वार्षिक प्रतिवेदन
ANNUAL REPORT
2023

भाकृअनुप
ICAR

भा.कृ.अ.प.-केन्द्रीय भैंस अनुसंधान संस्थान
हिसार - 125 001 (हरियाणा) भारत

ICAR- Central Institute for Research on Buffaloes
Hisar- 125 001 (Haryana) India

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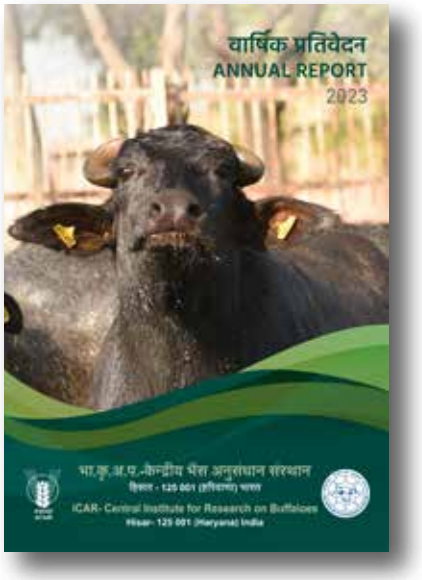

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ICAR - Central Institute for Research on Buffaloes
Hisar-125001 (Haryana) INDIA

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Contents

FROM DIRECTOR'S DESK

Along with contemplating the accomplishments of the past year, we are excited to share the contribution of ICAR-CIRB for the advancements achieved in 2023 towards conservation, research, and advocacy efforts dedicated to the prized possession of Indian buffaloes.

At ICAR-CIRB, our efforts are directed towards the scientific rearing of buffaloes, employing modern management techniques, good rearing practices, and enhanced animal welfare measures. Our research programs are strategically organized, focusing on diverse aspects including genetic improvement of buffalo breeds, development of various feeding modules, ration balancing for reduced enteric methane emission, production diseases of buffalo and their management, assisted reproductive technologies including cloning, genome editing, ovum pick up/ in vitro embryo production (OPU-IVEP), stem cell research, CRISPR technologies and studies of climatic changes on buffalo production. Recognizing the significance of pregnancy diagnosis, we have developed a Pregnancy Diagnosis Kit specifically tailored for buffalo farmers and breeders. We have also formulated a feed additive (RESMI) for reduced environmental pollution and enhanced production from buffaloes.

We are dedicated to advancing artificial insemination in buffaloes, recognizing its ability to provide superior-quality semen from high-performing breeding males. During the year, under Network Project on Buffalo Improvement (NPBI), a total of approximately 3.5 lakh semen doses were produced out of which about 3.2 Lakh doses were disseminated from Murrah and other breeds (Nili-Ravi, Jaffrabadi, Surti and Bhadawari). This year, we achieved highest ever wet average (kg/d) of 10.26 and herd average (kg/d) of 7.27 in the Institute Murrah buffalo herd. This is the highest ever since inception of the institute.

To encourage stakeholders to adopt buffalo farming as a lucrative investment and entrepreneurial opportunity, ICAR-CIRB is actively engaged in promoting awareness through skill development programs. In a pioneering move in 2023, the ICAR-CIRB initiated a collaborative germplasm exchange program with our neighbouring country Nepal to enhance the quality of buffalo breeds there. This is a testimony of our scientific excellence and this way we truly cater to the resolution of the recently concluded G20 summit, *Vasudaiva Kutumbakam*, "one earth … one family… one future".

I am immensely pleased to place forth the "Annual Report - 2023" to our readers, which chronicles the achievements of ICAR-CIRB during 2023. I would like to extend my sincere gratitude to Secretary DARE and DG, ICAR, for his continuous encouragement and astute guidance. The continued cooperation and guidance received from DDG (AS) ICAR, and ADG (AP&B) ICAR in all the activities of the Institute is also thankfully acknowledged.

Dr TK Datta
Director

निदेशक की कलम से

पिछले वर्ष की उपलब्धियों पर विचार करने के साथ-साथ, हम आईसीएआर-सीआईआरबी द्वारा वर्ष 2023 के दौरान भारतीय भैंसों के संरक्षण, उनसे संबंधित किए गए अनुसंधान और उनके स्वामित्व की दिशा में किए गए प्रयास को साझा करने के प्रति उत्साहित हैं।

आईसीएआर-सीआईआरबी में हमारा प्रयास भैंसों के वैज्ञानिक पालन, उनके आधुनिक प्रबंधन तकनीकों को अपनाने, अच्छी पालन प्रथाओं और उन्नत पशु कल्याण उपायों की ओर उन्मुख हैं। हमारे अनुसंधान कार्यक्रम कार्यनीतिक रूप से व्यवस्थित हैं, जिसमें भैंस की नस्लों के आनुवंशिक सुधार, विभिन्न आहार मॉड्यूल का विकास, कम आंत्र मीथेन उत्सर्जन के लिए राशन संतुलन, भैंस के उत्पादन संबंधी रोग और उनके प्रबंधन, क्लोनिंग, जीनोम एडिटिंग, डिंब सहित सहायक प्रजनन प्रौद्योगिकियों सहित विभिन्न पहलुओं पर ध्यान केंद्रित किया गया है। पिक अप/इन विट्रो भ्रूण उत्पादन (ओपीयू-आईवीईपी), स्टेम सेल संबंधी अनुसंधान, सीआरआईएसपीआर प्रौद्योगिकियां और भैंस उत्पादन पर जलवायु परिवर्तन का अध्ययन शामिल है। गर्भावस्था की पहचान के महत्व को समझते हुए, हमने भैंस रखने वाले किसानों और प्रजनकों के लिए गर्भावस्था की पहचान करने वाले किट को विशेष रूप से विकसित किया गया। हमने पर्यावरण प्रदूषण को कम करने और भैंसों से उत्पादन बढ़ाने के लिए एक फ़ीड एडिटिव भी तैयार किया है।

हम भैंसों में कृत्रिम गर्भाधान प्रणाली को आगे बढ़ाने के प्रति समर्पित हैं, जो उच्च गुणवत्ता वाले प्रजनक नरों से बेहतर गुणवत्ता वाले वीर्य प्रदान करने की क्षमता को पहचानने के कारण हुआ हैं। वर्ष के दौरान, नेटवर्क प्रोजेक्ट ऑन बफ़ेलो इम्प्रूवमेंट (एनपीबीआई) के अंतर्गत, कुल लगभग 3.5 लाख वीर्य डोज़ का उत्पादन किया गया, जिसमें से लगभग 3.2 लाख डोज़ मुर्रा और अन्य नस्लों (नीली-रवी, जाफराबादी, सुरती और भदावरी) से प्रसारित की गई। इस वर्ष, हमने संस्थान के मुर्रा भैंस समूह में अब तक का सबसे अधिक गीला औसत (किलो/दिन) 10.26 और समूह औसत (किलो/दिन) 7.27 प्राप्त किया। यह संस्थान की स्थापना के बाद से अब तक का सर्वाधिक है।

आईसीएआर-सीआईआरबी भैंस पालन को एक आकर्षक निवेश और उद्यमशीलता के अवसर के रूप में अपनाने की दिशा में हितधारकों को प्रोत्साहित करने, कौशल विकास कार्यक्रमों के माध्यम से जागरूकता को बढ़ावा देने के लिए सक्रियता से लगा हुआ है। आईसीएआर-सीआईआरबी ने वर्ष 2023 में एक अग्रणी कदम के द्वारा पड़ोसी देश नेपाल के साथ भैंस की नस्लों की गुणवत्ता बढ़ाने के लिए एक सहयोगी जर्मप्लाज्म आदान-प्रदान कार्यक्रम शुरू किया। यह हमारी वैज्ञानिक उत्कृष्टता का प्रमाण है और इस तरह हम वास्तव में हाल ही में संपन्न जी20 शिखर सम्मेलन, वसुदैव कुटुंबकम, "एक पृथ्वी ... एक परिवार ... एक भविष्य" के संकल्प को पूरा करते हैं।

मुझे पाठकों के समक्ष "वार्षिक रिपोर्ट - 2023" प्रस्तुत करते हुए बेहद खुशी हो रही है, जिसमें 2023 के दौरान आईसीएआर-सीआईआरबी की उपलब्धियों का विवरण किया गया है। मैं सचिव, डेयर और महानिदेशक, आईसीएआर को उनके द्वारा प्रदान किए गए निरंतर प्रोत्साहन एवं मार्गदर्शन के लिए हार्दिक आभार व्यक्त करना चाहता हूं। संस्थान की सभी गतिविधियों में उप महानिदेशक (पशु विज्ञान), भारतीय कृषि अनुसंधान परिषद और सहायक महानिदेशक (एपी एंड बी), भारतीय कृषि अनुसंधान परिषद से प्राप्त निरंतर सहयोग और मार्गदर्शन के लिए हम उनको भी धन्यवाद देते हैं।

डॉ. तीर्थ कुमार दत्ता
निदेशक

EXECUTIVE SUMMARY 2023

The ICAR- Central Institute for Research on Buffaloes (ICAR- CIRB) is a leading research institution in the country that focuses on the feeding, breeding, management and health of the buffalo population as well as the research and development needs of the industry. In order to fulfill its mandate, the institute has made significant progress over the years and developed technologies which are now being used by the farmers all over the country. Along with an elite herd of Murrah and Nili-Ravi buffaloes, the main and sub campus of the Institute works on the conservation, genetic improvement and dissemination of superior germplasm and much required training on scientific buffalo farming.

Organizational Structure

Among more than hundred ICAR institutions located all over the country, the institute is one of the 19 Animal Science institutes. The Director, who oversees administrative tasks as well as research and outreach activities, is in charge of the institute. A Research Advisory Committee (RAC) made up of notable scientists decide the research guidelines based on mandate, objectives and perspective plan of the institute. The Institute management Committee (IMC), which is chaired by the Director, makes key administrative and managerial decisions on financing status, actions taken in response to QRT and RAC recommendations, approval of higher budget projects, etc. The Institute Research Committee (IRC), presided over by the Director, evaluates the status of the many research projects being carried out by the scientists in addition to approving new projects based on mutual discussions amongst the scientists and experts. RAC, IMC and IRC regularly meet and provide guidance for further strengthening research and development activities. Every five years, Quinquennial Review Team (QRT), evaluates the output and outcome of the institute vis-à-vis resources of funds, manpower and facilities available, in order to provide critical appraisal to the council and the ICAR governing body. The research activities of the institute are assigned to three subject matter divisions: Animal Nutrition and Feed Technologies (ANFT), Animal Genetics and Breeding (AGB) and Animal Physiology and Reproduction (APR). In addition, a unit for Transfer of Technology (TOT) takes care the extension activities of the institute. Various sections viz. Agriculture farm, Animal farm, Workshop, Estate, Electrical, PME cell, AKMU, Library, Feed Unit, Landscape, Guest House, ITMU are managed by the concerned in charges under the advice of the Director of the institute. The administrative functions viz. purchase, security, cash & bill, establishment and central store are managed by the Senior Administrative Officer (SAO), while Senior Finance & Accounts Officer (SFAO) accomplishes the Audit & Accounts section. The institute presently has the strength of 26 scientists, 24 technical officers, 16 administrative staff and 106 skilled supporting staff.

Budget Outlay

The financial outlay of the institute in terms of sanctioned budget (2023-24) was 3640.04 lakh and the actual expenditure up to December 2023 remained 2803.83 lakh including TSP, NEH and SCSP funds. CIRB also received funds of Rs. 678.66 lakh and 357.56, respectively from plan schemes and externally funded schemes, out of which, Rs. 406.71 and 147.30 lakh were expensed. The revenue receipts of the institute were Rs. 371.93 lakh during April-Dec, 2023.

Salient achievements during 2023

- Achieved highest ever wet average (kg/d) of 10.26 (n= 122) and herd average (kg/d) of 7.27 (n=172) in Murrah buffalo. In Nili-Ravi buffalo average (kg/d) of 8.62 (n= 100) and herd average (kg/d) of 5.80 (n=150) was achieved.
- Achieved lowest ever AFC (37.79 months, n= 53 and 44.48 months, n= 34) and calving interval (436.23 days, n= 101 and 439 days, n= 64) for Murrah and Nili-Ravi, respectively.
- First time in the history of CIRB, 17 Murrah buffaloes crossed 4000 kg in a single lactation. Buffalo no 5179 was recorded 5170 kg in 305 days at 2nd lactation.
- Recorded highest ever single day milk yield (> 20 kg) for 14 Murrah buffaloes with average 305 days milk yield of total Murrah herd, 2952 kg.
- Evaluated the semen attributes and fertility potential of the cloned buffalo bulls and compared with semen attributes of breeding bulls and found comparable results.
- Treatment of donor somatic cells with mitoQ during culture significantly improved viability through reduction of ROS production.
- Supplementation of mitoQ during IVM or IVC significantly improved production of cloned embryos (7%) as compared to control group.
- The structural and functional properties as well as pregnancy rates with respect to 3 different sperm doses i.e. 12, 16 and 20 million spermatozoa per dose of insemination under field conditions remained similar. Production economics of different semen doses revealed that reduction in spermatozoa per semen straw enhanced the semen production and reduced the cost of per dose semen production.
- Supplementation of epigenetic modifier in combination of oxamflatin (1 μM) and ascorbic acid (50 μM) during IVC cloned improved embryo production and two animals are pregnant from these embryos.
- The NGS data reveals that there is no significant difference in the expression level of mRNAs and miRNAs in spermatozoa of cloned bulls and their somatic cell donor bulls for the genes that regulate spermatogenesis, fertility and early embryonic development.
- A total of 3822 artificial insemination has been performed using frozen semen of cloned bulls in different parity of buffaloes resulting in 1322 pregnancies and 186 calvings.
- *In vivo* fertility of cloned bulls' semen was also evaluated using artificial insemination on the basis of pregnancy rate and overall, 43.79% pregnancy was recorded which is similar to other breeding bulls.
- Established one myostatin (MSTN) knockout fibroblast single cell colony having monoallelic mutation.
- Optimized electroporation condition (15hpi, 15V, 5P, 3ms) for transduction of RNP with guide sequence of myostatin in buffalo zygote which is able to edit buffalo embryos, including indel (insertion/deletion) mutations, point mutations, large deletions, and small insertions.
- Electroporation conditions optimised for buffalo zygote and edited SRY gene to produced predetermined sex embryos.
- Direct electroporation of CRISPR/Cas9 using a single sgRNA is highly effective technique for causing POU5F1 mutations in buffalo embryos and upon validation our results demonstrate that POU5F1 is necessary for the maintenance of

pluripotency in buffalo pre-implantation embryo during the second lineage differentiation.

- A total of 235 cryovial containing 1 million fibroblasts derived from Murrah (n=4), Bhadawari (n=4) and Nili-Ravi (n=2) has been sent to ICAR-NBGAR, Karnal under Consortium of Agro-Biodiversity program.
- A gene bank has been established of 362 buffaloes (Murrah-219), Nili-Ravi (128), Clones (11) and Bhadawari (4) DNA is preserved.
- Total *in vitro* methane production (ml/g DM) was decreased by 11.3, 16.7 and 44.2 % in total mixed rations (TMR) constituted with malic acid heat treated (MAH-150) treated guar korma, groundnut cake and mustard cake compared to control.
- Body weight gain and average daily gain were increased (669 vs 424, g/d) in buffalo calves fed TMR with rumen protected protein at 100% replacement level (GNC + GK), along with improved FCR and higher feed efficiency, FE (10.76 vs 6.98).
- Feeding module developed with inclusion (12-15% on DM basis) of fermented sugar beet pulp in lactating buffalo ration, reduced feeding cost with enhanced (10%) milk production.
- Supplementation of *Eucalyptus* leaf meal, ELM (10 g/kg DM) to lactating buffaloes revealed improvement in nutritive value of the diet which was depicted with reduced enteric methane production and enhanced milk yield and quality, in terms of higher rumenic acids (*cis 9 trans 11,* C18:2 linoleic acids) having human health implications.
- Milk samples from CMT positive quarters subjected to bacteriological analysis resulted in isolation of *Staphylococcus aureus* (16), *Staphylococcus* spp. (8), *Streptococcus* spp. (21), *Enterococcus faecalis* (6), *Klebsiella* sp. (1), *E. coli* (6), *Kokuria rosea* (5), *Enterococcus faecalis* (6), *Kokuria kristinae* (4), 3 *Kokuria varians* (3), *Rothia mucilaginosa* (1), *Enterobacter cloaceae* (3) and *Sphingomonas paucimobilis* (1). Some of these bacteria are having zoonotic potential too. Bacteriologically identified isolates were confirmed by molecular methods.
- Semen doses of 3,03,484 and 46,756 were produced and 1,96,568 and 25,987 were disseminated for Murrah and other breeds (Nili-Ravi, Jaffrabadi, Surti and Bhadawari), respectively, under NPBI.
- CIRB organized 9 trainings for farmers during the year, where 325 dairy farmers participated. A calf rally at village Sarsod was organized on the occasion of CIRB Foundation day where 60 female progenies of different FPT farmers participated.
- HRD unit of ICAR-CIRB has facilitated the training of 4 Scientists and 1 Technical officer of the institute.
- ICAR-CIRB Hisar gifted 15 Murrah Buffalo bulls to Govt. of Nepal on 7th November, 2023 in an initiative by the Govt. of India to increase the milk production efficiency of Nepal's Buffalo breeds such as Terai, Lime, Gadi and Parkote.

Staff Position

Category	Sanctioned Strength	Filled	Vacant
Scientific	44+1	26	18
Technical	40	24	16
Administrative	25	16	9
Skilled Supporting	124	106	18

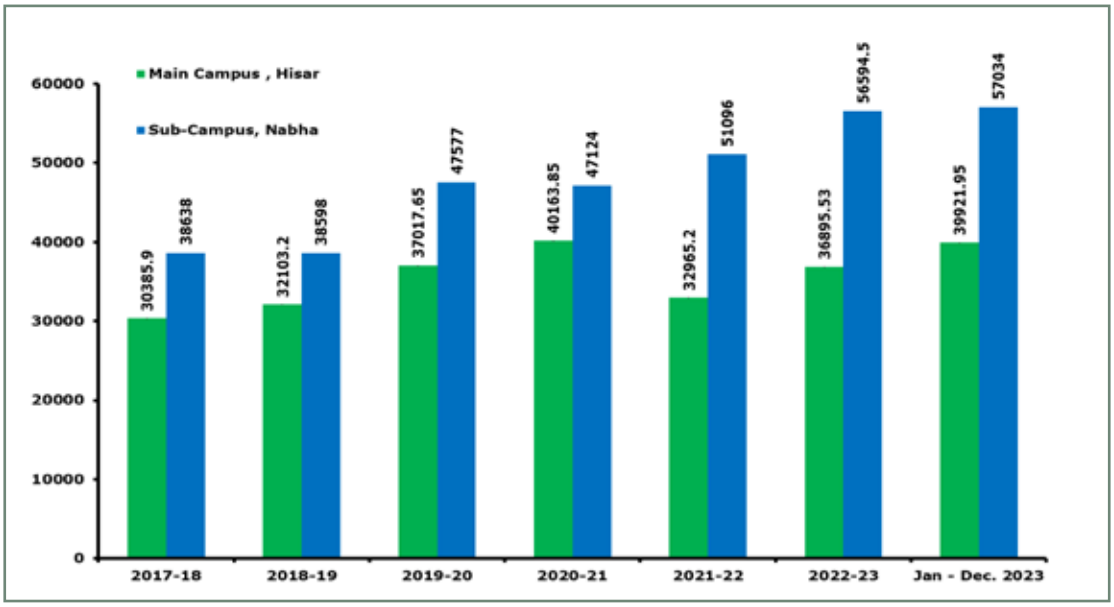
Buffalo production improvements

Criteria	Status	
	Murrah breed at main Campus Hisar	Nili Ravi breed at Sub- Campus Nabha
Total number of animals (as on 31.12.2023)	528	484
Age at First Calving (Months)	37.79	44.48
Calf Mortality (%)	4.29	4.61
Dairy buffaloes herd performance		
Overall annual wet average (Kg)	10.26	8.62
Overall total lactation milk yield (Kg)	3060	2784
Overall SLMY (Kg)	2952	2630
Service Period (days)	127	123
Calving Interval (days)	436	429
Conception rate (%)	42.42	40.67
Male germplasm		
Progeny tested bulls produced	42 (1-16th set)	12 (1-6th Set)
Semen doses produced	251712	8359
Frozen semen supplied	107768	6687
Revenue generation (Rs. Lakhs)	20.13	1.41
Bulls disseminated in field	580*	145

** Last thirteen years #Since 2006-07*

Agriculture farm production

Fodder	Main Campus Hisar	Sub Campus Nabha
Dry (Quintals)	858	2852
Green (Quintals)	39921.95	57034
Grains (Quintals)	793.10	4077.65



Green Fodder Production (Qtls) at Main Campus and Sub-campus, Nabha

Revenue receipts (all values in INR)

Rs. in Lakhs

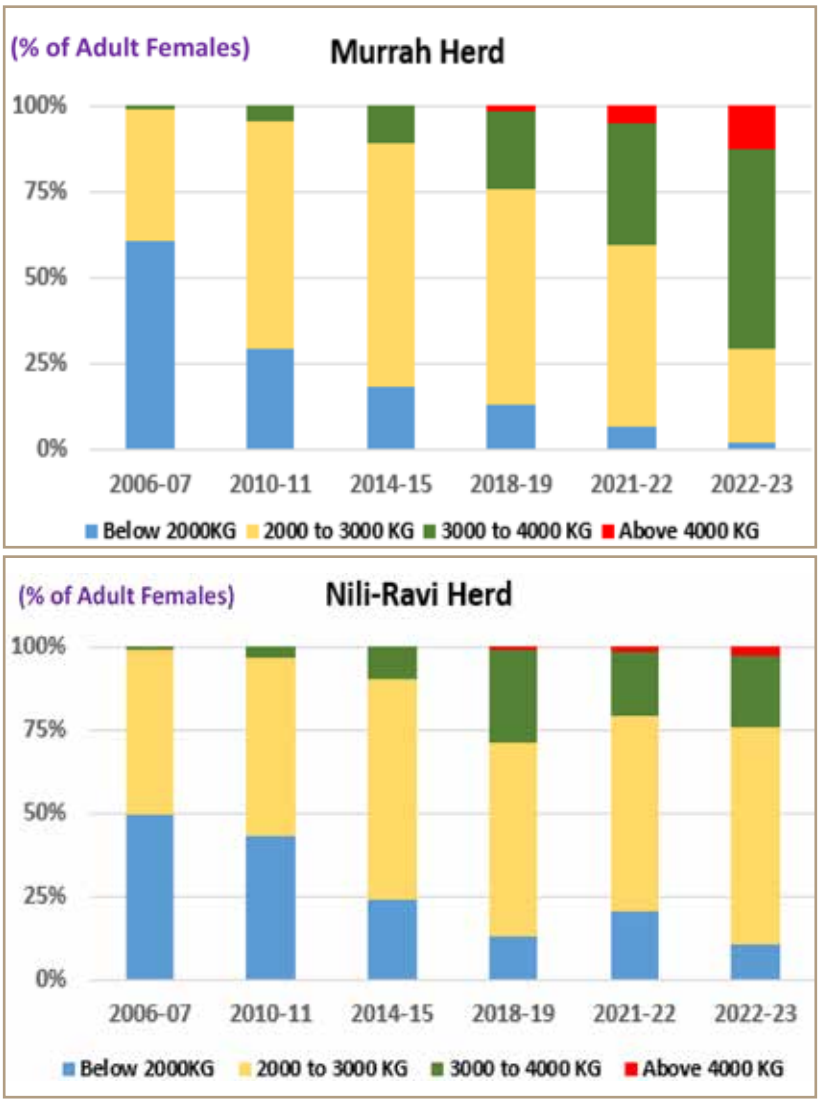
Sr. No.	Major/Minor/Detailed Head of Accounts	2019-20	2020-21	2021-22	2022-23	Up to Dec 2023
1.	Sale of Farm Produce					
	(i) Sale of Milk	336.20	370.31	371.56	386.12	260.06
	(ii) Sale of Wheat Busa/Mustard Bhusa/ Green Fodder	5.05	10.22	0.26	6.31	3.75
	(iii) Sale of grain/wheat/paddy	4.83	7.92	3.41	4.89	3.70
	(iv) Sale of Semen	27.54	23.83	30.95	20.29	15.52
	(v) Sale of Mineral Mixture	0.77	0.45	0.77	0.93	0.67
	(vi) Sale proceed of dry trees	0.00	10.15	1.60	10.43	23.53
	(vii) Sale of Books	0.66	0.03	0.15	0.02	0.00
	(viii) Sale of Technology/Royalty	0.76	0.19	0.17	0.07	0.77
2.	Sale proceeds of					
	(i) Land & Building	0.00	0.00	0.00	0.00	0.00
	(ii) Machine Tools & Plants Equipments/ Vehicle etc.	0.00	0.00	8.81	0.00	0.00
	(iii) Sale proceeds of Livestock.	84.13	89.47	110.24	127.26	55.41
3.	Rents (licence fee)	4.70	5.93	5.88	5.84	4.30
4.	Application fees from Candidates Tuition Fees, diploma Charges etc.	0.00	0.00	0.00	0.30	0.30
5.	Application fees from Candidates in connection with recruitment	0.00	0.00	0.00	0.00	0.00
6.	Receipts from Service rendered by Instt./ receipt from students	2.97	0.00	0.58	0.67	0.18
7.	Misc Receipt	0.00	0.00	0.00	0.00	0.00
	(i) Sale of Tender form	0.79	0.73	0.87	0.00	0.00
	(ii) Guest house charges	3.77	1.28	3.18	4.62	3.74
	Total:	**472.16**	**520.50**	**538.42**	**567.73**	**371.93**

Financial Outlay, INR in Lakh (2023-24)

Name of Institute/Project	Sanctioned Budget 2023-24	Expenditure 2023-24 up to 31.12.2023
CIRB Main (As per BE)	3605.04	2791.36
CIRB SCSP (As per BE)	30.00	12.47
CIRB TSP (As per BE)	5.00	0.00
CIRB NEH	0.00	0.00
Total	3640.04	2803.83
Plan Schemes		
Network Project on Buffalo Improvement (As per BE)	480.00	324.13
Network Project on Buffalo Improvement, SCSP (As per BE)	30.00	11.25
AICRP on Nutritional and Physiology (Dr R.K Sharma, PS&PI)	8.85	3.67
NAIF Project (Dr Sandeep Khurana, PS&PI)	6.00	4.43
NASF Project (Dr P.S Yadav, PS&PI)	89.49	40.49
NASF Project (Dr Dharmendra Kumar, SS&PI)	27.17	12.39
CABin Project (Dr Varij Nayan, SS & PI)	20.00	2.95
FFP (Dr Ashok Boora, SS & PI)	8.15	3.28
CRP Project (Dr.Meeti, Sci. & PI)	9.00	4.12
TOTAL	678.66	406.71

Externally funded Schemes (other than ICAR)

Sr. No.	Name of the Project	Sanctioned Budget 2023-24	Exp. upto 31.12.2023
1.	SERB Project entitled "Generation of predetermined sex buffalo embryos using CRISPR mediated gene editing technology" (Dr.Meeti Punetha)	10.00	9.94
2.	DBT Project entitled "Enhancing economy of livestock farmers through AI using cloned buffalo bull semen" (Dr.P.S. Yadav)	12.62	9.78
3.	DBT Project entitled "Investigating molecular basis of seasonal variation on seminal attributes for identification of probable biomarkers of semen quality in buffaloes" (Dr. Pradeep)	9.57	3.49
4.	Strengthening of Semen Station at ICAR-CIRB under Rashtriya Gokul Mission (DADF) (Dr. R.K. Sharma)	260.22	74.30
5.	Establishment of Centre of Excellence by ICAR-CIRB under Rastriya Gokul Mission (DADF) (Dr. Jerome A)		0.33
6.	BMGF Project entitled "Molecular Markers for Improving Reproduction in Cattle and Buffaloes (Dr. A.K. Balhara)	14.15	10.09
7.	Development of Urine-based Biosensor for Pregnancy Diagnosis in Ruminants (Dr. A. K. Balhara)	29.85	21.89
8.	Applications of Infrared Thermography as innovative non-invasive technological solution in early mastitis detection (Dr. Sunesh Balhara)	21.15	17.48



Genetic improvement & Trend of milk production (percent of adult female buffaloes)

कार्यकारी सारांश 2023

आईसीएआर- केंद्रीय भैंस अनुसंधान संस्थान (आईसीएआर-सीआईआरबी) देश का एक अग्रणी अनुसंधान संस्थान है जो भैंस आबादी के भोजन, प्रजनन, प्रबंधन और स्वास्थ्य के साथ-साथ उद्योग की अनुसंधान और विकास आवश्यकताओं पर ध्यान केंद्रित करता है। अपने दायित्व को पूरा करने के लिए, संस्थान ने पिछले कुछ वर्षों में महत्वपूर्ण प्रगति की है और ऐसी प्रौद्योगिकियाँ विकसित की हैं जिनका उपयोग अब पूरे देश में किसानों द्वारा किया जा रहा है। मुर्रा और नीली-रावी भैंसों के एक विशिष्ट झुंड के साथ, संस्थान का मुख्य और उप परिसर बेहतर जर्मप्लाज्म के संरक्षण, आनुवंशिक सुधार और प्रसार और वैज्ञानिक भैंस पालन के लिए आवश्यक प्रशिक्षण पर काम करता है।

संगठनात्मक संरचना

देशभर में स्थित सौ से अधिक आईसीएआर संस्थानों में से यह संस्थान 19 पशु विज्ञान संस्थानों में से एक है। निदेशक, जो प्रशासनिक कार्यों के साथ-साथ अनुसंधान और आउटरीच गतिविधियों की देखरेख करता है, संस्थान का प्रभारी है। उल्लेखनीय वैज्ञानिकों से बनी एक अनुसंधान सलाहकार समिति (आरएसी) संस्थान के अधिदेश, उद्देश्यों और परिप्रेक्ष्य योजना के आधार पर अनुसंधान दिशानिर्देश तय करती है। संस्थान प्रबंधन समिति (आईएमसी), जिसकी अध्यक्षता निदेशक करते हैं, वित्तपोषण की स्थिति, क्यूआरटी और आरएसी सिफारिशों के जवाब में की गई कार्रवाई, उच्च बजट परियोजनाओं की मंजूरी आदि पर महत्वपूर्ण प्रशासनिक और प्रबंधकीय निर्णय लेती है। संस्थान अनुसंधान समिति (आईआरसी) निदेशक की अध्यक्षता में, वैज्ञानिकों और विशेषज्ञों के बीच आपसी चर्चा के आधार पर नई परियोजनाओं को मंजूरी देने के अलावा वैज्ञानिकों द्वारा किए जा रहे कई शोध परियोजनाओं की स्थिति का मूल्यांकन करता है। आरएसी, आईएमसी और आईआरसी नियमित रूप से मिलते हैं और अनुसंधान और विकास गतिविधियों को और मजबूत करने के लिए मार्गदर्शन प्रदान करते हैं। हर पांच साल में, पंचवर्षीय समीक्षा टीम (क्यूआरटी) परिषद और आईसीएआर शासी निकाय को महत्वपूर्ण मूल्यांकन प्रदान करने के लिए, धन, जनशक्ति और उपलब्ध सुविधाओं के संसाधनों के साथ-साथ संस्थान के आउटपुट और परिणाम का मूल्यांकन करती है। संस्थान की अनुसंधान गतिविधियाँ तीन विषय वस्तु प्रभागों को सौंपी गई हैं: पशु पोषण और चारा प्रौद्योगिकी (एएनएफटी), पशु आनुवंशिकी और प्रजनन (एजीबी) और पशु शरीर क्रिया विज्ञान और प्रजनन (एपीआर)। इसके अलावा, प्रौद्योगिकी हस्तांतरण (टीओटी) के लिए एक इकाई संस्थान की विस्तार गतिविधियों की देखभाल करती है। विभिन्न अनुभाग अर्थात. कृषि फार्म, पशु फार्म, वर्कशॉप, एस्टेट, इलेक्ट्रिकल, पीएमई सेल, एकेएमयू, लाइब्रेरी, फीड यूनिट, लैंडस्केप, गेस्ट हाउस, आईटीएमयू का प्रबंधन संस्थान के निदेशक की सलाह के तहत संबंधित प्रभारियों द्वारा किया जाता है। प्रशासनिक कार्य अर्थात. खरीद, सुरक्षा, नकदी और बिल, प्रतिष्ठान और केंद्रीय स्टोर का प्रबंधन वरिष्ठ प्रशासनिक अधिकारी (एसएओ) द्वारा किया जाता है, जबकि वरिष्ठ वित्त और लेखा अधिकारी (एसएफएओ) लेखा परीक्षा और लेखा अनुभाग को पूरा करते हैं। संस्थान में वर्तमान में 26 वैज्ञानिक, 24 तकनीकी अधिकारी, 16 प्रशासनिक कर्मचारी और 106 कुशल सहायक कर्मचारी हैं।

बजट परिव्यय

स्वीकृत बजट (2023-24) के संदर्भ में संस्थान का वित्तीय परिव्यय 3640.04 लाख था और दिसंबर 2023 तक वास्तविक व्यय टीएसपी, एनईएच और एससीएसपी फंड सहित 2803.83 लाख रहा। सीआईआरबी को योजनाओं और बाह्य रूप से वित्त पोषित योजनाओं से क्रमशः 678.66 लाख और 357.56 रुपये की धनराशि प्राप्त हुई, जिसमें से रु० 406.71 और 147.30 लाख खर्च हुए। संस्थान की राजस्व प्राप्तियाँ अप्रैल-दिसंबर, 2023 के दौरान 371.93 लाख रु० रही।

2023 के दौरान प्रमुख उपलब्धियाँ

- मुर्रा भैंस में अब तक का उच्चतम गीला औसत (किलो/दिन) 10.26 (एन = 122) और झुंड का औसत (किलो/दिन) 7.27 (एन = 172) हासिल किया गया। नीली-रावी में भैंस का औसत (किलो/दिन) 8.62 (एन = 100) और झुंड का औसत (किलो/दिन) 5.80 (एन = 150) हासिल किया गया।
- मुर्रा और नीली-रवि के लिए क्रमशः अब तक का सबसे कम एएफसी (37.79 महीने, एन = 53 और 44.48 महीने, एन = 34) और ब्याने का अंतराल (436.23 दिन, एन = 101 और 439 दिन, एन = 64) हासिल किया।
- सीआईआरबी के इतिहास में पहली बार, 17 मुर्रा भैंसों ने एक ही स्तनपान में 4000 किलोग्राम का वजन पार किया। भैंस संख्या 5179 का वजन 305 दिनों में दूसरे ब्यांत के समय 5170 किलोग्राम दर्ज किया गया।
- 14 मुर्रा भैंसों के लिए अब तक की सबसे अधिक एक दिन की दूध उपज (> 20 किग्रा) दर्ज की गई, कुल मुर्रा झुंड की औसत 305 दिनों की दूध उपज 2952 किग्रा है।
- क्लोन किए गए भैंस सांडों के वीर्य गुणों और प्रजनन क्षमता का मूल्यांकन किया गया और प्रजनन करने वाले सांडों के वीर्य गुणों के साथ तुलना की गई और तुलनीय परिणाम पाए गए।
- संवर्धन के दौरान mitoQ के साथ दाता दैहिक कोशिकाओं के उपचार से आरओएस उत्पादन में कमी के माध्यम से व्यवहार्यता में काफी सुधार हुआ।
- आईवीएम या आईवीसी के दौरान mitoQ के अनुपूरण से नियंत्रण समूह की तुलना में क्लोन भ्रूण (7%) के उत्पादन में उल्लेखनीय सुधार हुआ।
- संरचनात्मक और कार्यात्मक गुणों के साथ-साथ गर्भावस्था दर 3 अलग-अलग शुक्राणु खुराकों के संबंध में यानी गर्भाधान की प्रति खुराक 12, 16 और 20 मिलियन शुक्राणु क्षेत्र की स्थितियों के तहत समान रहे। विभिन्न वीर्य खुराकों के उत्पादन अर्थशास्त्र से पता चला कि प्रति वीर्य भूसे में शुक्राणुओं की कमी से वीर्य उत्पादन में वृद्धि हुई और प्रति खुराक वीर्य उत्पादन की लागत कम हो गई।
- IVC क्लोन के दौरान ऑक्सामफ्लैटिन (1 μM) और एस्कॉर्बिक एसिड (50 μM) के संयोजन में एपिजेनेटिक संशोधक के पूरक से भ्रूण उत्पादन में सुधार हुआ और इन भ्रूणों से दो जानवर गर्भवती हुए।
- एनजीएस डेटा से पता चलता है कि क्लोन किए गए झोटो और उनके दैहिक कोशिका दाता झोटे के शुक्राणु में एमआरएनए और एमआईआरएनए के अभिव्यक्ति स्तर में उन जीनों के लिए कोई महत्वपूर्ण अंतर नहीं है जो शुक्राणुजनन, प्रजनन क्षमता और प्रारंभिक भ्रूण विकास को नियंत्रित करते हैं।
- विभिन्न भैंसों में क्लोन किए गए झोटो के जमे हुए वीर्य का उपयोग करके कुल 3822 कृत्रिम गर्भाधान किया गया है, जिसके परिणामस्वरूप 1322 गर्भधारण और 186 बच्चे हुए हैं।
- गर्भावस्था दर के आधार पर कृत्रिम गर्भाधान का उपयोग करके क्लोन किए गए झोटो के वीर्य की विवो प्रजनन क्षमता का भी मूल्यांकन किया गया था और कुल मिलाकर, 43.79% गर्भावस्था दर्ज की गई थी जो अन्य प्रजनन बैल के समान है।
- मोनोएलेलिक उत्परिवर्तन वाली एक मायोस्टैटिन (एमएसटीएन) नॉकआउट फ़ाइब्रोब्लास्ट एकल कोशिका कॉलोनी की स्थापना की गई।
- भैंस युग्मनज में मायोस्टैटिन के गाइड अनुक्रम के साथ आरएनपी के पारगमन के लिए अनुकूलित इलेक्ट्रोपोरेशन स्थिति (15 एचपीआई, 15 वी, 5 पी, 3 एमएस) जो भैंस के भ्रूण को संपादित करने में सक्षम है, जिसमें इंडेल (सम्मिलन / विलोपन) उत्परिवर्तन, बिंदु उत्परिवर्तन, बड़े विलोपन और छोटे शामिल हैं सम्मिलन.

- भैंस के जाइगोट और संपादित एसआरवाई जीन के लिए इलेक्ट्रोपोरेशन की स्थिति को अनुकूलित किया गया ताकि पूर्व निर्धारित लिंग भ्रूण का उत्पादन किया जा सके।
- भैंस के भ्रूण में POU5F1 उत्परिवर्तन पैदा करने के लिए एकल sgRNA का उपयोग करके CRISPR/Cas9 का प्रत्यक्ष विद्युतीकरण अत्यधिक प्रभावी तकनीक है और सत्यापन पर हमारे परिणाम दर्शाते हैं कि POU5F1 दूसरे वंश विभेदन के दौरान भैंस के पूर्व-प्रत्यारोपण भ्रूण में प्लुरिपोटेंसी के रखरखाव के लिए आवश्यक है।
- कृषि-जैव विविधता कार्यक्रम के कंसोर्टियम के तहत मुर्रा (एन = 4), भदावरी (एन = 4) और नीली-रवी (एन = 2) से प्राप्त 1 मिलियन फ़ाइब्रोब्लास्ट युक्त कुल 235 क्रायोवियल को आईसीएआर-एनबीजीएआर, करनाल को भेजा गया है।
- 362 भैंसों (मुर्रा-219), नीली-रावी (128), क्लोन (11) और भदावरी (4) का एक जीन बैंक स्थापित किया गया है, जिसमें डीएनए संरक्षित किया गया है।
- नियंत्रण ग्रुप कि तुलना में कुल इन विट्रो मीथेन उत्पादन (एमएल/जी डीएम) में मैलिक एसिड हीट ट्रीटेड (एमएएच-150) उपचारित ग्वार कोरमा, मूंगफली केक और सरसों केक की तुलना में कुल मिश्रित राशन (टीएमआर) में 11.3, 16.7 और 44.2% की कमी आई थी।
- 100% प्रतिस्थापन स्तर (जीएनसी + जीके) पर रूमेन संरक्षित प्रोटीन के साथ टीएमआर खिलाने वाले भैंस के बछड़ों में शरीर के वजन में वृद्धि और औसत दैनिक वृद्धि (669 बनाम 424, जी/डी) में वृद्धि हुई, साथ ही बेहतर एफसीआर और उच्च फ़ीड दक्षता, एफई (10.76 बनाम 6.98)।
- दूध पिलाने वाली भैंस के राशन में किण्वित चुकंदर के गूदे को शामिल करने (डीएम के आधार पर 12-15%) के साथ फीडिंग मॉड्यूल विकसित किया गया, जिससे दूध उत्पादन में वृद्धि (10%) के साथ फीडिंग लागत कम हो गई।
- दूध पिलाने वाली भैंसों को यूकेलिप्टस पत्ती भोजन, ईएलएम (10 ग्राम/किग्रा डीएम) के अनुपूरक से आहार के पोषक मूल्य में सुधार का पता चला, जो कम आंत्र मीथेन उत्पादन और उच्च रुमेनिक एसिड (सीआईएस 9 ट्रांस 11, सी18:2 लिनोलिक एसिड)) के संदर्भ में दूध की उपज और गुणवत्ता में वृद्धि के साथ दर्शाया गया था। जिसका मानव स्वास्थ्य पर प्रभाव पड़ता है। सी
- एमटी पॉजिटिव क्वार्टर से दूध के नमूनों को बैक्टीरियोलॉजिकल विश्लेषण के अधीन करने पर स्टैफिलोकोकस ऑरियस (16), स्टैफिलोकोकस एसपीपी को अलग किया गया। (8), स्ट्रेप्टोकोकस एसपीपी। (21), एंटरोकोकस फ़ेकेलिस (6), क्लेबसिएला एसपी। (1), ई. कोली (6), कोकुरिया रसिया (5), एंटरोकोकस फ़ेकैलिस (6), कोकुरिया क्रिस्टीना (4), 3 कोकुरिया वेरियंस (3), रोथिया म्यूसिलगिनोसा (1), एंटरोबैक्टर क्लोएसी (3) और स्फिंगोमोनस पॉसीमोबिलिस (1) इनमें से कुछ जीवाणुओं में ज़ूनोटिक क्षमता भी होती है। जीवाणुविज्ञानी रूप से पहचाने गए आइसोलेट्स की पुष्टि आणविक तरीकों से की गई।
- एनपीबीआई के तहत मुर्रा और अन्य नस्लों (नीली-रावी, जाफराबादी, सुरती और भदावरी) के लिए क्रमशः 3,03,484 और 46,756 वीर्य खुराक का उत्पादन किया गया और 1,96,568 और 25,987 का प्रसार किया गया।
- आईसीएआर-सीआईआरबी ने वर्ष के दौरान किसानों के लिए 9 प्रशिक्षण आयोजित किए, जिसमें 325 डेयरी किसानों ने भाग लिया। सीआईआरबी स्थापना दिवस के अवसर पर ग्राम सरसोद में एक बछड़ा रैली आयोजित की गई जिसमें विभिन्न एफपीटी किसानों की 60 मादा संतानों ने भाग लिया।
- आईसीएआर-सीआईआरबी की मानव संसाधन विकास इकाई ने संस्थान के 4 वैज्ञानिकों और 1 तकनीकी अधिकारी के प्रशिक्षण की सुविधा प्रदान की है।
- 7 नवंबर, 2023 को नेपाल सरकार की एक पहल में आईसीएआर-सीआईआरबी हिसार ने सरकार को 15 मुर्रा भैंस झोटे उपहार में दिए। भारत नेपाल की तराई, लाइम, गाडी और परकोटे जैसी भैंसों की नस्लों की दूध उत्पादन क्षमता को बढ़ाएगा।

स्टाफ की स्थिति

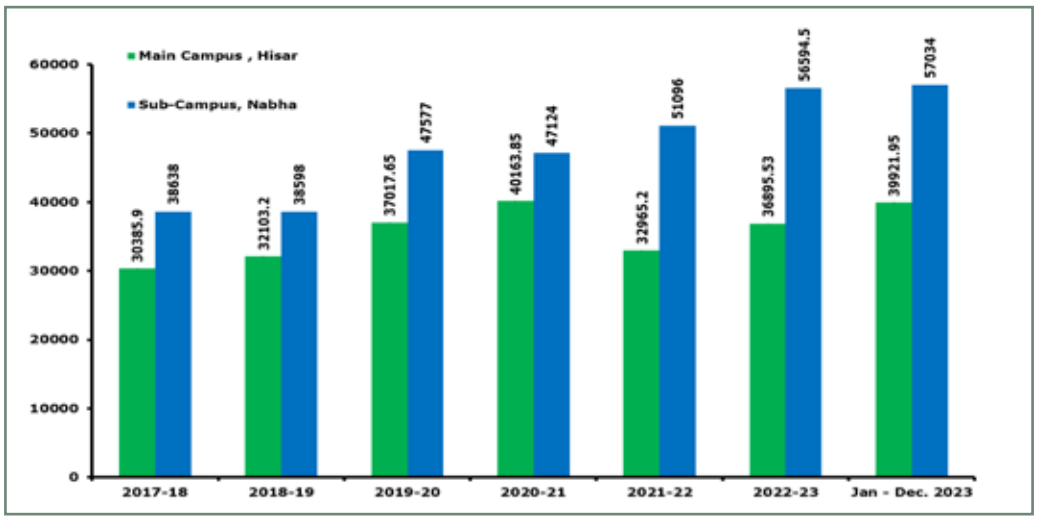
श्रेणी	स्वीकृत	कार्यरत	रिक्त
वैज्ञानिक	44+1	26	18
तकनीकी	40	24	16
प्रशासनिक	25	16	9
कुल सहायक कर्मचारी	124	106	18

भैंस के उत्पादन में विकास

मानदंड	स्थति	
	मुर्रा नस्ल, मुख्य परिसर हिसार	नीली- रावि नस्ल, उप परिसर नाभा
पशुओं की कुल संख्या (31.12.2020 को)	528	484
प्रथम ब्यांत उम्र	37.79	44.48
मृत्यु दर (%)	4.29	4.61
डेयरी भैसों का प्रदर्शन		
कुल मिलाकर वार्षिक औसत	10.26	8.62
कुल मिलाकर दुग्ध उपज	3060	2784
कुल मिलाकर एसएलएमवाई	2952	2630
सर्विस अवधि	127	123
ब्यांत अंतराल	436	429
गर्भाधान की दर	42.42	40.67
नर जर्मप्लास्म		
प्रोजेनी टेस्टेड सांडों का उत्पादन	42 (1-16th set)	12 (1-6th Set)
हिमीकृत वीर्य टीके उत्पादित	251712	8359
हिमीकृत वीर्य आपूर्ति	107768	6687
राजस्व उत्पत्ति (रुपये, लाख में)	20.13	1.41
क्षेत्र में बैल प्रसार	580*	145

कृषि फार्म उत्पादन

चारा	हिसार, मुख्य परिसर	नाभा, उप परिसर
गेहूं का भूसा	858	2852
हरा	39921.95	57034
अनाज	793.10	4077.65



मुख्य परिसर और उप-परिसर, नाभा में हरा चारा उत्पादन (क्यूटीएलएस)।

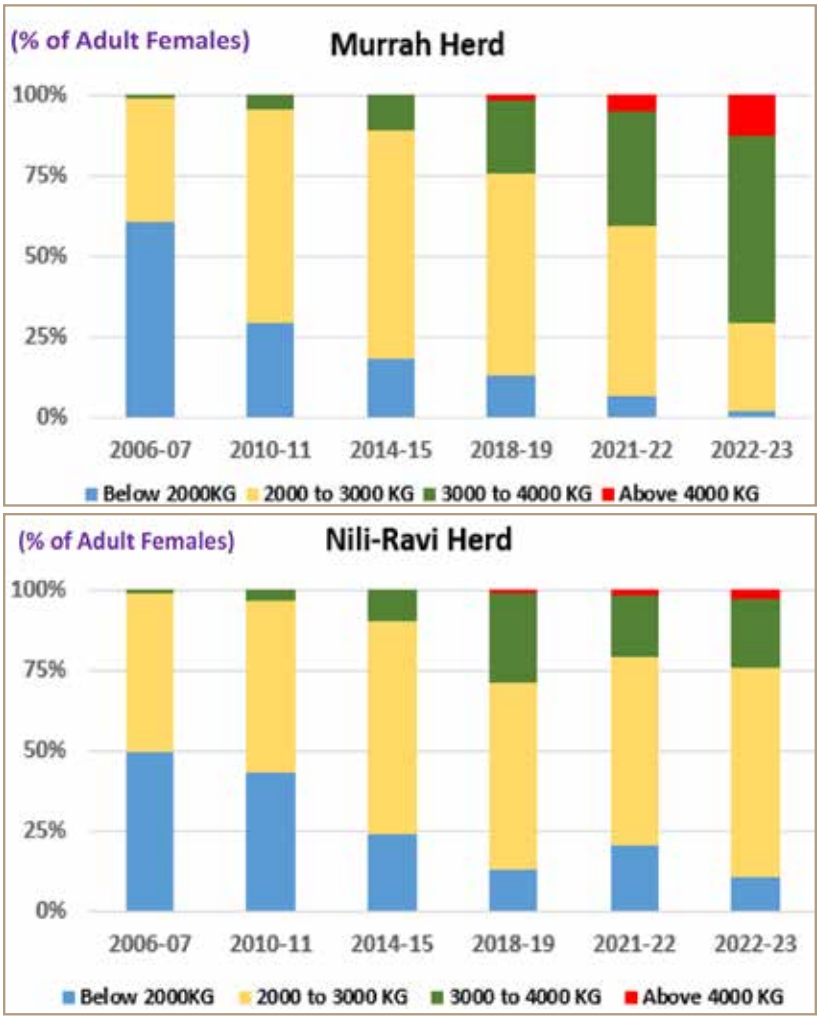
राजस्व प्राप्ति (भारतीय रुपये में सभी आंकड़े)

प्रमुख / लघु / खातों का विस्तृत विवरण	2019-20	2020-21	2021-22	2022-23	Upto Dec 2023
फार्म उत्पादों की बिक्री					
(i) दूध की बिक्री	336.20	370.31	371.56	386.12	260.06
(ii) गेहूं भूसा / सरसों भुसा / हरा चारा की बिक्री	5.05	10.22	0.26	6.31	3.75
(iii) अनाज / गेहूं / धान की बिक्री	4.83	7.92	3.41	4.89	3.70
(iv) वीर्य की बिक्री	27.54	23.83	30.95	20.29	15.52
(v) खनिज मिश्रण की बिक्री	0.77	0.45	0.77	0.93	0.67
(vi) सूखे पेड़ों की बिक्री प्रक्रिया	0.00	10.15	1.60	10.43	23.53
(vii) पुस्तकों की बिक्री	0.66	0.03	0.15	0.02	0.00
(viii) प्रौद्योगिकी / रॉयल्टी की बिक्री	0.76	0.19	0.17	0.07	0.77
बिक्री आय					
(i) भूमि और भवन	0.00	0.00	0.00	0.00	0.00
(ii) मशीन टूल्स और प्लांट उपकरण / वाहन आदि	0.00	0.00	8.81	0.00	0.00
(iii) पशुधन की बिक्री आय	84.13	89.47	110.24	127.26	55.41
किराए (लाइसेंस शुल्क)	4.70	5.93	5.88	5.84	4.30
अभ्यर्थी ट्यूशन फीस, डिप्लोमा शुल्क आदि से आवेदन शुल्क	0.00	0.00	0.00	0.30	0.30
भर्ती के संबंध में उम्मीदवारों से आवेदन शुल्क	0.00	0.00	0.00	0.00	0.00
योजना से प्राप्तियां	2.97	0.00	0.58	0.67	0.18
संस्थान द्वारा प्रदान की गई सेवा से प्राप्त रसीदें / छात्रों से रसीद	0.00	0.00	0.00	0.00	0.00
विविध प्राप्ति	0.79	0.73	0.87	0.00	0.00
(i) निविदा प्रपत्र की बिक्री	3.77	1.28	3.18	4.62	3.74
(ii) अतिथि गृह शुल्क	472.16	520.50	538.42	567.73	371.93

वित्तीय परिव्यय (लाख रुपये में)

संस्थान/परियोजना का नाम	स्वीकृत बजट 2022-2023	व्यय 2022-2023
सीआईआरबी मुख्य	3605.04	2791.36
सीआईआरबी टी एस पी	5.00	0.00
सीआईआरबी एन ई एच	0.00	0.00
सीआईआरबी एस सी एस पी	30.00	12.47
कुल	3640.04	2803.83
प्लान योजनाएं		
भैंस सुधार पर नेटवर्क परियोजना	480.00	324.13
भैंस सुधार पर नेटवर्क परियोजना, एस सी एस पी	30.00	11.25
पोषण और शरीर क्रिया विज्ञान पर ए आई सी आर पी (डॉ. आर.के. शर्मा, पीएस और पी आई)	8.85	3.67
एन ए आई एफ परियोजना (डॉ. संदीप खुराना, पीएस और पी आई)	6.00	4.43

संस्थान/परियोजना का नाम	स्वीकृत बजट 2022-2023	व्यय 2022-2023
एन ए एस एफ क्लोनिंग प्रोजेक्ट (डॉ. पी.एस. यादव, पीएस और पी आई)	89.49	40.49
एन ए एस एफ डी एम एम प्रोजेक्ट (डॉ. धर्मेंद्र कुमार, वरिष्ठ वैज्ञानिक और पी आई)	27.17	12.39
केबिन परियोजना (डॉ. वारिज नयन, वरिष्ठ वैज्ञानिक और पी आई)	20.00	2.95
एफ एफ पी परियोजना (डॉ. अशोक बूरा, वरिष्ठ वैज्ञानिक और पी आई)	8.15	3.28
सी आर पी परियोजना (डॉ. मीती पुनेठा, वैज्ञानिक और पी आई)	9.00	4.12
कुल	678.66	406.71
बाह्य वित्तपोषित योजनाएँ		
डी बी टी परियोजना (डॉ. प्रदीप कुमार, वरिष्ठ वैज्ञानिक और पी आई)	9.57	3.49
एनएलएम परियोजना (डॉ. अशोक बल्हारा, वरिष्ठ वैज्ञानिक और पी आई)	29.85	21.85
एनएलएम परियोजना (डॉ. सुनेश बल्हारा, वरिष्ठ वैज्ञानिक और पी आई)	21.15	17.48
बी एम जी एफ परियोजना (डॉ. वारिज नयन, वरिष्ठ वैज्ञानिक और पी आई)	14.15	10.09
डीएएचडी परियोजना (डॉ. आर.के. शर्मा, पीएस और पी आई)	260.22	74.30
डीएएचडी परियोजना (डॉ. जिरोम ए., वरिष्ठ वैज्ञानिक और पी आई)		0.33
डी बी टी परियोजना (डॉ. पी.एस. यादव, पीएस और पी आई)	12.62	9.78
एसईआरबी परियोजना (डॉ. मीती पुनेठा, वैज्ञानिक और पी आई)	10.00	9.94



आनुवंशिक सुधार एवं दूध उत्पादन की प्रवृत्ति (व्यस्क मादा भैंसों का प्रतिशत)

INTRODUCTION

INSTITUTE AT A GLANCE

The Central Institute for Research on Buffaloes (CIRB) was established on February 1, 1985 by acquiring the Progeny Testing Bull Farm from Haryana Government at Hisar. The Institute is dedicated to address the developmental needs of this virtuous species through interventions derived from research. The institute has come a long way towards addressing its mandated role. A sub-campus of the institute was established in December 1987 at Bir Dosanjh, Nabha, District Patiala (Punjab) with the transfer of Nili- Ravi Buffalo Farm from the Punjab State Government. Soon after its establishment, the institute came to lime-light in the 'buffalo world' by successfully hosting 2nd World Buffalo Congress (1988), 4th and 9th Asian Buffalo Congress (2003 and 2018, respectively).

Institute has developed considerable expertise over the last three decades in improving buffalo's genetic performance and fertility management with the application of reproductive biotechnologies and efficient nutrient utilization technologies. Information generated at the institute and the services offered to stakeholders have contributed to the growth of buffalo industry as a whole and well-being of millions of milk producers. Under the Network Project on Buffalo Improvement, the ICAR-CIRB coordinated establishment of pedigreed nucleus breeding herds of six important buffalo breeds in their respective home tracts in collaboration with other ICAR institutes and the state agricultural universities. This has allowed creation of a repository of data and information on various aspects of buffaloes and to undertake focussed technology transfer and extension activities across the country. The Institute has approved cadre strength of 44 scientists in various specialisations, including the sub-campus at Nabha.

Mandate

- Basic and strategic research for enhancing technology development on all aspects of buffalo productivity
- Information repository and dissemination of buffalo products technologies.

The Vision

- To develop and propagate high yielding elite buffalo germplasm for quality milk and meat production while retaining inherent draughtability across different regions of the country.

The Mission

- To improve buffaloes through identification, conservation and propagation of elite germplasm having high efficiency of reproduction and nutrient utilization for sustainable production and commercialization.

The Focus Areas

In view of the institute mandate and existing infrastructure and manpower, five major thrust areas and programs have been identified for research, as per recommendations made by Research Advisory Committee and Institute Research Council:

- Genetic Resource Improvement Program
- Feed Resource Utilization and Improvement Program
- Optimization of Reproductive Efficiency Program.
- Buffalo Management Program
- Extension

DIVISIONS

The institute research activities are managed under three subject specialized divisions with specific objectives and required infrastructure.

I. Division of Animal Genetics and Breeding

Genetic resources improvement programme is the major programme to undertake studies on genetic improvement of Murrah and Nili-Ravi breeds by implementing efficient breeding plans, envisaged with scientific breeding, using powerful computing systems, maintaining vast pedigree records with necessary technological interventions in the areas of nutrition and reproduction. Genetic improvement is evaluated through associated herd and field progeny testing, performance recording and genetic analysis of data under Network mode. Data resource is generated to develop 'genome-to-phenotype' models for predicting animal's genetic merit. Research focus is on developing methods to measure different conformation and performance traits for selecting high scoring germplasm to line-up the parents of next generation. Sound phonemic and genomic data collection has generated an authentic data resource, to understand the genetics of relevant but complex traits such as milk yield, faster gain in quality meat and reproductive traits. Grading superior buffaloes by digital imaging of animals, linking conformation/body size indices to productivity, identifying genetic variants through SNP technology elucidating genetic markers are aimed at developing selection tools.

II. Division of Animal Nutrition and Feed Technologies

The nutrition laboratories have the most modern equipment and facilities to undertake research on various aspects related to buffalo nutrition, aimed at developing economic growth and production rations by incorporating agro-industrial by-products. Feed and Forage Quality Control and Processing, Rumen Biome, Protein Nutrition, Toxicology and Mineral Nutrition laboratories are well-equipped and functional. Major studies include working out nutrient requirements of different categories of buffaloes for milk, meat and growth, with evaluation of different feed and fodder ingredient available in different regions.

III. Division of Animal Physiology and Reproduction

Facilities have been developed in the division for undertaking studies on semen technology, embryo biotechnology including OPU-IVF, embryo transfer and cloning, cell culture, biochemistry and molecular biology, and endocrinology in order to understand reproductive functions, development and function of the mammary gland, besides other physiological facets which have remained little explored in buffalo.

IV. Transfer of Technology Unit

The Transfer of Technology Unit at ICAR-CIRB actively engages in extension activities focused on buffalo breeding, feeding, reproduction, health, and management. This includes regular visits by scientists and technical personnel to adopted villages, as well as organizing training sessions, demonstrations, lectures, calf rallies, and treatment camps. These efforts aim to empower farmers with knowledge and skills essential for sustainable and efficient buffalo farming practices.

V. Semen Freezing Lab

Semen Freezing Lab was established during 2007-08 with most modern facilities for collection, processing, freezing and preservation of semen as per OIE guidelines to fulfil the requirements of the Network Project on Buffalo Improvement and to supply high quality semen in the field. Facilities include CASA, flow cytometry, fluorescent microscope, DIC and Phase contrast microscopes, biofreezer for cryopreservation of Murrah semen. Frozen semen is provided to the developmental agencies, farmers and inseminators engaged in buffalo improvement program. The lab has current stock of more than four lakh doses of frozen semen from nearly 250 Murrah breeding bulls out of which more than sixty-four thousand doses are from progeny tested bulls. Frozen semen doses are also prepared from farmers' champion/ superior bulls, which are available for introduction in organized herds and farmers' animals. Frozen semen production has significantly improved during recent years.

VI. Animal Farm

Highly pedigreed herds of over 550 Murrah buffaloes and an equal number of Nili-Ravi buffaloes, including followers, constitute the breeding herds at Hisar and Nabha, respectively. There are covered sheds for indoor housing of adult buffaloes attached with covered calf pens together with open paddocks for loose housing. At Hisar, a mechanized and automated shed for buffalo feeding, cleaning, milking and data recording system has been created, which is being equipped with necessary facilities for automated slurry management and milking. There is provision for housing of 200 buffaloes, 180 heifers and 10 down calvers, besides 5 individual pens for young calves (30 in each). Sub-Campus, Nabha is equipped with 12 unit cluster automatic milking machine for clean and hygienic milk production.

The production performance viz. wet average and 305 days or less milk yield of Murrah herd has improved from 4.80 kg/day and 1508 kg during 1992-93 to 10.26 kg/day and 2952 kg in 2023. The reproductive performance of the herd also improved as reflected by decline in calving interval (from 502 to 436 days) and age at first calving (50.7 to 37.41 months).

Elite Buffaloes at CIRB, Hisar

Buffalo No.	D.O.B.	Highest 305d or less MY (kg) /lactation no.	Best Peak Yield (kg)	Sire No.	Set No.
5179	24/03/17	5170 / 2	26.8	3591 PT(CIRB)	11
4316	31/03/11	4875 / 6	23.9	R-11(Field)	12
5074	01/08/16	4602 / 2	18.0	6139(NDRI)	15
5175	14/03/17	4553 / 3	23.0	2501(GADVASU)	16
4817	12/10/14	4507 / 5	23.5	4100(CIRB)	14
5081	27/08/16	4507 / 2	22.5	4354 PT(CIRB)	15
5151	07/01/17	4444 / 2	21.0	4592(CIRB)	16
4692	28/01/14	4431 / 5	20.0	1994 PT(GADVASU)	9
4978	25/10/15	4366 / 2	18.9	1693 PT(LUVAS)	10
4899	01/05/15	4350 / 3	20.0	6044 PT (NDRI)	14
4767	12/08/14	4308 / 4	20.6	2369(GADVASU)	14
4613	18/08/13	4180/ 4	20.2	5943(NDRI)	13
E182	19/05/17	4149 / 2	20.5	Not Known	-
4251	29/10/10	4138 / 3	22.0	2133 PT(GADVASU)	11
4462	03/06/12	4045 / 2	23.4	R-10(Field)	12
5021	17/02/16	4029 / 2	21.0	4354 PT(CIRB)	15
4458	16/05/12	4028 / 4	17.0	1796PT(GADVASU)	7

Similarly, during the year 2023 the production performance of Nili-Ravi herd at Sub-Campus, Nabha has recorded as - wet average 8.62 kg/day, 305 days or less milk yield 2670 kg. Age at first calving 44.48 months and service period 123 days, were recorded during the period.

ICAR-CIRB Buffalo Herd status (2023)

S. No.	Category	Addition						Disposal					
		M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
		OB	OB	B	B	P	P	D	D	S	S	CB	CB
Female													
1.	Calves below 3 months	26	14	80	48	-		5	02	3	02	32	16
2.	Calves 3-12 months	69	50			-		13	01	9	03	44	26
3.	Heifers a) 1-2 years b) Above 2.0 years	 80 76	 55 110	 - -		 - -		 5 1	 01 01	 9 11	 0 09	 71 80	 60 123
4.	Buffaloes in Milk	145	113	-		-		2	01	33	22	136	96
5.	Buffaloes Dry	47	46			-		3	01	18	21	48	50
	Sub Total	**443**	**388**	**80**	**48**	**-**		**29**	**07**	**83**	**57**	**411**	**371**
Male													
1.	Calves below 3 months	28	31	76	59	-		4	05	4	02	16	19
2.	3-12 months	39	38			-		9	0	6	09	47	33
3.	1) 1-2 years 2) > 2 years	26 29	42 27	-		-		0 0	0 1	35 34	57 11	23 15	25 35
4.	Breeding bulls	12	02	-		-		1	0	5	02	16	00
5.	Bullocks	0	-	-		-		0	0	0	0	0	-
6.	Teasers	0	01	-		-		0	0	0	0	0	01
	Sub Total	134	141	76	59	-		14	06	79	81	117	113
	Grand Total	**577**	**529**	**156**	**107**	**-**		**43**	**13**	**162**	**138**	**528**	**484**

M = Murrah (at Main Campus, Hisar), NR= Nili Ravi (at Sub Campus, Nabha), OB = Opening Balance, D = Death, S = Sale, R = Received, B = Birth, P = Purchased

ICAR-CIRB Calving statistics (2023)

Month	Male (number)		Female (number)		Abortions & Still Birth (number)		Overall (number)	
	M	NR	M	NR	M	NR	M	NR
January	4	06	7	07	--		11	13
February	3	02	2	03	--	01	5	06
March	7	06	4	04	--	--	11	10
April	1	01	1	02	--	--	2	03
May	4	-	3	01	--	--	7	01
June	1	01	3	02	1	01	5	04
July	11	06	7	02	1	--	19	08
August	12	08	10	02	--	--	22	10
September	11	08	10	07	--	03	21	18
October	14	10	14	12	--	01	28	23
November	6	06	15	03	--	06	21	15
December	2	05	4	03	--	02	6	10
Overall	**76**	**59**	**80**	**48**	**2**	**14**	**158**	**121**

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

Sex ratio Murrah (Male: Female) = 49:51(approx.) Sex ratio Nili Ravi (Male: Female) = 55:45 (approx.)

ICAR-CIRB Disposal of animals (2023)

Category	Surplus sold		Udder Health		Repd. problem		Weak & old		Death		Total	
	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Female												
< 6 months	3	02					3		8	03	14	05
6-12 months	-	03					6		10	00	16	03
Heifers												
1-2.5 yrs	-	0			0	06	9		6	01	15	01
> 2.5 yrs	-	03			0		11		0	01	11	10
Buffaloes												
Dry	6	15	1	01	3	02	8	03	3	01	21	22
Milch	-	10	10	05	13	04	10	03	2	01	35	23
Sub Total	9	33	11	06	16	12	47	06	29	07	112	64
Male												
< 6 months	4	03					6		5	05	9	08
6-12 months	-	08							8		4	08
>1 yr	40	70			9		20		0	01	69	71
Breeding bulls	-	0			0				1		1	0
Bullock + Teaser	-	-							0			0
Sub total	44	81	0		9		26		14	06	93	87
G. Total	**54**	**114**	**11**	**06**	**25**	**12**	**73**	**06**	**43**	**13**	**205**	**151**

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Month wise mortality of animals (2023)

Month	Deatails	0-3 (female)		3-6		6-12		>1yr		>2yrs		All		0-3 (male)		3-6		6-12		>1yr		>2yr		All		Total	
		M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Jan	No Died	26	17 --	36 --	31	35 --	13	79 --	63	267 --	271	443 --	395	26 --	27	23 --	27	20 --	14	40 --	47	36 --	32	145 --	147	588 --	542
Feb	No Died	24	12 01	33 --	23	39 1	24	78 --	66	275 --	272	449 01	397 01	22 --	14	24 --	33	19 --	17	38 --	53	40 --	32	143 --	149	592 01	546 01
Mar	No Died	14	11 01	33 3	14	43 1	30	81 --	68	253 02	240	424 06	363 01	12 --	13	26 --	30	25 02	17	42 --	20	36 --	28	141 02	108	565 08	471 01
Apr	No Died	12	09	25 01	14	54 02	32	80 --	67	253 --	243	424 03	365	13 01	09	23 --	26	29 02	26	27 --	20	54 --	28	146 03	109	570 06	474
May	No Died	7	07 --	23	10	52 04	39	82 --	66	258 --	243 01	422 04	365 01	10 --	06 01	19 --	13	31 04	40	29 --	21	55 --	27 01	144 04	107 02	566 08	472 03
Jun	No Died	8	05	12 --	11	054 2	41	82 01	66	261 --	244	417 03	367	12 --	02	11 --	12	35 01	46	30 --	20	55 01	28	143 02	108	560 05	475
Jul	No Died	7	05	10 --	09	43 --	44	79 02	64	254 --	247	393 02	369	06 --	06 01	12 --	08	22 01	50	25 --	20	33 --	29	98 01	113 01	491 03	482 01
Aug	No Died	13 01	06	7 --	07	41 --	32	73 01	71	253 --	255	387 02	371	16 --	13 01	10 --	06	24 --	45	25 --	23	35 --	33	110 --	120 01	497 02	491 01
Sep	No Died	20 01	11	8 --	05	36 --	25	70 01	72	263 03	265	397 05	378	24 --	20	12 --	02	23 --	42	24 --	31	38 --	33	121 --	128	518 05	506
Oct	No Died	24 01	20	7 --	05	29 --	21	57 --	67 01	259 --	256	376 01	369 01	31 --	23 01	06 --	06	23 --	32	23 --	11	37 --	31	120 --	103 01	479 01	472 02
Nov	No Died	33 01	20 01	11 --	06	24 --	17	68 --	69	251 --	258 01	387 01	370 02	35 02	22	15 --	13	19 --	19	22 --	23	35 --	32	126 02	109	513 03	479 02
Dec	No Died	32	16	10 --	10 01	34 --	16	71 01	60	264 --	269 01	411 01	371 02	16 --	19 01	20 --	19	27 --	14	23 --	25	31 --	36	117	113 --	528 01	529 03

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffalo conception rate (2023)

No. of AIs	Ist						IInd						IIIrd						IVth & above						Overall					
Criteria	I		C		CR		I		C		CR		I		C		CR		I		C		CR		I		C		CR	
Breed	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Heifers	63	79	31	34	49.21	43.04	36	51	13	22	36.11	43.14	19	33	11	18	57.89	54.55	27	30	9	07	33.33	23.33	145	193	64	81	44.14	41.97
Adult	141	137	56	56	39.72	40.88	92	70	45	25	48.91	35.71	34	48	16	22	47.06	45.83	76	56	26	21	34.21	37.5	343	311	143	124	41.69	39.87
Overall	204	216	87	90	42.65	41.67	128	121	58	47	45.31	38.84	53	81	27	40	50.94	49.38	103	86	35	28	33.98	32.56	488	504	207	205	42.42	40.67

M = Murrah (at Main Campus, Hisar), NR= Nili Ravi (at Sub Campus, Nabha), I = No. of animals inseminated; C= No. of animals conceived; CR% = Conception rate (%)

ICAR-CIRB Bull-wise conception rate (2023)

Sr. No.	Bull No.		Set No.		Total No. of AI		Total Conceived		CR%	
Breed	M	NR	M	NR	M	NR	M	NR	M	NR
1.	2850	03 (PT)	20th	5th	41	10	23	5	56.10	50.00
2.	2467	27 (PT)	16th	5th	6	11	3	4	50.00	36.36
3.	3591	252 (PT)	11th	6th	24	32	6	10	25.00	31.25
4.	6007	254 (PT)	15th	6th	12	21	6	8	50.00	38.09
5.	4705	561	16th	9th	10	7	2	4	20.00	57.14
6.	2930	728	21st	10th	6	75	0	36	0.00	48.00
7.	7584	753	20th	10th	1	33	0	15	0.00	45.45
8.	3004	800	20th	10th	18	112	3	45	16.67	40.18
9.	5500	852	20th	10th	15	130	10	42	66.67	32.31
10.	M 29	856	16th	10th	11	71	3	34	27.27	47.89
11.	4592	782	16th	10th	17	2	11	2	64.71	100.00
12.	5505		20th		26		11		42.31	
13.	2459		15th		9		4		44.44	
14.	5511		20th		29		13		44.83	
15.	4889		16th		14		6		42.86	
16.	6044		14th		24		4		16.67	
17.	2831		20th		18		8		44.44	
18.	1454		20th		64		24		37.50	
19.	2838		20th		13		7		53.85	
20.	19		20th		28		11		39.29	
21.	2793		20th		27		13		48.15	
22.	7768		21st		1		1		100.00	
23.	5629		21st		3		2		66.67	
24.	1053		16th		8		6		75.00	
25.	3014		21st		16		7		43.75	
26.	5647		21st		8		5		62.50	
27.	297		21st		17		7		41.18	
28.	5481		20th		22		11		50.00	

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffalo herds production status (2023)

Lact. No	Number		Av. Total Lactation Yield (kg)		Av. Lactation length (days)		305-days yield (kg)		Av. Peak Yield (kg)	
	M	NR	M	NR	M	NR	M	NR	M	NR
1st	41	39	2555	2653	306	340	2476	2450	12.60	11.57
2nd	40	20	3161	2898	304	301	3037	2873	15.95	14.42
3rd	27	11	3275	2891	308	310	3167	2783	17.21	14.13
4th	16	13	3318	2816	313	302	3219	27.56	16.38	14.30
5th and above	16	18	3480	2853	304	315	3327	2787	17.63	14.00
Overall	140	101	3060	2784	306	320	2952	2670	15.45	13.30

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffaloes reproduction performance (2023)

Traits	Value	1		2		3		4		5 & above		Overall	
Breed		M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Av. Age at First Calving (Months)	N X SE	53 37.79 ± 0.61	34 44.48 ±0.72										
Av. Service Period (Days)	N X SE			35 141.91 ± 11.58	25 149 ±13.19	26 120.92 ± 11.44	12 121 ±13.68	21 99.76 ± 12.40	8 125 ±20.47	19 135.37 ± 16.57	19 90 ±10.08	101 126.51 ± 6.52	64 123 ±7.48
Av. Dry Period (Days)	N X SE			35 147.60 ± 10.31	25 147 ±10.57	26 120.69 ± 6.58	12 125 ±16.38	21 118.24 ± 7.79	8 126 ±18.55	19 133.00 ± 12.13	19 111 ±12.96	101 131.82 ± 4.94	64 130 ±6.93
Av. Calving Interval (Days)	N X SE			35 451.26 ± 11.90	25 456 ±12.93	26 429.50 ± 11.39	12 421 ±13.96	21 412.48 ± 12.41	8 431 ±19.64	19 444.00 ± 16.29	19 398 ±9.48	101 436.23 ± 6.53	64 439 ±7.32

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Month wise milk sold (2023)

Month	Total Milk Produced (kg)	
	M	NR
Jan, 2023	39206.50	32084.60
Feb, 2023	35267.50	30283.90
Mar, 2023	33329.50	30434.90
Apr, 2023	28895.00	30643.10
May, 2023	27706.50	27528.5
Jun, 2023	25180.50	24080.30
Jul, 2023	23087.50	21040.70
Aug, 2023	25092.50	19960.00
Sep, 2023	26340.00	19776.80
Oct, 2023	29335.50	23235.50
Nov, 2023	32202.50	24481.00
Dec, 2023	37300.00	27372.60
Total	362943.50	310921.90

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffalo herd production performance (2023)

Month	In milk		Dry		Total		% in Milk		Wet Av.(kg)		Herd Av.(kg)	
Breed	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Jan	146	113	46	47	192	160	76	71	11.00	9.13	8.36	6.47
Feb	149	115	39	47	188	162	79	71	10.47	9.77	8.30	6.90
Mar	135	105	32	40	167	145	81	73	9.99	10.54	8.06	7.72
Apr	130	106	37	39	167	145	78	73	9.44	9.65	7.33	7.05
May	119	104	49	42	168	146	71	71	9.02	8.51	6.39	6.07
Jun	108	99	52	48	160	147	68	67	9.32	8.16	6.31	5.49
July	97	93	60	56	157	149	62	62	9.51	7.31	5.90	4.57
Aug	103	91	65	58	168	149	61	61	9.80	7.08	6.00	4.31
Sept	109	92	63	61	172	153	64	60	10.18	7.16	6.47	4.31
Oct	110	92	60	59	170	151	65	61	11.14	8.16	7.21	4.97
Nov	125	92	51	52	176	144	71	64	11.13	8.78	7.93	5.64
Dec	136	97	48	49	184	146	74	66	11.50	9.15	8.47	6.08
Overall	122	100	55	50	172	150	71	67	10.26	8.62	7.27	5.80

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffalo herd production performance since 1992-93 (Part I)

Year	In milk		Dry		Total		% in Milk		Wet Av (kg)		Herd Av (kg)	
Breed	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
1992-93	165	98	111	53	276	151	60.60	64	4.80	5.86	2.83	3.42
1993-94	153	81	125	58	178	139	55.00	58	5.65	5.75	3.10	3.39
1994-95	181	92	85	44	266	136	68.10	67	6.09	6.01	4.15	4.18
1995-96	153	86	82	35	235	121	65.19	71	6.43	5.61	4.19	3.99
1996-97	122	81	83	52	205	133	59.56	61	5.62	5.71	3.35	3.49
1997-98	121	113	76	40	197	153	61.38	74	6.12	6.03	3.75	4.45
1998-99	133	104	73	42	206	146	64.52	72	6.77	6.13	4.37	4.26
1999-00	137	85	72	39	209	124	65.48	68	6.85	6.01	4.49	4.23
2000-01	148	96	78	33	226	129	65.39	74	6.68	6.31	4.37	4.69
2001-02	147	86	70	38	217	124	67.70	69	6.59	6.85	4.46	4.82
2002-03	143	106	71	38	214	144	67.00	73	6.27	6.56	4.20	4.83
2003-04	151	106	72	37	223	143	67.69	74	6.49	6.35	4.39	4.70
2004-05	154	100	69	47	224	147	68.97	67	6.39	6.86	4.40	4.65
2005-06	151	114	77	46	238	160	66.37	71	6.57	6.85	4.36	4.84
2006-07	137	119	92	48	229	167	59.81	71	6.45	6.20	3.86	4.40
2007-08	146	102	71	54	217	156	67.32	65	6.64	6.73	4.47	4.46
2008-09	133	122	66	44	199	166	66.00	73	6.50	6.91	4.35	5.03
2009-10	106	110	65	58	171	168	62.00	65	7.01	7.00	4.35	4.66
2010-11	109	98	64	43	173	141	62.97	70	7.45	7.11	4.69	4.93
2011-12	110	84	58	40	168	124	65.38	68	7.83	7.74	5.12	5.30
2012-13	109	90	69	49	178	139	62.24	65	7.74	8.26	4.76	5.34
2013-14	105	94	65	52	170	146	61.78	64	8.01	8.25	4.95	5.32
2014-15	116	99	50	41	166	140	69.97	71	8.25	8.48	5.77	5.98
2015-16	114	110	62	41	176	151	64.83	72	8.04	8.51	5.21	6.22
2016-17	110	102	57	53	167	155	65.82	65	8.08	7.96	5.32	5.23
2017-18	115	97	54	45	169	142	67.78	68	8.71	8.52	5.90	5.84
2018-19	101	109	54	38	155	147	65.08	74	8.92	8.82	5.80	6.54
2019	118	99	49	56	167	155	70	64	9.53	9.09	6.70	5.83
2020	131	102	51	46	182	148	72	69	9.79	8.94	7.02	6.17
2021	132	102	48	43	180	145	73	71	10.18	8.70	7.50	6.70
2022	127	107	53	52	180	159	71	67	10.06	8.28	7.09	5.64
2023	122	100	50	50	172	150	71	67	10.26	8.62	7.27	5.80

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha)

ICAR-CIRB Buffalo herd production performance since 1992-93 (Part II)

Year	Av. Total Lact. Milk Yield (kg)		Av. Lact. Length (days)		Av. 305d or less Milk. Yield (kg)	
Breed	M	NR	M	NR	M	NR
1991-92	1761 (154)	2017 (68)	374 (154)	373 (68)	1552 (154)	1813 (68)
1992-93	1804 (137)	1974 (105)	395 (137)	309 (105)	1508 (137)	1921 (105)
1993-94	1980 (148)	1776 (70)	419 (148)	328 (70)	1686 (148)	1744 (70)
1994-95	1930 (206)	2043 (77)	334 (206)	350 (77)	1787 (206)	1944 (77)
1995-96	1936 (147)	2049 (70)	313 (147)	354 (70)	1855 (147)	1894 (70)
1996-97	1879 (173)	2092 (81)	313 (173)	392 (81)	1775 (173)	1807 (81)
1997-98	1784 (123)	2126 (67)	304 (123)	354 (67)	1688 (123)	2056 (67)
1998-99	1762 (153)	2153 (97)	284 (153)	341 (97)	1702 (153)	2056 (97)
1999-00	2138 (141)	1968 (99)	313 (141)	337 (99)	2042 (141)	1874 (99)
2000-01	1997 (173)	1890 (89)	306 (173)	305 (89)	1914 (173)	1812 (89)
2001-02	1954 (152)	1926 (86)	290 (152)	296 (86)	1898 (152)	1885 (86)
2002-03	1987 (148)	2007 (105)	303 (148)	293 (105)	1902 (148)	1941 (105)
2003-04	1910 (148)	1968 (93)	299 (148)	307 (93)	1837 (148)	1895 (93)
2004-05	2017 (167)	1974 (116)	319 (167)	315 (116)	1886 (167)	1848 (116)
2005-06	2047 (149)	2190 (102)	321 (149)	306 (102)	1921 (149)	2090 (102)
2006-07	1995 (170)	1921 (118)	322 (170)	304 (118)	1882 (170)	1795 (118)
2007-08	1954 (169)	1787 (122)	299 (169)	302 (122)	1891 (169)	1629 (122)
2008-09	2076 (138)	2036 (108)	325 (138)	289 (108)	1926 (138)	1929 (108)
2009-10	2285 (102)	1927 (146)	361 (102)	302 (146)	1995 (102)	1822 (146)
2010-11	2471 (113)	2042 (115)	337 (113)	292 (115)	2247 (113)	1972 (115)
2011-12	2598 (116)	2045 (88)	338 (116)	279 (88)	2374 (116)	1998 (88)
2012-13	2478 (110)	2048 (123)	318 (110)	264 (123)	2335 (110)	2017 (123)
2013-14	2394 (98)	2297 (109)	333 (98)	285(109)	2291 (98)	2241 (109)
2014-15	2502 (110)	2464 (115)	313 (110)	303(115)	2355 (110)	2384 (115)
2015-16	2483 (152)	2564 (110)	322 (152)	305(110)	2336 (152)	2471 (110)
2016-17	2567 (133)	2452 (136)	312 (133)	298(136)	2457 (133)	2377 (136)
2017-18	2480 (140)	2363 (110)	295 (140)	282(110)	2424(140)	2321 (110)
2018-19	2641 (123)	2797 (111)	305 (123)	311 (111)	2567 (123)	2679 (111)
2019	2673 (88)	2670 (81)	300 (88)	301 (81)	2607 (88)	2589 (81)
2020	2821 (164)	2645 (141)	306 (164)	303 (141)	2704 (164)	2576 (141)
2021	2977 (153)	2585 (119)	304 (153)	294 (119)	2867 (153)	2525 (119)
2022	2920 (151)	2651 (115)	298 (151)	299 (115)	2846 (151)	2571 (115)
2023	3060 (140)	2784 (101)	306 (140)	320 (101)	2952 (140)	2670 (101)

M = Murrah (at Main Campus, Hisar) NR= Nili Ravi (at Sub Campus, Nabha); Figures in Parentheses are Number of observation

Agricultural Farms

The institute at main campus has a total area of 780 acres at Hisar, out of which about 50 per cent land is arable and under fodder cultivation for institute livestock. The sub-campus has 516 acres of highly fertile land, which meets the requirements of green fodder, dry fodder and cereal grains for Nili-Ravi animals herd at Nabha. The institute is self-sufficient in meeting its grain and green fodder requirements for its herds, while majority requirement of dry fodder is also met from its own agricultural farms production. Excess grains are sold to earn extra revenue. During the year 2023, the total green and dry fodder production were, 39922 and 858 quintals, respectively, while grain production was 793 quintals. At Sub-Campus Nabha, the total green and dry fodder production during the year was 57034 and 2852 quintals, respectively, while grain production was 4078 quintals. Institute takes guidance from specialized agriculture institutes of ICAR and SAUs for land reclamation, advanced farming techniques and for meeting its requirements of quality seeds of fodder and grain crops.

Feed Units: Feed units, one at each campus, are engaged in preparation of concentrate feed for feeding to farm animals by formulating feed for different categories of animals. Feed unit prepares about 650 tonnes of concentrate feed for feeding to farm animals. In addition, approx. 17 tonnes of area specific mineral mixture is being prepared annually for farm animals. Feed processing unit and attached grain / cake store cover an area of about 4500 square feet together with an open drying place of about 1500 sq. ft. This unit is equipped with automatic feed grinder cum mixer of capacity (10 Q/hr) with lifts for grinding and mixing of concentrate mixture. Similarly, another feed unit with automation is available at sub-campus. These feed units allow the institute to ensure quality of the concentrate fed to the animals as well as experimentation.

Guest house and students' hostel: Institute guest house has fourteen well furnished rooms for accommodating 28 guests at a time. It has separate reception with attached well-furnished neat and clean lounge and dining hall to cater to the requirements of visitors as well as get together for institute fraternity. Recently, student hostel added in the institute campus having eight well furnished rooms for accommodating 16 persons at a time.

Farm Machinery and workshop: This section is having nine tractors equipped with agricultural implements such as straw making reaper, zero tillage seed drill machine, chaff cutter, harrow, fodder harvester cum chopper and a laser laveller to improve the farm efficiency. A tractor driven rain gun system for irrigation was also installed. In addition, a TMR (Total mixed ration) machine has also been procured and being used. The workshop section of sub-Campus Nabha is also equipped with agricultural implements such as nine tractors, straw making reaper, laser laveller, zero tillage seed drill machine, chaff cutter, harrow, fodder harvester cum chopper and six tractor trolleys to improve the farm efficiency.

Electrical section: Electrical section of the institute is responsible for providing round the clock electric supply to the laboratories of institute with zero fault maintenance motto at lowest possible cost. It maintains 11 KV sub-station comprising of 500 KVA transformer, OCB, ACB, LT panels and two DG sets of 250 and 110 Kva capacities for power backup. Section attends day to

day electric maintenance related complaints of different labs, guest house and residential units. Repair, servicing and maintenance of more than 100 air conditioners, geysers, electric motors upto 25hp, street lights, different size underground LT cables and HT and LT overhead lines of the agriculture farm of the institute are part of the day to day activity. Operation and maintenance of audio-visual equipment of the seminar hall like; power amplifiers, audio mixer, dbx- complete sound management system and LCD projections are taken care of. The institute has shifted to use LED lights for conserving energy. Instituted shifted 100% on LED lights to save electricity.

Estate Section: Estate Section of this institute is responsible for maintenance, modification and repairs works in all the residential, office building, animal sheds and water channels in the agriculture farm. Estate section ensures water supply and sewage disposal to the whole campus. Day to day maintenance activities including cleaning of roads, building and pathways in the campus are also executed through this section.

Landscaping: This section looks after greens at the campus including gardens, roadside maintenance and colony parks. Tree plantation, pruning of trees, removal of fallen dry trees, removal of horticulture wastes, plantation / landscaping at campus, creation & maintenance of nurseries of saplings of trees, shrubs & seedbeds of ground covers & seasonal flowers are the responsibilities of this section. The institute campus bears a neat and green look through plantation of appropriate ornamental plants, trees and agro-forestry trees throughout campus for a clean and healthy environment.

Land: At main campus, 70 acres of saline soil was reclaimed by growing paddy followed by barley crops. In this area, crops were taken for the first time since the inception of the institute. Due to encouraging results, it is proposed to grow paddy in another 30 acres of saline soil during next year. About 75 acres of agricultural farm land was levelled with laser leveller. Last year bushes were uprooted from 170 acres of land that was lying unused. This year about 50 acres of this land has been laid out with roads, channel and blocks for use in crop production. The emphasis is on increasing productivity per acre of land with optimum resource use.

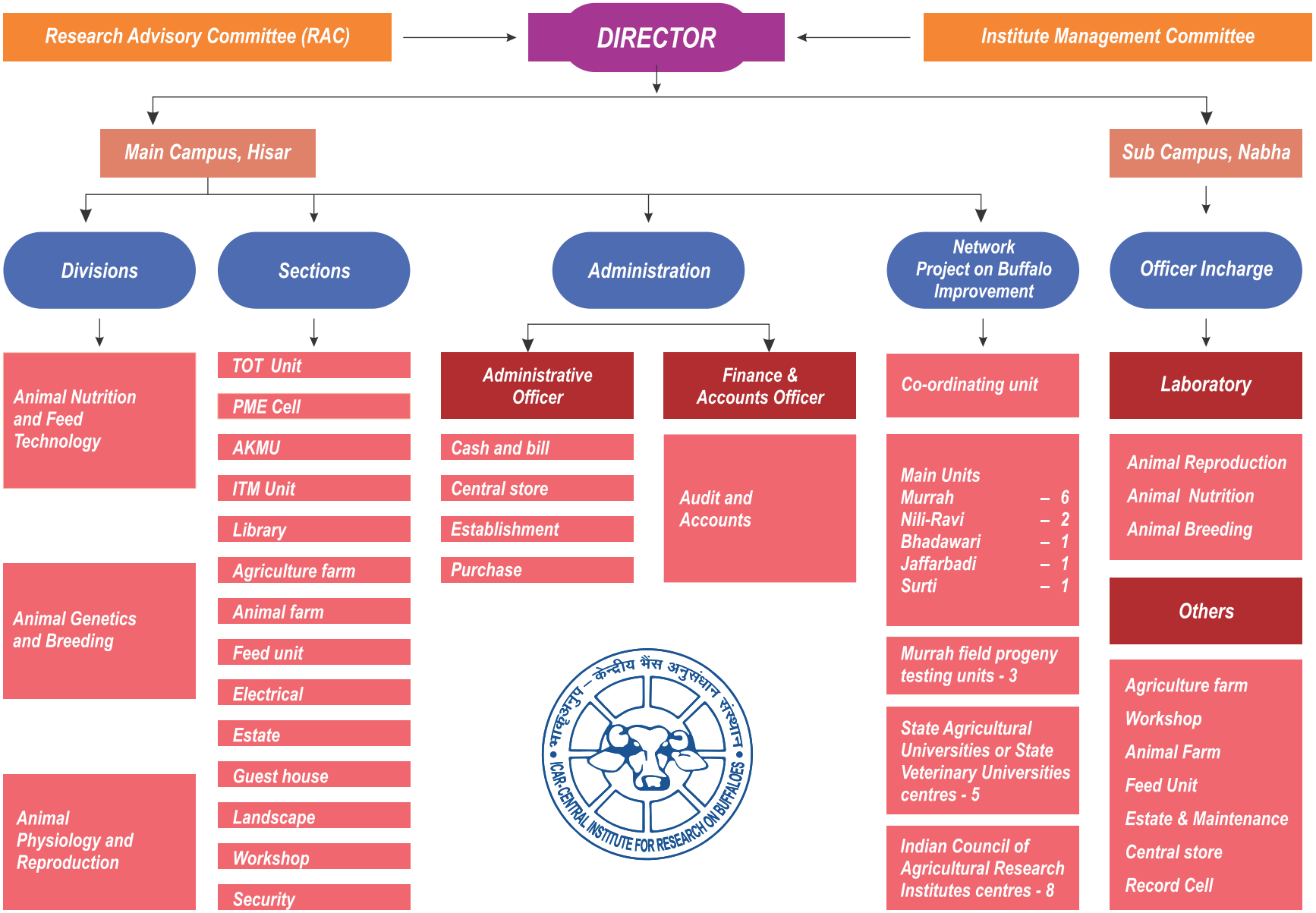
National and International Collaborations

Over the years, the institute has established collaborations with various national and international institutions. Projects were undertaken with various externally funded agencies at this institute sponsored by DBT, DST, USAID, NAIP, NASF, DADF, BMGF, Network / All India Coordinated projects and other external agencies. Collaboration is continuing with several ICAR institutes, including NDRI, IVRI, IASRI, NBAGR, NIANP, CSWRI, IARI and SAUs like CCS HAU, LUVAS, PAU, GADVASU, RAJUVAS, BASU and some KVKs for postgraduate research in the field of buffalo husbandry, nutrition, physiology and reproduction. For breed improvement activities, Network Project on Buffalo Improvement is being implemented in collaboration with several ICAR institutes and SAUs located in the home tracts of various buffalo breeds.

Priority setting, monitoring and evaluation (PME) of research activities of Institute

The institute receives advice on research and management through Quinquennial Review Team (QRT), Research Advisory Committee (RAC), Institute Research Committee (IRC) and Institute Management Committee (IMC) which consists of different stakeholders including prominent researchers, policy makers and progressive farmers. A number of sections like Priority Setting, Monitoring and Evaluation Cell, RFD Cell, Institute Technology Management Unit (ITMU) and Agriculture Knowledge Management Unit (AKMU) cater to different responsibilities for smooth functioning of research activities.

ICAR-Central Institute for Research on Buffaloes



RESEARCH ACHIEVEMENTS

GENETICS AND BREED IMPROVEMENT

Buffalo Genetic resources improvement programme is the major agenda undertaken for genetic improvement of Murrah and other buffalo breeds. Continuous efforts have been made to understand, characterize and take forward positives for breed improvement programme. The Division of Animal Genetics and Breeding (AGB) at the institute is the coordinating centre for Network Project on Buffalo Improvement, addressing important breeds and operating through different centres across India. Genetic improvement is targeted by implementing efficient breeding plans, envisaged with scientific breeding, using powerful computing systems maintaining large pedigrees of animals and vigilant technological interventions in the area of nutrition and reproduction. Genetic improvement is evaluated through associated herd and field progeny testing, performance recording and genetic analysis of data. An effective dissemination of high class buffalo germplasm with recording of performance data in fields through Field Progeny Testing Programme is generating data resource to develop 'genome-to-phenotype' models for predicting animal's genetic makeup. Keeping pace with international developments made in the subject as well as looking into national priorities, significant contribution have been made through a number of research projects undertaken in different areas of germplasm conservation, qualitative genetics, population genetics and molecular genetics.

Network Project on Buffalo Improvement

TK Datta, A Bharadwaj, RK Sharma, SK Phulia, Sanjay Kumar, Pradeep Kumar, Dharmendra Kumar, Jerome A

The Network Project on Buffalo Improvement was initiated in 1993 at 5 different Murrah centres and ICAR-Central Institute for Research on Buffalo, Hisar was coordinating centre. The project was started with the aim to produce genetically superior bulls for improvement of buffaloes. This has ensured sustained maintenance and production of improved germplasm on large scale for use in buffalo improvement program and for establishing linkages with institutions. Progeny testing in Murrah Breed is carried out at six participating institutional /SVU centres viz. CIRB Hisar, NDRI Karnal, IVRI Izatnagar, GADVASU Ludhiana, LUVAS Hisar and ICAR Research Complex for Eastern Region Patna. Three field units of Murrah were also initiated in 2001 at CIRB Hisar, NDRI Karnal and GADVASU Ludhiana with the aim to produce more number of daughters per bull for evaluating the breeding bulls with higher accuracy. A total of 1021 breedable buffaloes are being maintained at institutional Murrah centres for production of high genetic merit male and female calves to be used for production of future sires.

Five other breeds and progeny testing units were added in year 2001. Elite herds of Jaffarabadi, Surti, Bhadawari and Nili Ravi breeds of buffaloes are being maintained in their respective breeding tracts. Nili-Ravi and Bhadawari breed centres are functioning as conservation and improvement units and Jaffarabadi and Surti breed centre are concentrating on field progeny testing along with maintaining the elite herd for bull production and testing. A breedable herd of 661 (Nili-Ravi-318, Jaffarabadi-201, Surti-79 and Bhadawari-63) is being maintained at the above four breeds.

PARTICIPATING CENTRES UNDER NPBI

Coordinating Unit, CIRB, Hisar

Sr. No.	Name of Centre	Breed	Year of start
ICAR Institutes			
I	ICAR-CIRB, Hisar	Murrah	1993
II	ICAR-NDRI, Karnal	Murrah	1993
III	ICAR-IVRI, Izatnagar	Murrah	1993
IV	ICAR- IGFRI, Jhansi	Bhadawari	2001
V	ICAR-CIRB, Sub - Campus Nabha	Nili-Ravi	2001
VI	ICAR Research Complex, ER Patna	Murrah	2014
Animal Science/Agricultural Universities			
I	GADVASU, Ludhiana	Murrah	1993
II	LUVAS, Hisar	Murrah	1993
III	JAU, Junagarh	Jaffarabadi	2001
IV	RAJVASU, Vallabhnagar	Surti	2001
V	GADVASU, Ludhiana	Nili-Ravi	2018
Field Unit			
I	ICAR-CIRB, Hisar	Murrah	2001
II	ICAR-NDRI, Karnal	Murrah	2001
III	GADVASU, Ludhiana	Murrah	2001

Progeny test evaluation of 16th set (Murrah) used during January 2016 to July 2017

Bull no.	Centre	Date of Birth	Dam No.	Sire No./ Set No.	Dam's Best 305 DLMY (kg) / Lact No.	No of daughters	Average Daughter FLMY	Daughter Max FLMY	Breeding Value	Rank	% superiority (BLUP Model)
M-29	CIRB	16-10-05	4 P	P274	4600	60	2570.51	3191	2578.94	I	3.82
1053	LUVAS	17-12-13	683	M-29	3559	46	2561.37	3421	2567.15	II	3.35
2383	GADVASU	13-10-10	2489 P	3267PT/XI	4636	78	2553.09	3101	2546.77	III	2.53
4889	CIRB	23-10-04	S-802	FT 245	4120	73	2535.38	3445	2532.68	IV	1.96
4592	CIRB	28-06-13	4353 P	Khali	3528	61	2511.76	3430	2518.33	V	1.38
1064	LUVAS	19-02-14	613	BI 330	3579	8	2499.18	3057	2482.85	VI	-0.05
6753	NDRI	13-07-13	470 P	858/XIII	3389	16	2442.56	2931	2471.15	VII	-0.52
6379	NDRI	17-10-11	402 P	4915PT/ VII	3505	39	2468.03	3550	2469.65	VIII	-0.58
2467	GADVASU	01-04-12	2279 P	R-10/XII	3574	77	2444.15	3231	2456.79	IX	-1.10
4623	CIRB	01-09-13	4261 P	1875PT/ VIII	3506	8	2362.54	3272	2451.66	X	-1.30
6646	NDRI	17-02-13	6627 P	NK	3533	40	2441.11	3013	2451.06	XI	-1.33
1027	LUVAS	28-09-13	603	PC 461	3763	47	2433.51	2895	2448.85	XII	-1.41
2501	GADVASU	10-10-12	1794 P	1875PT/ VIII	3053	88	2440.47	2994	2440.90	XIII	-1.73
4705	CIRB	22-07-12	83 P	B 902	3990	78	2453.05	3152	2439.16	XIV	-1.80
6409	NDRI	09-01-12	490 P	4371PT/V	4090	43	2389.38	3265	2403.92	XV	-3.22

NK: Not Known

Average Breeding Value: 2483.99 kg (N=762)

Bull no. M-29 (CIRB), 1053 (LUVAS) and 2383 (GADVASU) ranked 1st, 2nd and 3rd, respectively declared as proven bulls for nominated mating during January 2022 to June 2023.

Breeding bulls of 20th set for test mating

Test mating of 14 Murrah bulls of 20th set initiated in January 2022 and completed on 30th June 2023 at associated centres of Murrah main unit and field progeny testing unit for genetic improvement under NPBI.

Bull no.	Centre	D.O.B.	Dam No.	Sire No./ Set No.	Dam's Best Yield / PY (kg)	Parity
19	LUVAS	29/10/18	777	2594/Set 17	3695/21.6	3
1454	LUVAS	19/06/18	976	183PT/Set 12	3355/17.4	4
2793	GADVASU	06/07/18	2788	2467/Set 16	3339/21.5	2
2831	GADVASU	11/10/18	2897	Virat/Field	4814/28.7	4
2838	GADVASU	02/11/18	2502	1354PT/Set 3	3340/22.7	3
2850	GADVASU	25/01/19	2973	2594/Set 17	3683/20.6	2
3004	GADVASU	13/10/16	Laado	Rustam/Field	4716/26.2	
5427	CIRB	10/11/18	3633	R-24/Field	3371/15.3	4
5481	CIRB	29/03/19	4621	4733/Set 17	3332/16.6	3
5500	CIRB	15/07/19	4934	1148/Set 17	3271/16.5	3
5505	CIRB	22/07/19	4251	1148/Set 17	4138/22.0	3
5511	NDRI	27/07/19	4800	6942/Set 17	3356/17.4	2
7584	NDRI	30/03/18	6147	6253/Non-Set	3600/16.5	2
7649	NDRI	15/10/18	6735	2558/Set 17	3203/13.5	1

Breeding bulls of 21st set for test mating

Test mating of 15 Murrah bulls of 21st set initiated in July 2023 and will be completed on 31st December 2024 at associated centres of Murrah main unit and field progeny testing unit for genetic improvement under NPBI.

Bull no.	Centre	D.O.B.	Dam No.	Sire No./ Set No.	Dam's Best Yield / PY (kg)	Parity
109	LUVAS	17/09/19	1068	M-53Set 17	3660/16.3	4
112	LUVAS	29/09/19	943	6942/Set 17	4390/17.2	6
297	IVRI	08/08/17	869	4705/Set 16	3407/17.5	5
2979	GADVASU	26/11/20	3083	2689/Set 18	3440/21.6	2
2990	GADVASU	24/12/20	2741 P	1219/Set 18	3723/21.2	4
3014	GADVASU	06/10/20	Dhano	Birla/Field	PY: 24.56	1
5414	CIRB	03/10/18	4593	4998/Non-set	3321/21.0	6
5629	CIRB	29/01/20	4613	2645/Set 18	4180/20.2	5
5638	CIRB	24/02/20	5223	2234 PT/Set 13	3691/19.5	2
5690	CIRB	02/08/20	5021	4905/Set 18	4029/21.0	3
5723	CIRB	07/10/20	5179	7227/Set 18	5170/26.8	2
5764	CIRB	22/11/20	4989	4905/Set 18	3644/17.5	4
7630	NDRI	05/09/18	6852	M-51/Set 17	3343/15.5	4
7768	NDRI	04/02/19	6922	2607/Set 17	3323/16.5	4
7990	NDRI	19/08/20	6626	183 PT/Set 12	3991/18.0	5

20th Annual Review Meet of Network Project on Buffalo Improvement (NPBI), held at ICAR-CIRB, Hisar on 8th December, 2023. In this meeting, progress of project for the year 2022-23 was reviewed. The meeting was chaired by Dr. J K Jena, DDG (AS), ICAR, New Delhi. Dr. G K Gaur, ADG (AP & B) and Dr. H K Narula, Principal Scientist (AP & B), ICAR-New Delhi, ICAR-New Delhi attended the meeting online. Dr. T K Datta, Director, ICAR-CIRB, Hisar & Project Coordinator, NPBI, Dr. B Ekambaram, Director of Research, PVNRTVU, Hyderabad, Dr. Yashpal Sharma, Head (APR), ICAR-CIRB, Dr. Umesh Singh, Head (AGB), ICAR-CIRB, Dr. A Dey, Head (ANFT), ICAR-CIRB and PIs of all participating centers were also present.

At the outset, Dr. T K Datta, Director ICAR-CIRB, Hisar & Project Coordinator, welcomed the chair, ADG (AP & B), participants present in the meeting and also the participants joined through online mode and made the introductory remarks regarding the objective and technical programme of Network Project.

The chairman Dr. J K Jena, DDG (AS), in his opening remarks, welcomed all the participants and underlined that NPBI has done a great job in achieving its objective. He emphasized that the growth trend in buffaloes under this project should be compared with animals of other countries. He admitted that our main focus is on Murrah breed, but we should also emphasize on the development of other breeds of buffaloes.

Genetic Improvement of Murrah Buffalo

A Bharadwaj, Pradeep Kumar, RK Sharma, SK Phulia, Sanjay Kumar, AKS Tomar, Madhu Singh, Rupali Rautela, Rajesh Kumar

A total of 156 (76 male and 80 female) calves of high genetic merit were born at CIRB during the year 2023. The test mating (400 inseminations) of 20th and 21st set was carried out during the year resulting in 178 pregnancies. Nominated mating (88 inseminations) using 6 progeny tested bulls of 11th, 14th, 15th, and 16th sets were also carried out resulting in 29 pregnancies. The wet average (10.26 kg), herd average (7.27 Kg), 305 days lactation milk yield (2952 kg), total lactation milk yield (3060 kg), peak yield (15.45 kg), were achieved in CIRB Murrah herd during the year. A total of 71% animals were found in milk and average dry period of 132 days was recorded in institute Murrah herd. Average lactation length was 306 days was recorded during the year. The reproductive traits viz., service period, calving interval and AFC were 127 days, 436 days and 37.79 months, respectively during the year. A total of 31 breeding bulls were sold to various agencies including various semen freezing stations in the year 2023. Due to better health management calf mortality (0-3 months) was restricted to 4.29% only in CIRB Murrah herd. Six future breeding bulls from CIRB were selected out of total 15 bulls from 5 Murrah centres under 21st set of progeny testing programme, the use of which was initiated from July 2023.

Field Progeny Testing of Bulls (FPT) – CIRB Hisar

A Bharadwaj, Sanjay Kumar

Under field progeny testing program (FPT) semen of test bulls is used for artificial insemination in the field, followed by pregnancy diagnosis, calving records and follow up of progenies till the completion of first lactation for milk records on the basis of monthly test day recording. During the period from January 2023 to December 2023, 3832 artificial inseminations were performed using test bulls of 20th and 21st set of test bulls. The conception rate in the field was worked out to be 52.34%. In this period 2006 pregnancies were confirmed and 1580 calving (males 779, females 801) were recorded. Besides, 171 daughters (63 of 17th and 108 of 18th set) with an average age at first calving of 41.02 months were also calved, out of which 156 completed the lactation and rest were sold before completion of lactation. The milk production records of 193 daughters in the field sired by 16th set of bulls were used for sire evaluation. The physical identification using ear tagging has been done in all female progenies born in the field. As on 31st December 2023, 1266 female progenies of 17th to 20th set of different age are standing at various field unit centres for future recordings.

Genetic Improvement of Nili-Ravi buffaloes

FC Tuteja, MH Jan, Rajiv Mehta, N Paul, AS Habbu, SK Kakraliya

The objective of this project is genetic improvement of Nili-Ravi Buffaloes through Progeny testing programme. The test mating of 10th set of bulls and, the preliminary selection and breeding soundness examination of 11th set of bulls is underway. The progeny testing of 6th set of bulls is also completed and the top two bulls have been selected for nominated mating. A total of 107 (59 male and 48 female) calves of high genetic merit were born this year. The test and nominated matings (504 inseminations) were carried out resulting in 205 pregnancies. The overall conception rate during this period was 40.67%. The overall mortality of 2.04% and calf mortality of

4.61% were recorded during year 2023. During this period, 39 daughters completed 1st lactation. The overall wet average (8.62 kg), herd average (5.80 kg), 305 days lactation milk yield (2670 kg, n=101), total lactation yield (2784 kg, n=101), peak yield (13.3 kg), percentage of animals in milk (67%) and lactation length (320 days, n=101) were achieved in Nili-Ravi herd. Improvement in reproductive traits viz., service period (123 days, n=64), AFC (44.48 months, n=34) calving interval (439 days, n=64) and dry period (130 days, n=64) were achieved during year 2023. The total milk produced during this year was 3,10,921.9 kg. A total of 8359 doses were produced at Sub-Campus Nabha, out of which 1149 doses were used for insemination, 5284 doses were sold for insemination of buffaloes in field, and 254 doses were transferred to GADVASU Ludhiana for insemination and pedigree testing. Total of 130 animals were sold through public auction and 8 bulls on book value to famers, universities and various developmental agencies.

Role of bacterial pathogens in subclinical mastitis in buffaloes

Sandip Kumar Khurana, Sanjay Kumar

The objective of this project was to find out the prevalence of subclinical mastitis with bacterial etiology in buffaloes and to find the remedial measures to reduce the subclinical mastitis. 2564 milk samples from 645 milch buffaloes were tested (CMT) as per details and 93 (14.4 %) were found positive for subclinical mastitis by CMT.

S. No.	Place of sampling	Total no. of animals tested*	Total no. of CMT positive animals	LF positive cases	LH positive cases	RF positive cases	RH positive cases
1.	ICAR-CIRB, Hisar	121	11	1	6	3	3
2.	ICAR-CIRB, Hisar-IInd Sampling	127	37	18	19	12	12
2.	Vill. Chindar, Fatehbad	129	8	5	2	1	2
3.	Vill. Dhandoor, Hisar	29	6	1	2	3	2
4.	Vill Kaimri, Hisar	48	6	1	2	3	2
5	Vill Daya, Hisar	23	3	-	1	1	2
6.	Vill. Neoli Kalan, Hisar	46	8	2	7	6	4
7.	Vill. Daya, Hisar	31	7	2	6	5	3
8.	Vill. Sarangpur, Fatehbad	53	3	1	-	1	2
9.	Vill. Arya Nagar	38	4	1	-	2	2
Total		645	93	32	45	37	34

Milk samples from CMT positive quarters subjected to bacteriological analysis resulted in isolation of Staphylococcus aureus (16), Staphylococcus spp. (8), Streptococcus spp. (21), Enterococcus faecalis (6), Klebsiella sp. (1), E. coli (6), Kocuria rosea (5), Kocuria kristinae (4), Kocuria varians (3), Rothia mucilaginosa (1), Enterobacter cloaceae (3) and Sphingomonas paucimobilis (1). Some of these bacteria are unusual and of zoonotic potential. All the isolates were tested against 28 antimicrobial agents. A large proportion of isolates were MDR having average MAR values from 0.31 to 0.37. Amikacin, Ciprofloxacin, Gentamicin and ofloxacin should be preferred antibiotics against S. aureus; amikacin, gentamicin, and azithromycin against Streptococcus spp. and amikacin, ampicillin, azithromycin, gentamicin and kanamycin against Kocuria spp. being most effective. Average SCC/ ml in CMT positive quarters was 3,95,702 and in CMT negative quarters was 73,949. Average SCC/ ml in CMT positive animals was 2,40,667 and in CMT negative quarters was 70,121. Information regarding causes of sub clinical mastitis and ameliorative measures will help in reducing the sub clinical mastitis and improving the economics of buffalo production.

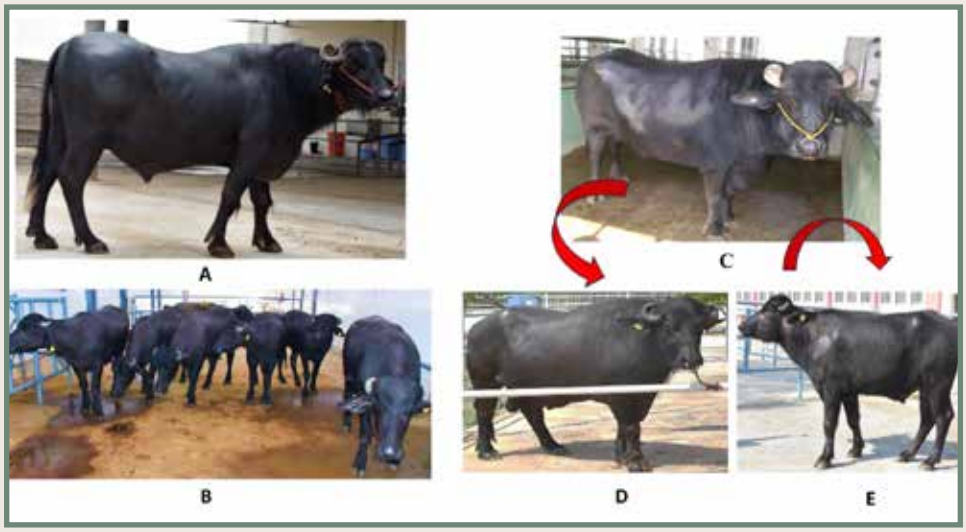
IMPROVEMENT OF REPRODUCTIVE EFFICIENCY AND ASSISTED REPRODUCTIVE TECHNOLOGIES

The ability of animals to reproduce efficiently is an integral component of animal production system. Animal Physiology and reproduction division is primarily involved in conducting research studies on multiplication of elite bulls using cloning technique, in vitro fertilization, developing technology for early pregnancy diagnosis and estrus detection, genome editing, semen cryopreservation technology for improved sperm freezability and higher conception rate. The division has also established and cryopreserved primary somatic cell lines from adult elite buffaloes which would be a viable biomaterial for long term maintenance of elite germplasm, which have wide range of applications including cloning even after death of animal, induced pluripotent stem cells production and unlimited DNA/RNA/protein source for any research purpose. Significant achievements have been made in cloning technology by producing multiple clones of an elite bull and re-cloning the already cloned bull. Cloned bulls have been found have good fertility and reproduce normally similar to non-cloned bulls. Urine based pregnancy diagnostic kit is being tested at farm and field with encouraging results. The division also organizes extension and outreach programs. These programs transfer research-based knowledge that fill the gap between fundamental research and its application to the farmer for managing their animal's reproductive health across the country. Scientists are making efforts to improve the buffalo farming techniques through both basic/discovery and translational/ development research.

Evaluation of Semen Characteristics and Fertility Parameters of Cloned Bulls and Performance of Clones Progenies-Phase-II

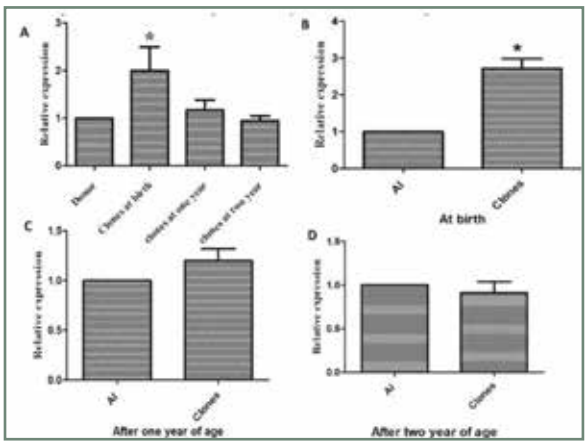
Prem Singh Yadav, Dharmendra Kumar, R K Sharma, Pradeep Kumar, Meeti Punetha, Rajesh Kumar

Animal cloning is a biological procedure that results in the creation of genetically identical animals. The most popular animal cloning process is somatic cell nuclear transfer (SCNT), in which clones and cell donor animals share the same genetic information. In recent past, we have produced seven clone copies of a superior buffalo bull and a re-clone of a previous clone of an elite bull.



(A) Donor bull M29, (B) Seven clones (E-263-269) of M29 at one year of age, (C) Donor bull M4354, (D) Clone (M4998) of M4354 produced earlier in 2015, and (E) re-clone (E-270) of cloned M4998 at one year of age

The production of multiple clones and a re-clone could be helpful for research into genome reprogramming and the mass production of high-quality domesticated animals. In the reporting period, we have comprehensively evaluate the postnatal growth, hematology, telomere length, and semen attributes of multiple clones and re-clone derived from superior buffalo breeding bulls. We have evaluated various parameters of cloned bulls such as their growth, blood hematology, plasma biochemistry, and telomere length and found comparable with non-cloned age matched bulls at various stages of development. Postnatal growth is a crucial indicator of the overall health and development of cloned animals. There was no significant difference in body weight between the cloned calves and the aged matched control calves at Day 0, 30, 60, 360 and 720 of age, and the body weight was within the breed standard range. Additionally, we evaluated haematological and biochemical parameters, including ALT, AST, ALP, creatinine, and others, which are crucial markers of an animal's immune system, general health, and physiological stress. These parameters include red blood cell count, white blood cell count, haemoglobin levels, and differential leukocyte counts. The haematological and biochemical parameters

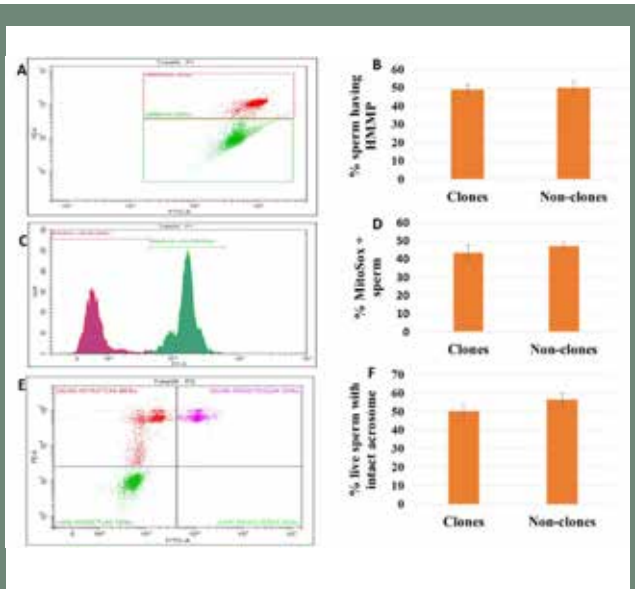


Telomere length estimation of clones with donor and AI born age matched control at different stage of growth. (A) Telomere length of cloned animal at birth (n = 8), after one (n = 8) and two year of age (n = 7) compared with their donor bull (M29 and M4998), (B) Telomere length of the cloned buffalo with their age matched AI born buffalo (n = 7) at birth; (C) after one year and (D) after 2 year of age

of cloned buffalo were comparable to those of age-matched non-cloned buffalo and were within the normal range for the breed. Telomere length is an intriguing parameter to investigate in cloned animals. Comparing telomere lengths of clones with their respective donor and AI born aged matched control buffalo bulls can shed light on whether cloning has any impact on cellular aging processes. In the current study, cloned buffalo calves' telomere length at birth was significantly ($P < 0.05$) longer than that of their donor bulls.

These bulls were used for semen production after being screened for testicular growth and training. Semen characteristics such as volume, concentration, and initial motility of fresh sperm as well as motility and kinetics characteristics such as straightness (STR), average lateral head displacement (ALH), and beat cross frequency (BCF) of frozen-thawed sperms of the cloned bulls were found to be similar to those of non-cloned bulls, including the donor bulls. Additionally, it was found that cloned bulls' functional sperm attributes, including acrosome intactness, mitochondrial membrane potential, and superoxide anion status, were comparable to those of non-cloned bulls (Fig. 3).

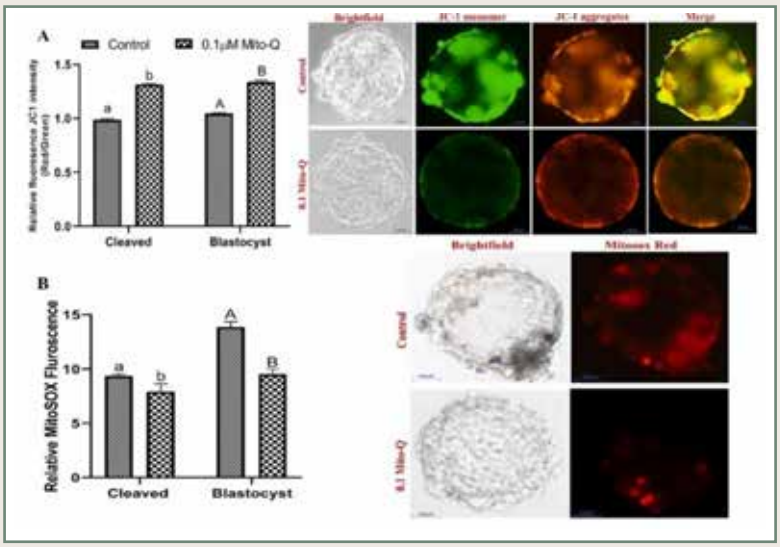
Further, studies has been extended to improve the cloning efficiency, we have used a mitochondrial based antioxidant Mito-Q in the culture media.



Evaluation of functional attributes including mitochondrial membrane potential, Mitosox and acrosomal integrity of frozen-thawed semen of cloned bulls and non-cloned breeding bulls using flow cytometry.

Mito-Q supplementation of IVM or IVC medium improves maturation of buffalo oocytes and developmental competence of cloned embryos by reducing ROS production

Mito-Q is a well-known mitochondria-specific superoxide scavenger. To our knowledge, the effect of Mito-Q on buffalo oocyte maturation and developmental competency of cloned embryos has not been examined. To investigate the effects of Mito-Q on the IVM of buffalo oocytes and the developmental competence of cloned embryos, different concentration of Mito-Q were supplemented with IVM (0, 0.1, 0.5, 1, 2 µM) and IVC medium (0, 0.1 µM). Supplementation of IVM medium with 0.1 µM Mito-Q significantly (P ≤ 0.05) increased the cumulus expansion, nuclear maturation, mitochondrial membrane potential (MMP) and antioxidants genes (GPX1 and SOD2) expression and effectively reduced ROS production leading to a significant improvement in the maturation rate of buffalo oocytes. Further, the supplementation of 0.1 µM Mito-Q in IVC medium promotes the cleavage and blastocyst rate significantly over the control. Mito-Q supplementation improves (P ≤ 0.05) MMP, antioxidant gene (GPX1) expression and reduced the ROS level and apoptosis related genes (caspase 9) expression in cloned blastocysts (Fig. 4). In conclusion, the present study demonstrated that the supplementation of 0.1 µM Mito-Q in IVM and IVC media exerts a protective role against oxidative stress by reducing ROS production and improving MMP, fostering improved maturation of buffalo oocytes and enhanced developmental competence of cloned embryos. These findings contribute valuable insights into the optimization of assisted reproductive technologies protocols for buffalo breeding and potentially offer novel strategies to enhance reproductive outcomes in livestock species.

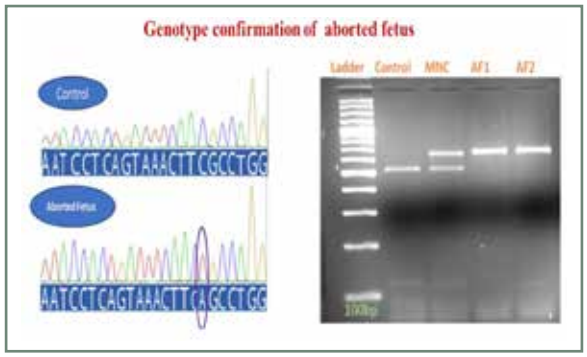


Effect of Mito-Q supplementation during IVC of cloned zygotes on mitochondrial membrane potential and ROS production. A) Evaluation of MMP levels in cloned zygotes through measurement of relative fluorescence intensity of JC1 in cloned embryo which showed that 0.1 µM Mito-Q supplementation improved MMP at both cleavage and blastocyst stage compare to control, B) Evaluation of mitochondrial ROS through quantitative analysis of MitoSOX red fluorescence intensity and 0.1 µM Mito-Q supplementation significantly reduced ROS level in cleaved and blastocyst of cloned embryos.

Production of Double Muscled-Mass Farm Animal using CRISPR

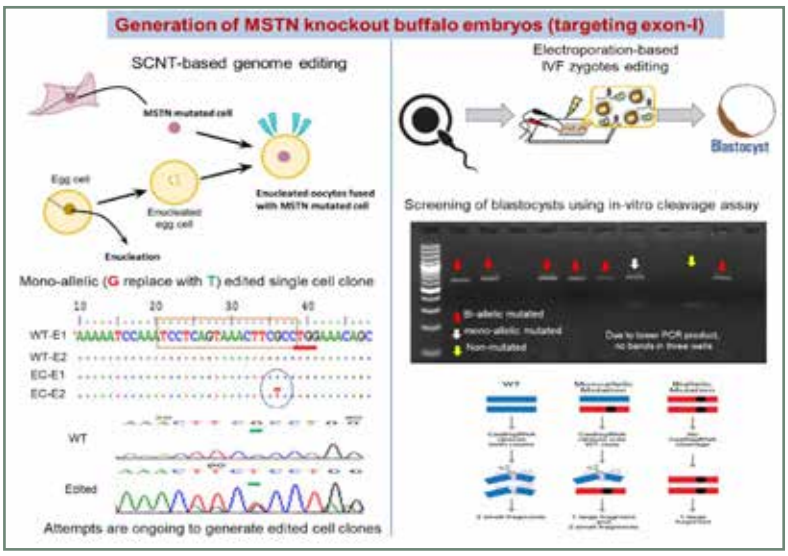
Dharmendra Kumar, P S Yadav, R. K. Sharma, Meeti Punetha, Rajesh Kumar

We used two approaches for the production of MSTN-edited buffalo. In the first approach, MSTN targeted guides were transfected to buffalo fibroblast cells via nucleofection and lipofection. The nucleofection resulted in significantly (P<0.05) higher transfection efficiency, cell survivability when analyzed using flow cytometry analysis. The cleavage efficiency was also found to be significantly (P<0.05) higher in nucleofection as compared to lipofection when analyzed using Tide software. Single cells were further isolated, cultured and expanded from these nucleofected fibroblasts and were Sanger sequenced (Fig. 5). One MSTN monoallelic mutated colony was confirmed



Confirmation of aborted fetus for MSTN editing via Sanger sequencing and genotype confirmation

via sequencing which was used for production of MSTN mutated embryos via HMC. A total of 96 reconstruct were made and out of that 78 (81%) cleaved and a total of 18 (23%) blastocysts were formed. Eight presumed MSTN edited blastocyst were transferred in 3 synchronized females but no pregnancy was established. In the second approach, buffalo zygotes were electroporated using 15hpi, 15V, 3P, 3 ms parameters standardized under project. The PCR product of individual electroporated blastocyst spanning the targeted sites was further confirmed by Sanger sequencing. The optimized electroporation conditions resulted in significantly (P<0.05) higher biallelic editing (54.16 ± 2.94) when compared to monoallelic (19.64 ± 3.79); mosaic (14.86±4.63), and wild (11.29 ±2.11) types. The presumed MSTN edited buffalo embryos were transferred to the recipients and resulted into 3 pregnancies which aborted around 4-5 months of gestation. The genomic DNA from the aborted fetus were extracted, amplified and sent for sequencing. Sequence of aborted fetus confirmed MSTN editing Fig. 6.

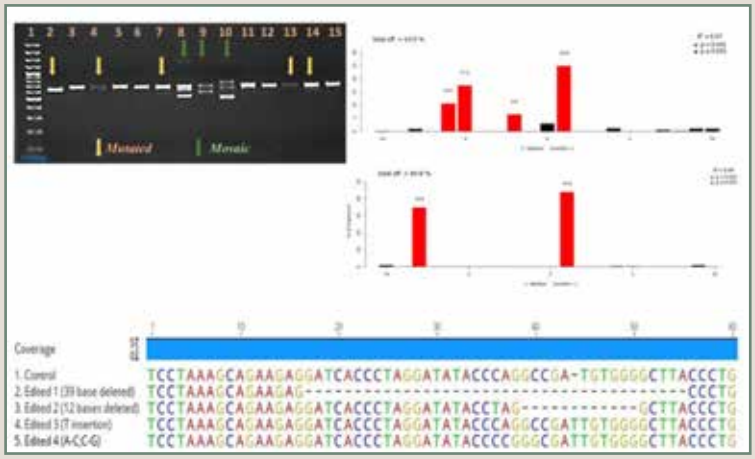


Overall method for the production of MSTN-edited buffalo

Deciphering the functional role of OCT4 during buffalo embryogenesis using CRISPR/Cas9

Meeti Punetha, P. S. Yadav, Dharmendra Kumar, Gururaj M.

Somatic cell nuclear transfer or cytoplasm microinjection has widely been used to produce genome-edited farm animals; however, these methods have several drawbacks which reduce their efficiency. In the present study, we describe an easy adaptable approach for the introduction of mutations using CRISPR-Cas9 electroporation of zygote (CRISPR-EP) in buffalo. The goal of the study was to determine the optimal conditions for an experimental method in which the CRISPR/Cas9 system is introduced into in vitro-produced buffalo zygotes by electroporation. Electroporation was performed using different combinations of voltage, pulse and time, and we observed that the electroporation in buffalo zygote at 20 V/mm, 5 pulses, 3 msec at 10 h post insemination (hpi) resulted in increased membrane permeability and higher knockout efficiency without altering embryonic developmental potential. Using the above parameters, we targeted buffalo POU5F1 gene as a proof of concept and found no variations in embryonic developmental competence at cleavage or blastocyst formation rate between control, POU5F1-KO, and electroporated control (EC) embryos. To elucidate the effect of POU5F1-KO on other pluripotent genes, we determined the relative expression of SOX2, NANOG, and GATA2 in the control (POU5F1 intact) and POU5F1-KO-confirmed blastocyst. POU5F1-KO significantly (P≤ 0.05) altered the expression of SOX2, NANOG, and GATA2 in blastocyst stage embryos. In conclusion, we standardized an easy and straightforward protocol CRISPR-EP method that could be served as a useful method for studying the functional genomics of buffalo embryos.

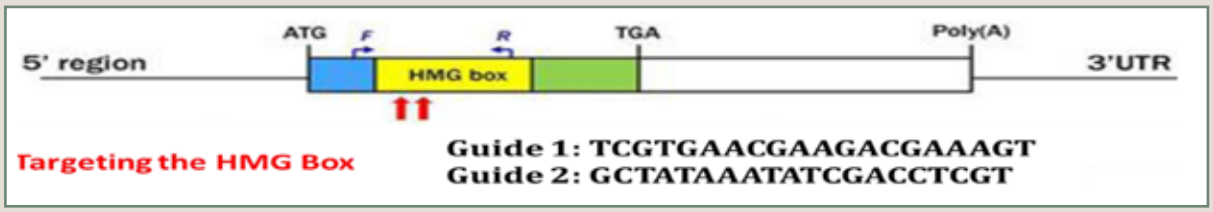


PCR products of individual electroporated blastocyst spanning the targeted sites were run in 4% agarose gel to check the mutation and were further confirmed by Sanger sequencing.

Generation of predetermined sex buffalo embryos using CRISPR mediated gene editing technology

Meeti Punetha

Sex determination is the process through which a bipotential gonad develops into a testis or ovary depending on the genetic background of the individual. The early developmental events that determine male-specific gonad formation are initiated by the expression of SRY. Nuclear translocation of the SRY protein and, subsequently, of SOX9 (a SRY downstream effector) diverts the fate of somatic cells in primordial gonads from the ovarian pathway towards testicular differentiation. To investigate the molecular regulation of the sex determination process in buffalo, we used loss of function approach using CRISPR-Cas9 strategy. In the present study, SRY-knockout (SRY-KO) embryos were generated by electroporating RNP targeting HMG domain of SRY at single stage using optimized protocol. The presumed KO male embryos were confirmed by using sanger sequencing. The control male, female and SRY-KO embryos were subjected to analyse the downstream pathway of sex determination by using real time analysis. In-silico analysis revealed that mutations in SRY gene altered the functional properties of SRY gene and its interaction network with other genes (Sox9, Foxl2, β-catenin, Amh, FGF9, PGD2, WNT4 and DMRT1). To determine the impact on protein structure and function of these mutations in SRY protein, HOPE server was used and the analysis showed that selected mutations were located in functionally important regions and were shown to change protein–protein interacting interfaces. Thus, the prediction of these protein-protein interactions demonstrated how SRY interacts with other related genes and its importance in various pathways. Thus, the present study will help in delineating the molecular pathway for sexual determination in buffaloes.



PCR products of individual electroporated blastocyst spanning the targeted sites were run in 4% agarose gel to check the mutation and were further confirmed by Sanger sequencing.

Consortium Research Platform on Agro-Biodiversity

Meeti Punetha, Dharmendra Kumar, P. S. Yadav

Skin-tissue from Murrah, Nili-Ravi, Surati and Bhadawari breeds of buffalo were collected from the underneath part of the tail, just above the anal region. Fibroblast-like cells at different passage are cryopreserved using a slow-freezing method. In brief, confluent cells of 25 cm2 culture flasks were trypsinized using 0.25% trypsin/EDTA (1 ml in each flask) for 5 min, and then dissociated cells were suspended in 5 ml of D10 medium. The suspended cells were collected in 15 ml tubes and were counted using a Neubauer chamber to determine the total cell number. The tubes were centrifuged at 1000 g for 5 min and cell pellets were resuspended in the cryopreservation medium (D20 containing 10% dimethyl sulfoxide) and transferred into 1 ml cryogenic vials with a final concentration of 0.1 million cells per ml. The informative data of each buffalo such as unique ID, breed, sex, date of freezing, and passage number were written on each vial Cryogenic vials were then subjected to slow-freezing, overnight at a rate of 1.0°C/min to −80°C in a freezing container in a −80°C freezer, and after 24 h, the vials were plunged into liquid nitrogen for storage.

Representative images of the buffalo from which tissue has been collected and brief process of somatic cell cryopreservation

DNA banking

Dharmendra Kumar, Sanjay Kumar, Meeti Punetha, Rajesh Kumar, M H Jan

A total of 642 Murrah buffaloes DNA has been isolated and stored at -80°C in duplicate. Out of that 184 blood samples were collected from Nili-Ravi, 11 from clones and 6 from Surti breed and DNA were extracted. Final DNA was eluted in 200µl volume of nuclease free water having average concentration of 45.71ng/µl. These 200µl was divided into two storage vials having volume of 100 µl and stored separately in two storage boxes in -80°C with proper label. Details of the isolated samples given below:

S.No.	Breed Name	Total number of animals from DNA isolated	Average Concentration (ng/µl)	Average Purity (260/280)
1.	Murrah	437	42.71	1.81
2.	Niliravi	184	37.30	1.83
3.	Clones	11	53.64	1.74
4.	Surati	6	49.2	1.82
Total		642	45.71	1.8

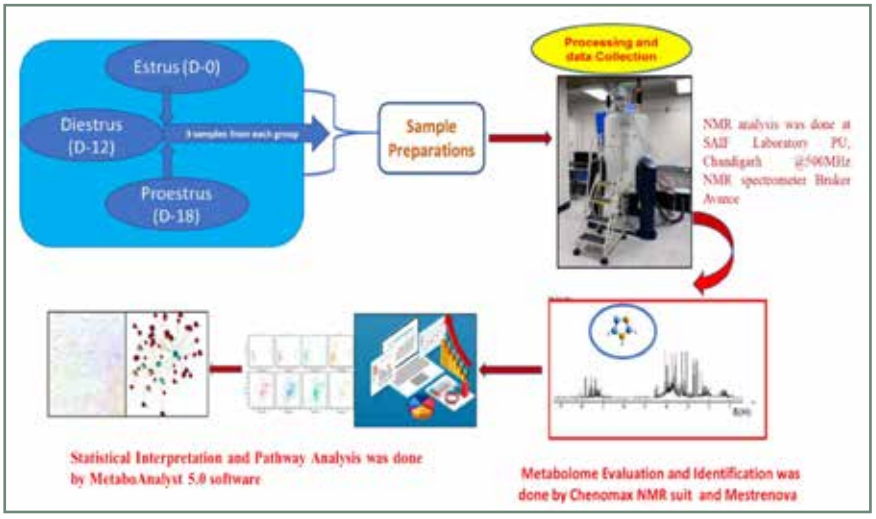
Metabolic Profiling of Estrous Cycle in Murrah Buffaloes: Insights from 1H NMR Analysis

Suman, MH Jan, Sunesh Balhara, Sarita Yadav, A Boora, SK Phulia, RK Sharma, Sajjan Singh, AK Balhara

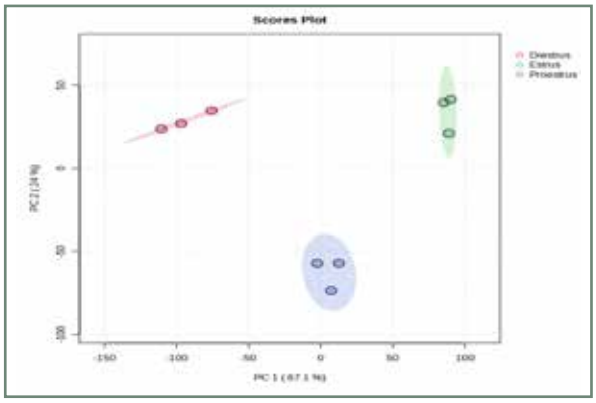
A comprehensive analysis utilizing 1H NMR spectroscopy revealed the presence of 72 distinct metabolites within the urine samples collected from cyclic Murrah buffaloes, employing the latest version of the Chenomx NMR Suite 9.0 software. Principal Component Analysis (PCA) was employed to categorize the data into three distinct groups: estrus, diestrus, and proestrus, allowing for the identification of variations in metabolite profiles across the estrous cycle.

To highlight the most significant metabolites, a five-component model was utilized to determine Variable Importance in Projection (VIP) scores. The top 30 metabolites, ranked based on their VIP scores, are depicted in Figure [insert figure number here]. The VIP score is a weighted sum of the squares of Partial Least Squares-Discriminant Analysis (PLS-DA) loadings, which takes into account the explained variance of each component in relation to the dependent variable (Y-variance).

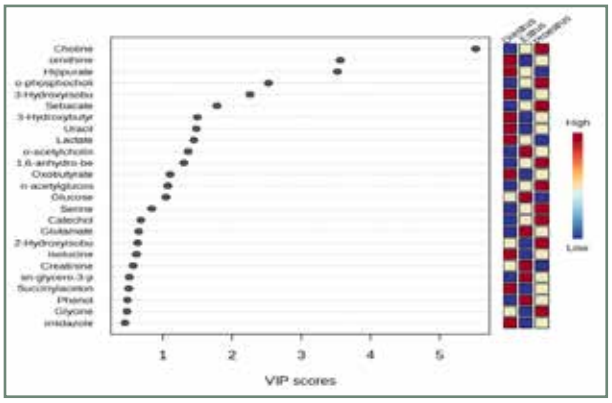
The VIP plot generated from the PLS-DA model facilitated the ranking of metabolites according to their discriminatory power across different estrous cycle phases. Metabolites with VIP values exceeding 1 are considered significant, while those surpassing 2 are deemed highly significant. Notably, the crucial metabolites identified in the urine samples include Choline, Ornithine, Hippurate, O-Phosphocholine, 3-Hydroxyisobutyrate, Sebacate, Glycolate, 3-Hydroxybutyrate, Lactate, O-Acetylcholine, 1,6-Anhydro-ß-D-Glucose, Oxobutyrate, Glycine, Glucose, Imidazole, Glutamate, Catechol, Isoleucine, Creatinine, 2-Hydroxyisobutyrate, Succinyl Acetate, Sn-Glycero-3-Phosphocholine, and Phenol. These metabolites play a pivotal role in delineating metabolic variations throughout the estrous cycle of Murrah buffaloes.



Schematic step involved in untargeted ^{1}H NMR analysis of urinary metabolites in Estrous Cycle of Murrah Buffalo



Principal Component Analysis (PCA) of identified metabolites in estrous cycle



VIP scores of identified metabolites during estrous cycle of buffaloes

IR thermal imaging for studying correlation between ocular and rectal temperatures in Murrah buffaloes

AK Balhara, MH Jan, Sunesh Balhara, Sarita Yadav, A Boora, SK Phulia, Sajjan Singh

A comprehensive investigation was undertaken to examine the correlation between ocular and rectal temperatures in Murrah buffaloes utilizing IR thermal imaging. The mean rectal temperature recorded for adult buffaloes was 38.42±0.29 ◦ C, while their corresponding mean eye temperature stood at 37.05±0.53 ◦ C. Similarly, a separate group of buffalo calves displayed mean rectal and eye temperatures of 38.33±0.32 ◦ C and 37.74±0.65 ◦ C, respectively. Statistical analysis unveiled a significant difference between rectal and ocular temperatures in both adult buffaloes and calves, with respective t-values of 21.89 and 4.2902. Furthermore, a moderate positive correlation was evident between these variables, supported by Pearson correlation coefficients of 0.38 for calves and 0.52 for adults ($p < 0.0001$). These findings underscore a marked disparity between mean eye and rectal temperatures across both adult buffaloes and calves. Additionally, the normality of temperature distributions for left and right eyes and rectal measurements was confirmed, reinforcing the reliability of the acquired data. Overall, this study yields crucial insights into the relationship between ocular and rectal temperatures in Murrah buffaloes, underscoring the potential efficacy of IR thermal imaging in temperature evaluation for this species.

Representative thermograph of an adult bull indicating ocular temperature

Nutritional and Physiological interventions for enhancing reproductive performances in animals

RK Sharma, SK Phulia, Vishal Mudgal, Pradeep Kumar, Jerome A

Effect of variable semen collection conditions on semen production in buffalo bulls

In first experiment the effect of four different semen collection variables (Artificial vagina [AV] temperature, size, liner and false mount) was studied in a step wise manner. In step one the study for AV temperature was carried out using twelve mature buffalo bulls (age

2-6 yrs) housed at frozen semen laboratory of ICAR-Central Institute of buffalo research, Hissar. AV with three different temperature range (40-43°C, 44 -47°C and 48-50°C) were used for semen collection. For each variable, minimum six replicates were studied. In the first step, of the experiment, small size AV (25 cm) and smooth liner were used and AV temperature range was fixed (40-43°C) for all buffalo bulls for six or more collections. The AV temperature range was changed to 44 -47°C for six and more collections and lastly the AV temperature range was fixed at 48-50°C for six or more collections. In the step two, best temperature range of AV observed in first step was used for comparing two different sizes of AV (25cm and 30 cm) using smooth liner alternately used for twelve collections. In the step three, the best temperature AV and best size AV was used for making comparison between smooth inner liner vs rough inner liner alternately used for twelve collections. In the step four, the frequency of false mounts (one false mount and two false mount) was evaluated for better semen production and quality parameters with best set parameters of AV alternately used for twelve collections. After evaluation the collected semen samples from all buffalo bulls were processed for cryopreservation as per routine practices of the institute.

Effect of variable semen collection conditions on semen production in buffalo bulls

Semen variables	AV temperature at the time of semen collection			Significance
	40-43°C	44-47°C	48-50°C	
Total no. of ejaculates	126	128	124	
Volume (ml)	3.09±0.13^{b}	3.63±0.18^{a}	3.26±0.15^{ab}	*
Mass motility (0-5 scale)	2.55±0.10	2.45±0.08	2.44±0.10	NS
Sperm concentration (million/ml)	1201.65±48.30^{b}	1228.82±66.77^{b}	1039.40±42.74^{a}	*
Total sperm in each ejaculate (million)	3613.95±197.6^{b}	4261.74±280.03^{a}	3269.84±179.53^{b}	**
Total no. of semen doses prepared from ejaculate	159.21±8.33^{b}	187.70±12.63^{a}	151.29±8.01^{b}	*

*NS: Non-significant; * Significant at 5% level; **Significant at 1% level.*

Effect of AV size on semen variables of buffalo bulls (Mean±SE)

Semen variables	Size of AV used for semen collection		Significance
	Small size AV (25cm)	Large size AV (30cm)	
Total number of ejaculates	142	142	
Volume (ml)	3.06±0.13	3.22±0.17	NS
Mass motility 0-5 scale	2.40±0.09	2.40±0.09	NS
Sperm concentration (million/ml)	1245.38±65.05	1203.31±43.98	NS
Total sperm in each ejaculate (million)	3644.74±209.80	3829.46±236.32	NS
Total no. of doses prepared from each ejaculate	158.56±7.60	173.44±10.83	NS
Residual sperm loss in AV (million)	35.17±7.64a	153.76±19.76b	**

*NS: Non-significant; **Significant at 1% level.*

Effect of AV liner on semen variables of buffalo bulls (Mean+SE)

Semen variables	Types of AV liner		Significance
	Rough liner	Smooth liner	
Total no of ejaculates	144	144	
Volume (ml)	2.97±0.10	3.17±0.14	NS
Mass motility	2.53±0.09	2.53±0.09	NS
Sperm concentration (million/ml)	1002.75±35.07b	1133.71±42.49a	*
Total sperm in each ejaculate (million)	2904.6±126.37b	3384.32±151.36a	*
Total no. of doses prepared from each ejaculate	131.52±5.79b	154.56±6.92a	*
Residual sperm loss in AV (million)	47.75±6.87a	24.85±2.65b	**

*NS: Non-significant; * Significant at 5% level; **Significant at 1% level.*

Effect of single and double false mount (FM) on semen variables of buffalo bulls (Mean±SE)

Semen variables	Number of false mounts		Significance
	Double FM	Single FM	
Total no. of ejaculates	144	144	
Volume (ml)	3.47±0.16a	2.72±0.10b	*
Mass Activity 0-5 Scale	2.9±0.09	2.82±0.09	NS
Sperm concentration (million/ml)	1059.28±40.51	1109.04±42.17	NS
Total sperm in each ejaculate (million)	3571.17±197.38a	2897.81±129.34b	*
Total no. of doses prepared from each ejaculate	158.47±8.89 a	132.38±5.81b	*

*NS: Non-significant; * Significant at 5% level.*

AV temperature (44-47°C), smooth AV liner and double false mount resulted in increase semen output during semen collection in buffalo bulls.

Advancing puberty using antioxidants/ micronutrients

An experiment was performed on 40 growing heifers with an average age of about 15 months and body weight of about 260 kg. There were 10 heifers in each control and treatment groups (Treatment 1, Treatment 2 and Treatment 3). All heifers were stall fed individually and managed under standard managerial practices as followed at the farm. Feeding of heifers was done as per the recommendations (ICAR, 2013) with a difference in the ratio of Zn:Cu in the mineral mixture that is fed in concentrate mixture to different treatment groups. The concentrate mixture were prepared at the institute using different feed ingredients (Wheat grain 30%, Mustard seed cake 30%, Wheat bran 37%, Mineral Mixture 2% and Common salt 1%). Feeding was continued for a period of nearly 12 months with monthly recording of body weights and ultrasound scanning for determination of onset of puberty by appearance of corpus luteum in the ovary. Heifers were inseminated following observed estrus and pregnancy diagnosis was made 30 days post insemination. Ultrasound monitoring of heifers continued till 5 months after end of experiment. Blood samples were collected before starting the experimental feeding as well as before terminating the experimental feeding and also in the middle of the experimental feeding.

The average body weight and age at the start of treatment was 262.45±4.57 kg and 14.88±0.21 months, respectively and did not vary in control and treatment groups. Puberty was attained at average body weight of 378.27±4.72 kg at an average age of 23.06±0.32 months. No significant difference (P>0.05) was observed in treatment and control groups.

All the pubertal and pregnancy parameters including average age and weight at puberty, average age and weight at first AI, average age at pregnancy was lowest in T1 group without any significant difference (P>0.05). None of the heifer return to prepubertal status in T1 group. However, one each in control, T2 and T3 group become anovular after attaining puberty. Furthermore, only 10% heifers remain non-pregnant in T1 group whereas 20% heifers in Control, 33% in T2 and 40% in T3 group remain non-pregnant 5 months after the end of experiment. Returning to prepubertal status after attaining puberty was probably due to commencement of low breeding season in the subsequent months. Overall pregnancy rate was highest (90%) in the group T1 (9/10), followed by control group (80%, 8/10), T3 (67%, 6/9) and T4 group (60%, 6/10), respectively 5 months after the end of experiment.

Effect of Zn:Cu ratio feeding variation in different treatment groups on onset of puberty and pregnancy rate in growing Murrah heifers

Attribute	Control	T1	T2	T3	Overall
No. of heifers	10	10	10	10	40
Average weight (kg) at start of experiment	262.51±9.44	262.44±9.34	262.48±10.7	262.35±8.45	262.45±4.57
Average weight at puberty (kg)	381.26±8.87	372.85±9.52	383.66±11.31	375.84±9.38	378.27±4.72
Average weight at first AI (kg)	388.03 ± 8.87	382.11±8.09	388.38±10.06 (9)	385.19±8.05	385.86±4.22
Average age (m) at start of experiment	15.07±0.48	14.57±0.4	14.91±0.43	14.95±0.42	14.88±0.21
Average age (m) at puberty (Months)	23.5±0.54	22.23±0.60	23.21±0.59 (9)	23.33±0.77	23.06±0.32
Average age at first AI (Months)	23.98±0.53	22.68±0.53	23.56±0.58 (9)	24.04±0.79	23.56±0.31
Average age at pregnancy (m)	24.66 ± 0.68	23.84 ± 0.41	24.65 ±0.99	26.05 ± 0.73	24.69±0.35
Number of animals return into anovular status after attaining puberty	10% (1/10)	Nil (0/10)	11% (1/9)	10% (1/10)	7.69% (3/39)
Overall pregnancy status 5 months after end of treatment	80% (8/10)	90% (9/10)	67% (6/9)	60% (6/10)	74.36% (29/39)

Zn:Cu ratio (5:1 and 4:1) fed resulted in early onset of puberty, early breeding and overall pregnancy in growing buffalo heifers as compared to 3:1 and 2:1 ratio.

Hormonal and nutritional interventions for silent estrus and anoestrus for fertility improvement in buffaloes

Silent oestrus and anoestrus are two major reproductive problems in buffaloes that require hormonal and nutritional interventions. Silent estrus condition is successfully treated with single prostaglandin injection. Buffaloes having a well developed CL as identified by ultrasound scanning but not observed in heat (silent estrus) were injected single injection of prostaglandin. Buffaloes observed in heat at 72h post-injection were inseminated using frozen thawed semen. Results were interpreted in terms of conception rate, and improvement in age at first calving and calving interval in the herd.

Earlier, CIDR+PMSG protocol has been found to provide a reasonably good response to induce ovulatory heat in buffaloes. Anovular multiparous buffaloes of more than 90 days postpartum were given CIDR implant either alone or in combination with PMSG, multimineral injection (Zn, Cu, Mn, Se) or GnRH injection at AI or along with Ovsynch protocol. The experiment was conducted to enhance the response of CIDR protocol in the absence of non-availability of PMSG hormone. Fixed time AI has been carried out at 48 h after CIDR removal and pregnancy diagnosis was made 30 days post-insemination.

Condition	Protocol	No. of animals (n)	Estrus induction rate (%)	Pregnancy rate on first AI (%)	Overall Anovular status within 30 days
Silent Estrus	Prostaglandin	219	85% (186/219)	42% (79/186)	-
Anovularanoestrus	CIDR+PMSG	50	82% (41/50)	42% (21/50)	18% (9/50)
	CIDR	8	42% (3/7)	14% (1/7)	88% (7/8)
	CIDR+ Multiminerals	15	80% (12/15)	20% (3/15)	20% (3/15)
	CIDR+ GnRH	8	63% (5/8)	0% (0/8)	75% (6/8)
	CIDR+GPG	10	40% (4/10)	10%(1/10)	70% (7/10)

In the absence of PMSG, the progesterone implants are not effective in correcting anovular status in buffaloes during low breeding season and addition of multiminerals and GPG protocol was without effect.

Use of OPU-IVEP in production of superior buffalo germplasm

Jerome A, RK Sharma, PS Yadav, D Kumar, M Punetha, Rajesh, Rupali

Ovum pick up-invitro embryo production (OPU-IVEP), in recent times has proven to be alternative method for propagate and disseminate superior germplasm, along with established techniques such as superovulation and embryo transfer. But, factors which needs to be addressed for success of OPU-IVEP technology includes selection of donors, development/ refinement of culture conditions of oocytes and embryos. OPU-IVEP can bring enhancement of female genetic pool which shall be future bull mothers. OPU-IVEP Technology, is an advanced reproductive technology for multiplication of superior female germplasm at much faster rate. Using MOET technology one can get 10-20 calf from a superior female animal in a year. At ICAR-CIRB a project OPU-IVEP and was successfully in producing male buffalo calf (Veer Gaurav) out of semen of cloned bull and elite female. Preliminary attempts showed that FSH stimulation resulted in better follicular response (7.64 follicles / animal) as compared to non-stimulated counterparts (2.6 follicles / animal). The number of follicles produced where significantly higher in the ovary without corpus luteum as compared to ovaries with corpus luteum irrespective of stimulated or non-stimulated buffaloes.

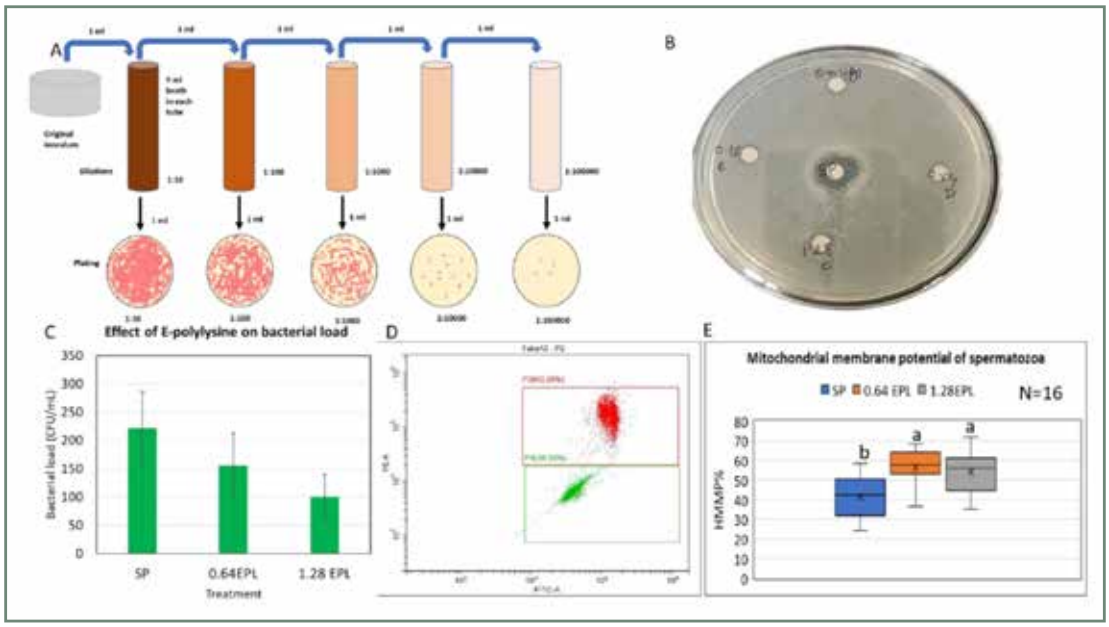
The OPU-IVF male calf, Veer Gaurav (at 1-year age)

Epsilon poly-lysine in buffalo semen extender: A step towards reducing the development of antibiotic resistance

Pradeep Kumar

The use of antibiotics in semen extenders can contribute to the development of antibiotic resistance. The objective of the study was to evaluate epsilon-polylysine (Ɛ-PL) as a substitute for antibiotics in the buffalo semen extender. For this, 20 semen ejaculates were collected from four Murrah buffalo bulls. Each ejaculate was divided into three equal aliquots and extended into an egg yolk-based semen extender containing either antibiotics (strepto-penicillin) or different concentrations of Ɛ-PL (0.64 and 1.28 g/L) to make the final concentration 80 million sperm/mL and cryopreserved as per the standard procedure. The antibiogram sensitivity test confirmed that Ɛ-PL is an effective antimicrobial against microbes present in buffalo semen ejaculates. Furthermore, the addition of Ɛ-PL in the semen extender significantly reduces the colony forming unit (CFU)/mL in cryopreserved semen equivalent to strepto-penicillin. The sperm motility and kinematic parameters assessed by a computer-assisted sperm analyser showed that Ɛ-PL did not inhibit either sperm motility not kinematic parameters of cryopreserved sperm. The flow-cytometric evaluation of frozen–thawed sperm revealed interesting results. The extender supplemented with Ɛ-PL protected sperm acrosome and mitochondrial membrane

potential greater than the extender supplemented with strepto-penicillin. Further, Ɛ-PL reduced significantly the production of superoxide anions from mitochondria during the cryopreservation process. In this way, Ɛ-PL may be a suitable alternative to antibiotics in semen extenders. In conclusion, Ɛ-PL at a concentration of 0.64 g/L acts as an effective antimicrobial as well as antioxidant in semen extender for cryopreservation of buffalo sperm.

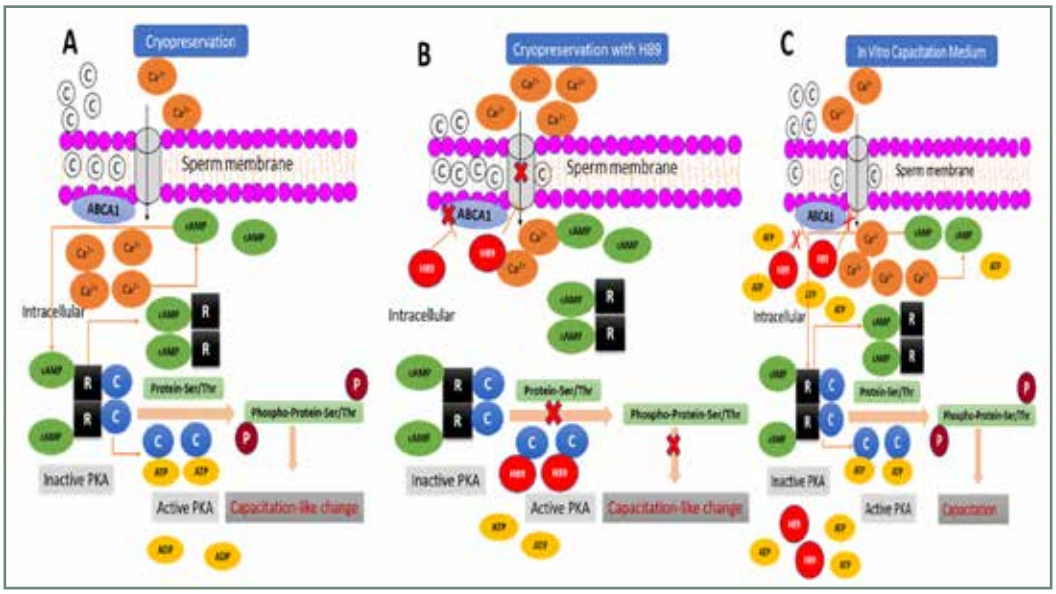


Diagrammatic representation of estimation of bacterial load using standard plate count method, B. antibiogram depicting zone of inhibition around the discs of antibiotics (streptomycin and pencillin;SP) and 0.04g/L, 0.16g/L, 0.64g/L, 1.28g/L of ε-polylysine, C. Bar diagram depicting different percentages of samples of frozen semen according to the level of bacterial load (CFU/mL) in different categories viz SP, 0.64g/L EPL and 1.28g/L EPL. D. Histogram showing two gated populations viz, HMMP (red colour) and LMMP (low mitochondrial membrane potential, green colour) and E. Percentage of HMMP sperm in the three groups of the ejaculates. The three group of ejaculates were: A. extender supplemented with antibiotics B. extender supplemented with 0.64g/L ε-polylysine C. extender supplemented with 1.28g/L ε-polylysine. The data were presented by box-and-whisker plots. Different superscripts differ significantly (P < 0.05). Number of ejaculates/groups=16.

A new role of H89: reduces capacitation-like changes through inhibition of cholesterol efflux, calcium influx, and proteins tyrosine phosphorylation during sperm cryopreservation in buffalo

Pradeep Kumar

It is a known fact that cryopreservation initiates premature capacitation in spermatozoa during the cryopreservation process. Protein tyrosine phosphorylation is a landmark of cascade reaction accountable for capacitation or capacitation-like changes in spermatozoa. Therefore, our hypothesis was to test an inhibitor (H89) that reversibly inhibits the cascade reaction responsible for capacitation during the cryopreservation process but does not hamper normal capacitation and fertilizing ability of sperm. For this, sixteen ejaculates were collected from Murrah buffalo bulls (n=4). Each ejaculate was divided into four equal aliquots and diluted in an egg yolk-based semen dilutor supplemented with 0, 2, 10, and 30 µM concentrations of H89 and cryopreserved. Interestingly, H89 reduces cholesterol efflux from spermatozoa and protects spermatozoa from membrane damage during the cryopreservation process. H89 did not prevent lipid peroxidation of the sperm membrane. H89 reduced intracellular calcium concentration in spermatozoa in a dose-dependent manner, but tyrosine phosphorylation reduction was observed in the 2 and 10 µM H89 groups. The CTC assay revealed that the percentage of uncapacitated spermatozoa in different treatment groups increases in a dose-dependent manner. In the in vitro capacitation medium, the effect of H89 is abolished and spermatozoa underwent normal capacitation, but H89-treated spermatozoa attached to zona pellucida in large numbers compared to untreated spermatozoa. In conclusion, H89 does not only inhibit tyrosine phosphorylation of spermatozoa but it reduces cholesterol efflux and calcium influx, and ultimately reduces capacitation-like changes during the cryopreservation process.



Proposed mechanism of action of H89. A. During the cryopreservation process, cholesterol (c) efflux occurs which increases the membrane permeability and intracellular calcium (Ca^{2+}). The increased intracellular calcium activates PKA (protein kinase A) through the binding of cAMP on regulatory subunits (R) of PKA. The catalytic subunit (C) of activated PKA with ATP phosphorylates tyrosine-containing proteins resulting in capacitation-like changes occurring in the process of cryopreservation. B. The supplemented H89 in freezing medium permeates into spermatozoa where it reduces cholesterol efflux through membrane-bound ABCA1 protein, decreased calcium influx by directly blocking of CatSper channel, and prevents phosphorylation by replacing ATP from the catalytic subunit of PKA resulting in the prevention of capacitation-like changes occurs in the process of cryopreservation, C. High number of endogenous ATPs are produced in sperm placed in capacitation medium. The high concentration of ATPs replaces H89 from the catalytic subunit of PKA resulting in the phosphorylation of tyrosine proteins and capacitation.

Buffalo sperm dosage in relation to functional parameters and field fertility outcome

Sajjan Singh, Pradeep Kumar, Jerome A, RK Sharma, Gururaj M

The effect of dilution (@12 and 16 million/straw) buffalo sperm viability and functional parameters were studied. The parameters included sperm post-thaw motility, plasma membrane integrity, thermal resistance, kinematic parameters are being estimated. Also, the sperm mitochondrial membrane potential as well as mitochondrial superoxide status was documented. Based on the results, conception rate for the 3 doses are in progress. For deduction of field conception rate 20 million/straw (3025 doses), 16 million/straw (3024 doses) and 12 million/ straw (3031 doses) were disseminated for field insemination. The conception rate of 20 million/straw, 16 million/straw and 12 million/ straw were 58.44 % (630/1078), 57.5 % (632/1099) and 57.23 % (609/1064), respectively. Reduction of sperm dosage per insemination can pave way for efficient utilization of resources by increase cost benefit ratio with enhanced production of semen doses for wider dissemination of superior buffalo germplasm to the stakeholders to increase productivity.

Fertility of Nili-Ravi buffaloes in relation to lactational, metabolic and environmental stressors

M.H. Jan, F.C. Tuteja

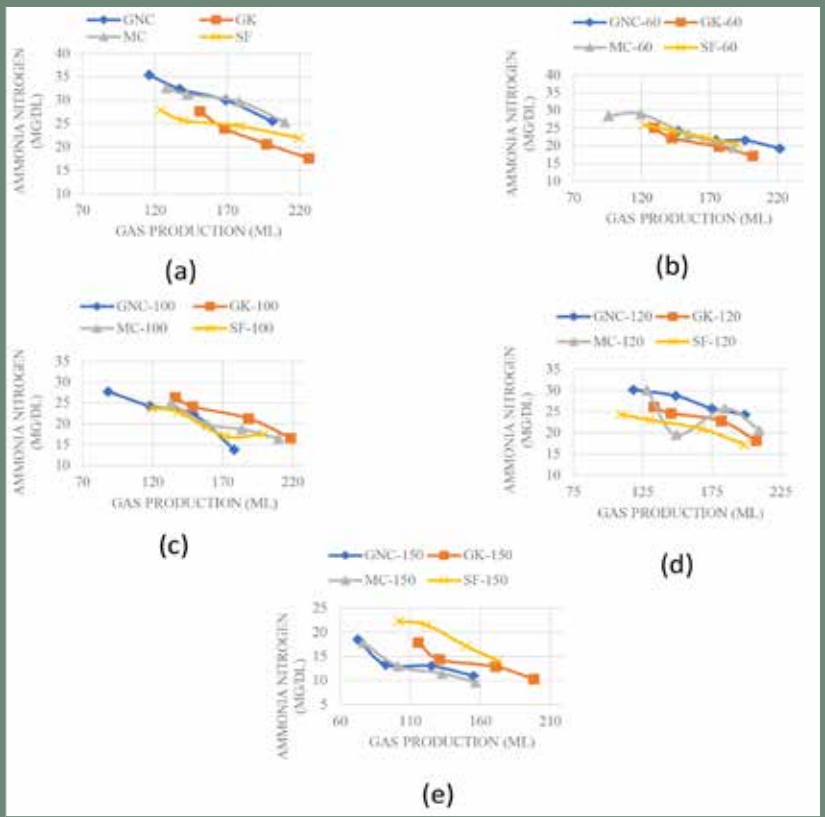
In this project normally calved buffaloes (n=127) were subjected to blood sampling and body weight recording on days 1, 15, 30 and 45 after parturition. It was observed that buffaloes suffered a drop in body weight till day 30 followed by recovery at day 45 onwards. The buffaloes were followed till completion of lactation and divided in 4 groups – Group A (Primiparous; SLMY <2500kg / PY <15kg), Group B (Primiparous; SLMY ≥2500kg / PY ≥15kg), Group C (Multiparous; SLMY <2500kg / PY <15kg), and Group D (Multiparous; SLMY ≥2500kg / PY ≥15kg). It was observed that the most affected group due to consequences of calving and lactation was group B which had the highest body weight loss at day 45 (-18±2 kg), longest median service period (149±4 days), poor first service conception rate (13%), and took more services per conception (3.2±0.3). The analysis of blood samples for markers of negative energy balance (BHBA and NEFA) will unravel the mechanism of lowered fertility in high yielding primiparous buffaloes.

FEED RESOURCE UTILIZATION AND IMPROVEMENT

Malic Acid-Heat treatment of Oil cakes enhances Rumen undegradable Protein for Effective Protein Utilization in Buffaloes (*Bubalus bubalis*)

Avijit Dey, Shubham Thakur, Ram Kumar Singh, Puran Chand Lailer

Protein nutrition in ruminants encompasses providing the optimum ratio of rumen-degradable and undegradable protein to strike a balance between optimizing rumen efficiency and maximizing animal productivity. The present study aimed to enhance the rumen undegradable proteins of groundnut cake, guar korma, mustard cake, and sunflower meal, and were sprayed with 1 M malic acid (400 ml/kg feed sample) and subjected to heat treatment at 60, 100, 120, and 150°C.Modified *in vitro* gas production technique (IVGP) was used to determine the *in vitro* rumen degradable protein of treated and untreated feeds. The malic acid heat treatment was found to be effective in increasing the rumen bypass fraction of feeds at all temperatures, with the highest increase occurring at 150°C. Sunflower meal was shown to be the most resistant to MAH treatment with only about 30% decrease in rumen protein degradability at 150°C as compared to groundnut cake, guar korma, and mustard cake, where a significant reduction (64-70%) was evidenced. The Acid Detergent Insoluble Crude Protein (ADICP) analysis of feeds treated at 120°C and 150°C for assessing the availability of bypass protein to the small intestine showed no significant (P>0.05) heat damage in groundnut cake, guar korma, and sunflower meal, and thus were considered useful in ruminant rations. However, mustard cake at 150°C was severely heat damaged (41.02%, ADICP) and was considered suitable for use only up to 120°C.Therefore, malic acid-heat treatment of oil cakes could be an effective technology to enhance rumen bypass protein sources for animals and to reduce environmental pollution through faecal and urinary nitrogen excretion.

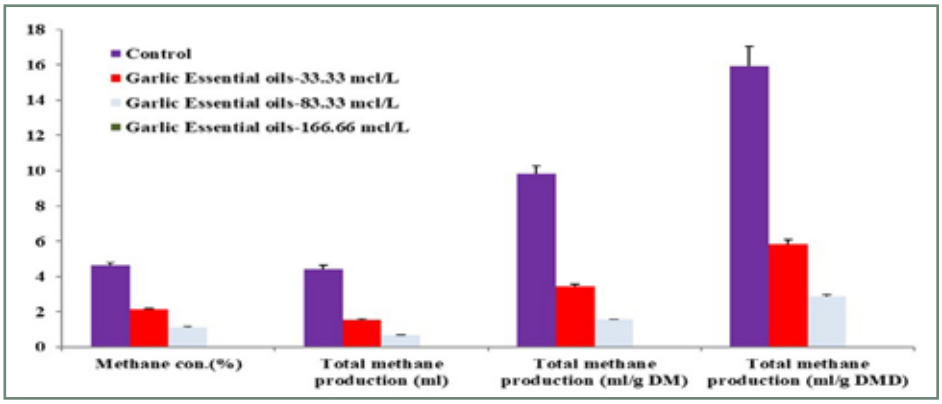


Graphs (a-e) representing the strong inverse relationship between Ammonia Nitrogen (mg/dl) and Gas Production (ml) from incubation of untreated and malic acid-heat treated protein feeds

Allium sativum (garlic) essential oils: supplemental effects on ruminal *in vitro* fatty acids bio-hydrogenation, methane production and fermentation pattern of total mixed ration

Avijit Dey, Ram Kumar Singh, Shubham Thakur, Puran Chand Lailer

Potential of plant origin essential oils to modulate rumen functions for reducing bio-hydrogenation of fatty acids and methane production have been an area of research in the recent days. The present study investigated the effects of garlic (*Allium sativum*) essential oils supplementation on *in vitro* bio-hydrogenation of fatty acids, methanogenesis and fermentation characteristics of total mixed ration in buffalo with the aim to enhance conjugated linoleic acid (CLA) content in animal products as well as reduce environmental pollution. *Allium sativum* (AS) essential oils was examined at four levels [0 (Control), 33.33 µl (AS-1), 83.33 µl (AS- 2) and 166.66 µl (AS- 3) per litre of buffered rumen fluid] in radio-frequency based automatic gas production system (ANKOM-RF). Two bottles per treatment per run with two incubation runs were accomplished to get representative results. Oats hay and concentrate mixture (1:1) was used as substrate (500± 5 mg) and incubated with 60 ml buffered rumen fluid in 250 ml ANKOM bottles fitted with automatic gas recording system at 39ºC for 24h following standard *In Vitro* Gas Production protocol. The results demonstrated reduction (p <0.01) in lipid bio-hydrogenation, measured by lowered saturated fatty acids and enhanced unsaturated fatty acids on supplementation of AS essential oils, irrespective of dose levels. Moreover, the increased (p <0.01) production of *trans* vaccenic (*trans* C18:1) acid (TVA) with graded dose supplementation of the AS essential oil envisaged more production of conjugated linoleic acids (CLA) in animal products. Although, reduced methane production (p <0.01) was evidenced, the decrease in total gas production and feed digestibility (TDDM) demonstrated strong antimicrobial activity of AS in all dose levels. The study reveals that the *Allium sativam* (Garlic) essential oils could be a potential agent to reduce rumen biohydrogenation of fatty acids and methanogenesis. However, *in vivo* examination is necessary to validate the findings and use as additive to enhance nutraceutical and organoleptic properties of animal products.

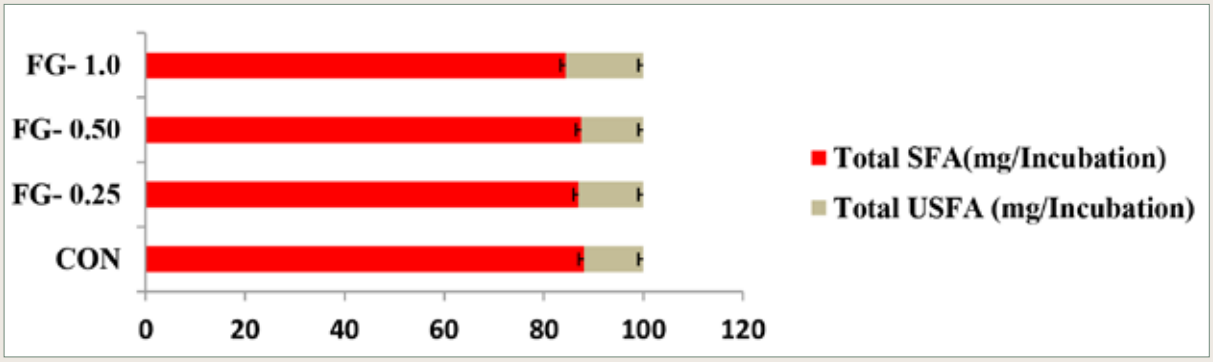


Effects of the graded levels of Garlic essential oils supplementation with mixed feed on ruminal methanogenesis

Modulating Enteric Methane Emission: Effects of *Ficus glomerata* Leaf Tannins

Avijit Dey, Ram Kumar Singh, Mala Singh

The present study investigated the effects of tannin extract from Ficus glomerata (FG) leaves on the rumen fermentation, methanogenesis, feed digestibility and fatty acid biohydrogenation of a total mixed ration with the aim of developing a feed supplement for enhanced livestock production and product quality with lower methane emission. The tannin extract of FG leaves in the total mixed ration (oat hay/concentrate mixture; 1:1) was studied at four graded dose regimens [0.0 (control), 0.25 mL (FG-0.25), 0.50 mL (FG-0.50) and 1.0 mL (FG-1.0) per 60 mL of buffered rumen fluid] in three replicates for each treatment in a radio-frequency-based automatic gas production system (ANKOM-RF) at 39°C for 24 h following the standard in vitro gas production protocol. The total gas production (mL or mL/g incubated dry matter (DM)) was gradually reduced ($p < 0.01$) at dose levels of FG-0.50 and FG-1.0; however, it remained intermediary and comparable ($p > 0.05$) for FG-0.25 with the control and FG-0.50. Compared to the control, the methane concentration (%) in the head space gas, as well as the total methane production (mL or mL/g DM incubated, or mL/g DM digested), were found to be gradually reduced ($p < 0.01$) with increasing doses (0.25–1.0 mL) of FG extract. The reduced ($p < 0.05$) feed degradability at higher levels (0.50–1.0 mL) of FG extract supplementation and the comparative ($p > 0.05$) effects with the control at a lower level of supplementation (FG-0.25) are suggestive of the dose-responsive detrimental effects of tannins on fibrolytic microbes in the rumen. However, the ammonia concentration decreased ($p < 0.05$) in all of the incubations compared to the control. Among the volatile fatty acids, acetate remained comparable ($p > 0.05$) with enhanced ($p < 0.05$) propionate at a lower dose (FG-0.25); however, a dose-dependent reduction was evident at higher dose levels (FG-0.50 and FG-1.0). The production of stearic acid (C18:0), which is a product of the rumen biohydrogenation process, was reduced ($p < 0.05$), irrespective of the concentration of the FG extract. Compared to the control, the concentration of t-vaccenic acid (C18:1), which is a precursor of conjugated linoleic acid (CLA) in animal products, was increased in all the FG-extract-supplemented groups. It may be concluded that Ficus glomerata leaf tannins can modulate rumen fermentation for reduced methanogenesis and fatty acid biohydrogenation in a total mixed ration. As a higher level of inclusion negatively affects feed digestibility, a lower dose (0.25 mL FG extract per 60 mL fermentation fluid or 4.17 mL FG extract per L of fermentation fluid) is suggested to achieve desirable effects on methane abatement and an improvement in fatty acid profiles in animal products.

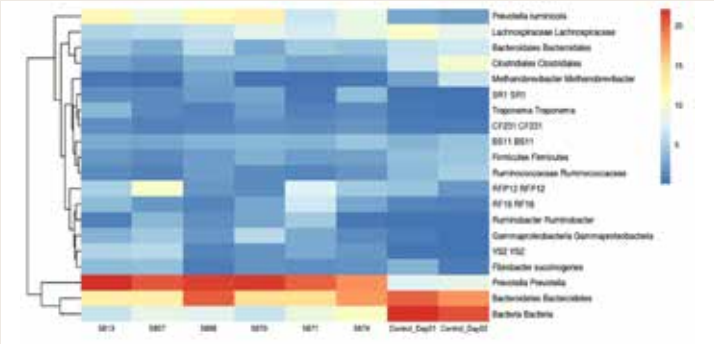


Effects of FG leaf extract supplementation with mixed feed on rumen biohydrogenation characteristics.

Molecular analysis of methanogenic archaeal diversity in rumen of Murrah buffaloes fed different diets

Sarita Yadav, P. C. Lailer, Ashok Boora, S.K. Khurana

In this study, rumen fluid samples were taken from 8 buffalo calves (n=6 treatment group: supplementation of 500 gm boiled Guar as a feed additive in addition to basal concentrate mixture, n=2 control group) from CIRB herd, the DNA of 8 rumen fluid samples were extracted and bacterial amplicons of the V3 V4 regions of 16S rRNA were subjected to Illumina sequencing. A total of 461 operational taxonomic units (OTUs) were identified. Taxonomic identification of sequences of 16S ribosomal RNA revealed 32 different bacterial phyla. Diversity and richness estimates based on OUTs (ACE index, Chao1 index, Shannon index, and Simpson index) revealed that treatment group had significantly high bacterial diversity than in the control group. The beta-diversity analysis of microbiome composition revealed that Methanobacteriales (*Methanosphaera, Methanobravibacter*), Methanosarcinales (*Methanimicrococcus*) decreased in treatment group significantly. There was a significant increase in *Prevotella*, *Proteobacteria* in treatment group. There is a potential use of *Cyamopsis tetragonoloba* seeds (Guar) as a low-cost anti-methanogenic feed additive.

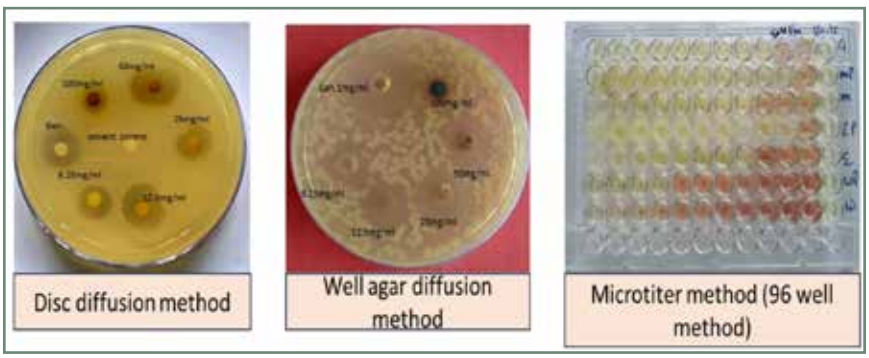


Heatmap representing distribution of top 20 Species of rumen microbes

Evaluation of potential plant-based agents for anti-biofilm and antimicrobial activities against major mastitis pathogens of buffaloes

Sarita Yadav, Ashok Boora, Sandeep Khurana, Sunesh Balhara

Propolis, a natural resinous substance produced by honeybees, has a long history of therapeutic use dating back to ancient times, particularly with its antimicrobial properties. This present study determined the antimicrobial activities of propolis extracts: methanol propolis extract (MPE), ethyl acetate (EacPE) propolis extract, and water propolis extract (WPE) on clinical isolates of *Escherichia coli* which have been isolated as a prominent environmental pathogen from mastitis cases of Murrah Buffaloes. The antimicrobial activities of the propolis extracts against these test isolates were determined by broth microdilution and diffusion assays (agar well and agar disc diffusion method).This study revealed the antimicrobial activities of methanol and ethyl acetate propolis crude extracts on extended spectrum β-lactamase-producing Enterobacteriaceae, with minimum inhibitory concentration (MIC) that ranged from 19.53 to 625 µg/ml. Water extract showed no antimicrobial activity against tested pathogen. The methanol extract proved to be more effective compared to ethyl acetate extract as shown by their lower MICs for *Escherichia coli*. Data from the study established methanol extract of *propolis* as an alternative source of antimicrobials against clinical isolates of *Escherichia coli.* Further purification and characterization of bioactive compounds, from active fractions of propolis, for its applications as antibacterial agent is recommended.



Antimicrobial activities of the propolis extracts

TRANSFER OF TECHNOLOGY

Economic analysis of milk supply chain in buffalo production system

Gururaj M, P C Lailer, Navneet Saxena, F C Tuteja, Meeti Punetha

Present study was conducted in Haryana and Punjab being breeding tract of Murrah and Nili-Ravi buffalo, respectively. A total of 120 Nili-Ravi buffalo farmers from Sangrur and Firozpur districts of Punjab and 120 Murrah buffalo farmers from Karnal & Hisar districts of Haryana were interviewed personally and collected required data. Selected dairy farmers were post-stratified into Group-I (farmer having 1-2 milch buffaloes), Group-II (3-4 milch buffaloes) and Group-III (5 & more milch buffaloes). Among Murrah buffalo farmers about 46.67% of farmers belongs to Group-I followed by Group-II (33.33%) and Group-III (20.00%). Whereas in case of Nili-Ravi farmers about 51.67% belongs to Group-I followed by 40.83% and 7.50% falls under Group-II and Group-III, respectively. The average milk production among Murrah buffalo farmers was 22.75 kg per day and in which 23.84% of milk used in household consumption (as milk & milk product) and remaining 76.16% is marketed surplus milk, in their counterpart Nili-Ravi buffalo farmers the per day milk production is 22.50 kg and in which about 24.26% of the milk used for household consumption in the form of raw milk & milk product and remaining is surplus milk sold to non-producers. About 68 per cent of Murrah buffalo farmers prefer un-organised milk marketing channels for dispose of the surplus milk and remaining 32% prefer organised milk marketing channels. However, in case of Nili-Ravi farmers about 71% of the surplus milk marketed through organised milk marketing channels followed by unorganised milk marketing channels. Regular market and timely payment against milk supply are the main reasons for choosing the organised milk marketing channel in the study area. However, door step milk collection and advance payment to purchase inputs attracts dairy farmers to opt for un-organised milk marketing channels. The binomial logistic regression results of how socio-economic characteristics influence the Nili-Ravi buffalo farmers to choose different milk marketing channels in the study area. Age of the respondent & number of Nili-Ravi buffalo holdings found to be statistically significant. It implies that Nili-Ravi farmers with young age & large number of Nili-Ravi buffalo holdings prefer organized milk marketing channels to dispose surplus milk. Similarly, results with respect to Murrah farmers, age of the respondent & educational level of Murrah buffalo farmers found to be statistically significant. It implies that Murrah buffalo farmers having older age group with better education level prefer organized milk marketing channels to dispose surplus milk. The cost and returns of the Nili-Ravi and Murrah buffalo milk production was calculated. The group-wise (Group-I, II & III) net income was estimated with highest returns for Group-III (Rs. 29750.64) followed by Group-II (Rs. 22831.12) and Group-I (Rs. 16166.81) with break-even milk production of 673.99, 947.67 and 1439.11 kg per buffalo per annum, respectively. Similarly, in case of Nili-Ravi buffalo milk production the highest net returns was found in case of Group-III (Rs. 36082.07) category of the farmers followed by Group-II (Rs. 29517.11) and Group-I (18875.43) with break-even milk production of 737.05 kg, 963.27 kg and 1490.90 kg per buffalo per annum, respectively. The average employment

generation per annum per farm was almost same for both categories of the dairy farmers in the study area. Inter-group analysis revealed that among Murrah buffalo farmers 85% of the dairying activities performed by the family labour, mostly women labour and remaining work taken care by the hired labour. Similarly, whereas, in case of Nili-Ravi buffalo farmers, about 78% of work related milk production activities performed by the family labour and remaining by the hired labour in the study area. Lower price for milk, increase in feed cost, non-availability of labor for the dairying are major constraints faced by the Murrah buffalo farmers in the study area. Lack of availability of superior germplasm/bulls for breeding, low price for milk and non-availability of timely veterinary services are the major constraints faced by the Nili-Ravi buffalo farmers. Study concludes that creation of FPOs with value addition to the milk may attract more number of dairy farmers to participation in organised milk channels in Haryana to reap the economies of scale. Need of hour is that create awareness among dairy farmers regarding Nili-Ravi buffaloes in the Punjab through convergence mode by involving research institute, universities, NGOs and state animal husbandry department and encourage & motivate dairy farmers to keep Nili-Ravi buffaloes in its breeding tract because Nili-Ravi buffalo milk production is a profitable enterprise.

Enhancing economy of livestock farmers through AI using cloned buffalo bull semen

P S Yadav, Hema Tripathi, Sajjan Singh, N Saxena, Dharmendra Kumar, Pradeep Kumar, Jerome A, Gururaj M

The project is implemented in the Nuh, aspirational district of Haryana. The main objectives of the project is to perform artificial insemination using superior cloned / breeding buffalo bull's semen in selected area for improvement of buffalo productivity, Record the AI, conception rate, calving and performance of progenies and to organise trainings on scientific buffalo husbandry for socio-economic upliftment of rural farmers. As on 31 December, 2022 a total of 1768 AIs were performed. Among the beneficiary farmers about 82.58% belongs to Other Backward Classes (OBCs) followed by general (11.41%) and schedule tribes (3.08%) & schedule caste (2.94%). In the study area, about 93.26% of AIs were performed in graded Murrah followed by pure Murrah (4.43%), non-descript (1.25%) and other descript type buffaloes (1.06%). It implies that dairy farmers keep superior quality buffalo breed for the milk production. The inter-parity of buffaloes reveals that dairy farmers prefer to keep buffaloes up to sixth lactation. In the study area, about 25.46 per cent of AIs were performed in third lactation buffaloes followed by heifers (21.3%), second lactation (19.78%), fourth lactation (15.21%), first lactation (9.91%) fifth lactation (5.15%) and

sixth lactation (3.18%). The maximum buffaloes are in third lactation may be due to buffaloes produce highest milk in this parity in the study area. During the period about 15 various program like training program (04) (improved buffalo husbandry practices), demonstrations (05) and awareness programs (06) were organised. A total of 415 dairy farmers (men & women) were participated in the different programs and in which about 37.62% participants are agricultural women. The training program has positive influence on the dairy farmers' knowledge regarding breeding, feeding, health and clean milk production in buffaloes. The preparation of balanced feed for buffaloes, heat detection in the buffaloes, benefits of cloned buffalo semen are most popular events among the dairy farmers in the study area.

Dairy farmer's perceptions and profitability of rearing superior breeds of buffalo in Punjab

N Saxena, Guuraj M, F C Tuteja, T K Datta, Sanjit Maiti, Biswjith Sen, Mukesh Bhakat

The present study is planned to be conducted in four districts of Punjab, namely Amritsar, Taran Tarn, Firozpur, and Gurdaspur, owing to the presence of the Nili-Ravi breeding tract in this area. The study aims to achieve several objectives. Firstly, it seeks to examine the perceptions of farmers towards superior buffalo breeds available in Punjab and how these perceptions influence breed selection. Secondly, the study aims to analyze the profitability of different superior buffalo breeds found in the region. Finally, it intends to investigate the constraints faced by dairy farmers in maintaining their preferred buffalo breed. Throughout the period from January to December 2023, a structured questionnaire was developed and tested for the purpose of collecting primary data. Currently, primary data collection is underway in the selected districts as part of the ongoing research efforts.

Economic impact of Field Progeny Testing (FPT) program on Income of Murrah Buffalo farmers

Sanjay Kumar, Gururaj M, A Bharadwaj

The present study was designed to evaluate the impact of the Field Progeny Testing (FPT) program on the income of Murrah buffalo farmers in CIRB adopted villages in Haryana. The study outlined two main objectives: firstly, to analyze the costs and benefits


मोटे अनाजों का अंतर्राष्ट्रीय वर्ष - 2023


कार्यालय
सेवा महिला ग्राम संगठन
गाँव - रंगाला खंड - नावद
वैज्ञानिक विधि द्वारा भैंस प्रबन्धन प्रशिक्षण


ICAR-Central Institute for Research on Buffaloes
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ToT Unit

associated with the FPT program for Murrah buffaloes, and secondly, to assess the economic impact of the FPT program on the income of participating buffalo farmers. Both primary and secondary data were collected and analyzed to yield meaningful results. During the study period, primary data was gathered from both FPT and non-FPT villages using structured interview schedules. Specifically, 10 beneficiary dairy farmers were randomly selected from each of the 10 FPT villages, including Bichpari, Jewra, Juglan, Bado Patti, Khedi Barki, Bir Babran, Sarsod, Dhiktana, and Bugana. Similarly, 10 non-beneficiary dairy farmers were randomly chosen from non-FPT villages such as Dabra, Bhoda Khera, Dabri, Muklan, and Thaska. In total, 150 dairy farmers were interviewed, providing information on various aspects including socio-economic characteristics, herd size and composition, milk production, consumption and marketed surplus, breeding methods, number of artificial inseminations or natural services per conception, age at first calving, cost of milk production, and income from milk production. The collected data has been meticulously entered into an MS Excel sheet for further analysis.

Marketing dynamics of Murrah buffaloes and its impact on livelihood of dairy farmers in Haryana

Gururaj M, N Saxena, P C Lailer, Sanjay Kumar, Aiswarya S

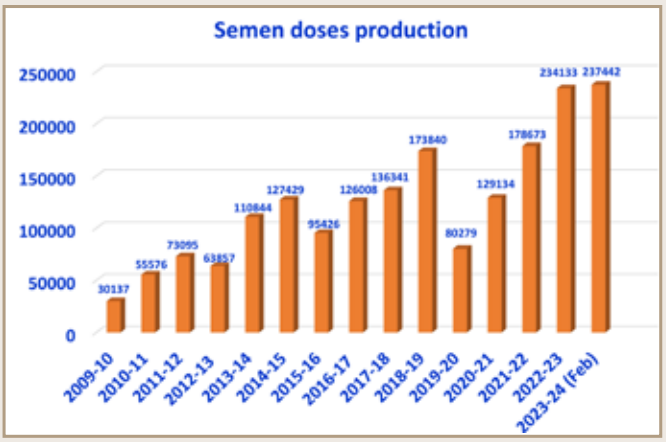
The present study is planned to be conducted across four districts of Haryana, namely Hisar, Jind, Bhiwani, and Rohtak, chosen due to the presence of the Murrah breeding tract in this region. The study has two primary objectives. Firstly, it aims to analyze the marketing dynamics surrounding superior quality Murrah buffalo within its breeding tract. Secondly, it seeks to assess the economic impact generated by the marketing of Murrah buffaloes in Haryana. To facilitate data collection, a structured questionnaire was developed for primary data collection during the period from August to December 2023. Additionally, efforts are underway to gather secondary data from published sources to supplement the primary data. Through this comprehensive approach, the study endeavors to shed light on the marketing strategies and economic significance of Murrah buffaloes in the specified regions, providing valuable insights for stakeholders in the dairy industry.

TECHNOLOGIES DEVELOPED AND THEIR TRANSFER TO END USERS

The institute has developed several technologies since its inception that were transferred to the farmers to increase the production and reproductive efficiency of their buffaloes. Many of the farmers trained in this institute are achieving ~60 % conception rates with the frozen semen from this institute. The developed technologies are also transferred through field visits, kisan melas, radio and TV talks and web portal based extension activities. Books, bulletins and popular articles are regularly written by scientists for dissemination of knowledge of scientific buffalo husbandry to the farmers. Some of the technologies which found acceptance with users are presented below.

Impact of quality semen produced by institute

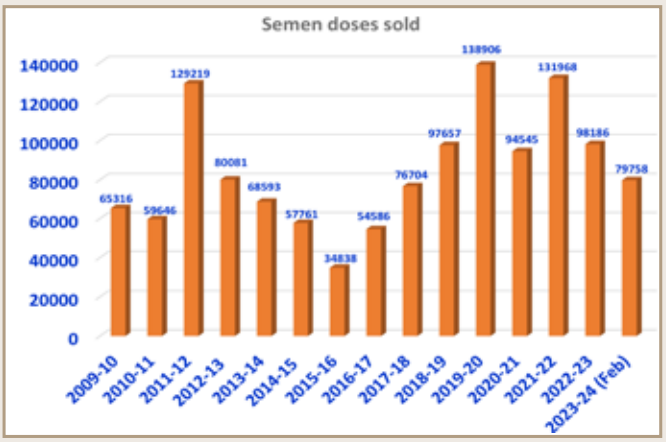
Institute maintains a high pedigreed herd of Murrah and Nili-Ravi buffaloes. The institute has been undertaking breed improvement programme through selective breeding since its inception. The genetic potential of bulls is evaluated through progeny testing. More than four lakh doses of frozen semen from test bulls and over sixty thousand doses from progeny tested bulls are available for Murrah breed improvement. High genetic merit Murrah and Nili Ravi bulls of have been supplied to various developmental agencies and village panchayats in 12 States for increasing milk production through genetic improvement. Under field progeny testing program in adopted villages, more than one lakh AIs were done so far with frozen semen of test bulls with conception rate of 48%. Year wise frozen semen production from Murrah bulls are indicated in the figure.



Number of frozen semen doses produced

Dissemination of quality germplasm (semen) for breed improvement

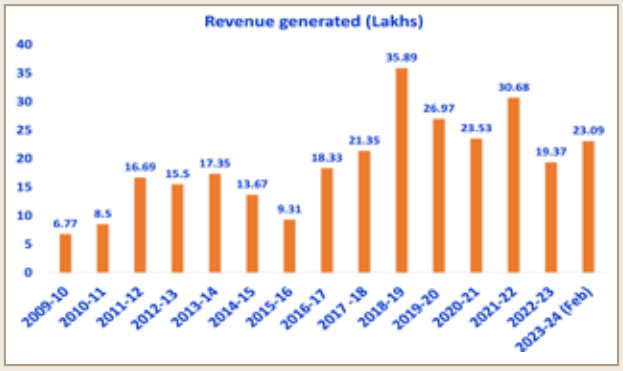
The quality semen cryopreserved from test bulls and progeny tested bulls having >50% post-thawed motility is used at our farm, Network centres and adopted villages for genetic improvement of the buffalo herd. The surplus quality frozen semen doses are being sold to farmers/stakeholders/ researchers to disseminate quality buffalo germplasm for improvement in the production of country buffaloes. Detail of the semen sold year wise depicted in the figure given below:



Number of frozen semen doses sold

Revenue generated through sale of semen

The frozen semen collected and cryopreserved at CIRB having huge demand and acceptability among the buffalo farmers due to good quality and farmers friendly environment in the institute. The CIRB earned more than rupees 182 lakhs from sale of frozen semen of Murrah bulls during a decades and details presented in the figure.



Revenue generation (Rs., lakhs) from sale of semen

Improved protocol for buffalo semen cryopreservation

A simple, reliable and economical method for freezing of buffalo semen has been developed and found to be effective to freeze the static ejaculates successfully, a phenomenon specific to buffaloes which greatly reduces the efficiency of utilization of buffalo semen for artificial insemination. A large proportion of buffalo semen ejaculates collected during summer months are rejected due to the high incidence of post-thaw backward motility of sperm cells. Through thorough investigations about the phenomenon, stage of glycerolization was identified to be the most critical step responsible for backward sperm motility. Glycerolization at room temperature during initial stage of semen dilution reduced/eliminated the backward motility due to which 20 percent more ejaculates could be preserved annually, thereby enhancing the frozen semen production. Overall semen freezing protocols improved resulting in almost 15% improvement in post-thaw motility and improved frozen semen quality and fertility on artificial insemination.

Further, novel cryopreservation protocol for buffalo sperm was developed by altering the freezing rates in 3-step cryopreservation protocol. Using this protocol, significant improvement in post-thaw sperm motility and kinetics parameters (average path velocity, straightline velocity, sperm elongation, total, progressive & rapid motility), sperm live percent, plasma membrane and acrosome integrity was obtained. Patent has been granted for this technology.

Sericin for improved semen freezing

Sericin is a water-soluble globular protein (a protein hydrolysate) derived from silkworm Bombyx mori. Supplementation of 0.25-0.5% sericin in semen extender improved frozen-thawed semen quality through protecting sperm from oxidative stress.

Ready to use buffalo semen extender

Egg yolk is most commonly used semen extender for semen cryopreservation. There are some limitations of egg yolk-based semen extender like wide variability of egg yolk composition, risk of microbial contamination, presence of high-density lipoproteins, calcium and steroids hormones. To solve the above stated problems, active ingredient of egg yolk was extracted and unwanted substances were removed from the egg yolk. Important additives were added and compared with raw egg yolk-based extender and found that customized extender showed better performance in terms of sperm motility and freezability compared to egg yolk-based extender. This technology is available at Agrinnovate (www.agrinnovateindia.co.in) for commercialization.

Reduced Buffalo Sperm Dosage for Artificial Insemination

This technology involved use of dilution (@12, 16 & 20 million sperm/straw) for field artificial insemination. In this technology the dilution buffalo on buffalo sperm showed no detrimental effect on sperm structural and functional parameters. Moreover, there was no difference in the field conception rate for the 3 doses. Reduction of sperm dosage per insemination pave way for efficient utilization of resources by increase cost benefit ratio with enhanced production of semen doses for wider dissemination of superior buffalo germplasm to the stakeholders to increase productivity.

Improved protocol for oocyte vitrification

Supplementation of BSA in place of FCS in maturation media ensures successful vitrification of in vitro matured oocytes. It has positive influence on post-thaw survival and maintenance of developmental competence of in vitro matured buffalo oocytes vis-à-vis FCS.

Area-specific mineral mixture

Surveys of feeding practices carried out in Haryana revealed deficiencies of essential minerals like calcium, phosphorus, zinc and manganese in 70 percent of buffaloes. On the basis of analysis of mineral intake vs requirement an area specific mineral mixture was developed. Seventy per cent of the buffaloes suffering from anaestrus conceived within a period of 2-4 weeks of feeding the area specific mineral mixture. The mineral mixture improves feed intake, milk production and reproductive efficiency. Institute has been preparing and selling mineral mixture to the farmers at no profit no loss basis.

Feeding standards for different categories of buffaloes

Feeding standards have been developed for different categories of buffaloes, viz. growing males, growing heifers, lactating buffaloes and pregnant buffaloes. Nutrient requirement for heat and humidity stress was also estimated and published.

RESMI- A Composite Feed Additive for Reducing Enteric Methane Emission and Enhancing Production Performances in Ruminants

A composite feed additive has been developed consisting of methane inhibitors and alternate hydrogen sinks for reducing methane emission and improvement in fibre utilization by ruminants. Supplementation of the composite feed additive can reduce methane emission significantly by reducing number of methanogenic archaea in rumen and promoting growth of alternate hydrogen utilizers like sulphate reducing bacteria. The feed additive stimulates rumen ecosystem by increasing microbial fibrolytic activity and thus increase fibre digestion, reduces rate of ammonia production in rumen with concomitant improvement in feed utilization and performance of buffaloes resulting in increase in growth rate by 10%, feed conversion efficiency by 15% and milk production by 10.42%. an Indian patent has been granted (Patent No. 388717, Dated February 8, 2022).

Ultrasonographic fetal sex determination in buffaloes

Ultrasonography guided fetal age and sex determination technology has been standardized. The accurate diagnosis can be made at 55 day of gestation in buffaloes in contrast to 50 days reported in cows.

Method for estimation of gestational age

By ultrasonography fetal age can be accurately assessed that is useful in better management of pregnant buffalo at the time of calving. The length of gestation in buffalo can be estimated by following standard chart that is developed for crown-rump length of buffalo fetus on different days postinsemination. When this plot was used for determining the age of fetus in pregnant buffaloes the exact date of mating/gestation could be predicted.

Ultrasonography for monitoring ovarian activity

The non-invasive technique of ultrasonographic scanning has been standardized for diagnosis of ovarian activity. This technique is very useful for follicular dynamics studies. With the use of this technique, time of ovulation can be predicted very precisely to allow fixed time insemination.

Early pregnancy diagnosis in buffaloes

A protocol has been standardized for establishment of early pregnancy diagnosis in buffaloes. With ultrasonic scanning, pregnancy could be diagnosed as early as 26 days post insemination. The technique can be used to assess date of service in case of unobserved mating.

Identification of molecular markers for MAS

RAPDs, Microsatellites and traits governing specific genes as growth hormone, seminal fluid protein gene specific primers based buffalo genome characterization done for identification of genetic diversity and markers for higher milk production and bull performance. A twenty nucleotide base pair length having di-nucleotide repeats have been identified showing polymorphic expression of milk production in low and high milk producing buffaloes. Study revealed more than 30 percent dissimilarity between high and low yielding buffalo genotypes.

OvSynch plus protocol for estrus induction in buffaloes

Anestrus, in pubertal heifers and postpartum buffaloes, is the primary cause for low reproductive and productive performance of buffaloes. The condition is associated with the presence of static ovaries and though follicular

development may occur, none of the ovarian follicles becomes mature enough to ovulate. In anestrus animals, doninant follicle (DF) undergoes atresia instead of ovulation. Analysis of ovarian response of anestrus buffaloes to 'Ovsynch' protocol revealed that only the buffaloes with a large DF (>9mm) at the time of first GnRH injection respond well to this treatment. However, such an accurate assessment of follicular size is difficult under field conditions with routine per-rectal palpation. Hence, to ensure consistently similar ovarian follicular picture of all anestrus buffaloes at the time of first GnRH injection, a new protocol was developed and named 'Ovsynch Plus.' In this protocol, an injection of PMSG is administered 72 h prior to the first GnRH injection of Ovsynch treatment, in order to support ovarian follicular development so that at least one large follicle is available after 72 h for responding to the GnRH injection with ovulation/ luteinization. Resulting luteal structure in the ovary is then subjected to luteolysis by PGF given 7 days later. Further administration of GnRH ensures synchronous ovulations of preovulatory follicles to allow fixed time insemination of treated animals.

The major advantage of this protocol is that it induces oestrus in cyclic as well as acyclic animals within a close window. Buffaloes not coming into estrus within the defined period following this protocol also become cyclic and get pregnant within one month of treatment, if initiated during breeding season.

Modified artificial vagina with temperature control

Embryo transfer technology

Efforts have been made in developing and improving the embryo transfer technology for buffaloes which has resulted in the production of 20 calves at this Institute. Technology for large scale production of *in-vitro* matured and *in-vitro* fertilized embryos using slaughter house ovaries has also been developed. The embryo cryoprservation technique has been standardized. This technique has been standardized for *in-vitro* maturation of oocytes obtained from abattoir ovaries followed by their *in-vtiro* fertilization and culture of the resulting embryos to transferable stage. The technique of IVF will be of immense use for faster multiplication of elite germplasm and progeny testing of bulls after collecting oocytes from live animals.

Use of OPU-IVEP in production of superior buffalo germplasm

Use of Ovum pick up-invitro embryo production (OPU-IVEP), in recent times has proven to be alternative method for propagate and disseminate superior germplasm, along with established techniques such as superovulation and embryo transfer. OPU-IVEP Technology, is an advanced reproductive technology for multiplication of superior female germplasm at much faster rate.

Scrotal circumference for bull selection

Scrotal circumference of Murrah buffalo males is highly correlated with age and body weight and it can, therefore, be used for pre-selection of breeding bulls at an early age. For mature (>600 Kg BW) Murrah buffalo bulls (n=86), mean SC values were 35.23 cm, with S.D. of 3.00. Therefore Murrah bulls having scrotal circumference <29 cm (Mean -2 S.D.) must be excluded from the breeding programme, while males with SC of over 41 cm (Mean +2 S.D.) should qualify as the best semen donors.

Super ovulation with ablation of dominant follicle

Superovulatory treatment in buffaloes starts from day 9-12 of the estrous cycle (Day 0 = Estrus). At this stage ovary invariably has a large dominant follicle (DF) ranging from 12- 15 mm that suppresses the growth of other subordinate follicles. During superovulatory treatment also this DF suppresses other subordinate follicles to grow in response to FSH treatment. This results in less number of preovulatory follicles at the time of insemination leading to less number of ovulations and embryos. Therefore, DF was ablated using ultrasound guided transvaginal follicle ablation technique prior to start of superovulatory treatment. This technique is minimal invasive and has no ill-effect on animal fertility. Ablation of DF results in better superovulatory response and establishment of pregnancies in recipients.

Sexing of IVF produced embryos

Sexing of *in-vitro* produced embryos was successfully done with PCR technique using bovine primers.

Micromanipulation of the embryos was done for obtaining biopsy for sexing.

Cloning of breeding bulls for semen production

Using cloning technology, it is possible to make multiple copies of outstanding bulls in the shortest possible time that could mitigate demand of proven semen. The institute produced Hisar-Gaurav, which is cloned of a superior breeding bull, in 2015. This cloned bull has started donating semen at the age of 22 months and qualifies all semen and fertility parameters. Using his semen, 20 progenies were produced that are healthy and normal. In addition to Murrah bull cloning, institute has cloned Assamese breeding bull, which is growing normal and healthy. The semen of this bull has also been collected and cryopreserved successfully with acceptable post-thawed sperm motility. Institute also produced seven cloned calf of M-29, superior bull and one re-clone of Hisar-Gaurav which is first report of its kind.

Repository of somatic cells

Three hundred somatic cell lines were established and cryopreserved from different buffalo breeds (Murrah, Nili- Ravi, Bhadawari) of both sexes. These primary cell lines were characterized using expression of cytoskeleton markers including vimentin for fibroblast origin type and cytokeratin for epithelial origin type. Cryopreserved cell lines would be a viable biomaterial for long term maintenance of elite germplasm, which have wide range of applications including cloning even after death of animal, induced pluripotent stem cells production and unlimited DNA/RNA/protein source for any research purpose. Frozen somatic cells were shared with ICAR-NBAGR, Karnal and these cell lines are also available for researchers on written consent.

DNA bank

DNA repository of about 412 buffaloes has been established at the institute for genome analysis. Phenotypic data on all the animal is being collected which shall be used for establishing linkages with performance traits and identification of molecular markers.

Induction of lactation

Farmers rear the dairy animals for milk production and livelihood but they are commonly facing the problems of conception failure, long calving interval, anestrous, cystic ovaries, specific abortions and repeat breeding. They can benefit by inducing such animals into lactation by induced lactation therapy. The buffalo is weighed and appropriate dose of hormones, Estradiol- 17b and progesterone @ 0.1 mg/kg body weight/day each, is calculated for seven days therapy, dissolved in absolute ethanol and stored. On the day of treatment, 1 ml of each hormone solution is administered subcutaneously in the morning and evening at an interval of 12 hours, for seven consecutive days. Thereafter, on day 17,19 and 21 of treatment, 10 ml Largectil injection and on day 16, 18 and 20, injection of 20 mg of Dexamethasone are also given intramuscularly. Between 15th and 21st day of treatment, udder massage is given for fifteen minutes each in the morning and evening daily till the udder is turgid with milk, which is usually around 21st day when milking is started. The milk becomes normal in physical and chemical properties within 10 -15 days of start of milking and the amount of milk yield increases with time. Almost 60-75 percent of the buffalo's milk yield potential can be achieved following induced lactation.

Colostrum feeding for higher growth and calf survival

Higher levels of immunoglobulins absorbed within 16 h of birth, reduce the mortality in calves and result in faster growth rate by 20-22 percent. High titre of circulating immunoglobulins in calves at an early age of 24 h showed the association with weight gain upto the age of 2 years. Status of immunoglobulin levels at such an early age could also predict the health status of calves. A critical level of these blood proteins required for the survival of calves has been assessed.

Antioxidants in survival and growth of neonates

Advanced pregnant (270 to 280 days' gestation), buffaloes are administered two doses of antioxidant micronutrients, consisting of vit A (Palmitate), vit D and vit E (dl- alpha 3 Tocopherol acetate, within 30 days before calving, at 15 days intervals. These buffaloes

secreted 25-80% more Ig protein in colostrum than control buffaloes. Calves born to treated buffaloes were also supplemented with mineral mixture @ 5 g/calf/day, colostrum feeding @ 10% of birth weight, concentrate mixture started 10 to 15 days after birth and green folder offered after 3 weeks, in order to achieve high growth rate and survival. Calves born to vitamins administered buffaloes and further supplemented with mineral mixture gained 10 percent higher body weight and 30% better immunity status. Calves bearing higher body weight and better immunity are economically more rewarding for meat and milk industry.

Uromol preparation

Uromol is a compound prepared by heating urea and molasses in the ratio of 1 : 3 and then mixing it with equal amount of wheat bran/deoiled rice bran. Four kg urea along with 12 kg molasses is slowly heated in a container for 30 minutes. Then equal amount (16 kg) of wheat bran or deoiled rice bran is mixed in it and the mixture is cooled to room temperature. This material contains 36 percent DCP and 72 percent TDN and can replace conventional compound feeds in the ration of buffaloes yielding 8-10 litres milk/day.

Urea molasses mineral blocks (UMMB)

Urea molasses mineral blocks are prepared in the same way as Uromol, except with the addition of mineral mixture, salt and binder. By *ad-lib* feeding these blocks along with other feed ingredients, about 20 percent of the conventional concentrate mixture can be saved. UMMB prepared by the 'cold process' technology has yielded even better results.

Superior isolates of anaerobic fungus

Superior isolates of anaerobic fungus were isolated and evaluated for ability to increase *in vitro* digestibility of straw by buffalo rumen microflora. Such isolates have the potential to be used as feed additives.

Enzyme supplementation

Fibrolytic enzyme supplementation can be used as feed ingredient in the concentrate mixture of calves to increase the growth rate. Further, the cost of enzyme can be reduced by using feed grade enzyme or enzymes used in textile industry (cellulase) and paper industry (Xylanase).

Thermal stress management

Microclimate modifications with supplementation of niacin @ 6 gms/day/animal, yeast @10 gms/day/animal and mustard oil @150 gms/day/animal; enhance milk production of lactating buffaloes by reducing thermal stress.

Marker based early detection of post-partum anestrus (PPA) in buffaloes

This technology has been granted patent 'An in vitro method for detection of postpartum anestrus condition in buffaloes' vide application No. 2940/DEL/2013CBR No. 10352 Docket No. 16369, patent granted on 05/02/2019. SNPs at position 251 of 5' untranscribed region of HSP70 gene has been used for assessing genetic predisposition to postpartum anestrus (PPA) condition in buffaloes. This tool can be used for selection of animals for breeding programs.

Mobile based App

The mobile based app on buffalo reproduction, nutrition and health has been developed and put in public to impart knowledge for buffalo owners and also a guide for VLDA and graduating veterinarians. The App provides basic information on different areas of buffalo reproduction, nutrition and healthfor better management of animals by farmers. . The App additionally provides answers on frequently asked questions under each section of buffalo reproduction. The three Apps is presently available in Hindi and English languages. Complete App content has audio backup with download facility.

The app is now placed on Google Play store on following link.

For buffalo reproduction app link : https://play.google.com/store/apps/details?id=com.cirb

For buffalo nutrition app link: https://play.google.com/store/apps/details?id=com.cirb.buffaloposhahar

For buffalo health app link: https://play.google.com/store/apps/details?id=com.cirb.buffhealth

e-Bhains Vigyan Kendra (ई-भैंस विज्ञान केन्द्र)

This portal is hosted at www.ebhainsgyan.cirb.res.in for two ways interaction between scientists and farmers. This interface has designed to substantiate CIRB's efforts towards use of ICT for popularizing buffalo farming and bridging gaps between end users and scientists. Under this project 'CIRB-Central Institute for Research on Buffaloes' YouTube channel was launched in July 2014. The channel has received overwhelming response from internet users with more than thirty thousand subscribers and more than 80 lakh views. The amateur 'e-lessons' by the Institute scientists themselves explains the processes in very simple and easy to understand language. 91% of the views have been accessed through mobile phones indicating huge penetration of these devices among the buffalo owners. The channel has more than seventy thousand subscribers.

Buffalopedia

(http://www.buffalopedia.cirb.res.in)

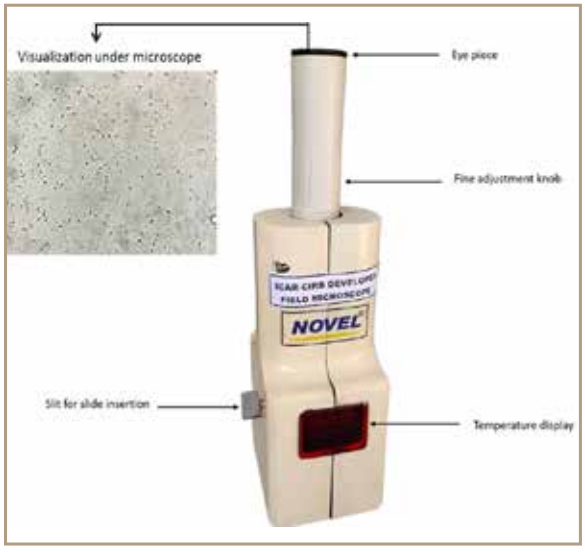
It is an internet accessible interactive instructional resource available free at the official website of the ICAR-Central Institute for Research on Buffaloes, Hisar (http://www.cirb.res.in). It is aimed at providing concise information on various aspects of buffalo statistics, breeds, health, reproduction, nutrition and management aspects. This web portal allows different stake holders in buffalo farming to use resources in an integrated and interactive learning manner on the internet. It presents facts, figures, demonstrations, examples, graphics and more regarding the concepts, practices and vocabulary used in buffalo husbandry in user-friendly formats. 'Buffalo e-library' is the main repository of information on various facets of buffalo husbandry, covering the broad areas of buffalo breeds, health, reproduction, nutrition, meat production and extension activities. Buffalopedia is CIRB's contribution towards the broader goal of rural upliftment through popularization of buffalo farming in the most scientific manner. It is an effort to address the need of providing comprehensive information on different aspects of buffalo rearing through ICT tools for wider access. Additionally, it will also give a platform for contributions by different stakeholders to the buffalo farming community. This computer application software is a ready to use technology which can be used by all stake holders through internet. The Buffalopedia has already got lakhs of hits since it was made online and has recorded more than 7.3 lakh visits.

Mobile based App 'ODK collect'

This is an android based smart recording tool for capturing animal related data from field and its transfer to CIRB based central bio-repository database. This collection of data will strengthen ongoing FPT Programme. The data can be immediately accessed by ICAR scientists in different locations through linking of all field units. The program has been customized at ILRI with help of CIRB scientists. Twenty netbooks loaded with complete application forms were distributed under CIRB- CGIAR collaborative project 'Genomic selection in Murrah buffaloes' (2016-18) among the FPT field workers in three Field Units under Network Project on Buffalo Improvement during October 2018.

Modified Artificial Vagina for semen collection from bulls

At the time of semen collection, some bulls take more time to donate the semen meanwhile the temperature of artificial vagina (AV) goes down from the required temperature. In that condition, the semen collector can change the AV to get better quality of semen. Routinely semen is collected in early morning and in winter season if the environmental temperature is very low in



Spermoscope, the field microscope for semen evaluation

the situation AV temperature also fall down rapidly in that condition, it helps to collector in change the AV to get better semen quality. Generally young bulls require low temperature of AV while mature bull requires high temperature of AV to donate good quality of semen. In that condition, semen collector can identify the bulls which one requires high or low temperature of AV. The temperature sensor is fixed in the AV in such a way that it does not hinder the semen collector at the time of semen collection. Further it does not hinder the washing and sterilization process of AV. This technology is available at Agrinnovate (www.agrinnovateindia.co.in) for commercialization. Intitute sold this technology to Chemtron Analytical Instruments Pvt Ltd, New Delhi on non-exclusive licence for production and sale to the users.

Field Microscope (Spermoscope)

High motile sperm in cryopreserved semen is essential for better conception rate in field condition through artificial insemination (AI). But there is no facility available to check the sperm motility of a semen dose that would be used to inseminate particular animals at the time of AI. Hence, keeping these difficulties in mind institute scientists designed a handy and portable microscope namely 'Field Microscope' of 'Spermoscope' especially for the evaluation of sperm motility in field condition. This technology is available at Agrinnovate (www.agrinnovateindia.co.in) for commercialization. Intitute sold this technology to Novel Industries, Ambala Cantt, Haryana on non-exclusive licence for production and sale to the users.

Preg-D: Buffalo Pregnancy Diagnosis Kit (Urine based)

The kit is a urine based novel technique for pregnancy diagnosis in dairy animals. The kit utilizes a simple thermophilic biochemical colour reaction in urine to diagnose pregnancy. It does not require any instrumentation and results can be interpret by naked eye. The kit is a very effective alternate method for identifying non-pregnant animals in the herd. The kit can be used by the farmer himself, so very useful in rural areas where it is very difficult to have a Veterinarian for pregnancy diagnosis.

RESEARCH PROJECTS AT CIRB

S.No.	Title	PI	Co-PIs	Duration
Animal Nutrition & Feed Technologies Division				
1.	Effect of Feeding Sugar Beet Pulp, and Guar Korma on Rumen Functions, Methanogenesis, Nutrient Utilization and Milk Production in Buffaloes.	Avijit Dey	PC Lailer, A Bharadwaj, TK Datta	March 22 - April 2024
2.	Genetic enhancement of energy sorghums for renewable fuels and fodders	AV Umakanth (ICAR-IIMR)	Avijit Dey; A Bellundagi, PG Padmaja, IK Das, S Srividya, CV Ratnavathi, J Jacob (ICAR-IIMR)	Aug 2021-July 2026
Animal Genetics & Breeding Division / Production Diseases/ Management/ Extension activities				
3.	Genetic improvement of Murrah buffaloes (Network project CIRB, Hisar Centre)	A Bharadwaj	Sanjay Kumar, P Kumar, RK Sharma, SK Phulia, Rajesh Kuamr, Rupali Rautela, Madhu Singh	Jul 1993 - Contd
4.	Genetic improvement of Nili Ravi buffaloes (Network project, CIRB Sub-Campus Nabha Centre)	FC Tuteja	MH Jan, R Mehta, N Paul, AS Habbu, SK Kakraliya	Jul 2001 - Contd
5.	Network Project on Bhadawari Buffaloes (IGFRI centre)	BP Kushwaha	IGFRI: Sultan Singh, Deepak Upadhyay	Apr 2001 - Contd.
6.	Progeny testing of bulls under field conditions (FPT) (CIRB Hisar)	A Bharadwaj	Sanjay Kumar	Apr 2001 - Contd
7.	Development of Soft Computing Tool for Dairy Buffalo Selection	S Balhara	AK Balhara, SK Phulia, Naresh Kumar	Apr 2021- Mar 2023
8.	Role of bacterial pathogens in subclinical mastitis in buffaloes	SK Khurana	Sanjay Kumar	Apr 2021 - Mar 2023
9.	Development of web tool for real-time field data collection and analysis for improved buffalo productivity and breeding management	Sunesh Balhara	Sanjay Kumar, A Bharadwaj, Vikash Vohra (NDRI), Puneet Malhotra (GADVASU), TK Datta, UB Angadi (IASRI), Mir Asif Iquebal (IASRI), Sarika (IASRI), Dinesh Kumar (IASRI)	Apr 2021 - Mar 2023
10.	National Agricultural Innovation Fund (Institute Technology Management Unit (ITMU)	SK Khurana	-	Apr 2008-Contd.
11.	Diversified farming through livestock and agriculture –Farmer First Programme	A Boora	PC Lailer, Sarita Yadav, RK Chaudhary, Bharat Singh, Jagan Singh Gora (ICAR-CIAH), Anil Kumar, Hanuman Ram (ICAR-CIAH), Manjeet Singh (IARI), Ramesh (CIAH), Mukesh Kumar (CIAH), SR Meena (CIAH),A Kumar (IASRI), Sukanta Dash (IASRI)	April 2022- March 2024
12.	Economic analysis of milk supply chain in buffalo production system	Gururaj Makarabbi	N Saxena, PC Lailer, Meeti Punetha, FC Tuteja	Feb 2021-Jan 2023
13.	Evaluation of potential plant-based agents for anti-biofilm and antimicrobial activities against major mastitis pathogens of buffaloes	Sarita Yadav	Ashok Boora, Sandip Kumar Khurana, Sunesh	Oct 2022-Oct 2024
14.	Economic Impact of Field Progeny Testing (FPT) Program on the Income of Murrah Buffalo Farmers	Sanjay Kumar	Gururaj Makarabbi, Anurag Bharadwaj	May, 2022 - April, 2024

S.No.	Title	PI	Co-PIs	Duration
15.	Production Systems, Agribusiness and Institutions: Component I - Impact Assessment of Agricultural Technologies, Sub-group: Livestock & Poultry	PS Birthal, ICAR-NIAP, New Delhi	Prem Chand, D. Bardhan CIRB: Gururaj M	2022 - 2026
16.	Dairy farmer's perception towards buffalo breeds and its impact on selection and profitability in Punjab	Navneet Saxena	Gururaj M, FC Tuteja, TK Datta ICAR-NDRI: Sanjit Maiti, Biswajit Sen	Sept 2022 - Aug 2024
17.	Applications of infrared Thermography as innovative non-invasive technological solution in early mastitis detection (NLM)	Sunesh Balhara	CIRB: AK Balhara, Sarita, SK Phulia, Ashok Boora, FC Tuteja, Rajkumar, SK Ambatipudi (IIT Roorkee)	April 2023- April 2026
18.	Marketing dynamics of Murrah Buffaloes and its impact on livelihood of dairy farmers in Haryana	Gururaj M	Navneet Saxena, Sanjay Kumar	Aug 2023- July 2025
	Animal Physiology & Reproduction Division			
19.	Buffalo sperm dosages in relation to its functional parameters and field fertility outcome	Sajjan Singh	P Kumar, Jerome A RK Sharma, Gururaj M	Mar 2018- Dec 2023
20.	Reproductive performance of Murrah buffaloes in relation to milk production	SK Phulia	RK Sharma, AK Balhara, A Bhardawaj, Sunesh Balhara	Feb 2020 - Jan 2023
21.	Establishment of DNA bank of Murrah and Nili-Ravi buffalo herd	D Kumar	Sanjay Kumar, Meeti Punetha, Rajesh Kumar, MH Jan, Madhu	Jan 2022 - Dec 2023
22.	Testing and validation of pregnancy diagnosis kit (PregD) in Mithun	AK Balhara	SK Phulia, RK Sharma	Nov 2020 - Oct 2023
23.	Molecular markers for improving reproduction of cattle and buffaloes (BMGF) - CIRB Centre (Lead Centre- NDRI, Karnal)	V Nayan NDRI: Rakesh Kumar	TK Datta, Anurag Bharadwaj, RK Sharma, AK Balhara, Rajesh Kumar	Aug 2018 - July 2023
24.	Production of double-muscled mass farm animals through CRISPR (NASF Project)	D Kumar	Meeti Punetha, PS Yadav, RK Sharma Rajesh	Jan 2021- Dec 2023
26.	Nutritional and physiological interventions for enhancing reproductive performance in animals (AICRP)	RK Sharma	SK Phulia, V Mudgal P Kumar, Jerome A	Apr 2020-Mar 2025
27.	Network Project on "Agricultural Bioinformatics and Computational Biology" (CABin scheme network project): Immunoreagent design, drug discovery and –omics approaches for buffalo production and reproduction	CIRB: Varij Nayan; IASRI: Mir Asif Iquebal	CIRB: Anurag Bharadwaj, S.K. Phulia, Rajesh Kumar; IASRI: Ratna Prabha	July 2020 - June 2025
28.	Investigating molecular basis of seasonal variation on seminal attributes for identification of probable biomarkers of semen quality in buffaloes (DBT project)	Pradeep Kumar (Lead centre-NDRI, Karnal)	D Kumar, Jerome A	Sept 2020 - Aug 2023
29.	Deciphering the functional role of OCT4 during buffalo embryogenesis using CRISPR/Cas9	Meeti Punetha	PS Yadav, Dharmendra Kumar, Gururaj Makarabbi	Feb 2021 - Jan 2023
30.	Fertility of Nili-Ravi buffaloes in relation to lactation, metabolic and environmental stressors.	MH Jan	FC Tuteja, RK Sharma, SK Phulia	Feb 2021- Jan 2023
31.	Consortium Research Platform on Agro-Biodiversity (NBAGR funded)	Meeti Punetha	D Kumar, PS Yadav	Feb, 2022-March 2026
32.	Use of OPU-IVEP in production of superior buffalo germplasm	Jerome A	RK Sharma, PS Yadav, D Kumar, M Punetha, Rajesh, Rupali	Jan 2022 - Dec 2023

S.No.	Title	PI	Co-PIs	Duration
33.	Enhancing economy of livestock farmers through AI using cloned buffalo bull semen (DBT Project)	PS Yadav	Sajjan Singh, Navneet Saxena, Hema Tripathi, Dharmendra Kumar, Pradeep Kumar, Jerome A, Gururaj M	Jan 2022 - Jan 2024
34.	Evaluation of semen characteristics and fertility parameters of cloned bulls and performance of cloned progenies (Phase-II) (NASF Project)	PS Yadav	D Kumar, RK Sharma, Pradeep Kumar, Meeti Punetha, Rajesh Kumar	June 2022 - April 2025
35.	Generation of predetermined sex buffalo embryos using CRISPR mediated gene editing technology	Meeti Punetha	-	Feb 2022 - Jan 2024
36.	Sequestrating X- and Y-sperm using receptor-ligand based approach in buffalo	Pradeep Kumar	TK Datta, Sajjan Singh, RK Sharma, Jerome A, D Kumar, Meethi Punetha	Oct 2022 - Sept 2025
37.	Deciphering the association of Milk Urea Nitrogen (MUN) with reproductive efficiency in lactating Murrah Buffaloes	SK Phulia	Avijit Dey, RK Sharma, AK Balhara	Sept 2023- Aug 2025
38.	Testing and Validation of Pregnancy Diagnosis Kits in Yak	AK Balhara	Vijay Paul, Mokhtar Hussain, Mihir Sarkar (NRC Yak) Co-PI: SK Phulia, Sajjan Singh, TK Datta	July 2023- June 2025
39.	Development of urine-based biosensor for pregnancy diagnosis in ruminants (NLM)	AK Balhara	RK Sharma, SK Phulia, MH Jan, Sunesh, Sarita Yadav, Rupali	April 2023- March 2026
40.	Establishment of Centre of Excellence by ICAR-CIRB	Jerome A	RK Sharma, D Kumar, Meeti Punetha, Rupali, Rajesh	August 2023- March 2026

IMPORTANT COMMITTEES

Quinquennial Review Team (QRT)

During 15 March 2023, by virtual meeting the QRT drafted the report and recommendations were discussed. QRT to have a physical meeting at ICAR-CIRB Hisar in the first week of May to finalize the report. Subsequently, on 11-12 May 2023 at ICAR-CIRB Hisar, a meeting was convened in hybrid mode, wherein QRT discussed thoroughly the recommendations and finalized the QRT report.

Composition of the QRT members

Chairman

Dr. P. Biswas, Ex-Vice Chancellor WBUAFS, Kolkata

Members

Dr. Kusumakar Sharma, Former ADG, ICAR, New Delhi
Dr. BK Joshi, Ex Director, NBAGR, Karnal
Dr. HK Verma, Former Director Extension, GADVASU, Ludhiana
Dr. Mahesh Chander, Joint Director (Extn), IVRI, Izatnagar
Dr. G. Dhinakar Raj, Professor & Head, TANUVAS
Dr. T.K. Datta, Director, CIRB Hisar

Member secretary

Dr. Navneet Saxena, Principal Scientist, ICAR-CIRB, Hisar

Research Advisory Committee (RAC)

The meeting was held at CIRB Hisar on June 1-2, 2023 in hybrid mode under the chairmanship of Prof. U.K. Mishra, where all the members participated physically at CIRB Hisar. Dr. NSR Sastry, joined the meeting virtually. All scientists from CIRB participated in the meeting:

The Chairman RAC, Prof. UK Mishra and all the Hon'ble members visited the CIRB Animal Farm on 1st June 2023, where they overviewed the feeding and management practices being followed, milk production and health status of the animals. After their visit to animal farm, all the members joined the meeting in committee room where Director, CIRB formally welcomed Hon'ble Chairman and members of RAC and other invitees to the XXVI RAC meeting. The Chairman, suggested that the institute should continue to further strengthen research relating to breed improvement, buffalo cloning technology, feed efficiency, unconventional feeds and fodders, methane mitigation, genomic selection, calf management, improvement of reproductive efficiency and dissemination of technologies and scientific knowledge on improved buffalo husbandry practices to the farmers.

Composition of RAC members

Chairman

Dr. U.K. Mishra, Ex-Vice Chancellor, Chhattisgarh Kamdhenu University, Raipur

Members

Dr. Arjava Sharma, Ex-Director, NBAGR, Karnal
Dr. S.S. Kundu, Ex-Head, DCN, NDRI, Karnal
Dr. N.S.R. Sastry, Ex-Prof. NIRD Hyderabad

Dr. S.V.N. Rao, Ex-Prof. Pondicherry Veterinary College, Puduchery

Dr. V.K. Saxena, ADG (AP&B), ICAR, New Delhi

Dr. Madan Lal, Farmers' Representative

Mr. Manish Kumar, Farmers' Representative

Dr. T.K. Datta, Director, CIRB Hisar

Member Secretary

Dr. Avijit Dey, Principal Scientist, CIRB, Hisar

Institute Management Committee (IMC)

The proceedings of 29th meeting of IMC held on 20 March 2023 to discuss the action taken report on 28th meeting of IMC, Publication charges, briefing the IMC about Institute research activities and others.

Chairman

Dr. T.K. Datta, Director, CIRB Hisar

Member Secretary

Sh. Raj Kumar, Senior Administrative Officer, CIRB, Hisar

Institute Research Committee (IRC)

IRC meeting of the institute was conducted under the chairmanship of Dr. T.K Datta. Director ICAR-CIRB during 20-21 July 2023 at ICAR-CIRB, Hisar as per meeting schedule. A follow up meeting to discuss few projects was conducted on 4 August 2023. Total of 40 projects from different divisions were discussed.

Chairman

Dr T.K. Datta, Director, CIRB, Hisar

Member Secretary

Dr. SK Khurana, In Charge, PME cell

PATENTS/ COPYRIGHTS/ TRADEMARKS

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भारत सरकार
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THE PATENT OFFICE
पेटेंट प्रमाणपत्र
PATENT CERTIFICATE
(Rule 74 of The Patents Rules)

पेटेंट सं. / Patent No.	:	411766
आवेदन सं. / Application No.	:	201711039431
फाइल करने की तारीख / Date of Filing	:	06/11/2017
पेटेंटी / Patentee	:	Indian Council of Agricultural Research (ICAR)

प्रमाणित किया जाता है कि पेटेंटी को, उपरोक्त आवेदन में वर्णनकरित PROCESS FOR IMPROVING BUFFALO SPERM VIABILITY नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख नवम्बर 2017 के छठे दिन से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled PROCESS FOR IMPROVING BUFFALO SPERM VIABILITY as disclosed in the

Application/ Patent/ Registration No.	Name of Innovation / Technology	Date of Grant/ Filing	Inventors
Patent Granted			
2940/DEL/2013	An in vitro method for detection of postpartum anestrus condition in buffaloes	Granted on 05.02.2019	Rajesh Kumar, AK Balhara, M Gupta, SK Phulia, RK Sharma, Inderjeet Singh
1840/DEL/2013	BUFCOL-A complete diet for enhanced survivability and growth of neonatal buffalo calves	Granted on 21.11.2019	P Sikka, D Lal, S Khanna, RK Sethi
364236	Peptide sequence and polyclonal antibodies for the detection of cow and buffalo luteinizing hormone	Granted on 09.04.2021	Varij Nayan, Suneel Kumar Onteru, Dheer Singh
201711046302	Composite feed additive for reducing methane emission and improving fibre utilization in ruminants	Granted on 08.02.2022	Avijit Dey, SS Paul, SS Dahiya, AK Balhara, Jerome A, BS Punia and YM Chanu
408952	Mangifera indica flower panicles' extract stabilized gold nanoparticles and method for making the same.	Granted on 12.10.2022	Varij Nayan, SK Onteru, Deer Singh
201711039431	Process for improving buffalo sperm viability	Granted on 17.11.2022	Ravindra Kumar, Jerome A, Pradeep Kumar, Monika Saini, Dharmendra Kumar, RK Sharma, Inderjeet Singh
474562/2023	Development of an in-house built lamp assay for rapid detection of cow components adulterated in buffalo milk/ meat	Granted on 29.11.2023	Rajib Deb, Umesh Singh, Sushil Kumar, AK Das, T V Raja, Rafeeque Rahman Alyethodi, Rani Alex, Gyanendra Sengar, B Prakash
Copyright Granted			
SW-17701/2023	Copyright granted for computer software Work for SIReDAM software	Granted on 07.12.2023	UB Angadi, Umesh Singh, M A Iquebal, TV Raja, Sarika, Sushil Kumar, AK Das, Rani Alex, Abhijit Mitra, Anil Rai, Dinesh Kumar
Patent Filed			
1451/DEL/2015	Kalrump Scale - A device to measure Buffalo rump angularity for identification of dairy characters	Filed on 07.01.2017	SN Kala
202011013074	Urine based pregnancy detection method for ruminant livestock animals.	Filed on 25.03.2020	AK Balhara, Suman, Archana, Rajesh Kumar, Mayukh Ghosh, SK Phulia, RK Sharma, P Sikka, Sunesh Balhara, Sudershan Kumar, AK Mohanty, Inderjeet Singh, SS Dahiya

HUMAN RESOURCE DEVELOPMENT

Human Resource Development

Nodal Officer: Dr. Avijit Dey, Pr. Scientist
Co-Nodal Officer: Dr. Jerome A, Sr. Scientist

The objectives of human resource development programmes are to develop professional, impartial, effective and efficient DARE/ICAR personnel responsive to the needs of the farmers, citizens and other stakeholders and help in realizing organizational mandate and vision. Considering this, HRM Unit of ICAR has been set up for monitoring and implementation of ICAR HRM Policy for training and capacity building of the staff of ICAR from time to time though HRD unit set up in different ICAR institutes. The role of HRD unit at the institute level is to organize, facilitate and implement training programmes to all the employees of the institute. During the year 2023, HRD unit of ICAR-CIRB has facilitated the training of **4 Scientists and 1 Technical officers** of the institute.

S.No.	Employee Name / Designation	Training Details	Place and Period of Training
Scientific Staff			
1.	Dr. TK Datta Director	Executive Development Program	ICAR-NAARM, Hyderabad [21-26 August 2023]
2.	Dr. Sarita Yadav Senior Scientist	Data Science in Agriculture	ICAR-IASRI, New Delhi [9 - 15 September 2023]
3.	Dr. Meeti Punetha Scientist	Basic Bioinformatics Tools for Genome Analysis	ICAR-NBAGR, Karnal [16-20 October 2023]
4.	Dr. Aishwarya S Scientist	On line training 'NSSO Unit Level Data Utilization, organized by Stats2Econo	[11 November - 16 December 2023]
Technical Staff			
1.	Dr. N Paul, Senior Technical Officer	Motivation, Positive Thinking and Communication Skills for Technical Officers of ICAR (T-5 & above)	ICAR-NARM, Hyderabad [11-15 September 2023]

PUBLICATIONS

Environmental Science and Pollution Research (2023) 30:125510–125525
https://doi.org/10.1007/s11356-023-31089-0

RESEARCH ARTICLE

Reduction of methane and nitrogen emission and improvement of feed efficiency, rumen fermentation, and milk production through strategic supplementation of eucalyptus (*Eucalyptus citriodora*) leaf meal in the diet of lactating buffalo (*Bubalus bubalis*)

Sandeep Sheoran[1,2] · Avijit Dey[1] · Sonia Sindhu[2]

Research Articles

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Presentations in Conference / Symposium / Workshop

Abstracts

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Book / Manual / Compendium

- Datta TK, Bharadwaj A, Kumar S, Ram Chander (2023). Annual Report - Network Project on Buffalo Improvement, 2022-23 and Project Coordinator's Observations, ICAR-CIRB Hisar.
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- Dey A, Kumar S, Jerome A, Gururaj M, Punetha M, Jan MH, Kumar K. ICAR-CIRB Annual Report 2022. (ISBN No. 978-81-966640-8-4; Publication no. 01/2023).
- Gururaj M, Balhara S. Yadav S, Balhara A K (2023). ICAR-CIRB newsletter January-June, 2023. ICAR-Central Institute for Research on Buffaloes, Hisar, Haryana-125001, India.
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- Gururaj M, Ana Raj J, Saxena N, Chikkathimme Gowda H R, Amrutha T (2023). Policy strategies to develop agri-business in Buffalo meat export in India, published in a book Prospects of agri startups in India, ISBN No: 9789355403858. Kalyani publishers. pp.129-136.
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- Mishra DC, Bhati J, Yadav S, Avashthi H, Sikka P, Jerome A, Balhara AK, Singh I, Rai A, Chaturvedi

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Popular / Technical articles / Press release

- Dey A, Jerome A, Paul SS (2023). Connecting Animal Reproduction with Immune Function, Nutrition and Health. In 32nd ISSRF Newsletter 2023. pp.39-41.
- Habbu AS, Paul N (2023). Metritis in Buffaloes: A menace to Dairy Industry. Indian Dairyman, Issue October 2023, pp. 44-46.
- Jerome A, Kumar P, D Kumar, Shivani, Renu Bala, Nisha Verma, RK Sharma (2023). Genetic & Epigenetic Markers Regulating Animal Reproduction. In 31th ISSRF Newsletter February 2023. pp. 96-99.
- Jerome A (2023). Points of Conjunction between Reproduction and Immunology. In 32nd ISSRF Newsletter 2023. pp. 01-02.
- Paul N, Jan MH, Habbu AS, Tuteja FC (2023). Current Concepts in Uterine Defense Mechanism in Bovines. ISSRF Newsletter, Issue 32: 49-51.
- Shivani, Bala R, Verma N, Kumar D, Nain S, Jerome A, Kumar D, Kumar P (2023). Impact of season on immune functions. In 32nd ISSRF Newsletter 2023. pp. 02-04.
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Invited / Lead lectures

- Kumar D (2023). Genome Editing Technologies in Livestock IDP-NAHEP sponsored national workshop from August 07 to 13, 2023 at Animal Biotechnology Division, ICAR-National Dairy Research Institute, Karnal on 12th August, 2023.
- Kumar D (2023). Overview of genome editing and its application in livestock. In Winter School organized by GADVASU, Ludhiana collaborated with Research and Teaching Experience (CREATE) program me funded by The Natural Sciences and Engineering Research Council of Canada (NSERC) on 28th February, 2023.
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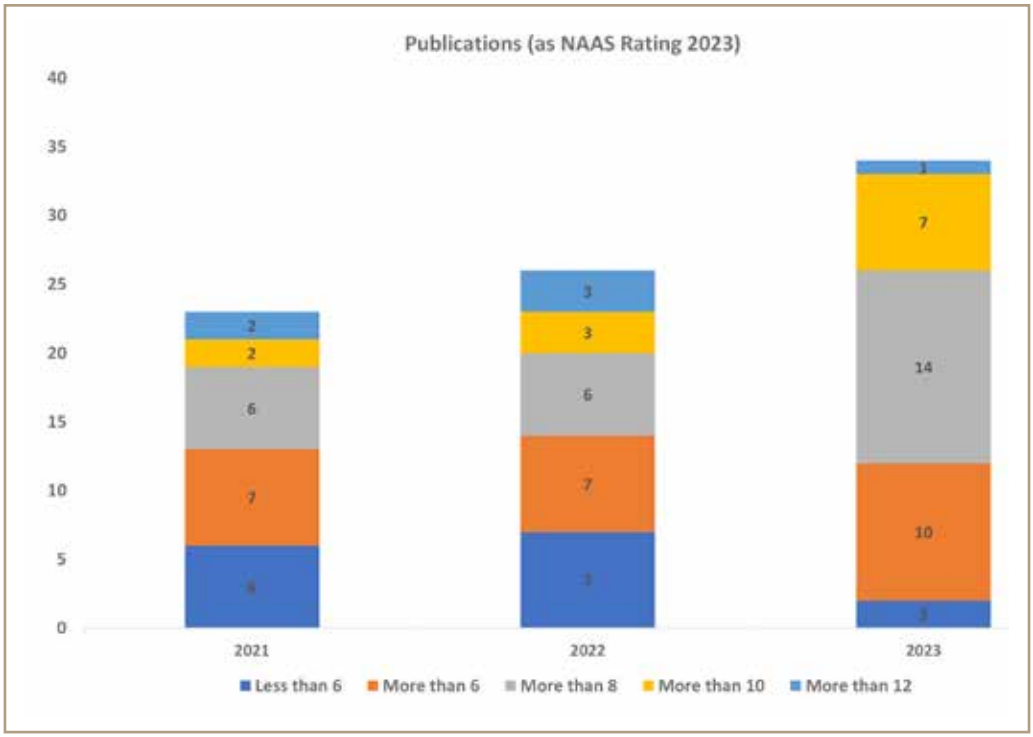


AWARDS/RECOGNITIONS/ FELLOWSHIPS

Award/ Recognitions	Name of scientist
Early Career Reviewer – Reproduction and Fertility Journal.	Jerome A
Acted as Co-Chairman in Bovine Fertility and Obstetrics Technical Session at ISSAR Conference 2023 held during 6th-8th December, 2023, Mannuthy Kerala.	
Received "Best Poster Presentation Award" (First Prize) in the "XII ANA Conference" during Feb. 16-18, 2023 at DUVASU, Mathura.	Thakur S, Dey A, Berwal, RS. and Singh, RK
Received "Best Poster Presentation Award" (Second Prize) in the "XII ANA Conference" during Feb. 16-18, 2023 at DUVASU, Mathura.	Singh, RK., Dey, A., Singh, M., Thakur, S. and Lailer, PC.
Awarded as the Fellow of Animal Nutrition Association (FANA) in the "XII ANA Conference" during Feb. 16-18, 2023 at DUVASU, Mathura.	Avijit Dey
Awarded Best Oral Presentation Award during the National Conference by Indian Society for Buffalo Development during 27th-28th October, 2023 at DUVASU, Mathura.	Supriya Chhotaray
Best oral presentation award during the National conference by Indian Society for Buffalo Development (ISBD) during 27th-28th October, 2023 at DUVASU, Mathura.	Kushwaha BP
Acted as Co- Chairman at "International Conference On Feeding the Future through Sustainable Eco-friendly Innovations in Rangeland, Forages and Animal Sciences, 2nd-4th December, 2023, UAS Bangalore.	
Member of Institute Management Committee of ICAR-CSWRI, Avikanagar.	
Member of Institute Management Committee of ICAR-NBAGR, Karnal for 3 years.	Umesh Singh
Chaired session in National Conference on Natural and Organic Farming for ecological, economical and Nutritional Security held at CSKHPKV, Palampur during 7th-9th June,2023.	
Acted as Chairman for the best of poster presentation in the first technical Session of National Conference of Indian Society of Animal Genetics and Breeding 2023 held at ICAR-NBPGR, Karnal during 16th-17th November, 2023.	
Received "Best Poster Presentation Award" (Second) during the National Conference by Indian Society for Buffalo Development during 27th-28th October, 2023 at DUVASU, Mathura.	Jinagal S, Dutt R, Sharma M, Saini S, Chaudhary S, Punetha M, Thakur S, Kumari N, Kumar P, Kumar D and Yadav PS
Received Best Scientist Award from ICAR-CIRB, Hisar on 15th August, 2023.	Kumar D
Received ICAR Award for leading technology developed (Preg D Urine based pregnancy diagnosis kit) during the ICAR Foundation & Technology Day held on 16th July 2023.	Ashok Balhara
Received Distinguished Scientist award during the National Conference by Indian Society for Buffalo Development during 27th-28th October, 2023 at DUVASU, Mathura.	
Awarded Best paper presentation award during XXXI Annual Conference & Symposium, Society of Animal Physiologists of India (SAPICON-2023) at Division of Veterinary Physiology, FVSc & AH, SKUAST – Kashmir during 3rd -5th May 2023.	Pradeep Kumar
Received Best Oral Presentation Award at International Extension Education Congress – 2023 held at SKN Agricultural University, Durgapur, Rajasthan during 18-20 December, 2023	Aiswarya S

EVENTS

Organizing Trainings/meetings/ seminars/ symposia/ conferences

- One Day Training Program on "CRISPR mediated Genome Editing: Strategies for Livestock Improvement" Sponsored by Science and Engineering Research Board: A statutory body under DST, Govt. of India, on January 18, 2023. Co-ordinators: Dr. Meeti Punetha and Dr. Dharmendra Kumar
- 20th Annual Review Meet of Network Project on Buffalo Improvement, 8th December, 2023 at ICAR-CIRB, Hisar (Co-ordinators: TK Datta, Umesh Singh, Sanjay Kumar, Supriya)
- Meeting of Project coordinator, NPBI and NPBI team members at Surti Unit Vallabhnagar (RAJUVAS) on 23rd February 2023 (Co-ordinators: TK Datta, Sanjay Kumar)

Participation in conferences/ workshops/meetings

Event	Date	Venue	Participants
Online Livestock Epigenomics Workshop	31 March, 2023	Roslin Institute, The University of Edinburgh	Jerome A
XII Biennial Conference of Animal Nutrition Association	16-18 February, 2023	DUVASU, Mathura	Avijit Dey, Lailer PC
Interface Meeting between Industry and academia	07 December, 2023	ICAR-NDRI, Karnal	Avijit Dey
National Conference of Indian Society of Buffalo Development,2023	27-28 October, 2023	DUVASU, Mathura	Yadav PS, Kumar D, Pradeep Kumar,
National Conference of Indian Society of Animal Genetics and Breeding 2023	16-17 November, 2023	ICAR-NBAGR, Karnal	Umesh Singh, Supriya Chhotaray
International Conference On Feeding the Future through Sustainable Eco-friendly Innovations in Rangeland, Forages and Animal Sciences	02-04 December, 2023	University of Agriculture Sciences, Bangalore	Kushwaha BP
Agricultural Science Congress	10-13 October, 2023	ICAR-CMFRI, Kochi, Kerala	Kumar D, Ashok Balhara
XXXI Annual Conference & Symposium, Society of Animal Physiologists of India (SAPICON-2023)	03-05 May, 2023	SKUAST, Srinagar, Kashmir	Pradeep Kumar
Workshop on gene editing of mammalian cells	02 March, 2023	ICAR-NDRI, Karnal	Yadav PS, Kumar D
Foundation Day and Institute Industry Meet of ICAR and Institute	16-18 July, 2023	NASC Complex, New Delhi	Umesh Singh
IMC meeting, ICAR-CSWRI, Avikanagr	21October, 2023	NTRS, Garsa, Kullu	
IMC meeting, ICAR-NBAGR Karnal	5 January, 2024	ICAR-NBAGR Karnal	
IMC meeting ICAR-CIRG, Makhdoom	24 January, 2024	ICAR-CIRG, Makhdoom	
20th Annual Review Meeting of Network Project of Buffalo Improvement	8, December, 2023	ICAR-CIRB, Hisar	
SCSP Program at ICAR-CIRC, Meerut	June, 2023	ICAR-CIRC, Meerut	
ISSAR Annual convention and International Symposium on "Frontiers in Theriogenology: Research and Practice	6 - 8 December, 2023	College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala	Pradeep Kumar, Jerome A
International Extension Education Congress – 2023	18-20 December, 2023	SKN Agricultural University, Durgapura Campus, Jaipur , Rajasthan	Aiswarya S

Farmers Trainings organized

S. No.	Training title	Date	No. of participants	Co-ordinators
1.	Improved buffalo husbandry practices	22-28 February, 2023	21	Sharma ML, Sanjay Kumar and Madhu Singh
2.	Scientific buffalo husbandry practices	13-17 March, 2023	30	Phulia SK, Gururaj M and Ram Chander
3.	Package of practices for Nili-Ravi buffalo milk production	13-20 March, 2023	30	Tuteja FC, Mustaf Jan
4.	Women farmer buffalo husbandry practices	16-18 May, 2023	65	Sharma ML and Saxena N
5.	Scientific buffalo husbandry practices	7-13 June, 2023	16	Sharma M L and Saxena N
6.	Scientific buffalo husbandry practices	8-14 August, 2023	20	Varij, Rajesh Kumar and Sharma M L
7.	Scientific buffalo husbandry practices	9-11 October, 2023	40	Yadav P S, Jerome A and Gururaj M
8.	Improved buffalo husbandry practices	16-18 October, 2023	41	Yadav P S, Jerome A and Gururaj M
9.	Improved buffalo husbandry practices	25-31 October, 2023	15	Sharma M L and Saxena N
10.	Scientific buffalo husbandry practices	28-30 November, 2023	52	D Kumar, Pradeep Kumar and Gururaj M
11.	Improved buffalo husbandry practices	6-8 December, 2023	51	D Kumar, Pradeep Kumar and Gururaj M
12.	Scientific buffalo husbandry practices	18-22 December, 2023	20	Gururaj M, Aiswarya S, Saxena N and Ram Chander

Kisan Gosthis

S. No.	Date	Title of the event	Number of participants	Venue	Co-ordinators
1.	23-02-2023	Kisan gosthi and frontline demonstration	60	Kevalpur village Chittorgarh	SK Phulia, AK Balhara and Gururaj M
2.	24-02-2023	Kisan gosthi	60	Roba village, Udaipur, Rajasthan	SK Phulia, AK Balhara and Gururaj M

Participation in mela

S. No.	Particulars	Date
1.	Pashu mela, Muzzafarnagar	6-7 April, 2023
2.	Dairy mela, ICAR-NDRI, Karnal	8 April, 2023

Vice President of India visited ICAR-CIRB, Hisar

Hon'ble Vice President of India, Sh. Jagdeep Dhankhar Ji, and Dr. (Smt.) Sudesh Dhankhar visited ICAR-CIRB, Hisar, on 26th December, 2023 and addressed the farmers, scientists, students, and staff of the institute. Sh. Bandaru Dattatraya Ji, Governor of Haryana, Sh. Kailash Chaudhary Ji, Minister of State for Agriculture, GoI and Dr. Kamal Gupta, Minister of Urban Development & Housing, Govt. of Haryana were also present on the occasion. The dignitaries were welcomed by Dr. T.K. Datta, Director, ICAR-CIRB. Hon'ble VPI acknowledged the contributions of the farmers of the country in transforming India from being a food-deficit nation to a self-sufficient, food-secure country. He also acknowledged and appreciated ICAR's unwavering commitment to technological development and cutting-edge research delivered to the farming community. In his address, he also emphasized on the importance of fostering demand-driven agriculture, implementing effective marketing mechanisms, and promoting value addition of agricultural produce.

DDG (AS) Dr. JK Jena Visited ICAR-CIRB, Hisar

Dr. JK Jena, DDG (AS), ICAR visited ICAR-CIRB on 8th December, 2023 and chaired the 20th Annual Review Meeting of Network Project on Buffalo Improvement (NPBI). Dr. GK Gaur, ADG (AP&B) and Dr. HK Narula from ICAR HQ also joined the meeting online. Dr. TK Datta, Director and Project Coordinator presented the overall progress of the project. PIs and Co-PIs from different participating centres of NPBI on Murrah, Nili-Ravi, Bhadawari, Jaffrabadi, and Surti units joined the meeting and presented their respective centre's annual progress. DDG (AS) also visited the Animal Farm Section at ICAR-CIRB, and addressed all the scientists and staffs of ICAR-CIRB. DDG (AS) emphasized on enhancing research productivity of scientists and motivated all the staffs of ICAR-CIRB, Hisar with his inspiring speech.

ICAR-CIRB Hisar Collaborates with Nepal Government to Enhance Buffalo Quality through Exchange Program

ICAR-CIRB Hisar gifted 15 Murrah Buffalo bulls to Govt. of Nepal on 7th November, 2023 in an effort to increase the milk production efficiency of Nepal's Buffalo breeds such as Terai, Lime, Gadi and Parkote. Four members delegation from Nepal headed by Dr Samjhana Kumari Kafle, Director General & Joint Secretary, Department of Livestock Services, Lalitpur (Nepal) visited ICAR-CIRB for completing all the necessary formalities for the transfer of the bulls and thanked Government of India and ICAR for extending help for improving their buffaloes.

ICAR-CIRB Welcomed Three Newly Appointed Heads of the Divisions: Advancing Buffalo Research Expertise

ICAR-CIRB, Hisar welcomed newly appointed heads of the Division on 30th October, 2023: Dr. Avijit Dey, Division of Animal Nutrition and Feed Technologies; Dr. Umesh Singh, Division of Animal Genetics and Breeding; Dr. Yash Pal, Division of Animal Physiology and Reproduction. Their expertise promises innovative strides in buffalo research, optimizing nutrition, breeding, and reproduction for healthier and productive herds.


होली
मिलन
7 मार्च, 2023


Independence Day


MILLETS
हिन्दी सप्ताह
से 22 सितम्बर, 2023

ICAR-CIRB JOURNAL CLUB

The ICAR-CIRB Journal Club offered a diverse array of topics accessible to a wide audience. These lectures served as a gateway to the latest advancements in science and humanity, catering to the interests and needs of various stakeholders. Each session provided a platform for engaging discussions and knowledge exchange, fostering a vibrant intellectual community. With topics ranging from cutting-edge scientific research to broader societal issues, the club ensured that its deliberations remain relevant and enriching for all participants. Eminent speakers from diverse backgrounds were invited to contribute their perspectives and insights by keeping the discourse open and inclusive. Through these regular gatherings, the club not only disseminated knowledge but also cultivated a culture of continuous learning and exploration. It sparked curiosity and inspired attendees to delve deeper into areas of interest by addressing a wide range of subjects. ICAR-CIRB Journal Club's monthly lectures served as a cornerstone of intellectual enrichment and community engagement, providing a platform for lifelong learning and discovery.

Lecture No	Topic	Speaker
1.	Making of an Embryo: All that Glitters are not Gold	Datta TK
2.	Science, Technology & Innovation :Impact of Education Skills and Work with Human Interface	Yadav PS
3.	Bull Fertility Prediction: How Close We Are?	Kumaresan A
4.	Officer's like Qualities	Singh KP
5.	Bhadawari: The Buffalo Known for High Milk Fat	Kushwaha BP
6.	Data Driven Dairy Production Systems: Smart Dairy Farming	Mohanty TK
7.	The Saviour of GI tract: Prebiotics	Samanta AK

DISTINGUISHED VISITORS AT ICAR-CIRB

- His Excellency Shri. Jagdeep Dhankhar, Vice President of India
- His Excellency Shri. Bandaru Dattatreya, Governor of Haryana
- Shri Kailash Choudhary, Union Minister of State for Agriculture and Farmers Welfare
- Dr. Kamal Gupta, Minister, Govt. of Haryana
- Dr. Vinod Kumar Verma, Vice-Chancellor, LUVAS, Hisar, Haryana
- Dr. SL Goswami, Ex-Director, ICAR-NAARM, Hyderabad
- Dr. Dheer Singh, Director, ICAR-NDRI, Karnal, Haryana
- Dr. BP Mishra, Director, ICAR-NBAGR, Karnal, Haryana
- Dr. RK Yadav, Director, ICAR-CSSRI, Karnal, Haryana
- Dr. RK Sethi, Ex- Director, ICAR- CIRB, Hisar, Haryana
- Dr. Samjhana Kumari Kafle, Department of Livestock Services, Nepal
- Dr. Jagdish Pandeye, Department of Livestock Services, Nepal
- Dr. Rajesh Yadav, Department of Livestock Services, Nepal
- Mr. Shiva Nash Mahato, Department of Livestock Services, Nepal

ACADEMIC AND RESEARCH COLLABORATIONS

S. No.	University/Institute/Organization entering in MoU	Scope of Collaboration	Date of Signing MoU with ICAR- CIRB Hisar
1.	Rajasthan University of Veterinary and Animal Sciences, Bikaner (Rajasthan)	Academics and Research (UG teaching and PG research)	18-05-2019
2.	Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (Punjab)	Academics and Research	09-01-2012
3.	Hitech Sach Dairy, Sirsa (Haryana)	Biotechnological research - buffalo cloning	02-01-2019
4.	Punjab National Bank Farmers Training Centre, Sacha Kheda (Jind)	Training and extension	19-11-2019
5.	Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.)	PG Research	01-09-2018
6.	Bihar Animal Sciences University, Patna (Bihar)	Academics and Research	05-07-2018
7.	Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar (Haryana)	Academics and Research	09-05-2014
8.	Lovely Professional University, G.T. Road, Phagwara, Punjab	Academics and Research	24-06-2022
9.	Uttarakhand Council for Biotechnology, Haldi, Uttarakhand	Academics and Research	20-03-2023
10.	Association for Innovation Development of Entrepreneurship in Agriculture (a-IDEA), NAARM, Hyderabad	Research and Transfer of Technology	23-08-2023

STUDENT RESEARCH AT CIRB

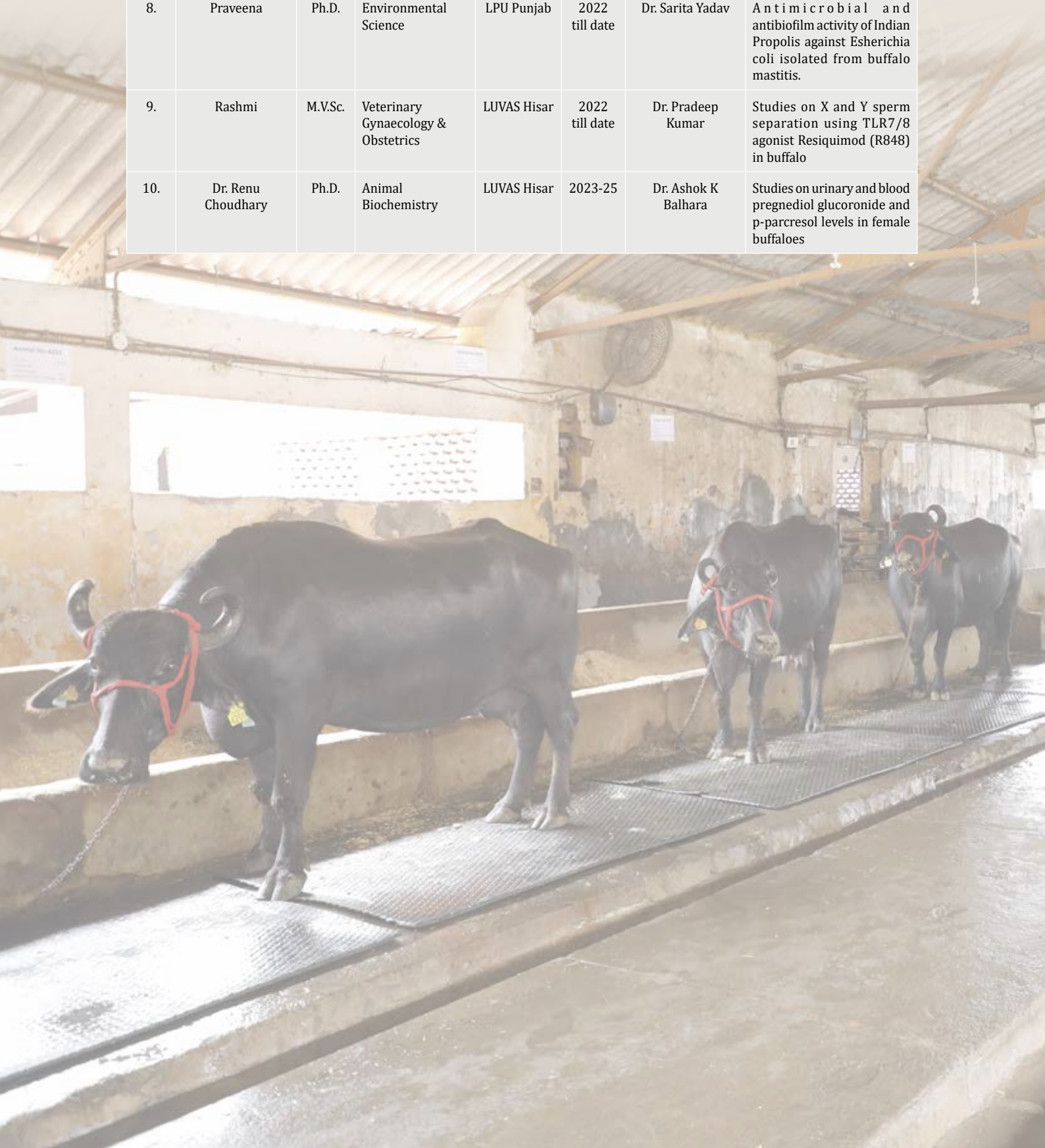
Completed Research

S. No.	Name of the scholar	Degree	Subject/ Discipline	University	Year	Advisor Major/ Co-Major	Title of the thesis
1.	Renu Choudhary	M.V.Sc.	Animal Biochemistry	LUVAS Hisar	2021- 22	Dr. Ashok K Balhara	Studies on urinary and blood pregnediol glucoronide and p-parcresol levels in female buffaloes
2.	Shipra Chauhan	M.Sc.	Animal Biochemistry	NDRI Karnal	2021- 22	Dr. Varij Nayan	In silico identification and characterization of buffalo TLR4 and HSP70 Epitope peptides
3.	Usha Yadav	M.V.Sc.	Veterinary Gynaecology & Obstetrics	LUVAS Hisar	2021-23	Dr. Pradeep Kumar	Influence of antibiotic substitutes on bacterial load and semen quality of buffalo bulls
4.	Krishna Nand Bansal	M.V.Sc.	Veterinary Gynaecology & Obstetrics	LUVAS Hisar	2021- 23	Dr. Pradeep Kumar	Estimation of lower threshold of sperm concentration and evaluation of semen quality parameters
5.	Sujata	M.V.Sc.	Veterinary Gynaecology & Obstetrics	LUVAS Hisar	2021- 23 date	Dr. Dharmendra Kumar	Effect of lipopolysaccharide on in vitro developmental competence of buffalo oocytes
6.	Krishan Ahuja	M.Sc.	Agricultural Economics	NDRI Karnal	2022- till date	Dr. Gururaj M	Economic Analysis of buffalo population dynamics and breed preference in Punjab
7.	Maninder Sharma	M.Sc.	Animal Biotechnology	NDRI Karnal	2021- 23	Dr. Dharmendra Kumar	Role of mitochondria-targeted antioxidant on buffalo oocytes maturation and embryonic development of cloned Embryo
8.	Nidhi Kumari	M.Sc.	Animal Biotechnology	NDRI Karnal	2022- 23	Dr. Dharmendra Kumar	Effect of melatonin on in vitro maturation of buffalo oocytes and subsequent development of cloned embryos
9.	Nisha	M.Sc.	Animal Biochemistry	NDRI, Karnal	2022- 23	Dr. Varij Nayan	In silico identification and characterization of epitope-based peptides for buffalo SERPINB1 and ENO3

Ongoing Research

S. No.	Name of the scholar	Degree	Subject/ Discipline	University	Year	Advisor Major/ Co-Major	Title of the thesis
1.	Komal	Ph.D.	Animal Genetics & Breeding	LUVAS, Hisar	2022 till date	Dr. Sanjay Kumar	Genetic evaluation of Fertility, Production performance and Longevity traits in Murrah buffaloes
2.	Amandeep	Ph.D.	Livestock Production & Management	LUVAS Hisar	2022 till date	Dr. Sarita Yadav	Potential of IRT as a tool of screening of mastitis in dairy animals
3.	Subham Thakur	Ph.D.	Animal Nutrition	LUVAS Hisar	2019 till date	Dr. A Dey	Effect of dietary malic acid protected protein supplementation on growth performance, nutrient utilization and methane emission in Murrah buffalo calves
4.	Akanksha Gupta	Ph.D.	Animal Physiology	NDRI Karnal	2021- till date	Dr. P.S.Yadav	Studies on hair cortisol, testosterone and fertility biomarkers in buffalo bulls
5.	Swati Thakur	Ph.D.	Animal Physiology	LUVAS Hisar	2021- till date	Dr. P.S.Yadav	To study the role of major histocompatibility class (MHC) I in buffalo cloned embryos to enhance success rate of pregnancies
6.	Prashant Kumar	Ph.D.	Animal Biochemistry	NDRI Karnal	2020- till date	Dr. Varij Nayan	Silver and silica nanoparticles effects on steroidogenic and apoptotic pathway genes expression in cultured buffalo granulosa cells

S. No.	Name of the scholar	Degree	Subject/ Discipline	University	Year	Advisor Major/ Co-Major	Title of the thesis
7.	Kanchan Arya	Ph.D.	Veterinary Medicine	LUVAS Hisar	2022 till date	Dr Sarita Yadav	Clinico-epidemiological and therapeutic studies on hepatic lipidosis in dairy buffaloes
8.	Praveena	Ph.D.	Environmental Science	LPU Punjab	2022 till date	Dr. Sarita Yadav	Antimicrobial and antibiofilm activity of Indian Propolis against Esherichia coli isolated from buffalo mastitis.
9.	Rashmi	M.V.Sc.	Veterinary Gynaecology & Obstetrics	LUVAS Hisar	2022 till date	Dr. Pradeep Kumar	Studies on X and Y sperm separation using TLR7/8 agonist Resiquimod (R848) in buffalo
10.	Dr. Renu Choudhary	Ph.D.	Animal Biochemistry	LUVAS Hisar	2023-25	Dr. Ashok K Balhara	Studies on urinary and blood pregnediol glucoronide and p-parcresol levels in female buffaloes



PERSONNEL

General Administration

S.No.	Name	Designation
1.	Dr. Tirtha Kumar Datta	Director
2.	Sh. Raj Kumar	Sr. Administrative Officer
3.	Smt. ShammiTyagi	Sr. Finance & Account Officer
4.	Sh. Rajesh Kumar	AAO
5.	Sh. GirdhariLal	AAO
6.	Sh. Viksit Kumar	AAO
7.	Sh. Abdul Mazid	AAO
8.	Sh. Ashok Kumar	Assistant
9.	Smt. Indira Devi	Assistant
10.	Sh. Satbir Singh	Assistant
11.	Sh. Dharam Pal	UDC
12.	Sh. Sunil Kumar	UDC
13.	Sh. Mahabir Singh	UDC
14.	Smt. Savita	LDC
15.	Sh. Rajbir Singh	LDC
16.	Sh. Radhey Krishan	LDC
Sub Campus, Nabha		
1.	Dr. F C Tuteja	Sr. Scientist & Officer In-charge
2.	Dr. Mustafa Hasan Jan	Scientist
3.	Dr. Ashish Baladhare	Scientist
4.	Sh. Rajiv Mehta	Chief Tech. Officer
5.	Sh. RS Pippal	Chief Tech. Officer
6.	Dr. AK Saini	Senior Tech. Officer
7.	Dr. Aishwarya Habbu	Senior Tech. Officer
8.	Dr. Nilendu Paul	Senior Tech. Officer
9.	Dr. Suresh Kumar Kakraliya	Senior Tech. Officer
10.	Sh. Daljit Singh	Tech. Officer
11.	Sh. Mohan Singh	Tech. Officer
12.	Sh. Tejinder Singh	UDC
13	Sh. Jaspal Singh	LDC
Transfer of Technology (TOT)		
1.	Dr. Navneet Saxena	Principal Scientist & Incharge
2.	Dr. Gururaj M	Scientist
3.	Dr. Aiswarya S.	Scientist
4.	Dr. ML Sharma	Chief Tech. Officer
Priority Setting, Monitoring and Evaluation (PME) Cell		
1.	Dr. SK Khurana	Principal Scientist
2.	Dr. FC Tuteja	Senior Scientist
3.	Dr. AK Balhara	Senior Scientist
4.	Dr. Dharmendra Kumar	Senior Scientist
5.	Dr. Jerome A	Senior Scientist
6.	Sh. Raj Kumar	Asst. Chief Tech. Officer
AKMU		
1.	Smt. Sunesh Balhara	Scientist & In-charge
2.	Sh. Raj Kumar	Asst. Chief Tech. Officer

HRD Cell		
1.	Dr. Avijit Dey	Principal Scientist, Nodal Officer
2.	Dr. Jerome A	Senior Scientist, Co-Nodal Officer
Public Relations Officer (PRO)		
1.	Dr. Sajjan Singh	Principal Scientist
Academic Coordinator		
1.	Dr. Sanjay Kumar	Senior Scientist
2.	Dr. Ashok Kumar Balhara	Senior Scientist
Estate Section and Electrical Section		
1.	Dr. S.K. Phulia	Principal Scientist
2.	Sh. B. P. Singh	CTO & I/c Estate Section
3.	Sh. Rajesh Prakash	CTO & I/c Electric Section
4.	Sh. Anil Kumar	Technician
Workshop Section		
1.	Dr. Sanjay Kumar	Senior Scientist
2.	Sh. Bhim Singh	Tech. Officer
3.	Sh. Satpal	Tech. Officer
Landscape Section		
1.	Sh. AKS Tomar	CTO
2.	Sh. S. Kundu	Assistant
Network Project on Buffalo Improvement (NPBI)		
1.	Dr. Tirtha Kumar Datta	Director
2.	Dr. Umesh Singh	Head, AGB Division
3.	Dr. A. Bharadwaj	Principal Scientist & Incharge
4.	Dr. B.P. Kushwaha	Principal Scientist (at IGFRI, Jhansi)
5.	Dr. Sanjay Kumar	Senior Scientist
6.	Sh. Ram Chander	Technical Officer
Animal Nutrition & Feed Technology		
1.	Dr. Avijit Dey	Principal Scientist & Head (w.e.f. 30.10.23)
2.	Dr. P.C. Lailer	Principal Scientist
3.	Dr. Navneet Saxena	Principal Scientist
4.	Dr. Vishal Mudgal	Principal Scientist
5.	Dr. SaritaYadav	Senior Scientist
6.	Sh. Krishana Kumar	Chief Technical Officer
Animal Physiology & Reproduction		
1.	Dr. Yash Pal	Principal Scientist & Head (w.e.f. 27.10.23)
2.	Dr. Sajjan Singh	Principal Scientist
3.	Dr. Prem Singh Yadav	Principal Scientist
4.	Dr. Rakesh Kumar Sharma	Principal Scientist
5.	Dr. Sushil Kumar Phulia	Principal Scientist
6.	Dr. Varij Nayan	Senior Scientist
7.	Dr. Ashok Kumar Balhara	Senior Scientist
8.	Dr. Dharmendra Kumar	Senior Scientist
9.	Dr. Jerome A	Senior Scientist
10.	Dr. Pradeep Kumar	Senior Scientist
11.	Dr. Meeti Punetha	Scientist

Animal Genetics & Breeding		
1.	Dr. Umesh Singh	Principal Scientist & Head (w.e.f. 30.10.23)
2.	Dr. Anurag Bharadwaj	Principal Scientist
3.	Dr. Sandip Kumar Khurana	Principal Scientist
4.	Dr. B.P. Kushwaha	Principal Scientist (at IGFRI, Jhansi)
5.	Dr. Sanjay Kumar	Senior Scientist
6.	Dr. Ashok Kumar	Senior Scientist
7.	Smt. Sunesh Balhara	Scientist
8.	Dr. Supriya Chhotaray	Scientist
9.	Sh. AKS Tomer	Chief Technical Officer
10.	Sh. Ram Chander	Technical Officer
Public Information		
1.	Dr. R. K. Sharma	CPIO, Hisar
2.	Dr. Mustafa Hussan Jan.	CPIO, Nabha
3.	Sh. Rajesh Kumar	Nodal Officer
Vigilance Officer		
1.	Dr. Navneet Saxena	Principal Scientist & Vigilance Officer
2.	Dr. RK Sharma	Principal Scientist
Animal Farm Section		
1.	Dr. Anurag Bharadwaj	Overall In-charge
2.	Sh. AKS Tomer	In-charge Animal farm
3.	Dr. Sanjay	In-Charge Animal Health
4.	Dr. Madhu Singh	STO
5.	Dr. Rupali Rautela	STO
6.	Dr. Rajesh Kumar	TO
7.	Sh. Joginder Singh	Technician
Agriculture Farm Section		
1.	Dr. PC Lailer	Overall In-charge
2.	Sh. Surender Singh	Incharge
3.	Sh. Krishna Kumar	Chief Technical Officer
4.	Sh. Baljeet Singh	Technical Officer
5.	Sh. Jagdeep	Technician
Results- Framework Documents (RFD) Cell		
1.	Dr. Jerome A	Senior Scientist
Library		
1.	Smt. Sunesh Balhara	Scientist
2.	Sh. Raj Kumar	In-charge & ACTO
Hindi Section		
1.	Dr. Sajjan Singh	Principal Scientist
2.	Sh. Krishna Kumar	Chief Technical Officer

SSS, CIRB Main Campus, Hisar					
	Pooran	Ram Kumar	Randhir Singh	Satpal Singh	Ashok Kumar
	Jai Prakash	Gopi Ram	Ram Kesh	Smt. Santro	Om Parkash
	Yam Bahadur	Siri Ram	Subhash	Balwant Singh	Shri Mange Ram
	Chander	Pahlad	Rambir Singh	Surjeet Singh	Baljeet Singh
	Raj Kumar	Ashok Kumar	Jagdeep	Dalbara	Ranbir Singh
	Rajender	Sarla Rani	Jitender Kumar	HiraLal	Ram Pal
	HariKishan	Jai Kumar	Om Prakash	Suraj Pal	Raj Mal
	Nakchhed	Radhey Shyam	Hawa Singh	Rameshwar	Smt. Anita
	Ramesh Chand	Mahabir Singh	Satish Kumar	Jagdish	
	Satbir Singh	Satyawan	Balwant Singh		
	Dilbag Singh	Joginder Singh	Om Prakash		
	Rati Ram	Sadhu Ram	Jarnail Singh		
	Devi Dayal	Prem Singh	Ram Sawroop		
	Reshma	Ramesh	Bhadur		
Sub- Campus, Nabha					
	Shyamdev	Ram Anuj	Rajender	Mohinder Singh	Ved Raj
	Raju	Bhim Singh	Balwant Singh	Jaswinder Singh	Ram Singh
	Brij Mohan	Hansraj	Gurnaam Singh	Nachater Singh	Ram Preet
	Rulda Singh	Ram Kewal	Ram Suraj	GirdhariLal	Krishan Singh
	Jaswant Singh	ShriNath	Rajesh Kumar	Ashwani Kumar	Nazar Singh
	Mukhtaryar Singh	Deshraj	Baljeet Singh	Kulwant Singh	Ram Jeon
	Chotu Ram	Kuldeep Singh	Tara Singh	Vinod Kumar	Karnail Singh
				Ram Kumar	Mohinder Singh
				Bhagwant Rai	Mewa Singh
				Smt. GurmeetKaur	Ganga Singh
				Jaswinder Singh	Karnail Singh
				Malkiat Singh	Gurdeep Singh
				Radhey Sham	Lakhbir Singh
				Pritam Singh	Smt. Harmeet Kaur
				Goli Ram	Ramu
				Avtar Singh	

Joining

Sh. Suresh Kumar Kakraliya joined as STO, CIRB, Nabha w.e.f 31.03.23.

Dr. Supriya Chhotaray joined as Scientist, CIRB, Hisar w.e.f. 21.07.2023.

Dr. Aiswarya S. joined as Scientist, CIRB, Hisar w.e.f.21.07.2023.

Dr. Ashish Baladhare joined as Scientist, CIRB, Nabha w.e.f.21.07.2023.

Sh. Raj Kumar, joined as SAO, CIRB, Hisar 23.08.2023.

Dr. Yash Pal joined as Head, APR Division 27.10.2023.

Dr. Umesh Singh joined as Head, AGB Division 30.10.2023.

Dr. Avijit Dey joined as Head, ANFT Division 30.10.2023.

Promotions

Dr. Sanjay Kumar, Sr. Scientist promoted to the poist of Sr. Scientist (RGP 9000/-) w.e.f. 08.10.2021.

Dr. Ashok Kumar, Sr. Scientist promoted to the post of Sr. Scientist (RGP 9000/-) w.e.f. 21.04.2022.

Dr. Pradeep Kumar, Sr. Scientist promoted to the post of Sr. Scientist (RGP 9000/-) w.e.f. 17.05.2022.

Dr. Jerome A, Sr. Scientist promoted to the post of Sr. Scientist (RGP 9000/-) w. e. f. 23.08.2022.

Dr. Mustafa Hassan Jan, Scientist promoted to the post of Scientist (RGP 7000/-) w.e.f. 15.07.2019.

Sh. Surinder Singh, CTO was granted one advance increment w.e.f. 17.01.2021.

Dr. RS Pippal, ACTO promoted to the post of CTO w.e.f. 20.06.2022.

Transfer

Dr. Varij Nayan, Sr. Scientist has been transferred to NDRI, Karnal & relieved on 21.12.2023 (AN).

Retirement

Sh. Satish Kumar, T-1 retired on 31.01.2023.

Sh. Balwant Singh, SSS retired on 31.01.2023.

Sh. Rajesh Kumar, AAO retired on 31.03.2023.

Sh. A.K.S. Tomer, CTO retired on 30.04.2023.

Sh. Jarnail Singh, SSS retired on 30.06.2023.

Smt. Anita, SSS retired on 30.06.2023.

Sh. Mewa Singh, SSS (Nabha) retired on 31.07.2023.

Sh. Balwant, SSS (Nabha) VRS on 01.09.2023.

Sh. Surender Singh, CTO retired on 30.09.2023.

Sh. Radhey Sham, SSS retired on 31.10.2023.

Sh. Ram Kesh, SSS VRS on 01.12.2023.

Sh. Bhim Raj, STA retired on 31.12.2023.

Dr. A. Bharadwaj, PS retired on 31.12.2023.

Sad Demise

Sh. Raj Kumar SSS died on 02.01.2023.

Sh. Hansraj, SSS (Nabha) died on 06.06.2023.

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