



वार्षिक प्रतिवेदन  
ANNUAL REPORT  
2010-11

राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो  
NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES





2010 International Year of Biodiversity



वार्षिक प्रतिवेदन  
**ANNUAL REPORT**  
2010-11



राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो  
NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES

# Contents

## PUBLISHED BY

Dr. B.K. Joshi,  
Director,  
National Bureau of Animal  
Genetic Resources

## COMPILED BY

Dr. N.K. Verma, Pr. Scientist &  
I/C P M E Cell

Dr. Rekha Sharma, Sr. Scientist

## EDITORS

Dr. N.K. Verma, Pr. Scientist

Dr. P.K. Singh, Pr. Scientist

Dr. Rahul Behl, Sr. Scientist

Dr. R.S. Kataria, Sr. Scientist

Dr. Rekha Sharma, Sr. Scientist

## PHOTOGRAPHS

Sh. Moti Ram, T-5

## ASSISTANCE

Sh. PS Dangi, Technical Officer (T-7)

Ms. Indu Bala, Steno Gr III

1. Foreword	3
2. Executive Summary	5
3. History of Bureau	7
4. Financial Outlay	9
5. Research Activities	11
• Livestock Information Management	11
• Phenotypic Characterization and Evaluation of Animal Genetic Resources	13
• Genetic Characterization & Functional Genomics	20
• Network Project on Animal Genetic Resources	27
6. Other Activities	33
7. Personnel	38
8. Research Projects during the year	40
9. Research Publications	44
10. हिन्दी खण्ड	49
प्राक्कथन	50
सारांश	52
राजभाषा	55



## Foreword

I feel immensely pleased to present the Annual Report 2010-11 of National Bureau of Animal Genetic Resources. Twenty seven years ago, on 21st September, 1984 the bureau got officially off the ground and has become an internationally renowned excellence center for research on characterization and conservation of AnGR. The year 2010 was a very special year for NBAGR as it has been declared as the International Year of Biodiversity. In this annual report, we highlight the achievements that strengthen the four pillars of our scientific strategy: "Identification", "Characterization" "Conservation" and



"Sustainable utilization of AnGR". As we know, India's livestock production systems are changing in response to globalization, urbanization, mechanization, intensive agriculture, environmental degradation, climate change and emerging science and technology. Rising human population and household income are causing increased demand for milk, meat, eggs and other livestock foods. As one would expect, livestock markets are growing and changing to serve that growing demands. The rate of change within the livestock sector is so rapid that many local populations of livestock developed by livestock keepers over millennia no longer have time to evolve adaptations to their new circumstances or the new needs of their owners. They are simply dying out at unprecedented and accelerating rates. At NBAGR, we are focused on groundbreaking research pertaining to indigenous AnGR. Scientists of Bureau concentrated their efforts on establishing the physical attributes of Hill cattle, Patanwadi sheep, Berari and Bundelkhandi goats, goats of Uttarakhand, Spiti donkey and Shahabadi cattle of Bihar. The phylogenetic relationship among Assamese swamp and hill buffaloes of North-east region of India on the basis of polymorphism existing in the mtDNA D loop region was explored. Our researchers are bent on analyzing economically important traits down to the smallest details to find genetic variations at functionally important genes like Catsper gene, Thyroglobulin gene, Insulin like growth factor-1 gene, CAPN1 gene, Fec B, Somatotrophic Axis genes, toll like receptor genes and immune response genes etc. Coding regions of ten buffalo TLR genes (TLR1-10) have been sequenced completely and data analysis revealed buffalo specific domain structural changes. As an attempt towards whole genome sequencing of riverine buffalo, more than 90 GB DNA sequence data has been generated providing nearly 30 fold coverage with a read depth of 17-19X. The whole genome buffalo assembly has been integrated into a publicly available genome browser (<http://210.212.93.84/cgi-bin/gb2/gbrowse/bovine/>). NBAGR research is also used as the foundation for the development of new research protocols, physical characterization formats, computerized data storage and retrieval. To protect the lesser known germplasm of our country, NBAGR started to register breeds. During the year, six new breeds of cattle and buffalo were registered and few more are in pipeline. To take our research results to custodians of livestock, we work closely with State Animal Husbandry Departments. They are the ones who utilize the information generated by NBAGR for planning programmes for conservation and genetic enhancement of breeds/populations of their respective ecologies. It is this linkup of basic research with grass root level that gives our Institute its unique status. Based on the research findings fifty eight scientific papers have been published in the national and international journals of high impact factors. Scientists have

been rewarded for their scientific presentations. Seven research projects were completed during the period and thirty seven including six NAIP are in progress. Six new projects have been initiated. Apart from the research, the staff of bureau has excelled in many other social and sports events. We are in the process of preparing programmes for the twelfth five year plan and our vision we intend to realise by 2030. In the coming year too, NBAGR will continue to give researchers a chance to let their creativity bloom. It is quite apparent that the effects of this will stretch far beyond the walls of our laboratories.

I sincerely thank Dr S Ayyappan, Secretary, Department of Agricultural Research and Education & Director General, ICAR, for his guidance, help and support. I also acknowledge the cooperation and encouragement from Dr KML Pathak, Deputy Director General (Animal Sciences) and Dr S C Gupta, ADG (AP&B). Special thanks are due to my dynamic team of scientists, administrative, technical and supporting staff for their hard work and cooperation.

  
(Dr. B.K. Joshi)



## Executive Summary

National Bureau of Animal Genetic resources was established on 21<sup>st</sup> September, 1984. Since its inception the scientists are actively engaged in research related to its mandate of Identification, evaluation, characterization, conservation and Utilization of livestock and poultry genetic resources of the country.

- A Phenotypic breed identification system (PBIS), the user friendly interface for scoring based methodology of breed identification was enhanced and finalized.
- Genetic and phenotypic characterization of Hill cattle through systematic surveys conducted in Almora, Pithoragarh, Rudraprayag, Chamoli and Uttarkashi districts of Uttarakhand was completed.
- Phenotypic characterization of Berari goat (Maharashtra and Madhya Pradesh), Bundelkhandi goats (Uttar Pradesh and Madhya Pradesh) and non-descript goat genetic resources of Uttar Pradesh and Uttarakhand was carried out through systematic surveys made in their respective breeding tracts.
- Characterization and evaluation of Patanwadi sheep was carried out by undertaking stratified random sampling survey in various villages of Kutch, Rajkot, Amreli, Bhavnagar and Surendernagar districts of Gujarat.
- Phenotypic characterization of Spiti donkey was also carried out through systematic surveys undertaken in the Spiti sub-division of Lahaul & Spiti district and Puh sub-division of Kinnaur district of Himachal Pradesh with an average altitude of about 3700 meters.
- Effect of drying on structure and fertilizing ability of bovine sperms under various media conditions revealed altered morphology to the extent rendering them non-fertile.
- Sequence characterization showed considerable nucleotide variations in the Catsper gene of buffalo and cattle, which could play important role in sperm motility in two species compared.
- Novel single nucleotide polymorphism observed in 5' upstream sequence of buffalo thyroglobulin gene. Allelic frequencies of these SNPs varied among riverine and swamp buffaloes.
- Coding regions of ten buffalo TLR genes (TLR1-10) sequenced completely and sequence data analysis revealed buffalo specific domain structural changes.
- Real-time analysis of fecundity related genes in FecB carrier and non-carrier ewes showed differential expression of BMPRIA and BMP4 in the ovaries, indicating their implications in regulating the rate of ovulation in sheep.
- Polymorphism detected in the IGF1, IGF binding protein and growth hormone receptor genes of Indian goat breeds, which is being correlated with the effects on phenotypes.
- SNPs detected in immune-response genes of TLR4, TLR9, NOS2, MCP1 and IFN-gamma among Indian cattle breeds, which are being further analysed for their association with incidence of mastitis in Sahiwal cattle breed.
- Work on NAIP sponsored project on National Agricultural Bioinformatics Grid (NAGB) has been initiated with conducting of training programme and establishment of protein and microsatellite databases on indigenous livestock and poultry species.
- Microsatellite based diversity analysis of Indian sheep breeds revealed a deficiency of heterozygotes as well as high genetic variability among them, suggesting stratification of the breeds in subpopulations.
- PCR-RFLP, SSCP and SNP analysis revealed polymorphism at the keratin associated protein (KAP1.3), Agouti (ASIP), Insulin like growth factor binding protein 3 (IGFBP-3), Callipyge (CLPG) and ovine bone morphogenetic protein type 1B receptor (BMPR1B) gene loci in the indigenous sheep breeds.

- Using cytogenetic, microsatellite and mitochondrial D-loop analysis, pure swamp buffaloes have been documented for the first time in north-east states of India.
- Microsatellite markers based genetic diversity has been documented in the Shahabadi cattle population of Bihar and Malaimadu cattle alongwith Katchakatty, Mecheri, Coimbatore and Nilagiri sheep breeds of Tamil Nadu and hill and plains goat populations of Assam.
- Sequence analysis and SNP identification in CAPN1, Akirin and Titin genes in a panel of Indian goat breeds carried out having role in meat quality.
- As an attempt towards whole genome sequencing of riverine buffalo, more than 90 GB DNA sequence data has been generated providing nearly 30 fold coverage with a read depth of 17-19X. The assembly has 185,150 contigs with the median contig length of 2.3 Kb and the largest contig length of 663 Kb.
- The whole genome buffalo assembly has been integrated into a publicly available genome browser (<http://210.212.93.84/cgi-bin/gb2/gbrowse/bovine/>) with tracks for read pair insert distances, read depth, nucleotide variations, coverage, and the availability of custom tracks for scientific community.
- As part of allele mining for abiotic stress response in goat, transcriptome data generated on various tissues of goat, which is being analysed further.
- Bureau completed 7 research projects during the reported period and work continued under 32 institutes (26 ongoing & 6 new) and 3 externally funded projects. Six National Agricultural Innovative Projects (NAIP) are running in the Bureau.
- Scientists of the Bureau published 58 research papers in reputed National & International Journals. Two young scientists awards and 4 best poster awards were fetched by Scientists.
- Monograph on 'Sangamneri', 'Surti' goats; 'Equine breeds of India'; Jaiselmeri camel; the leaflets on 'A success Story on Conservation of Beetal Goats' and 'Cattle breeds of India' were published.
- The bureau brought out the first issue of Hindi Journal *Pasudhan Prakash*. (ISSN 0976-4569)
- Apart from the research, the staff of bureau participated in various activities like ICAR zonal and inter-zonal sports meet and fetched the Winners trophy (Joint with CSSRI, Karnal) in zonal and Runners trophy in inter-zonal sports meet.
- Hindi section of bureau organized various activities including the Foundation Day of the bureau in which the staff participated actively.
- The bureau could utilized more than 99% of its allotted Plan and Non-plan budget. A revenue of Rs. 36.12 lakh was generated through different resources.



## History of the Bureau

The need for the establishment of National Institute of Animal Genetics was accepted in principle during 4th Five Year Plan. During 5th and 6th Five Year Plan, various government agencies coordinated the efforts for the establishment of the Institute. Therefore, National Bureau of Animal Genetic Resources and National Institute of Animal Genetics were set up on 21st September, 1984. These Institutes started at Regional Station of National Dairy Research Institute, Bengaluru. Bureau and institute were then shifted to Karnal in 1985 and temporarily housed in NDRI Campus before shifting to its own campus at Makrampur, Karnal in 1994. The Institute of Animal Genetics and Bureau were merged in 1995 to function as a single unit as National Bureau of Animal Genetic Resources.



### Mandate:

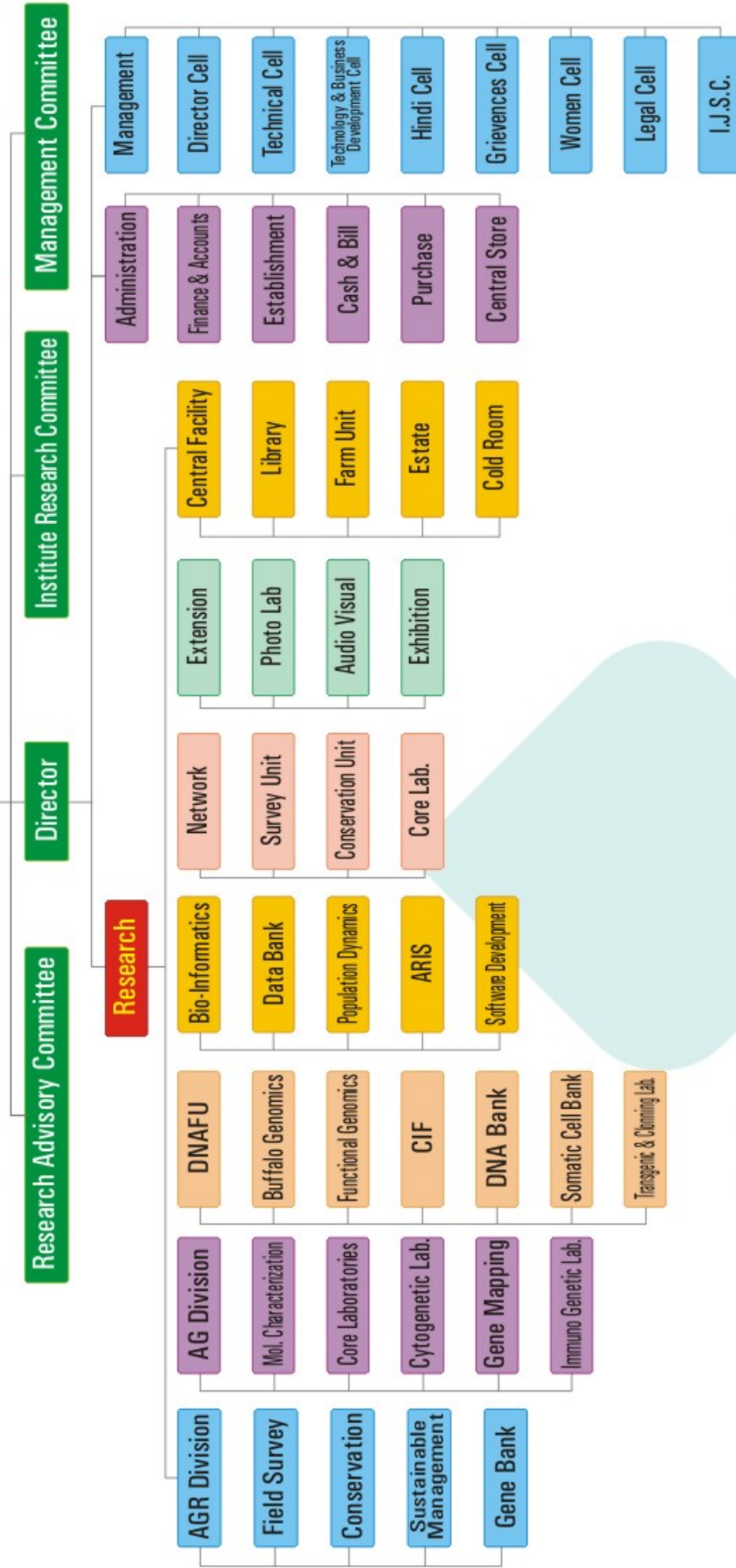
'Identification, evaluation, characterization, conservation and utilization of livestock and poultry genetic resources of the country'.

### Objectives:

- To conduct systematic surveys to characterize, evaluate and catalogue farm livestock and poultry genetic resources and to establish their National Database.
- 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.

## ORGANOGRAM OF NBAGR, KARNAL

## NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES





# Financial Outlay

Budget Estimate under Plan and Non-Plan for the financial year 2010-11 along with expenditure upto March, 2011.

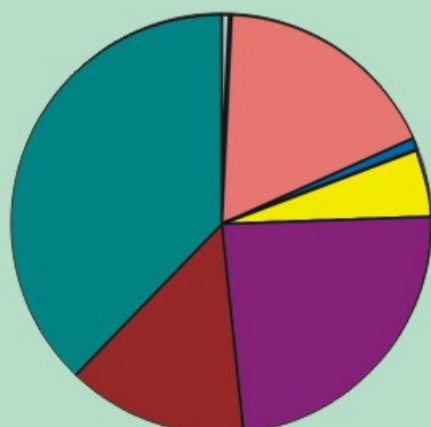
(Rs. in Lakhs)

Sr. No.	HEAD	NON-PLAN		PLAN	
		Budget	Expenditure	Budget	Expenditure
01	a. Estt. Charges	452.00	451.95	0.00	0.00
	b. Wages (R.As)	0.00	0.00	0.00	0.00
	c. O.T.A.	0.10	0.07	0.00	0.00
02	a. Traveling Expenses	1.60	1.52	10.00	9.53
	b. HRD	0.00	0.00	0.56	0.55
03	Other Charges (Including Equipments)	70.80	67.89	226.44	223.99
04	Works				
	a. Annual repair and maintenance				
	a. Office Building	7.00	6.95	0.00	0.00
	b. Residential building	6.00	6.00	0.00	0.00
	c. Minor Works	10.00	9.82	0.00	0.00
	b. Work as per approved EFC				
	i) Special Works		0.00	0.00	0.00
	ii) Major works		0.00	68.27	68.26
05	Other items	0.00	0.00	0.00	0.00
	<b>Total (01-05)</b>	<b>547.50</b>	<b>544.20</b>	<b>305.27</b>	<b>302.33</b>
06	AICRP on AGR	0.00	-	180.00	180.00
	<b>Total (01-06)</b>	<b>547.50</b>	<b>544.20</b>	<b>485.27</b>	<b>482.33</b>

## Revenue Generated during the year 2010-11.

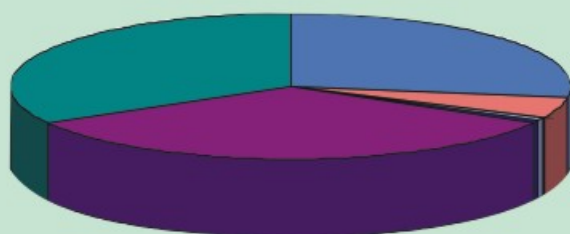
Sr. No.	Head of Account	Amount (Rs.)
1.	Sale of Publication & Advertisement	38,060
2.	License Fee	1,02,832
3.	Training Programmes-Income	13,82,000
4.	Hostel & Guest House Charges	4,04,005
5.	Sale of Technology	1,83,970
6.	Sale of Farm Produce	7,25,920
7.	Other Misc. Revenue Receipts	7,75,803
	<b>Total</b>	<b>36,12,590</b>

## Utilization under plan budget



- Estt. Charges
- Wages (R.As)
- O.T.A.
- Traveling Expenses
- HRD
- Other Charges
- a. Office Building
- b. Residential Building
- c. Minor Works
- i) Special Works

## Utilization under non-plan budget



- Estt. Charges
- Wages (R.As)
- O.T.A.
- Traveling Expenses
- HRD
- Other Charges
- a. Office Building
- b. Residential Building
- c. Minor Works
- i) Special Works
- ii) Major Works
- Other Items

## Revenue Generated during the year 2010-11.



- Sale of Publication & Advertisement
- License Fee
- Training Programmes - Income
- Hostel & Guest House Charges
- Sale of Technology
- Sale of Farm Produce
- Other Misc. Revenue Receipts

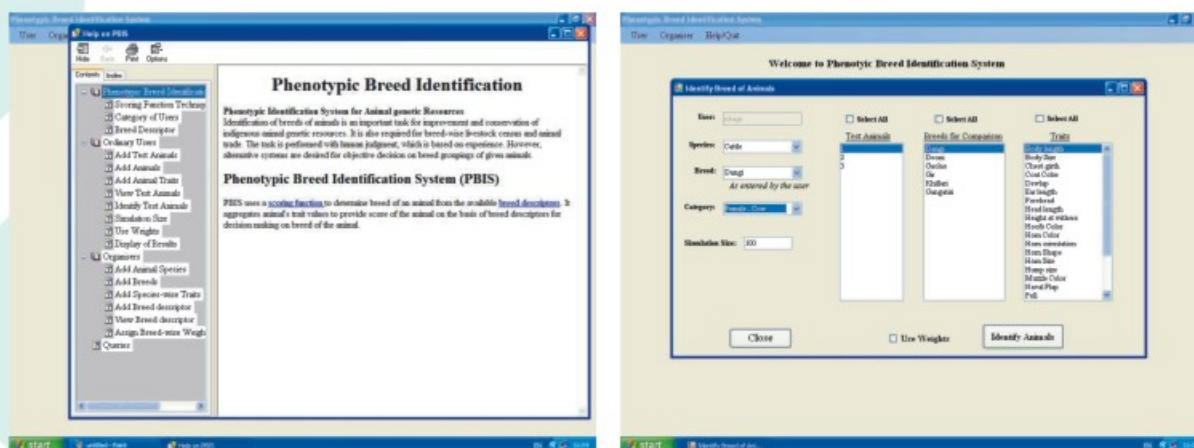


# Research Activities

## LIVESTOCK INFORMATION MANAGEMENT

Apart from updating the database on Animal Genetic Resources, other programmes for managing the data generated through research projects, were developed. Applications received from the stakeholders for registering the new livestock germplasm were also processed.

**Scoring based phenotypic identification methodology:** Phenotypic breed identification system (PBIS), the user friendly interface for scoring based methodology of breed identification was enhanced and finalized. A help subsystem was developed. A setup system was developed for installation and use on a standalone computer. Breed descriptors have been entered from detailed survey reports of Dangi, Deoni, Gir, Khillar, Gaolao, Gangatiri cattle breeds and Surti, Nagpuri, Jaffrabadi buffalo breeds. PBIS is now available on a CD. It can be installed with a setup file that creates icons for PBIS, help and user's guidelines.



**Development of SNP database for indigenous AnGR:** The database on SNPs has been designed to store information on livestock and poultry species and reported SNPs. It has files to store information on: chromosomes in various species, genes along with functions, SNPs, accession number along with hyperlinks to relevant database on internet. It also stores information on references that are source of SNPs in the database. Database files have been stored in SQL Server. A total data of 350 SNPs from nine domestic animal species have been collected (buffalo-120, cattle-142, chicken-23, goat-10, pig-11, sheep-7, camel-8, mithun-11 and yak-18). User interface has been developed using ASP.NET with VB-Script. Data entry is under progress with updating of newly reported SNPs.

**Registration of Livestock and Poultry Genetic Resources:** Registration of livestock and poultry genetic resources has been initiated to protect and check the biopiracy of indigenous AnGR. Following steps have been taken up in this regard:

- Guidelines, descriptors and application form for registration of new breeds of livestock and for new strains/lines of poultry have been prepared and put on bureau's website (<http://www.nbagr.res.in/guidelines.html>).



- The breed registration committee chaired by DDG (AS) approved the registration of 6 new breeds: four cattle breeds (Binjharpuri, Ghumsuri, Khariar Motu cattle) and two buffalo breeds (Banni, Chilka buffalo). The breed descriptor of these six new breeds for which details are given below in the table, has also been published in October 2010 issue of Indian Journal of Animal Sciences.

SN	Breed	Home Tract	Accession number
1.	Banni	Gujarat	INDIA_BUFFALO_0400_BANNI_01011
2.	Chilika	Orissa	INDIA_BUFFALO_1500_CHILIKA_01012
3.	Motu	Orissa, Chattisgarh and Andhra Pradesh	INDIA_CATTLE_1526_MOTU_03031
4.	Ghumsuri	Orissa	INDIA_CATTLE_1500_GHUMSURI_03032
5.	Binjharpuri	Orissa	INDIA_CATTLE_1500_BINJHARPURI_03033
6.	Khariar	Orissa	INDIA_CATTLE_1500_KHARIAR_03034



Banni Buffalo



Binjharpuri Cattle



Chilka Buffalo



Ghumsuri Cattle



Khariar Cattle



Motu Cattle



### Germplasm Repository

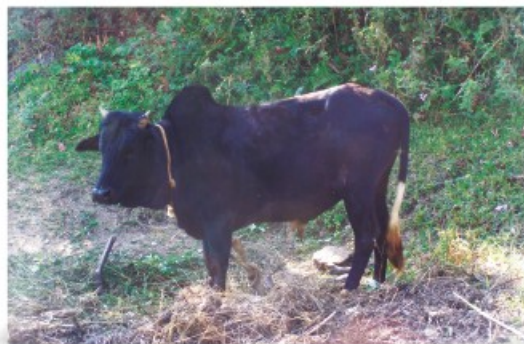
- At the Gene Bank established at the NBAGR, Karnal for *ex-situ* conservation of Animal Genetic Resources, a total of 77,583 doses of semen of 214 bulls belonging to seven livestock species and 27 breeds are preserved.
- Approximately 50 random samples of 15 breeds of poultry, 25 breeds/populations of goat, 6 breeds of cattle and 4 breeds of sheep have been preserved at the DNA Bank of the NBAGR, Karnal.

### PHENOTYPIC CHARACTERIZATION AND EVALUATION OF ANIMAL GENETIC RESOURCES

**Hill Cattle:** To characterize the hill cattle of the state, surveys were conducted in 5 districts of the Uttarakhand state i.e. Almora, Pithoragarh, Rudraprayag, Chamoli and Uttarkashi. Information on various management practices followed by the livestock owners in these districts and production performance traits was generated by interviewing the farmers using a structured questionnaire in 32 villages of Kumaun and Garhwal regions. A total of 309 farmers were interviewed to know the habitat, status, management, utility and performance of the cattle available. Eight different body measurements were recorded on 819 animals of different ages and sex and analyzed.

The survey revealed that there is large population of hill cattle in the state. Hill cattle are reared mainly for bullock power, milk and manure. Most of the animals were farm born. Sale and purchase of the animals were observed among the farmers. Land holding was small; about 75% farmers had less than 20 nali of land. Family size was large i.e. 4- 8 members per family. Animals of the breed were reared mainly on extensive system of management i.e. grazing from morning to evening. Cows in milk and bullocks during the work were provided with some feeds and concentrate in the evening. Animals were kept in houses only during night. Milk is mostly used for household purposes. Herd size ranged from 2 to 5 animals. Breeding was natural. Dehorning and deworming practices were not adopted. Vaccinations for H.S., FMD and BQ were observed in very few cases. It was observed that in Garhwal region animals were given more attention than the Kumaun region with respect to feeding, management, utility, breeding and production etc.

Animals of Hill cattle were small in size with cylindrical type of body. Animals were well built and compact with strong legs. Body colour varied in different colours and shades i.e. white, grey, black, red/reddish, brown and in different combinations of these two or more colours. In Kumaun region brown and black were almost in similar proportion while in Garhwal region black colour was predominant. The colour variability was more in Kumaun region than the Garhwal region. All the biometric traits in the age groups 0-3 months, 3-6 months, 6-12 months and 1-3 years did not reveal significant differences in Kumaun and Garhwal cattle. It was observed that cows and



Hill Cattle - Male



Hill Cattle - Female



bullocks of Kumaun region had significantly higher values than the Garhwal region. The discriminate stepwise cluster analysis on various morphometric traits in cows based on Mahalanobis distances revealed that hill cattle at Rudraprayag and Chamoli districts had minimum distances (3.884) means closest while hill cattle at Rudraprayag and Pithoragrah districts had maximum distances (29.03) followed by hill cattle at Chamoli and Pithoragarh districts (28.03) and Rudraprayag and Almora districts (24.42).

A total of 51 Blood samples of unrelated hill cattle animals were collected from Garhwal region. DNA was isolated and analyzed by a panel of 21 microsatellite markers. The average observed and expected number of allele, observed and expected heterozygosity and heterozygote deficit were  $12.61 \pm 4.80$  (6-22),  $5.66 \pm 2.64$  (2.41 to 11.39),  $0.699 \pm 0.19$  (0.271 to 0.938),  $0.782 \pm 0.10$  (0.585 to 0.912) and  $0.118 \pm 0.17$  (-0.198 to 0.537), respectively. The different genetic diversity parameters showed that population is comparable with the hill cattle of Kumaun region and Haryana cattle.

It may be concluded that hill cattle available in Garhwal region had more uniformity. The Kumaun cattle had larger shape and size. Farmers in Garhwal region gave more attention to feeding, management and breeding. Productivity of hill cattle was better in Garhwal region than the Kumaun region. The hill cattle populations at different locations showed uniformity on different parameters with a slight variation. It may thus be considered for recognition as a distinct breed.

**Berari Goat:** Berari goats exist in the Vidarbha region of Maharashtra state. The name of breed has emerged from 'Berar state'. The native tract of this goat population is found in Nagpur, Akola, Wardha district of Maharashtra and Nimar district of Madhya Pradesh. The goat is low yielding and is mainly reared for meat by the local farmers.

The data on the biometry of Berari goats was generated from 102 animals belonging to 26 flocks in the villages : Dongaon, Borgaon, Punoti, Bondrkhoda, Klashimba of Akola Taluk; Balapur, Gaygaon, Shegaon of Balapur taluk and Mahagaon of Akot taluk of Akola district of Maharashtra state. For comparison, animals maintained at cattle breeding farm, Borgaon Manju farm of Post Graduate Institute of Veterinary and Animal Sciences, Akola were recorded.

The animals were tall and dark coloured having coat colour light to dark tan, thin and cylindrical legs, flat horn, leafy drooping ears, convex face, slightly roman nose, light or dark colour strips on lateral sides extending from base of horn to nostril, black hair line along vertebral column extending upto tail & light tan to black color belly. In males, black colour ring around neck was invariably noticed.



*A Berari doe*



*A Berari buck*

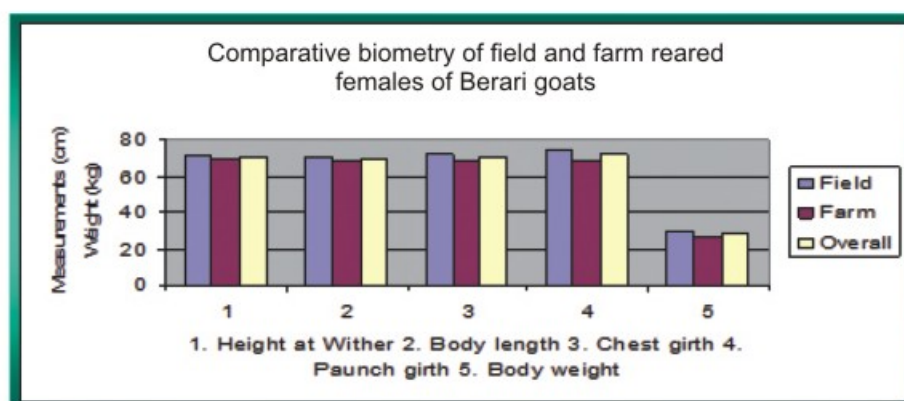


The average measurements of height at withers, body length, chest girth, paunch girth, face length, horn length, ear length and tail length ( in cm) of farm reared adult animals were 75.50, 73.00, 76.50, 74.50, 17.50, 19.00, 19.00 and 18.00, respectively in males and 70.95, 69.60, 69.45, 69.55, 16.70, 11.65, 18.20, 15.70, respectively in females. The average measurements for the same traits recorded on the pasture grazing animals in the field were 78.00, 76.00, 74.00, 76.00, 18.00, 15.50, 21.50, 19.00, respectively in males and 71.35, 71.03, 72.23, 74.33, 16.65, 13.25, 18.38 and 15.58, respectively in females.

*Means with SE of different body measurement (cm) and body weights (kg) in adult Berari goats under field and Farm conditions*

TRAITS	FIELD		FARM		OVERALL	
	Male(6)	Female(40)	Male(5)	Female(20)	Male(11)	Female(60)
Body Height	78.00±7.00	71.35±0.50	75.50±0.50	70.95±0.67	76.75±2.95	71.22±0.40
Body Length	76.00±7.00	71.03±0.57	73.00±1.00	69.60±0.69	74.50±2.35	70.55±0.45
Chest Girth	74.00±7.00	72.23±0.69	76.50±3.50	69.45±0.85	75.25±2.93	71.33±0.56
Paunch Girth	76.00±7.00	74.33±1.03	74.50±0.50	69.55±1.07	75.25±2.59	72.73±0.82
Face Length	18.00±1.00	16.65±0.14	17.50±0.50	16.70±0.16	17.75±0.43	16.67±0.11
Horn Length	15.50±4.50	13.25±0.61	19.00±1.00	11.65±0.90	17.25±1.91	12.72±0.51
Ear Length	21.50±0.50	18.38±0.33	19.00±0.00	18.20±0.46	20.25±0.67	18.32±0.27
Tail Length	19.00±0.00	15.58±0.22	18.00±0.00	15.70±0.25	18.50±0.26	15.62±0.17
Body Weight	37.00±6.00	31.38±0.76	40.00±5.00	28.25±0.86	38.50±2.96	30.33±0.61

The average body weights of males and females under the two different mangemental systems were 40.00 kg for males and 28.25 kg for females in farm bred animals and 37.00 and 31.38 kg in pasture grazing males and females, respectively. The comparative studies indicated better growth of farm bred animals. The overall averages ( in cm) irrespective of the type of the management for height at withers, body length, chest girth, paunch girth, face length, horn length, ear length and tail length were 76.75, 74.50, 75.25, 75.25, 17.75, 17.25, 20.25, 18.50, respectively in males and 71.22, 70.55, 71.33, 72.73, 16.67, 12.72, 18.32, 15.62, respectively in females. The body weights were 38.50 and 30.33 kg for male and females.



*A comparison between measurements of field and farm managed goats*



**Bundelkhandi goat:** Bundelkhandi is inadequately studied goat population which is found in Bundelkhand region particularly in and around Jhansi district of Uttar Pradesh and Datia taluk of Madhya Pradesh. Bundelkhand region experiences extreme temperatures crossing 40°C in summer and touching 1°C in winter, irregular rains and regular draughts. The Bundelkhandi goats are large sized, hardy and sustain in extreme climatic conditions of its habitat. The morphological features are jet black coat color, long legs, narrow face, roman type nose, long hair on body, black eyelids and muzzle, long curly and pendulous ears and bushy tail. The body height of adult goats (>2yrs) varies between 70 to 75 cms and body weight between 30 to 38 kgs. The different phenotypic traits of farm and field reared animals were measured and a comparison was made between the animals reared under two different managemental systems.



*A Bundelkhandi doe*



*A Bundelkhandi Buck*

*Means±SE of different body measurements (cm) and body weights (kg) in adult Bundelkhandi goats under field and Farm conditions*

TRAITS	FIELD		FARM		OVERALL	
	Male(10)	Female(27)	Male(2)	Female(23)	Male(12)	Female(50)
Body Height	77.00±1.65	71.63±0.60	78.50±4.50	73.17±0.60	77.25±1.48	72.34±0.49
Body Length	78.10±1.73	71.93±0.72	80.00±5.00	72.61±0.78	78.42±1.57	72.24±0.60
Chest Girth	77.40±1.87	72.11±0.83	75.50±5.50	72.43±0.76	77.08±1.70	72.26±0.63
Paunch Girth	79.50±2.68	72.26±1.03	68.50±4.50	72.52±0.98	77.67±2.59	72.38±0.80
Face Length	18.40±4.048	12.88±0.92	19.00±1.00	16.96±0.16	18.50±0.42	14.80±0.58
Horn Length	14.80±0.79	12.67±0.82	14.50±0.50	9.63±0.31	14.75±0.65	11.53±0.54
Ear Length	19.20±0.63	19.33±0.62	18.50±1.50	18.78±0.38	19.08±0.56	19.08±0.40
Tail Length	17.20±0.33	15.67±0.31	16.00±0.00	15.52±0.21	17.00±0.30	15.60±0.21
Body Weight	39.70±2.18	32.90±1.13	37.50±6.50	33.13±0.99	39.33±1.98	33.01±0.75

**Goat populations of Uttarakhand:** The body weights and biometrical measurements on 125 goats of different age groups across 15 villages of Rudraprayag and Okhimath blocks of Rudraprayag district of Uttarakhand were recorded. 25 farmers were also interviewed to generate the information on production and reproduction traits, housing and management systems. The photographs of goats of different colors, age groups, various pastures and management practices were also taken. It was observed that there was no unique name by which these goats are known, however, the population of these goats were having uniform characteristics and hence deserve characterization of their attributes. The goats in this region are mainly reared for meat purposes only. The goats are of medium size with varying colour patterns. Most of the goats are of white color. However, black, brown and mottled animals





*Different colour variants of goats found in Uttarakhand*

are also found. The animals are hairy. The flock size usually varies from 5 to 70 and mainly reared by Rajput community. The animals are mostly pasture fed. The breeding tract of these goats lies in higher altitude which range from 800-8000m above sea level. The temperature varies from 34°C in summer to 0°C in winter. January is the coldest month after which the temperatures begin to rise till June or July. The morphometric traits of the population have been presented in table below.

*The Morphometric traits (in cm) and Body weight (in kg) of the goat population of Uttarakhand*

Trait	≤ 10 days (F) (4)	3 month (M) (12)	3 month (F) (2)	6 month (M) (8)	6 month (F) (12)	12 month (M) (4)	12 month (F) (55)
Height (Cm)	35.00 ± 1.47	44.91 ± 2.57	55.50 ± 4.50	62.12 ± 2.48	57.16 ± 1.89	60.75 ± 10.04	65.63 ± 0.62
Length (cm)	31.50 ± 0.95	48.50 ± 2.90	59.50 ± 5.50	65.00 ± 2.93	59.50 ± 1.67	66.50 ± 11.83	71.03 ± 0.85
Chest girthcm	45.25 ± 6.30	52.75 ± 3.00	62.00 ± 9.00	69.75 ± 2.00	67.91 ± 2.38	68.50 ± 11.86	79.16 ± 0.79
PG (cm)	36.00 ± 1.22	53.00 ± 2.98	64.50 ± 8.50	73.75 ± 2.63	71.75 ± 3.31	72.75 ± 13.68	84.25 ± 0.98
Face (cm)	9.00	12.83 ± 0.32	13.00 ± 3.00	16.00 ± 0.50	14.66 ± 0.58	15.25 ± 2.17	17.07 ± 0.19
Horn (cm)	-	7.41 ± 0.85	14.00 ± 6.00	17.75 ± 1.94	15.66 ± 2.03	28.33 ± 2.33	24.92 ± 1.12
Ear (cm)	10.00	14.16 ± 0.96	17.00 ± 1.00	16.87 ± 0.22	16.66 ± 0.37	16.50 ± 2.02	17.58 ± 0.19
Tail (cm)	7.00	11.90 ± 0.41	13.50 ± 1.50	13.12 ± 0.47	14.08 ± 0.43	14.25 ± 1.93	14.08 ± 0.29
B.Wt (kg)	4.87 ± 0.12	16.87 ± 1.66	24.00 ± 8.00	28.12 ± 2.98	27.83 ± 2.06	40.13 ± 11.91	42.14 ± 1.05

**Spiti Donkey:** The breeding tract of Spiti donkey is distributed in the Spiti sub-division of Lahaul and Spiti district and Puh subdivision of Kinnaur district with an average altitude of about 3700 meters. The minimum/maximum temperatures (°C) in the month of February and July are -22/-3 and 13/27, respectively. The total donkey population as per 2007 livestock census in Lahaul and Spiti district is 2,007 and Kinnaur district is 2,361. In each household, 1-3 (average 1.64 ± 0.48) Spiti donkeys are kept. They are raised mainly on grazing in pastures. They are also supplemented with either dry or green fodder and about 250 gm -1kg concentrate/animal/day depending upon the amount of work undertaken by the animal as well as availability of fodder/concentrate. When used for rigorous work, the concentrate supplementation is increased to about 1 kg/animal/day. The concentrate mainly consists of barley, pea-husk, wheat or even commercial feed. Water is provided once a day at about 12:00 noon.



*A male Spiti donkey*

The Spiti donkeys are comparatively smaller in size, strongly built with compact body with strong and straight back, strong legs and thick coat with long hair. The main coat colour are dark brown/black





A female Spiti donkey

(14%), brown (58%), brown with lighter bellies (16%) and light brown with whitish bellies (12%). The main white markings are muzzle (68%) and around eyes (12%). The dorsal cross is visible only in lighter shades. Long hair cover most of the face. Small manes are also present. The ears are comparatively smaller and straight and slightly oriented laterally. The nostrils are large. The tail extends upto hocks. The tail switch is not distinguishable due to presence of thick hair on rest of the tail. The main body measurements for adult animals are given in the table.

#### Morphometric traits of the spiti donkey

Trait	Male			Female		
	Mean $\pm$ SD (cm)	n	Range (cm)	Mean $\pm$ SD (cm)	n	Range (cm)
Body length	91.10 $\pm$ 2.88	29	86-97	90.96 $\pm$ 2.52	26	85-95
Height at withers	88.59 $\pm$ 3.27	29	84-95	88.65 $\pm$ 3.30	26	80-94
Heart girth	100.5 $\pm$ 5.02	28	90-115	98.58 $\pm$ 4.23	26	90-107
Neck length	31.10 $\pm$ 2.21	29	27-36	30.15 $\pm$ 1.52	26	28-33
Face length	32.10 $\pm$ 1.47	29	29-35	31.5 $\pm$ 1.03	26	30-34
Ear length	21.39 $\pm$ 1.13	28	19-23	21.5 $\pm$ 0.81	26	20-23
Tail length	30.07 $\pm$ 2.23	28	26-35	31.52 $\pm$ 1.81	25	27-35
Tail length	54.21 $\pm$ 7.63	28	39-68	55.56 $\pm$ 9.26	25	37-70
Leg length (FL)	80.0 $\pm$ 3.46	7	76-87	81.0 $\pm$ 3.02	8	77-86
Leg length (HL)	87.71 $\pm$ 2.93	7	84-91	87.5 $\pm$ 1.85	8	85-90
Canon circum (FL)	12.04 $\pm$ 0.71	27	11-13	11.57 $\pm$ 0.70	26	10-13
Canon circum (HL)	12.79 $\pm$ 0.85	19	11-14	12.7 $\pm$ 0.92	20	11-14
Canon length (FL)	19.93 $\pm$ 0.84	29	18-21	19.96 $\pm$ 0.77	26	19-22
Canon length (HL)	26.10 $\pm$ 1.35	29	23-28	26.4 $\pm$ 1.0	25	24-28
Pastern circum (FL)	11.51 $\pm$ 0.85	27	10-13	11.27 $\pm$ 0.78	26	10-13
Pastern circum (HL)	12.36 $\pm$ 1.21	11	10-15	11.94 $\pm$ 1.61	18	10-15
Pastern length (FL)	8.66 $\pm$ 0.72	29	7-10	8.62 $\pm$ 0.57	26	8-10
Pastern length (HL)	8.68 $\pm$ 0.56	25	8-10	8.6 $\pm$ 0.65	25	8-10
Hoof length (FL)	5.83 $\pm$ 0.54	29	5-7	5.73 $\pm$ 0.45	26	5-6
Hoof length (HL)	5.53 $\pm$ 0.51	19	5-6	5.45 $\pm$ 0.50	21	5-6
Hoof circum (FL)	20.88 $\pm$ 1.01	25	19-23	20.25 $\pm$ 1.03	24	18-22
Hoof circum (HL)	20.67 $\pm$ 2.02	12	18-26	19.18 $\pm$ 1.13	17	17-21

The main breeding season for Spiti donkeys is March-September but they are said to breed throughout the year. The age of puberty for the males is 1.5-2.0 years. The age of first service is 2.0-2.5 years. One stud is kept for about 4-6 females. The stud is selected by village community based on criteria like health, working ability, agility, good looks, erect ears, lustrous eyes etc. Other males are castrated at about 2-3 years of age by trained veterinary persons in castration camps. The age of puberty for females is 1.5-2.0 years. The duration of estrus is 4-10 days. The age of first conception is 2.0-3.0 years. Two to three services are required per conception. The age of first foaling is 3.0-4.0 years. The gestation period is 12-12.5 months. About 12-14 foalings are expected in a life span of 20-22 years.

The Spiti donkeys are used as pack animals mainly for bringing back dung / manure from the pastures to the villages/fields carrying fuel-wood from the forests, carrying materials of tourists undertaking tracking and transporting construction materials. However, due to rapid mechanization their population has started coming down and requires serious conservation efforts.

**Patanwadi Sheep:** Characterization and evaluation of Patanwadi sheep was carried out by undertaking stratified random sampling survey in various villages of Kutch, Rajkot, Amreli, Bhavnagar and



Surendernagar districts of Gujarat. The sheep in the southern parts of Kutch district, Surendernagar, Rajkot and western parts of Amreli district conformed to Patanwadi while those in the Bhavnagar and adjoining area of Amreli district conformed to Dooma. Of the 67 flocks studied, the sheep in 44 and 23 flocks conformed primarily to Patanwadi and Dooma types respectively. The purity ranged from 75-95 % in Patanwadi and 70-100 % in Dooma flocks. In Patanwadi the average flocks size was 137 comprising 109 ewes, 2 rams and 26 young ones whereas in Dooma it was 118 with 82 ewes, 2 rams and 34 young stock.

Majority of Patanwadi flocks are stationary whereas the Dooma flocks are migratory. Flocks are maintained on grazing. Lambs and pregnant ewes are supplemented with dry groundnut leaves. The sheep are vaccinated, most of the times by the government departments, against enterotoxaemia, sheep pox and Peste Des Petits Ruminants. Deworming is done twice a year. Mortality rate ranged between 6-20 % in adults and 25-30 % in young stock.

Patanwadi animals are compact and thickset, face colour is dark, and wool is soft and fine. Dooma sheep is comparatively taller and leggy, face colour is lighter, and wool is rough and coarser. Nose is typical roman. Ears are medium to large and tubular with a hairy tuft. Both sexes are polled. Tail is thin and short to medium in length. The ewes have well developed udder. Average body weight in rams and ewes were  $46.1 \pm 1.28$  and  $34.7 \pm 0.26$  kg in Patanwadi and  $49.0 \pm 1.85$  and  $39.3 \pm 0.53$  kg in Dooma sheep, respectively.



*A Patanwadi Ewe*



*A Patanwadi Ram*

Farmers select the breeding rams from own flocks on the bases of body conformation, growth, dam's milk yield and breed characteristics. Age at first breeding ranged between 24-30 months in males. About 60% lambing occurs in major lambing season (October-December) and about 20 % in minor season (February- April). Lamb mortality rate is higher in minor season due to fodder shortage. The lambing rate ranged between 50-100 %. Twinning is rare. Age at first lambing is about 24 months with a lambing interval of 12-18 months. An ewe produces an average of 3- 5 lambs in its lifetime.

The estimated body weight of Patanwadi lambs at birth, 3, 6 and 12 months of age were 3.5, 13.5, 18.5 and 25.4 kg in males and 3.5, 13.4, 18.0 and 24.1 kg in females. The corresponding body weights of Dooma lambs were 4.0, 17.0, 22.6 and 30.0 kg in males and 3.5, 16.9, 23.0 and 31.3 kg in females respectively. The male lambs are disposed off at 6 to 8 months of age in Patanwadi and at 2-3 months of age in Dooma. Sheep droppings are sold or given in lieu of grazing in the farmers' field. Milk production was reported to be 400-500 ml per day during peak lactation period. The ewes are milked for human consumption also after lamb suckling. The sheep are shorn twice a year in Feb/August or March/September months. Average wool production was about 400 g/shearing which is sold for Rs 8-10 to the shearer or traders.

Patanwadi sheep has multifaceted utility for mutton, milk, dung and wool. The animals of this breed need good feed and fodder for their maintenance, growth and production and cannot sustain fodder scarcity. Therefore, some of the farmers are crossing Patanwadi ewes with Marwari rams. Disease resistance was reported to be better in Marwari. However, production and lamb growth are better in Patanwadi.

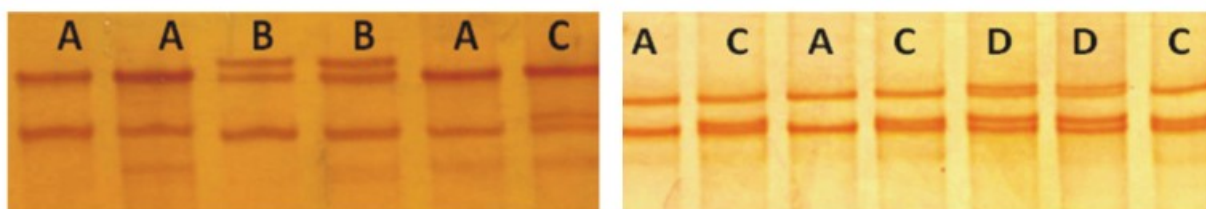


## GENETIC CHARACTERIZATION & FUNCTIONAL GENOMICS

**Effect of drying on structure and fertilizing ability of bovine sperm:** Semen of Murrah bull (3.5 years old) from NDRI, Karnal, consistently yielding semen of good mass motility (2.5-3), was used in present study. Five media (EGTA; EGTA + Trehalose; PBS; PBS + Trehalose and FCS + Trehalose) were used for drying the sperm preparations having sperm concentration of 10 million/ml. Three drying procedures (Vacuum drying at normal and freezing temp., and drying at high temp.) were used and dried suspensions stored at three temperatures for varying durations. Freeze drying resulted in more number of coiled tail abnormalities than drying at normal temperature. Highly significant influence of different drying methods on percentage curved tail abnormalities ( $p < 0.01$ ) was observed. Vacuum drying showed significantly less curved tail abnormality as compared to incubated drying and freeze drying. The different drying methods had highly significant influence on acrosome staining of spermatozoa. Vacuum drying showed less percentage of acrosome stained sperms. Sperm biometry studies showed that tail length and sperm head area were significantly influenced by different media used for dehydration. Evaluation of chromatin integrity using acridine orange staining and fluorescence microscopy showed large proportion of intact chromatin in dried spermatozoa. Electron microscopy of differently treated spermatozoa did not show much variation in their ultra structure. The DNA fragmentation as assessed through TUNNEL assay did not differ much among various suspensions and it varied from 2 to 5%. The sperm fertility, assessed through sperm-oolemma binding tests showed no sperm adhesion with oolemma or any zygote formation. It can be inferred from the studies that spermatozoa dehydration altered them morphologically to great extent and rendered it non-fertile.

**Genetic characterization of Catsper gene in Indian cattle and buffalo:** The genomic DNA of three buffalo breeds (Jaffarabadi, Murrah and Mehsana) and three cattle breeds (Krishna Valley, Kankrej and Sahiwal) were used for amplifications of 15 exons of Catsper 1 gene and 12 exons of CatSper 2 gene through custom synthesized primer pairs. There was no variation across 7 exons (1,9,10,11,12,13 and 15) of CatSper 1 gene in *Bos taurus* vs *Bubalus bubalis*, whereas variations in later species across another 8 exons (2,3,4,5,6,7,8 and 14) was almost similar to *Bubalus bubalis* vs *Bos indicus*. The similar trend was observed for CatSper 2 exons w.r.t. these two sets of species. 0.34% (exon 2) and 0.88% (exon 5) nucleotide variation was observed across Catsper 1 and CatSper 2 gene respectively in *Bos taurus* vs *Bos indicus*. The results show large scale coding sequence homology of CatSper 1 and CatSper 2 genes among *Bos taurus* and *Bos indicus*, which differs with *Bubalus bubalis*. The observed nucleotide variations may be responsible for differential sperm motility observance in *Bubalus bubalis* and *Bos indicus*.

**Characterization of candidate genes regulating muscle growth and meat quality in buffalo:** Four SSCP variants were identified in 5' upstream of buffalo thyroglobulin gene. By sequencing of these variants, the nucleotide variations at three different positions were assigned to them. Based on nucleotide variations detected, genotype and allele frequencies were calculated. Due to higher



Detection of SSCP variants in 5' upstream of buffalo thyroglobulin gene



*Assigning of nucleotide variations in 5' upstream region to SSCP variants and their allele frequencies in buffalo thyroglobulin gene*

Breed/ population	5' Upstream (826)		5' Upstream (662)		5' Upstream (640)		SSCP Variants	-826 Exon1	-626 Exon1	-640 Exon1
	A	G	C	A	A	G				
Niliravi	4.37	95.63	91.25	8.75	8.75	91.25	A	G	C	G
Mehsana	5.8	94.2	88.71	11.29	11.29	88.71	B	A/G	C	G
Assamese	13.11	86.89	87.70	12.30	12.30	87.70	C	G	C/A	A/G
							D	A/G	C/A	A/G

frequency of allele 'A' at -826 position, SSCP variant D of TG gene was at high frequency in swamp buffaloes. Also two buffalo genes, Insulin-like growth factor-1(IGF1) promoter and coding regions and calpain (CAPN1) coding region have been characterized. Using genomic DNA of six riverine and six swamp type buffaloes a 2.2 kb promoter region of IGF1 amplified in six overlapping fragments and sequenced. Analysis of sequence data revealed presence of nine polymorphic sites within buffalo. As compared to cattle IGF1 promoter sequence there was an insertion of stretch of four nucleotides 'TTTC' at -1226 and single nucleotide insertion at -1720 and one deletion at -1791 in buffalo.

*Polymorphism in the IGF1 promoter region of buffalo*

Position	Variation	Binding Site
-15 upstream	C/T	No
-254 upstream	C/T	No
<b>-1226 upstream</b>	<b>TTTC Addition</b>	<b>STE-12</b>
-1431 upstream	C/T	No
-1436 upstream	A/G	No
<b>-1530 upstream</b>	<b>A/G</b>	<b>SP-1</b>
-1683 upstream	C/T	No
<b>-1725 upstream</b>	<b>A-Addition</b>	<b>Delta E</b>
<b>-1796 upstream</b>	<b>A-Deletion</b>	<b>Oct-1</b>
-2009 upstream	A/G	No
-2025 upstream	A/G	No

When IGF1 promoter region of swamp and riverine buffalo was compared, there were three nucleotide changes. In the coding region, buffalo IGF1 exon1 sequence analysis showed no polymorphism whereas exon2 and adjoining introns had two polymorphic sites. Exon 3 and adjoining introns of buffalo IGF1 when analyzed, there were three polymorphic nucleotide sites each in intron2 and intron3. Exon4 was found to be having one nucleotide change in coding sequence and one in 3'UTR at +66 position.

In order to analyze the polymorphism existing in buffalo CAPN1 gene, genomic DNA of six animals each of riverine and swamp buffaloes amplified in 11 fragments of exonic and adjacent introns of CAPN1. In the 5' upstream sequence there was a deletion of one

nucleotide in buffalo as compared to cattle and there was one nucleotide insertion in intron1. Total number of polymorphic sites observed across total eight exons and adjoining introns were 17.

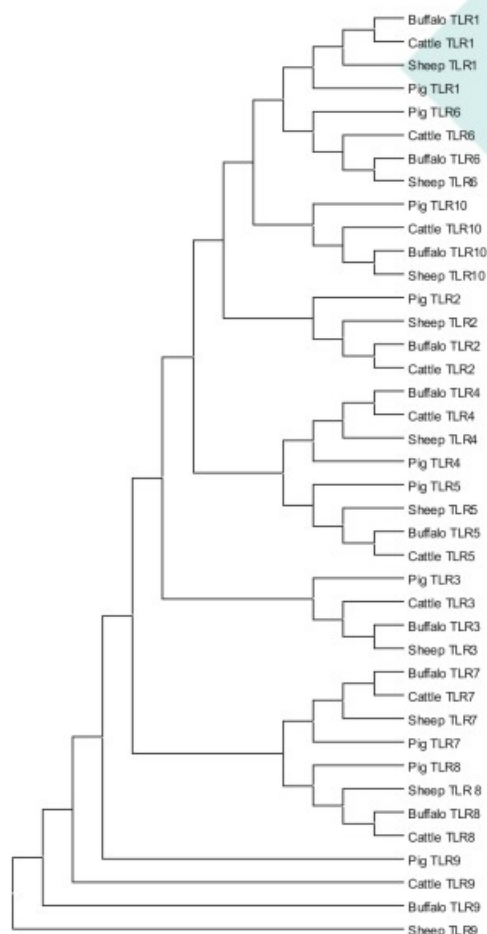
**Toll-like receptors in farm animals-Evolutionary lineages and application in disease resistance:**

Complete ORFs of ten buffalo TLR genes amplified into overlapping fragments and sequenced using the primers designed from reported cattle TLR gene sequences. Data analysis revealed the nucleotide length of buffalo TLRs and the amino acid length they code for as given in table below. Like cattle, buffaloes have same ORF in all the TLRs except TLR6. Buffalo TLR6 was found to be having insertion of 3 nt (TTA) at 545 nucleotide position adding amino acid Tyr at position182. Six nucleotides insertion in 3'UTR of buffalo TLR2 gene of buffalo as compared to cattle has also been found. The nucleotide sequence data generated for buffalo TLR2, 3, 5, 6 and 10 genes and its translated amino acid sequence

*Accession numbers obtained for ten buffalo TLR genes alongwith other characteristics*

Gene	Accession no.	ORF (bp)	Amino acids	Extracellular domain	Trans -membrane	Intracellular domain	TLR domain
TLR1	HQ327989	2184	727	1-520	521-543	544-727	575-718
TLR2	HM756162	2355	784	1-587	588-610	611-784	640-784
TLR3	HQ343417	2715	904	1-703	704-726	727-904	755-900
TLR4	HQ343416	2526	841	1-634	635-657	658-841	674-819
TLR5	HQ327990	2577	871	1-656	657-679	680-871	705-850
TLR6	HQ327992	2355	794	1-587	588-610	611-785	642-784
TLR7	GU903503	3153	1050	1-841	842-854	855-1050	891-1037
TLR8	GQ499855	3102	1033	1-817	818-840	841-1033	871-1017
TLR9	HQ242779	3090	1029	1-745	-	746-1029	865-1012
TLR10	HQ327991	2439	812	1-577	578-600	601-812	634-779

was compared with other livestock species. As expected, buffalo TLR2, TLR5, TLR6 and TLR10 had maximum identity with cattle, followed by goat, sheep and pig both at nucleotide and amino acid level. But buffalo TLR3 showed maximum identity with sheep, followed by cattle and pig both at nucleotide and amino acid levels. Phylogeny between 10 TLR genes of buffalo revealed TLR1, TLR6 and TLR10 having maximum homology between them as compared to other TLRs. TLR7, TLR8 and TLR9 showed more identity to each other as compared to rest of the TLRs. TLR2, TLR4, TLR5 and TLR3 branched separately.

*Sequence Alignment of Ten Buffalo TLR Genes alongwith reported sequences of other Livestock Species*



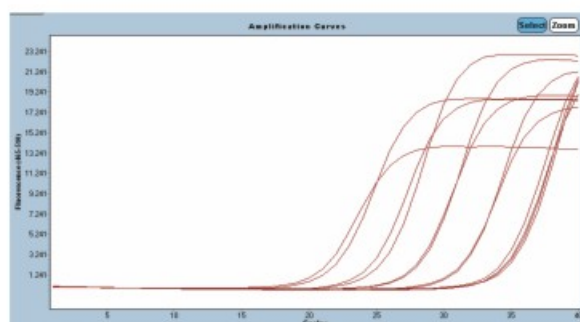
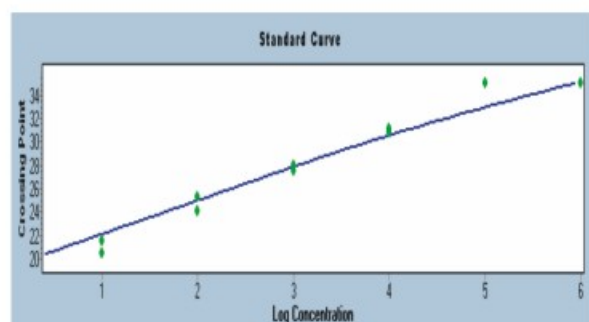
**Bioprospecting of genes and allele mining for abiotic stress response:** The transcriptome data have been generated on 10 different goat tissues, using Next generation Sequencer (Illumina GA II). The tissues included are mostly the ones which are associated with the thermal regulation of the goat like Brain, hypothalamus, fibroblast, blood, heart, liver, kidney, spleen, lungs and mammary gland.

*The details of the data generated for eight tissues of goats*

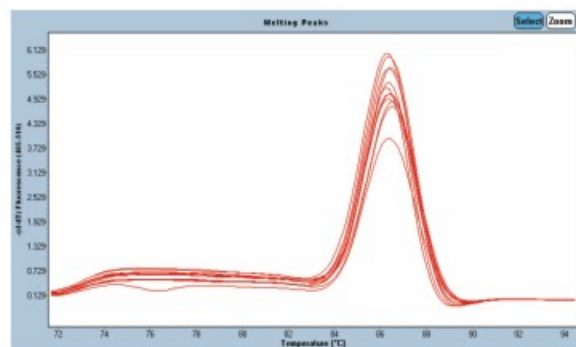
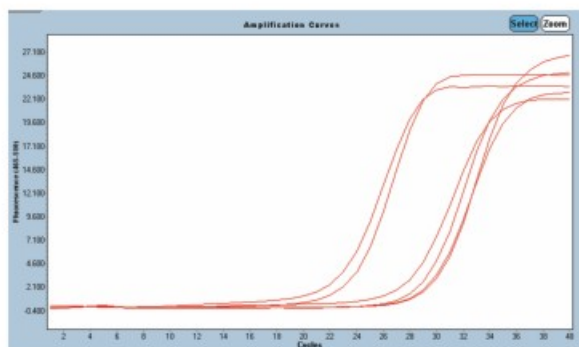
Tissue	Total sequence data generated (Bytes)	Undiscovered CDS	BLASTX Transcripts
Kidney	630,797,944	448	10182
Spleen	6,758,583,022	430	9814
Heart	4,911,352,824	214	6457
Lungs	5,938,410,712	371	9931
Liver	6,802,300,566	299	7765
Muscle	5,385,320,380	209	6823
Fibroblast	4,173,524,670	245	6734
Mammary gland	4,666,890,978	243	7748

Using various software, the data on numbers of undiscovered contigs for various tissues have been generated by *de-novo* assembly of the transcripts. The conserved CDS pipeline was utilized consisting of alignment of translation with of amino acids with cattle, mouse and goat proteins. BLASTX used to discover conserved genes using Cattle (11667 proteins), Mouse (42786 proteins), and Goat (511 proteins) as reference to discover conserved proteins. Largest transcript (one transcript to one protein) selected with complete ORF that meets the minimum selection criteria of e-value. There may be some common house-keeping genes and other genes expressed in two or more tissues. The genes are being sorted out and all the common genes expressed have been removed to get the tissue specific genes. The files are being prepared to submit all the accessions to NCBI GenBank. The expression values of all the genes have also been calculated in terms of RPKM values, which provides the number of reads per kilo-base per million mapped.

**Increasing profitability of sheep production by genetic improvement using the FecB (Booroola) mutation and improved management:** To analyse the gene expression in FecB carrier and non-carrier ewes by real-time PCR, RNA was extracted from the ovary tissues after synchronization of estrous. All the samples were run as biological replicates. The fold change was calculated for the BMP4, BMP7 and BMPR1A genes across FecB genotypes. Amplification efficiency of the assays ranged from 90-105% and the correlation coefficients of all the standard curves were  $\geq 0.998$ . GAPDH was used as internal control which showed equal expression across ovary samples (difference of less than 1 Cp).



Standard curve analysis to check the efficiency of real time PCR



Expression profile of BMP4, BMP7, BMPR1A and GAPDH & dissociation curve analysis

Real-time PCR analysis revealed similar expression of BMP7 across different genotypes which is also reported in Chinese ewes. Further the mRNA expression levels of BMP4 and BMPR1A were found to be significantly higher in high fecundity ewes as compared to low fecundity ewes.

#### Fold change expression of BMP4 and BMPR1A across FecB genotypes

FecB Genotype	Breed	Litter Size	$\Delta\Delta Ct$ (BMP4)	Fold change	$\Delta\Delta Ct$ (BMPR1A)	Fold change
BB	Garole	2.67	3.86	14.5	8	>100
++	Deccani	1.00				
BB	CB	1.33	-0.90	1.8	1.13	2
B+	CB	1.33				
BB	CB	1.33	-0.28	1	-2.49	5.6
BB	CB	>2				
BB	Garole	2.67	1.90	3.7	4.28	19
BB	CB	>2				

BMP4 mRNA abundance in ovaries of high fecundity ewes might suggest their role in regulation of ovulation rate and implicating the role of BMP4 as a candidate gene for high fecundity. However the expression of BMPR1A was found to be more in homozygous individuals with higher litter size. Based on these results it may be suggested that the changes in expression of BMPs receptor genes could influence the ovulation rate in ewes.

**Identification of SNP markers in candidate genes of somatotrophic axis in diverse indigenous goat breeds and their association with production traits:** SNP markers in candidate genes of somatotrophic axis were studied in nine goat breeds viz. Jamunapari, Beetal, Jharkhand Black, Sirohi, Barbari, Osmanabadi, Black-bengal, Changthangi and Gaddi. Total 18 heterozygous SNPs in IGF1 (Insulin like growth factor 1), 8 heterozygous SNPs in IGFBP3 (Insulin like growth factor binding protein 3) and 5 heterozygous SNPs in GHR (Growth hormone receptor) gene have been identified across these studied breeds

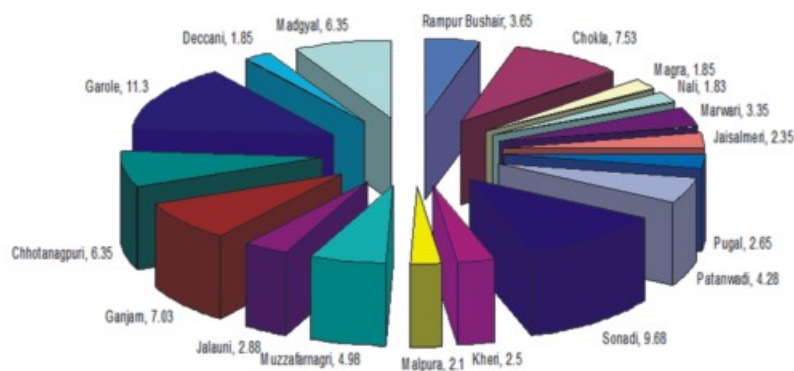
**Analysis of candidate genes involved in immune response regulation:** Gene sequences of the TLR4, TLR9, MCP1 and NOS2a genes have been delineated across the animals of the *Bos indicus* Sahiwal population. The SNPs present in these genes have been studied. Analysis of the genes in the animals suffering from mastitis is in progress.



**Genetic Variation in Bovine cytokines:** The exon-1, exon-2 and exon-3 along with the flanking regions and the 5'-UTR of the IFN-gamma gene has been sequenced over a panel of 40 animals of the different *Bos indicus* breeds viz. Sahiwal, Hariana, Tharparkar, Kankrej and Rathi. Sequence analysis has been carried out. Exon-2 and Exon-3 were conserved. The sequences were the same as observed in *B. taurus*. Exon-1 showed a non-synonymous SNP that resulted in the substitution of the glycine with the valine residue in the signal peptide of the molecule.

**Establishment of National Agricultural Bioinformatics Grid (NABG) in ICAR:** The project had provision of two trainings during the year 2010-11. Sensitization training on "Soft Computing Techniques in Animal Bioinformatics" was organized during November 8-12, 2010. A subject training on "Bioinformatics for Animal Genomics and Proteomics" was organized during February 24 to March 9, 2011. A partner's meet was organized on November 19, 2010 with participation from NABG partners, ICAR animal science institutes and State Animal & Veterinary Science Universities. A livestock protein database has been designed to contain information on protein sequences, domain, 3-D structure, pathways, functions, and literature. The data entry work has been completed for database on genetic characterization using microsatellite markers for all the indigenous breeds of livestock and poultry species.

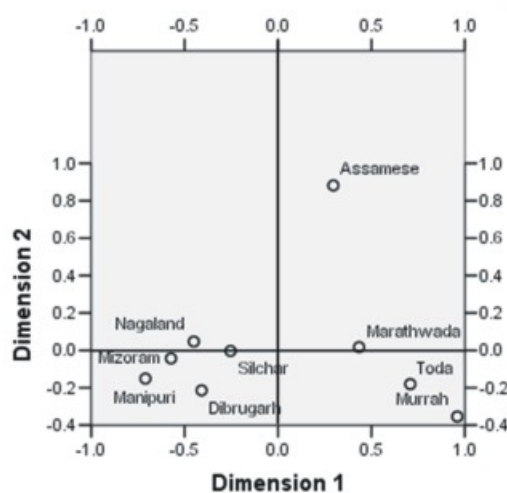
**Genetic profiling of important meat and wool type indigenous sheep breeds using neutral and functional markers:** The genetic profiles and structure of Indian sheep breeds/populations was elucidated using a panel of 25 microsatellite markers with the aim to provide genetic information useful for improving selection strategies and conservation policies. Diversity indices were estimated using various software for population genetic analyses. The average number of alleles observed and the expected heterozygosity across all the breeds/populations were 18.32 and 0.802 respectively. A significant positive FIS value ( $p < 0.05$ ) or a lack of heterozygotes was observed for all the breeds/populations investigated except Madgyal, Ganjam, Chhotanagpuri, Jaisalmeri and Patanwadi. The results obtained highlight that most of the Indian sheep investigated reflect a deficiency of heterozygotes as well as high genetic variability, suggesting stratification of the breeds in subpopulations. Application of Weitzman approach showed that the contribution of each breed/population to the marginal genetic diversity ranged from 1.83% to 11.3%. It was observed that Chokla, Sonadi, Ganjam and Garole breeds depict a higher marginal diversity ( $>7\%$ ) and are therefore, potential contenders for conservation precedence over other investigated breeds. The measure of the marginal loss of diversity for each breed using the Weitzman approach therefore enables the ranking of breeds for conservation purposes.



Marginal losses of Weitzman's diversity in Indian sheep breeds

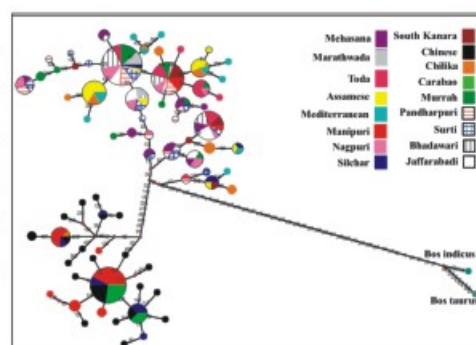
Phylogenetic analysis revealed the genetic closeness of Nali-Jaisalmeri, Deccani-Madgyal and Magra-Pugal breed pairs which lie in geographic proximity to each other. Analysis of data using STRUCTURE software revealed poor resolution between Jaisalmeri, Magra, Nali and Pugal breeds. Further, PCR-RFLP, SSCP and SNP analysis revealed polymorphism at the keratin associated protein (KAP1.3), Agouti (ASIP), Insulin like growth factor binding protein 3 (IGFBP-3), Callipyge (CLPG) and ovine bone morphogenetic protein type 1B receptor (BMPR1B) gene loci in the indigenous sheep breeds.

**Genetic Characterization of Assamese swamp and hill buffaloes of North-East region:** Diversity analysis using microsatellite genotype data was carried out for 23 Assamese buffalo from upper Assam region around Dibrugarh and 16 Mizoram buffaloes and compared with other swamp and river buffaloes. During the period pilot survey of buffaloes from Nagaland state was completed. Biometry data collected on 24 adult Nagaland buffaloes and 50 blood samples from random individuals were collected from different locations. The phenotypic features indicated swamp type similar to earlier characterized Manipuri swamp buffaloes. Further 48 Nagaland buffalo samples were genotyped using set of 22 microsatellite markers for diversity analysis, which showed Nagaland buffaloes having mean number of alleles 9.64 with mean observed heterozygosity of 0.723 and expected heterozygosity to be 0.76. Phylogenetic analysis comparing the microsatellite data of five other populations of NE region showed Nagaland buffaloes placed in a distinct cluster, which was also evident by their grouping in Principal Component Analysis.



MDS plot of pair-wise  $F_{ST}$  among different buffalo breeds (Stress value = 0.01088) based on microsatellite genotypic data

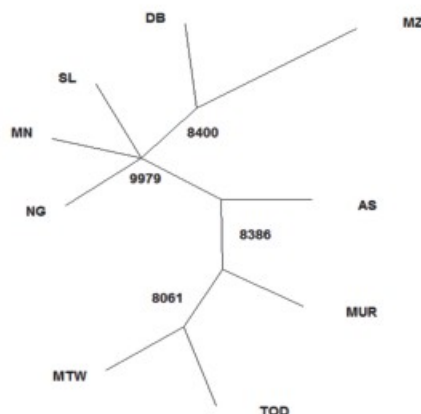
Phylogenetic analysis including three riverine breeds, Toda, Murrah and Marathwada further revealed, Assamese buffaloes clustering in between riverine and true swamp types of North-east. Multi-dimensional scaling also showed placement of swamp buffaloes of North-east together, Assamese and riverine clustering separately.



Rooted reduced median-joining network of mitochondrial haplotypes of different buffaloes (breed wise)



Median joining network of haplotypes of different buffaloes based on mitochondrial DNA D-loop polymorphism analysis showed swamp buffaloes of North-east India sharing haplotypes with Chinese and Carabao buffaloes.



*NJ tree based on pair-wise Nei's genetic distance (10000 bootstraps) based on microsatellite genotyping data (MZ-Mizoram; DB-Dibrugarh; NG-Nagaland; MN-Manipuri; SL-Silchar; As-Assamese; MUR-Murrah; TOD-Toda; MTW-Marathwada)*

## NETWORK PROJECT ON ANIMAL GENETIC RESOURCES

### Conservation Units

**Kilakarsal Sheep:** Conservation is being undertaken through TANUVAS Small Ruminant Research Centre, Ramayanpatti in Tirunelveli district of Tamil Nadu. The elite rams are being supplied to the farmers and the progeny is being followed.

- Established a nucleus Kilakarsal flock at VUTRC, Tirunelveli (T N)
- Present flock strength is 29 males and 93 females
- 30 Rams supplied to shepherds for breeding in the field
- 507 progenies have been produced and are being followed
- Vaccinated against diseases like Sheep pox, Anthrax, PPR, Blue tongue



Kilakarsal Lambs



Kilakarsal Rams

**Krishna Valley Cattle:** The conservation project is being undertaken through BAIF Development Research Foundation. Krishna valley cattle are being inseminated with frozen semen produced in the project. The semen is being utilized in the breeding tract through BAIF and Karnataka Animal Husbandry Department network.

- Operational Area is 150 villages from Bagalkot, Belgaum & Bijapur districts
- Average conception rate is 53.42%
- 939 Progeny born so far
- Calves are followed for recording growth parameters

#### Core Lab, TANVASU, Chennai

##### Genetic Characterization of breeds

**Malaimadu Cattle:** A total of 166 alleles were observed across 25 marker loci under investigation with a mean of  $6.64 \pm 0.68$  across all loci. The observed heterozygosity mean value was  $0.47 \pm 0.06$  and expected heterozygosity was  $0.60 \pm 0.05$ . The mean FIS value observed was  $0.27 \pm 0.06$ . The microsatellite data generated in Malaimadu cattle has been subjected to phylogenetic analysis along with the other breeds of cattle, screened so far. The dendrogram shows closeness among cattle breeds of Karnataka such as Amritmahal, Hallikar and Krishna Valley. While the other breeds such as Burghur, Pulikulam and Malaimadu cattle are distinct from rest of the populations

**Katchakatty Sheep:** The number of observed alleles ranged from 1 (OarHH64) to 11 (TGLA37) with a mean of 6.88 across all loci. The mean observed and expected heterozygosity values were 0.5566 and 0.6671 respectively. The FIS value was negative.

**Mecheri Sheep:** The number of observed alleles ranged from 3 (OarHH64 & BM6506) to 11 (TGLA377) with a mean of 6.40 across all loci. The mean observed and expected heterozygosity values were 0.611 and 0.69 respectively.

**Coimbatore Sheep:** The number of observed alleles ranged from 3 (OarHH64, OMHC1 & BM6506) to 9 (OarHH47) with a mean of 5.52 across all loci. The mean observed and expected heterozygosity values were 0.661 and 0.7276 respectively.

**Nilagiri Sheep:** The number of observed alleles ranged from 2 (OarHH64) to 9 (OarJMP29) with a mean of 5.24 across all loci. The mean observed and expected heterozygosity values were 0.6621 and 0.7016 respectively.

Genetic relationships and genetic distance among eight sheep breeds of Tamil Nadu based on microsatellite genotyping were utilized to determine relationship / differences between them. Nilagiri and Coimbatore sheep breeds are clustered together, indicating their closeness, thereby confirming the fact that Coimbatore sheep had also contributed in the evolution of Nilagiri sheep (or sharing a common ancestor). Further, the geographical distribution of the breeds such as Madras Red, Trichy Black, Katchakatty and Kilakarsal, present along the coastal Tamilnadu, are forming the main cluster in the top of the dendrogram and the rest of the breeds present along the Western ghats are in the other cluster.

##### Trait Specific Gene Characterization

**Growth hormone gene:** Growth hormone gene in Ongole and Malanad-giddaa cattle was sequenced to find out the involvement of this gene in the body size of these two cattle breeds. No confirmed SNP was evidenced in indigenous cattle for the body size.

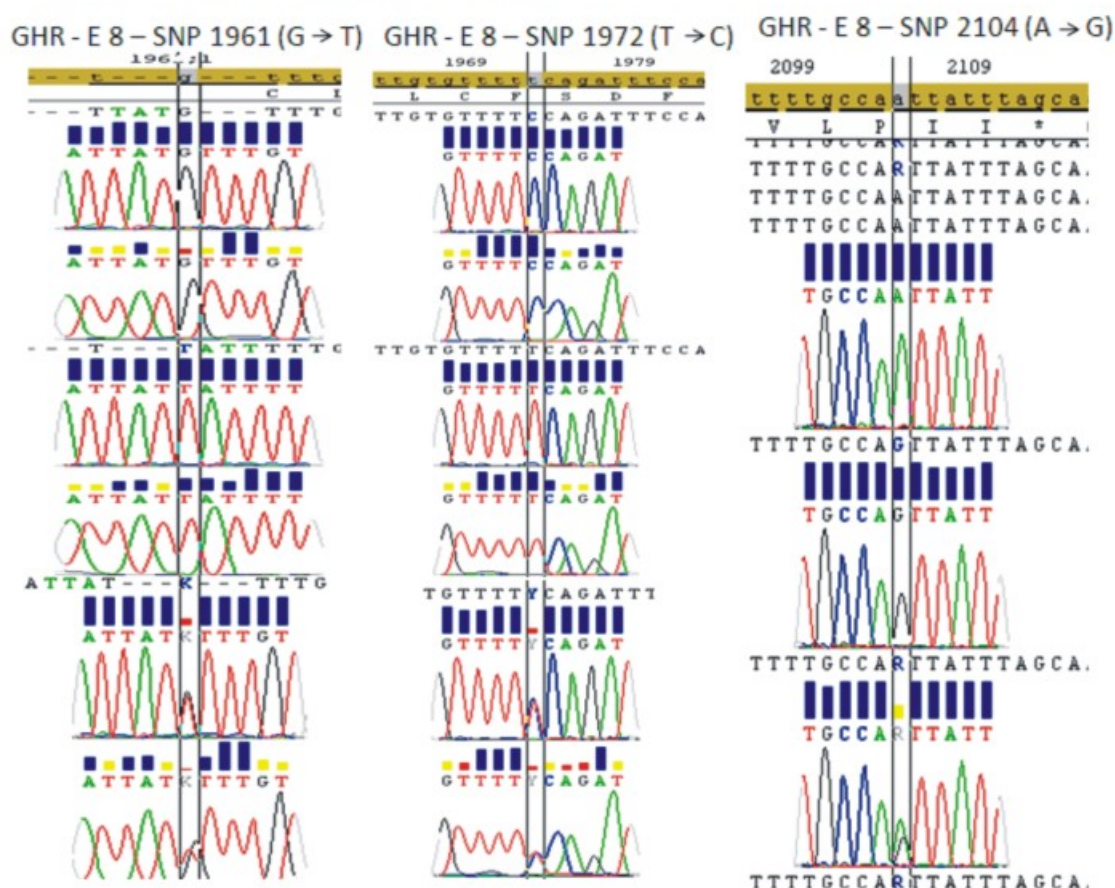


The sequence of ACTN3 gene contains 21 exons and the exon 15 is highly polymorphic containing the SNP for endurance power in human beings. Hence, the area covering the intron 14, exon 15 and intron 15 was concentrated and primers constructed to amplify and sequence subsequently. Sequences of ACTN3 gene in Burghur, Hallikar, Kangayam and Pulikulam revealed SNPs.

#### Core Lab, AAU, Anand

**GHR and Leptin gene:** Genotyping of SNPs in GHR and leptin genes in Mehsana has been carried out. Statistical analysis indicated A/G in exon 4 and C/T in exon 5 of GHR gene to be of particular interest having significant difference in milk yield and fat %. Other SNPs did not show any significant difference between the genotypes. However, this observation is based on limited number of data (data uncorrected for effect of non-genetic factors). Data from Surti and Jaffarabadi will be incorporated in the analysis to draw final conclusions.

For detection of exonic SNPs in the pituitary specific transcription factor (PIT-1) gene, direct sequencing of the PCR amplicons was carried out in 40 samples (4 samples each from Jaffarabadi, Mehsana, Surti, Murrah, Pandarpuri, Toda, Bhadawari, Chilika, Banni and Nili Ravi). A total of five buffalo specific SNPs were identified in Exons 1, 2 and 3. There is indicative association but large data shall be analysed to establish any association.



#### Core Lab, NBAGR

**Shahabadi Cattle:** The Shahabadi cattle constitute important livestock germplasm of Bihar state. Two decades earlier enough animals of Shahabadi cattle were available in its breeding tract but at present the population is declining and need immediate conservation/genetic improvement measures. Thus



Shahabadi cattle population was characterized both phenotypically as well as at molecular level using microsatellite markers. A survey was conducted in different villages of Ara and Buxar districts for collecting morphometric information. Morphometric data on 175 Shahabadi cattle was collected. The Shahabadi cattle are greyish- white or totally white. The muzzle, eyelids, switch of tail and hooves of the animals are generally black. The horn colour is black or muddy. The orientation of horns is outwards, upwards, inwards and with pointed tips in majority of cases. Ears are horizontal in orientation and forehead is straight. Hump and dewlap are medium. Udders (fore and rear) are bowl shaped with cylindrical teats having rounded tips. Milk vein is small to medium. The milk production of Shahabadi cattle ranges from 2 to 6 litres /day but in rare cases it was 8 litres/day.



*A Shahabadi Male*



*A Shahabadi Female*

*Body measurement (cm) in different age group animals of Shahabadi cattle*

Traits	Cows N=70	Bullocks N=10	Young stock (1-3) Males N=18	Young stock (1-3) Females N=45	Calves N=32
BL	123.80±0.39	127.10±0.94	97.44±2.34	106.36±1.77	82.81±1.84
CG	155.96±0.58	165.9±3.08	116.39±4.07	130.36±2.35	98.38±2.99
Height	122.4±0.58	129.8±1.66	103.33±2.23	108.76±1.25	91.13±1.82
PG	169.64±1.25	180.4±2.53	126.94±4.21	137.67±2.63	103.44±3.68
FL	44.91±0.20	47.7±0.80	37.39±1.16	40.71±0.66	31±1.12
FB	55.29±0.09	16.4±0.37	13.61±0.28	14.96±0.60	12.09±1.66
TWOS	83.56±0.99	92.2±2.46	64.61±2.20	69.51±1.72	54.53±1.66
TWS	106.1±1.49	113.9±4.17	79.44±3.14	86.98±2.10	63.47±2.14
HL	15.16±0.61	17.1±1.86	2.67±0.59	4.30±0.48	2.09±0.59
EL	27.39±0.17	28.3±0.52	24.5±0.64	24.96±0.30	21.75±0.48

BL= Body Length, CG= Chest Girth, Height= Height at Withers, PG= Paunch Girth, FL= Face Length, FB= Face Breadth, TWOS= Tail length without switch, TWS= Tail length with switch, HL= Horn Length, EL= Ear Length

Fifty unrelated Shahabadi animals were randomly chosen from the breeding tract for genotyping with 23 microsatellite markers on automatic DNA sequencer. A total of 241 alleles were observed with an average of  $10.48 \pm 0.8$  alleles per locus indicating reasonable amount of polymorphism in Shahabadi cattle. The number of observed alleles (No) varied from 4 (ILSTS11) to 18 (INRA35). The effective number of alleles ranged between 1.84 (TGLA227) to 10.381 (INRA35) with a mean of  $4.751 \pm 0.48$ . The average observed heterozygosity (Ho) varied from 0.417 (TGLA227) to 1 (HEL05) with a mean of  $0.713 \pm 0.033$  which was less than the expected heterozygosity (He). The f-estimates varied from -0.171 (HEL05) to 0.243 (ILSTS06) with an average of 0.037. Thus, an average of 3.7% heterozygote deficit was detected in the Shahabadi population.



### Identification of polymorphisms in genes controlling marbling trait in Indian goats

Through the application of genomic tools efforts are being made to identify SNPs (Single Nucleotide Polymorphisms) in a set of candidate genes associated with meat quality trait. Thus sequence analysis and SNP identification in CAPN1, Akirin and Titin genes was continued in a panel of Indian goat breeds. The CAPN1 (calcium-activated neutral proteases) is thought to be the main candidate marker gene for the beef meat quality. SNPs in exon 9, 14 and intron 17 of CAPN1 in cattle have been associated with meat tenderness. Variations and new polymorphisms were detected in exon 9, exon14 and intron 17 along with their boundary regions in caprine CAPN1. Sequenced caprine genomic segments share >90% similarity with corresponding bovine and pig sequences. Seventy nine nucleotide differences were recorded in studied region of caprine CAPN1 gene as compared with that of *Bos taurus* (AF 252504S1 and AF 252504S2). Ten novel SNPs were identified, one in exonic region (5707, C/T) and nine in intronic region (one in intron 8; 5543 T/C; two in intron14; 4638 T/C, 4689 C/T and six in intron 17; 6417 T/G, 6499 T/C, 6529 T/C, 6533 C/G, 6539 A/G and 6541 T/G). The SNP 5707 in exon 9 corresponds to non-conservative substitution (CGG to TGG) that changes an amino acid (Arg to Trp) in the protein sequence. Titin has been associated with meat tenderness in cattle. Thus 5'UTR region of Titin gene was sequenced. On comparing the goat sequence with that of exotic cattle (NW\_001494580.2), five variations and four 'G' insertions were observed. These included one SNP A/G at position 448 in indigenous goats. The sequence homology of 5'UTR region of Titin was 93% with *Bos taurus*. 3'UTR of Akirin gene is also associated with meat quality in *Bos taurus* (188G>A). Three variations A>G at position 1100, deletion of A and T at position 1175 and 1176 were identified in the indigenous goats as compared to that of *Bos taurus* (NW\_001495576.1), while no SNP was identified in goat. The sequence homology of goat 3'UTR region was 96% with *Bos taurus*, 93% with *Homo sapiens* and 94% with *Sus scrofa*.

### Core Lab, AAU, Khanapara, Guwahati

The main objective is to carry out molecular characterization of indigenous species of livestock of Eastern region of India using DNA markers. Two goat populations from planes and hills were studied. The results based on 13 microsatellite markers revealed mean observed number of alleles of  $4.4615 \pm 2.15$  and  $4.6923 \pm 2.02$ , while the mean observed heterozygosity was  $0.4359 \pm 0.26$  and  $0.4218 \pm 0.27$ , in hill and planes goat populations respectively. Four pig populations viz. Meghalaya local (Niang Meghalaya), Ghungroo, Doom and Local pigs of Assam genotyping work have been initiated.

### Buffalo Genomics

Whole genome sequencing of one female Murrah buffalo (NDRI 5620) has been undertaken using the next generation sequencing platform. More than 90 GB DNA sequence data has been generated providing nearly 30 fold coverage. The first version of assembly was constructed with Illumina paired end and mate pair short read sequencing using the cattle genome (Btau 4.0 assembly) as a reference. The assembly has read depth of 17-19X. The buffalo assembly represents ~ 91%-95% coverage in comparison to the cattle assembly Btau 4.0. The assembly has 185,150 contigs with the median contig length of 2.3 Kb and the largest contig length of 663 Kb. The mitochondrial genome is fully covered by a single contig. Whole genome comparison between this assembly and of cattle revealed 52 million mismatches/indels. The present analysis also unveils about 300 structural variants in the buffalo genome. The buffalo assembly has been integrated into a publicly available genome browser (<http://210.212.93.84/cgi-bin/gb2/gbrowse/bovine/>) with tracks for read pair insert distances, read depth, nucleotide variations, coverage, and the availability of custom tracks for scientific community.



This assembly of the Water Buffalo is the first deep sequencing project that provides the resources to better understand the genomic basis of adaptable traits and genetic variation that distinguishes buffalo from cattle.

*Contig coverage summary statistics for buffalo read mapping assembled across the Btau\_4.0 chromosomes*

Chromosome		Total Length	Contig length	Coverage	Count	N90
Buffalo	Cattle					
1q	1	161,112,571	148,689,783	92%	12,605	35,387
2q	2	140,809,139	132,108,058	94%	9,644	40,874
6	3	127,931,374	118,378,207	93%	8,838	40,464
8	4	124,461,602	117,031,333	94%	8,591	41,453
4q	5	125,851,629	116,531,865	93%	9,655	35,596
7	6	122,567,560	112,098,606	91%	10,269	32,480
9	7	112,086,926	104,509,580	93%	8,433	35,460
3q	8	116,952,631	107,607,137	92%	7,894	41,069
10	9	108,154,237	100,651,363	93%	8,587	34,822
11	10	106,392,721	100,016,561	94%	7,239	40,875
12	11	110,177,331	103,360,885	94%	6,415	46,543
13	12	85,365,658	79,834,680	94%	7,563	30,720
14	13	84,426,694	79,428,116	94%	3,843	66,048
15	14	81,352,385	76,761,875	94%	4,986	46,897
16	15	84,636,695	77,910,307	92%	7,991	25,979
5q	16	77,911,411	71,906,287	92%	5,300	40,986
17	17	76,512,898	70,559,927	92%	5,218	38,550
18	18	66,145,125	60,816,937	92%	3,857	47,523
3p	19	65,321,398	60,605,098	93%	3,460	52,660
19	20	75,802,968	70,350,645	93%	5,444	39,413
20	21	69,177,455	64,581,383	93%	4,858	40,903
21	22	61,853,906	58,455,445	95%	2,672	66,821
2p	23	53,383,219	49,900,510	93%	3,447	42,632
22	24	65,027,238	60,974,074	94%	3,896	46,124
24	25	44,066,150	41,280,505	94%	2,145	58,084
23	26	51,757,727	47,863,689	92%	3,776	36,991
1p	27	48,755,914	44,741,898	92%	4,277	33,321
4p	28	46,088,657	42,810,178	93%	3,013	42,521
5p	29	52,001,983	47,325,309	91%	4,401	31,455
X	X	88,519,689	81,348,221	92%	6,832	35,322
Mitochondrion		16,367	16,367	100%	1	



## Other Activities

### LIBRARY

The NBAGR library has been playing an important role in serving the scientists and technical staff of the bureau. Library Advisory Committee (LAC) is guiding force in the management of the library issues pertaining to purchase of scientific books/journals etc. The Bureau LAC was reconstituted on 19.7.2010.

Books and journals worth Rs. 8,71,492/- were procured in the library during the period. Fourteen foreign journals and thirty four Indian Journals have been subscribed for the benefit of scientific readers.

### Library Advisory Committee

1.	Director	Chairman
2.	I/c AGR	Member
3.	I/c AG	Member
4.	I/c DNAFU	Member
5.	I/c Computer	Member
6.	A.O.	Member
7.	AF&AO	Member
8.	I/c Purchase	Member
9.	I/c Network project	Member
10.	I/c Library	Member

### Basic Statistics

1.	Total collection	3723
2.	No. of books added	233
3.	No. of Indian Journals subscribed	34
4.	No. of Foreign journals subscribed	14
5.	No. of News papers subscribed	07

### IMPORTANT MEETINGS

**Institute Research Committee (IRC):** Institute Research Committee meetings were held under the chairmanship of Dr B.K. Joshi, Director NBAGR, to discuss the research projects. During the mid term IRC meeting held on 2nd August, 2010, progress of thirty five institute and eight externally funded ongoing research projects was reviewed. Dr R.K.Singh, Director, NRC Equines, Hisar was invited as an expert member. The annual IRC meeting was held on 8th March 2011. Final reports of six completed projects and proposals for six new projects were discussed. Dr. Vineet Bhasin, Principal Scientist from Indian Council of Agricultural Research, Delhi attended this meeting as an expert member.



IRC meeting in progress

**Research Advisory Committee (RAC):** The Research Advisory Committee (RAC) meeting was held on 22nd March, 2010 under the Chairmanship of Prof. Lalji Singh, former Director CCMB Hyderabad. The progress of research projects was reviewed by the committee and important recommendations emerging from the discussion were sent to the council for approval.

**Network project scientists' meet:** The Scientist's meet of Network project on Animal Genetic Resources (ICAR) was held on 13th March, 2010 at NBAGR. Dr K M L Pathak, DDG (AS), Dr S.C. Gupta, ADG(AP&B), Dr Vineet Bhasin, Principal Scientist, ICAR, Dr R.K.Sethi, Director CIRB, Hisar, Incharge



9th Scientist meet of Network project in progress



Core lab's and Incharge Conservation units participated in the meeting. Dr M.S.Tantia presented the Action Taken Report on the recommendation of 8th Scientists meet as well as PC Report. After detailed deliberations, recommendations were finalized for all Core labs and other network units.

**FAO Regional Training Workshop:** NBAGR in collaboration with FAO organized a Regional Training Workshop on “*in vivo* conservation of animal genetics resources” at National Agricultural Science Complex (NASC), New Delhi on 28-30th October, 2010. Ten countries participated in this workshop. The main objectives of the workshop were to build capacity in conservation of AnGR in Asia and Pacific countries with economies in transition and to obtain feedback on the draft version of FAO's “Guidelines for the *in vivo* Conservation of Animal Genetic Resources”.



*Delegates of FAO Regional Training Workshop*



*Director distributing certificate and trophy to the students*



*Dr. V.K Bhatia, Director, IASRI, New Delhi addressing the gathering at the valedictory function*

## TRAININGS/HRD

- Summer Training Program on “Biotechnological tools for Biodiversity analysis” was conducted from 20th May to 30th June and then from 6th July to 16th August, 2010 at NBAGR. One hundred forty three students of B.Sc. / M.Sc. and B.Tech. / M.Tech from various universities / engineering colleges attended the training.
- Bureau organized sensitization training on “Soft Computing Techniques in Animal Bioinformatics” during November 8-12, 2010 under NAIP-subproject “Establishment of National Agricultural Bioinformatics Grid (NABG) in ICAR”. Fourteen scientists/technical officers working in ICAR/SAUs from different states were trained in this important area of bioinformatics by eminent experts from reputed institutes including ISI, Kolkata. The valedictory function was held on 12th November. Dr. V.K. Bhatia, Director IASRI graced the occasion as chief guest and distributed the certificates to the participants.
- A subject training on “Bioinformatics for Animal Genomics and Proteomics” was organized during February 24 to March 9, 2011 under the NAIP subproject “Establishment of National Agricultural Bioinformatics Grid (NABG) in ICAR”. There were 13 participants in this training. Speakers were invited from reputed institutes such as IASRI, NDRI, IVRI, IIT-New Delhi including from NBAGR, Karnal.



## CELEBRATIONS

**REPUBLIC DAY:** The NBAGR staff and families celebrated 61st and 62nd Republic Days with traditional fervor. Dr B.K.Joshi, Director, NBAGR hoisted the tricolor. Children presented cultural programmes wherein spectacular performances exhibiting the cultures of various states and regions of India were displayed. On this occasion, Director felicitated the Volleyball (smashing) team of the bureau for winning the ICAR volleyball championship 2008-09.



*A view of Republic Day celebration*

**INDEPENDENCE DAY:** The NBAGR staff and families celebrated 63rd Independence Day on August 15, 2010. Dr B.K. Joshi, Director, NBAGR hoisted the tricolor. Children presented a cultural programme to mark this occasion.



*A view of Independence Day celebration*

**INSTITUTE'S SPORTING SUCCESS:** NBAGR participated in the ICAR zonal sports meet held at IIPR Kanpur from 6-9th April, 2010 and won the Volleyball (Smashing) trophy jointly with CSSRI, Karnal. Bureau



*NBAGR sports contingent in inter-institutional sports (North Zone)*



*NBAGR Volleyball (Smashing) team*

also became ICAR Runner ups of Volleyball (Smashing) in ICAR Inter-zonal sports meet held at CAZRI, Jodhpur from 9-13th November, 2010.

## OVERSEAS DEPUTATIONS

- Dr. BK Joshi, Director and PK Vij of NBAGR visited Budapest (Hungary) under bilateral agreement for implementation of work under plan between India and Hungary in the field of Animal husbandry from 05-12 May, 2010.
- Dr. BK Joshi, Director, NBAGR participated in FAO writing workshop for the preparation of the FAO guidelines for in vivo conservation of Animal Genetic Resources organized by FAO at Como, Italy from June 21-24, 2010.
- Dr. DK Sadana, participated in the Conference of Parties (COP-10) to the Convention on Biodiversity (CBD) under the theme "Access to genetic resources and the fair and equitable sharing of benefits arising from their utilization" held at Nagoya, Japan from 18-24th October, 2010.



- Dr. R S Kataria was deputed for three months' training in the area of 'Genome Resource Conservation' under NAIP-HRD at Iowa State University, Ames, Iowa, USA from 24th March to 23rd June 2010.

### FAIRS AND EXHIBITIONS

Exhibition on Animal Genetic Resources of India was installed from time to time to depict status and prospects of indigenous livestock:

1. during North zone livestock championship 2010, organized by Punjab government held at Muktsar on 8-12 Jan 2010.
2. Feb. 3-5, 2010, at NDRI, Karnal on the occasion of International Sugar Rice and Maize Expo (ISMEX India 2010).
3. Feb. 24-26, 2010 on the occasion of National Dairy Research Institute (NDRI) Dairy mela.
4. September 9, 2010 on the occasion foundation day of Directorate of Wheat Research (DWR), Karnal.
5. October 08, 2010 at Central Soil Salinity Research Institute (CSSRI), Karnal on the occasion of Kisan Mela.
6. 12th November 2010, on the occasion of Kisan mela organized by Sugarcane Breeding Institute (SBI).
7. 3rd December 2010, at National Dairy Research Institute (NDRI) on the occasion of All India dairy husbandry officer workshop.
8. A Livestock Fair and Farmers' Meet under the NAIP Project on "Harmonizing biodiversity conservation and agricultural intensification through integration of plant, animal and fish genetic resources for livelihood security in fragile eco-systems" was organized jointly by NBAGR, CSK HPKV, Palampur and Department of Animal Husbandry, Himachal Pradesh on 20th October 2010.

### CONSULTANCIES

Karyotyping of 274 breeding bulls maintained at different semen production centres of the country was done by the Bureau. The reports were submitted to concern agencies for chromosomal defects, if any, in the screened bulls. A revenue of Rs. 99,600/- was generated from this activity @ of Rs. 400/- per bull.

### INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)

The ITMU of the Bureau has created the awareness among the scientists regarding IPR and related issues through the following:

- i. "The Intellectual Property Awareness Campaign" newsletters received from ZTMC, Izatnagar were forwarded to the all the scientists of the Bureau for creating awareness among them.
- ii. ITMU of the Bureau has made patent search on different aspects of Animal Genetic Resources/ genomics and information on relevant US patents granted in the field were sent to all the scientists of the Bureau.
- iii. Books and copies of Acts related to IPR were purchased and kept in the Bureau's library. Indian patent office journals for the years 2005 to 2011 were downloaded and kept in the Bureau's library for the information of scientists.

### DISTINGUISHED VISITORS

1. Mr. Bui Quoc Khanh, M.S., First Secretary (Science, Technology & Education), Embassy of the Socialist Republic of Vietnam on 07.01.2010.
2. Dr. Vo Van Su, Head, Department of Rare Animal and Biodiversity, NIAH, Mrs. Dao Thi Kim Dung, NIAH and Mrs. Le Thi Binh, NIAH, Vietnam on 01-12.01.2010.
3. The students from DAV Sr. Secondary School, Ambala under Bioresources Awareness Club Programme on 16.01.2010.



4. The participants of the training programme on Entrepreneurship Development Programme (EDP) on Commercial Dairy Farming organized at NDRI, Karnal on 22.01.2010.
5. The students from Gita Niketan Avasia Vidyalaya, Kurukshetra on 25.01.2010.
6. The students from Rajiv Gandhi College of Veterinary and Animal Sciences, Pondicherry on 25.01.2010.
7. Dr. James M. Reecy, Associate Professor & Director, Biotechnology, Iowa State University, USA on 28-30.01.2010.
8. The participants of the training programme on "Recent Advances in Dairy Nutraceuticals and Bioinformatics Applications" from NDRI on 04.02.2010.
9. The students of B.Sc. (Hons.) Zoology from Hans Raj College, Delhi on 11.02.2010.
10. Dr. K.M.L. Pathak, Deputy Director General (AS), ICAR on 24.02.2010.
11. The progressive farmers from Centre for Agriculture and Rural Development, New Delhi on 11.03.2010.
12. The PG Students from RAK College of Agriculture, Sehore (M.P.) on 30.03.2010.
13. The PG students from Breeding & LPM Division of NDRI on 30.03.2010.
14. Students under Bioresources Awareness Programme sponsored by DBT, New Delhi and coordinated by NDRI, Karnal on 17.06.2010.
15. Dr. Ani. S. Das, Managing Director, Kerala Livestock Development Board Ltd., Kerala on 26.10.2010.
16. The B.Sc. (Bio-Technology) students from Elphinstone College, Mumbai on 15.12.2010.



#### COMPLETED RESEARCH PROJECTS

1. **Project:** Phenotypic characterization of Patanwadi sheep breed.  
**Workers:** Anand Jain, Gurmej Singh, K.N. Raja. and K.P. Singh
2. **Project:** Characterization and Evaluation of Hill Cattle of Northern India. -Workers: RK Pundir, PK Singh, B Prakash, Neel Kant, CV Singh and K Singh
3. **Project:** Genetic characterization of Assamese swamp and hill buffaloes of North-East region.  
**Workers:** BP Mishra, RS Kataria, DK Sadana, B Prakash, P Kathiravan, RN Goswami and GC Das.
4. **Project:** Effect of drying on structure and fertilizing ability of bovine sperm.  
**Workers:** RAK Aggarwal, MS Chauhan (NDRI) and BK Joshi
5. **Project:** Genetic characterization of Catsper gene in Indian Buffaloes.  
**Workers:** RAK Aggarwal, KN Raja, SK Atreja and VS Raina (NDRI).
6. **Project:** Development of SNP database for indigenous AnGR.  
**Workers:** Dinesh Kumar (BT) and Avnish Kumar
7. **Project:** Genetic profiling of important meat and wool type indigenous sheep breeds using neutral functional markers. (DBT Project)  
**Workers:** Reena Arora, S Bhatia and BP Mishra

# PERSONNEL

## List of Staff of NBAGR as on 31.03.2011 SCIENTIFIC STAFFZ

SR. NO.	NAME OF SCIENTIST	DESIGNATION
1.	Dr.B.K.Joshi	Director
2.	Dr.(Ms) S.Bhatia	Pr. Scientist
3.	Dr.D.K.Sadana	Pr. Scientist
4.	Dr. B.Parkash	Pr. Scientist
5.	Dr.R.K.Vijh	Pr. Scientist
6.	Dr.Anand Jain	Pr. Scientist
7.	Dr.Neelam Gupta	Pr. Scientist (upto 30.07.10)
8.	Dr.M.S.Tantia	Pr. Scientist
9.	Dr.N.K.Verma	Pr. Scientist
10.	Dr.P.K.Vij	Pr. Scientist
11.	Dr.Rajeev A.K.Aggarwal	Pr. Scientist
12.	Dr.P.K.Singh	Pr. Scientist
13.	Dr.R.K.Pundir	Pr. Scientist
14.	Dr. B.P. Mishra	Pr. Scientist (upto 23.02.11)
15.	Dr.Sat Pal Dixit	Pr. Scientist
16.	Dr.Rahul Behl	Sr. Scientist
17.	Dr.R.S.Kataria	Sr. Scientist
18.	Dr. Dinesh Kumar (SS)	Sr. Scientist
19.	Dr.Jyostna Behl	Sr. Scientist
20.	Dr.Monika Sodhi	Sr. Scientist (SGP)
21.	Dr.Avnish Kumar	Sr. Scientist
22.	Dr.Reena Arora	Sr. Scientist
23.	Dr.Dinesh Kumar (BT)	Sr. Scientist
24.	Dr.Rekha Sharma	Sr. Scientist
25.	Dr.Manishi Mukesh	Sr. Scientist & National Fellow
26.	Dr. P.Kathiravan	Scientist
27.	Dr.K.N.Raja	Scientist
28.	Dr. Jaya Kumar S.	Scientist
29.	Dr. Sonika Ahlawat	Scientist

## SUPPORTING STAFF

S.no.	Name	Designation
1.	Sh. Krishan Lal	Attdt Gr.III
2.	Sh. Sewa Ram	Attdt.Gr.II
3.	Sh.Ram Sagar	Attdt.Gr.II
4.	Sh. Deepak	Attdt.Gr.II
5.	Sh.Satbir	Attdt.Gr.I
6.	Sh. Babu Ram	Attdt.Gr.I
7.	Sh. Naresh Kumar	Attdt.Gr.I
8.	Smt. Neerja Kaul	Attdt. Gr.I



## TECHNICAL STAFF

S.No.	NAME OF SCIENTIST	DESIGNATION
1.	Sh. P. S. Dangi	T-7/8
2.	Dr. P. S. Panwar	T-6
3.	Sh. S. K. Jain	T-6
4.	Sh. Sanjeev Mathur	T-5
5.	Sh. Moti Ram	T-5
6.	Sh. Harvinder Singh	T-5
7.	Sh. Sat Pal	T-5
8.	Smt. Pravesh Kumari	T-4
9.	Sh. Ramesh Kumar	T-4
10.	Sh. Subhash Chander	T-4
11.	Sh. Rakesh Kumar	T-4
12.	Sh. Jamer Singh	T-4
13.	Sh. Naresh Kumar	T-4
14.	Sh. Om Prakash	T-3
15.	Sh. Ramesh Chand	T-3
16.	Sh. Ashok Kumar	T-2
17.	Sh. Mahavir Singh	T-II-3
18.	Sh. Vijay Singh	T-3

## ADMINISTRATIVE STAFF

S.no.	Name	Designation
1.	Sh Mohinder Singh	A.O. (upto 1.6.10)
2.	Sh. J.I.P. Madan	A.O. (from 2.6.10)
3.	Sh. H.R.Arya	AAO
4.	Sh. Sunil Kumar	AF&AO
5.	Sh. Pawan Kumar Gupta	JAo
6.	Sh. Karambir Malik	PS to Director
8.	Sh. Ramesh Behl	Assistant
8.	Smt. Anita Chanda	PA
9.	Smt. Amita Kumari	PA
10.	Sh. Shashi Pal, Steno	Steno Gr.III (upto 21.1.11)
11.	Smt. Indu Bala, Steno	Steno Gr.III
12.	Smt. Shashi Bala	Assistant
13.	Sh. Sopal	Assistant
14.	Sh. Jita Ram	Assistant
15.	Sh. Satish Kumar	UDC
16.	Sh. Shiv Chander	LDC
16.	Sh. Rajnish Kumar	LDC

## PROMOTIONS

1. Sh. Karambir Malik, PA to Director, promoted to the post of Private Secretary to Director w.e.f. 09.09.2010.
2. Sh. Satpal, T-4 promoted to the post of T-5 w.e.f. 27.09.2010
3. Sh. Moti Ram, T-4 promoted to the post of T-5 w.e.f. 30.12.2008
4. Sh. Harvinder, promoted to the post of T-5 w.e.f. 14.05.2009
5. Sh. Rakesh, T-3 promoted to the post of T-4 w.e.f. 01.01.2010
6. Sh. Subhash Chander, T-3 promoted to the post of T-4 w.e.f. 31.03.2010
7. Sh. Shiv Chander, SSS promoted to the post of LDC notionally w.e.f. 28.07.2006
8. Dr S P Dixit joined as Principal Scientist on 14/02/2011.

## APPOINTMENTS/ TRANSFERS

1. Dr. Sonika Ahlawat joined as scientist on 24.04.2010.
2. Sh. Rajnish Kumar joined as lower divisional clerk on 28.04.2010.
3. Dr. Jai Kumar, Scientist joined NBAGR Karnal on transfer from NRC on Yak, Dirang, on 25.05.2010.
4. Sh. JIP Madan joined as Administrative officer on 02.06.2010
5. Sh. Mohinder Singh, AO transferred from NBAGR on 02.06.2010.
6. Dr. Neelam Gupta, Principal Scientist transferred to ICAR on 05.07.2010.
7. Sh Shashi Pal, Steno Group III to PA to Director, Zonal Project Directorate, Punjab Agricultural University Campus, Ludhiana, relieved on 22.01.11.
8. Dr BP Mishra, Principal Scientist & I/c DNAFU unit selected as Head Division of Animal Bio-Technology and relieved to join at IVRI, Izatnagar on 24.02.11.

# Research Projects During The Year 2010

## ONGOING RESEARCH PROJECTS

- Project:** Assessment of current status, breed characteristics and genetic structure of Nili Ravi buffaloes in its breeding tract.

**Workers:** BP Mishra (upto 24.02.11), RS Kataria, DK Sadana, BK Joshi, P Kathiravan (NBAGR), G Singh, SM Deb, RK Sethi (CIRB, Nabha)

**Duration:** January, 2008 to December, 2010 (extended upto June, 2011).
- Project:** Diversity analysis of prolific sheep populations of Orissa.

**Workers:** KN Raja, DK Yadav, Reena Arora, S Bhatia, Anand Jain and B.K. Joshi, (G Singh upto 31.12.09).

**Duration:** January, 2009 to December, 2010 (extended upto December, 2011).
- Project:** Characterization of lesser known goat populations of Maharashtra and Orissa states of India.

**Workers:** NK Verma, RAK Aggarwal, SP Dixit, PS Dangi, VS Kawitkar, SK Das and SV Kuralkar.

**Duration:** January, 2009 to December, 2012.
- Project:** Characterization of non-descript goat genetic resources of Ruhailkhand Region of Uttar Pradesh and Uttarakhand.

**Workers:** SP Dixit, Triveni Dutt (IVRI), RS Barwal (GBPUAT), PS Dangi and Neel Kant (GBPUAT)

**Duration:** January, 2010 to December, 2013.
- Project:** Characterization of Nukra horses for variations in KIT gene.

**Workers:** Rahul Behl, Jyotsna Behl, RK Vijh, PK Vij, KN Raja and B.K. Joshi, (N Gupta upto 05.07.10)

**Duration:** January, 2010 to December, 2011.
- Project:** Characterization and evaluation of Bhutia horses in their native tract.

**Workers:** Rahul Behl, RK, Pundir, DK Sadana, KN Raja and BK Joshi, (S C Gupta upto 08.02.10), N Gupta (upto 05.07.10)

**Duration:** January, 2010 to December, 2011.
- Project:** Phenotypic and genetic characterization of Indian donkey population.

**Workers:** Rahul Behl, Jyotsna Behl, DK Sadana, KN Raja, BK Joshi and YP Thakur (HPKV, Palampur), (S C Gupta upto 08.02.10, N Gupta upto 05.07.10).

**Duration:** January, 2010 to December, 2012.
- Project:** Utilization and Conservation of Indigenous Cattle Germplasm in Gaushalas of Haryana.

**Workers:** KN Raja, RAK Aggarwal, DK Sadana and BK Joshi.

**Duration:** January, 2009 to December, 2013.
- Project:** Transcriptional profile and identification of genes associated with thermoregulation in response to in-vitro hyperthermic challenge in Indian zebu cattle.

**Workers:** M Mukesh, RS Kataria, M Sodhi and BP Mishra (upto 24.02.11)

**Duration:** July, 2006 to June, 2009 (Extended up to June, 2010, then extended upto June, 2011).
- Project:** Heuristic studies to select locus combinations and physical traits to define Murrah – an elegant breed of buffalo.

**Workers:** RK Vijh and Dinesh Kumar Yadav.

**Duration:** January, 2009 to December, 2010 (extended upto June, 2011).
- Project:** Study of the genetic variability in the Bovine Cytokines (*Bos indicus*).

**Workers:** Jyotsna Behl, Rahul Behl, RS Kataria and NK Verma.

**Duration:** January, 2009 to December, 2012.



12. **Project:** Transcriptome analysis of circulating PMN to characterize parturition-induced immune suppression in buffalo and cattle.  
**Workers:** M Mukesh, M Sodhi, BP Mishra (upto 24.02.11), RS Kataria, MS Tania and AK Mohanty (NDRI)  
**Duration:** January, 2010 to December, 2013.
13. **Project:** Delineating polymorphism and evolution of Toll like receptors in Indian native *Bos indicus* cattle breeds.  
**Workers:** M Sodhi, M Mukesh and BP Mishra (upto 24.02.11)  
**Duration:** January, 2010 to December, 2012.
14. **Project:** Investigating molecular basis of cellular response to heat stress in skin fibroblasts of riverine buffalo (*Bubalus bubalis*)  
**Workers:** M Mukesh, M Sodhi, BP Mishra (upto 24.02.11), RS Kataria, MS Tania, D Malakar, AK Mohanty (NDRI)  
**Duration:** January, 2010 to December, 2013.
15. **Project:** Characterization and tissue specific expression profiling of micro RNA (miRNA) in river buffaloes (*Bubalus bubalis*).  
**Workers:** P Kathiravan, RS Kataria, BP Mishra (upto 24.02.11) and BK Joshi  
**Duration:** January, 2009 to December, 2011.
16. **Project:** Characterization of candidate genes regulating muscle growth and meat quality in buffalo.  
**Workers:** RS Kataria, P Kathiravan, M Mukesh and BP Mishra (upto 24.02.11).  
**Duration:** January, 2009 to December, 2010 (extended upto December, 2011).
17. **Project:** Identification of SNP markers in candidate genes of somatotrophic axis in diverse indigenous goat breeds and their association with production traits.  
**Workers:** SP Dixit and NK Verma  
**Duration:** January, 2009 to December, 2011.
18. **Project:** Isolation, characterization and cloning of lactoferrin gene from various species.  
**Workers:** M Sodhi, M Mukesh, and P Kathiravan  
**Duration:** January, 2010 to December, 2011.
19. **Project:** Development of DNA base parentage testing system for cattle.  
**Workers:** Dinesh Kumar, BK Joshi and Avtar Singh (NDRI)  
**Duration:** January, 2010 to December, 2011.
20. **Project:** Candidate gene analysis and identification of allelic variants associated with incidence of mastitis in dairy cattle and buffaloes.  
**Workers:** P Kathiravan, RS Kataria, BP Mishra (upto 24.02.11) and BK Joshi and AK Dang (NDRI)  
**Duration:** January, 2010 to December, 2012.
21. **Project:** Exploring field - applicability of scoring-based phenotypic identification methodology for animal genetic resources under field conditions.  
**Workers:** Avnish Kumar, Anand Jain, DK Sadana, SB Gokhale and RL Bhagat  
**Duration:** January, 2009 to December, 2010 (extended upto June, 2011).
22. **Project:** Network Project on Animal Genetic Resources.  
**Workers:** BK Joshi ( Project Coordinator, MS Tania (I/c Network Project)  
**Duration:** 1992- Contd.

23. **Project:** Network Project on Animal Genetic Resources – Buffalo Genomics.  
**Workers:** MS Tantia, BK Joshi, RK Vijh, BP Mishra (upto 24.02.11), PK. Vij and RS Kataria (NBAGR) and RK Sethi, P Sikka, AK Pandey and PS Yadav (CIRB) and Vineet Bhasin (ICAR)  
**Duration:** October, 2008 to March, 2012.
24. **Project:** Characterization of Shahabadi and Purnia cattle population and genetic relationship with other grey cattle of Indo-gangetic plain  
**Workers:** Rekha Sharma, PK Singh, SR Singh (BVC Patna) and M Mukesh  
**Duration:** January, 2009 to December, 2011.
25. **Project:** Identification of polymorphisms in genes controlling marbling trait in Indian goats.  
**Workers:** Rekha Sharma; AK Pandey( upto 07.03.10) and BP Mishra (upto 24.02.11)  
**Duration:** August, 2007 to July, 2009 (Extended up to July 2010, then extended upto June, 2011).
26. **Project:** Application of Microorganisms in Agriculture and Applied Sectors (AMAAS)  
**Sub-Project:** Isolation of microorganisms from fermented dairy foods and sequencing of 16 S rDNA for strain identification.  
**Workers:** Dinesh Kumar, Rameshwar Singh\* & S.K.Tomar\* (\*NDRI, Karnal)  
**Duration:** 19th July, 2006 to 31st March, 2012.

#### EXTERNALLY FUNDED PROJECTS

1. **Project:** Analysis of Candidate Genes involved in the Immune Response Regulation in Indigenous Cattle. (DBT)  
**Workers:** Jyotsna Behl, RS Kataria, Rahul Behl and NK Verma  
**Duration:** 12th July, 2007 to 31st July, 2010 (extended upto 11.07.11).
2. **Project:** Molecular marker based genetic structuring of important native cattle (*Bos indicus*) breeds from different agro-climatic regions of India. (DBT)  
**Workers:** Monika Sodhi, M. Mukesh, B P Mishra (upto 24.02.11) and B Prakash  
**Duration:** July, 2007 to July, 2011.
3. **Project:** Identification of SNP's in QTL region in Indian goats and their association with milk quality traits for healthfulness. (DBT)  
**Workers:** SP Dixit, M Mukesh and Rajesh Kumar (NDRI)  
**Duration:** June, 2010 to May, 2012.
4. **Project:** Identification of Quantitative Trait Loci for Milk yield, Fat and Protein Percent in Buffaloes. (NAIP)  
**Workers:** RK Vijh (CPI), MS Tantia, PK Vij, SB Gokhale (CCPI), DN Shinde and RL Bhagat.  
**Duration:** January, 2008 to March, 2012.
5. **Project:** Analysis of mammary gland transcriptome and proteome during lactation and involution in indigenous cattle and buffalo for identification of probable mammary biomarkers. (NAIP)  
**Workers:** BP Mishra (CCPI) (upto 24.02.11), RS Kataria and M Mukesh.  
**Duration:** July, 2008 to March, 2012.
6. **Project:** Toll-like receptors in farm animals-Evolutionary lineages and application in disease resistance. (NAIP)  
**Workers:** RS Kataria (CCPI), BP Mishra (upto 24.02.11) and P Kathiravan  
**Duration:** July, 2008 to March, 2012.



7. **Project:** Bio-prospecting of Genes and Allele Mining for Abiotic Stress Tolerance. (NAIP)  
**Workers:** RK Vijh (CCPI) and M S Tania  
**Duration:** April, 2009 to March, 2012.
8. **Project:** Establishment of National Agricultural Bioinformatics Grid (NABG) in ICAR(NAIP)  
**Workers:** Avnish Kumar, DK Yadav, Dinesh Kumar, B Prakash and PK Vij  
**Duration:** April, 2010 to March, 2012
9. **Project:** Harmonizing Biodiversity conservation and Agricultural Intensification through Integration of plant Animal and fish genetic resources for livelihood security in fragile ecosystem (NAIP)  
**Workers:** BK Joshi, Anand Jain, PK Vij, NK Verma, MS Tania and KN Raja and RAK Aggarwal  
**Duration:** September, 2009 to March, 2013

#### OUT STATIONED PROJECTS

1. **Project:** Conservation of Red Jungle fowl (*Gallus gallus*) in India.  
**Workers:** S. Sathyakumar, Wild Life Institute of India, Dehradun, Rahul Kaul, Wildlife Trust of India, New Delhi, Rajiv S Kalsi, MLN College, Yamuna Nagar, RK Vijh, and MS Tania.  
**Duration:** January, 2009 to December, 2010.
2. **Project:** Effect of vitamin E supplementation on hormones and m-RNA transcript expression of associated genes in high and low producing indigenous and crossbred cows.  
**Workers:** Anjali Aggarwal, Manishi Mukesh, Ashutosh and Veena Mani, (N Gupta upto 05.07.10).  
**Duration:** January, 2009 to December, 2011.

## Research Publications

### RESEARCH PAPERS

1. Aggarwal RAK, Tantia MS, Kumar Y, Mehta SC (2009). Biometry of frozen-thawed sperm from Indian Jaiselmeri camel. *Journal of Camel Practice and Research* 16(2):149-151.
2. Aggarwal RAK, Yadav DK, Yadav S, Verrma NK, Raja KN and Joshi BK (2010). Association of bGH, PRL and Pit-1 genes polymorphism with milk production traits in Murrah buffalo. *Indian Veterinary Journal*, 87 (9): 896-898.
3. Aggarwal J, Kataria RS, Ghalsasi P, Nimbkar C, Joshi BK and Mishra BP (2010). Expression analysis of fecundity related genes in FecB carrier and non-carrier ewes by semi-quantitative PCR. *Journal of Livestock Biodiversity*, 2: 15-19.
4. Arora R, Bhatia S, Yadav DK, and Mishra BP (2011). Current genetic profile of sheep breeds/populations from Northwestern semi arid zone of India. *Livestock Science*, 135: 193-198.
5. Arora R, Bhatia S, Mishra BP, Jain A and Prakash B (2011). Diversity analysis of sheep breeds from Southern peninsular and Eastern region of India. *Topical Animal Health and Production*, 43: 401-08.
6. Arora R, Bhatia S, Mishra BP, Prakash B, Yadav HK and Sahu A (2010). Evaluation of genetic diversity of Deccani and Madgyal sheep from Southern peninsular region of India. *Journal of Livestock Biodiversity* 2(1) 23-29
7. Arora R, Bhatia S and Mishra BP (2010). Genetic structure analysis of Deccani sheep-A major breed from Maharashtra. *Indian Veterinary Journal* 87 (11)1109-1111
8. Arora R, Bhatia S and Jain A (2010). Morphological and genetic characterization of Ganjam sheep. *AGRI*, 46, 1-9.
9. Arora R, Bhatia S, Mishra BP, Sharma R, Pandey AK, Prakash B, and Jain A (2010). Genetic polymorphism of the  $\beta$ -lactoglobulin gene in native sheep from India. *Biochemical Genetics*, 48:304-311
10. Behl Rahul, Behl Jyotsna and Joshi BK (2010). Heat tolerance mechanisms in cattle – status in zebu cattle. *Indian Journal of Animal Sciences*, 80 (9): 891-897.
11. Behl Rahul, Behl Jyotsna, Sadana DK and Joshi BK (2010). The mule: an artificially bred beast of burden. *Livestock International*, 14 (2): 2, 14, and 23.
12. Bhatia AK, Jain A, Sadana DK, Gokhale SB and Bhagat RL (2010). Phenotypic identification of farm animal genetic resources using computer learning with scoring function. *Computers and Electronics in Agriculture*, 73: 37-43.
13. Bhatia AK, Jain A, Sadana DK, Gokhale SB, Bhagat RL (2010). Phenotypic identification of farm animal genetic resources using computer learning with scoring function. *Computers and Electronics in Agriculture*, 73 (1): 37-43.
14. Bhatia S and Arora R (2010). Lesser known ovine germplasm-an underevaluated asset of India. *Indian Journal of Animal Sciences*, 80(9): 880-890
15. Deshpande SB, Sabapara GP, Malik PK, Sadana DK, Singh PK, Singh Gurmej, and Joshi BK (2010). Morphometric characteristics of Surti goats and socio-economic status of Surti goat keepers. *The Indian Journal of Animal Sciences*, 80(6): 575-577.
16. Dixit SP, Verma NK, Aggarwal RAK, Vyas MK, Rana Jyoti, Sharma Anurodh, Tyagi Pooja, Arya Pooja, Ulmek BR (2010). Genetic diversity and relationship among southern Indian goat breeds based on microsatellite markers. *Small Ruminant Research*, 91:153-159.
17. Dixit SP, Singh Gurmej and Dhillon J S (2011). Genetic and environmental factors affecting fleece traits in Bharat Merino sheep. *Indian Journal of Animal Sciences*, 81 (1): 80-83



18. Dixit SP, Aggarwal RAK, Verma NK, Vyas MK, Rana Jyoti, Sharma Anurodh And Chander R (2011). Genetic variability and bottleneck analyses of Kanniadu goat breed based on microsatellite markers. *Indian Journal of Animal Sciences*, 81 (1): 40-43
19. Dubey PK, Selvakumar M, Kathiravan P, Yadav N, Mishra BP and Kataria RS (2010). Detection of polymorphism in exon 2 of Toll-like receptor 4 gene of Indian buffaloes using PCR –SSCP. *Journal of Applied Animal Research*, 37: 265-268.
20. Ganu Radhika S, Garrow Timothy A, Sodhi Monika, Rund A Laurie and Lawrence B. Schook (2011). Molecular characterization and analysis of the porcine betaine homocysteine methyltransferase and betaine homocysteine methyltransferase-2 genes. *Gene*, 473: 133–138
21. Gaur U, Chaudhary A, Tantia MS, Sharma U, Javed R, Sharma A, Banerjee P, Joshi J and Vijh R K. (2010). Genetic relationship among duck populations of India. *Indian Journal of Animal Science*, 80(5): 444-47.
22. Jyotsna Dhingra Behl, Rahul Behl and N. K. Verma. (2010). MHC-DRB exon-2 (BuLA-DRB3) polymorphism in Banni breed of Indian buffalo. *Indian Journal of Animal Science*, Vol. 80, No. 3: 234-238.
23. Kataria RS, Kathiravan P, Bulandi SS, Pandey D and Mishra BP (2010). Microsatellite based genetic monitoring to detect cryptic demographic bottleneck in Indian riverine buffaloes (*Bubalus bubalis*). *Tropical Animal Health & Production*, 42: 849-855.
24. Kataria RS, Tait Richard G, Kumar Dinesh Jr, Ortega Manuel A, Rodriguez Jose and Reecy James M (2011). Association of Toll-like receptor 4 single nucleotide polymorphisms with incidence of infectious bovine keratoconjunctivitis (IBK) in cattle. *Immunogenetics*, 63:115–119.
25. Kathiravan P, Kataria RS, Dubey PK, Selvakumar M, Tyagi Neetu and Mishra BP (2010). Seven novel single nucleotide polymorphisms identified within river buffalo (*Bubalus bubalis*) lactoferrin gene. *Tropical Animal Health and Production*, 42:1021–1026.
26. Kathiravan P, Sachdeva GK, Gandhi RS, Singh PK, Raja TV, Raja KN and Rajesh Kumar S (2010). Effect of non genetic factors and estimation of heritability of lifetime traits in Sahiwal cattle. *Journal of Livestock Biodiversity*, 2(1): 30-34.
27. Khate K, Kishore A, Mukesh M and Sodhi M (2010). Livestock diversity in India and tools for its management. *Everyman's Science*, XLV (3): 182-185.
28. Mishra Priyanka, Verma NK, Aggarwal RAK and Dixit SP (2010). Breed characteristics and genetic variability in Changthangi goats. *Indian Journal of Animal Sciences*, 80(12): 1203-1209.
29. Mishra BP, Kataria RS, Kathiravan P, Singh KP, Sadana DK and Joshi BK (2010). Microsatellite based genetic structuring reveals unique identity of Banni among river buffaloes of Western India. *Livestock Science*, 127: 257-261.
30. Mishra BP, Prakash B, Kataria RS, Sadana DK, Kathiravan P, Das GC, Joshi BK, Bhasin V, Rasool TJ and Bujarbaruah KM (2010). Cytogenetic profiling and mitochondrial DNA analysis reveal existence of swamp buffalo population in Manipur state. *Indian Journal of Animal Sciences*, 80: 31-36.
31. Mishra BP, Prakash B, Kataria RS, Kathiravan P, Sadana DK, Das GC, Goswami RN, Joshi BK, Bhasin V, Rasool TJ and Bujarbaruah KM (2010). Genetic diversity analysis and cytogenetic profiling Assamese buffaloes from North-East India. *Indian Journal of Animal Sciences*, 80: 142-147.
32. Mukesh M, Bionaz M, Graugnard DE, Drackley JK and Looor JJ (2010). Adipose tissue depots of Holstein cows are immune responsive: inflammatory gene expression in vitro. *Domestic Animal Endocrinology*, 38(3):168-78



33. Pandey A K, Sharma R, Singh L V, Maitra A and Mishra B P (2010) Estimation of genetic variability parameters in Kumaun hill cattle (Kumauni cattle) by STR markers. *Indian Journal of Animal Sciences*, 81 (2): 194-195
34. Pundir RK, Singh PK, Singh CV and Prakash B (2010). Physical parameters and management of hill cattle of Almora district of Uttarakhand. *Indian Journal of Animal Sciences*, 80 (11): 1145-1147.
35. Raja AR, AnnMary Vignesh B, Tirumurugaan KG, Raj G Dhinakar, Kataria RS, Mishra BP, Kumanan K (2011). Sequence analysis of Toll-like receptor genes 1-10 of goat (*Capra hircus*) *Veterinary Immunology and Immunopathology*, 140: 252-258.
36. Sharma R, Pandey AK, Singh LV, Maitra A, Arora R, Bhatia S and Mishra BP (2010). Microsatellite based diversity estimation of Changthangi-a high altitude sheep breed of India. *Indian Journal of Animal Sciences*, 80 (5) 436-440
37. Sharma R, Pandey A K, Maitra A, Singh L V and Mishra B P (2011). Diversity analysis of Binjharपुरी breed of cattle. *Indian Veterinary Journal*, 88(2): 23-24
38. Sharma R, Pandey A K, Singh L V, Maitra A and Mishra B P (2011) Genetic variability in Ghumsuri cattle through microsatellite DNA profiling. *Indian Veterinary Journal*, 88(3): 27-28
39. Sharma R , A Maitra and B P Mishra (2010) Meat Quality Markers in Omics Era *Indian buffalo journal*, Vol. 8 No. 1-2
40. एल.वी. सिंह, ए.के. पाण्डेय, रेखा शर्मा, ए. मित्रा एवं बी.पी. मिश्रा (2010)। भारतीय परिपेक्ष्य में पशुधन उत्पादन व स्वास्थ्य में जैव तकनीक की आवश्यकता। *पशुधन प्रकाश*, 1 : 39-43
41. अमित किशोर, प्रवेश कुमारी, मोनिका सोड़ी, रेखा शर्मा, मनीषी मुकेश एवं बी.के. जोशी (2010) प्राकृतिक संसाधनों की सतत उपलब्धता हेतु परम्परागत एवं आधुनिक प्रौद्योगिकियों का समन्वय। *कृषि किरण*, 3: 10-13
42. शर्मा डी, पुंडीर आर.के. और सोमवंशी, एस.पी.एस. 2010, पशु सम्पदा-भैंस की नस्लें, खेती, 64 (अप्रैल), 26-29.
43. Singh SR, Mandal KG, Singh PK and Verma SB (2010). Phenotypic characterization of Bachaur breed of cattle. *Indian Veterinary Journal*, 87(9): 893-895.
44. Sodhi M, Mishra BP, Prakash B, Kaushik R, Singh KP and Mukesh M (2010). Distribution of Major Allelic Variants at Exon-IV Region of Kappa Casein Gene Locus in Indian Native Cattle (*Bos indicus*) Breeds. *Journal of Applied Animal Research*, 38: 117-121.
45. Sodhi M, Mukesh M, Mishra BP, Ahlawat SPS, Prakash B and Sobti RC (2011). Microsatellite Analysis of Genetic Population Structure of Zebu Cattle (*Bos Indicus*) Breeds from North-Western Region of India. *Animal Biotechnology*, 22: 1, 16 - 29
46. Sodhi M, Mukesh M, Mishra BP, Parvesh K, and Joshi BK (2011). Analysis of Genetic Variation at Prolactin-Rsal (PRL-Rsal) Locus in Indian Native Cattle Breeds (*Bos indicus*). *Biochemical Genetics*, 49, 1-2, 39-45. DOI: 10.1007/s10528-010-9383-7
47. Sodhi M and Lawrence B Schook (2010). Genomics Research: *Livestock Production. Encyclopedia of Biotechnology in Agriculture and Food*, 310-315. DOI: 10.1081/E-EBAF-120043005
48. वर्मा एन के, कौर नवनीत व मिश्रा प्रियंका (2010)। भारतीय बकरी: प्रबन्धन, संरक्षण और भारतीय अर्थव्यवस्था में योगदान। *पशुधन प्रकाश*, 1 (1): 32-38.
49. Verma NK, Kaur Navneet and Mishra Priyanka (2010). Lesser known goat populations- Need for their characterization and recognition. *Journal of Livestock Biodiversity*, 2 (1): 01-06.



50. Verma NK, Dixit SP, Aggarwal RAK, Dangi PS and Joshi BK (2010). Phenotypic and Genetic Characterization of Sangamneri goat breed. *Indian Journal of Animal Sciences*, 80(11):1109-1114.
51. Vijn RK, Tandia MS, Behl R and Mishra Bina (2010). Genetic architecture of Black Bengal and Chegu goat. *Indian Journal of Animal Sciences*, 80 (11): 1134-1137.
52. Vyas M K, M K Singh, S K Singh and S P Dixit (2010) Polymorphism at kappa-casein gene in Barbari goats studied by PCR-SSCP. *Indian Journal of Animal Sciences*, 80:572-574.
53. Yadav D K and Pradeep Kumar Vij (2010). Inventorization of Gaushala resources and their use in breed improvement and conservation programmes. *Indian Journal of Animal Sciences*, 80 (4):343-345.
54. Yadav D K, Gurmej Singh, Anand Jain, Amrit Kumar Paul and Surender Singh 2010. A comparison of nonlinear models for describing growth in Muzaffarnagri lambs under field conditions. *Indian Journal of Animal Sciences*, 80(6):581-583.
55. Yadav D K, Reena Arora, S. Bhatia and Gurmej Singh (2010). Management and Conservation of Munjal Sheep: A Threatened Sheep population of North-West India. *Journal of Livestock Biodiversity*, 2 (1): 20-22.
56. Yadav D K and Dixit SP (2010). A Digitized Inventory of Domestic Animal Resources of India. *Journal of Livestock Biodiversity*, 2 (1): 50-54.
57. Yadav D K, Reena Arora, Bhatia S and Gurmej Singh (2011). Short tandem repeat based analysis of genetic variability in Munjal-the threatened sheep population of Northwestern India. *Indian Journal of Animal Sciences*, 81 (2): 171-175.
58. Yogesh S Akshay, Dhruva Malakar, Arun K De, Manoj K Jena, Shweta Garg, Rahul Dutta and M Mukesh (2010). Hand-Made Cloned Goat (*Capra hircus*) Embryos- A Comparison of Different Donor Cells and Culture Systems. *Cellular Reprogramming*, 12(5):581-8

#### BOOK CHAPTERS

P.K. Singh (2010). Protection and conservation of Animal Genetic Resources. Book Chapter in "Fundamentals of Intellectual Property Rights" Ed. Dr. Neeru Bhushan and published by U.P. Council of Agricultural Research (UPCAR), Lucknow and printed by City Graphics, Lucknow. Pp 76-88.

#### BULLETINS/LEAFLETS

1. Sangamneri – An important goat breed of Maharashtra by NK Verma, RAK Aggarwal, PS Dangi, SP Dixit and BK Joshi, Monograph # 67, 2010 (ISBN: 978-81-908779-5-4).
2. Equine breeds of India by Behl R, Behl J and Gupta N (2011).
3. Cattle breeds of India by Pundir R K, Singh P K, Sharma D and Prakash B. (2010), NBAGR, Karnal.
4. Goat Farmer's Participation-A success Story on Conservation of Beetal Goats. Leaflet published by MS Tandia, PK Singh, Ramesh Dular, Upasana Singh, Maroof Ahmad & Safeer Alam (2010). NBAGR, Karnal.
5. Goat Genetic Resources of India- Surti Breed by SB Deshpande, GP Sabapara, DN Rank, CG Joshi, PK Singh, DK Sadana, Gurmej Singh, MS Tandia and BK Joshi (2010). Published by Department of Animal Science N.M. College of Agriculture Navsari Agricultural University Navsari- 396450 (Gujarat) and NBAGR, Karnal.
6. Pasudhan Prakash Volume-1, Jan-Dec 2010 Issue, published by NBAGR, Karnal, Total pages 68; ISSN 0976-4569.
7. Genetic Resources of India – 'Jaisalmeri Camel – the Indian safari joy ride camel'. Jyotsna Dhingra Behl, Rahul Behl, D. K. Sadana, R. K. Vijn, Neelam Gupta, S. C. Gupta and B. K. Joshi.



## AWARDS/REWARDS/RECOGNITIONS

- First Best Poster award for the poster "Indian sheep: An elucidation of population structure and conservation priorities by R Arora, S Bhatia, B P Mishra, D K Yadav and B K Joshi was conferred by the Society for Conservation of Domestic Animal Biodiversity on the following paper during VIII Annual Convention of SOCDAB & National Symposium on Animal genetic resources for sustainable livestock sector in India held Orissa University of Agriculture and Technology, Bhubaneswar, Orissa from 18-19 February 2011. The award carries cash prize and a citation:
- Second, best poster award for "पशुधन प्रजातियों में डाटा खनन के लिए बायोइनफॉर्मेटिक्स का उपयोग" कविता त्रिपाठी, पूनम यादव, शुभम गोयल, जिज्ञासा अग्रवाल, प्रवीन अग्रवाल, प्रवीन दूबे, आर.एस. कटारिया एवं बी.पी. मिश्रा presentation made at Foundation Day celebrations of NBAGR on 21st Sept. 2010.
- Young Scientist award for the presentation "Improving reproduction and productivity of Deccani sheep through introgression of FecB gene from prolific Garole sheep" by Saste S.R., Ghalsasi P.M., Kataria R.S., Mishra, B.P. and Nimbkar C. at International Symposium on "Biotechnologies for optimization of reproductive efficiency of farm & companion animals to improve global food security and human health" organized by Indian Society for Study of Animal Reproduction to be held at College of Veterinary and Animal Sciences, Pantnagar, Uttarakhand on 10-12 November 2010.
- Young scientist award for the presentation "Profiling of metabolic proteome of secretory mammary epithelial cells isolated from buffalo milk" by Jagadeesh Janjanam, Nishant Varshney, Surender Singh, Manoj Kumar Jena, Manu, Ajay K. Dang, Jai K. Kaushik, D. Malakar, S. Kumar, B.P. Mishra, Manishi Mukesh, Ranjit S. Kataria, T. Mukhopadhyay, Sunita Grover, B.S. Prakash, V. K. Batish, Aswini Panigrahi and Ashok K. Mohanty. (2011) at VIII National Convention of SOCDAB and National Symposium on 'Animal Genetic Resources for Sustainable Livestock Sector in India' held at OUAT, Bhubaneswar, during Feb 18-19, 2011.
- Second Best poster award for the poster "Phenotypic and Cytogenetic Characterization of buffaloes of Nagaland and Mizoram states of North-East revealed swamp type." By R.S. Kataria, B. Prakash, N. Yadav, P. Kathiravan, D.K. Sadana and B.P. Mishra (2011). Presented at VIII National Convention of SOCDAB and National Symposium on 'Animal Genetic Resources for Sustainable Livestock Sector in India' held at OUAT, Bhubaneswar, during Feb 18-19, 2011.
- First Best Poster prize for the poster "Evaluation of indigenous goat for meat quality associated markers" by Rekha Sharma, A Maitra, A K Pandey and B P Mishra (2011). Presented at VIII National Convention of SOCDAB and National Symposium on 'Animal Genetic Resources for Sustainable Livestock Sector in India' held at OUAT, Bhubaneswar, during Feb 18-19, 2011.
- First Best paper award on the research paper entitled "Genetic Polymorphism in the Major Histocompatibility Complex Class II DRB3 Exon 2 Locus in Bos Indicus Tharparkar Breed of Cattle" by Jyotsna Behl, Manish Gupta, Rahul Behl and N.K.Verma, published in the "Dairy Production Area" in the Indian Journal of Dairy Science for the calendar year 2009.
- First Best Poster Award to the poster on "भारत में गौ-विविधता एवं उपयोग" presented by P.K. Singh and Karuna Asija in the Poster Competition of the Scientists' Symposium on "Bhartiya pashudhan ka vartman paripreksh mein prabhavi upyog" organized by National Bureau of Animal Genetic Resources at NBAGR, Karnal during 20-21st September 2010.



# ਹਿੰਦੀ ਖਾਓਡ

## प्राक्कथन

राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो के वार्षिक प्रतिवेदन वर्ष (वर्ष 2010-11) को प्रस्तुत करते हुए मुझे अपार प्रसन्नता का अनुभव हो रहा है। लगभग 27 वर्ष पूर्व, 21 सितम्बर 1984 में ब्यूरो की स्थापना हुई थी। तीन दशकों से भी कम अवधि में राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो, पशु आनुवंशिक सम्पदा के गुण निर्धारण एवं संरक्षण पर अनुसंधान के लिए अंतर्राष्ट्रीय ख्याति प्राप्त उत्कृष्टता केन्द्र बन गया है। वर्ष 2010 राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो के लिए एक विशिष्ट वर्ष था, क्योंकि इसे जैव विविधता का अंतर्राष्ट्रीय वर्ष घोषित किया गया था। इस प्रतिवेदन में हमारी वैज्ञानिक रणनीति के चार स्तंभों (पशु आनुवंशिक सम्पदा की पहचान, गुण निर्धारण, संरक्षण एवं सुधार) को सुदृढ़ बनाने के लिए प्राप्त की गई उपलब्धियों पर प्रकाश डाला गया है। जैसा कि हम जानते हैं कि भारतीय पशुधन उत्पादन प्रणालियों में भूमंडलीकरण, शहरीकरण, मशीनीकरण, गहन कृषि, पर्यावरण क्षरण, जलवायु परिवर्तन और विज्ञान एवं प्रौद्योगिकी के फलस्वरूप परिवर्तन आ रहा है। हमारी बढ़ती मानव जनसंख्या व घरेलू आय, दूध, मांस, अंडे और अन्य पशु आहार के लिए वृद्धि की मांग पैदा कर रहे हैं। उम्मीद के अनुसार पशुधन बाजार की बढ़ती मांग को पूरा करने के लिए बदल रहे हैं एवं प्रगति कर रहे हैं। पशुधन क्षेत्र में परिवर्तन की दर इतनी तेज है कि पशुओं की कई स्थानीय नस्लें, जिन्हें पशु स्वामियों द्वारा सैकड़ों वर्षों में विकसित किया गया है, अपने स्वामियों की नई आवश्यकताओं की न तो पूर्ति कर पा रही हैं, न ही बदलते परिदृश्य में अपने को ढाल पा रही हैं। यह नस्लें अभूतपूर्व और त्वरित दर से समाप्त हो रही है। राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो में हम पशु आनुवंशिक सम्पदा सम्बन्धी आधारभूत अनुसंधान पर अपना ध्यान केन्द्रित कर रहे हैं। ब्यूरो के वैज्ञानिकों ने पहाड़ी गोवंशीय पशुओं, पटनवाड़ी भेड़, बेरारी और बुन्देलखंडी व उत्तराखंड की बकरियों, स्पीति गधा और बिहार के शाहाबादी गोवंशीय पशुओं का वाह्य गुण निर्धारण का कार्य पूर्ण करने पर ध्यान केन्द्रित किया है। भारत के पूर्वोत्तर राज्यों की असमिया स्वाम्य व पहाड़ी मैसों के मध्य वंशावली संबंध mtDNA डी लूप क्षेत्र की बहुरूपता के आधार पर स्थापित किया गया है। हमारे शोधकर्ताओं ने आर्थिक रूप से महत्वपूर्ण गुणों को नियंत्रित करने वाले जीन जैसे Catsper जीन, Thyroglobulin जीन, इंसुलिन रूपी विकास कारक—। जीन, CAPN1 जीन, Fec बी जीन, Somatotropic ऐक्सिस जीन, टोल रूपी रिसेप्टर जीन आदि की आनुवंशिक विभिन्नता का गहन अध्ययन किया है। राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो के शोध का उपयोग नए शोध प्रोटोकॉल के विकास, गुण निर्धारण प्रारूपों, कम्प्यूटरीकृत डाटा संग्रहण और पुनः प्राप्ति हेतु भी किया जाता है। हमारे देश के अवर्णित एवं कम ज्ञात पशु समूहों की रक्षा हेतु राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो ने नस्लों के पंजीकरण का कार्य आरम्भ किया है। वर्ष 2010 में छह नई गाय व भैंस नस्लों को पंजीकृत किया गया है और कुछ अन्य नस्लों का पंजीकरण विचाराधीन है। शोध परिणामों को पशु स्वामियों तक पहुँचाने के उद्देश्य से हम राज्यों में पशुपालन विभागों के साथ कार्य करते हैं। ये विभाग राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो द्वारा विकसित सूचनाओं का उपयोग अपने-अपने राज्यों की पशु संरक्षण एवं संवर्धन योजनाओं को बनाने में करते हैं। आधारभूत शोध के जन साधारण स्तर से इस सह-सम्बन्ध ने हमारे संस्थान को अद्वितीय स्थान प्रदान किया है। शोध निष्कर्षों के आधार पर हमारे वैज्ञानिकों द्वारा लगभग 60 शोध पत्र राष्ट्रीय और अंतर्राष्ट्रीय प्रभावी पत्रिकाओं में प्रकाशित किये हैं। वैज्ञानिकों को विभिन्न मंचों पर उनके वैज्ञानिक प्रस्तुतियों के लिए पुरस्कृत किया गया है। इस अवधि के दौरान सात अनुसंधान





परियोजनाओं को पूरा किया गया और छह एन.ए.आई. परियोजनाओं सहित 37 परियोजनाओं का कार्य प्रगति पर है। इसके अतिरिक्त छह नई परियोजनाओं को शुरू किया गया है। शोध के अलावा ब्यूरो के कर्मचारियों ने अन्य गैर वैज्ञानिक गतिविधियों में उत्कृष्ट प्रदर्शन किया है। हमने 12वीं पंचवर्षीय योजना प्रारूप एवं दृष्टि को सही रूप में विकसित किया है, जिसे 2030 तक प्राप्त करने का लक्ष्य है। आगामी वर्षों में भी राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो अपने शोधकर्ताओं की रचनात्मकता को खिलने का अवसर प्रदान करेगी।

मैं डॉ. एस. अययप्पन, सचिव, कृषि अनुसंधान और शिक्षा विभाग एवं महानिदेशक, आई.सी.ए.आर. को उनके दिशा निर्देशन, सहायता एवं समर्थन हेतु निष्ठापूर्वक धन्यवाद देता हूँ। मैं डॉ. के.एम.एल. पाठक, उप महानिदेशक (पशु विज्ञान) और डॉ. एससी गुप्ता, सहायक महानिदेशक (ए.पी.एंड बी.) के प्रति उनके समन्वय एवं उत्साहवर्धन हेतु कृतज्ञता व्यक्त करता हूँ। मेरा विशेष धन्यवाद मेरे कार्य बल, वैज्ञानिकों, प्रशासनिक, तकनीकी और सहायक स्टाफ की कड़ी मेहनत और सहयोग को भी जाता है।



(बी.के.जोशी)

## कार्यकारी सारांश

राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो की स्थापना 21 सितम्बर 1984 को हुई थी। स्थापना के समय से ही ब्यूरो के वैज्ञानिक इसके अधिदेश, देश की पशु और कुक्कुट आनुवंशिक संसाधनों के पहचान, मूल्यांकन, लक्षण वर्णन, संरक्षण एवं टिकाऊ उपयोग, के अनुरूप सक्रिय रूप से शोध कार्यों में लगे हुए हैं।

- एक वाह्य लक्षण नस्ल पहचान प्रणाली (PBIS), जो कि उपयोगकर्ता के अनुकूल नस्ल पहचान हेतु स्कोर आधारित पद्धति है, को अंतिम रूप दिया गया।
- पशुधन एवं कुक्कुट प्रजातियों सम्बन्धी सूचनायें एवं उपलब्ध SNP's को संग्रहित करने हेतु SNP's पर एक डेटाबेस डिजाइन किया गया।
- स्वदेशी पशुधन व कुक्कुट सम्पदा की सुरक्षा की दृष्टि से पशुधन व कुक्कुट आनुवंशिक संसाधन पंजीकरण का कार्य आरम्भ किया गया है। उप महानिदेशक (पशु विज्ञान) की अध्यक्षता में नस्ल पंजीयन समिति द्वारा 6 नई नस्लों, जिसमें 4 गोवंशीय (बिन्द्वारापुरी, घुम्सुरी, खरिअर व मोटू) और दो भैंस की नस्लें (बन्नी, चिलिका) सम्मिलित हैं, का पंजीकरण किया गया है। इन छह नई नस्लों की नस्ल विवरणक इंडियन जर्नल ऑफ एनिमल साइंसेस के अक्टूबर 2010 के अंक में प्रकाशित किया गया है।
- राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो पर पशु आनुवंशिक संसाधन के एक्स-सीटू संरक्षण के उद्देश्य से जीन बैंक की स्थापना की गई है। जिसमें 7 पशु प्रजातियों की 27 नस्लों के 214 सांडों द्वारा प्राप्त 77,583 वीर्य खुराकें संरक्षित की गई हैं।
- दैहिक कोशिका केन्द्रक हस्तांतरण तकनीक द्वारा क्लोन भ्रूण के उत्पादन की तकनीक का मानकीकरण किया गया है और क्लोन भ्रूण उत्पन्न किये गए। गोवंश, बकरी, भेड़ और कुक्कुट के अतिरिक्त डी.एन.ए. नमूनों को डी.एन.ए. बैंक में सम्मिलित कर इसे समृद्ध किया गया है।
- उत्तराखंड के अल्मोड़ा, पिथौरागढ़, रुद्रप्रयाग, चमोली और उत्तरकाशी जिलों में किए गए व्यवस्थित सर्वेक्षणों के माध्यम से पहाड़ी गोवंशीय पशुओं के आनुवंशिक और वाह्य गुण निर्धारण कार्य पूर्ण किया गया।
- बेरारी बकरी (महाराष्ट्र और मध्य प्रदेश), बुन्देलखंडी बकरी (उत्तर प्रदेश और मध्य प्रदेश) और उत्तर प्रदेश और उत्तराखण्ड की अवर्णित बकरी आनुवंशिक संसाधन के वाह्य गुण निर्धारण उनके संबंधित प्रजनन इलाकों में किए गए व्यवस्थित सर्वेक्षणों के माध्यम से किया गया।
- गुजरात के कच्छ, राजकोट, अमरेली, भावनगर और सुंदरनगर जिलों के विभिन्न गांवों में स्तरीकृत सांयोगिक नमूना सर्वेक्षण उपक्रम द्वारा पटनवाड़ी भेड़ का वाह्य गुण निर्धारण एवं मूल्यांकन किया गया।
- लगभग 3700 मीटर की औसत ऊंचाई पर स्थित हिमाचल प्रदेश के लाहौल और स्पीति जिले के स्पीति उप संभाग तथा किन्नौर जिले के पुह उप संभाग में किए गए व्यवस्थित सर्वेक्षणों के माध्यम से स्पीति गधे का वाह्य गुण निर्धारण भी किया गया।
- भैंस के थायरोग्लोबुलिन जीन के 5 अपस्ट्रीम अनुक्रम में नवीन एक न्यूक्लियोटाइड बहुरूपता पाई गई। रिवोराइन एवं स्वाम्प भैंसों में इन SNP's की एलीलिक आकृति में भिन्नता पाई गई।
- भैंसों की टी.एल.आर. जीन (TLR1-10) के कोडिंग क्षेत्र को पूर्ण रूप से अनुक्रमित किया गया और अनुक्रम डाटा विश्लेषण द्वारा भैंस विशेष डोमेन संरचनात्मक परिवर्तन का पता चला।



- FecB वाहक एवं गैर वाहक मादा भेड़ों में जननशक्ति सम्बंधी जीन के रियल टाइम विश्लेषण द्वारा अंडाशय में BMP RIA, एवं BMP 4 की विभेदक अभिव्यक्ति पाई गई जो कि भेड़ में अंडाणु उत्पन्न करने की दर को विनियमित करने में इसके प्रभाव का संकेत है।
- भारतीय बकरी की नस्लों के 1GF1, 1GF बंधनकारी प्रोटीन एवं वृद्धि हॉर्मोन रिसेप्टर जीन्स में बहुरूपता पाई गई, जिसे इसके फीनोटाइप पर प्रभाव से सहसम्बंधित किया गया।
- भारतीय गोवंशीय नस्लों में प्रतिरक्षा प्रतिक्रिया जीन्स, TLR 4, TLR - 9, Nos 2, MCP1, oA IFN - गामा में SNPs का पता लगाया गया एवं साहीवाल नस्ल में इनके मेस्टाइटिस से सम्बंधों की जानकारी हेतु विश्लेषण किया जा रहा है।
- एन.ए.आई.पी. वित्त पोषित परियोजना “राष्ट्रीय कृषि जैव सूचना ग्रिड” का कार्य एक प्रशिक्षण कार्यक्रम, पशुधन के प्रोटीन डेटाबेस एवं स्वदेशी पशुधन एवं कुक्कुट के माइक्रोसेटेलाइट डेटाबेस की स्थापना के साथ आरम्भ किया गा।
- भारतीय भेड़ों में माइक्रोसेटेलाइट आधारित विविधता विश्लेषण द्वारा ज्ञात हुआ कि हेटरोजाइगोट्स की कमी एवं उनमें परस्पर अत्यधिक भिन्नता नस्लों के उप पशु समूहों में स्तर विन्यास का संकेत देती है।
- पी सी आर – आर एफ एलपी, एस एस सी पी एवं एस एन पी विश्लेषण द्वारा भारतीय भेड़ नस्लों में किरोटिन सम्बन्धी प्रोटीन (KAP1.3), अगौती (ASIP), इन्सुलिन समान वृद्धि कारक बंधनकारी प्रोटीन 3 (IGFBP-3), केलीपारज (CLPG) एवं ओवाइन बोन मारफोजेनेटिक प्रोटीन टाइप 1B रिसेप्टर (BMPT1B) जीनों में बहुरूपता पाई गई।
- सायटोजेनेटिक, माइक्रोसेटेलाइट एवं माइटोकान्डीय डी क्षेत्र विश्लेषण के प्रयोग से भारत के पूर्वोत्तर राज्यों की शुद्ध स्वाम्प भैंसों को अभिलेखित किया गया।
- बिहार की शाहाबादी गोवंशीय पशु समूह एवं मलाईमाछू गोवंश, तमिलनाडू की केटचाकटी, मचेरी, कोयम्बटूर और नील गिरी भेड़ों तथा असम की पहाड़ी एवं मैदानी बकरियों में माइक्रोसेटेलाइट आधारित आनुवंशिक विविधता अभिलेखित की गई।
- भारतीय बकरी नस्लों के एक पैनल में माँस गुणवत्ता में भूमिका वाले CAPN1, आकिरिन व टिटिन जीनों के अनुक्रम विश्लेषण एवं SNP पहचान की गई।
- रिवेराइन भैंस के पूर्ण जीनोम को अनुक्रमित करने के प्रयास किए गए। 90जी बी से अधिक डी.एन.ए. अनुक्रम डाटा विकसित किया गया जिससे 17 – 19X पठन गहराई के साथ 30 गुणा विस्तार प्राप्त हुआ। एसेम्बली में 185, 150 कानटिग्स थे, जिसमें मध्य कानटिग की लम्बाई 2.3 के.बी. एवं अधिकतम कानटिग की लम्बाई 663 के.बी. थी।
- भैंस की पूर्ण जीनोम एसेम्बली जन साधारण की सूचना हेतु <http://210.212.93.84/cgi-bin/gb2/gbrowse/bovine> पर उपलब्ध है।

- बकरी ट्रान्सक्रिप्टोम डाटा बकरी के विभिन्न ऊतकों में एबायोटिक स्ट्रेस रिसपान्स के लिए ऐलील माइनिंग के एक भाग के रूप में विकसित किए गए, जिनका विश्लेषण किया जा रहा है।
- ब्यूरो ने योजना और गैर योजना बजट का 99 प्रतिशत का उपयोग किया एवं 36.12 लाख की राजस्व प्राप्तियाँ भी संग्रहित की गईं।
- प्रतिवेदन अवधि में ब्यूरो द्वारा सात अनुसंधान शोध योजनाएँ पूरी की गयी, 32 अन्य संस्थान की योजनाओं (26 चल रही और 6 नई) और तीन बाह्य वित्त पोषित शोध परियोजनाओं पर कार्य चल रहा है।
- ब्यूरो को एन ए आई पी द्वारा 6 परियोजनाओं की स्वीकृति भी प्रदान की गई है।
- ब्यूरो के वैज्ञानिकों द्वारा राष्ट्रीय और अन्तर्राष्ट्रीय ख्याति प्राप्त प्रभावी शोध पत्रिकाओं में 58 शोध पत्र प्रकाशित किए गए हैं।
- वैज्ञानिकों के श्रेष्ठ वैज्ञानिक प्रस्तुतिकरण हेतु दो युवा वैज्ञानिक पुरस्कार एवं 4 सर्वश्रेष्ठ पोस्टर पुरस्कार प्राप्त हुए हैं।
- संगमनेरी व सुर्ती बकरियों पर मोनोग्राफ, इक्वाइन ब्रीड ऑफ इंडिया, जैसलमेरी ऊँट, बीटल बकरियों के संरक्षण पर एक सफलता कहानी एवं कैटल ब्रीड ऑफ इंडिया पर लीफलेट प्रकाशित किये गए।
- ब्यूरो के अलावा ब्यूरो के स्टाफ द्वारा अंचलीय एवं अंतर अंचलीय खेलकूद प्रतियोगिता में भाग लिया। ब्यूरो को अंचलीय प्रतियोगिता में विजेता एवं अंतर अंचलीय प्रतियोगिता में उप-विजेता ट्रॉफी प्रदान की गयी है।
- ब्यूरो के हिन्दी एकक द्वारा अनेक कार्यक्रम ब्यूरो के स्थापना दिवस पर आयोजित किए गए, जिसमें ब्यूरो कर्मियों द्वारा सक्रिय रूप से भाग लिया गया।



## राजभाषा प्रकोष्ठ की मुख्य गतिविधियां

1. दिनांक 22-24 अप्रैल 2010 को भारतीय कृषि अनुसंधान समिति, करनाल एवं केन्द्रीय मृदा लवणता अनुसंधान संस्थान, करनाल के तत्वाधान में आयोजित बारहवीं राष्ट्रीय वैज्ञानिक संगोष्ठी में ब्यूरो के निदेशक डॉ. बी.के. जोशी, डॉ. प्रताप सिंह पंवार व डॉ. दिनेश कुमार (बी.टी.) ने "भारतीय पशु आनुवंशिक सम्पदा के प्रमुख मुद्दे एवं चुनौतियां" विषय पर तथा ब्यूरो में कार्यरत अमित किशोर, प्रवेश कुमारी, मोनिका सोडी, रेखा शर्मा, मनीषी मुकेश एवं बी.के. जोशी ने "परम्परागत एवं आधुनिक प्रौद्योगिकियों का समावेश: प्राकृतिक संसाधनों की सतत उपलब्धता हेतु" विषय पर हिन्दी लेख प्रस्तुत किए।
2. दिनांक 24 अप्रैल 2010 को भारतीय कृषि अनुसंधान परिषद, कृषि भवन, नई दिल्ली के निदेशक (राजभाषा) कार्यालय के अधिकारी श्री मनोज कुमार ने ब्यूरो कार्यों में हिन्दी के प्रयोग का निरीक्षण किया तथा अपनी टिप्पणी में ब्यूरो द्वारा किये गये हिन्दी में कार्य की सराहना की। निरीक्षण अधिकारी ने हिन्दी भाषण "कार्यशाला में राजभाषा अधिनियम" तथा "संसदीय समिति की रिपोर्ट" भरने पर दो व्याख्यान प्रस्तुत किए।
3. दिनांक 24.05.10 को राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो करनाल तथा हरियाणा साहित्य अकादमी एवं शुरुआत समिति करनाल के तत्वाधान में अंतराष्ट्रीय जैव विविधता वर्ष के उपलक्ष्य में हिन्दी कार्यशाला, "भारतीय साहित्य में पर्यावरण एवं जैव विविधता संरक्षण" विषय पर ब्यूरो में आयोजित की गई जिसका उद्घाटन डॉ. मुक्ता, निदेशक हरियाणा साहित्य अकादमी ने किया। श्रीमति जयवंती श्योकंद, सेवानिवृत्त भा.प्र.से अधिकारी ने जैव विविधता तथा पर्यावरण को बचाने के लिए लोक गीतों के माध्यम से प्रयास आरम्भ करने पर बल दिया। इस कार्यक्रम में हिन्दी के प्रसिद्ध साहित्यकार तथा यशपाल पुरस्कार सम्मानित डॉ. विक्रम सिंह ने अपने व्याख्यान में कहा कि विभिन्न प्रकार के प्राणियों व प्राकृतिक ध्वनियों से लिपि बनी। इसके साथ ही उन्होंने लिपि के सर्जन में पेंटिंग के योगदान पर बल देकर कहा कि ज्ञान का संरक्षण लिपि के माध्यम से ही सम्भव है ताकि अनुभव तथा विश्वासों को अगली पीढ़ी तक पहुँचाने का प्रयोग जारी रहे। इस गोष्ठी में करनाल एवं पानीपत के जिला वन अधिकारी सुश्री वाश्वी त्यागी ने भी अपने विचार प्रस्तुत किये। ब्यूरो निदेशक डॉ. बी.के. जोशी ने अपने अध्यक्षीय संबोधन में प्राचीन वेद, उपनिषद्, रामायण एवं अन्य संस्कृत ग्रंथों में उल्लेखित पर्यावरण एवं जैव विविधता संरक्षण पर रोचक प्रस्तुति दी।
4. दिनांक 29.05.2010 को राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो, करनाल में एक व्याख्यान गोष्ठी का आयोजन किया गया। इस गोष्ठी में इंदिरा गाँधी राष्ट्रीय मुक्त विश्व विद्यालय, क्षेत्रीय केन्द्र के निदेशक डॉ. अशोक शर्मा ने "मुफ्त विश्व विद्यालय द्वारा कृषि एवं पशुपालन शिक्षा: अवसर एवं आयाम" विषय पर प्रस्तुति दी। डॉ. शर्मा ने बताया कि कृषि एवं पशुपालन से जुड़े लोग सर्टिफिकेट कोर्स से लेकर डिप्लोमा एवं पी.एच.डी तक की डिग्री हासिल कर सकते हैं। डॉ. शर्मा के अनुसार खेती, जल संसाधन संरक्षण, खाद्य प्रसंस्करण, कुक्कुट, मछली पालन, बौद्धिक सम्पदा अधिकारी सम्बन्धी अनेकों लोकप्रिय एवं रोजगार उन्मुखी पाठ्यक्रम आज मुफ्त विश्व विद्यालय द्वारा उपलब्ध कराये जाते हैं। सभा की अध्यक्षता करते हुए ब्यूरो निदेशक डॉ. बी.के. जोशी ने कहा कि पशु जैव विविधता संरक्षण सम्बन्धी, ब्यूरो एवं मुफ्त विश्वविद्यालय के संयुक्त उपक्रम में एक नए पाठ्यक्रम आरम्भ करने तथा इससे होने वाले चेतना एवं फायदे पर बल दिया।



हिन्दी कार्यशाला में पधारे माननीय वक्तव्यगण

5. ब्यूरो के इतिहास में हिन्दी पत्रिका, जनवरी 2010 अंक: पशुधन प्रकाश, का प्रकाशन अन्तर्राष्ट्रीय मानक क्रम संख्या ISSN 0976-4569 के साथ आरम्भ हुआ है। इस हिन्दी पत्रिका के प्रकाशन पर निदेशक महोदय ने पशुधन प्रकाश हिन्दी पत्रिका के मुख्य सम्पादक, ब्यूरो के हिन्दी सलाहकार व वरिष्ठ वैज्ञानिक डॉ. दिनेश कुमार बी.टी. तथा सम्पादक मण्डल के सभी सदस्यों को हार्दिक बधाई दी।
6. ब्यूरो में सितम्बर-2010 के दौरान हिन्दी चेतना मास आयोजित किया गया। आयोजन के दौरान पत्र लेखन, आशुभाषण, मसौदा लेखन, उत्कृष्ट वार्षिक कार्य, निबंध जिस का विषय “जलवायु परिवर्तन के खाद्य सुरक्षा पर प्रभाव” आदि विभिन्न प्रतियोगिताएं आयोजित की गईं। इस के अतिरिक्त दिनांक 21.9.2010 को ब्यूरो के स्थापना दिवस समारोह के अवसर पर एक वैज्ञानिक संगोष्ठी जिसका शीर्षक “भारतीय पशुधन विविधता का वर्तमान परिपेक्ष में प्रभावी उपयोग” रखा गया। इस अवसर पर आमन्त्रित प्रवक्ताओं ने जैव विविधता संरक्षण पर ज्ञानवर्धक व्याख्यान प्रस्तुत किये। उपरोक्त वैज्ञानिक संगोष्ठी के दौरान प्रतियोगिता में वैज्ञानिकों ने अपने-अपने शोध पत्र प्रदर्शित किये। संगोष्ठी के समापन अवसर पर भारतीय कृषि अनुसंधान परिषद, कृषि भवन, नई दिल्ली के भूतपूर्व उप महानिदेशक (पशु विज्ञान), डॉ. आर. एम. आचार्य ने बतौर मुख्य अतिथि विजेताओं को नकद पुरस्कार व प्रमाण पत्र देकर सम्मानित किया।
7. राष्ट्रीय डेयरी अनुसन्धान संसथान, करनाल, के राजभाषा एकक के निमंत्रण के अनुरूप वहां पर आयोजित सहायकों हेतु प्रशासनिक राजभाषा हिन्दी कार्यशाला के द्वितीय सत्र में एक व्याख्यान जिसका विषय “कम्प्यूटर पर राजभाषा (हिन्दी) में कैसे कार्य करें” प्रभारी हिन्दी डॉ. प्रताप सिंह पंवार ने प्रस्तुत किया।



वैज्ञानिक संगोष्ठी में पोस्टर की व्याख्यान करते हुए विद्यार्थी

8. ब्यूरो निदेशक डॉ. बी.के. जोशी ने दिनांक 25.11.2010 को 52वीं नराकास की बैठक में भाग लिया। माननीय श्री प्रदीप टम्टा जी, सांसद (लोकसभा), सदस्य, संसदीय राजभाषा समिति, भारत सरकार, नई दिल्ली ने इसी बैठक में वर्ष 2009-2010 के दौरान राजभाषा के क्षेत्र में उल्लेखनीय कार्य करने के लिए ब्यूरो के निदेशक डॉ. बी.के. जोशी तथा ब्यूरो के प्रभारी हिन्दी डॉ. प्रताप सिंह पंवार को प्रोत्साहन पुरस्कार तथा प्रशस्ति पत्र प्रदान किया।
9. ब्यूरो में दिनांक 8.01.2011 को, पाश पुस्तकालय तथा जिला प्रशासन के सहयोग से भ्रूण हत्या की रोकथाम तथा यातायात सुरक्षा विषयों पर हिन्दी में दो नाटक आयोजित किये गए। दोनों हिन्दी नाटकों के पात्र जिला पंचकुला में स्थित विभिन्न कालेजों के छात्र-छात्राएं रही। जिला करनाल उपायुक्त महोदय श्रीमति नीलम प्रदीप कासनी की अध्यक्षता में यह कार्यक्रम उत्साह पूर्वक सम्पन्न हुआ।









राष्ट्रीय पशु आनुवंशिक संसाधन ब्यूरो  
(भा.कृ.अ.प.)  
करनाल-132001 (हरियाणा) भारत

**NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES  
(ICAR)**

G.T. Road Bye Pass, Near Vasant Vihar, P.O. Box No. 129, Karnal-132 001 (Haryana) India.

Tel.: 0184-2267918 (0) Fax: 0184-2267654

Email: [directornbagr@gmail.com](mailto:directornbagr@gmail.com) | Home Page: <http://www.nbagr.res.in>