DEDICATED TO ANIMAL GENETIC RESOURCES OF INDIA

भाकृअनुप–रापअनुसंब्यूरो समाचार-पत्र
ICAR-NBAGR Newsletter

Volume 20
January-December, 2023

Warm Greetings from ICAR-NBAGR!

I am delighted to connect with you through the ICAR-National Bureau of Animal Genetic Resources (NBAGR) newsletter. As the custodian of India's invaluable livestock and poultry germplasm, we are dedicated to our mission of safeguarding, characterizing, conserving, evaluating, and sustainably utilizing Animal Genetic Resources (AnGR). I am pleased to share exciting news that India has been elected as Vice-chairperson and represented Asia in the 12th Session of the Intergovernmental Technical Working Group (ITWG-AnGR) on Animal Genetic Resources at the FAO headquarters in Rome. During 2023, ICAR-NBAGR has made significant progress in documenting and conserving indigenous AnGR. With the registration of new breeds, the total number of indigenous animal breeds in India now stands at 219, covering various species including cattle, buffalo, goat, sheep, horses, ponies, camels, pigs, donkeys, dogs, yaks, chickens, ducks, and geese. Especially, the registration of Frieswal cattle marks a significant milestone as the first synthetic breed in the country.

Our unwavering commitment to mission towards zero-non descript AnGR of India has driven us to identify and characterize native animal germplasm across diverse terrains, including remote areas like the Andaman and Nicobar Islands. Through extensive surveys and interface meetings with state animal husbandry departments and universities, we continue to deepen our understanding of genetic diversity and uniqueness in our native breeds.We have identified 13 new homogeneous populations across 14 states through surveys. Moreover, our research endeavours have yielded significant results, such as identifying key markers for analysing native cattle admixture and assessing genome-based inbreeding in Indian goat breeds. We have also advanced our understanding of specific genomic regions in native goat breeds, conducted transcriptome analysis to evaluate heat stress in indigenous buffalo, and performed skin transcriptome profiling in Changthangi sheep.

In line with our commitment of conservation and management of valuable genetic resources, ICAR-NBAGR introduced the Breed Watchlist-2022 to assess the risk status of indigenous breeds. We have initiated in-situ conservation units for crticially threatened breeds like the Teressa goat, and to date, nineteen at-risk indigenous breeds have been cryopreserved at the National Gene Bank. I am delighted to highlight our recognition of stakeholders for the registration of indigenous animal breeds by the Indian Council of Agricultural Research (ICAR). We also celebrated the establishment of the Ladakhi Cattle Breed Society on the International Day for Biological Diversity (IBD) at Ladakh, highlighting our commitment to advancing regional breed conservation efforts. As we move forward, we are committed to actively involving stakeholders and encouraging collaboration. Our efforts, such as the Breed Conservation Awards-2023 and participation in national and international events, emphasize our dedication to excellence and the sharing of knowledge.

As we progress, I extend heartfelt thanks to our devoted scientists, staff, stakeholders, and community members for their unwavering support. Your input and partnership are essential as we pursue excellence across all facets of our mission.

For any suggestions or queries, please reach out to me directly at director.nbagr@icar.gov.in.

With warm regards!

[B.P. Mishra]

HIGHLIGHTS OF THIS ISSUE...

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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 21st September, 1984 at the campus at National Dairy Research Institute (Southern Regional Station), Bangalore and further shifted to Karnal on 19th 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.
- To conduct training programmes as related to evaluation, characterization and utilization of animal genetic resources.

Major activities

Identification, characterization and documentation of native AnGR in country

- Survey and documentation of entire livestock and poultry population in the country with a target towards Zero Non- Descript AnGR of India.
- Identification and characterization of homogenous populations qualifying for breed.
- Registration and notification of all types of livestock and poultry populations.

Conservation of native breeds of livestock and poultry species

- *In situ* conservation of threatened breeds of livestock and poultry.
- Cryopreservation of germplasm of all registered breeds
- Assessing risk status of native breeds.

Genomics for population structure and diversity of native AnGR

- Assessing genomic diversity and uniqueness of all registered livestock and poultry breeds.
- Developing molecular signature for breed standard of native breeds.
- Creation of genome assemblies for native breeds of high importance.

Trait identification and characterization of native AnGR for value addition

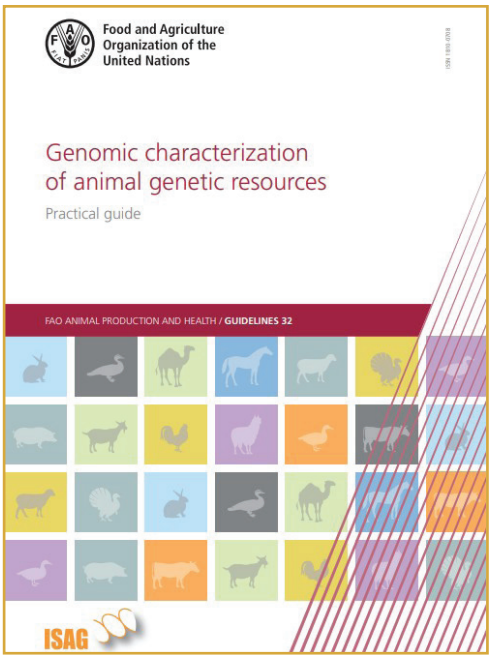
- Characterization of unique products and identification of biomolecules in milk and meat of native germplasm and their effect/utility for human nutrition and health.
- Transcriptome and metabolome for evaluating adaptive and endurance traits of native breeds.

Policy support and capacity building for AnGR management

- Creation of databases and other ICT on AnGR for policy support in the country.
- Developing policy support for AnGR management in states.
- Organizing training and sensitization programs for AnGR management.
- Providing consultancy services to government agencies for policy support.

Sectoral News

The FAO's *Genomic characterization of animal genetic resources – Practical guide*



Utilizing the insights may facilitate the dissemination of knowledge aimed at enhancing the genetic characterization of AnGR, leading to improved sustainable practices and conservation of livestock genetic diversity; in recently published document on "Genomic characterization of animal genetic resources – Practical guide" by the Food and Agriculture Organization (FAO) of the UN.

The document consists of five main sections plus appendices.

- **Section 1:** Outlines the rationale for characterization of AnGR.
- **Section 2:** Describes the complete process of genomic characterization.
- **Section 3:** Describes the main methods for transforming biological samples into genomic data.
- **Section 4:** Explains the most common applications for the use of genomic data for characterization of populations.
- **Section 5:** Contains the main conclusions and recommendations.

Finally, nine appendices are included that provide in-depth information to complement the main sections.

The creation of this document aligns with Strategic Priority 2 of the Global Plan of Action, which emphasizes the establishment of international technical standards and protocols for AnGR characterization. It underwent review by an independent panel of experts, as well as by Members of the Commission on Genetic Resources for Food and Agriculture and its Intergovernmental Technical Working Group for Animal Genetic Resources. Although the document endeavors to present the latest advancements in genomic characterization of AnGR, technology will inevitably progress, necessitating ongoing refinement and updates to reflect new developments and field experience.

India elected Vice-chair in ITWG

India participated in the 12th Session of the Intergovernmental Technical Working Group (ITWG) on Animal Genetic Resources (WG-AnGR), held at Food and Agriculture Organization (FAO) headquarters in Rome during 18-20 January 2023 and elected as Vice-chair, representing Asia. Dr BN Tripathi, Deputy Director General (Animal Sciences), ICAR, the National Coordinator, Vice-chaired the Session. He also worked as a Rapporteur for the Session.

The WG-AnGR established by the FAO's Commission on Genetic Resources for Food and Agriculture (CGRFA), functions to review technical issues; advise and make recommendations to the Commission and further implementing the Commission's programme related to AnGR, at a global level. Earlier, India was elected as a member of the WG-AnGR in the 18th Session of the CGRFA held in September 2021. Other Asian members are China, Malaysia, the Philippines, and the Republic of Korea.

In the 12th Session of ITWG, implementation of the Global Plan of Action for Animal Genetic Resources, monitoring of AnGR diversity and preparing 3rd Country Report were reviewed. It also discussed role of microorganisms relevant to ruminant digestion, the role of genetic resources in mitigation of and adaptation to climate change; access and benefit-sharing for AnGR; and "digital sequence information" and potential implications for the conservation and sustainable use of genetic resources. Earlier, in the Global National Coordinators' Workshop held in Rome, during 16-17th January, 2023, Indian efforts to preserve its large AnGR diversity were widely appreciated. Dr BN Tripathi presented about the country's breed diversity, the cataloguing of native breeds, breed registration and notification system and efforts to document non-descript AnGR. In the workshop, he also shared the country's experience in filling the data in the Domestic Animal Diversity – Information System (DAD-IS) and suggested including more species and relevant data to define a breed in the DAD-IS portal. National priorities for germplasm cryopreservation and documenting non-descript AnGR to fulfill SDG indicators were widely commended by the FAO members.

Dr BN Tripathi, DDG (AS) ICAR attending ITWG at FAO, Rome

Mission Activities *- On the path to achieving "Zero non-descript AnGR of India"*

Newly registered indigenous breeds

ICAR-National Bureau of Animal Genetic Resources, in December 2023 registered seven new indigenous breeds- Andmani 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, based on the recommendation of Breed Registration Committee (BRC) of ICAR. After registration of these breeds, total indigenous animal breeds are now 219 in the country, including 53 for cattle, 20 for buffalo, 39 for goat, 45 for sheep, 8 for horses & ponies, 9 for camel, 14 for pig, 3 for donkey, 3 for dog, 1 for yak, 20 for chicken, 3 for duck, 1 for geese. The Bureau also registered Frieswal cattle as the first synthetic breed in the country.

The BRC headed by Deputy Director General (Animal Science), ICAR is the apex body for registration of newly identified animal breeds in the country. The BRC chaired by Dr J K Jena, DDG (AS), ICAR, in its 11th meeting on 5th December, 2023 approved the registration of these livestock and poultry breeds of different states. The Bureau also allotted Accession numbers to these registered breeds.

Accession numbers of the new registered breeds

S.N.	Species	Name of breed	Native tract	Accession Number
1.	Chicken	Aravali	Gujarat	INDIA_CHICKEN_0400_ARAVALI_12020
2.	Duck	Andamani	Andaman & Nicobar	INDIA_DUCK_3300_ ANDAMANI_11003
3.	Goat	Anjori	Chhattisgarh	INDIA_GOAT_2600_ANJORI_06038
4.	Goat	Andamani	Andaman & Nicobar	INDIA_GOAT_3300_ANDAMANI_06039
5.	Horse	Bhimthadi	Maharashtra	INDIA_HORSE_1100_BHIMTHADI_07008
6.	Pig	Andamani	Andaman & Nicobar	INDIA_PIG_3300_ANDAMANI_09014
7.	Sheep	Macherla	Andhra Pradesh	INDIA_SHEEP_0100_MACHERLA_14045
8.	Synthetic Cattle	Frieswal	Uttar Pradesh Uttarakhand	INDIA_CATTLESYNTHETIC_2024_FRIESWAL_04001

Aravali chicken is a dual-purpose chicken used for meat and egg, distributed in Banaskantha, Sabarkantha, Aravalli and Mahisagar districts of Gujarat State. Males have birchen, while females shafty and/or laced plumage patterns. These birds show excellent heat tolerance. In adult males, the average body weight is 2 Kg. Female produces 72 eggs annually, on average.

Andamani duck is a dual-purpose breed, distributed in Nimbudera to Diglipur region of Andaman & Nicobar Islands (UT). The whole body of these birds is covered with black plumage with white markings under the neck extending up to the belly. The average adult body weight for drake is 1406 gm. The average annual egg production is 266 eggs.

Anjori goat is a medium-sized goat, used for meat purposes. It is distributed in Raipur, Durg, Rajnandgaon, Kanker, Dhamtari, and Mahasamund districts of Chhattisgarh state. The majority of animals are brown in colour. It is hardy and well-adapted to the local climate. The average adult body weight for males is 35 kg and for females is 28 kg.

Andamani goat is a medium-sized animal, reared for meat purposes in the Middle and North Andaman districts of Andaman & Nicobar Islands (UT). These goats are well adapted to the tropical hot-humid climate of the island. Meat is preferred for its excellent quality by the local people. The average adult body weight of males is 29 kg. The average milk production per lactation is 29 kg.

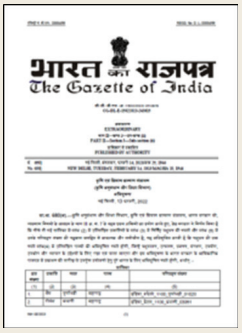
Bhimthadi horse is distributed in the Pune, Solapur, Satara, and Ahmadnagar districts of Maharashtra. The average height of a stallion is about 130 cm and of a mare is 128 cm. The predominant coat colour is liver chestnut. The chest barrel is well-developed. Bhimthadi horses are mainly used for transportation of household materials during the migration of the pastoralist people.

Andamani pig is a native to the islands of Andaman & Nicobar (UT) and is mainly reared for meat (pork). These pigs are sturdy and medium in size. The coat is mostly black and sometimes rusty gray. They are fast runners and have evolved to thrive under a low-input management system. The average adult body weight is 71 kg in males and 68 kg in females.

Macherla sheep is a meat-purpose sheep breed of Guntur, Krishna, and Prakasam districts of Andhra Pradesh and nearby regions of Telangana**.** It is medium to large. The coat color is white with large black or brown patches on the body, face and legs. The average adult body weight for males is 43 kg.

Frieswal is synthetic dairy cattle with Sahiwal (37.5) and Holstein Friesian (62.5) inheritance, developed by ICAR-Central Institute for Research on Cattle, Meerut. It is capable of producing about 7000 kg of milk yield in a standard lactation with a peak yield of about 41 kg. This breed is acclimatized to all agro-climatic regions of the country.

Gazette Notification indigenous breeds


भारत का राजपत्र
The Gazette of India

Ten indigenous animal breeds, registered in August 2022 were gazette notified by the DARE, Ministry of Agriculture and Farmers Welfare, Govt of India in February 2023 [No. 650 (S.O.680(E)) (Feb 13, 2023)]. These breeds are - Sanchori cattle (Rajasthan) and Masilum cattle (Meghalaya); Purnathadi buffalo (Maharashtra); Sojat goat (Rajasthan), Karauli goat (Rajasthan) and Gujari goat (Rajasthan); Banda pig (Jharkhand), Manipuri Black pig (Manipur) and Wak Chambil (Meghalaya).

This was fifth gazette notification for the registered breeds. Till now 212 indigenous breeds have been gazette notified by the Government.

Interface meetings on AnGR documentation

Arunachal Pradesh

The 14th State-wise interface meet on "Characterization and Documentation of Animal Genetic Resources of Arunachal Pradesh" was organized by ICAR-NBAGR on March 23, 2023, at Animal Husbandry Directorate, Nirjuli (Arunachal Pradesh) under "Mission towards zero non-descript AnGR of India". About 60 delegates including the officers of Department of Animal Husbandry, Veterinary & Dairy Development, Arunachal Pradesh (AHVDD), Arunachal Pradesh State Biodiversity Board, Scientists of ICAR and scholars of Rajiv Gandhi University participated in the event.

Andaman & Nicobar (UT)

Interface Meet on documentation of AnGR of Andaman & Nicobar under the Mission towards Zero Non-descript AnGR of India was organized in ICAR-CIARI, Port Blair on May 8, 2023. Scientists of ICAR-NBAGR, CIARI and officers of AHD attended the meet.

Interface meetings in progress

Kerala

The Bureau organized an interface meet for 'Documentation of Indigenous AnGR of Kerala' at College of Veterinary and Animal Sciences, Mannuthy on September 8, 2023, in collaboration with Animal Husbandry Department, Govt. of Kerala and Kerala Veterinary and Animal Sciences University (KVASU). This was the 16th State Interface Meet under the mission. About 60 delegates including Officers of State Animal Husbandry Department, Kerala Livestock Development Board, Faculty of College of Veterinary and Animal Sciences, research scholars, and progressive farmers ensured their participation in the event.

Participants of the interface meet of Kerala

Initiatives on characterization of indigenous AnGR

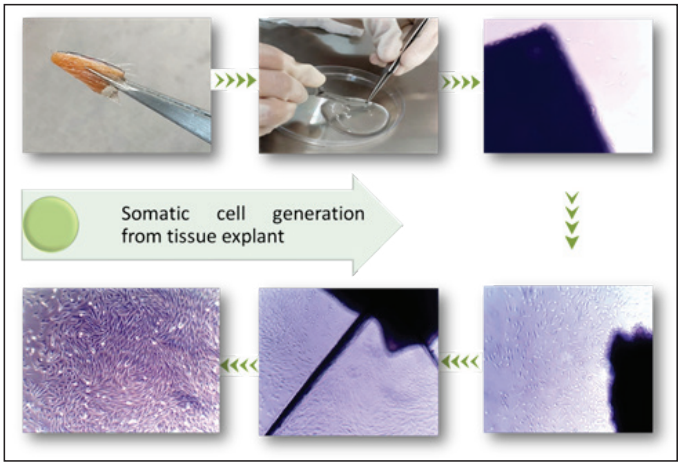
- AnGR survey in 13 states/UT (Arunachal Pradesh, Nagaland, Tamil Nadu, Odisha, HP, UP, Bihar, Rajasthan, Maharashtra, Meghalaya, Gujarat, Ladakh, Andaman & Nicobar); total 19 states and 2 UTs under the Mission.
- Initiated 24 new Network Units in 20 states/UT for characterization of native populations. Total 27 Network Units in 23 states/UT.
- Characterization of 8 new native populations of 8 states/UT. Khamgaon cattle and Balona buffalo in Maharashtra, Simanchali sheep and Sitamrhi goat in Bihar and Monyul cattle in Arunachal Pradesh, Mullai goat of Tamil Nadu, Marluk sheep, Malra goat of Ladakh.

Conservation of AnGR

Conservation Initiatives of Threatened Teressa Goat of Andaman & Nicobar Islands

Dr BN Tripathi, Deputy Director General (Animal Sciences), ICAR inaugurated the first conservation unit of Teressa goat at ICAR-Central Island Agriculture Research Institute (CIARI). ICAR-NBAGR provided technical support for establishing the conservation unit. Teressa goat is one of the threatened indigenous breeds as per Breed Watchlist 2022 released by NBAGR, New Delhi. Dr. E.B. Chakurkar, Director, ICAR-CIARI showcased the modern, ecofriendly and less labor-intensive goat sheds at ICAR-CIARI.

Cryopreservation of germplasm



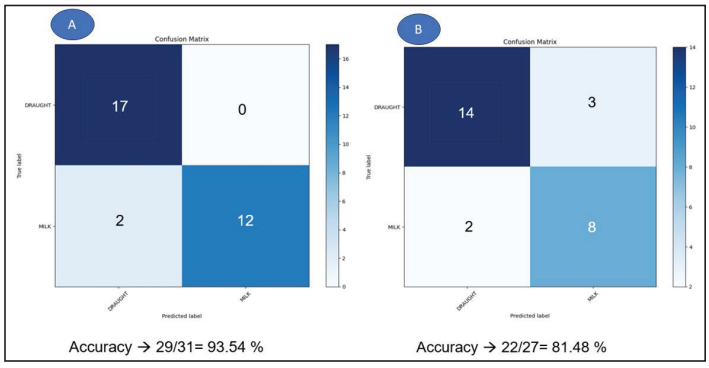
Preservation of Animal Genetic Resources (AnGR) diversity is of utmost priority for posterity as an effective AnGR management in the country. ICAR-NBAGR has been notified as a Germplasm Repository for safe custody of the genetic material of domesticated animals by the Government of India in 2008 under the Biological Diversity Act. Cryopreservation of germplasm is an important activity under the United Nation's Sustainable Development Goal (SDG) 2 (Zero Hunger). During 2023, the germplasm of a total of 24 breeds was cryopreserved in the form of semen and somatic cells in the National Gene Bank of the Bureau. 18050 semen doses of 9 breeds and 1760 somatic cell vials of 15 breeds were cryopreserved. Under Medium & Long-term conservation of AnGR under (SDG) Indicator 2.5.1, the bureau has cryopreserved the germplasm-Semen of 63 indigenous breeds/populations, -and Somatic cell of 49 breeds/populations have been cryopreserved at the National Gene Bank of the Bureau upto 2023. Further, the Bureau has cryopreserved the germplasm of around 45 percent of indigenous breeds in the country and further committed to cryopreserve the germplasm of all indigenous breeds by 2030. As a special effort through somatic cell cryopreservation, fourteen indigenous breeds at risk as per the Breed Watch List were conserved by 2023.

Research Accomplishments

Assessment of Genetic Diversity of AnGR

Identification of markers for admixture analysis of native cattle

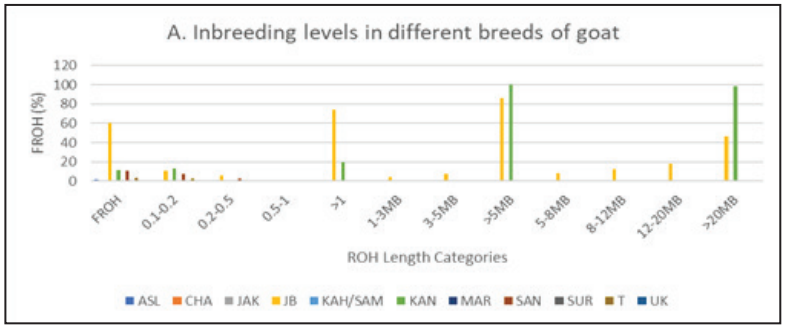
The concept of ancestry informative markers (AIMs) involves identifying the likelihood of origin of a population from the DNA sample where the source individual is not known or is unable to declare their ancestry. They are mainly used for studying admixture and inferring individual biogeographical ancestry. The analysis identified the top 1000 SNPs out of >50,000 SNPs in cattle based on three fundamental statistical measures: Delta value, Wright's F_{ST} value, and Informativeness for assignment (In) value. Notably, the 1st ranked SNP exhibited a Delta value of 0.43, while the 1000th ranked SNP displayed a slightly lower Delta value of 0.36. In the context of Wright's F_{ST} statistic, the leading SNP had an F_{ST} value of 0.38, whereas the 1000th ranked SNP showed an F_{ST} value of 0.24. Meanwhile, the top-ranked SNP possessed an In value of 0.72, while the 1000th ranked SNP registered an In value of 0.43. Significantly, 657 markers were found to be common across the three statistical measures, signifying their consistent high ranking and highlighting their potential importance in genetic analyses. The Ancestry Informative Markers (AIMs) were able to classify dairy and draft breeds with an accuracy of 93.54% whereas the accuracy of such classification was 81.48% based on selection signatures. The machine learning models may further enhance the precision and efficiency of breed discrimination and classification.



A) Accuracy of classification of breeds as milk and draught purpose using Breed informative markers. B) Accuracy of classification of breeds as milk and draught purpose using selection signatures.

Assessment of genome-based inbreeding in Indian goats

Runs of Homozygosity (ROH) were analyzed in 102 individuals from eleven Indian goat breeds using whole-genome sequencing on Illumina NOVASEQ 6000 platform. A total of 51,705 ROH and 21,271 consensus regions, with distinct patterns across breeds, were identified. The meat breed Jharkhand Black exhibited the highest number of ROH, while the Changthangi showed the lowest. The study links long ROH to recent inbreeding and short ROH to ancient inbreeding. Notably, Kanniadu displayed higher recent inbreeding levels than Jharkhand Black, but the latter had a higher overall F_{ROH} (inbreeding based on ROH) due to a mix of recent and ancient inbreeding. Dairy breeds (Jakhrana and Surti) and pashmina-producing Changthangi exhibited low consanguinity in Runs of Homozygosity (ROH) patterns, while meat breeds (Jharkhand Black, Kanniadu, Sangamneri, and Tellicherry) displayed noticeable recent inbreeding. Furthermore, analysis of ROH consensus regions highlights selection sweeps in genes governing traits such as fat deposition, meat production, milk fat percentage, mammary gland development, and cold adaptation in different breeds.



Genomic inbreeding (F_{ROH}) in all 11 goat breeds in various ROH length categories

Trait characterization and value addition of AnGR

Identification of climate-specific genomic regions in native goat breeds

The genomic adaptation of Indian goat breeds to tropical (Beetal, Sirohi, Osmanabadi, Jamunapari) and temperate (Chegu, Chagthangi, Gaddi) ecosystems was explored based on whole-genome sequencing (WGS) data analysis. Whole-genome sequencing of 55 samples from seven breeds identified 40.02 million SNPs and 6.5 million INDELs. Selection signature analysis, utilizing F_{ST}, CLR, XPEHH, and nucleotide diversity methods, identified key candidate genes such as NOS2, DNAJC3, and DNAJC28 for cold adaptation and DNAJC6 and DNAJB14 for heat tolerance. Enriched KEGG pathways associated with hair follicle growth, morphogenesis, Ras Signaling, MAPK Signaling, and focal adhesion were elucidated. Notably, the enrichment of the HIF-1 signaling pathway in the temperate group highlights their adaptability to high-altitude hypoxic environments. This research work

provides valuable insights into the genomic landscape of adaptation in Indian goat breeds, contributing to our understanding of the evolutionary responses to diverse environmental conditions.

Skin transcriptome profiling of Changthangi sheep

Changthangi sheep, which inhabit the high-altitude regions of Ladakh, are known for their fine fiber production and are characterized by grey skin and either black or white coats. In contrast, Muzzafarnagri sheep from the plains of Uttar Pradesh produce coarse wool and have white skin and coats. Comparative global gene expression profiling was conducted on four biological replicates of skin from each breed. The analysis identified 149 up-regulated genes and 2,139 down-regulated genes in Changthangi sheep compared to Muzzafarnagri sheep, with a p-adjusted value (padj) of ≤ 0.05 and a Log2 fold change of ≥ 1.5. Gene Ontology analysis of the up-regulated genes revealed an enrichment of terms related to melanin biosynthesis and developmental pigmentation. Additionally, enriched KEGG pathways included tyrosine metabolism and metabolic pathways. Among the melanogenesis-related genes that exhibited higher expression in Changthangi sheep were *TYR, TYRP1, DCT, SLC45A2, PMEL, MLANA,* and *OCA2*. These findings confirm melanin's role in both the animals' black coat color and UV protection at high altitudes. Furthermore, more pronounced expression of genes related to fiber quality, namely *KRTAP6, KRTAP7, KRTAP13,* and *KRTAP2,* was observed in the fine wool-producing sheep from Ladakh. The research provided insights into the genetic differences associated with distinct phenotypic traits and environmental adaptability.

Delineating proteomic signatures of colostrum of native cows in high altitude region

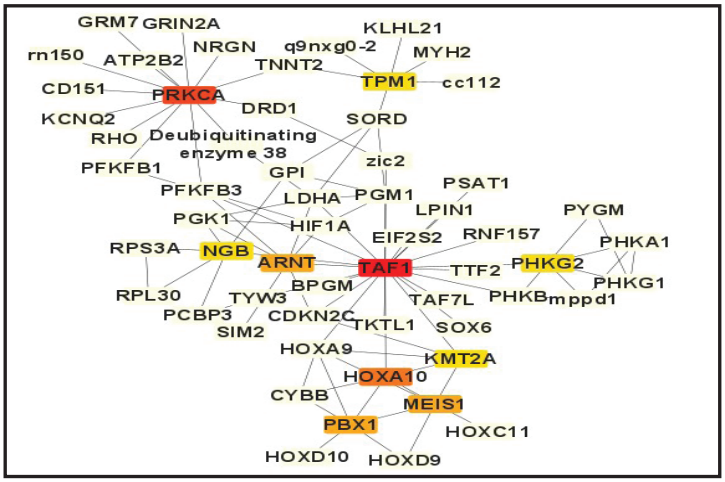
For characterizing the proteomics signatures of colostrum and mature milk in Ladakhi cows adapted to high altitude region of Ladakh (UT), the LC-MS/MS-based ultra-deep characterization of whey protein samples of colostrum (0-day) and mature milk (>60 days) was performed. Among 815 proteins identified, 268 proteins were present in high abundance in colostrum as well as mature milk of Ladakhi cows. The most abundant proteins in colostrum *vis a vis* mature milk of Ladakhi cows (with a fold change > 2) were-Clusterin (4.14); Alpha-1-acid glycoprotein (3.89); Alpha-1B-glycoprotein (3.57); Tyrosine-protein kinase (3.44); Serotransferrin (2.90); Alpha-2-macroglobulin (2.68); Alpha-2-HS-glycoprotein (2.68); and Vitamin D-binding protein (2.32); demonstrating uniqueness of the milk proteome of Ladakhi cows.

Metabolome signatures of colostrum of native bovines

NMR-based metabolome data in 180 samples of colostrum, transition and mature milk of Ladakhi cows, yak, Sahiwal cows and Murrah buffaloes was generated. A total 46 metabolites in milk colostrum, transition and mature milk of Ladakhi cows, yak, Sahiwal cows and Murrah buffaloes were identified with varying concentrations. Zero-day colostrum was distinctly different while, 2-day and 4-day samples clustered together. Hierarchical clustering based on metabolite concentration in colostrum and mature milk showed distinct clustering indicating the species-specific metabolomic signatures. Analysis revealed the dynamic nature of colostrum metabolome, as many of the metabolites decreased from 0-day to transition (2-day and 4-day) and mature milk.

Skeletal muscle transcriptomics of sheep acclimated to cold desert and tropical regions

The differences in gene expression in *longissimus thoracis* muscles between sheep breeds acclimated to diverse environments were investigated. Changthangi sheep inhabits the cold arid plateau of Ladakh, at an altitude above 3000 metres with prevalence of rarefied atmosphere. Muzzafarnagri sheep, on the other hand is found in the sub-tropical hot and humid plains at an altitude of about 250 metres. Comparative transcriptomics was used to provide a molecular perspective of the differential adaptation of the two breeds. RNA sequencing data was generated from four biological replicates of the *longissimus thoracis* muscles from both breeds. The common genes expressed in both breeds were involved in muscle contraction and muscle fibre organization. The most significant pathways enriched in Changthangi muscles were glycogen metabolism, reduction of cytosolic Ca^{++} levels and NFE2L2 regulating anti-oxidant, while those in Muzzafarnagri were extracellular matrix organization and collagen formation. The hub genes identified in Changthangi were involved in hematopoiesis and HIF signaling pathway, suggesting the molecular acclimatization of Changthangi to the high altitude cold desert of Ladakh. The nodal genes discovered in Muzzafarnagri sheep were associated with the extracellular matrix which accentuates its significance in the development, growth and repair of muscles. The observed transcriptomic differences underscore the morphological and adaptive disparity between the two breeds. The candidate genes and pathways identified in this study will form the basis for future research on adaptation to high altitude and body size in small ruminants.



Gene-protein network for up-regulated genes in Changthangi sheep, showing top 10 hub genes ranked on the basis of maximal clique centrality (MCC). Colour of nodes changes from yellow to red in increasing order of rank.

Important Events

ICAR felicitated stakeholders for registering indigenous animal breeds

The Indian Council of Agricultural Research (ICAR) honored stakeholders for the registration of 28 indigenous animal breeds during the period of 2020 to 2022. A ceremonial event was hosted on February 16, 2023, at the NAS Complex, ICAR, New Delhi. Approximately 80 delegates, including 60 breed applicants from 17 states, were recognized for their contributions. The ceremony was attended by vice-chancellors and directors of various State Agricultural Universities, State Veterinary Universities, along with Deputy Directors General (DDGs) and Assistant Directors General (ADGs) of ICAR. Shri Narendra Tomar, the Honorable Union Minister of Agriculture & Farmers Welfare, Government of India, participated as the chief guest in virtual mode. Shri Tomar praised the applicants and other contributors for their efforts toward breed applications and emphasized the need for intensified efforts by all stakeholders to reduce the proportion of non-descript AnGR in the country. He appreciated ICAR's initiative for a country-wide mission to identify such breeds. Ms. Alka Nagia Arora, Additional Secretary, DARE & Financial Advisor, ICAR; Dr. B.N. Tripathi, Deputy Director General (Animal Sciences), ICAR; and Dr. Abhijit Mitra, Animal Husbandry Commissioner, Government of India, also commended the breed applicants. The program garnered extensive coverage in both print and electronic media nationwide.

Dignitaries felicitating the breed applicants

Ladakhi Cattle Breed Society established in Ladakh

The Ladakhi Cattle Breed Society was established in Ladakh for the promotion of Ladakhi cattle in the region. During the "International Day for Biological Diversity (IBD)" celebration on May 22, the logo of the Society was released by the DDG (AS), ICAR. An MoU for the promotion of the Society was also signed between ICAR-NBAGR and AHD, Ladakh (UT).

This was the first effort of the Bureau to established breed society in the Himalayan region of the country.

Exhibition during ICAR Foundation Day

On the occasion of ICAR-Foundation – Technology Day, a combined exhibition by the Animal Science Division was showcased at the NAS Complex. The exhibition highlighted activities on "Characterization and registration of indigenous breeds of India," capturing the Honorable Minister of FAHD's interest in the Bureau's mission activities.

Release of Breed Watchlist 2022

The "Breed Watchlist 2022," published by ICAR-NBAGR, was released by the Honorable Minister of FAHD, MoS-A&FW, DG-ICAR during the ICAR Foundation Day on July 16, 2023. This publication, based on the 20th Livestock Census data, assesses the threat status of indigenous breeds and outlines the population trends of registered breeds in the country. It serves as a crucial tool for prioritizing indigenous breeds for conservation and formulating appropriate strategies by stakeholders.

Interactive Meet with Bioversity International

The Bureau hosted an Interactive Meet on the Agrobiodiversity Index (ABDI) - AnGR Component with the Alliance of Bioversity International & CIAT, Region-Asia (India Office) at ICAR-NBAGR, Karnal, on August 11, 2023. The meeting saw participation from Dr. J.C. Rana, Country Representative, India Office, Alliance of Bioversity International & CIAT, Region-Asia, along with his team.

Skill Development Training Programme

A five-day-long Skill Development Training Programme on "Basic Bioinformatics Tool for Genome Analysis" commenced on October 16, 2023, at ICAR-NBAGR, Karnal. The programme was attended by 76 participants from diverse groups including professors, teachers, scientists, research associates, SRF/JRFs, research scholars, and students from medical, plant, and animal sciences fields across 18 states. The training program aimed to build capacity for analyzing eukaryotic genomes to assess genetic diversity and identify unique genomic regions using bioinformatics tools. The training was structured into five distinct modules.

ISAGB National Symposium

The National Symposium on "Advances in Genetics and Genomics for Sustainable Livestock Transformation" was organized by ICAR-NBAGR in collaboration with the Indian Society of Animal Genetics & Breeding (ISAGB) in hybrid mode during November 17-18, 2023. The symposium drew approximately 200 participants, including scientists, researchers, academicians, students from various institutes, and retired faculty members, both offline and online.

Dr. JK Jena addressing the delegates of the symposium

Breed Conservation Awards on Rashtriya Kisan Diwas

On December 23, 2023, the Bureau celebrated "National Farmers Day" by organizing the "Breed Conservation Award-2023." The event honored animal breeders/farmers and institutions nationwide for their conservation efforts of indigenous animal breeds. Dr. G.K. Gaur, Assistant Director General (AP&B), Indian Council of Agricultural Research, New Delhi, served as the chief guest. A total of eight farmers/livestock keepers and nine institutions/organizations were recognized for their contributions to the conservation and improvement of indigenous breeds.

Breed Conservation Awardees at the Bureau

List of Awardees

Prize	Awardee	Breed conserved
Individual category		
First	Sh. D Ranjit Kuttan, Nilgiri (Tamil Nadu)	Toda buffalo
	Sh. Surendra Awana, Dudu (Rajasthan)	Gir cattle
Second	Sh. Harshit Jhuria, Sikar (Rajasthan)	Tharparkar cattle
	Sh. Prem Singh Rao, Jodhpur (Rajasthan)	Tharparkar cattle
Third	Sh. Deva Ram, Barmer (Rajasthan)	Marwari goat
	Sh. Jadeja GabhubhaVagha Ji, Kachchh (Gujarat)	Patanwadi sheep
Consolation	Sh. Satyajit Khachaar, Jasdan (Gujarat)	Gir cattle
	Sh. Surendra Kumar, Hanumangarh (Rajasthan)	Sojat goat
Institutional category		
First	Gomantak GausevakMahasang, Goa	Shweta Kapila cattle
	Amritmahal Cattle Breeding Centre, Chikkamagaluru, Karnataka	Amritmahal cattle
Second	ICAR-National Research Centre on Equines, Equine Production Campus, Bikaner, Rajasthan	Marwari horse
	Poultry Research Station, Tamil Nadu Veterinary and Animal Sciences University, Chennai	Aseel chicken
Third	Bargur Cattle Research Station, Bargur, Tamil Nadu	Bargur cattle
	AICRP on Cattle- Sahiwal, GBPUA&T, Pantnagar, Uttarakhand	Sahiwal cattle
Consolation	Sri Venkateswara Veterinary University, Lam, Andhra Pradesh	Ongole cattle
	ICAR- Central Avian Research Institute Izatnagar, Bareilly, UP	Nicobari chicken
	Red Kandhari Research & Instructional Farm, COVAS, Parbhani (M.S.)	Red Kandhari cattle

Celebrations

Republic Day

The 74th Republic Day was celebrated at the Bureau with great zeal and enthusiasm among the staff and their families. The National Flag was unfurled by the Director of ICAR-NBAGR in a ceremonial gesture. On this occasion, the "Best Division Award 2022" was bestowed upon the Animal Genetics Division of the Bureau, recognizing their exemplary contributions and achievements.

International Women's Day

ICAR-NBAGR commemorated "International Women's Day" on the 6th and 7th of March, 2023, with a series of events dedicated to women's empowerment, aligning with this year's theme, "Digit ALL: Innovation and Technology for Gender Equality." The events witnessed enthusiastic participation from all staff members and students. A variety of competitions, including speeches, extemporaneous speaking, and rangoli creation, were organized and outstanding contributions were awarded.

Rangoli competition participants with the judging team

World Intellectual Property Day

ICAR-NBAGR celebrated 'World Intellectual Property Day' on April 26, 2023, embracing the theme "Women & IP: Accelerating Innovation & Creativity." The celebration involved all scientific staff, research associates, senior research fellows, as well as Postgraduate and Ph.D. students engaged in research at the institute. A lecture on "Intellectual Property Rights (IPR)" was delivered by the In-charge ITMU to raise awareness among faculty members and young scholars about the importance of intellectual property rights. Furthermore, an Extempore Competition focused on the theme of "Women & IP" was organized, with the participation of 15 research scholars, facilitating a platform for dynamic discussions on the subject.

Dr S K Niranjan, I/c ITMU delivering a lecture on IPR

International Biodiversity Day 2023

The Bureau commemorated International Day for Biological Diversity (IBD) on May 22, 2023, amongst Ladakhi cattle keepers in the high altitudes of Leh, Ladakh. The event was organized in collaboration with the Animal Husbandry Department of Ladakh (UT). Approximately 100 delegates, including scientists from the Bureau, officers from the Animal Husbandry Department of Leh, and livestock keepers, attended the program. Dr. B.N. Tripathi, DDG (Animal Science), ICAR, graced the occasion as the Chief Guest. Nineteen Ladakhi cattle keepers from various regions of Ladakh were felicitated by the Chief Guest for their contribution to promoting Ladakhi cattle. Discussions on the Livestock Breeding Policy for Ladakh (UT) took place during the workshop. Additionally, a Breed Monograph on Ladakhi cattle was released.

Delegates during the International Day of Biodiversity celebration

Independence Day

The Bureau celebrated the 77th Independence Day with the unfurling of the National Flag by the Director, followed by a cultural program on the Bureau campus. The "Har Ghar Tiranga" campaign was also observed by the staff from August 13-15, 2023.

Children's performance on Independence Day

40th Foundation Day

ICAR-NBAGR celebrated its 40th Foundation Day on September 21, 2023, by organizing various activities involving farmers, scientists, and researchers. Dr. S.L. Goswami, former Vice Chancellor of Banda University of Agriculture & Technology and former Director of ICAR-NAARM, delivered the Foundation Lecture on "AnGR Biodiversity in India: Readiness for Impending Climate Change." Dr. G.K. Gaur, Assistant Director General (AP&B), ICAR, also addressed the Bureau staff on this occasion. An updated version of the Bureau's website was launched by the dignitaries.

In celebration of the Foundation Day, forty plants were planted on the Bureau premises by the staff.

A poster competition themed 'AnGR Biodiversity of India: Readiness for Impending Climate Change' was held at the Bureau on September 21, 2023. Research scholars participated in the competition, presenting their posters. Winners were awarded for their insightful contributions.

Dignitaries during the "Foundation Day celebration"

Glimpses of the plantation drive in the Bureau premises

Research scholars participating in the poster competition

Vigilance Awareness Week

In accordance with the directive from the Central Vigilance Commission, the Bureau observed Vigilance Awareness Week from October 30 to November 5, 2023. The week's activities commenced with Dr. B.P. Mishra, the Director of the Institute, leading the officers and employees in taking an oath to "Say no to corruption; commit to the Nation," thereby reinforcing the commitment to transparency within the institution.

Documentary of the Bureau by DD Kisan

A documentary showing various activities of the Bureau was prepared by the DD Kisan during July 26-28, 2023. The documentary was subsequently telecasted on DD Kisan under Shrestha Santhan series on August 20, 2023.

FAO's Intergovernmental Technical Working Group-AnGR Meeting

An online meeting of the FAO's Intergovernmental Technical Working Group-AnGR for preparation of the 3rd Report of State of the World Animal Genetic Resources for Food & Agriculture was attended by the DDG (AS), ICAR and Director, ICAR-NBAGR held on August 17, 2023.

Interface Meet with AHS, DAHD

The second interface meet between Animal Husbandry Statistics, Dept. of Animal Husbandry & Dairying, GoI and ICAR-NBAGR was held on December 12, 2023. Mr Jagat Hazarika, Advisor (Statistics) and Dr VP Singh, Director, AHS of the DAHD attended the meeting. Discussions on technical support for conducting the Breed-wise Livestock Census were held during the meeting.

Distinguished Lectures Organized

Under Azadi ka Amrit Mahotsav, ICAR-NBAGR organized a motivational Speech on the "Power of Positive Thinking" by Prof. Onkar Chand Sharma (Mt Abu) on May 18, 2023. The programme was attended by all the staff and students of the Bureau with full zeal and enthusiasm.

Motivation speech by Prof. Onkar Chand Sharma

ICAR-NBAGR in association with National Academy of Agricultural Sciences (NAAS) Karnal Regional Chapter organized a special lecture on 'Genomic Selection of Cattle and Buffaloes in India – Challenges and Prospects' which was delivered by Dr S P Dixit, Head, Animal Genetics Division, ICAR-NBAGR at ICAR-NBAGR on May 30, 2023. All scientific staff and research scholars attended the lecture. Dr M.L. Madan, Padma Shree Awardee and Convener of the NAAS Karnal Regional Chapter presided over the programme.

Dr SP Dixit delivered the lecture on Genomic Selection during NAAS-Karnal Regional Chapter Lecture series

Under the ISAGB-Distinguished Lecture Series, a lecture on "Human Origin, Health and Diseases" was organized on August 23, 2023. The lecture was delivered by Dr K Thangaraj, JC Bose Fellow, CCMB and Former Director, Centre for DNA Fingerprinting, Hyderabad. All scientists, young researchers and students attended the lecture.

Important Meetings

RAC meeting

Meeting of the Research Advisory Committee of the institute was conducted on May 2, 2023. Various research programs including "Mission towards zero non-descript AnGR" were discussed and suggestions were made by the members.

RAC meeting proceedings

ISO 9001:2015 Surveillance

A meeting of ISO implementation committee of the institute was held on June 20, 2023. Further, the annual surveillance for continuing the certification of the institute for ISO9001:2015 was also conducted.

Review meeting of NBGC-IB

The review meeting of National Bovine Genomic Centre-Indigenous Breeds (NBGC-IB) project was held on June 14, 2023 at ICAR-NBAGR, Karnal under the chairmanship of Dr. Abhijit Mitra, Animal Husbandry Commissioner (AHC), Department of Animal Husbandry and Dairying (DAHD), Ministry of Fisheries, Animal Husbandry and Dairying (MoFAHD), Govt. of India, New Delhi.

Review meeting of the Network Project

Review meeting of Network Project on AnGR was held on 15.6.2023 under the chair of Asst. Director General (AP&B), ICAR. The progress of three NWP centres in Maharashtra, Bihar and Arunachal Pradesh involved in characterization of six populations was presented and discussed.

Institute Research Committee Meeting

Institute Research Committee meeting was held on July 7 and 10, 2023 under the chairmanship of the Director, ICAR-NBAGR. A total of 39 projects were discussed. New projects for survey and documentation of AnGR of Uttarakhand, Andhra Pradesh, Telangana and Andaman & Nicobar (UT) were initiated under the zero non-descript AnGR mission.

Review meeting of NAIF-ITMU

Review meeting of NAIF -ITMU of the Bureau was held on June 28, 2023 through virtual mode to discuss the progress of the ITMU.

QRT meeting

The first meeting of Quinquennial Review Team (QRT) of ICAR-NBAGR for the period of 2017-22 was held during October 30-31, 2023 at the institute under the chairmanship of Dr. MC Sharma, Former Director -cum- Vice-Chancellor, ICAR-IVRI.

QRT meeting in progress

Exhibitions on Native AnGR

Bureau displayed native farm animal breeds during exhibitions organized by research institutes or state animal husbandry departments wherein livestock keepers, entrepreneurs, industry personnel, NGOs, government organizations and other stakeholders were sensitized about the importance of indigenous livestock genetic resources, breed registration process, breed watchlist, and conservation of AnGR.

Kisan Mela 2023 organized by IIWBR, Karnal	February 9, 2023
Kisan Mela 2023 organized by the Department of Animal Husbandry & Dairying, Govt. of Haryana at Bhiwani	March 11-13, 2023
Mahapashudhan Expo-2023 held at Shirdi (Maharashtra)	March 24-25, 2023
Pashupalan Mela organized by GADVASU, Ludhiana, Punjab	September 14-15, 2023

Exhibition at ICAR-IIWBR, Karnal

Farmers-Scientists Interaction Programs

Haryana: Scientist-farmers meet was organized at Kamalpur Rodan, Karnal district of Haryana state on March 17, 2023 under SCSP scheme. In this programme, health kits and concentrate feeds were distributed to 55 SC beneficiaries. Another program was organized in Kirajpur village, Karnal on September 21, 2023. About 60 farmers along with veterinary officers of the state animal husbandry department participated in the program. Feed supliments were distributed to 40 beneficiaries under SCSP plan.

Uttarakhand: Scientist-farmers meet was organized at Chudiyala, Bhagvaanpur, Haridwar district of Uttarakhand on March 25, 2023 under SCSP scheme. About 200 farmers participated in the programme and 100 SC beneficiaries received animal health kits.

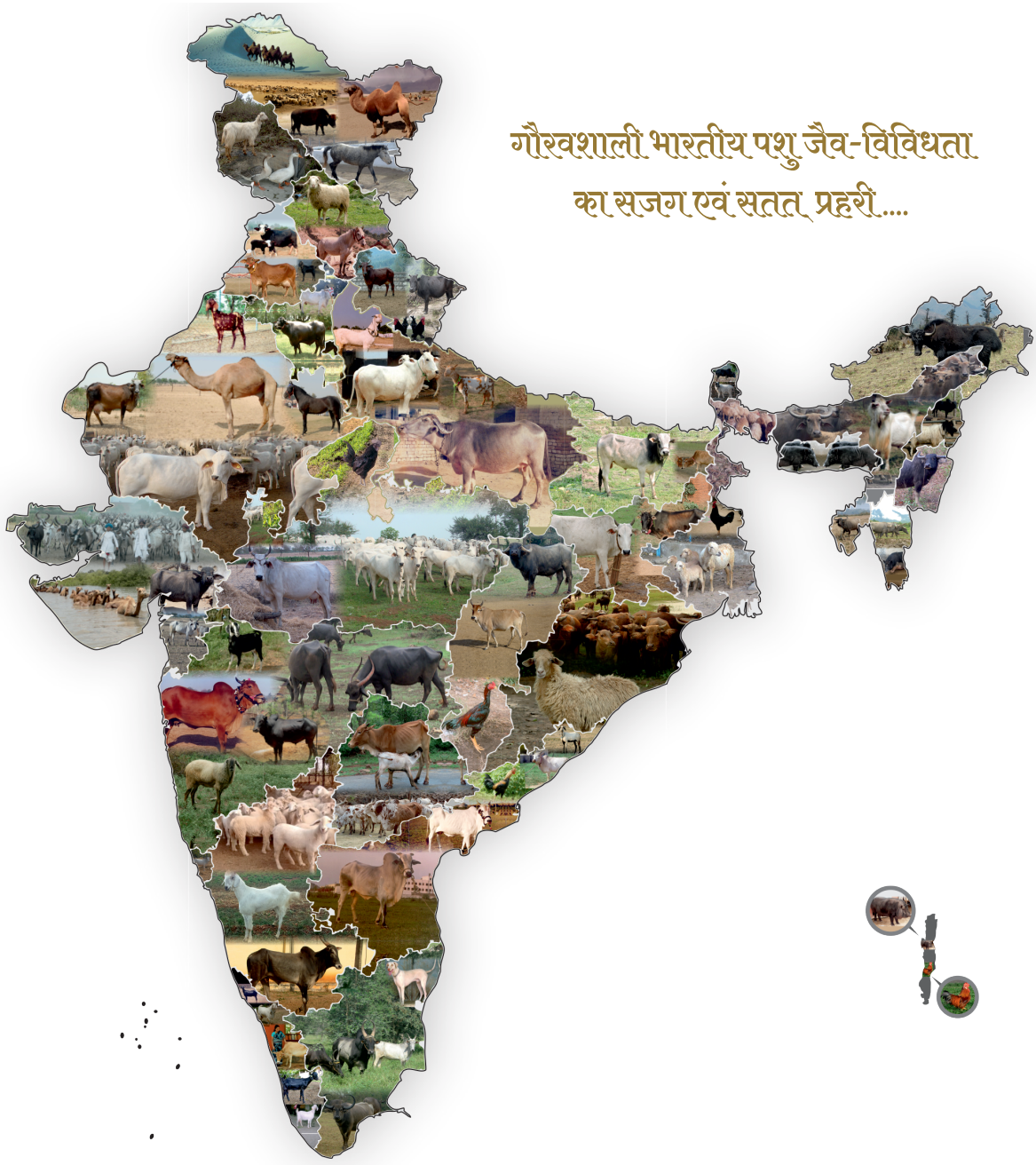
Arunachal Pradesh: Bureau organized Farmers Awareness Programs on AnGR management in collaboration with AHVDDD at Ziro (Lower Sobensiri district) and Palin (Kra Daadi district) on March 24-25, 2023 under NEH scheme. Feed supplements and other common health promoting medicines were distributed among 50 livestock keepers of the regions during the program. Livestock keepers were also sensitized about importance and uniqueness of native animals and their improved management.

Ladakh: Two Farmers Awareness Programs were organized in Kanji and Photoksar of Leh district in Ladakh (UT) during May 23-24, 2023. Farmers were sensitized for promotion and conservation of native breeds. More than 100 farmers attended the programs. Supplements were distributed among the farmers. Other Farmers Awareness Programs were conducted in Shila, Sunny and Rangdum, and Mulbek villages of Zanskar region of Kargil district with the help of Animal and Sheep Husbandry Department. The team distributed mineral mixtures and skin ointments to livestock keepers of these villages.

Distribution of medicines to SC beneficiaries

Farmers Awareness Program at Palin (Arunachal Pradesh)

Distribution of feed supplement at Kanji (Ladakh)



ICAR-NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES

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