## DEDICATED TO ANIMAL GENETIC RESOURCES OF INDIA







#### Dear Readers,

It's a privilege to reach out to you through this edition of the ICAR–National Bureau of Animal Genetic Resources (NBAGR) newsletter. At NBAGR, we are deeply committed to preserving and promoting India's rich tapestry of livestock and poultry genetic diversity, a treasure that sustains millions of livelihoods and shapes our agricultural heritage.

In 2024, the Bureau played a pivotal role in the 21<sup>st</sup> Livestock Census, a landmark national exercise shaping the future of animal husbandry policy and planning. In partnership with the Department of Animal Husbandry and Dairying (DAHD),

we conducted 11 regional training programs across all states and union territories to build capacity among State and District Nodal Officers. This effort supported breed-wise enumeration of over six billion livestock and nine billion poultry a globally unmatched initiative. Our scientists actively contributed to technical committee meetings, aligning breed-specific data with census requirements. The Director also presented NBAGR's mission activities during a sensitization meeting at Vigyan Bhawan, New Delhi. A major highlight of the year was the release of "21st Livestock Census Livestock & Poultry Breeds: A Ready Reckoner" by the Hon'ble Union Minister of Fisheries, Animal Husbandry and Dairying on October 25, 2024, in New Delhi, marking the launch of the census operations.

Our commitment to the Zero Non-Descript Mission gained substantial momentum this year. We conducted AnGR surveys in 26 States and UTs including remote and challenging terrains like Lakshadweep, Ladakh, and Arunachal Pradesh. Through our interface meetings with state stakeholders and institutions such as CMFRI-KVK in Lakshadweep, ICAR-CCARI in Goa, and the Fisheries & Animal Resources Development Department in Odisha we have strengthened grassroots breed documentation efforts. In Odisha, a documentary on the indigenous Chilika buffalo was launched, and the application for a Geographical Indication (GI) tag for Chilika curd was formally submitted. A significant achievement this year was the characterization of 17 new native livestock and poultry populations from 10 States/UTs, including breeds like Ruhelkhandi cattle (Uttar Pradesh), Melghati buffalo (Maharashtra), Tanjavur goat (Tamil Nadu), and Shinl mithun (Mizoram). In a landmark development, seven indigenous breeds like Andamani goat, Andamani pig, and Andamani duck (Andaman & Nicobar Islands); Bhimthadi horse (Maharashtra); Anjori goat



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(Chhattisgarh); Macherla sheep (Andhra Pradesh); and Aravali chicken (Gujarat) along with the synthetic Frieswal cattle, were officially gazette-notified by DARE, Ministry of Agriculture & Farmers Welfare.

Our genomic research yielded key insights into

breed-specific adaptations ranging from high-altitude resilience in Ladakhi cattle and yaks, to epigenetic stress markers in Murrah buffalo semen. We also developed advanced SNP chips/array like Axiom\_MaruPri for camels and Axiom\_Ashwa for horses. The Genetic Testing Laboratory at ICAR-NBAGR achieved NABL accreditation for six molecular tests in cattle and buffalo, further strengthening our scientific capabilities. On the conservation front, we cryopreserved 3,820 somatic cell vials representing 43 breeds, achieving 60% coverage of recognized indigenous breeds, with a target of 100% by 2030. Our special focus remains on breeds at-risk as per the breed watchlist 2022. We established a conservation unit for Tibetan sheep in Arunachal Pradesh, along with sustained in-situ conservation activities. Public engagement was at the heart of our mission this year. Events like International Biodiversity Day (Arunachal Pradesh), the International Year of Camelids celebration (Ladakh), and our Foundation Day, showcased our commitment to breed conservation awareness. The launch of a dedicated YouTube channel, release of breed calendars, and the Breed Conservation Awards-2024 honoring five exemplary farmers and institutions demonstrate our drive to involve communities in this vital cause.

As we move forward, I extend my heartfelt gratitude to our scientists, staff, collaborators, and livestock-keeping communities. Your dedication and partnership are the backbone of our continued success.

For suggestions or queries, I welcome you to write to me at director.nbagr@icar. gov.in.

With warm regards,

(N H Mohan) Director, ICAR-NBAGR

### ICAR-NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES

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# **Institute Profile**

With the realization of the unique significance of native animal and poultry genetic resources and their potential utilization at global level, a need was felt by the ICAR in 1960s for establishing an organization which could undertake the responsibility of evaluating, certifying and conserving the country's rich and diverse germplasm resources. The establishment of two different institutes- National Bureau of Animal Genetic Resources (NBAGR) and National Institute of Animal Genetics (NIAG) was approved, in principle, during IV Five-Year-Plan. The Institute was set up on 21<sup>st</sup> September, 1984 at the campus at National Dairy Research Institute (Southern Regional Station), Bangalore and further shifted to Karnal on 19<sup>th</sup> July, 1985. Finally, NBAGR and NIAG were merged in 1995.

## **Mission**

To protect and conserve indigenous Farm Animal Genetic Resources for sustainable utilization and livelihood security.

## Mandate

- Identification, evaluation, characterization, conservation and sustainable utilization of livestock and poultry genetic resources of the country.
- Coordination and capacity building in animal genetic resources management and policy issues.

# **Objectives**

- To conduct systematic surveys to characterize, evaluate and catalogue farm livestock and poultry genetic resources and to establish their National Data Base.
- To design methodologies for *ex-situ* conservation and *in-situ* management and optimal utilization of farm animal genetic resources.
- To undertake studies on genetic characterization using modern techniques of molecular biology.

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• To conduct training programmes as related to evaluation, characterization and utilization of animal genetic resources.





# **Sectoral News**

# 21st Livestock Census (2024)

Government of India is presently conducting 21<sup>st</sup> Livestock Census. started in September 2024. The practice of Head-wise enumeration of all livestock and poultry being conducted every five years interval in our country is a unique framework in the world. The Livestock Census in India has more than 100 years of history. First Livestock Census was conducted in year 1919, by the Britishers, and so far, 20 livestock censuses have been conducted. The 19th Livestock Census (2013) had a special mark, as it initiated breed-wise animal data collection, for the first time in the country.

The Livestock Census data provide all kinds of information not only about the livestock

species but also their keepers. A complete count of the livestock and poultry at a pre-defined reference point of time is carried out during the Census, periodically. Therefore, it is important for proper planning, formulation, implementation, and monitoring of programs to improve the livestock sector. Many of the development programs require real livestock numbers in any area for their further improvement. These may be allocation of funds, supply of germplasm for the breeding, conducting disease control and eradication, nutritional support, farmers support etc. Rationalized fund allocation is feasible only after the availability of real population data, in a region. It also provides information about the present demography of various livestock species as well its trends and patterns. Breed-wise Census, therefore, become important for monitoring of the indigenous breed diversity in the country and work as a primary source for identifying the breeds at risk. The data are important for fulfilling the United Nation's Sustainable Developmental Goal 2 (Zero Hunger), specifically Indicator 2.5, related to Animal Genetic Diversity preservation in the country.

The 21<sup>st</sup> Livestock Census is the largest enumeration in terms of total livestock population and number of breeds in the country. The Census is being conducted on 15 livestock species and three major poultry species, including 220 breeds registered by the Bureau along with other exotic breeds and their crosses with head-wise enumeration, under various categories. The 21<sup>st</sup> Livestock Census is to be conducted pan India during Sept-Dec, 2024 in all 36 states and UTs. This is first time, when the Census is conducted using Web based MobileApp. The Census would cover each household in rural and urban areas in all districts/ states in the country. First time, during this Census, animals under the pastoral system and their pastoralist communities, would also be enumerated.

# Bureau's contribution in Census

Bureau is actively contributing to the upcoming 21st Livestock Census 2024, a significant national exercise that informs policy development and the strategic implementation of programs in the Animal Husbandry sector. For conducting the breed-wise Census; DAHD and NBAGR has conducted 11 Regional Trainings of the State and District Nodal Officers of all the states and UTs. Although, the enumeration of about six billion livestock and nine billion poultry is a herculean task and only one of its kind in the world; higher accuracy of the overall data in general and breed data in special of the Census is now much expected this time. In support of the census, NBAGR also provided critical breed-related information to the Animal Husbandry Statistics Division, DAHD.

The Bureau's scientists attended the DAHD's Technical Committee-Livestock Census 2024 meetings held at New Delhi, on 9<sup>th</sup> January and May 15, 2024, ensuring that the breed-specific data aligns with the census requirements. The Director of the Bureau attended the Sensitization Meeting on 21<sup>st</sup> Livestock Census 2024 at Vigyan Bhawan, New Delhi chaired by Secretary, DAHD. The Director, ICAR-NBAGR has also made the presentation on the breeds to be covered in the Livestock Census and also briefed about Mission activities of the institute. The meeting was attended by the Animal Husbandry Commissioner, DAHD; Advisor (AHS), DAHD, Chief Secretaries/Secretaries/ Commissioners/ Directors of Animal Husbandry Departments of various states. A comprehensive workshop to strategize and empower the states and Union Territories for the preparation of 21<sup>st</sup> Livestock Census was conducted on 25<sup>th</sup> June, 2024 at Vigyan Bhawan, New Delhi by the DAHD. Sh. Rajiv Ranjan Singh Hon'ble Union Minister of Fisheries, Animal Husbandry and Dairying, Gol and Senior Vice-President of the ICAR inaugurated the Workshop. He emphasized over the importance of the Census for formulation of various policies and implementation of programs for livestock improvement. Prof. S P Singh Baghel and Sh. George Kurian; Hon'ble Ministers of State, Ministry of FAHD were also present on this occasion. Dr. B P Mishra, Director NBAGR presented the breed details of species covered in 21<sup>st</sup> Livestock Census in the workshop.











Bureau has attended a workshop on 'Pilot Survey for 21<sup>st</sup> Livestock Census 2024' held on 12<sup>th</sup> June, 2024 at Ziro, Arunachal Pradesh. Dr. B P Mishra, Director NBAGR and Dr SK Niranjan, Nodal Officer made the presentations for conducting Breed-wise census along with identifiable features of the registered breeds of the states under the survey.

### **Regional Trainings on Livestock Census 2024**

Bureau participated in six 'Regional Trainings for "21st Livestock

Census on software (mobile app/dash board) and Breeds' held for the training of the State and District Nodal officers involved in Livestock Census in various states. Bureau provided the trainings on the breeds included in the Livestock Census to all the Nodal Officers. The trainings were inaugurated by the Honorable Ministers of the Central & State Governments, Secretaries, Animal Husbandry Directors, Advisor AHS, Govt. of India and other officials of the DAHD.

S.N.	States	Date	Place
1	Assam, Arunachal Pradesh, Sikkim and Meghalaya	10 July 2024	Guwahati (Assam)
2	Nagaland, Mizoram, Manipur and Tripura	12 July 2024	Dimapur (Nagaland)
3	Uttar Pradesh, Madhya Pradesh & Uttarakhand	16 July 2024	Lucknow (UP).
4	Odisha, West Bengal, Chhattisgarh, Jharkhand and Bihar	20 July 2024	Puri (Odisha).
5	Rajasthan and Gujarat	23 July 2024	Ahmedabad (Gujarat).
6	Maharashtra, Daman Div, Dadra Nagar Haveli	25 July 2024	Pune (Maharashtra)
7	Andhra Pradesh, Telangana and Karnataka	31 July 2024	Vishakhapatnam (Andhra Pradesh)
8	Tamil Nadu, Puducherry, Andaman & Nicobar and Lakshadweep	2 August 2024	Chennai (Tamil Nadu)
9	Punjab, Haryana, Himachal Pradesh, Delhi and Chandigarh	6 August 2024	Amritsar (Punjab)
10	Jammu & Kashmir and Ladakh	9 August 2024	Srinagar (J&K)
11	Kerala and Goa	13 August 2024	Panji (Goa)

#### **Release of Breed Reckoner**

21<sup>st</sup> Livestock Census Livestock & Poultry Breeds: A Ready Reckoner was released by the Union Minister of Fisheries, Animal Husbandry & Dairying, Govt. of India on 25<sup>th</sup> October 2024 at New Delhi on the occasion of Lauch of the 21<sup>st</sup> Livestock Census Operation. The Reckoner prepared by the Bureau for Livestock Census would be useful for identifying the animal breeds during conducting the Census by the enumerators and nodal officers in the country.





# **Mission Towards Zero Non-Descript AnGR**

As part of its ongoing mission to conserve and document India's unique Animal Genetic Resources (AnGR), the National Bureau of Animal Genetic Resources (NBAGR) has launched the Mission Towards Zero Non-descript AnGR of India in August 2021 and expanded several initiatives to identify new indigenous breeds across the country, and thereby reducing the non-descript livestock population. The initiative has received a great prominence, when it has also been mentioned in the Report of the Parliamentary Standing Committee for Agriculture in year 2023-24.

### AnGR Survey

AnGR survey were conducted in Arunachal Pradesh, Nagaland, Tamil Nadu, Odisha, Uttar Pradesh, Rajasthan, Maharashtra, Karnataka, J&K, Ladakh, Lakshadweep this year. Under the Mission, total 26 states / UTs have been surveyed for documentation of AnGR till now.

### Network Project on AnGR

Network project on Animal Genetic Resources (NWP-AnGR) plays a significant role in achieving the targets of the Mission. It has a vast network of State Veterinary Universities, State Animal /Veterinary Departments, ICAR institutes etc. as Network centres across the country involved in characterization of indigenous AnGR of the respective state. During 2024, six new Network Centres in various states were initiated. At present,



total 33 Network centres are involved in characterization of potential populations in 26 states/UT.

In 2024, 17 new native populations from 10 states/UT were characterized. These populations are- Ruhelkhandi cattle (Uttar Pradesh), Melghati buffalo (Mahrashtra), Tanjavur goat (Tamil Nadu), Totapuri goat (Uttar Pradesh), Umarda cattle (Maharashtra), Mullai goat (Tamil Nadu), Marluk sheep, Malra goat (Ladakh), Shinl mithun (Mizoram), Battisi goat (Uttar Pradesh), Jharkhandi buffalo (Jharkhand), Mayurbhanj chicken (Jharkhand), Kaikadi donkey (Maharashtra) Malvi sheep (Madhya Pradesh), Kow-Debar sheep (UK), Jammu Hill cattle (J&K), Periyar cattle (Kerala).

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The Gazette of India

### **Gazette Notification**

Seven indigenous breeds-Andamani goat, Andamani pig and Andamani duck of Andaman & Nicobar, Bhimthadi horse of Maharashtra, Anjori goat of Chhattisgarh, Macherla sheep of Andhra Pradesh, Aravali chicken of Gujarat; and one synthetic breed -Frieswal cattle registered by the ICAR-NBAGR in December, 2023 have been gazette notified by DARE, Min. of Agriculture & Farmers Welfare, Govt. of India [No. 4906 (S.O.5301 (E), 5302 (E) (Dec 09, 2024)].





### Hon'ble Prime Minister released Gau & Mahish chips

The NDDB developed the unified SNP chips for cattle and buffalo, after pooling the genomic data from the NBAGR, NDDB, BAIF and NIAB. Unified LD chip for cattle (Gau chip) with about 66342 markers; which carried 12871 SNPs exclusively from the LD chip of the cattle from NBAGR and rest from NDDB, BAIF, and few from public domain. Similarly, for the buffalo (**Mahish Chip**), with about 61353 SNPs, 14088 SNPs from NBAGR were included. These contributing markers from participating agencies added the robustness of the unified SNP chip, with their wider genomic distribution and increased polymorphism for indigenous cattle and buffalo populations. Both Gua chip and Mahish chip were released and dedicated to the Nation by the Hon'ble Prime Minister, Govt. of India on 5thAugust 2024 at Washim (Maharashtra).



### State Interface Meet on AnGR Documentation

*Lakshadweep:* On April 26, 2024, ICAR-NBAGR, in collaboration with CMFRI-KVK, organized the 17th State Interface Meet focused on the "Characterization and Documentation of Animal Genetic Resources (AnGR) of Lakshadweep" at Kavaratti, Union Territory of Lakshadweep. The event brought together officers from ICAR, KVK, the Animal Husbandry Department of Lakshadweep, and local livestock keepers to discuss critical issues related to indigenous AnGR management. The meet aimed to sensitize local agencies and farmers about the importance of preserving and managing indigenous animal genetic resources. Experts from NBAGR and KVK delivered insightful lectures on the various AnGR resources available in the Lakshadweep islands and outlined effective strategies for their documentation.

*Goa:* ICAR-NBAGR, in collaboration with the ICAR-Central Coastal Agricultural Research Institute (CCARI), held an Interface Meet on June 7-8, 2024, in Old Goa, focusing on the Characterization and Documentation of Goa's Animal Genetic Resources (AnGR). This mission-driven event aligns with the national goal of achieving a "Zero Non-Descript Population," aiming to identify



and document all indigenous animal breeds within Goa, thus reducing reliance on undefined or "non-descript" breeds.

Hosted at ICAR-CCARI, the meet brought together AnGR experts, state animal husbandry officials, and local livestock keepers to discuss strategies for effectively documenting and managing Goa's native breeds.

Odisha: Under the Mission towards zero non-descript AnGR of India, Bureau organized the 19th State Interface meet on 'Characterization and Documentation of Animal Genetic Resources of Odisha' in collaboration with Fisheries and Animal Resources Development Department, Govt. of Odisha and Odisha Livestock Resources Development Department (OLRDS), at Loka Seva Bhawan, Bhubaneshwar on 26 September 2024. Shri Gokulananda Mallik, Hon'ble Minister of FARD, Govt of Odisha launched a documentary on Chilika buffalo produced by ICAR-NBAGR. Shri Suresh Kumar Vashishth, Principal Secretary, Shri Ramashis Hazra, Director of Animal Husbandry & Veterinary Services, Dr. Hadibandhu Bhoi, CEO, OLRDS, Senior officers of FARD, OLRDS, Chief District Veterinary officer and members of various animal societies and filed veterinary officers attended the Meet. Dr. B.P. Mishra, Director of ICAR-NBAGR, delivered a keynote address on the mission towards zero non-descript AnGR. Bureau scientists also made presentations on AnGR documentation. Application for registration of 'Chilika Curd' as Geographical Indication (GI) was also prepared and handed over to the Odisha Livestock Resources Development Society (OLRDS) for further filing on the occasion.



# **PUBLISHED RESEARCH HIGHLIGHTS**

# Whole-genome based studies in indigenous livestock and poultry

# Genomic characterization and diversity of indigenous chicken breeds

Whole-genome resequencing of 16 indigenous chicken breeds, alongside the Red Jungle Fowl (RJF) and commercial White Leghorn (WLH), led to the identification of 76,978 SNPs for comparative analysis. The findings revealed substantial genetic contributions from RJF to native breeds and a population structure consistent with geographical distribution. Genetic differentiation ( $F_{sT}$ ) categorized the breeds into three groups. Notably, Miri and Kaunayen exhibited high levels of genetic uniqueness, marked by numerous private alleles, underscoring their importance in conservation efforts aimed at preserving avian genetic diversity.

Arora R, Kumar H, Sharma U, Ahlawat S, Sharma R, Chhabra P, Sankhyan V and Vijh RK (2024) Mapping genome-wide diversity and population dynamics in Indian chicken breeds for targeted conservation and breeding. British Poultry Science 10.1080/00071668.2024.2379968.

# Genomic variation and adaptive pathways in Indian yak populations

The genetic diversity and adaptive traits of Arunachali, Himachali, and Ladakhi yak populations were explored through whole-genome sequencing. Between 27 to 32 million SNPs and approximately 4.4 to 4.8 million Indels were identified across the three populations. Genes such as *RYR2*, *SYNE2*, *BOLA*, and *HF1* harbored a high number of impactful variants linked to stress response, immune function, and highaltitude adaptation. Functional enrichment analyses revealed key pathways associated with physiological fitness, providing a robust genomic foundation for yak conservation and adaptive trait studies in diverse ecological settings. Additionally, regions of homozygosity (ROH) hotspots were found to contain genes such as *WNT2*, *YIPF4*, *SPAST*, *TLN2*, and *DSG4*. These genes are implicated in key biological functions including the initiation of hair follicles, response to nutrient stress, microtubule organization, cardiac muscle development, and traits related to hair follicle formation and coat coloration. The presence of these genes in ROH hotspots indicates strong selective pressure, highlighting their critical role in the environmental adaptation of yak populations.

- Mahar K, Gurao A, Kumar A, Chitkara M, Gowane GR, Ahlawat S, Niranjan SK, Pundir RK, Arora R, Kataria RS and Dige MS (2024) Genomic insights into highaltitude adaptation and evolutionary dynamics of Indian yaks in the TransHimalayan region. Conservation Genetics https://doi. org/10.1007/s10592-024-01650-6.
- Mahar K, Gurao A, Kumar A, Singh LP, Chitkara M, Gowane GR, Ahlawat S, Niranjan SK, Pundir RK, Kataria RS and Dige MS (2024) Genomic inbreeding analysis reveals resilience and genetic diversity in Indian yak populations. Gene 928: 148787.

### High-altitude adaptation in Ladakhi cattle

The genome of Ladakhi cattle was analyzed to investigate their genetic structure and adaptive mechanisms to highaltitude environments. Whole-genome sequencing revealed approximately 3.76 million unique SNPs. Admixture analysis indicated a composition of 68% *Bos indicus* and 32% *Bos taurus* ancestry. These cattle exhibited low levels of inbreeding, rapid linkage disequilibrium decay, and moderate genetic differentiation from other breeds. Selection signatures were identified in genes associated with hypoxia response, energy metabolism, and cold adaptation, including *HIF1A*, *EPO*, *MAPK3*, and *MTOR*, highlighting complex molecular networks underpinning high-altitude resilience.

Koloi S, Ganguly I, Singh S and Dixit (2024) Whole genome re-sequencing reveals high altitude adaptation signatures and admixture in Ladakhi cattle. Gene 936: 149096



HIF-1 signaling pathway under selection in Ladakhi cattle



# Insights into maternal genetic diversity of indigenous livestock through mitogenome analysis

### Complex maternal origins of indigenous horses and ponies

A comprehensive mitochondrial genome (mitogenome) analysis of six indigenous Indian horse and pony breeds: Bhutia, Kathiawari, Manipuri, Marwari, Spiti, and Zanskari, has unveiled significant maternal genetic diversity. Hierarchical Analysis of Molecular Variance (AMOVA) demonstrated that 95.20% of the genetic variation exists within populations, with only 4.80% occurring among different groups, indicating limited genetic structuring based on geographic distribution. Phylogenetic analyses incorporating global mitogenome sequences revealed considerable genetic variability without clear geographic clustering. This pattern suggests extensive gene flow and interbreeding across regions. Notably, Indian horses were found to belong to seven of the 18 globally recognized haplogroups, underscoring the complex and diverse maternal origins of these breeds.

Ahlawat S, Sharma U, Niranjan SK, Chhabra P, Arora R, Sharma R, Singh KV, Vijh RK, and Mehta SC (2024) Unraveling the maternal heritage: identifying the complex origins of indigenous Indian horse and pony breeds through mitochondrial genome analysis. Mammalian Genome https://doi.org/10.1007/s00335-024-10089-6.

### Independent domestication of riverine and swamp buffaloes

Mitogenome sequencing of riverine buffaloes from diverse agro-climatic regions and swamp buffaloes from the North-Eastern Hill (NEH) region has shed light on the genetic diversity and evolutionary trajectories of Indian buffaloes. Indian swamp buffaloes predominantly belonged to the SA haplogroup, with the SB2b haplogroup reported for the first time in this population. In contrast, riverine buffaloes aligned with established sub-haplogroups RB1, RB2, and RB3, reinforcing the hypothesis that Northwestern India served as a key domestication center for riverine buffaloes. These findings provide robust support for the independent domestication events of riverine and swamp buffaloes, demonstrating the value of mitogenomic data in tracing the evolutionary history of domesticated animals.

Ahlawat S, Sharma U, Chhabra P, Arora R, Sharma R, Singh KV and Vijh RK (2024) Maternal genetic diversity and phylogenetic analysis of Indian riverine and swamp buffaloes: Insights from complete mitochondrial genomes. Mammalian Genome https://doi.org/10.1007/s00335-024-10048-1.

# Indian subcontinent: A crucial center for zebu cattle diversification

Phylogenetic analyses of three major cattle subspecies: *Bos primigenius, Bos taurus*, and *Bos indicus*, revealed distinct maternal haplogroups, indicating independent maternal origins for *Bos taurus* and *Bos indicus*. Indian zebu cattle were exclusively associated with two maternal haplogroups, 11 and 12, with no evidence of haplotypes from taurine lineages (T1–T5 and Q), suggesting an absence of foreign genetic introgression in their maternal lineage. These results support the hypothesis of separate primary domestication events for *Bos taurus* and *Bos indicus*, each derived from genetically distinct auroch populations. Divergence time analysis further confirmed that the genetic split between zebu and European cattle preceded the domestication of *Bos indicus*, substantiating its independent evolutionary trajectory.

Kumar TS, Singh S, Ganguly I and Dixit SP (2024) Mitogenome diversity and evolution of Bos indicus cattle in India. Gene 936 (2025) 149096.

# Functional genomics and epigenetics insights into economically relevant traits

### Impact of heat stress on semen quality in buffalo bulls

The effect of summer heat stress on semen quality in Murrah buffalo bulls was investigated by identifying DNA methylation signatures using Reduced Representation Bisulfite Sequencing (RRBS). Bulls were classified as seasonally affected (SA) or nonaffected (SNA) based on semen quality variations. Elevated physiological stress indicators in SA bulls correlated with



Neighbor joining tree based on the whole mitogenome sequences of African and Asian buffaloes



altered CpG methylation patterns. Differentially methylated regions were observed in genes involved in calcium transport (e.g., *ANO1*, *NPTN*), sperm structure (*SEPT4*, *SEPT6*, *SPATA*), and the FOXO signaling pathway, all associated with reduced semen quality under heat stress.

Kumar G, Gurao A, Vasisth R, Chitkara M, Singh R, Ranganatha SK, Dige MS, Mukesh M, Singh P and Kataria RS (2024) Genome-wide 5'-C-phosphate-G-3' methylation patterns reveal the effect of heat stress on the altered semen quality in Bubalus bubalis. Gene 906: 148233.

#### Adaptation to hypoxic conditions in Changthangi sheep

The genetic and physiological adaptations of Changthangi sheep to high-altitude hypoxia were explored via comparative transcriptomic profiling of muscle, skin, lung, and heart tissues with Muzaffarnagri sheep. In Changthangi sheep, genes involved in melanin biosynthesis (e.g., *TYR*, *TYRP1*), immune signaling (NF-kB, cytokine pathways), and cardiac remodeling (apoptosis, EGFR signaling) were significantly up-regulated. These adaptations enhance UV protection, oxygen utilization, and cellular resilience. In contrast, Muzaffarnagri sheep exhibited gene expression patterns associated with metabolic homeostasis and structural stability, indicative of lowland environmental adaptation.

- Arora R, Kaur M, Kumar A, Chhabra P, Mir MA, Ahlawat S, Singh MK, Sharma R and Gera R (2024) Skeletal muscle transcriptomics of sheep acclimatized to cold desert and tropical regions identifies genes and pathways accentuating their diversity. International Journal of Biometerology https://doi.org/10.1007/s00484-024-02708-3.
- Gera R, Arora R, Chhabra P, Sharma U, Parsad R, Ahlawat S, Mir MA, Singh MK, Sharma R and Kumar R (2024) Comparative transcriptome analyses of cardiac tissue reveals differential gene expression profiles in sheep in response to altitudinal adaptation. Small Ruminant Research 238: 107330.
- Gera R, Arora R, Chhabra P, Sharma U, Parsad R, Ahlawat S, Mir MA, Singh MK and Kumar R (2024) Exploring transcriptomic mechanisms underlying pulmonary adaptation to diverse environments in Indian rams. Molecular Biology Reports (2024) 51: 1111.
- Vasu V, Ahlawat S, Chhabra P, Sharma U, Arora R, Sharma R, Mir MA and Singh MK (2024) Genetic insights into fiber quality, coat color and adaptation in Changthangi and Muzzafarnagri sheep: A comparative skin transcriptome analysis. Gene 891: 147826.

#### Pashmina fiber development in Changthangi goats

A transcriptomic comparison between Changthangi goats and Changthangi sheep highlighted molecular determinants responsible for the exclusive production of Pashmina fiber by the goats. Changthangi goats showed significantly higher expression of genes in pathways such as Wnt, MAPK, PI3K-Akt, and Hedgehog, all critical for hair follicle development, epidermal stem cell maintenance, and fiber traits. Additionally, genes involved in cell adhesion molecules and ECM-receptor interactions were enriched, emphasizing their role in follicle structure, signaling, and fiber formation.

Ahlawat S, Vasu V, Mir MA, Singh MK, Arora R, Sharma R, Chhabra P and Sharma U (2024) Molecular insights into Pashmina fiber production: comparative skin transcriptomic analysis of Changthangi goats and sheep. Mammalian Genome 35(2): 160-169.

### Heat tolerance in Jamunapari goats

Thermo-tolerance in Jamunapari goats was examined through transcriptomic analysis of heat-tolerant (HT) and heat-susceptible (HS) animals exposed to high environmental stress (THI >92). RNA-Seq of PBMCs identified 734 differentially expressed genes (DEGs), including modules related to heat tolerance, respiration, and cardiac function as determined by Weighted Gene Co-expression Network Analysis (WGCNA). Enrichment of genes involved in mitochondrial function, immune regulation, and metabolic pathways offers vital insights into the molecular mechanisms of heat resilience and climate-adaptive traits in goats.

Dige MS, Gurao A, Mehrotra A, Singh MK, Kumar A, Kaushik R, Kataria RS and Rout PK (2024) Deciphering the molecular mechanisms of heat stress tolerance in goats: Insights from transcriptome and Gene Coexpression analysis. Journal of Thermal Biology 125: 104007.

# Advancing livestock genomics through SNP arrays

Commercial SNP genotyping arrays, widely utilized in livestock genomics, often lack adequate representation of genetic variation unique to Indian breeds. This underrepresentation introduces ascertainment bias, which may obscure the presence of distinct alleles and rare variants characteristic of indigenous germplasm. To overcome these limitations and ensure precise genomic characterization, species-specific SNP arrays have been developed for Indian horses/ponies and camels, facilitating accurate genotyping and enabling advanced genetic research tailored to native livestock populations.

# Axiom\_MaruPri: A medium-density SNP chip for Camelus bactrianus and Camelus dromedarius

The Axiom MaruPri chip, encompassing 182,122 SNP markers, was designed from re-sequencing data of nine Indian dromedary breeds and the double-humped Bactrian camel. Of these, 34,894 markers are polymorphic across both species, enabling cross-species genotyping. The chip achieves an average inter-marker distance of 14 kb, significantly enhancing genome coverage for camelids. Validated on 480 camel samples, the chip delivered an impressive average call rate of 99%, with 96% of SNPs proving highly reliable. Phylogenetic and DAPC analyses clearly differentiated Bactrian from dromedary camels, and further enabled breed-level classification within dromedaries. The Axiom\_MaruPri array offers enhanced genomic resolution, economic viability, and high genotyping precision. It is poised to serve as a critical genomic resource for population genetics, genome-wide association studies (GWAS), and the implementation of genomic selection strategies in camel breeding programmes.

Vijh RK, Sharma U, Arora R, Kapoor P, Raheja M, Sharma R, Ahlawat S and Dureja V (2024) Development and validation of the Axiom-MaruPri SNP chip for genetic analyses of domesticated old world camelids. Gene 921: 148541.







Neighbour joining phylogenetic tree depicting genetic relationship of Indian dromedary and Bactrian camels based on Medium density SNP Array

#### Axiom\_Ashwa: A high-density SNP chip for Indian horses and ponies

The Axiom\_Ashwa chip was developed using whole-genome re-sequencing data from two horse breeds and four pony breeds indigenous to India. Comprising 613,950 SNPs, this high-density array provides extensive genome-wide coverage with an average inter-marker distance of approximately 4 kb. The chip was validated on a diverse panel of indigenous equine samples, including Thoroughbreds, and demonstrated a robust average call rate of 99.4%. Phylogenetic and population stratification analyses utilizing Principal Component Analysis (PCA) and Discriminant Analysis of Principal Components (DAPC), effectively distinguished between horses, ponies, and thoroughbreds. These findings affirm the chip's efficacy and utility in genetic analysis, offering a cost-effective and high-throughput solution for comprehensive genetic characterization of Indian equine germplasm.

Ahlawat S, Niranjan SK, Arora R, Vijh RK, Kumar A, Sharma U, Raheja M, Popli K, Yadav S and Mehta SC (2024) Advancing equine genomics: the development of a high density Axiom\_Ashwa SNP chip for Indian horses and ponies. Functional & Integrative Genomics 24:195.

### Quest for reference genes for qPCR analysis

Quantitative PCR (qPCR) is a widely utilized technique for quantifying gene expression across different tissues and under varying physiological and environmental conditions. The identification of stable and universally applicable reference genes remains a fundamental step in gene expression studies across species and tissue types.

# Reference genes in ovine and caprine tissues

A comprehensive evaluation involving 18 candidate reference genes from various functional categories was conducted across ten tissues: muscle, skin, kidney, liver, intestine, rumen, lung, testis, heart, and spleen, as well as peripheral blood mononuclear cells in sheep and goats. Stability analysis using the RefFinder algorithm, which integrates multiple computational tools (geNorm, NormFinder, BestKeeper, and the comparative  $\Delta$ Ct method), identified ACTB, PPIB, BACH1, and B2M as the most reliable reference genes for normalization in gPCR studies across these tissues.

Ahlawat S, Vasu V, Choudhary V, Arora R, Sharma R, Mir MA and Singh MK (2024) Comprehensive evaluation and validation of optimal reference genes for normalization of qPCR data in different caprine tissues. Molecular Biology Reports 51: 268. Vasu V. Ahlawat S. Choudhary V. Kaur R. Arora R.

a dromedary and Sharma R, Sharma U, Chhabra P, Mir MA and Singh MK (2023) Identification and validation of stable reference genes for expression profiling of target genes in diverse ovine tissues. Gene 897: 148067.

### Normalizer genes in buffalo bull spermatozoa

In Murrah buffalo bulls, the stability of nine candidate reference genes was assessed across different seasons using the 'endoGene' computational pipeline. This analysis revealed *GAPDH* and *PP1A* as the most stable and suitable reference genes for gene expression studies in buffalo spermatozoa, ensuring robust data normalization irrespective of seasonal variations.

Vasisth R, Gurao A, Chitkara M, Kumar G, Sriranga KR, Mukesh M, Dige MS, Singh P, Aggarwal RAK and Kataria RS (2024) Selection of reference genes for normalizing gene expression data across seasons in spermatozoa of water buffalo (Bubalus bubalis). International Journal of Biometeorology 68(7):1397-1409.

# Development of PCR-based test to detect genetic defect

A stop-gain mutation (rs715966442; located at position 102,463,944 on BTA11) in the *transcription termination factor 1 (TTF1*) gene has been identified as a causative factor for abortion in Holstein Friesian (HF) cattle. To detect this mutation, a PCR-restriction fragment length polymorphism (PCR-RFLP) assay was developed and validated. This genetic screening protocol was applied to 80 HF and HF crossbred animals, identifying two carriers of the mutant *TTF1* allele. The assay is economical, efficient, and highly accurate, making it a valuable tool for identifying carriers of the *TTF1* mutation within the HF population.

Surati U and Niranjan SK (2024) Development of PCR-based genetic test for detection of TTF1 mutation causing abortion in Holstein Friesian cattle. Reproduction in Domestic Animals 59(5):e14581.





## Cryopreservation of germplasm

Preserving the genetic diversity of India's Animal Genetic Resources (AnGR) is an important mandate for the ICAR-NBAGR. Since its designation as the national Germplasm Repository in 2008 under the Biological Diversity Act, ICAR-NBAGR has led efforts in safeguarding genetic material of domesticated animals through cryopreservation, supporting the United Nations' Sustainable Development Goal (SDG) 2 on Zero Hunger. In 2024, the Bureau cryopreserved the germplasm of 3820 somatic cell vials from 43 breeds/populations in the National Gene Bank. This effort contributes to the long-term conservation of AnGR diversity under SDG Indicator 2.5.1, with preservation reaching into 2024. Aiming to achieve 100% cryopreservation of indigenous breeds by 2030, NBAGR has already preserved the germplasm of around 60% of such breeds. Special focus is given to breeds at risk, with 12 at risk breeds conserved through somatic cell cryopreservation by 2024.

# Celebrations

### **Celebration of the International Biodiversity Day, 2024**

Bureau celebrated International for Biodiversity (IBD) on 22<sup>nd</sup> May, 2024 among Arunachali Yak pastoralists at ICAR- NRC on Yak, Dirang (Arunachal Pradesh). Program was organized in collaboration with the NRC on Yak, Deptt. of Animal Husbandry, Veterinary and Dairy Development, Govt. of Arunachal Pradesh. About 120 pastoralists and scientists of ICAR, Officers of AHV& DD attended the program. Dr. Raghavendra Bhatta, DDG (AS), ICAR was the Chief Guest of the Day. Ten Yak pastoralists belonging to different regions of West Kameng and Tawang were also felicitated by the Chief Guest for promoting Arunachali Yak. A Memorandum of Understanding (MoU) was signed between ICAR-



NBAGR, ICAR-National Research Centre on Yak (ICAR-NRCY) and Arunachal Pradesh Yak Herders & Products Development Cooperative Society Ltd. for sustainable utilization, promotion and improvement of Arunachali yak on 22<sup>nd</sup> May, 2024 at NRCY.

### Establishing Tibetan sheep conservation unit

Conservation Unit was established for Tibetan sheep of Arunachal Pradesh at Regional Sheep Breeding Farm, Deptt. Of AHV&DD, Sangti, Dirang (Arunachal Pradesh) under the Network project on AnGR. Tibetan sheep is a threatened indigenous breed as per Breed Watchlist 2022 released by ICAR-NBAGR.

### **Celebrating International Year of Camelids- 2024 in Ladakh**

Bureau, in collaboration with Animal Husbandry Department of the Ladakh organized the International Year of Camelids-2024 with the double humped camel keepers and other stakeholders in Nubra valley of Ladakh (UT) on 9<sup>th</sup> September, 2024. About 60 double humped owners, along with the Bureau scientists, Dr Raghvendra Bhatta, Deputy Director General (Animal Science), ICAR; Dr B P Mishra, Director NBAGR, scientists of the Bureau, Officers of Animal Husbandry Department, DIHAR, District Administration attended the program. Camel owners were felicitated for conservation of the species. Three monographs on Double humped camel, yak and donkey of Ladakh were also released.







## **Bureau's Foundation Day celebration**

ICAR-NBAGR celebrated its 41<sup>st</sup> Foundation Day on 21<sup>st</sup> September, 2024. Sh. Sanjay Kumar, Chairman, ASRB gave the Foundation Lecture and emphasized over the true role of the AnGR, in terms of bio economy as well as their economical, ecological, values and nutraceutical uses. Breed calendars for indigenous cattle and buffalo breeds was released by the chief guest. An official YouTube channel of the Bureau was also launched. Bureau staff along with Chairman, ASRB also participated in Swachhta Abhiyan and made a Human chain for the awareness and planted the trees along with staff.

### **Breed Conservation Awards on Rashtriya Kisan Diwas**

ICAR-National Bureau of Animal Genetic Resources (NBAGR), Karnal organized "Breed Conservation Award-2024" on 23<sup>rd</sup> December, 2024 on "National Farmers Day" and felicitated animal breeders/farmers and institutions, across the country, for their efforts for conserving the indigenous animal breeds. Dr A K Srivastava, Vice Chancellor, U.P. Pt. DUVASU, Mathura and chief guest of the occasion. Shri Jagat Hazarika, Advisor (Statistics), Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India, New Delhi, on the occasion told that native livestock breeds are country's heritage and addressed the delegates. Total 5 farmers/livestock keepers and five institutions/organizations were awarded for conservation and improvement of indigenous breeds.

### List of Awardees

Prize	Awardee	Breed Conserved			
Individual category					
First	Shri Bhanwar lal, Bara, Rajasthan.	Malvi camel			
Second	Shri Margundan Nandukuppannam, Dharmapuri, Tamilnadu	Tiruchi black sheep			
Third	Shri Dilip Ganpatrao Kulkarni, Udgir, Maharashtra	Red Kandhari cattle			
	Shri Balan Maadhappan, Salem, Tamilnadu.	Mecheri sheep			
Consolation	Shri Surendra Awana, Dudu, Rajasthan	Bikaneri Camel			
Institutional category					
First	Animal Breeding Farm, Dehradun Uttarakhand	Red Sindhi cattle			
Second	ICAR- National Research Centre on Camel, Bikaner, Rajasthan	Mewari camel			
Third	Khillar Cattle Breeding Centre, Haveri, Karnataka	Khillar cattle			
	ICAR-National Research Centre on Equines, Regional Station, Bikaner, Rajasthan	Halari Donkey			
Consolation	Livestock Research and Information Centre (Deoni), Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka	Deoni cattle			

### Skill Development Programme

Second Skill Development Programme on Basic Bioinformatics Tools for Genome Analysis was conducted in hybrid mode during 18-22 March, 2024. Total 50 participants (15 offline and 35 online) of diverse backgrounds including scientists, research research scholars, and students from plant and animal science fields belonging to more than 10 states attended the training program.







## **Brain Storming Session in Maharashtra**

Bureau scientists attended the Brain Storming Session Workshop on "Advanced Research Avenues for Genetic Improvement in AnGR of Maharashtra" at MAFSU, Nagpur on 29<sup>th</sup> August 2024. Dr BP Mishra, Director, ICAR-NBAGR was the Chief Guest. Head, Animal Genetics Division and two other scientists along with MAFSU faculty participated in the Session.

## Workshop on the Animal Genetic Resources of Ladakh

A workshop and stakeholder meet on 'Status and Way forward for Characterization, Registration & Value Addition of Animal Genetic Resources of Ladakh' was organized by ICAR-National Bureau of Animal Genetic Resources, Karnal, in collaboration with the Animal Husbandry Department of Ladakh at Leh (Ladakh) on 17th December 2024. The workshop was attended by the scientists of the ICAR-NBAGR, DRDO- Defence Institute of High Altitude Research (DIHAR), KVK-Leh, Officers of Dept. of Animal Husbandry, and Sheep Husbandry, Ladakh, livestock keepers and pastoralists.

The Chief Guest Shri Tashi Gyalson, Chief Executive Councillor, Ladakh Autonomous Hill Development Council, emphasized the importance of conserving Ladakh's distinct breeds and lauded work carried out by NBAGR. Dr Raghavendra Bhatta, DDG (Animal Science), ICAR, highlighted the importance of such initiatives in sustaining the biodiversity of high-altitude regions and creating avenues for value addition and economic upliftment for local communities. The Guest of Honour, Tashi Namgyal Yakzee, Executive Councillor (Animal Husbandry), LAHDC, Leh highlighted the activities and schemes carried out by the council for farmers of Ladakh. Dr B P Mishra, Director, ICAR-NBAGR, Karnal, Dr O.P. Chaurasia, Director, DIHAR also addressed the delegates. The workshop featured the release of publications on Ladakh's animal genetic resources and a documentary on Ladakh AnGR. More than 60 pastoralists from across Ladakh rearing cattle, yak, sheep, goats, donkeys, horses, etc., were felicitated on the occasion.

### Handson Training to Animal Husbandry Official

A Handson training on DNA Testing is being conducted for five Veterinary Officers of Animal Husbandry Department, Govt. of Haryana during 22-26 July 2024.

### Training Programme on AnGR management

Five days Training Programme on 'Characterization, Registration and Conservation of Native Animal Genetic Resources' sponsored by Fisheries & Animal Resources Development Department (FARD) Govt. of Odisha was organized by the Bureau on 5<sup>th</sup>-9<sup>th</sup> August, 2024 and 19<sup>th</sup> -23<sup>rd</sup> August, 2024. Total 32 Officers of the FARD attended the training in two batches.





### NABL Accreditation for Genetic Testing Laboratory at ICAR-NBAGR

ICAR-NBAGR marked a major milestone with the NABL assessment and subsequent ISO 17025:2017 accreditation of its Genetic Testing Laboratory (GTL), achieved on May 17, 2024. The accreditation covers six genetic tests for cattle and buffalo, following an intensive assessment conducted from March 23-24, 2024. Recognized by the National Accreditation Board for Testing and Calibration Laboratories (NABL), this accreditation endorses the GTL's competency in testing genetic diseases such as Bovine Leukocyte Adhesion Deficiency (BLAD), Citrullinemia, Factor XI Deficiency, and Deficiency of Uridine Monophosphate Synthase (DUMPS) in cattle, as well as A1A2 allele genotyping.

These accredited genetic tests are vital for the early identification of genetic disease carriers, especially in breeding males, enhancing the health and productivity of dairy animals. The newly accredited A1A2 allele genotyping, significant for milk value assessment and selective breeding for the A2 allele, exemplifies NBAGR's dedication to advancing livestock genetics.

### **Farmers Program and Outreach**

### Farmer-scientist interaction and distribution of germplasm under SCSP plan

ICAR-NBAGR organized a Farmer-scientist Interaction program at Earathu grama panchayat Parakode (Minor) block, Kollam district, Kerala on 5<sup>th</sup> March 2024; in collaboration with KVASU, Mannuthy and AHD, Govt. of Kerala under SCSP plan. During the program, 11 clusters of 40 goat keepers (SC category) were supplied elite Malabari buck for their goat breeding and improvement in the region. Comprehensive support package (utensils, goat feed, mineral mixture, de-wormers, a training manual, leaflets, and an anaemia check card) was also supplied to individual goat farmers.



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CERTIFICATE OF ACCREDITATION GENETIC TESTING LABORATORY

ISO/IEC 17025:2017 "General Requirements for the Competence of Testing &

Calibration Laboratories'

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Skill Development Training on goat rearing was also

conducted in collaboration for the selected goat farmers in the Parakode block during 4<sup>th</sup> - 5<sup>th</sup> March, 2024. Farmers were trained on various animal husbandry topics including goat nutrition, breeding, and disease control.

#### Women farmers and scientists interface meet under SCSP

A women farmers and scientists interface meet under SCSP program was organized at Munak village in Karnal district (Haryana) on 7<sup>th</sup> March 2024 in collaboration with LUVAS wherein 100 women farmers participated in the event. The officers interacted with the women farmers and explained in detail about the program, scientific housing, management and health aspects of livestock as well as characterization and conservation of Animal Genetic resources. Mineral mixture, liver tonic, calcium, dewormer, digestive stimulant etc were distributed among100 beneficiaries belonging to SC community.

### Farmers Interactive program under SCSP

A program under Schedules Caste Sub-Plan (SCSP) was organized and an interactive programme with farmers and livestock keepers was conducted at Mallimajra -Mustafabad village of Yamunanagar district (Haryana) on 13<sup>th</sup> March 2024. The programme was attended by about 125 farmers and they were educated about importance of rearing indigenous livestock. A kit consiting of nutritional supplements and de-worming medicines was distributed to the 90 SC beneficiaries to enhance the productivity of their livestock.





### Interactive Meet and Animal Health Camp

ICAR-NBAGR in collaboration with SKUAST-Jammu organized a Farmers Interactive Meet cum Animal Health Camp in Sumbli village, Samba district of Jammu & Kashmir (UT) on 14<sup>th</sup> March, 2024. Farmers were informed about animal health, nutrition, breeding, feeding, and management, as well as the prevention and control of major livestock diseases. The initiative included the provision of feed, medicines, and parasite screening. Concurrently, a human health camp was conducted Medical Officer of SKUAST-Jammu, offering free haemoglobin estimation, blood tests, and supplements to the villagers. Over eighty farmers attended, they received livestock kits and actively engaged in enlightening discussions facilitated by domain experts.

### Conducting Scientists -Farmers Interface Meet in Changthang -Ladakh

Scientists -Farmers Interface Meet was organized on 11<sup>th</sup> September 2024 at Sapo, Changthang (Ladakh) with highland pastoralists of Changthang region. Farmers were sensitized about scientific management of indigenous AnGR and pastoralism. Around 25 pastoralists attended the program.

#### **Farmers Scientists interaction**

Bureau Scientists visited breeding tract of Chilika buffalo in Puri district & Binjharpuri cattle breeding tract in Jajpur district of Odisha and conducted Scientist-Farmers interaction meetings on 27-28 September, 2024. Another interaction of Bureau scientists with the pastoralists /livestock keepers was held in Dalang village for Lahaul & Spiti district of Himachal Pradesh on 19.10.2024.

*Ladakh*: Scientists -Farmers Interface Meets were organized on 16, 18 & 19<sup>th</sup> December 2024 at Gya, Lamayuru and Kanji villages of Ladakh with cattle, yak and donkey keepers and highland pastoralists of the region, in collaboration with the Animal Husbandry Department of Ladakh. Farmers were sensitized about scientific management of indigenous AnGR and pastoralism. Around 25 pastoralists attended the program. Dr Raghavendra Bhatta, DDG (AS) ICAR, Dr B P Mishra, Director, ICAR-NBAGR, other scientists of the NBAGR, Officers of Dept. of Animal Husbandry, Ladakh, Dept. of Animal Husbandry, Ladakh attended the programs. Feed/ neutraceutical supplements were also distributed to the beneficiaries under the TSP.

Kerala: А Farmers Skill Development Training program (under TSP fund) for tribal goat farmers was organized by the Bureau during 3-4 December, 2024 in Palakkad district, Kerala in collaboration with CVSc, Mannuthy. Total 113 tribal goat farmers attended and to all the beneficiaries a comprehensive support package comprising utensils, goat feed, mineral mixture, de-wormers, training manuals, leaflets, and an anemia check card were distributed. The sessions emphasized skill development



on critical areas of goat rearing, including nutrition, breeding, and disease management.

## हिंदी में कार्य करने के लिए नराकास करनाल से प्रथम पुरस्कार

ब्यूरो को वर्ष 2023 में हिंदी में कार्य करने के लिए नराकास करनाल से प्रथम पुरस्कार प्राप्त हुआ। ब्यूरो द्वारा प्रकाशित हिंदी पतिका-पशुधन पतिका को भी प्रथम पुरस्कार प्राप्त हुआ।





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**ICAR-NBAGR** 

Cattle (53)

Buffalo (20)

Sheep (45)

Goat (39)

Camel (9)

Synthetic Cattle (1)

Horse & Ponies (8)

Poultry (20)

Duck (3)

Geese (1)

Yak (1) Donkey (3)

Dog (3)

Pig (14)

