, Guwahati-22, Assam on 7th November'2020	D Medhi
6.	Online workshop on "*Gender Sensitization*" organized by National Academy of Human Resource Development, Defence Colony, New Delhi on 02.06.2020	J Bam
7.	Attended through virtual mode and presented the abstract in the "*National online research paper presentation competition*" from August 18-24, 2020 organized by Lakhimpur college of veterinary science, Joyhing, North Lakhimpur-787051 in collaboration with collage of veterinary science, Khanapara-781022, Guwahati, Assam Agricultural University.	T P Singh
8.	MDP on "*Intellectual Property Valuation and Technology Management*" from September 01-05, 2020 organized by ICAR-NAARM, Hyderabad, Telangana 500030.	T P Singh
9.	Fourteen days webinar series on "*Intellectual property rights in agricultural research & education in India*" from September 12-28, 2020 organized by NAHEP and IP&TM Unit, ICAR Hqrs, Pusa Campus, New Delhi 110012	T P Singh
10.	National Online Workshop on **"***Psychometric scale construction techniques: Basic to advances***"** organized by the Dairy extension Division, ICAR- National Dairy Research Institute, Karnal, during 24th to 28th November 2020.	K Mepfhuo

11.	National workshop on "*Modern interventions in environmental management*" organized by ICAR-IIAB, Ranchi on December 30, 2020.	S S Choudhary
12.	Training Programme on "*Right to Information-Public Information Officers*" organized by ISTM, Department of Personnel and Training, Govt of India from 19th to 20th November, 2020.	M Hussain
13.	National Webinar on "*Elimination of Rabies Adopting One Health Approach*" organized by LCVSc., AAU, Joyhing, North Lakhimpur-787051 on 28.09.2020 on the occasion of World Rabies Day, 2020.	M Hussain
14.	National Webinar on "*Basic to Recent Advances in Veterinary Andrology*" organized by Department of ARGO, LCVSc., AAU, Joyhing, North Lakhimpur-787051 from 19th to 20th September, 2020.	M Hussain
15.	Online Orientation Training from 06th April to 05th May, 2020 at ICAR-NRC on Yak, Dirang.	S S Choudhary
16.	Three month Professional Attachment Training programme at ICAR-NRC on Camel from 8th June to 7th September, 2020.	S S Choudhary
17.	Three month Professional Attachment Training programme. at ICAR-NRC on Mithun from 11th June to 10th September, 2020.	K Mepfhuo
18.	Seven days online short course on "*Technology coated roadmap for profitable dairying in Assam*" organized by Teaching Veterinary Clinical Complex, CVSc., AAU, Khanapara, Guwahati-22 from 1st to 7th September, 2020.	M Hussain
19.	National Webinar on "*Zoonosis and Human Health*" organized jointly by ZSA unit of ADP College, Nagaon and Zoological Society of Assam (ZSA) on 30.08.2020.	M Hussain
20.	National Webinar on "*Recent Advances in Diagnosis and Therapeutic Management of Infertility in Dairy Animals*" organized by Department of ARGO, CVSc., AAU, Khanapara, Guwahati-22 on 28.08.2020.	M Hussain
21.	National workshop on "*Modern Interventions in Enviromental Management*" organized by ICAR-IIAB, Ranchi on December'2020	D Medhi
22.	Webinar on "*New platform of J-gate@CeRA*" organized by ICAR-NRCY, Dirang on 08/10/2020 in collaboration with J-gate@JCCC	P Chakravarty D Medhi T P Singh M Hussain

VARIOUS PROGRAMMES AND EVENTS ORGANIZED

Swachhata Pakhwara Programme

- Under *Swachh Bharat Abhiyan,* various cleanliness drives were organized by the institute to inculcate the awareness among the society from 20th December to 31st December'2020. A series of activities relating to cleanliness, personal and social hygiene has been conducted during the period. The major events in this connection includes-
- Launched "*Swachhata Pakhwara*" programme with cleanliness drive of office campus with cleaning and sanitization drive of nearby Yewang village on 20th December'2020.
- Cleaning of sewage cum water line of the office campus was carried out on 21-12-2020. Water harvesting facility already exist in the campus have also been cleaned for agriculture and fish farming.
- Swacchta Pakhwara rally and workshop on waste to wealth undertaken on 22-12-2020.

- Celebrated Kisan Diwas and felicitated farmers from different nearby villages and civil society officials under Dirang circle on 23th December'2020.
- Organized one drawing Competition on Swacchata *Hi Sewa* amongst the school students of the institute.

- Awareness on recycling of waste water for better agricultural outcomes carried out on 28/12/2020.
- Cleaning and sweeping of the entire premises of the Kalachakkra Gompa, Thuptsung Dargeyling Gonpa, Dirang bazar with cleaning of nearby tourist spot at Hot Spring, Dirang carried out with involvement of the staffs of

the institute during this perid of *Swachhata Pakhwara.*

- The Concluding function was organized in presence of Zilla Parishad Member, Lish block Smt. Rinchin Zomba, Circle Officer, Dirang Mr. Nima Phuntsok with other officials of Dirang Circle.

Celebration of World Veterinary Day'2020

World Veterinary Day 2020 was celebrated at ICAR-National Research Centre on Yak, Dirang campus on April 25, 2020 taking into account

all the preventive measures of Covid-19 like wearing of mask and social distancing during the celebration. A presentation on the theme for World Veterinary Day 2020, "*Environmental protection for improving animal and human health*" was made by Dr. D. Medhi. The presentation focussed on the relationship between environment to animal and human health, different harmful aspects on the environment that affect animals and humans, the protective issues thereof and the role and responsibility of veterinarians for maintaining good health of animals and human being as well under such challenges. The programme was attended by all the staff of the institute.

Week Long celebration of "150th Gandhi Jayanti Programme"

A week long programme was organized at ICAR-National Research Centre on Yak celebrated on the occasion of 150th Gandhi Jayanti from September

26th to October 2nd 2020. The celebration was kicked off with cleanliness programme of the office and residential campuses on September 26th 2020.

Celebration also included plantation programme on September 28th 2020 and painting competition amongst the school students at the institute on 2nd October, 2020.

During the closing programme a short film on Gandhiji's biography with some short stories on his philosophy screened in the institute Auditorium. Winners of the painting competition were awarded certificates & prizes. Total twenty-eight students participated in the programme.

Mahila Kisan Diwas observed on 15th October'2020

A *Gosti* on "*Importance of Nutrition for women*" was organized during *Mahila Kisan Diwas* celebration on 15.10.2020 at Nyukmadung Yak farm. A presentation on "Importance of Nutrition for women" was made by Dr. K. Mepfhuo followed by interactive session on the topic with the participants. Thirteen (13) women farmers from Nyukmadung village participated in the programme.

Organized live webcasting programme of Hon'ble Prime Minister's address to the farmers and release of PM-Kisan Samman Nidhi scheme

Awareness Programme on "PM-*Kisan Samman Nidhi* scheme" was organized on 25 December, 2020 by ICAR-NRC on Yak in collaboration with Krishi Vigyan Kendra, West Kameng, Arunachal Pradesh at ICAR-NRCY Auditorium to create awareness among the farmers about the benefits of the scheme. Total Eighty-Five (85) people participated in the programme which included 57 tribal farmers and 27 staff members from institute and KVK. Chief Guest, Dr. R.M. Pant, Director, National Institute of Rural Development & Panchayati Raj, North Eastern Regional Centre, Guwahati appreciated the efforts made by the government for the benefit of the farming community and urged the farmer participants to take benefit from the scheme. The live webcasting of Hon'ble Prime Minister's address to the farmers and release of PM-*Kisan Samman Nidhi* scheme was also screened during the programme.

World Environment Day'2020

ICAR-National Research Centre on Yak, Dirang was celebrated World Environment Day'2020

on 5th June'2020. The Director and all the staff of the institute participated in the programme maintaining lockdown protocols of Covid 19 pandemics.

Promoting Entrepreneurship

Workshop conducted on prospects of Commercialization of Yak Products, Institute Technology Management Unit- ICAR National Research Centre on Yak organized a two-day's workshop on "*Prospects of commercialization of yak products*" from February 14-15, 2020 at Dirang. The aim of the workshop was to create awareness among the scientists, research scholars, stakeholders, entrepreneurs, innovators and progressive farmers towards commercialization

of yak products and protection of their relevant Intellectual Property. The workshop was attended by 26 participants involving research scientists, officials of Dept. of Textile & Handicrafts, Govt. Polytechnic, Dirang, Dept. of Horticulture, progressive yak farmers and local entrepreneurs. Dr. T.P. Singh, Scientist & In-charge ITMU cum organizing secretary while welcoming the guests, introduced the purpose and objectives of the workshop. Dr. Vijay Paul, Principal Scientist, ICAR-NRC on Yak highlighted the Institute activities and technologies and their scope of commercialization and IP protection. Sh. Sunil Soni, Commandant, 30th Bn, SSB, Dirang graced the occasion as a Chief Guest. In his

inaugural speech he emphasized on showcasing of yak products to narrow down the gap of their accessibility to wider range of consumers including tourists. The prioritize technologies on yak products were highlighted by Dr. Joken Bam, Scientist, ICAR-NRC on Yak to the participants. The participants also visited the newly created training facility of Dept. of Textile & Handicrafts, Govt of Arunachal Pradesh at Rama camp, Dirang. On the second day, the invited talks on "*Prospects of commercialization of yak products*" and "*Innovative Entrepreneurship towards start-up and Transfer of Technology*" were delivered by Dr. P.J. Das, Senior Scientist, ICAR-NRC on Pig and Dr. A. N. Roy, Head, ToT, ICAR-NINFET Kolkata, respectively. Ms. Vidisha Garg, IPR Specialist and Strategist, Anand and Anand, Noida delivered her invited talk on "*Legal issues pertaining to Intellectual Property Right, Geographical Indication and Technology Commercialization*". Dr. P. Chakravarty, Director (Acting) of the Institute extended his greetings to all the participants, resource persons and organizing committee for successful organization of the workshop, in his presidential speech during the valedictory function. The participants appreciated their learning experiences through the workshop.

Vigilance awareness week'2020

Vigilance awareness week was observed by the institute from during 27th October to 2nd November'2020 with the theme "***Satark Bharat, Samriddh Bharat*** (Vigilant India, Prosperous India)". In this connection an awareness programme on internal (housekeeping) activities of the institute in campaign mode was undertaken at Dirang office and Nyukmadung farm campus of the institute on 31st October'2020 with an extempore speech competition on 2nd November, 2020 amongst the employees of the institute. Awardees received Certificates of merits with prizes on valedictory function from Director of the institute.

International yoga day

Sixth International Yoga Day was celebrated by all employees of the institute on 25th June, 2020 in their own home looking of the Covid-19 pandemics of the country as per instruction of the Hon'ble Secy. DARE & Director General, ICAR.

Hindi Diwas'2020

The institute celebrated Hindi Diwas, 2020 in presence of all employees of the institute in its Dirang campus maintaining Covid 19 pandemics on 14th September'2020

ICAR Foundation Day celebration

The staffs of ICAR-National Research Centre on Yak, Dirang along with Director celebrated ICAR's

Foundation Day on 16/07/2020 with virtual participation in the prgramme organized by ICAR, HQ from New Delhi with live telecasting events of Hon'ble Agriculture ministers.

31st Foundation Day of ICAR-NRC on Yak

ICAR-National Research Centre on Yak, Dirang celebrated its 31st Foundation Day on 23rd January,

2020. The programme began with the hoisting of institute flag by Dr. D. Medhi, the Director in-Charge with his address to the staffs for their great work and dedication for all the achievement made by the institute in the last 31 years. He further urged upon everyone to give their best for making the institute one of the best institutes for the country. In this connection, a farmer-scientists interaction programme was organized in the institute's auditorium in presence of experts from the institute, Krishi Vigyan Kendra, Dirang and Department of Veterinary and Animal Husbandry. At the end, 160 tribal farmers attended in the programme were provided with TSP benefits of the institute in the form of concentrate feed, common salts with some basic veterinary medicines like anthemantics, anti-diarrhoeals, fly repellents, liver tonics etc.

Global Potato Conclave'2020

The institute arranged the live telecasting programme of Hon'ble PM's address to the nation in response to 3rd Global Potato Conclave from Gandhinagar, Gujarat through remote video conferencing on 28th of January 2020.

Implementation of Covid-19 Advisories in the institute

The institute adopted all the rules and regulations as per ICAR cum Govt. of Arunachal Pradesh amended time to time during the Covid 19 periods viz.-

- Strict restriction on visitors to the institute.
- Maintaining duty roaster of the staffs as instructed.
- Daily Thermal Scanning of farm and office workers before entry in the premises.
- Facilities for hand sanitization with soap/ sanitizers at entry gate and different locations were provided and workers are advised to sanitize their hands time to time.

- Farm animal produced were processed, preserved and sold to consumers following the recommended preventive guidelines of Covid-19.
- Staffs residing within the campus are advised to strictly follow the measures like-
  - Stay home quarantine to safe from Covid-19.
  - Regular checking of temperature.
  - Mandatory to use masks to the sufferer of cold, cough, flu etc and use handkerchief during coughing and sneezing.
  - Frequent hand washing using soap and application of hand sanitizer.

DISTINGUISHED VISITORS

Date	Visitor's Name &Address	Remarks/Comments
11th September'2020	Sh. Naresh Kumar Chief Secretary, Governor of Arunachal Pradesh, Itanagar	Visited the centre today along with my colleague from Itanagar and District Administration. Delighted to know with concealed efforts population of yaks in Arunachal increased. We continue to work to make yak rearing more productive and useful with technology intervention.
23rd October, 2020	Er. Tage Taki, Minister, Agriculture, Horticulture, Veterinary & Animal Husbandry, and Fisheries, Arunachal Pradesh, Itanagar	I am really impressed to see the activities of yak farm. I on behalf of people of Arunachal Pradesh, as Minister, Veterinary & Animal Husbandry expressed gratitude of ICAR, Govt. of India for this institute.
31st October, 2020	Dr. S. K. Dwivedi Director, DRL (DRDO), Tezpur, Assam	I am delighted to visist this institute of natural importance. This institute has developed excellent lab and farm facilities on yak. I am indeed very impressed with the kind of dedication and enthusiasm NRC has in its team. A very remarkable contribution such a remote location. With best wishes!

ICAR-NRC-YAK PERSONNEL

Scientific

Sl. No.	Name	Designation	Date of joining at ICAR-NRCY	Date of joining at ICAR
1.	Dr. Prithiviraj Chakravarty Ph. D. (Anim. Physiology)	Director (Acting)	05/06/2017	20/02/2008
2.	Dr. Vijay Paul Ph. D. (Anim. Physiology)	Principal Scientist	13/04/2009	13/04/2009
3.	Dr. Dinamani Medhi Ph. D. (Anim. Nutrition)	Principal Scientist	27/04/2012	27/04/2012
4.	Dr. Joken Bam Ph. D. (Vety. Parasitology)	Scientist	22/04/2010	15/12/2009
5.	Dr. Tarun Pal Singh Ph. D. (LPT)	Scientist	17/10/2017	05/07/2017
6.	Dr. Shyam Sunder Choudhary, Scientist (Vety. Medicine)	Scientist	04/04/2020	07/01/2020
7.	Dr. K. Mepfhuo, Scientist (Vety. Extn.)	Scientist	04/04/2020	07/01/2020

Technical

Sl. No.	Name	Designation	Date of joining at ICAR-NRCY
1.	Dr. Mokhtar Hussain Ph.D., ARGO	Sr. Technical Officer (Vety. Officer)	01/11/2014
2.	Mr. P. Namje	Technical Officer (Stock Asstt.)	01/03/1993
3.	Mr. R. K. Das	Technical Assistant (Driver)	28/12/1989
4.	Mrs. Chokyong Lhamu	Senior Technician (Field Asstt.)	18/11/2008
5.	Mr. Sanjay Sarkar	Senior Technician (Driver cum Mechanic)	03/06/2016

Administrative

Sl. No.	Name	Designation	Date of joining at ICAR-NRCY
1.	Mr. N. Khochilu	AAO	21/04/1995
2.	Mr. Gaurav Srivastava	AF & AO	13/08/2010
3.	Mr. Khokan Paul	Private Secretary	14/03/2011

4.	Mr. Gouri Sankar Sinha	Assistant	22/10/1996
5.	Mrs. R. D. Dirkhipa	Personal Assistant	15/06/2006
6.	Mr. T. W. Sharchokpa	Steno Gd. II	25/10/2014
7.	Mrs. Mudang Yapa	LDC	20/02/2013
8.	Mr. Gautam Chatterjee	UDC	Promoted to UDC w.e.f. 28/01/2020
9.	Mr. Pran Krishna Nath	LDC	Promoted to LDC w.e.f. 13/11/2020

Supporting

Sl. No.	Name	Designation	Date of joining at ICAR-NRCY
1.	Mr. Dawa Tsering	Skilled Support Staff	01/04/1991
2.	Mr. Nawang Tsering	Skilled Support Staff	01/12/1991
3.	Mr. Rinchin Norbu	Skilled Support Staff	24/04/1992
4.	Mr. Lek Phuntso	Skilled Support Staff	15/07/1993
5.	Mr. Nima Dorjee	Skilled Support Staff	03/04/1995
6.	Mr. Passang Khandu	Skilled Support Staff	15/12/1997
7.	Mr. Tsering Khandu	Skilled Support Staff	15/12/1997
8.	Mr. Sang Khandu	Skilled Support Staff	15/12/1997
9.	Mr. Pem Norbu	Skilled Support Staff	08/08/2005
10.	Mr. Phuntso	Skilled Support Staff	11/11/2005
11.	Mr. N. K. Choudhary	Skilled Support Staff	14/11/2005
12.	Mr. Ashok Thakur	Skilled Support Staff	15/06/2006
13.	Mrs. Sonam Drema	Skilled Support Staff	29/09/2015
14.	Mrs. Sonam Choten	Skilled Support Staff	29/09/2015

New member

- Dr. Shyam Sunder Choudhary, Scientist (Vety. Medicine) joined ICAR- National Research Centre on Yak on 04/04/2020
- Dr. Khriengunuo Mepfhuo, Scientist (Agri. Extn.) joined ICAR- National Research Centre on Yak on 04/04/2020

Promotion

- Dr. Dinamani Medhi promoted from Senior Scientist (Anim. Nutrition) to Principal Scientist w.e.f. 27/04/2018
- Mr. Gautam Chatterjee promoted to UDC w.e.f. 28/01/2020 through LDCE.
- Mr. Pran Krishna Nath promoted to LDC w.e.f. 13/11/2020 from Skilled Support Staff.

Transfer

- NIL

INFRASTRUCTURE DEVELOPMENT

RESAERCH LABORATORY

The institute has one central laboratory with central instrumentation facilities (CIF) and other specific laboratories (nutrition laboratory, yak health laboratory, physiology laboratory,

parasitology laboratory, animal biotechnology laboratory, semen processing laboratory and genetics laboratory). To support the laboratories one media and sterilization room has been

established which caters the need of all the laboratories. The laboratories are equipped with rotary microtome, kjeltec protein analyser, ELISA reader, western blot apparatus, gradient thermal cyclers, real time PCR, gel documentation systems, HPLC system, laminar flow, BOD incubators, lyophiliser, nano-drop spectrophotometer, atomic absorption spectrophotometer, vertical and horizontal gel electrophoresis systems, UV-visual spectrophotometer, automated blood analyser, automatic blood analyser, fluorescent and phase contrast microscopes, stereozoom microscopes, live cell imaging system, embryo-freezer machine, geranium oil extraction unit, colour doppler, ultra sound machine, inverted research microscope with image analyzer, auto dilution and dispensing unit, biological safety cabinets, CO_2 incubator, incubator with shaker, BOD incubator etc.

LIBRARY

As on 31st December, 2020, the total number of books in the library is 2949. Books covering animal nutrition, animal physiology, genetics, veterinary medicine, pharmacology & toxicology,

veterinary parasitology, veterinary microbiology, biochemistry, biotechnology, immunology and veterinary epidemiology etc. are available for issuing to the members as well for reference. For the library, numbers of journal and magazine of national repute has been subscribed. This library also has a collection of annual reports, newsletters, research highlights and other special publications of ICAR institutes and state agricultural universities. Apart from this, the library is also supported through J-gate@CeRA for assessing scientific literatures, lectures and books.

AKMU

The ARIS cell has been established in 1998. Presently the cell is equipped with BB VSAT having 2 Mbps bandwidth capacity through which internet facility has been provided to Director's cell, ARIS cell, CeRA and laboratories. Periodic updating of web contents of the institute home page is carried out by this cell.

HUMAN HEALTH UNIT

The institute has a human health unit which is run by a part time doctor with one contract worker to fulfill the basic needs of scientists and staff of this institute. Medicines are provided to the employees of this institute as per their need from the contingency head of the institute. During this report period 203 patients (cases) were registered and taken care accordingly.

YAK PRODUCT TECHNOLOGY UNIT

Yak product technology unit is having two types of facilities i.e. milk and wool processing. This unit is a part of the revenue generation cell of the institute.

Milk processing unit

The unit has the facility for making different yak milk products. *Chhurpi* (loose cheese), *paneer*, low fat *paneer*, ghee and cream are regularly prepared.

Value added yak milk products developed

In pursuits of transforming yak into an economical animal there had been continuous efforts in terms of preparation of value added yak milk products like vegetable extended *paneer*, kiwi flavoured whey drink, vitamin C enriched whey drink and enrobed *paneer*. These value added yak milk products have been developed, standardized and evaluated. Such technological preferment would benefits yak farmers by fetching better returns for their milk products.

Wool processing unit

The yak fibre is a valuable item integral to the life of yak herdsmen. This institute is having a

yak fibre processing facility to prepare different products from yak outer coarse hair and down hair using locally available tools. The unit has the facility for regular preparation of different yak fibre products such as carpet, mat, hand gloves, caps, muffler and *chamar* etc. Many woollen products using yak down fibre and sheep wool are also prepared in the unit. Recently, coarse yak fibre blended with jute fibre has been developed for making fabrics and garments in collaboration with ICAR-NINFET, Kolkata. A complete fabric forming unit donated by ICAR-

NINFET (under their North Eastern scheme) is used for making different designs/patterns of yak-jute blended fabric for making garments, file covers, caps, ladies hand bag, table runners and cushion covers etc. This unit also has sewing and interlocking machines for making jackets and other garments.

HINDI CELL

Hindi diwas was celebrated maintaining Covid 19 pandemics on 14th September'2020 at this institute, as one of the main activities of Hindi cell under the chairmanship of Dr. Vijay Paul, Director, In-charge. It was felt that the Hindi is such a language which is acceptable in all spheres of communications. Therefore, the institute has been using Hindi as the medium of communication and writing in most of its official work. The Director expressed that use of Hindi as a medium would help to reach maximum stakeholders during different activities of the institute. He appealed to the staffs to promote Hindi in all kind of official works. During this Hindi diwas different competitions like quiz, slogan writing and noting etc. were organized.

ANIMAL FACILITY/FARM SECTION

The institute yak farm is situated at Nyukmadung at a distance of 31km from Dirang township on a diversion (Mohan camp) of Tezpur-Tawang highway. The altitude of the farm is 2750 m above msl. The total farm area is about 67 hectare with 1, 09, 020 m2 pasture of temperate grasses such as Dactylis glomerata, Lolium perenne and legumes (Trifolium repens) along with fodders trees like Salix and Bamboo for green fodder production.

The animals are reared under semi-confinement farming system, kept in both sheds and open

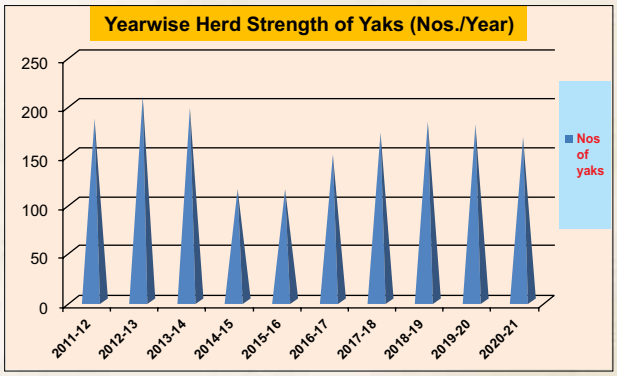

Fig-1: Yearwise Herd Strength of Yaks (Nos./Year)

paddocks. The total numbers of animal shed at the farm complex are 22 in numbers (bull shed – 01, kacha sheds - 02, open sheds - 03, parturition shed - 01, metabolic shed – 01,milking sheds – 02,calf sheds – 04, female sheds – 02,experimental shed – 01, quarantine& isolation sheds – 05). At present (as on 31st December 2020), the farm is having 198 yaks (63 males and 135 females). The highest strength was 198 yaks in the month of December, 2020. A total of 45 yak calves (22 males and 23 females) were born during the period of January

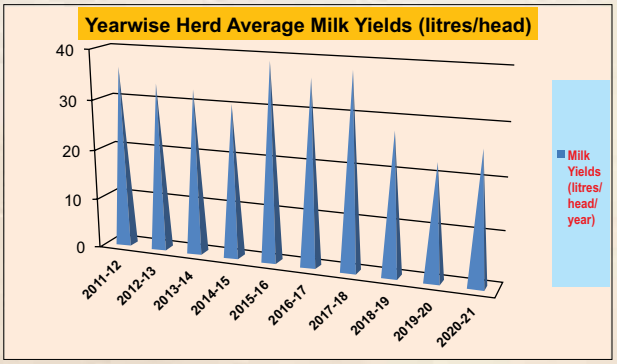

Fig-2: Yearwise Herd Average Milk Yields (litres/head)

to Decmber'2020. The highest and lowest birth weight of calf was recorded 23.20 kg and 12.55 kg, respectively with the average of 15.64 kg. The overall mortality during the period was recored 6 (2 males and 4 females) which contributes 3.03 percent of the farm animals. The total milk production of yak during the year was 6765.20 liters with the highest milk production recored in the month of January 2020 i.e. 689.80 litres.

To produce yak-cattle hybrids (Dzo and Dzomo) for adaptation at mid-altitudes, the institute farm also has 01 cattle and 03 yak cattle (Dzomo)

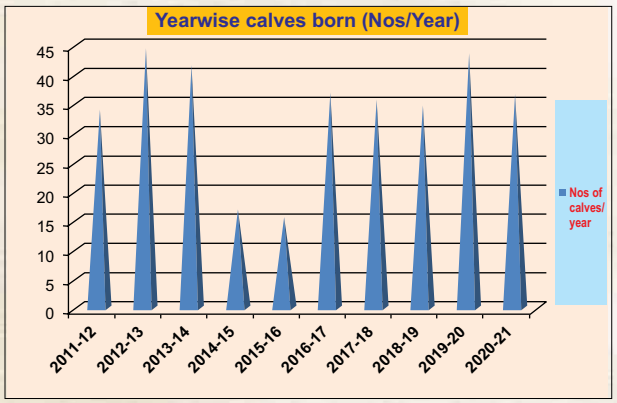

Fig-3: Yearwise calves born (Nos./Year)

hybrids as experimental animals. Total milk production from cows/hybrid during the year was 2700.30 litres with the highest milk production recored in the month of January 2020 i.e. 331.80 litres.

The performance of the yak farm in terms of herd strength, calf born and milk productition during last ten years is depicted with the figures 1, 2 and 3.

FODDER PRODUCTION UNIT

Fodders and tree leaves are regularly cultivated at

Dirang and Nyukmadung farm premises which are used to feed the farm animals. The surplus fodder during summer was used for silage preparation

to feed the yaks during winter. Varieties of green fodders including some frost resistant fodders like

Dactylis glomerata, Tall Fescue, Hybrid Napiers etc have been producing in both Dirang and Nyukmadung farm complex of the institute.

The total fodder production including trees leaves during 2020 was:

Fodders	Yield (Kg)
Maize (green fodder)	50,320
Dactylis glomerata (grass)	1, 55,352
Oat (green fodder)	6,300
Hybrid Napier	10,600
Salix tree fodder	13,000
Mixed tree leave fodder	63,226
Bamboo (fodder leaves)	6,259
Local grass	14,361

FEED TECHNOLOGY UNIT

Keeping in view the winter feed scarcity; the institute has one feed technology unit for process and conserved feed/fodders to feed yaks during winter and to meet the demands of Tribal Sub Plan (TSP) of the institute and others like KVKs and progressive farmers. The unit has two mobile feed block making machines in Dirang with one stationary feed block machine in Nyukmadung farm campus and two chaff cutters which are using at regular interval. During the year 2020 (up to 31st December'2020) a total of approximately 19,381kgs (11,075 numbers) of paddy straw based Complete Feed Blocks were prepared; Out of which 16, 400kgs (9, 371 Nos) Complete Feed Blocks were distributed amongst tribal livestock farmers of North Sikkim and West Kameng district of Arunachal Pradesh under TSP programme of the institute. The rest Complete Feed Blocks were fed to institute's farm animals during winter. The compositions of the Complete Feed Blocks were as follows-

Feed Ingredients	Parts per 100kg
Roughage	
Paddy Straw/Maize Stover	50
Concentrates	
Maize crushed	22
GNC/MOC	22
Molasses	03
Mineral mixtures	02
Common Salts	01

The feed technology unit also has one silo pit constructed at Nyukmadung farm for conservation of surplus fodder during summer in the form of silage. During this report period approximately 5 tons of green maize along with 5 quintals of salix leaves with twigs, 2 quintals hybrid napier and 40kgs of sugar cane tops mixing with green maize fodder were conserved as silage and utilized for feeding yaks during harsh winter.

ARUNACHAL OBSERVER

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COVID-19: Yak farmers get help from ICAR-NRCY & DEWS

August 4, 2020

Echo of Arunachal

First News Paper From The State

ICAR-NRCY holds supportive program for Brokpas

SELA, Jul 3: Due to COVID-19 pandemic, the traditional migratory route of Brokpas of Lubrang and Mandala villages facing difficulty in movement to high altitude Luguthang and Mago areas, which they are following since long for spending the summer grazing of yaks, leaving the brokpas stuck up at Sanya GG and rocky areas under Selapass.

In this regard, the ICAR-National Research Centre on Yak, Dirang in collaboration with Dirang Employees' Welfare Society and department of Animal Husbandry, Veterinary and Dairy Development Dirang conducted a supportive programme at RA-I he yesterday, maintaining all preventive measures of COVID-19 pandemic.

Almost 300 yak/yak cattle hybrids of six farmers from Lubrang areas took part in the programme. The far

sides, they were advised on hygienic aspects for clean milk production and value addition of their products.

As supportive measures, the beneficiaries were provided with Concentrate Yak Feed, Common Salts, chelated mineral mixtures and some basic veterinary medicines like anthemantics, antidiarrhoeas, tick-out etc for their animals under TSP of the institute.

Dor Phunchu, president, Dirang Employees' Welfare Society appreciated the effo Dr P Chakravar ICAR-NRC taki

The Arunachal Times

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State News

NRC on Yak conducts 3 days training for highland farmers

October 1, 2020

GROW MORE HEALTHY YAKS

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