



ANNUAL REPORT

2022



ICAR- National Research Centre on Yak
(ISO 9001:2015 Certified Institute)
Dirang - 790 101, Arunachal Pradesh, INDIA
www.nrcy.icar.gov.in

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 Conference on “Sustainable Yak Husbandry”.

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

Cryopreservation of yak semen standardized.

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: Challenges & 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: NORGYAL, 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: A MoA was signed the Director, ICAR-NRC on Yak and local tribal youth for the yak-jute blended fabric technique.

Ensiling of forages for mitigation of winter feed crisis in highland animals.

2018: Yaks of Arunachal Pradesh has been registered as a breed called “Arunachali” with accession number INDIA_YAK_2300_ARUNACHALI_16001.

Organized Workshop on “Yak Resource Towards Doubling Farmer’s Income”.

2019: Developed value-added ripened cheese from yak milk.

Varieties of maize production potentiality identified.

2020: Developed Cheddar Style Yak Milk Cheese with shelf-life of four months.

2021: ICAR-HQ approved setting-up of regional centre of NRCY at Ladakh.

Yak Insurance Policy approved.

2022: Bankable Scheme for profitable Yak farming formulated by the institute and approved NABARD.

Yak declared as a food animal by SP of FSSAI.



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PUBLISHED BY

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Citation : Annual Report 2022. ICAR- National Research Centre on Yak,
Dirang, Arunachal Pradesh. Pp. 1-66

Number of prints : 150 copies

Printed : July, 2023

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The achievement and activities presented in this Annual Report cover the period from January' 2022 to December' 2022 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.

Cover Page:

1. Front cover: Semi-intensive yak rearing system
2. Back cover: *Arunachali* female yak grazing on highland pasture

CONTENTS

	PREFACE	
	EXECUTIVE SUMMARY	1
1.	INTRODUCTION	5
2.	RESEARCH ACHIEVEMENTS	14
3.	TECHNOLOGY DISSEMINATION AND EXTENSION	23
4.	EVENTS AND HAPPENINGS	31
5.	AWARDS AND RECOGNITIONS	33
6.	LINKAGES AND COLLABORATION	34
7.	INSTITUTE FUNDED PROJECTS	36
8.	PUBLICATIONS	37
9.	TRAININGS AND CAPACITY BUILDING	41
10.	INSTITUTE COMMITTEES	43
11.	DISTINGUISHED VISITORS	48
12.	YAK HEADLINES	50
13.	ICAR-NRC ON YAK PERSONNEL	52
14.	INFRASTRUCTURAL FACILITIES	55
15.	EXPENDITURE STATEMENTS	64



PREFACE



ICAR-National Research Centre on Yak has been at the forefront in carrying out cutting-edge research in the fields of Yak production, reproduction and health while providing scientific knowledge and technological support to the yak rearers (*Brokpas*) at the same time. Despite being a quite young institute (established in 1989), the laurels achieved by the institute scientists are hugely significant in terms of advancement of yak science and their socio-economic impact on our major stakeholders *viz.* yak pastoralists.

The institute derives a major source of motivation and strength from its prime research animal i.e. Yak, which is one of the most resilient creatures on earth as it can survive in extreme cold (up to -40°C) and hypoxic conditions of high-altitude terrain. Besides, it sustains the highlander communities across the Trans-Himalayan region by providing them with milk, meat, wool, hide, dung and transportation services. Also, this unique bond of mutualism forged between yak and yak pastoralists serves the critical intangible roles like biodiversity conservation, environmental sustainability and preservation of cultural heritage.

As per the latest census (2019), Yak population of the country stands at 58,000, a majority (>95%) of which is distributed amongst three major yak rearing states *viz.* Arunachal Pradesh, Ladakh and Sikkim. The institute is already working proactively for yak research and development in the aforementioned states and prepares its strategy by taking cues from the existing ground reality in the yak belts of India. For instance, looking into the drastic fall in the yak population of Ladakh (~52% decline), recently, the institute mobilized support to get the approval for a new outreach activity centre at Leh in order to curb the decline and promote the animal in the region. Also, the dreadful incident of unprecedented snowfall and the severe feed scarcity resulting in the deaths of hundreds of yaks in Sikkim in 2019 served as a clarion call to push for yak insurance. Due to relentless pursuit of the institute, in 2021, National Insurance Company Limited accorded a formal approval for yak insurance so as to sustain the tribal pastoralists in the event of natural disasters and other mishaps. Further, as a shot in the arm for yak husbandry, the institute worked to get approval from NABARD to get the credit support for yak farming from leading banks. This has made yak farming bankable in Tawang, West Kameng and Shi-Yomi districts of Arunachal Pradesh and will be a boon to promote yak entrepreneurship and attracting younger generation to the occupation. In order to widely disseminate the awareness on Bankable Scheme on Yak Farming, a helpline number was also launched during the report period.

The institute owes its success to the extremely dedicated, perseverant and efficient staff including scientific, technical, administrative and supporting staff. This can be further substantiated by the fact that despite facing severe scientific staff crunch, the institute is running four (4) externally funded projects including two (2) AICRPs, one (1) DBT and one (1) Network/Collaborative project with IIMR, Ludhiana and ten (10) institute projects successfully. Apart from this, the institute has recently signed five (5) Memorandum of Understandings (MoUs) in the areas of value addition of yak wool, poultry farming to supplement the income of tribal yak farmers, collaboration in teaching and research and providing good healthcare facilities to the institute staff at cost-effective rates.

Important research highlights during the report period included checking the effectiveness of Doublesynch protocol and timed Artificial insemination in yaks, designing the blueprint for portable and detachable animal shelters for young ones and milking yaks during migration, identifying the most suitable maize fodder and grain variety to be grown at 5500 ft above mean sea level, sero-monitoring and sero-surveillance of yak samples for Foot and Mouth disease and vaccination for protection against the disease and omic insights on infertile or subfertile yak sperm and estimation of genetic parameters for Arunachali yak hair fibre diameter. Publication of seven (07) research papers in high impact factor journals is a further testimonial to the research acumen of the institute scientists. The hard work of the scientists and technical staff was also recognized with certificates of appreciation and other honors. My heart swells with pride in the scientific achievements of my team and I congratulate them on their every single endeavour.

Besides research, the institute has a strong and active dimension regarding technology dissemination and extension. Awareness, technology demonstration programmes, trainings, workshops, vaccination drives etc. were conducted extensively in Arunachal Pradesh and Sikkim to promote the cause of scientific yak husbandry and to provide the pastoral stakeholders with the much needed scientific and other inputs.

Finally, I take deep pride in being guided by the leaders of the stature of Dr. Himanshu Pathak, Secretary DARE and Director General, ICAR and Dr. Trilochan Mohapatra, Ex-Secretary DARE and Director General, ICAR whose constant supports and far-sightedness's have immensely helped the institute to grow. Special thanks are due to Dr. B.N. Tripathi, DDG Animal Sciences, ICAR for his valuable guidance and advice. Dr. Ashok Kumar, ADG (AH) and Dr. Amrish Kumar Tyagi, ADG (AN&P) deserve a special mention for their unequivocal helps, warm supports and immense co-operations towards accomplishment of various institutional errands. I would like to extend my heartiest thanks to Dr. (Mrs.) Jyoti Misri, Principal Scientist (AH), Dr. Rajan Gupta, Ex-Principal Scientist (AN&P), Dr. Vineet Bhasin, Ex-Principal Scientist (AP&B), and other officials of ICAR Headquarters for their guidance, unwavering help and support. Lastly, I would like to give a round of applause to all the scientists, technical officers and staff of the institute for toiling hard for the overall growth and betterment of this institute. The entire editorial board deserves an affirmation for meticulously preparing the ICAR-NRC on Yak Annual Report – 2022. I sincerely wish that it serves the purpose of sustaining the livelihood of yak rearers of the country and making yak husbandry profitable.

Let's work together for Sacred and Flexible Yak.

Thank you

Jai Hind



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EXECUTIVE SUMMARY

ICAR-National Research Centre on Yak under the aegis of Indian Council of Agricultural Research is the sole authority on yak (*Peophagus grunniens*) research and development in the country. Since its inception in 1989, this research institute has been constantly endeavoring to conserve and propagate superior yak germplasm and improve yak husbandry through scientific interventions. Besides, the institute is committed to addressing high-altitude sectoral issues, national goals and international commitments of the country by strengthening food security, poverty alleviation, entrepreneurship and skill development and sustainable production in the fragile highland ecosystem.

ORGANIZATIONAL STRUCTURE

ICAR-National Research Centre on Yak (NRCY) is functioning under Indian Council of Agricultural Research (ICAR) through its Animal Science Division and is run by Director (RMP Cadre) of the institute. The Director exercises complete authority for research strategy formulation and administration with the help of Institute Management Committee (IMC), Research Advisory Committee (RAC) and other functional committees constituted by ICAR. These committees provide advice to the Director for smooth and efficient functioning of the institute. The Director is supported by a team of scientists, technical, administrative and supporting staff, all of which assist in research as well as development activities.

The institute research is directed at various aspects of yak husbandry and is chiefly executed through scientific sections *viz.* Animal Genetics and Breeding, Animal Nutrition, Animal Physiology and Reproduction, Animal Health, Livestock Production and Management, Livestock Product Technology and Veterinary Extension Education. Despite being situated in a remote location, the institute has excellent research infrastructure consisting of Experimental Yak farm, Central laboratory, Central Instrumentation Facility, *In-vitro* Fertilization laboratory, Semen processing laboratory and dedicated laboratories for yak genetics, nutrition, physiology, parasitology, biotechnology and medicine etc. Important support sections of the institute include Estate and Maintenance section, AKMU cell, Library, Account & Finance section, Establishment section and store etc. Administrative functions are taken care of by the Administrative Officer (AO) whereas the financial work is executed under the supervision of Finance and Account Officer (FAO). As on 31st December, 2022, the institute is run by a Director (1 RMP) assisted by a strength of six (6) scientific, seven (7) technical, seven (7) administrative and seventeen (17) skilled supporting staff.

FINANCIAL STATEMENT

The total financial outlay of the institute during the year 2022 was Rs. 11,13,83,764.00, out of which Rs. 1,82,48,040.00 was disbursed under capital head, Rs. 4,36,59,221.00 under salary head and Rs. 4,94,76,503.00 under General head. The total revenue generated from the proceeds of sale and other items was Rs. 45,15,052.00

RESEARCH ACHIEVEMENTS

A total of ten (10) institutional, three (03) ICAR externally funded & one (01) DBT funded research projects were carried out at the institute during the year 2022.

WHOLE-GENOME AND TRANSCRIPTOME STUDY OF INFERTILE YAK SPERM

Bull infertility or subfertility severely threatens herd economics and is a serious impediment to the cause of yak conservation in the country. In order to understand the 'omic' basis of infertility or subfertility in *Arunachali* yak, whole-genome and transcriptome sequencing of sperm samples from three infertile or subfertile bulls was performed. Our findings revealed that immune response pathways may be playing an important role in regulating bull infertility or subfertility. Further validation of the findings can open new prospects of treating infertility or subfertility in yak bulls.

ESTIMATION OF GENETIC PARAMETERS OF YAK HAIR FIBRE DIAMETER

Yak hair fibre is an organic, luxury fibre with huge scope for marketing and commercialization. In order to explore the genetic parameters of yak hair fibre diameter in *Arunachali* yak population, posterior heritability was estimated using Bayesian approach. Hairs from all the body parts had medium to high heritability values with hairs from flank (0.126 ± 0.072) and loin (0.351 ± 0.179) regions reporting the lowest to highest estimates. Also, the posterior mean heritability of soft wool diameter was 0.170 ± 0.099 . These findings indicate a scope of genetic improvement of hair fibre diameter of coarse and soft wool in *Arunachali* yak population for better economic returns.

MORPHOMETRIC DIFFERENTIATION BETWEEN ARUNACHALI AND SIKKIMESE YAK

Based on the morphometric data analysis of Arunachali and Sikkimese yak populations, it was deduced that *Sikkimese* yak has smaller average body length and heart girth than *Arunachali* yaks whereas height at withers was higher in the former than the latter.

TIMED ARTIFICIAL INSEMINATION IN YAK

Timed Artificial Insemination (TAI) was implemented in yak, yak-cattle hybrids and cattle subjected to Doublesynch estrus synchronization hormonal regimen initiated with PGF2 α administered on day 0 followed by GnRH on day 2 and a second PGF2 α dose on day 9. Finally, second dose of GnRH on day 11 was followed by Timed AI with yak semen at 16 and 24 h post GnRH treatment. The conception rates of 41.7% in multiparous yak and 50% in cattle highlighted the potential of this reproduction management strategy in genetic improvement of yak as well as yak-cattle hybrid production for better productivity and adaptability at low altitude alpine region under farm and field conditions.

A MAKE-SHIFT DUAL PURPOSE SHELTER FOR HIGHLANDS

A light weight and detachable, prefabricated animal cum herder shelter of 10 x 12/14 ft was fabricated with plastic and Galvanized iron material for sheltering the young and milking yaks from predators and heat stress under transhumance rearing. The shelter could also be used for temporary halting of the herders during the migration.

MAIZE PRODUCTION IN NEH REGION FOR SUSTAINABLE LIVESTOCK PRODUCTION

Maize is one of the most widely cultivated crops in North-eastern India and has immense potential to be used as fodder. However, challenges like diseases and infestations, lower yield, lack of awareness and absence of scientific interventions etc. severely hinder the potential of maize fodder,

resulting in financial losses for the farmers. In order to address this issue, a project on maize production was initiated to provide scientific know-how on methods of sowing, good maize varieties, soil treatment etc. To explore the best genotype for cultivation at an altitude of 5500 ft above MSL, different maize varieties were cultivated. African Tall variety of maize fodder and Dirang local variety of maize grain were identified as the best performers in these environmental conditions. African tall is used for making silage and found beneficial in comparison to green maize fodder in terms of their nutritive value and productivity for both in growing and lactating yaks.

POULTRY FARMING AN ALTERNATE SOURCE OF INCOME FOR TRIBAL YAK FARMERS

In order to supplement the income of yak farmers, poultry farming is suggested as a viable income source for remuneration and socio-economic upliftment of the herders. Hence, a study was conducted to evaluate the performance of broilers fed on probiotic supplemented maize-based diets in high altitude environmental conditions. The results indicated that dietary supplementation of probiotic had no significant differences in body weight, body weight gain, feed intake, feed conversion ratio and mortality. However, higher net profit was reported with probiotic supplementation at the rate of 1.00g/kg feed in broiler diets.

SURVEILLANCE OF FOOT AND MOUTH DISEASE IN HIGHLAND LIVESTOCK

A total of 676 animals were vaccinated against Foot and Mouth Disease during the report period. 231 serum samples belonging to yak, yak-cattle hybrids and cattle in different pastures were screened for serosurveillance and 14.28% of the samples were found to be positive for DIVA test.

A STUDY ON THE FACTORS INFLUENCING THE PASTORAL YAK REARING SYSTEM IN NORTH-EAST INDIA

Notable data gathered on the factors influencing the pastoral yak rearing system through focused group discussions with the yak herders of major yak rearing villages of West Kameng and Tawang districts of Arunachal Pradesh will act as a roadmap for framing the strategies and required interventions for gradual transitioning of traditional yak rearing into semi-intensive farming.

TECHNOLOGY DISSEMINATION

The institute conducted awareness, technology demonstrations, trainings and capacity building programmes in the two major yak rearing states *viz.* Sikkim and Arunachal Pradesh. The major focus of these programmes was centred around various themes including scientific yak husbandry, yak health and reproduction and value addition of yak products. Major highlights include a training programme on “Fodder conservation techniques to mitigate winter feed crisis in highland animals” in Sikkim, an awareness cum technology demonstration programme on “Artificial Insemination techniques for Highland Animals” in North and East Sikkim and implementation of “Estrus Synchronization and TAI programme for upgrading tribal farmers Yaks” in Sikkim and Arunachal Pradesh, training programmes on “Yak Fibre Based Fabric Making” and “Scientific feeding and management of highland animals” in Arunachal Pradesh and “Animal health cum vaccination camps” in Arunachal Pradesh. Various programmes were conducted under the collaborative NEH activities with other ICAR institutes on “Empowering tribal farmers through backyard poultry farming in the NEH region of India”, “Scientific maize cultivation for improved livestock productivity” and “Awareness about Livestock Care and

Management cum distribution of inputs”. An awareness camp on “Empowering tribal farmers for alternate income generation through backyard poultry farming in Arunachal Pradesh” was organized in one of the aspirational villages under Papumpare district of Arunachal Pradesh.

Besides, a number of trainings cum awareness drives and workshops were conducted under Scheduled Tribe Component (STC). The beneficiaries included tribal yak farmers who were supported with inputs like concentrate feed, complete feed block, chelated mineral mixture, basic veterinary medicines like anthelmintics, anti-diarrhoeals and wound healers, tents, tarpaulin, gumboots, solar light etc. Progressive farmers and communities were also provided with chaff cutters and cream separators.

A special “Advanced Yak Management Course for ITBP Veterinary Cadre Officers” was conducted to train the paramilitary officials on yak handling and management. Another mega event, “Training-cum-Awareness programme on Bankable Scheme for Profitable Yak Farming” was organized by the Institute in collaboration with NABARD, Itanagar. Er. Tage Taki Ji, Hon’ble Minister of Agriculture, Horticulture, Animal Husbandry, Veterinary, Dairy Development & Fisheries, Govt. of AP graced the occasion as Chief Guest and Shri Phurpa Tsering, Hon’ble MLA, Dirang cum Advisor, PWD, Western Zone, Govt. of AP and Shri B.P. Mishra, Deputy General Manager, NABARD, Itanagar were the Guest (s) of Honour. The programme was attended by the Chief Manager, SBI (Credit & NPA), Ex. Minister cum Chairman, Resource Mobilization & PI, Govt. of AP, Ex-MD, State Co-operative Bank Ltd Director, Dept. of AHV & DD, Govt. of AP, officials of the District Administration, HoDs of allied departments, bankers, ZPC of Tawang, ZPMs, progressive farmers, yak Brokpas and other farmers aside from the Scientists, officers and staff of ICAR-NRC on Yak. The main highlights of the event included the technical presentation about the Banking Scheme for Profitable Yak farming, followed by announcement of the helpline for the banking scheme and release of booklet on “Bankable Model for Yak farming”.

Extension unit of the Institute participated in various activities like nationwide observance of campaign on *Kisan Bhagidaari-Prathamikta Hamari* under *Azadi Ka Amrit Mahotsav*, *Expo-cum Kisan Mela* and live telecast on *PM Kisan Samman Sammelan*. Other activities, such as observance of vigilance awareness week, celebration of International Yoga Day, Institute foundation day and *Swachhta Pakhwara* were carried out at Institute.

One scientist participated as an Indian representative in the PC committee of World Congress on Genetics Applied to Livestock Production (WCGALP) held at Rotterdam, Netherlands.

PUBLICATIONS

During the report period, seven (07) research papers were published in highly reputed, peer reviewed national as well as international journals. Besides, the institute contributed three (03) technical bulletins/training manuals, three (03) book chapters, five (05) technical papers, seven (07) conference abstracts and six (06) leaflets or folders. Five (05) MoUs were also signed by the Institute for undertaking collaborative research, extension and seeking health aids.

A mobile helpline on “Bankable Scheme for Profitable Yak Farming” was also launched during the report period.

INTRODUCTION

ICAR-National Research Centre on Yak is situated at the heart of a peaceful and blissful town of Dirang (also known as Arunachal's best kept secret) in West Kameng district of Arunachal Pradesh, India's easternmost state. The institute was established in 1989 under the aegis of Indian Council of Agricultural Research with a vision to work towards research and development of yak (*Peophagus grunniens L.*) in India. Initially, the campus was located in Regional Temperate Fodder Station of Animal Husbandry and Veterinary Department, Government of Arunachal Pradesh. Subsequently, in 1995, it was shifted to its present location in Dirang over an area spanning 11.32 acres and at an elevation of 1500 metres above mean sea level (MSL). Also, in 1995, the experimental yak farm of the institute was established and started functioning at Nyukmadung, 31 kms from Dirang township on a diversion (Mohan camp) in Tezpur-Tawang highway and at an altitude of 2750 metres above MSL. Further attempts at improving infrastructural facilities at the institute continued and the present laboratory-cum-office building was inaugurated on 19th April, 2009. ICAR-NRC on Yak is also ISO 9000:2015 certified to work for “*Conservation and Improvement of Yaks*”.



Google Earth image of ICAR-National Research Centre on Yak, Dirang



Laboratory cum Office building of ICAR-NRC on Yak, Dirang



Experimental Yak farm of ICAR-NRC on Yak at Nyukmadung

ICAR-NRC on Yak is a unique and premier research institute constantly endeavoring to conserve and improve yak, which is one of the most resilient creatures on earth and in this process, making yak husbandry highly profitable and sustainable. The institute aims to carry out socio-economic upliftment and improve the standards of living of yak rearers of the country.

MANDATE

The mandate of the Institute focuses on:

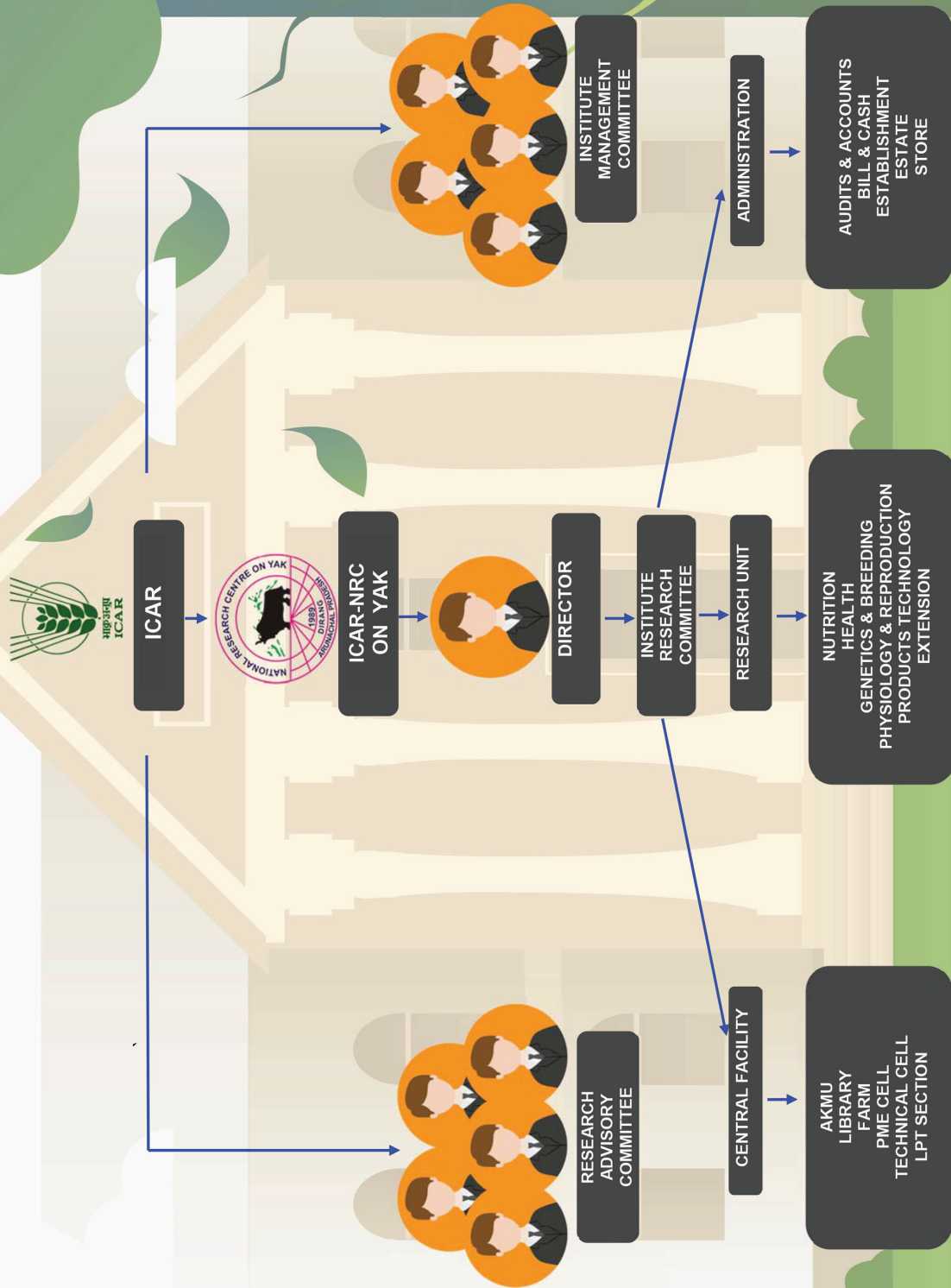
- ❖ Identification, conservation, characterization and evaluation of yak germplasm
- ❖ Improvement of yak for draught and milk

OBJECTIVES

In order to realize the mandate of the institute, different objectives have been outlined as under:

- ❖ 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

ORGANOGRAM



PAST ACHIEVEMENTS

The institute has received critical acclaim and accolades for path-breaking research in various aspects of yak health and production. Yak science has been greatly enriched with the novel studies on energy budgeting of yak, non-invasive approach for detection of bull infertility and subfertility, standardization of *in vitro* fertilization (IVF) and embryo transfer technology (ETT) in yaks, molecular characterization of yak pathogens, toxicological fingerprinting of yak tracts of India, highland pasture development and value addition of yak products. In the past year, efforts were made to develop a bankable yak farming scheme for profitable semi-intensive yak rearing supported with the yak insurance for attracting locals to adopt yak farming as their means of subsistence.

The salient achievements of the institute in different areas since its inception are highlighted as under:

YAK NUTRITION

- ❖ Fifty-one varieties of various fodder species received from Food and Agriculture Organization (FAO) were tested in different altitudes and habitats and it was deduced that *Dactylis*, *Vicia* and *Agrostis* spp. may be suitable for growing in yak habitats and migratory tracts.
- ❖ In the quest for suitable pastures and forage crops to be introduced in the yak tracts to meet the nutritional requirements during cold and inclement weather, exotic grasses like *Phleum pratense*, *Dactylis glomerata*, *Lolium perenne*, *Trifolium pratense* and *Trifolium repense* and three varieties of *Salix* spp. from Jammu and Kashmir were introduced for establishment of pastures and feeding of yak and high-altitude animals.
- ❖ Taking into consideration the fact that soils of high altitude are deficient in various minerals due to leaching, an area-specific mineral mixture was developed to ensure optimum production, fertility and health of yak. An area-specific mineral mixture with the composition Zinc, Copper, Cobalt and Manganese in the ratio of 40:20:2:1 has been developed which considerably improves the milk production in animals.
- ❖ To identify locally available unconventional and highly nutritious forage resources, nutritional profiling of different tree fodders fed to yak was done and it was deduced that protein content was highest for Phrengpa (*Quercus walliasehiana*) whereas the lowest and highest cellulose content was observed in Zimbu (*Lingustrum myrsinites*) and Baggar (*Berberis* spp.) leaves, respectively.
- ❖ Low-cost Complete Feed Blocks (CFBs) were prepared using locally available crop residues and tree leaves (*Salix* tree leaves) with the objective to meet energy needs of yak during lean winter season in a cost-effective manner. Feeding of CFBs ensured that weight gain in growing calves and milk production in lactating yaks was maintained even during harsh winter months.
- ❖ As a part of contingency measures for feeding during winter season, ensiling technique has been introduced to convert surplus green foliage into silage for feeding to yaks. Maize silage along with concentrate supplementation was recorded as the best feeding regimen to maintain body weight and milk production in growing and lactation yaks during winters.
- ❖ Experimental trial proved that yak calves can be successfully weaned at 2-3 months of age for profitable farming. Also, calf starter with 24% CP and 68-70% TDN resulted in highest average daily gain and feed efficiency in young calves and milk yields in their dams.

- ❖ Maize silage is beneficial in comparison to green maize fodder in terms of their nutritive value and productivity for both growing and lactating yaks
- ❖ Complete substitution of normal maize with QPM in the concentrate mixture of growing yaks has beneficial effects in growth, feed efficiency, nutrient digestibility and plane of nutrition
- ❖ Incorporation of QPM in the concentrate mixture have no significant effect on the performances of lactating yaks in terms of their milk yields, nutrient digestibility and plane of nutrition. However, it can improve the average daily gain and feed efficiencies both in growing and lactating yaks.

YAK GENETICS AND BREEDING

- ❖ Five phenotypically differentiated yet genetically similar types of yaks were documented viz. Common, Bisonian, Bare Back, Hairy Forehead and White yaks. Also, different horn types encountered in the yaks of Arunachal Pradesh were documented for the first time.
- ❖ Cytogenetic studies on yak have been completed and the basic karyogram of yak was found to consist of 60 chromosomes and all the 29 pairs of autosomes were found to be acrocentric similar to cattle.
- ❖ Polymorphism studies with respect to FASN, TLR, Leptin, GH, GHR and IGF-I genes have been conducted in case of yaks. Single Stranded Conformation Polymorphism (SSCP) studies in yak TLR2 gene revealed polymorphism in the otherwise conserved region.
- ❖ Lot of work has been conducted in the area of male specific genes (MSY) and the first global report of these genes as valid biomarkers for distinguishing male and female genotypes in yaks and yak-cattle hybrids has been published. Ten MSY genes which are predominantly expressed in testis have been deduced based on RT-PCR results. This finding also found a special mention in the two years achievements of the Ministry of Agriculture and Farmers Welfare, Govt. of India.
- ❖ In order to determine the paternal origins of yak hybrids, a molecular technique has been standardized to identify male-mediated introgression based on mutation in SRY gene.
- ❖ Micro-RNA specific primers have been designed to delineate the mechanism of sub-fertility in male yaks. Expression levels of mir19a, 19b, 23a, 23b, 1248 and 1468 were found to be high in yak sperm.
- ❖ Phenotypic data analysis revealed that body weight at six months of age was the best criteria for selecting yaks for higher growth rate and body weight at an early age.
- ❖ Due to the relentless efforts of the scientists of the institute, all the yaks of Arunachal Pradesh were found to be genetically diverse population and have been successfully characterized and registered as '*Arunachali*' breed (Accession No: INDIA_YAK_2300_ARUNACHALI_16001), the first and the lone breed of yak (till date) in India.
- ❖ The genomic variability in *Arunachali* yak population was estimated using ddRAD sequencing data, the nucleotide diversity was estimated to be 0.041 in 200 bp windows whereas the effective population size was 83. Runs of Homozygosity (ROH) analysis revealed that majority of ROHs were of short and medium length further hinting at historical inbreeding incidences. The findings elucidated that the genomic diversity in *Arunachali* yak breed as of now, is optimum. However, future conservation efforts could be strengthened with the implementation of a planned breeding programme.

- ❖ Selection signatures identified in *Arunachali* yak genome revealed that it has been selected for platelet aggregation and olfactory perception, both of which are adaptive mechanisms to explain the evolutionary processes in *Arunachali* yak genome.

YAK PHYSIOLOGY AND REPRODUCTION

- ❖ To implement artificial insemination in yak, an estrus synchronization & fixed time artificial insemination strategy based on doubleSynch regimen; initiated with PGF2 α administration on day 0 (any day of estrous cycle) followed by GnRH on day 2 and a second PGF2 α dose on day 9 and finally, second dose of GnRH on day 11, and Timed AI with yak semen at 16 and 24 h post GnRH treatment was developed and validated. The conception rate of 43.7% in multiparous yaks emphasized the potential of the protocol in genetic improvement under farm and field conditions.
- ❖ To protect the young yak calves as well as milking animals from predation and heat stress under transhumance rearing, a 10 X 12/14 ft make-shift portable animal shelter was fabricated with plastic and Galvanized iron material.
- ❖ For detection of progesterone in blood plasma of yaks, a competitive ELISA assay has been standardized which can detect 0.4ng/ml during beginning of estrus and can measure upto 12.5 ng/ml blood progesterone towards luteal phase and during pregnancy.
- ❖ A sensitive enzyme immunoassay has also been developed and validated for estimating protein and steroid hormones for efficient reproductive management in yaks. Also, research data showed that antepartum administration of Vitamin E and selenium in yaks reduced calving abnormalities and placental retention and treated calves exhibited increased neonatal birth weight as compared to the control group.
- ❖ In the wake of climate change, studies were conducted to determine heat stress in yaks wherein heat shock protein HSP70 was found to have significantly higher concentrations in summer season (May to October) as compared to winter season (November to April) in yak calves, adults and lactating cows. This was indicative of the fact that seasonal interventions need to be made to ensure sustainability in yak farming and production. Accordingly, a modified Thermal Humidity Index (THI) was developed and it was concluded that THI values of 52 or less came under climatic comfort zone of yaks whereas THI more than 52 was suggestive of underlying thermal stress in yaks.
- ❖ A lot of exemplary work has been done with respect to reproduction in yaks including the standardization of frozen semen production and artificial insemination (AI) for ex-situ conservation of yaks. Heatsynch and Ovsynch regimens were developed for estrous synchronization and fixed-time AI in yaks.
- ❖ Studies on Follicular dynamics revealed that superovulatory treatments of pFSH stimulates the growth of small follicles of 3.00mm -5.00 mm diameter along with a corresponding increase in ovarian size by 1.4-2.9 folds.
- ❖ Two male calves were born to estrous synchronized yaks using progesterone impregnated vaginal sponge followed by AI.
- ❖ For faster dissemination of superior germplasm in yak, the technique of Ultrasound guided Ovum pick up (OPU) was standardized with the recovery percentage of good oocytes viz. A. and B as 59.09

and 22.73 percent, respectively. Maturation percentage of oocytes was 71.43% whereas the success of the subsequent *in vitro* fertilization (IVF) was 42%. The recovered embryos were cryopreserved and transferred to suitable recipients. Persistent efforts in this direction resulted in the much-acclaimed feat of the birth of first female yak calf through ETT called MISMO on 2nd June, 2005. This achievement further emboldened the vision and endeavors for ex-situ conservation of yaks.

- ❖ A further success in the area of *ex-situ* conservation of yaks came with the birth of first yak calf born through IVF named as NORGYAL (*Ratnaraj*) on 15th June, 2013.
- ❖ Climatological studies conducted to determine the shelter material to minimise summer heat stress highlighted that under semi-intensive system of rearing (2750m above MSL), yaks experienced heat stress when housed inside a shelter with corrugated galvanized iron roof during summers.
- ❖ Tris-extender containing vitamin E alone or in combination with vitamin C was found to be the best combination for higher viability and motility in cryopreserved yak semen. Also, autumn season was observed to be the best for semen collection in order to ensure optimum fertility.
- ❖ Treatment regimen including combination of FSH and LH (Stimufol®), and PMSG (Folligon®) was found to be ideal for superovulation and recovery of yak embryos.

YAK HEALTH

- ❖ With respect to disease identification and diagnosis in yak, molecular detection of Babesiosis (*Babesia bigemina*) was standardized for accurate treatment and prognosis. Seroprevalence of Bovine Herpes Virus-I was also detected in the population (12.3%).
- ❖ DNA sequencing of proviral partial gene for capsid protein enabled the first global report of cutaneous papillomatosis in yaks. Also, molecular signatures of *Toxocara canis*, *T. cati* and *T. vitulorum* (from cattle, yak and mithun) collected from different geographical locations *viz.* West Bengal, Arunachal Pradesh and Nagaland were determined and host assemblage was done for the first time in the country. Molecular characterization of ATP6 gene helped in phylogenetic differentiation of Indian isolates of *Toxocara* in two different clades.
- ❖ Alkaloids of *Senecio crysanthomoides* were found to be having a fatal toxic effect on yak. The pathways of potentially fatal *Senecio* poisoning were explored in yak by conducting studies on its pro-inflammatory, oxidative and pro-apoptotic signaling in murine macrophage cell line.
- ❖ A major problem encountered in the rainy season in yaks is the leech infestation. Studies in the yak rearing tracts showed that the methanolic extracts of *Zanthoxylum spp.*, *Artemesia spp.*, *Solanum* and aqueous extracts of tobacco were found to be effective repellants against all leeches.
- ❖ Studies on stress factors among yak population have deduced that higher than permissible arsenic concentration in the soil and water (permissible limit of 10 ppb as per WHO standard) in various locations in West Kameng district as the major abiotic stressor and Brucellosis, Infectious Bovine Rhinotracheitis (IBR) and Foot and Mouth Disease (FMD) as the major biotic stressors in yaks. Brucellosis and IBR were also implicated in causing abortion in yaks.

- ❖ Correlation of diseases in yaks with the seasonal prevalence, type of disease and rearing system highlighted that the winter season resulted in maximum mortality in yaks and respiratory disorders were the predominant causes of calf mortality followed by digestive disorders.
- ❖ Biochemical mining was done for the first time to elucidate the effect of colostral immunity in experimental conditions.
- ❖ The institute also contributed to the national project by providing database on yak health documented in India Admas Epitrak software. This has become a guiding document for formulating national policy to control diseases in yaks.
- ❖ In order to detect anthelmintic resistance in gastrointestinal nematodes of yak and high-altitude ruminants, *in-vivo* and *in-vitro* (for Benzimidazole) tests were conducted in farm as well as field conditions. No resistance was detected against Albendazole, Fenbendazole, Benzimidazole etc. in yak, yak-cattle hybrids and cattle in both farm as well as field. However, sheep reared under farm conditions showed resistance against the abovementioned anthelmintics.
- ❖ In continuation with the efforts to wipe out Foot and Mouth disease (FMD) in bovines, the institute has been proactively conducting sero-surveillance and sero-prevalence studies and prophylactic FMD vaccination from time to time in different yak rearing tracts.

YAK PRODUCTION AND MANAGEMENT

- ❖ Studies have revealed that there is a reduction in the body weight with the rise in environmental temperature above 15°C in yaks thus, reflecting the problem of heat stress in yaks.
- ❖ Immense potential exists for exploiting the capabilities of yak as a pack animal at higher altitudes as it can carry a load of up to 35% of its body weight and can walk with a speed of 4-6 km/hr with no change in its body temperature between groups of animals carrying varying percentages of load.

YAK PRODUCTS TECHNOLOGY

- ❖ The polymorphic chemical composition of yak hair was confirmed for the first time.
- ❖ Structure of yak hair observed microscopically was described as an interrupted medulla with long flattened cells and air gaps in between. This knowledge was further used to prepare products from yak wool like carpets, mats and caps etc.
- ❖ Consistent efforts have been directed towards blending of yak hairs with sheep wool and jute for value addition. In this context, the institute collaborated with ICAR-NINFET, Kolkata for creating the appropriate blend of Yak-Jute fibre for making fabric.
- ❖ Innovative milk products created from yak milk include dietary fibre enhanced low fat paneer, Kiwi flavoured whey drink, vegetable extended paneer, Vitamin C enriched whey beverage and enrobed paneer finger. Value added yak wool products include chamar, carpet, doormat, blended cap, jacket, purse etc.

- ❖ A value-added product Sausage was prepared from yak meat with the composition of 60% yak meat, 20% pork and 20% pork fat. The sensory evaluation of the product revealed that the overall acceptability of the product was 8 out of 9 on the hedonic scale in terms of flavor, juiciness, texture and tenderness and had good market potential.
- ❖ Recently, Cheddar style yak milk cheese with semi-hard consistency and characteristic sharp flavor has been developed by the institute. The product has unique taste, flavor, texture and is easy to store and transport with shelf life of around four months. In fact, the sensory attributes of the product improved with the duration of storage.
- ❖ Comparative evaluation of milk from *Arunachali* yak, yak-cattle hybrid and cattle for nutrient composition and physico-chemical properties showed that fat, SNF and protein content was significantly higher in yak milk followed by yak-cattle hybrid milk and cattle milk. Ghee prepared from yak-cattle hybrid milk had higher content of mono-unsaturated and polyunsaturated fatty acids whereas yak ghee was richer in saturated fatty acids.

YAK EXTENSION EDUCATION

- ❖ A psychometric scale was developed and standardized to measure the socio-economic status of the highlanders. Benefit-cost analysis revealed that yak husbandry was a profitable venture with a B:C ratio of 4.34:1.
- ❖ In the steps towards participatory technology development, methodology for farmers led participatory assessment of ethno-veterinary practices was standardized and it was found that ethno-veterinary practices against ephemeral fever in yaks using the root of *Thalictrum foliosum* was most effective.
- ❖ Lab to land transfer of technologies was promoted through demonstration of different technologies developed at the institute *viz.* preparation of complete feed blocks, area-specific concentrate mixture, silage preparation, urea molasses enrichment of poor-quality roughages and trainings for development of different value-added products from yak milk and wool among yak rearing communities of India.

RESEARCH ACHIEVEMENTS

THEME: 'OMIC' STUDIES IN YAKS

Whole-genome and transcriptome study of infertile yak sperm

Bull fertility is a critical parameter determining the herd economics and long-term sustainability of gradually declining yak population in the country. Understanding the genomic and transcriptomic landscape of infertile or subfertile bulls can shed some interesting insights on the genetic basis of infertility or subfertility in *Arunachali* yak.

Fresh ejaculates were collected from three infertile or subfertile yak bulls by artificial vagina method and whole genome and transcriptome sequencing was performed. Whole genome sequencing highlighted that GO terms related to 1089 biological processes were statistically overrepresented in sperm DNA. The infertile yak sperm genome comprised of all the biological processes necessary for growth, development, survival, immunity and multiplication of an organism *viz.* biological regulation, localization, metabolic process, reproductive process, response to stimulus, immune system processes and signaling etc (Figure 1). This is quite obvious given the fact that, sperm, being a gamete, possesses one complete set of genes that combines with the other set from the ovum to produce a diploid individual with normal bodily functions and development.

Further, downstream transcriptome sequencing of infertile sperm cDNA pointed towards an important role being played by immune response in regulating infertility or subfertility in bulls. Immune response pathways related to eosinophil mediated immunity, neutrophil activation and neutrophil mediated immunity were significantly overrepresented. Based on our findings, we can postulate the role of genotype-environment (GXE) interactions in determining infertility or subfertility in male bulls. Further, differential expression and epigenetic studies can consolidate our findings and can improve our biological understanding in this aspect.

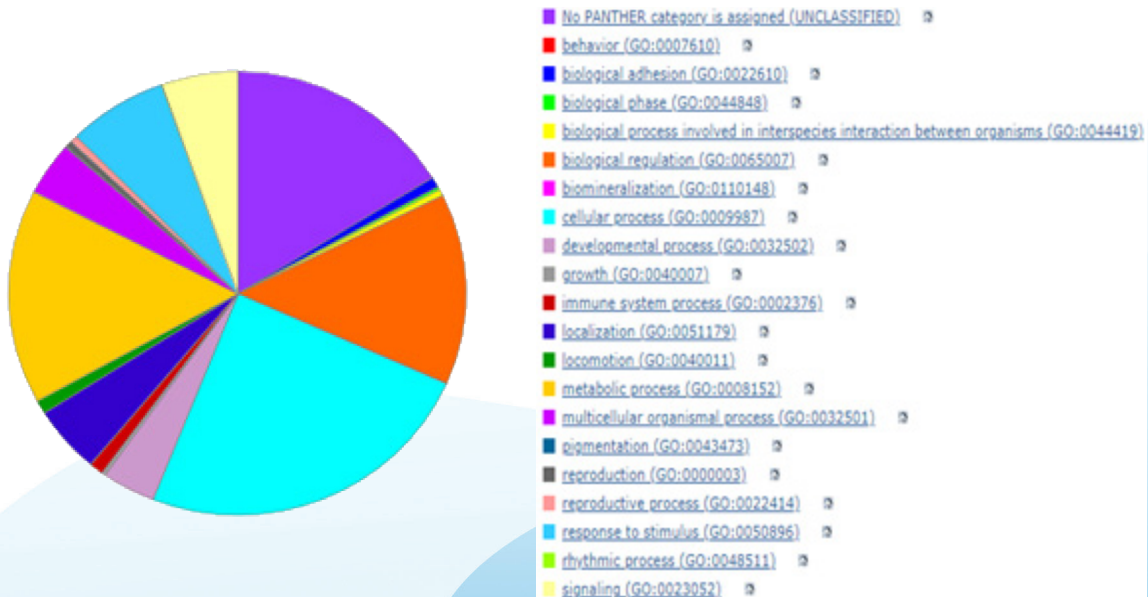


Figure 1: Gene Ontology (GO) terms related to various biological processes in infertile or subfertile bull DNA

Estimation of genetic parameters of yak hair fibre diameter

Yak fibre is listed among, one of the luxury fibres; with the outer coarse and inner soft fibres having a huge potential for socio-economic upliftment of the communities rearing this unique animal. *Arunachali* is the only registered yak breed of India till date and is found in Tawang and West Kameng districts of Arunachal Pradesh. However, till date, there is no available literature related to the genetic parameter estimates of hair fibre diameter and softness in *Arunachali* yak population.

The present study was conceived to address this shortcoming and record fibre diameter of yak hairs collected from different body parts *viz.* shoulder, knee, loin, flank, mane, tail and soft wool. The recorded data was analyzed to obtain posterior heritability estimates using Bayesian approach.

The average fibre diameter was highest for the hairs from tail region i.e. $101.90 \pm 0.001 \mu\text{m}$ whereas the fibre diameter of soft wool or down fibre was $20.20 \pm 0.000 \mu\text{m}$. Least-squares analysis revealed that period of birth, sex and phases of hair growth were significantly regulating hair fibre diameter measurements. Younger animals, females and measurements taken during anagen period of hair growth witnessed lower diameter estimates.

Using Bayesian approach, it was found that all the traits reported medium heritability estimates except for loin hairs for which trait heritability was on the higher side. The lowest and highest heritability values were reported for flank (0.126 ± 0.072) and loin (0.351 ± 0.179) regions, respectively. The posterior mean heritability of soft wool diameter was 0.170 ± 0.099 with highest probability density interval ranging from 0.027-0.369.

Morphometric differentiation between Arunachali and Sikkimese Yak

In an attempt to characterize *Sikkimese* yak breed, a study was conducted in collaboration with ICAR-National Bureau of Animal Genetic Resources, Karnal to determine the morphometric differences, if any, between *Arunachali* and *Sikkimese* yak populations found in Arunachal Pradesh and Sikkim, respectively.

Body length, height at withers and heart girth was recorded with the help of a measuring tape in *Sikkimese* yak populations. The recorded measurements were compared with the corresponding measurements for the same traits in *Arunachali* yaks. It was found that *Sikkimese* yak has smaller average body length and heart girth than *Arunachali* yaks whereas height at withers was higher in the former than the latter (Figure 2).

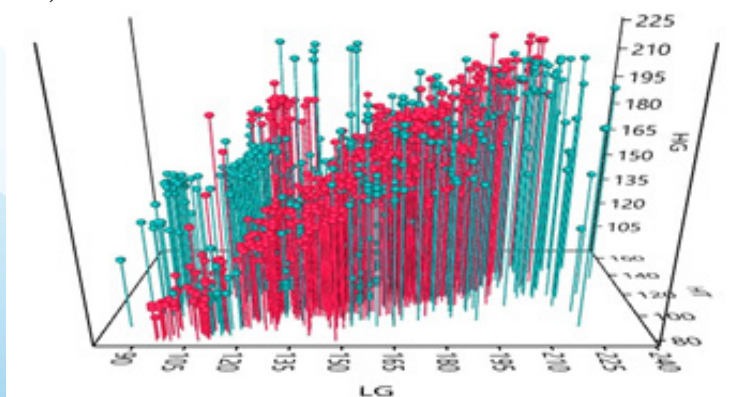


Figure 2: A 3D Bubble and Stick plot showing the differences between *Arunachali* (crimson colour) and *Sikkimese* (teal blue colour) yak (LG: Body length, HT: Height at withers and HG: Heart Girth)

THEME : YAK REPRODUCTION

Optimizing Reproductive Efficiency in Yak through Timed Artificial Insemination

Reproductive efficiency in yak is closely linked to the profitability of a herd, with the early onset of postpartum ovarian activities, breeding and subsequent reconceiving within the short time after voluntary waiting period by reducing the inter calving period. There are various factors impacting the reproductive performance, including accurate detection of estrus for breeding of the animal, reattaining optimum body status with nutritional management, and implementation of specific reproduction management programme. Artificial insemination (AI) is one of the oldest and important biotechnological tools used for reproduction management for the rapid genetic improvement of livestock. Further, AI could also be successfully implemented in reproduction management of an animal herd along with estrus synchronization programme. Estrus synchronization minimize the problems associated with estrus detection and allows to perform fixed time artificial insemination (TAI). The basic aim of estrus synchronization programs is manipulation of estrous cycle length by use of one or a combination of hormones. The length of the luteal phase can be shortened by treatment with prostaglandin F_{2α} or its analogues; or it can be extended by treatment with exogenous progestogens. Other hormones, such as gonadotropin-releasing hormone and estrogens, have been incorporated into some programs to reduce the spread in time of onset of estrus and to improve conception rate by manipulating follicular wave development. The current trend of such programs is toward ovulation synchronization, which allows timed breeding without estrus detection.

Therefore, an estrus synchronization & TAI strategy based on Doublesynch regimen, initiated with administration of PGF_{2α} on day 0 (without regard to the estrous cycle stage), GnRH on day 2, a second PGF_{2α} injection on day 9, and a second GnRH injection on day 11 followed by TAI performed with yak semen at 16 and 24 h after the second GnRH treatment was tried in 36 multiparous cyclic yaks. The conception rate of 41.7% was recorded through pregnancy diagnosis performed on day 35 post-AI by Transrectal ultrasonography using 5MHz probe. The findings indicate that the Doublesynch estrus synchronization strategy has the potential to utilize timed artificial insemination in yak for their genetic improvement under farm and field conditions.



A field trial on estrus synchronization treatment using doublesynch regimen and fixed timed artificial insemination was also performed in 11 (*Dzomo*) yak-cattle hybrids of livestock farmer of Lubrang village located at about 10000 ft elevation in West Kameng district of Arunachal Pradesh. In an effort to produce yak-cattle hybrids, another trial was conducted on 4 cows of a farmers of Dirang village in West Kameng district. The animals were synchronized with doublesynch treatment and subsequently inseminated with yak semen. The conception rate of 50% was recorded in cattle, whereas no yak-cattle hybrid was pregnant with the protocol. The trial was conducted in non-breeding season which could be the reason for low conception in yak and yak - cattle hybrids.

Ex-situ conservation of Yak germplasm

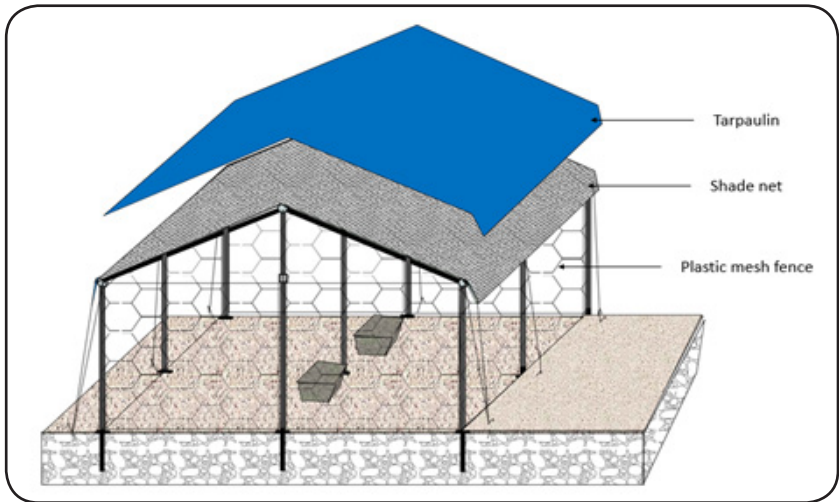
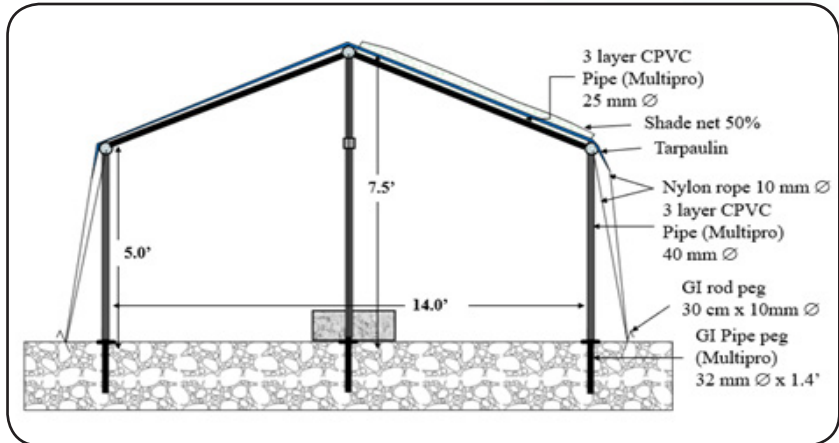
To conserve the yak germplasm (semen), four yak bulls were trained for semen donation in artificial vagina. Subsequently, semen was collected from these animals and evaluated for cryopreservation. Semen samples having more than 70 percent initial motility were frozen using Tris - Egg yolk - Glycerol - Citrate extender. Around 2000 semen doses were cryopreserved in liquid nitrogen for further use in propagation and multiplication of elite yak germplasm at farm and field.

THEME : ENVIRONMENTAL STRESS MANAGEMENT

A Dual-Purpose Make-shift Portable Animal & Herder Shelter for Highlands

Yaks are raised on highland pastures under vertical transhumance by various pastoral communities (*Changpas, Brokpas, & Drokpas*) of Ladakh, Himachal Pradesh, Arunachal Pradesh and Sikkim for sustenance of their livelihood. This system of yak rearing is adopted by the herding communities to cope with the seasonal changes in ambient temperature and forage availability. The temperature is one of the most important environmental variables that can impact the health, welfare and the production efficiency of animals. Yak can tolerate extreme cold but susceptible to rising ambient temperature beyond its thermoneutral zone i.e., 5°C - 13°C with an average of 10°C. The changes in physiological response and metabolic adjustments to cope with rising temperature may have negative consequences on yak health and productivity. Therefore, to cope with the rising ambient temperature due to impending climate change, the sensitive animals like yak needs access to shade while grazing in order to mitigate the stress associated with radiant heat load for sustained animal production. Besides, young and milking animals often fall prey to wild animal attacks especially to feral dogs on open pastures without animal shelters. Hence, the milking animals and calves are often kept inside the temporary enclosures during nights to protect them from predation. These enclosures are made of bamboo, stone wall, wood or tarpaulin tents at low and mid altitude pastures. Mostly, the transhumant livestock herders do not construct animal shelters during their migration and stay at high altitude pastures due to lack of resources (construction materials) in these areas. Furthermore, the transportation of these bulky materials for construction of animal shelters from low lands to high lands through difficult terrains, devoid of motorable roads is also not easy. Therefore, an effort was made to construct a light weight and detachable, prefabricated animal and herder shelter with plastic-based materials for sustainable yak production at high altitude areas for protecting animals from predation and radiant heat load.

Considering the possibilities of sudden snowfall in yak rearing high altitude areas of Arunachal Pradesh, a dual purpose (animal & herder) shelter of size 10x14feet was fabricated by using triple layered (MultiPro) CPVC pipes (40mm and 25mm diameter), GI anchoring pegs (32 mm diameter), nylon rope (8mm diameter), GI rod and anchoring pegs (10mm diameter), Shade net & Tarpaulin. This type of shelter is suitable for herding 4 adult yak females or 10-15 yak calves. The tent can also be used as yak herder's shelter. The approximate weight of the shelter material is around 36Kg and approximate cost is Rs. 34,000/-.



Design for a Pre-fabricated Dual Purpose Animal and herder's shelter



Yak calves seeking shelter for shade during open grazing in a sunny day of October month at an altitude of 8700 ft above mean sea level when the ambient temperature was around 23°C and 45% relative humidity.

THEME : NUTRITIONAL INTERVENTIONS

Maize production in NEH region for sustainable livestock production

Maize crop has key importance in livestock raising through fulfilling the feed and fodder requirements beside an integral component of human food basket. Therefore, four varieties of maize viz. *African Tall*, *Hybrid (DMRH 1301 & Badshah PMH 25P30)* and *Dirang local* were cultivated in Dirang, West Kameng district of Arunachal Pradesh to assess their production performance. An out-standing growth was observed for the *African Tall* and green fodder production was recorded approximately 26,000 kg/ha per cut. Among the grain varieties, DMRH 1301 showed the best results with production level of almost 4.82 quintal per hectare in Yewang village of West Kameng located at about 5000 ft above msl. The other varieties of maize like sweet corn and baby corn were grown at farmers and institute fields in Dirang locality also showed satisfactory production. The maize cultivated for green fodder during the period was utilized for feeding farm yaks. Besides, the surplus green maize fodder (almost 12 tons) was conserved into silage using both concrete silo and polybags and offered for lactating and growing yaks during winter. The experiments conducted in yaks revealed feeding maize silage is beneficial in comparison to green maize fodder in terms of the nutritive value and productivity of growing and lactating yaks.



The maize grains produced from the experimental fields using hybrid seeds were used in diet for feeding trials on broilers under the Institute FLD unit on poultry. No significant variations in the growth of broilers were recorded when compared to those fed on normal maize grain diet.

Capacity building of the tribal farmers:



Four capacity building programmes in the form of awareness, training and field demonstration programmes were conducted for the tribal farmers of Showda, Shagaor, Chug, Pansen, Sangti, Nyukmadung, Yewang villages of West Kameng district in Arunachal Pradesh. All these programmes were carried out in collaboration with KVK, West Kameng, Dirang. During the programmes, the farmers were briefed on scientific cultivation of maize covering the topics on importance for genotype selection, proper use of fertilizers and irrigation, and impact of climate on crop productivity. A total of 258 tribal farmers gathered the knowledge on scientific cultivation of maize through these programmes and also received the inputs like improved varieties of maize seeds, fertilizers,

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agricultural tools, and pesticides as per the availability of their cultivable land. Besides, the farmers were also motivated for adopting intercropping and some seasonal vegetable seeds *viz.* cabbage, chilli, cauliflower, brocolli, cowpea, french bean were provided to them for promoting intercropping with maize.

Maize based feeding module in poultry–An Alternate source of income for tribal yak farmers

The declining yak population in the country is a serious concern among different stakeholders associated with yak husbandry. The reason being inbreeding, degradation of highland pastures for yaks, lack of scientific knowledge, marketing facilities and shifting of yak rearers mainly the young generations because of difficulties associated with the profession. Hence, a supportive programme was planned for alternate income generation of the yak farmers of Arunachal Pradesh through poultry farming for



uplift their socio-economic status and ensuring nutritional security. Therefore, a maize based Research cum Front Line Demonstration (FLD) unit on poultry farming was established in collaboration with ICAR-DPR, Hyderabad and ICAR-CARI, Bareilly by signing MoUs on “*Empowering tribal yak farmer through backyard poultry farming in NEH region*”. Accordingly, two experiments were conducted to evaluate the effect of probiotic on the performance of broiler and to check the performances of poultry fed maize based diets with different sources of proteins. The study revealed dietary supplementation of probiotic as well as replacement of Ground Nut Cake (GNC) with Soyabean cake in poultry diets had no significant differences in growth, feed intake, feed conversion ratio and mortality, however, the higher net profit was earned with supplementation of probiotic in broiler diets and replacement of Ground Nut Cake (GNC) with Soyabean cake in poultry diets. Awareness programme on empowering tribal farmers on backyard poultry farming was conducted in different regions of Arunachal Pradesh including Aspirational village, Kullung under Mengio circle of Papumpare district.

Nutrient requirement of different categories of yaks

Yaks are traditionally raised on highland pastures and nutrients obtained from the available biomass are utilized by the animal for different productive functions. So far, there is no information available on the key nutrient requirements of yaks worldwide. Imbalance and lack of required core dietary ingredients may lead to sub-optimal performance. Therefore, a systematic study was planned on their growth performance, feed conversion and nutrients metabolism with different levels of protein and energy for estimation of the nutrient requirements for different categories of yaks and according feeding trials are ongoing.

THEME : YAK HEALTH

Livestock Health & Disease Control Programme on Foot and Mouth Disease (FMD)

Foot and Mouth Disease is highly infectious disease of cloven-hoofed animals including yak. It is associated with economic losses rather than mortality of animals. Control of FMD can be achieved by mass vaccination of susceptible livestock repeatedly at regular intervals till the incidence of the disease comes down. This will pave way to gradual eradication of the disease from the region and country. Therefore, as the project activity, a total of 676 animals (yak, cattle and yak cattle hybrids) were vaccinated against FMD, HS and BQ in yak rearing region of West Kameng and Tawang districts in Arunachal Pradesh. Further, as per the OIE guidelines sero-surveillance should be performed by an assay capable of differentiating infected from vaccinated animals (DIVA strategy) in the regions which are adopting vaccination to control FMD. Accordingly, around 231 serum samples collected from yak, yak-cattle hybrids and cattle raised on different pastures in West Kameng district of Arunachal Pradesh were screened for sero-surveillance and 14.28% samples were tested positive for DIVA. Besides, a series of FMD awareness cum vaccination programmes were conducted at different yak tracts of Sikkim and Arunachal Pradesh under the project and STC activity of the Institute. All these activities were undertaken in collaboration with the Department of Animal Husbandry & Veterinary, Govt. of Arunachal Pradesh, and ICAR - National Institute on Foot and Mouth Disease, Aragul, Bhubaneswar – 752 050, Odisha, India.

The details of programmes undertaken during January 2022 to December 2022 are hereunder:

- ◆ A day long training programme for women farmers on “Foot and Mouth Diseases” in Nyukmadung village, West Kameng District, Arunachal Pradesh on 23rd March 2022.
- ◆ A three days vaccination cum awareness programme on “FMD vaccination programme in Yaks” at Chander, Lubrang and Mandala in West Kameng district, Arunachal Pradesh during 24th to 26th March 2022.
- ◆ A two days programme on “FMD awareness cum vaccination programme for high altitude animals” at Zemithang, Tawang District, Arunachal Pradesh on 28th-29th May, 2022, in collaboration with WWF, India.
- ◆ A week long “National FMD Control Awareness Week and Vaccination Programme” at ICAR-NRC on Yak Centre, Sangti-Phudung, Lubrang, Nyukmadung and Dirang villages of West Kameng District from 12th to 17th September, 2022.



THEME: YAK PRODUCT TECHNOLOGY

Nutrient profiling for the milk of Arunachali Yak

Comparative evaluation of milk from *Arunachali* yak, yak-cattle hybrid and cattle for nutrient composition and physico-chemical properties showed that fat, SNF and protein content was significantly higher in yak milk followed by yak-cattle hybrid milk and cattle milk. Ghee prepared from yak-cattle hybrid milk had higher content of mono-unsaturated and polyunsaturated fatty acids whereas yak *ghee* was richer in saturated fatty acids. Further, studies in respect to the chemical composition including mineral, fatty acid and protein profiles of *Arunachali* Yak milk was undertaken under this project.

Besides the project work, various value-added yak fibre products were developed like yak fibre-jute blended designer hat, yak fibre-jute blended designer ladies side bags etc. as the routine activities of Livestock Product and Technology section of the institute. These products are attracting the locals and tourists coming from different localities of the country.



LPT products sale counter (Singba Singba) of ICAR-NRC on Yak

THEME : YAK EXTENSION

Factors Influencing the Pastoral Yak Rearing System in North East India

Intensive interactions carried out under the on-going institute project on “A study on the factors influencing the pastoral yak rearing system in North East India” with the yak farmers i.e. *Brokpas* of Arunachal Pradesh (West Kameng and Tawang) through focused group discussion. Notable achievements in respect to final round of data collection from the yak herders (60) spread across the yak rearing villages of West Kameng and Tawang districts of Arunachal Pradesh were completed, and the information will act as a roadmap for framing the strategies and required interventions for gradual transitioning of traditional yak rearing into semi-intensive farming.



Data collection through Focussed Group Discussion with yak farmers

TECHNOLOGY DISSEMINATION AND EXTENSION

CAPACITY BUILDING

THEME: SCIENTIFIC YAK HUSBANDRY

ICAR-NRC on Yak envisions making yak farming sustainable and profitable through scientific husbandry inputs and practices. In accordance with this, the institute regularly conducts awareness, technology demonstration and hands-on training programmes in the yak rearing belts of the country.

- ❖ A two-days training programme on *“Empowering tribal farmers through backyard poultry farming in the NEH region of India”* alongwith input support in the form of Vanaraja chicks, poultry feed, and basic veterinary medicines to the tribal farmers of Arunachal Pradesh under NEH component of ICAR-DPR, Hyderabad was conducted during 22nd and 23rd January, 2022 at ICAR-NRC on Yak, Dirang.
- ❖ A three-days demonstration on *“Fodder conservation techniques to mitigate winter feed crisis in highland animals”* with STC supports to the tribal yak farmers of Sikkim was organized during 9th to 11th March, 2022 at different places of Sikkim. The programme was conducted in collaboration with the department of Animal Husbandry, Livestock, Fisheries and Veterinary Sciences, Govt. of Sikkim at Lachen & Lachung of North Sikkim and Kupup of East Sikkim. A total of 64 farmers participated in the programmes and also received the STC inputs in form of concentrate yak feed, complete feed blocks, common salts, gumboots, liquid calcium and some basic veterinary medicines for their animals. Some capital items viz. 12 cream separator and 10 chaff cutters were also provided to the tribal farmers.



- ❖ Field demonstrations on conservation of fodder for mitigation of winter feed crisis in highland animals were organized for ITBP officials during *“Advanced Yak Management Course”* conducted in two batches on 17th to 30th May, 2022 and 17th to 30th August, 2022 at ICAR-NRC on Yak, Dirang. A total of eight officials acquired knowledge in the field of scientific breeding, feeding, reproductive and healthcare practices. Besides, they were also provided hands-on-practices on laboratory techniques for disease diagnostics and Artificial Insemination. The techniques for conservation of feed and forages in the form of complete feed block and silage making to mitigate winter fodder crisis at highlands were also demonstrated during the training period. Besides, they were also educated on management of pasture and cultivation of different frost resistant forages.



- ❖ A three-days training on “*Scientific maize cultivation for improved livestock productivity*” with input support in the form of maize seed, fertilizers, and agricultural tools under NEH component of ICAR-IIMR, Ludhiana was organized during 16th to 18th March 2022, in different parts of Dirang circle of West Kameng district in Arunachal Pradesh.



- ❖ A programme on “*Input support for tribal yak herders on the onset of summer migration*” under STC was held on 10th May 2022 at Nyukmadung, West Kameng District of Arunachal Pradesh. A total of 56 bags of Animal feed i.e., 2800Kg was distributed among 14 yak herders to aid in feeding their livestock during migration. The participants were also briefed on the various care and measures to be adopted by the herders for their animals.



- ❖ A similar programme was carried out on 13th May 2022 in ICAR-NRC on Yak, Dirang, Arunachal Pradesh. The resource person during the course of the programme briefed the participants about the care and management of the yak during the summer migration and the ensuing months. The participants also interacted with the resource person and put forth the queries related to health care and feeding for the yaks during the migration period. A total of 160 bags of Animal feed i.e., 8000 Kg was distributed among the 32 yak herders to aid in feeding their animal during migration.



- ❖ Inputs support for tribal yak herders on the onset of summer migration under STC at Senge village of West Kameng District in Arunachal Pradesh was also undertaken by the institute. In total, 10 yak herders were provided with a total of 50 bags of Animal feed i.e. 2500 Kg during the programme to aid in feeding their animals during migration.



- ❖ A programme on “*Awareness about Livestock Care and Management cum distribution of inputs*” for the tribal livestock farmers of Lish and Chug villages of Dirang, West Kameng District, Arunachal Pradesh was organized under STC on 26th September 2022.

- ❖ A two-days awareness programme for the highland livestock farmers on “*Scientific feeding and management of highland animals with STC supports*” during 06th and 07th December, 2022 was organized at Jang and Tawang under STC.



- ❖ An awareness camp on “*Empowering tribal farmers for alternate income generation through backyard poultry farming in Arunachal Pradesh*” was organized on 16th November, 2022 in Kullung, one of the Aspirational villages under Papumpare district of Arunachal Pradesh. A total of 70 tribal farmers were supported for alternate income generation through poultry farming and provided inputs in the form of improved varieties of backyard poultry, poultry feed, feeder, drinkers and some basic vety medicines



THEME: YAK PRODUCT AND TECHNOLOGY

A 6-days training on “*Yak Fibre Based Fabric Making*” was organized by ICAR-National Research Centre on Yak in collaboration with ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata in Dirang during 31st October, 2022 to 5th November, 2022. The participants were educated on manufacturing different products from yak fibre-jute blended fabric, their prospects of commercialization and setting up the yak fibre-based product business. All 14 trainees were also rewarded with the participation Certificate.



THEME: YAK HEALTH & REPRODUCTION MANAGEMENT

- ❖ A three-days programme on demonstration of “*Artificial Insemination techniques for Highland Animals*” was organised for the tribal farmers of Sikkim from 9th to 11th March, 2022 under STC of the institute. Another programme on “*Estrus Synchronization and TAI programme for upgrading tribal farmers Yaks*” was also conducted during this period in collaboration with the Department of Animal Husbandry Livestock, Fisheries and Veterinary Services, Govt. of Sikkim in North & East Sikkim. Farmers were educated on the benefits of AI in genetic upgradation of their stock for better productivity. The yaks were also screened for ascertaining the ovarian and pregnancy status before initiating the DoubleSynch estrus synchronization treatment (GnRH, Gynarich & PGF2a, Pragma regimen). In total, seven (07) non-pregnant yak females (including heifers) were treated with DoubleSynch estrus synchronization regimen and subsequently the respondent females were inseminated with the yak semen taken from ICAR-NRC on Yak, Dirang.



- ❖ An “*Awareness cum Vaccination programme*” was organized through AICRP on FMD project of the institute at Jang, Mandala, Khasso and other parts of Arunachal Pradesh.



THEME: SPECIALIZED TRAINING PROGRAMME

Advanced Yak Management Course for ITBP Officials

- ❖ The ‘*Advanced Yak Management Course for ITBP Veterinary Cadre Officers*’ was organised through Extension Unit of ICAR-NRC on Yak, Dirang, conducted in two batches on 17th to 30th May, 2022 and 17th to 30th August, 2022 at ICAR-NRC on Yak, Dirang. Eight officials from different battalions of ITBP attended the course. Throughout the course, 36 classes including theory and practical classes were conducted. Farmers’ field visit was also undertaken to give the trainees a hands-on experience

of the yak herders lives. The resource persons included scientists and technical officer of the institute while two external experts on yak husbandry were also invited to deliver lectures during the course. Certificates were handed out to the trainees and feedback and related submissions of the trainees which included a training manual on yak husbandry for all the ITBP Veterinary cadre were taken into consideration.



Training-cum-Awareness programme on Bankable Scheme for Profitable Yak Farming

A “Training-cum-Awareness programme on Bankable Scheme for Profitable Yak Farming” was organized by ICAR-NRC on Yak, Dirang in collaboration with NABARD, Itanagar from 27th to 29th September 2022. The three-day programme included field visits to the *Brokpas*’ field to create awareness about the bankable scheme on 27th and 28th September. On the first day, thirty (30) *Brokpas* were covered at Wa Naga Brok, Mandala. On the second day, sixteen *Brokpas* of Nyukmadung village were made aware of the scheme. On the third day a mega event was conducted at ICAR-NRC on Yak, Dirang. Er. Tage Taki Ji, Hon’ble Minister of Agriculture, Horticulture, Animal Husbandry, Veterinary, Dairy Development & Fisheries, Govt. of AP graced the occasion as Chief Guest and Shri Phurpa Tsering, Hon’ble MLA, Dirang cum Advisor, PWD, Western Zone, Govt. of AP and Shri B.P.



Mishra, Deputy General Manager, NABARD, Itanagar were the Guest (s) of Honour. The programme was attended by the Chief Manager, SBI (Credit & NPA), Ex. Minister cum Chairman, Resource Mobilization & PI, Govt. of AP, Ex-MD, State Co-operative Bank Ltd Director, Dept. of AHV & DD, Govt. of AP, officials of the District Administration, HoDs of allied departments, bankers, ZPC of Tawang, ZPMs, progressive farmers, yak *Brokpas* and other farmers aside from the Scientists, officers and staff of ICAR-NRC on Yak. The main highlights of the event included the technical presentation about the Banking Scheme for Profitable Yak farming, followed by announcement of the helpline for the banking scheme by the Chief Guest and release of booklet on “Bankable Model for Yak farming”. Dr. Mihir Sarkar, Director, ICAR-NRC on Yak, in his address to the august house shared about the hardships and challenges faced by the *Brokpas* and also the scope of yak husbandry while stressing on the bankable scheme which is a measure to socio-economically uplift the lives of the yak herders and to make husbandry sustainable in the long run. In total about 200 participants attended the programme over 3 days and the programme ended with vote of thanks by Dr K. Mepfhuo, Organising Secretary of the programme who also shared the feedback of the *Brokpas* about the scheme.



EXTENSION ACTIVITIES

The Extension Unit of ICAR-NRC on Yak, Dirang involved in organizing various extension programmes for dissemination and popularization of the institute's technologies and products related to yak and other highland animal husbandry through showcasing and field demonstration on the same. During this report period of January to December 2022 several programmes were conducted with the aim to maximise the knowledge of the farmers and other stakeholders participating in the programmes and in accelerating the outreach of the institute in accordance with its mandate and the same were as follows -

KISAN BHAGIDAARI-PRATHAMIKTA HAMARI UNDER THE BANNER OF AZADI KA AMRIT MAHOTSOV

In view of the nationwide observance of campaign on *Kisan Bhagidaari-Prathamikta Hamari* under *Azadi Ka Amrit Mahotsav*, ICAR - NRC on Yak collaborated with KVK, West Kameng and arranged for farmers to view the launching of the KBPH Campaign through Online Mode on 26th April 2022.



As a continuation of the campaign, Scientist

- Farmers meet was organized on 28th April 2022 in collaboration with KVK West Kameng. The programmes were attended by 81 participants which included Seventy (70) farmers and Eleven (11) staff members of ICAR-NRC on Yak and KVK West Kameng.

EXPO-CUM-KISAN MELA WITH EXHIBITION OF INSTITUTE PRODUCTS



An exhibition stall was set up by ICAR-NRC on Yak during one-day Expo Cum Kisan Mela Cum Sale Exhibition under RKVY-RAFTAAAR 2021 organised on 17th May 2022 at Dirang by the Dept. of Agriculture & KVK, West Kameng. The purpose of the exhibition stall was to showcase the technologies developed by ICAR-NRC on Yak since its inception in 1989 during the event. The products that were displayed on the occasion included popular publications published by the institute, yak milk and fibre products prepared in the LPT section of the institute.

INDEPENDENCE DAY CELEBRATION

On the occasion of the Independence Day 2022, the Extension Unit of ICAR-NRC on Yak set up a stall at Lopen Ground, Dirang which was organized under the aegis of the ADC Dirang. The stall was set up on the theme, "Exhibition of technologies developed by ICAR-NRC on Yak"



PM KISAN SAMMAN SAMMELAN 2022

On the occasion of PM Kisan Samman Sammellan 2022 that was held at IARI Campus, Pusa, New Delhi, the Extension Unit of ICAR-NRC on Yak, Dirang organised web live casting of the event on 17th Oct. 2022 to enable the farmers of the adjoining villages to view the address of the Honourable PM's address to the farmers of the nation. A total of 58 participants attended the programme.



EVENTS AND HAPPENINGS

OBSERVANCE OF VIGILANCE AWARENESS WEEK

'Vigilance Awareness Week' 2022 with the theme "Corruption Free India for a Developed Nation" was organised by the Institute during 31st October, 2022 to 6th November, 2022 and arranged a series of programmes viz. Gram Sabha and speech competition etc. A total of 110 villagers and ICAR-NRCY staff under the chairmanship of Director, ICAR-NRCY, Dirang attended the Gram Sabha programme on 6th November 2022. AIPR of the employees of the institute was also scrutinized during the programme.



33RD FOUNDATION DAY

The 33rd Foundation Day of the institute was celebrated on 23rd January, 2022 with a day long celebration commenced with plantation drive and tug of war competition flagged by ADC, Dirang. This was followed by a Farmer's Meet attended by Sixty-two (62) tribal farmers.



CELEBRATION OF INTERNATIONAL YOGA DAY

ICAR-National Research Centre on Yak celebrated the International Yoga Day on 21st June, 2022 at Thupsung Dhargge Buddhist Monastery in Dirang organized in collaboration with ITBP and various departments of Govt of Arunachal Pradesh, Dirang Sub-Division, West Kameng. The programme started with religious norms at 7:45 am and ended at 9:30 am. The various yoga exercises were performed under the guidance of medical officer from ITBP force. Hon'ble MLA Dirang, Shri Phurpa Tsering graced the occasion with his presence and appreciated the collective efforts of all central and state departments for promotion of Yoga as a routine practice of healthy living.



SWACHHTA PAKHWADA (16TH-31ST DECEMBER 2022)

The Swachhta Pakhwada programme was carried out in the institute from 16th December to 31st December, 2022. In this programme various activities were carried out regarding cleanliness and sanitation. All the staff members took part in this programme. The campus area and nearby area of campus was cleaned by the staff members.



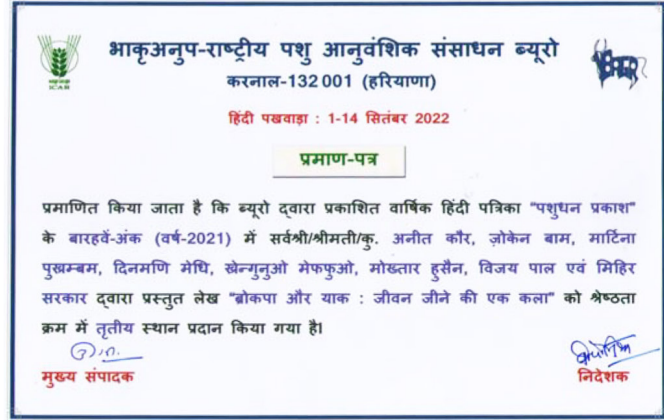
EXPOSURE OF POST-GRADUATE STUDENTS TO INSTITUTE ACTIVITIES

On 1st December, 2022 a team of twenty-nine (29) PG students of Department of Molecular Biology and Biotechnology, Tezpur University accompanied by Faculty in-charge visited ICAR-NRC on Yak, Dirang and interacted with the Scientists and visited the different labs and facilities of the institute.



AWARDS AND RECOGNITIONS

- ❖ Dr. Mihir Sarkar, Director of this institute conferred the “Fellowship of National Academy of Dairy Sciences” in 2022.
- ❖ Scientists of the Institute received third prize for the hindi publication: अनीत कौर, जोकेन बाम, मार्टिना पुख्रम्बम, दिनमणि मेधि, खेन्नुओ मेफफूओ, मोख्तार हुसैन, विजय पॉल, मिहिर सरकार। **ब्रोकपा और याक: जीवन जीने की एक कला।** पशुधन प्रकाश, बारहवाँ अंक-2021:24-28. भा कृ अनु प -राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो, करनाल



- ❖ The Institute Scientist Dr. Dinamani Medhi, received Reviewer Excellence Award from Agricultural Research Communication Centre (ARCC) for reviewing manuscripts for the Journal “Asian Journal of Dairy and Food Research”
- ❖ Dr. Aneet Kour participated as an Indian representative in the PC committee of World Congress on Genetics Applied to Livestock Production (WCGALP) held at Rotterdam, Netherlands from 3rd to 8th July, 2022



LINKAGES AND COLLABORATIONS

S. No.	Project Title	PI and Associates	Started from	Sanctioned Fund (Rs. in lakhs)
ICAR Funded Project				
1.	AICRP on Foot and Mouth Disease (FMD)	PI - Dr. M. Hussain Co-PI – Dr. D. Medhi	2014	4.00
2.	AICRP on Plastic Engineering in Agriculture Structures and Environment (PEASEM; erstwhile PET).	PI - Dr. V. Paul Co-PI – Dr. J. Bam Dr. D. Medhi	2015	13.50
	i) Prefabricated Animal Shelters for High Altitude` ii) Application of Plasticulture Technology for Farmyard Waste Utilization at High Altitude Areas		April 2021 to March 2023(ex- tended till March 2024)	
3.	Institute Technology Management Unit (ITMU) under National Agricultural Innovative Fund (NAIF)	PI - Dr. D. Medhi	-	3.80
DBT Funded Project				
1.	Socio-economic upliftment of yak rearing communities in Northeastern region by capacity building and technological interventions	PI - Dr. V. Paul Co-PI – Dr. D. Medhi Dr. J. Bam	2019-2022	33.76
Network/Collaborative Projects				
1.	Collaborative project with ICAR-IIMR, Ludhiana on “Maize production in NEH region for sustainable livestock production”	PI - D. Medhi, Co-PI – Dr. V. Paul	2019-2023	24.06

MEMORANDUM OF UNDERSTANDING (MOU)

1. A Memorandum of Understanding was signed between ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh and ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad, Telangana on 12th July, 2022 for empowering tribal yak farmer through backyard poultry farming in NEH region.

2. A Memorandum of Understanding was signed between ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh and ICAR-Central Avian Research Institute, Bareilly, Izatnagar, Uttar Pradesh for empowering tribal yak farmer through backyard poultry farming in NEH region

3. A Memorandum of Understanding was signed amongst ICAR-National Institute of Natural Fibre Engineering and Technology (ICAR-NINFET), Regent Park, Kolkata : 700040, West Bengal, India (first party), ICAR-National Research Center on Yak, Dirang, Pin-790101, Arunachal Pradesh, India (second party) and Mon Sangti-Khasso Welfare Association (third party), located at Village Sangti P.O. & P.S. Dirang, District West Kameng, Arunachal Pradesh, India to promote and accelerate the technological out put into commercialization and technology transfer for the benefit of the society which are common interest to all the parties.



4. A Memorandum of Understanding was signed between ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh and GNRC Hospital, Dispur, Assam on 11th May, 2022 for providing good healthcare facilities to the staff of the institute at cost effective rates

5. A Memorandum of Understanding was signed between ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh and ASG Eye Hospital, Dispur, Assam on 11th May, 2022 for providing good healthcare facilities to the staff of the institute at cost effective rates

INSTITUTE FUNDED RESEARCH PROJECTS

S. No.	Project Title	Name of the PI & CoPIs	Year	
			Start	Status
1.	<i>Ex-situ</i> conservation of yak germplasm	PI - Dr. V. Paul Co-PI – Dr. M. Hussain & Dr. Martina Pukhrambam	June, 2017	Continuing
2.	Nutrient profiling for the milk of Arunachali Yak	PI - Dr Joken Bam & Dr. Mokhtar Hussain	October, 2019	Continuing
3.	Maize based feeding module in poultry for alternate source of income in tribal yak farmers of Arunachal Pradesh	PI - Dr. D. Medhi Co-PI – Dr. Aneet Kour, Dr. M. Pukhrambam, M. Hussain and collaboration with ICAR-IIMR, Ludhiana	August, 2021	Continuing
4.	Effect of parasitic load on growth of young yak calves	PI - Dr. Joken Bam & Dr. M. Hussain Co-PI – Dr. Aneet Kour	August, 2021	Continuing
5.	A Study on the factors influenching the pastoral Yak rearing system in NE India.	PI - Dr. K. Mepfhuo	January, 2021	Continuing
6.	Identification of Mitogenomic Diversity and Phylogenetic Analysis of Indian Yaks	PI - Dr. M. Pukhrambam Co-PI – Dr. Aneet Kour, Dr. J. Bam and Dr. P. J Das, NRCP, Rani.	September, 2021	Continuing
7.	Deciphering the genomic architecture of complex economic traits in Arunachali Yak	PI - Dr. Aneet Kour Co-PI – Dr. M. Pukhrambam, Dr. Joken Bam and collaborator from ICAR-NBAGR	September, 2021	Continuing
8.	Nutrient requirement of different categories of <i>Arunachali</i> Yaks	PI- Dr. D. Medhi Co-PI – Dr. V. Paul & Dr. M. Hussain	October, 2022	Continuing
9.	Understanding performance of different pasture under farmyard waste, drip irrigation system and mulch treatments in high altitude areas	PI - Dr. Mansukh Singh Jatana Co-PI – Dr. V. Paul & Dr. D. Medhi	October, 2022	Continuing
10.	Understanding the follicular dynamics in <i>Arunachali</i> yak: An insight to identify candidate proteomics marker(s)	PI - Dr. M. Hussain Co-PI – Dr. V. Paul & Dr. D. Medhi	October, 2022	Continuing

PUBLICATIONS

Research Papers :

1. Medhi, D., Sharma, P. P., Ali, E. and Chakravarty, P. (2022). Efficacy of tree leaf based complete feed blocks on performance of growing yaks. *Indian Journal of Animal Sciences* 92 (1): 139–142 <https://doi.org/10.56093/ijans.v92i1.120942> [NAAS rating (2023): 6.29]
2. Das, P. J., Kour, A., Deori, S., Begum, S.S., Pukhrambam, M., Maiti, S., Sivalingam, J., Paul, V. and Sarkar M. (2022). Characterization of Arunachali Yak: A roadmap for Pastoral sustainability of yak in India. *Sustainability* 14, 12655. <https://doi.org/10.3390/su141912655> [NAAS rating (2023): 9.89]
3. Kour, A., Niranjana, S.K., Malayaperumal, M., Surati, U., Pukhrambam, M., Sivalingam, J., Kumar, A. and Sarkar, M. (2022). Genomic Diversity Profiling and Breed-Specific Evolutionary Signatures of Selection in Arunachali Yak. *Genes*, 13, 254. <https://doi.org/10.3390/genes13020254> [NAAS rating (2023): 10.14]
4. Hussain, M., Ahmed, K., Begum, S.S, Kalita, M.K., Borah, P., Bhuyan, D., Tamuly, S., Medhi, D., Paul, V., Chakravarty, P. and Sarkar, M. (2022). Effect of seasons and additives in Arunachali Yak bull semen at different stages of processing and freezing along with fresh semen characteristics. *Reproduction, Fertility and Development*, 35(2), 161-161. <https://doi.org/10.1071/RDv35n2Ab70> [NAAS rating (2023): 7.97]
5. Raina, V.S., Chakravarty, A.K., Mohanty, T.K., Kour, A., Das, R. and Vohra, V. (2022). Decoding HF crossbred bull fertility: Candidate gene markers contributing significantly to the phenotypes. *Indian Journal of Animal Sciences*, 92(4):443-451. <https://doi.org/10.56093/ijans.v92i4.124063> [NAAS rating (2023): 6.29]
6. Jose, B., Samad, H.A., Bharati, J., Tejaswi, V., Konda, P., Manoj K.S., Tripathi, K., Kumar, S., Punetha, M., Mohan, D., Verma, V., Chouhan, V.S., Maurya, V.P., Sharma, G.T., Kumar, P., Sarkar, M. and Singh, G. (2022). Evaluation of thermo-adaptability between Tharparkar (*Bos indicus*) and crossbred (*Bos indicus* X *Bos taurus*) calves in a controlled environment. *Journal of Thermal Biology*, 110:10338 <https://doi.org/10.1016/j.jtherbio.2022.103381> [NAAS rating (2023): 9.19]
7. Bharati, J., Kumar, S., Kumar, S., Mohan, N.H., Islam, R., Pegue, S.R., Banik, S., Das, B.C., Borah, S. and Sarkar, M. (2022). Androgen receptor gene deficiency results in the reduction of steroidogenic potential in porcine luteal cells. *Animal Biotechnology*, <https://doi.org/10.1080/10495398.2022.2079517> [NAAS rating (2023): 8.14]

Compendium/Training Manual/Technical Bulletin/Booklet

1. Medhi, D., Prakash, B., Sarkar, M. and Chatterjee, R.N. (2022). Poultry farming for alternate

income generation in tribal farmers of NE region of India. Compendium cum Training Manual related to the collaborative programme on “*Empowering tribal farmer through backyard poultry farming in NEH region of India*” published by ICAR-National Research Centre on Yak, Dirang -790101, West Kameng, Arunachal Pradesh, India, Pp. 1-130

2. Kour, A., Bam, J., Pukhrambam, M., Paul, V., Medhi, D., Mepfhuo, K., Hussain, M. and Sarkar, M. (2022). Traditional hybridization practices of the *Brokpas* of Arunachal Pradesh. Yak Production/Technical Bulletin/2022-23/01 published by ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh, India, pp. 1-36.

3. Kour, A., Mepfhuo, K., Bam, J., Paul, V. and Sarkar, M. (2022). Bankable Model for Yak farming ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh in collaboration with National Bank for Agriculture and Rural Development, Arunachal Pradesh pp: 1-8

Book Chapters

1. Kour, A., Raina, V.S., Sadana, D.K. and Sarkar, M. 2023. Adaptive Resilience: Sustaining Dryland Agriculture the pastoralist way. In: *Enhancing Resilience of Dryland Agriculture under Changing climate: Interdisciplinary and Convergence Approaches*. Eds: Naorem, A.K. and Machiwal, D. Springer publications, pp:637-654. <https://doi.org/10.1007/978-981-19-9159-2>

2. Raina, V.S., Singh, A.P., Kour, A. and Tyagi, B. 2023. Understanding linkages between livestock sensitivity and climate variability in drylands for developing appropriate management strategies. In: *Enhancing Resilience of Dryland Agriculture under Changing climate: Interdisciplinary and Convergence Approaches*. Eds: Naorem, A.K. and Machiwal, D. Springer publications, pp:563-574. <https://doi.org/10.1007/978-981-19-9159-2>

3. Chakravarty, P., Paul, V., Medhi, D., Bam, J., Singh, T.P. and Hussain, M. (2022). Propects of Entrepreneurship Development through Yak resources. In *Agri-business opportunities in North east India*. Eds: Kadirvel, G., Roy, S.S., Ghatak, S. and Mishra, V.K. 310 pages, Today & Tomorrow's Printers and Publisherd, New Delhi, India, pp: 119-122.

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1. Hussain, M., Medhi, D., Kour, A., Martina, P., Bam, J., Begum, S.S, Paul, V. and Sarkar, M. (2022). Importance and benefits of backyard poultry farming in India. In: Compendium cum Training Manual on “*Poultry farming for alternate income generation in tribal farmers of the NEH region of India*”. Published by ICAR-NRC on Yak, Dirang -790101, pp-36-41.

2. Kour, A., Raina, V.S, Martina, P. and Hussain, M. (2022). Selection and breeding of economic traits in poultry. In: Compendium cum Training Manual on “*Poultry farming for alternate income generation in tribal farmers of the NEH region of India*”. Published by ICAR-NRC on Yak, Dirang-790101, pp: 52-55.

3. Martina, P., Kour, A., Hussain, M. and Medhi, D. (2022). Improved backyard poultry farming. Compendium cum Training Manual on “Poultry farming for alternate income generation in tribal farmers of the NEH region of India”. Published by ICAR-NRC on Yak, Dirang -790101, pp: 85-88.
4. Medhi, D., Hussain, M., Deori, S., and Sarkar, M. (2022). Vanaraja: A dual bird for better income generation with limited inputs. In: Compendium cum Training Manual on “Poultry farming for alternate income generation in tribal farmers of the NEH region of India”. Published by ICAR-NRC on Yak, Dirang-790101, pp: 93-95.
5. Mepfhuo, K. (2022). Potential of backyard poultry farming as a supplementary source of income and nutrition for the yak rearers of Arunachal Pradesh, In: Compendium cum Training Manual on “Poultry farming for alternate income generation in tribal farmers of the NEH region of India”. Published by ICAR-NRC on Yak, Dirang-790101, pp: 17-18

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1. Kour, A., Niranjana, S.K., Jayakumar, S., Pukhrabam, M. And Sarkar, M. (2022). Olfaction: A critical force driving adaptive evolution in Yaks. *World Congress on Genetics Applied to Livestock Production*, 3rd – 8th July, 2022, Rotterdam, The Netherlands. DOI: 10.3920/978-90-8686-940-4_517
2. Kour, A., Das, P.J., Mishra, D.C., Bhati, J., Pukhrabam, M. and Sarkar, M. (2022). ‘Omic’ insights on infertility or subfertility of yak sperm. *Society for Conservation of Domestic Animal Biodiversity (SOCDAB)* 21-22 Sep, 2022, Page no:160-161.
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Annual Report

- ◆ Annual Report 2021. ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh. Pp. 1-93

TRAININGS AND CAPACITY BUILDING OF THE STAFFS

S. No.	Title	Participating officials and staff
1.	<i>As per nomination of ICAR-HQ attended the Training Workshop for Vigilance Officers of ICAR Institutes organized by ICAR-NAARM, Hyderabad during August 24-26, 2022</i>	Dr. Dinamani Medhi
2.	Online Training Programme on “ <i>Impactful ICT Applications and Technologies in Agriculture</i> ” Organized by ICAR-NAARM, Hyderabad during 03-07 January, 2022	Dr. Khriengunuo Mepfhuo
3.	National Workshop on “ <i>Advanced Research Methodologies in Agricultural Extension</i> ” from 17 th – 22 nd February, 2022 organized in Virtual mode by the Department of Agricultural Extension Education, Agricultural College, Bapatla – ANGRAU	Dr. Khriengunuo Mepfhuo
4.	One Day Workshop on Commercialization of yak based products held on 17 th March 2022 at ICAR- National Research Centre on Yak, Dirang organised by ICAR-NINFET, Kolkatta In collaboration with ITMU, ICAR-NRC on Yak, Dirang	Dr. Mihir Sarkar Dr. Dinamani Medhi Dr. Khriengunuo Mepfhuo Dr. Aneet Kour
5.	North East Research Conclave 2022 at IIT Guwahati during May 20 th -22 th , 2022	Dr. Khriengunuo Mepfhuo
6.	Two Day Internation Virtual Conference on “ <i>Post Pandemic Perspectives: Reflections and Realities</i> ” during August 5 th -6 th , 2022 organised by Dept. of Management, Humanities & Social Sciences, NIT Agartala	Dr. Khriengunuo Mepfhuo
7.	Training-cum-Awareness programme on Bankable Scheme for Profitable Yak Farming” was organized by ICAR-NRC on Yak, Dirang in collaboration with NABARD, Itanagar from 27 th -29 th September 2022	Dr. Mihir Sarkar Dr. Vijay Paul Dr. Dinamani Medhi Dr. Khriengunuo Mepfhuo Dr. Martina Pukhram bam Dr. Aneet Kour Dr. Mokhtar Hussain
8.	21 days CAFT training on “ <i>Exploring integration of multiomics and conventional breeding approaches for sustainable livestock production</i> ” at ICAR-NDRI, Karnal, Haryana from 1 st to 21 st December, 2022.	Dr. Aneet Kour
9.	World Congress on Genetics Applied to Livestock Production from 3 rd to 8 th July, 2022 at Rotterdam, The Netherlands and presented a paper on “ <i>Olfaction: A critical force driving adaptive evolution in Yaks</i> ” (Foreign Deputation)	Dr. Aneet Kour

S. No.	Title	Participating officials and staff
10.	Attended National Symposium on “Contemporary Technology for Animal Genetic Resource (AnGR) Management” organized by Society for Conservation of Domestic Animal Biodiversity (SOCDAB) online from 21 st to 22 nd September, 2022, and presented a paper on “Omic’ insights on infertility or subfertility of yak sperm”.	Dr. Aneet Kour
11.	Attended one week virtual International workshop on “Computational Genomics for NGS Data Analysis: Concepts, Methods & Applications” organized jointly by NyBerMan Bioinformatics Europe Orleans, France, Delhi University, Delhi, India and Quanta Calculus Pvt. Ltd., India during 26 th to 30 th November, 2022	Dr. Martina Pukhrambam
12.	Attended three days online training programme on “Emotional and Social Intelligence at Workplace” organized by ICAR-IIWBR, Karnal, India during 13 to 15 th December, 2022	Dr. Martina Pukhrambam
13.	Attended online training programme on “Analysis of Experimental Data” organized by ICAR-NAARM, Hyderabad, India. during 19 th -28 th December, 2022	Dr. Martina Pukhrambam
14.	Attended online Training program on “Fodder Technology Innovation for Sustainable Livestock Production” organized by MANAGE and ICAR- Indian Grassland and Fodder Research Institute on August 1 st -5 th , 2022.	Dr Mansukh Singh Jatana

INSTITUTE COMMITTEES

RESEARCH ADVISORY COMMITTEE (RAC)

Composition of Research Advisory Committee

Position	Status	Names and Designation
71A(a) 1 An eminent scientist from outside the ICAR system nominated by DG, ICAR	Chairman	Dr. P. D. Juyal Former Vice-Chancellor, NDVSU, Jabalpur, Madhya Pradesh
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. A. K. Mohanty Joint Director, ICAR-IVRI, Mukteshwar, Uttarakhand Dr. L. C. Choudhary, Principal Scientist and Head, Animal Nutrition, ICAR-IVRI, Bareilly, Izatnagar, Uttar Pradesh Dr. J. K. Prasad Dean, BASU, Patna, Bihar Dr. Vineet Bhasin, Ex-Principal Scientist, AS Division, ICAR-HQ Dr. Srikant Tyagi, Principal Scientist and Head, CPR Division, ICAR-CIRC, Meerut, Uttar Pradesh
71A(a) 3 Director of the Institute	Member	Dr. Mihir Sarkar, Director, ICAR-NRC on Yak, Dirang Arunachal Pradesh
71A(a) 4 ADG, concerned with the Institute/nominated scientist	Member	ADG (AN&P), Dr. A.K. Tyagi ICAR-HQ, New Delhi
71A(a) 5 Two persons representing agriculture/ rural interests on the Institute Management Committee of the Institute in terms of Rule 66(a) 5 for the period of their membership of the Institute Management Committee	Member	Shri Lobsang Tsering Namshu Village, PO/PS. Dirang, Dist. West Kameng, Arunachal Pradesh Shri Lobsang Tsewang Komu Munna camp, PO/PS Dirang, Dist. West Kameng, Arunachal Pradesh
71A(a) 6 One Senior 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 - 790 101, Dist. West Kameng, Arunachal Pradesh

Major Recommendations of the RAC Meeting held on 23rd September, 2022

The meeting was conducted in a dual mode (virtual & physical at ICAR-NRC on Yak) and Chaired by Dr. P. D. Juyal, Former Vice-Chancellor, NDVSVU, Jabalpur. After threadbare discussion the RAC worked out the following recommendations –

1. A structured long-term on farm breeding program for genetic improvement of yak with effective use of Artificial Insemination technique. Therefore, proper data recording tools and appropriate/ prioritized selection criteria should be used for faster improvement/ genetic gain in economic traits viz., milk yield in females and growth rate in males.
2. Collaborations and partnerships are vital for fruitful research into sustainable yak husbandry. Hence, the institute should explore the possibilities of collaborating with various ICAR institutes and other universities for developing inter-institutional research programs. At the same time, trainings and workshops should be conducted for yak farmers from time to time.
3. There is an acute shortage of scientific manpower at the Institute seriously affecting the mandated research and extension activities, hence, this issue needs to be addressed on priority by the Council.
4. A comprehensive programme for using yak as a productive animal for farmers need to be designed with a focus on disease epidemiology, model housing and promotion of commercialization and e-marketing.



INSTITUTE MANAGEMENT COMMITTEE (IMC)

Composition of Institute Management Committee

S. No	Status	Names and Designation
1.	Director, ICAR-NRC on Yak, Dirang, West Kameng, Arunachal Pradesh (CHAIRMAN)	66 (a) 1
2.	District Animal Husbandry & Vety. Officer, Tawang, District Tawang, Arunachal Pradesh (MEMBER)	66 (a) 2 vide Council's letter No. AS/7/7/2019-IA.I dtd. 18.12.2020
3.	Dr. Karma T. Bhutia, Additional Director, Deptt. of Animal Husbandry & Fisheries & Vety. Sciences, Govt. of Sikkim, Krishi Bhawan, Tadong, Sikkim (MEMBER)	66 (a) 3 vide Council's letter No. AS/7/7/2019-IA.I dtd. 18.12.2020
4.	Prof. Saidul Islam, CVSc., AAU, Khanapara, Guwahati, Assam (MEMBER)	66 (a) 4 vide Council's letter No. AS/7/7/2019-IA.I dtd. 18.12.2020
5.	Shri Lobsang Tsering, Village-Namshu, Dirang, West Kameng District, Arunachal Pradesh (MEMBER)	66 (a) (5) vide Council's letter No. AS/7/7/2019-IA.I dtd. 10.07.2020
6.	Shri Lobsang Tsewang, Munna Camp, PO/PS: Dirang, West Kameng District, Arunachal Pradesh (MEMBER)	66 (a) (5) vide Council's letter No. AS/7/7/2019-IA.I dtd. 10.07.2020
7.	Prof. Probodh Borah, Prof. & Head, Deptt. of Animal Biotechnology, CVSc., AAU, Khanapara, Guwahati, Assam (MEMBER)	66 (a) 6 vide Council's letter No. AS/7/7/2019-IA.I dtd. 07.04.2021
8.	Dr. Arnab Sen, Pr. Scientist & Head, ICAR Research Complex for NEH Region, Umiam, Meghalaya (MEMBER)	66 (a) 6 vide Council's letter No. AS/7/7/2019-IA.I dtd. 07.04.2021
9.	Dr. P.J. Das, Pr. Scientist, ICAR-NRC on Pig, Rani, Guwahati, Assam (MEMBER)	66 (a) 6 vide Council's letter No. AS/7/7/2019-IA.I dtd. 07.04.2021
10.	Dr. Vijay Paul, Pr. Scientist, ICAR-NRC on Yak, Dirang, West Kameng District, Arunachal Pradesh (MEMBER)	66 (a) 6 vide Council's letter No. AS/7/7/2019-IA.I dtd. 07.04.2021
11.	Dr. A. K. Tyagi, Assistant Director General (AN&P), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi (DG/DDG Nominee)	66 a (7) vide Council's letter No. AS/7/7/2019-IA.I dtd. 07.04.2021
12.	Mr. P.K. Nayak, Asstt. Finance & Accounts Officer, ICAR-NRC on Pig, Rani, Guwahati (MEMBER)	66 (a) 8 vide Council's letter No. AS/7/7/2019-IA.I dtd. 05.11.2019
13.	Adm. Officer, ICAR-NRC on Yak, Dirang, West Kameng, Arunachal Pradesh (MEMBER SECRETARY)	66 a (9)

INSTITUTE ANIMAL ETHICS COMMITTEE (IAEC)

Name	Status
Dr. Mihir Sarkar Director, ICAR-NRC on Yak	Chairman
Dr. Dinamani Medhi, Principal Scientist	Biological Scientist
Dr. Khriengunuo Mepfhuo Scientist, ICAR-NRC on Yak	Scientist from different discipline
Dr. Mokhtar Hussain, ACTO, ICAR-NRC on Yak	Scientist Incharge of Animal House Facility
Dr. Aneet Kour Scientist, ICAR-NRC on Yak	Member Secretary, IAEC

CPCSEA Nominee for IAEC

S. No.	NAME OF THE NOMINEE	DESIGNATION IN IAECPI & CoPIs	ADDRESS	ORGANIZATION TO WHICH THEY BELONG
1.	Dr. P. Chakravarty	Main Nominee	Prof and Head Department of Pharmacology Tezpur Medical College, Bihaguri, Tezpur:784010, Assam	Department of Pharmacology Tezpur Medical College
2.	Dr. Raja Chakraborty	Link Nominee	Associate Professor, Department of Pharmacy Assam down town University, Panikhaiti, Guwahati, Assam – 781026	Departement of Pharmacy, Assam Down Town University, Panikhaiti, Guwahati
3.	Mr. Suresh Chandra Pathak	Socially aware Nominee	Manik Hazarika Road, Bengpukhuri, Tinsukia – 786125, Assam	Tinsukia Bar Association, Assam
4.	Dr. Pankaj Kumar	Scientist from out side of the Institute	Dept. of Zoology, Rajiv Gandhi Universaity, Rono Hills, Doimukh, Itanagar-791112 Arunachal Pradesh	Rajiv Gandhi University

8th Institute Animal Ethics Committee Meeting

The eighth (8th) Institute Animal Ethics Committee (IAEC) meeting was conducted on 5th of November, 2022 at ICAR-NRC on Yak, Dirang, Arunachal Pradesh. The meeting was chaired by Dr. Mihir Sarkar (Chairperson, Veterinarian) and attended by CPCSEA nominees including Dr. P. Chakravarty (Main nominee), Mr. Suresh Chandra Pathak (Socially aware nominee) and Dr. Pankaj Kumar (Scientist from outside the institute). The institute members of IAEC including Dr. Dinamani Medhi (Biological Scientist), Dr. Khriengunuo Mepfhuo (Scientist from different discipline), Dr. Mokhtar Hussain (Scientist Incharge of Animal House Facility) and Dr. Aneet

Kour (Member Secretary) were also present in the meeting. Six (6) new research protocols were presented before the committee members and were accorded approval for carrying out animal experimentation. The approved protocols included : *Maize based feeding module in poultry for alternate source of income in tribal yak farmers of Arunachal Pradesh*, *Nutrient requirements of different categories of Arunachali Yak* (PI: Dr. Dinamani Medhi), *Effect of parasitic load on the growth of young yak calves*, *Understanding the follicular dynamics in Arunachali Yak: An insight to identify the candidate proteomic marker(s)* (PI: Dr. Mokhtar Hussain), *Identification of mitogenomic diversity and phylogenetic analysis of Indian Yaks* (PI: Dr. Martina Pukhrambam) and *Deciphering the genomic architecture of complex economic traits in Arunachali Yak* (PI: Dr. Aneet Kour).



INSTITUTE RESEARCH COMMITTEE MEETING

Key points of 26th IRC Meeting conducted on 20th October, 2022

The Institute Research Committee (IRC) meeting was held in person on 20th October, 2022 and was chaired by Dr. Mihir Sarkar, Director, ICAR-NRC on Yak. The introductory note by Honorable Director was followed by presentation of a total of thirteen RPPs (7 RPP-II and 3 RPP-I). The house unanimously decided to extend the project entitled “*Nutrient profiling for the milk of Arunachali Yak*” and “*Effect of parasitic load on growth of young yak calves*” by another six (6) months. In-house approval was accorded to three new projects entitled “*Nutrient requirement of different categories of Arunachali yaks*”, “*Understanding the follicular dynamics in Arunachali yak: An insight to identify candidate proteomics marker(s)*” and “*Understanding performance of different pasture under farmyard waste, drip irrigation system and mulch treatments in high altitude areas*” with some modifications as submitted by Dr. Dinamani Medhi, Dr. Mokhtar Hussain and Dr. Mansukh Singh Jatana, respectively. The Chairperson appreciated the activities undertaken by the limited numbers of scientists and suggested to modify all the projects as discussed in the meeting and to implement accordingly after getting approval from IAEC to be held on 05-11-2022. The committee also reviewed the progress of the three (03) externally funded projects and appreciated the efforts of PIs and Co-PIs involved.

DISTINGUISHED VISITORS

Date	Visitor's Name and Address	Remarks
10 th May, 2022	Kate Choillat, Mumbai Kate Choillat, Mumbai	Appreciated the heartiest welcome to this institute. He commented "It was my pleasure to shoot our yak documentary here"
10 th May, 2022	Rimi Dupong, Gascong	Let's save the yak all together. Thank you for your commitment
17 th May, 2022	G. P. Sharma, Director (Finance), ICAR-HQ G. P. Sharma, Director (Finance), ICAR-HQ	The institute is having very good infractueters, well equipped and well-maintained laboratories. The campus is very green and clae also. The farm is also impressive with proper maintained. The institute is doing very well by using 100% grants (in 2021-22) and with zero external audit para. The institute needs support of manpower (scientists and administrative staffs) as the institute has been facing acute manpower shortage. My best wishes to the Director of the institute for excellent leadership and his team of scientists and officials also for doing yeoman service to the nation.
21 st July, 2022	Dr. Prakash Kinjavdeur, Ex- Principal Scientist, ICAR-IVRI, Bareilly	Thank you to the Director of the centre and staff of ICAR-NRC on yak for nice hospitality.
21 st July, 2022	Dr. Mohammad Hafiz, Former VC, i/c Dir. of Research, SV Vety. University, Tirupati /Emiratus Scientist (ICAR),	It is pleasure me to visit NRCY Dirang. I really appreciate cleanliness, maintenance and beautification of the campus. Both technical and non-technical staffs are good, workminded. I congratulate the Director for the excellent Administration. I wish all the staff and especially Director and staff all the best of luck
23 rd September, 2022	Dr. Amrish Tyagi, ADG (AN&P), ICAR-HQ, New Delhi Dr. Amrish Tyagi, ADG (AN&P), ICAR-HQ, New Delhi	Excellent facility, doing wonderful for yak rearing framers under the dynamic Director Dr. Mihir Sarkar. I congratulate and wish you all the best. Excellent facility, doing wonderful for yak rearing framers under the dynamic Director Dr. Mihir Sarkar. I congratulate and wish you all the best.

Date	Visitor's Name and Address	Remarks
23 rd September, 2022	Dr. L. C. Choudhary, Principal Scientist & Head (Animal Nutrition), ICAR-IVRI, Bareilly, U. P.	Very good work is being done with limited manpower in the institute. Congratulation and best wishes to the Head of the centre and all the staffs. Very good work is being done with limited manpower in the institute. Congratulation and best wishes to the Head of the centre and all the staffs.
23 rd September, 2022	Dr. A. K. Mohanty, Principal Scientist & Head (RS), ICAR-IVRI, Mukteshwar, U.K.	Great facilities and very good arrangement. Lots of scope for research for young scientists needs encouragement and support for world class reaserch. Great facilities and very good arrangement. Lots of scope for research for young scientists needs encouragement and support for world class reaserch.
23 rd September, 2022	Dr. J. K. Prasad, Dean, Bihar Vety. College, BASU, Patna	Excellenet arrangement made by the NRCY. Good research activities are being carried out by the scientists of NRCY. Best Wishes.
23 rd September, 2022	Dr. Vineet Bhasin, Ex-Principal Scientist, AS Division, ICAR-HQ	All praise for the staff of this institute, have put in hardwork with complete dedication in making this institute and livestock species of centre of research and livelihood for the animal scientists and keepers of yak rearing states. The institute in a knowledge hub for yak with in and outside the country.
29 th September, 2022	Dr. B.P. Mishra, NABARD, Itanagar, Arunachal Pradesh Dr. B.P. Mishra, NABARD, Itanagar, Arunachal Pradesh	Impressed by the effort of the institute on ground daoing a vaiable project for farming yak husbandry in the region. There relationship with the yak farmers praiseworthy. The packing programme arranged will go a long way in helping the farmers and will create confidence among the bankers. I appreciate NRC on yak acceptance to introduce new model to more option available to farmers as well as bankers. Excellent facilities and motivated team are the hallmarked of the institute. I wish allk the success to the team.
29 th September, 2022	Dr. Satyajit Borah, RBO, SBI, Tezpur, Assam	It is a mark of privilege and homely opinion in conference can NRC Yak. It is a grant initiative and effort to home intraserrimony and mobility. I truely knew home book miding and cofidence. Really Congrates to Dr. Mihir Sarkar sir, all scientists for their effortsss.

YAK HEADLINES



The Arunachal Times

STATE NEWS READERS FORUM EDITORIAL RING SIDE VIEW MONDAY MUSING SPARK

मानसून जमा बोनस

\$200* तक पाएँ

100%

State News

Workshop on commercialisation of yak-based products held

March 18, 2022



DIRANG, 17 Mar: The National Research Centre on Yak (NRCY) here in West Kameng district, in collaboration with the Kolkata (WB)-based National Institute of Natural Fibre Engineering & Technology (NINFET), organised a workshop on 'Commercialization of yak based products' here on Thursday.

NINFET Director Dr DB Shakywar spoke on "the prospects of yak fibres and its opportunity to develop entrepreneurship," while NRCY Director Dr M Sarkar highlighted "the scope of yak-based products for its commercialisation."

The Arunachal Times

STATE NEWS READERS FORUM EDITORIAL RING SIDE VIEW MONDAY MUSING SPARK



All Indians wondering

State News

Yak declared as food animal by FSSAI

November 27, 2022



Yaks under farm conditions in the housing facility of the NRCY, Dirang, West Kameng.

DIRANG, 26 Nov: Yak, a multipurpose bovid living in the highlands in the Himalayan region, has been declared as a food animal by the Food Safety & Standard Authority of India (FSSAI).

The development came in response to an application submitted by the National Research Centre on Yak (NRCY) here in West Kameng district in 2021.

"However, before awarding approval, the agency sought inputs from the department of animal husbandry & dairying (DAHD). In response,

ICAR-NRC ON YAK PERSONNEL

**Sanctioned and actual position of employees at ICAR-NRC on Yak and its campuses / station
(as on 31st December, 2022)**

Class of posts	No. of sanctioned posts	No. of Employees in position	No. of SC category employees	No. of ST category employees	No. of OBC category employees	No. of PHs category employees	No. of EWS category employees
SCIENTIFIC							
Scientist	11	4	1	2	-	-	-
Sr. Scientists	3	2	-	-	-	-	-
Pr. Scientists	1	-	-	-	-	-	-
RMP	01	1 (Filled by Diirector)	-	-	-	-	-
TECHNICAL							
Category-I	3	3	-	2	-	-	-
Category-II	1	1	1	-	-	-	-
Category-III	3	3	-	-	-	-	-
ADMINISTRATIVE							
AO	1	1	-	1	-	-	-
AAO	1	1	-	-	1	-	-
PS	1	1	-	-	1	-	-
F&AO	1	-	-	-	-	-	-
PA	2	PA-1 + Steno-III-1 against PA	-	2	-	-	-
Assistant	3	-	-	-	-	-	-
UDC	1	1	-	-	-	-	-
LDC	1	1	-	1	-	-	-
Skilled Support Staff	16	16	1	13	2	-	-

Scientific

S. No.	NAME	Designation	Date of joining at ICAR-NRC on Yak	Date of joining at ICAR
01	Dr. M. Sarkar	Director	18/01/2021	22/03/1996
02	Dr. Vijay Paul	Pr. Scientist (Animal Physiology)	13/04/2009	13/04/2009
03	Dr. D. Medhi	Pr. Scientist (Animal Nutrition)	27/04/2012	27/04/2012
04	Dr. Joken Bam	Scientist (Veterinary Parasitology)	22/04/2010	15/12/2009
05	Dr. K. Mepfhuo	Scientist (Agricultural Extension)	04/04/2020	07/01/2020
06	Dr. Martina Pukhrambam	Scientist (Animal Genetics & Breeding)	12/01/2021	05/10/2020
07	Dr. Aneet Kour	Scientist (Animal Genetics & Breeding)	12/01/2021	05/10/2020

Technical

S. No.	NAME	Designation	Date of joining at ICAR-NRC on Yak
01	Dr. Mokhtar Hussain	Asstt. Chief Tech. Officer (Vety. Officer)	01/11/2014
02	Dr. Mansukh Singh Jatana	Sr. Technical Officer (Agronomy)	09/06/2022
03	Dr. Ninad Bhatt	Sr. Technical Officer (LPM)	24/11/2022
04	Mr. Phunchu Namje	Technical Officer (Stock Assistant)	01/03/1993
05	Mr. R. K. Das	Technical Officer (Driver)	28/12/1989
06	Mrs. Chokyong Lhamu	Technical Assistant (Field. Assistant)	18/11/2008
07	Mr. Sanjoy Sarkar	Senior Technical Assistant (Driver cum Mechanic)	03/06/2016

Administrative



S. No.	NAME	Designation	Date of joining at ICAR-NRC on Yak
01	Mr. Ngoichung Khochilu	AO	21/04/1995
02	Mr. Khokan Paul	Principal Private Secretary	14/03/2011
03	Mr. Gouri Sankar Sinha	AAO	22/10/1996
04	Mrs. Rinchin Droima Dirkipa	P.A.	15/06/2006
05	Mr. Tsering Wangchu Sharchokpa	Stenographer Gd. – III	25/10/2014
06	Mr. Gautam Chattarjee	UDC	25/02/2013
07	Mrs. Mudang Yapa	LDC	20/02/2013

Supporting

S. No.	NAME	Designation	Date of joining at ICAR-NRC on Yak
01	Mr. Dawa Tsering	Skilled Support Staff	01/04/1991
02	Mr. Ngawang Tsering	Skilled Support Staff	01/12/1991
03	Mr. Rinchin Norbu	Skilled Support Staff	24/04/1992
04	Mr. Lek Phuntso	Skilled Support Staff	15/07/1993
05	Mr. Nima Dorjee	Skilled Support Staff	03/04/1995
06	Mr. Passang Khandu	Skilled Support Staff	15/12/1997
07	Mr. Tsering Khandu	Skilled Support Staff	15/12/1997
08	Mr. Sang Khandu	Skilled Support Staff	15/12/1997
09	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

15	Mr. Nima Leto	Skilled Support Staff	23/03/2021
16	Mr. Rinchin Khandu	Skilled Support Staff	08/10/2021
17	Mr. Pran Krishna Nath	Skilled Support Staff	29/08/2003

New Members

Dr. Mansukh Singh Jatana	Sr. Technical Officer (Agronomy) joined as on 09-06-2022	
Dr. Ninad Bhatt	Sr. Technical Officer (LPM) joined as on 24-11-2022	

Promotion

Mr. Ngoichung Khochilu promoted to AO from AAO w.e.f. 20.05.2022
 Mr. Gouri Sankar Sinha promoted to AAO from Assistant w.e.f. 01.06.2022
 Mr. Sanjoy Sarkar promoted to STA from Technical Assistant w.e.f. 12.10.2022

Superannuation from service

Mr. Ngawang Tsering, SSS retired on 31.03.2022

INFRASTRUCTURAL FACILITIES

EXPERIMENTAL YAK FARM

The institute yak farm is located at an altitude of 2750 metres above MSL in Nyukmadung, about 31 km away from the Dirang main campus. It is spread across 67 hectares area including 1,09,020 m² pasture of temperate grasses like *Lolium perenne*, *Dactylis glomerata* and legumes like *Trifolium repens*. Also, fodder trees like Salix and Bamboo are being cultivated for green fodder production. Different crop-grass combinations viz. grass-legume, grass-grass, grass-vegetable, are also being tried from time to time along with mulching so as to facilitate the optimum biomass growth and meet the nutritional requirements of the farm animals.



Animals are reared under semi-confinement farming system i.e. are raised both in sheds as well as open paddocks. There are in total of twenty two (22) sheds in the farm which include one (1) bull shed, two (2) kaccha sheds, three (3) open sheds, one (1) parturition shed, one (1) metabolic shed, two (2) milking sheds, four (4) calf sheds, two (2) female sheds, one (1) experimental shed and five (5) quarantine and isolation sheds. As on 31st December 2022, there were 151 yaks in the farm including 41 males and 110 females. A total of 23 calves (13 males and 10 females) were born in the farm during the year. The average recorded birth weight of yak calf was 14.65 kg with the lowest and highest recorded birth weights as 12.00 and 18.00 kg, respectively. The overall mortality rate during the year was 4.57%. All the animals were vaccinated against *Haemorrhagic Septicemia*, *Black Quarter* and *Foot and Mouth disease*.

Total milk production from yaks during the report period was 5376.2 litres with the highest production in the month of January, 2022 (576.7 litres).

Inter-species hybridization is being practiced and yak-cattle hybrids i.e. male *Dzo* and female *Dzomo* are being raised for adaptation at mid-altitudes and for higher milk production. The institute farm had one (1) yak-cattle hybrid (*Dzomo*) as experimental animals, as on 31st December 2022. Total milk yield from cows and *Dzomo* during 2022 collectively was 5599.5 litres and the maximum yield was recorded in the month of September, 2022 (505.2 litres).

FODDER PRODUCTION UNIT

The institute has a fodder production unit to grow different varieties of green fodder and tree foliages regularly in Dirang campus and Nyukmadung farm for feeding of yaks. During the year 2022, approximately 13,080 kg of *Salix* tree leaves, 3,300 kg of green oats, 53,120 kg of maize fodder and 18,100 kg of hybrid Napier grass, 1, 57,375 kg of *Dactylis glomerata* grass, 5,840 kg of Bamboo leaves, 8,955 kg of mixed tree leaves fodder and 5,336 kg of local grass were produced collectively at Dirang campus and Nyukmadung farm campus.

Fodder along with tree leaves was fed to yaks in the farm at different periods and the surplus produce during summer was used for silage preparation for feeding yaks in winter.



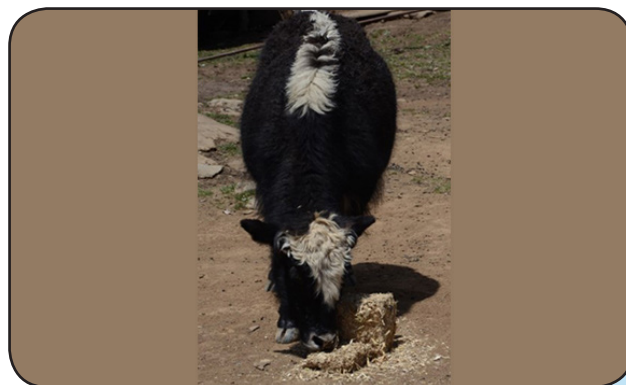
FEED TECHNOLOGY UNIT

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 Schedule Tribe Component (STC) of the institute and others like KVKs and progressive farmers. The unit has one mobile feed block making machine in Dirang with one stationary feed block machine in Nyukmadung farm campus and one chaff cutter which are used at regular interval. During the year 2022 (up to 31st December'2022) a total of approximately 2530 kgs (843 numbers) of maize stover based

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

Complete Feed Blocks were prepared and utilized for feeding animals in institute yak farm during harsh winter. The compositions of the Complete Feed Blocks prepared by the institute varies depending upon the physiological statuses of the animals and a general maintenance CFB is composed as shown in figure herewith.

The feed technology unit of the institute also has one silo pit at Nyukmadung farm for conservation of surplus fodder during summer in the form of silage under this unit. During this report period approximately 15 tons of green maize along with almost 2550 kgs of salix leaves with twigs were conserved as silage and utilized for feeding yaks during harsh winter.



RESEARCH LABORATORIES

There is a central laboratory and one Central Instrumentation Facility (CIF) in the institute with all the necessary instruments and structures to carry out basic research work. Besides, there are designated laboratories for research in different areas like:

1. Molecular Genetics Laboratory
2. Animal Biotechnology laboratory
3. Animal Nutrition laboratory
4. Animal Physiology laboratory
5. Animal Health laboratory
6. Parasitology laboratory
7. IVF Laboratory

The laboratories are well-furnished with all the requisite instruments and chemicals so as to cater to the research needs of the institute in accordance with its mandate. Laboratory facilities and equipments available at the institute includes:

Rotator microtome, Kjeltac protein analyser, ELISA reader, Ultrahigh speed centrifuge, Western Blot apparatus, Gradient thermal cycler, Real time PCR, Gel documentation system, HPLC system, Laminar Air Flow, BOD incubator, Lyophiliser, UV-Visual spectrophotometer, Automated blood analyser, Vertical and horizontal Gel electrophoresis system, Fluorescent and phase contrast microscopes, Stereozoom microscope, Live cell imaging system, Embryo freezing machine, Geranium oil extraction unit, Colour Doppler, Ultra sound machine, Micromanipulator with inverted microscope and image analyzer, Biological safety cabinets, CO₂ incubator etc. Some of the instruments like Real time PCR, ELISA Reader, Gel documentation systems, HPLC systems, stereo-zoom microscope etc. are available for use by the interested parties on payment of user charges.



LIBRARY

The institute have an well equipped library and as on 31st December, 2022, the total number of books in the library is 2952. Books covering animal nutrition, animal physiology, genetics, veterinary medicine, pharmacology & toxicology, veterinary parasitology, veterinary microbiology, veterinary parasitology, biochemistry, biotechnology, immunology and veterinary epidemiology etc are available for issuing to the members as well for reference.



For the library, number 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 the scientific literatures, lectures and books.

AGRICULTURAL KNOWLEDGE MANAGEMENT UNIT (AKMU)

AKMU cell of the Institute was established as ARIS cell in 1998. The Cell is equipped with Jio and Airtel Lease Line of 30Mbps bandwidth respectively to provide uninterrupted internet connectivity to different Sections of the Institute through LAN access points. AKMU cell is also responsible for maintaining the website of the Institute, www.nrcy.icar.gov.in, which provides information on all the latest research, publications, scientific interventions and extension activities of the Institute. A well equipped computer laboratory with printing facility is also available in the AKMU cell through which all the scientific, technical and administrative staff of the Institute can access the Internet for any office related work and information retrieval from online resources. AKMU is also responsible for facilitating virtual mode trainings and meetings for the personnel of the institute. Scientists and Officers of ICAR-NRC on Yak attending the virtual meeting related to the Secretary, DARE and DG, ICAR presentation on “Revitalizing ICAR: Aspirations and Action Plan” on November 11, 2022 as arranged by the AKMU Unit of the institute.



Staff of ICAR-NRC on Yak availing the AKMU facilities of the institute



Scientists and Officers of ICAR-NRC on Yak attending the virtual meeting Chaired by Secretary, DARE and DG, ICAR

HINDI CELL

In order to promote the use of Hindi in official communications, a Hindi cell has been created in the institute. Hindi Divas was organized on 14th September, 2022 with a focus to promote the oral as well as written usage of Hindi in the Institute. Hindi cell regularly maintains a Hindi board to convey the Hindi meanings of commonly used words in the institute. During the report period, the cell assisted in the translation and publication of institute reports and dissemination of scientific knowledge regarding yak husbandry through leaflets, pamphlets and technical papers in Hindi. In order to promote verbal usage of the language and its proper pronunciation, all the major functions and events organized in the institute during the report period were moderated in Hindi.

YAK PRODUCT TECHNOLOGY UNIT

The development of technologies related to yak products have been focused towards processing of milk and wool. This unit contributes substantially to the revenue generated by the institute. During the year 2022, the total revenue generated by the section amounted to Rs. 11, 32, 444.00

a. Milk processing unit

This unit has the expertise for preparing yak milk products like dahi, cream, ghee, lassi, paneer, churpi (loose cheese), churkam (milk candy), designer paneer and low-fat paneer. Unique value-added products like Vitamin C enriched whey beverage, kiwi flavoured whey drink, vegetable extended paneer and enrobed paneer finger have also been standardized. During the report period, the production from milk processing unit was:

Name of product	Quantity produced in 2022
Yak paneer	973.044 kg
Cow and Dzomo paneer	379.245 kg
Chhurpi	174.711 kg
Ghee	134.738 kg

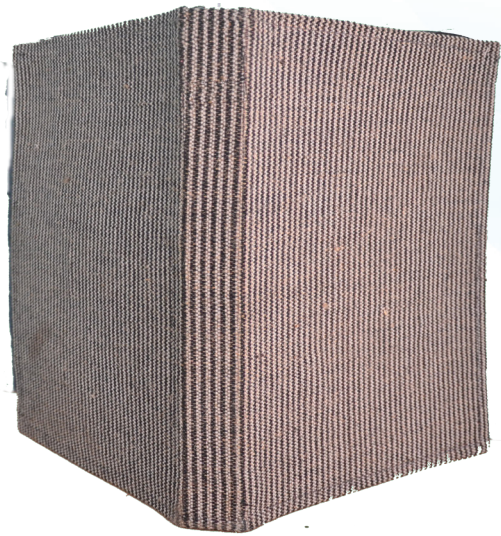
b. Wool processing unit

Yak fibre is a valuable item which could be a good source of income for the yak herdsman after proper processing of outer coarse hairs and inner fine hairs. ICAR-NRC on Yak is having a yak fibre processing facility which is equipped to make carpets, foot mat, chamar, rope/belts, mats and caps using *Choudhary charkha* and locally available tools like *Tha, Thong, Dichung, Chaksi, Yukur, Fiang, Changtha, Jamsi* etc. Sewing and interlocking machines are also available to prepare jackets and other garments. The institute is also engaged in the pursuit of blending yak and sheep wool in definite proportions to prepare creative design of sweaters, mufflers and other woollen items. Besides, the institute collaborates with ICAR-NINFET, Kolkata to prepare value-added yak fibre products (like door mats, purses, file folders bags etc.) after blending it with jute. Additionally, the institute prepared



some designer items like Yak-hair Jute blended Hat, Yak-hair Jute blended ladies side bag etc using the fabric made up of Yak Coarse hair and Jute. During the report period, the products produced by the wool processing unit included:

Name of product	Quantity produced (in numbers)
Carpet (14" X 23")	10 Nos.
Chamar white	Nil
Chamar black	01 Nos.
Blended cap (sheep + yak wool)	Nil
Coarse hair round mat	07 Nos.
File folders and zipper	122 Nos.
Coarse yak hair mat	17 Nos.
Purse	285 Nos.
Kitchen Apron	Nil
Coarse hair cap (cross Knit)	11 Nos.
Ladies bag (medium)	21 Nos.
Wall hanging	03 Nos
Half coat (ladies)	Nil
Half coat (gents)	01 Nos.
Stool cover	10 Nos.
Toilet kit	25 Nos.
Mobile bag	Nil
Scarf (muffler)	02 Nos
Hand gloves	07 Nos.
Socks	07 Nos.
Coarse yak hair cap (plain Knit)	04 Nos.
Yak and Jute blended Febric	71.875 Mtrs.



Yak-wool blended fabric products



Yak wool carpet/ Wall hanging



Yak Hair-Jute Blended Fabric & Products

HUMAN HEALTH UNIT

The institute Human Health unit has been established to cater to the medical needs of the staff and their family members. The unit engages an Authorized Medical Attendant (AMA) and one contractual worker to provide basic medical care and health facilities to the ailing scientists and staff members. As prescribed by AMA, the patient employees are also provided essential medicines from the maintained stock as per their need. During the report period, 429 cases were registered and were taken care of accordingly.

The human health section also organized a lecture on “*Motivation for Blood Donation*” by Dr. Neeraj Bhargava, Chief Medical Officer, 4th Bn, ITBP, Dirang for all the staff members on 30th May, 2022 at ICAR-NRC on Yak, Dirang campus. This was also followed by one day long blood donation drive on 31st May, 2022 which witnessed overwhelming participation by ICAR-NRCY staff and their family members.



Dr. Neeraj Bhargava, CMO, ITBP, Dirang addressing the gathering

EXPENDITURE STATEMENTS

[w.e.f. 1st January, 2022 to 31st December, 2022]

Sl. No.	Head	Amount (in Rupees)
(A) Grant in Aid - (Capital)		
1	Office Building (Original Works)	75,30,920.00
2	Residential Building	0.00
3	Minor Works	0.00
4	Equipments	14,66,627.00
5	Information Technology	8,04,917.00
6	Library Books & Journals	0.00
7	Vehicle & Vessels	0.00
8	Livestock (NEH)	0.00
9	Furniture & Fixture	2,61,576.00
10	Livestock (TSP)	7,84,000.00
11	Disaster Emergency Fund	74,00,000.00
Total (A)		1,82,48,040.00
(B) Grant in Aid - (Salaries)		
1	Establishment Charges	4,36,59,221.00
Total (B)		4,36,59,221.00
(C) Grant in Aid - (General)s		
1	Pension	19,09,560.00
2	Travelling Allowance	7,44,162.00
3	Research Expenses	85,60,596.00
4	Operational Expenses (Including TSP)	30,33,536.00
5	Repair & Maintenance	19,56,321.00
6	Others (excluding TA)	2,89,25,790.00
7	HRD	1,53,094.00
8	Other Misc. (Including TSP)	41,93,444.00
Total (C)		4,94,76,503.00
Total (A+B+C)		11,13,83,764.00

ICAR & OTHER Scheme Expenditure Statement

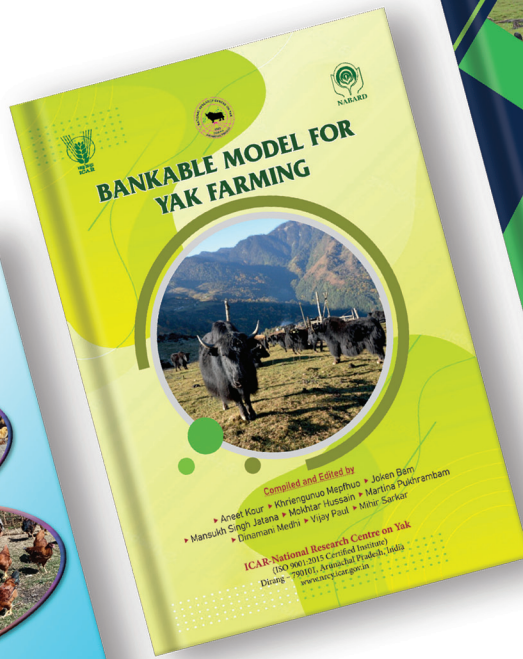
[w.e.f. 1st January, 2022 to 31st December, 2022]

Sl. No.	Head	Amount (in Rupees)
ICAR & OTHER SCHEME		
1	AICRP on PEASEM	11,60,106.00
2	FLD ICAR CARI	15,31,402.00
3	FLD ICAR DPR	3,34,717.00
4	AICRP on FMD	3,98,383.00
5	NABARD	2,47,317.00
6	CBP ICAR-IIMR Maize Project	5,00,991.00
7	ICAR-NINFET, Kolkata	1,81,950.00
8	ITMU (NAIF)	2,44,320.00
Total		45,99,186.00

Revenue Generation Statement

[w.e.f. 1st January, 2022 to 31st December, 2022]

Sl. No.	Head	Amount (in Rupees)
1	Sales proceed of farm produces	11,32,444.00
2	Sales of fruits, vegetables etc.	12,840.00
3	Sales of livestock	23,03,490.00
4	Sale of poultry egg	55,875.00
5	Sale of book	900.00
6	Other revenue	1,45,100.00
7	Licence fees	2,09,133.00
8	Generator charges	75,500.00
9	Revenue for auditorium / Conference room	30,000.00
10	Revenue of Scientist home/ Guest house	5,37,270.00
11	Tender fees	10,000.00
12	Misc. revenue	2,500.00
Total		45,15,052.00



PRESERVE YAK & ITS HERITAGE

