वार्षिक प्रतिवेदन
Annual Report
2018-19

भाकृअनुप-केन्द्रीय भैंस अनुसंधान संस्थान
ICAR-Central Institute for Research on Buffaloes

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ICAR - Central Institute for Research on Buffaloes

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Published by

Dr. Satbir Singh Dahiya

Director

Compiled, designed and edited by

Dr. Ashok K. Balhara

Dr. Sanjay Kumar

Dr. Dhramendra Kumar

Smt. Sunesh Balhara

Dr. Naresh Selokar

Sh. Rajkumar Chaudhary

ICAR - Central Institute for Research on Buffaloes

Hisar -125001, Haryana, India

Tel No: +91-1662- 2816002

Fax: +91-1662-275004

Website: http://www.cirb.res.in

Email: director.cirb@icar.gov.in

Preface

Livestock have been an essential constituent of India's agronomic and bucolic economy and buffaloes top the priority list in this regard. The livestock sector has been growing faster than crop sector – a fact demonstrated by India being the leading country in milk production and leading exporter of buffalo meat. Buffalo is the target dairy species for sustainable development mainly because of the ability of the species to utilize low quality roughage, higher economic returns and additional advantage as a meat animal in the country where cow slaughter is banned largely.

The Indian Council of Agricultural Research (ICAR) has a long-standing commitment to the conservation, improvement and use of India's indigenous livestock species for the welfare of masses and food secure future. The Central Institute for Research on Buffaloes takes pride in providing research-based solutions to dairy farmers, policy makers, entrepreneurs and developmental agencies for sustainable, economically viable and futuristic buffalo production systems. The Institute recorded best ever herd performances in terms of wet average (8.92 kg), TLMY (2641 kg) and CLMY (2567 kg) for Murrah herd. The performance parameters for Nili Ravi herd at the same time were herd average (6.54 kg), SLMY (2679 kg) and TLMY (2797 kg) which are highest since the inception of the sub campus.

During the period 2018-19, the Institute gained due recognition in scientific and public arena. With limited resources, the Institute was able to connect with more than fifteen thousand farmers through various trainings, Kisan Gosthis, demonstrations and outreach programs. The Institute has funding support of DBT, DST, NASF, BMGF and ILRI to augment research outputs for the service of Nation. In addition,

the Institute also got funding from the CABIN scheme of ICAR. Under the mega project on cloning, 16 cloned pregnancies were established out of 79 transfers. Research efforts are continuing in the areas of pregnancy diagnosis, estrus detection and semen freezing. As a major achievement, the Institute got its first patent for technology for identification of buffaloes prone to post partum anestrus. Methane mitigation, increasing bio-availabitlity of inorganic minerals through chelation and assessing nutritional quality of new sorghum varieties are some research areas being pursued.

I take this moment to extend heartily commendations to the CIRB family of scientist, technical, administrative personnel and supportive staff for their untiring efforts in making a very successful year for the Institute. The Institute organized two brain storming sessions on very relevant topics of animal farming - economic aspects of buffaloes and buffalo health. The achievements like publication of quality research papers, external funding support increased number of post graduate students and best ever herd performance will definitely encourage CIRB family to work tirelessly. The encouragement, support, motivation and guidance from the Council, especially from Dr. Trilochan Mohapatra, Secretory Department of Agricultural Research and Education, Director General, ICAR and Dr. Joykrushna Jena, Deputy Director General (Fisheries and Animal Sciences), ADG and Scientists at ICAR, is gratefully acknowledged by the Institute.

Satbir Singh Dahiya
Director

Jai Hind !!

प्रस्तावना

पशुधन भारतवर्ष की कृषि आधारित ग्रामीण अर्थव्यवस्था का एक अभिन्न अंग है जिसमें भैंसों का सबसे ज्यादा महत्व है। देश में पशुधन आधारित क्षेत्र का विकास फसल आधारित कृषि से ज्यादा हुआ है जिसके कारण हमारी गणना विश्व के स्वाधिक दूध उत्पादन तथा सर्वोत्तम भैंस मांस निर्यातक के रूप में होती है। भैंस निम्न गुणवत्ता वाले चारे को दक्षता के साथ पचा सकती है, इसके दूध की बाजार में ज्यादा कीमत है तथा गैर उत्पादक पशुओं को मांस के लिए उपयोग में लिया जा सकता है।

भारतीय कृषि अनुसंधान परिषद् लम्बे समय से देशी पशुओं की प्रजातियों को संरक्षित तथा सुधारने के लिए प्रतिबद्ध है ताकि सामान्य नागरिकों को कल्याणकारी एवं खाद्यान सुरक्षित भविष्य सुनिश्चित किया जा सके। केन्द्रीय भैंस अनुसंधान संस्थान विज्ञान आधारित ज्ञान को डेयरी किसानों, नीति निर्माताओं, उद्यमियों तथा विकासात्मक संस्थाओं से साझा करके देश को सतत, कम खर्चीली तथा भविष्य के लिए तैयार पशु पालन प्रणाली विकसित करने में अग्रसर है। संस्थान ने मुर्राह भैंसों में वेट औसत (8.92 कि.ग्रा.), ब्यांत का कुल उत्पादन (2641 कि.ग्रा.) और ब्यांत, 305 दिन का दूध उत्पादन (2567 कि.ग्रा.) के संदर्भ में सबसे अच्छा उत्पादन किया। वर्ष 2018-19 में नीली रावी भैंसों ने भी उत्कृष्ट उत्पादन दर्ज किया। इन भैंसों में दूध देने वाली व शुष्क भैंसों का प्रतिदिन औसत दूध उत्पादन (6.54 कि.ग्रा.), ब्यांत 305 दिन का दूध उत्पादन (2679 कि.ग्रा.) और ब्यांत का कुल उत्पादन (2797 कि.ग्रा.) रहा जो संस्थान उप-परिसर बनने के बाद का उच्चतम दूध उत्पादन रिकॉर्ड है।

वर्ष 2018-19 में संस्थान को वैज्ञानिक और सार्वजनिक क्षेत्रों में सराहनीय पहचान मिली है। अपने सीमित संसाधनों से संस्थान ने विभिन्न प्रशिक्षण कार्यक्रमों, किसान

गोषठियों, प्रदर्शनियों तथा संस्थान की गतिविधियों द्वारा लगभग पंद्रह हजार किसानों को जोड़ा तथा उन तक भैंस विज्ञान का प्रसार किया। देश की वैज्ञानिक प्रगति में योगदान हेतु संस्थान को अनेक वित्त संस्थाओं से सहयोग मिला जिनमें DBT, DST, NASF, ILRI तथा BMGF प्रमुख हैं। संस्थान को आईसीएआर की कैबिन परियोजना के अंतर्गत शोघ कार्य के लिए आर्थिक सहयोग मिला। क्लोनिंग पर मेगा परियोजना के तहत, 79 भ्रूण स्थांनातरणों में से 16 क्लोन गर्भधारण हुए। गर्भावस्था जांच, मद् चक्र और वीर्य हिमीकृण की प्रक्रिया के लिए शोघ जारी है। संस्थान को ब्यांत उपरांत मद् में न आने वाली भैंसों की पहचान की तकनीक विकसित करने के लिए पहली बार पेटेंट मिला है। मिथेन अल्पीकरण, चिलेशन विधि द्वारा अकार्बनिक खनिजों की शरीर में उपलब्धता बढ़ाना और चारे की नई किस्मों की पोषण गुणवत्ता के आंकलन पर भी अनुसंधान किया जा रहा है।

इस अवसर पर मैं CIRB परिवार के सभी वैज्ञानिकों, तकनीकी व प्रशासिनक अधिकारियों तथा सहयोगी कर्मचारियों के संस्थान की तरक्की के लिए किए गए कठिन परिश्रम की दिल से प्रशंसा करता हूँ जिसके कारण यह एक सफल वर्ष रहा। संस्थान ने दो संगोष्ठियों– भैंसपालन के आर्थिक पहलुओं व स्वास्थ्य पर संगोष्ठियों का आयोजन किया। उच्च श्रेणी के शोध पत्रों के प्रकाशन प्रतिस्पर्धा अनुदान, अधिक संख्या में स्नातकोत्तर छात्राओं द्वारा संस्थान में शोध तथा संस्थान के भैंस फार्मो में उत्कृष्ट उत्पादन निश्चित रूप से CIRB परिवार को अथक परिश्रम के लिए प्रोत्साहित करेगा। संस्थान को परिषद् से अदम्य प्रोत्साहन, समर्थन, प्रेरणा तथा मार्गदर्शन मिला जिसके लिए मैं डॉ. त्रिलोचन महापात्र, सचिव कृषि अनुसंधान एवं शिक्षा विभाग तथा महानिदेशक, भाकृअनुप, डॉ. जय कृष्ण जेना, उपमहानिदेशक (मत्स्य एवं पशुपालन), ADG तथा वैज्ञानिकों का विशेष रूप से आभार व्यक्त करता हूँ।

सतबीर सिंह दहिया

निदेशक

जय हिन्द !!

Contents

Assamese Buffalo

EXECUTIVE SUMMARY कार्यकारी सारांश 2018-19

Staff position (as on 31.03.2019)

Category	Sanctioned	In position
Scientific	44	30
Technical	42	33
Administrative	19	16
Skilled supporting staff	73	64
Total	**179**	**143**

स्टाफ की स्थिति (31.03.2019)

श्रेणी	स्वीकृत	स्थिति
वैज्ञानिक	44	30
तकनीकी	42	33
प्रशासनिक	19	16
कुशल सहायक कर्मचारी	73	64
कुल	**179**	**143**

Internal Revenue Generation

Item	Value in (Rs., lakh)
Sale of farm produce	335.23
Sale of other products	001.26
Sale of semen	035.89
Training programmes	003.44
Application fees for recruitment	000.01
Total	**375.83**

आंतरिक राजस्व सृजन

विवरण	रू., लाखों में
कृषि/पशु उपज की बिक्री	335.23
अन्य उत्पादों की बिक्री	001.26
वीर्य की बिक्री	035.89
प्रशिक्षण कार्यक्रमों के आवदेन शुल्क	003.44
भर्ती के लिए आवदेन शुल्क	000.01
कुल	**375.83**

Competitive Grants

Funding agency	Number of projects	Total budget (Rs., lakh)
DBT	2	118.3
BMGF	1	028.5
NASF	2	530.0
DST	2	049.0
Farmer first	1	105.0
CABin	1	064.0
Total	**9**	**894.8**

स्पर्धात्मक अनुदान प्राप्तियाँ

अनुदान एजेंसी	परियोजना सं.	कुल बजट (रू. लाख में)
डी.बी.टी.	2	118.3
बी.एम.जी.एफ.	1	028.5
एन.ए.एस.एफ.	2	530.0
डी.एस.टी.	2	049.0
किसान प्रथम	1	105.0
कैबिन परियोजना	1	064.0
कुल	**9**	**894.8**

Buffalo production improvement

- Overall annual wet average (over 305 days standard lactation) of milk production was 8.92 kg in the Murrah herd and 8.82 kg in the Nili-Ravi herd which is highest ever since inception of the Institute.
- Overall TLMY 2641 Kg and SLMY 2567 kg of

भैंस उत्पादन में सुधार

- मुर्रा भैंसों का Wet average (305 दिन का ब्यांत मानने पर औसत हर रोज) समग्र दुध उत्पादन 8.92 और नीली–रावी भैंसों का 8.82 कि.ग्रा. था। यह संस्थान की स्थापना के बाद से अब तक का सर्वोत्तम रिकॉर्ड रहा है।
- मुर्रा भैंसों का पूरे ब्यांत के हिसाब से सत् औसत कुल दुध उत्पादन 2641 और 305 दिन के ब्यांत के हिसाब से

institute's Murrah herd, highest ever since inception of the institute.

- Significant improvements recorded in service period (136 days) and calving interval (446 days) in the Murrah herd, which are lowest in the last 15 years.
- The overall highest ever herd average (6.54 kg), 305 days lactation milk yield (2679 kg), total lactation yield (2797 kg), peak yield (13.7 kg), percentage of animals in milk (74%) and lactation length (311 days) were achieved in Nili-Ravi herd.
- CIRB field progeny testing unit performed 3977 AIs (55.64% conception rate) using the semen of 17th and 18th set of Murrah bulls (n=15) in 10 adopted villages resulting in 2150 confirmed pregnancies and 1710 calvings. Daughter's first lactation milk yield records were completed for 122 daughters.
- A total of 173840 semen doses of Murrah bulls were produced and 97657 semen doses were disseminated to farmers.

Agriculture farm's production

Fodder	Main Campus Hisar	Sub Campus Nabha
Wheat straw	820.25 qtls	2991.0 qtls
Green	31903.00 qtls	38598.00 qtls
Silage	---	3909.0 qtls

Research achievements

- Different parameters like growth health and fertility of cloned bull 'Hisar-Gaurav' were found normal. The mega project has been initiated to make multiple copies of elite breeding bulls. 'Sach-Gaurav' cloned Assamese bull, has been shifted to institute for semen production. During this year, total 16 clone pregnancies were established.
- The reduction on sperm concentration to 12 million per straw did not effect the conception rate (54.92%) in buffalo under filled condition as

औसत दुध उत्पादन 2567 कि.ग्रा. दर्ज किया गया है जो संस्थान की स्थापना के बाद से सबसे अधिक है।

- ★ मुर्रा भैंसों का ब्यांत-गर्भधारण अंतराल 136 और ब्यांत अंतराल 446 दिन रहा जो एक महत्वपूर्ण सुधार है। ये पिछले 15 वर्षो में सबसे कम है।
- ★ नीली रावी भैंसों का उच्चतम झुंड औसत (6.54 कि.ग्रा.), 305 दिन दुग्ध उत्पादन (2679 कि.ग्रा.), समस्त दुग्ध उत्पादन (2797 कि.ग्रा.) उच्चतम दुध उत्पादन (13.7 कि.ग्रा), दूध में पशुओं का प्रतिशत (74%) और दुग्ध उत्पादन कार्यकाल (311 दिन) अब तक का सर्वोत्तम दर्ज किया गया।
- ★ संतान परिक्षण योजना के तहत गोद लिए गए 10 गाँवों में 17वें और 18वें सत् के 15 सांड़ों के अंतर्गत 3977 कृत्रिम गर्भाधान दर्ज किए गए। 54.46 प्रतिशत 'गर्भधारण दर' के साथ 2150 गर्भधारण हुए जिनमें से 1710 ब्यांत दर्ज किए गए। 122 कटड़ियों के पहले ब्यांत के दूध उत्पादन रिकॉर्ड दर्ज किए गए।
- ★ वीर्य प्रयोगशला ने 173840 वीर्य के हिमीकृत टीके तैयार किए और 97657 वीर्य के टीके किसानों को उपलब्ध कराए।

कृषि फार्मों का उत्पादन

चारा	मुख्य परिसर, हिसार	उपपरिसर नामा
गेहूँ चारा	820.25 क्विटंल	2991.0 क्विटंल
हरा	31903.00 क्विटंल	38598.0 क्विटंल
साइलेज	-----	3909.00 क्विटंल

अनुसंधान उपलब्धियाँ

- ★ एक कोषीय निषेचन (Cloning) द्वारा पैदा किए गए सांड 'हिसार गौरव' का विकास, स्वास्थ्य और प्रजनन क्षमता सामान्य पाई गई। इसके उपरांत प्रजनन के लिए श्रेष्ठ भैंसे की कई प्रतियाँ बनाने के लिए एक बड़ी परियोजना शुरू की गई है। असमिया सांड का क्लोन 'सच गौरव' वीर्य उत्पादन के लिए संस्थान में स्थानांतरित कर दिया गया है। इस वर्ष कुल 16 क्लोन गर्भधारण में सफलता मिली।
- ★ प्रति नली शुक्राणु की संख्या घटाकर 1.2 करोड़/नली (54.92%) करने पर गर्भाधारण दर में वास्तविक स्थितियों में 2 करोड़ /नली (57.65%) तथा 1.6 करोड़

compared to 20 million per starw (57.65%) and 16 million per straw (57.92%).

- High number of informative SNPs (n=93,860), having a normal distribution of minor allele frequency and expected observed heterozygosity were determined by genotyping a subgroup (n=165) of Indian Murrah buffalo population.
- For the first time, LDL superiority was established over egg yolk to protect sperm to undergo premature capacitation during cryopreservation process.
- Single prostaglandin injection was good for induction of oestrus as well as conception rates in silent oestrus buffaloes.
- Estrus induction rate was highest with progesterone implants as compared to GnRH based protocols. Also, conception rates were highest on fixed time insemination using progesterone implants in anoestrus buffaloes.
- Mifepristone (RU 486) to buffalo semen prevented cholesterol efflux and protect plasma membrane integrity that increased the ability of sperm to with stands stress imposed by cryopreservation.
- Extracts from six different herbs known for lactogenic properties - Shatavari and Jivanti roots; Methi and Kalaunji seeds, Anise and Safed Jeera, were analyzed for total tannin contents, total phenolic contents (TPC), total flavonoid contents (TFC) and there antioxidant properties. Based on total tannin, TPC and TFC contents four different herbal mixture were formulated for feeding to lactating buffaloes.
- Seven sorghum stovers developed by IIMR, Hyderabad were screened (*in vitro*) for ruminal fermentation kinetics, gas production potential and methane production to established there supremacy as potential animal feed. Stovers from brown midrib sorghum cultivars (SPV- 2017 and SPV-2018) and forage sorghum (CSV- 32F) could be preferred over others as better animal feed due to their potential for enhanced utilization

/ नली (57.92%) की तुलना में कोई अंतर नहीं मिला।

- ★ भारतीय मुर्रा भैंसों की आबादी के उपसमूह (संख्या 165) का जीनांटाइप करके उच्च संख्या में सूचनात्मक एस.एन.पी. (संख्या 93,860) जिसकी मामूली अलील आवृति का सामान्य वितरण तथा विषयलैगिता का अपेक्षित अवलोकन निर्धारित किया गया है।
- ★ पहली बार तुलनात्मक रूप से एल.डी.एल. को अण्डे की जर्दी की तुलना में कायोप्रिजवेशन प्रक्रिया के दौरान शुक्राणु की जल्दी निद्राघात से बचाने के लिए बेहतर प्रमाणित किया गया है।
- ★ गूंगा आमा (Silent oestrus) भैंसों में एकल प्रोस्टाग्लैडिन इंजेक्शन गर्मी में आने के साथ-साथ गर्भधारण दर के लिए अच्छा है।
- ★ GnRH आधारित प्रोटोकॉल की तुलना में प्रोजेस्टेरोन प्रत्यारोपण से मद प्रेरण दर (Estrus induction rate) उच्चतम थी। इसके साथ ही, एनोस्ट्रस भैंसों में प्रोजेस्ट्रान प्रत्यारोपण का उपयोग करके निश्चित समय पर गर्भधारण दर की क्षमता भी सबसे अधिक थी।
- ★ भैंसें के वीर्य में माइफप्रिस्टोन (RU486) कोलेस्ट्रॉल के प्रवाह को रोकता है और प्लाजमा झिल्ली की अंखंडता की रक्षा करता है जिससे शुक्राणु की अतिशीतल सरंक्षण (Cryopreservation) द्वारा उत्पन्न तनाव को झेलने की क्षमता को बढ़ता है।
- ★ लैक्टोजेनिक गुणों (दूध बढ़ाने के गुण) के लिए जानी जाने वाली छः विभिन्न जड़ी-बूटियाँ- शतावरी की जड़े, जिवंती की जड़े, मेथी और कलौंजी के बीज, एनीज़, मोटी सौंफ और सफेद जीरा, कुल टैनिन सामग्री, कुल फेनोलिक सामग्री (टीपीसी), कुल फ्लेवोनोइड सामग्री (टीएफसी) और एंटीऑक्सीडेंट गुणों का विशेलषण किया गया। कुल टैनिन, टीपीसी और टीएफसी सामग्री के आधार पर दूध देने वाली भैंसों के लिए चार हर्बल मिश्रण तैयार किए गए।
- ★ IIMR हैदराबाद द्वारा विकसित सात जवार की किस्मों को पशु चारे में प्रयोग हेतू रूमेन खमीर काइनेटिक्स, गैस उत्पादन क्षमता और मीथेन उत्पादन के लिए जांचा गया। भूरी ड़ंडी वाली जवार फसलों में SPV 2017, SPV 2018 तथा चारे वाली किस्म CSV-32F पशुओं में अधिक उत्पादन के लिए अन्य किस्मों से अच्छी पाई गई।

- Vitamin A and E supplementation at higher level had positive influence on performance of peri-parturient Murrah buffaloes.
- Inclusion of chelated copper, manganese and zinc in mineral mixture reduced the requirement of these elements upto half compared to that of their inorganic counterparts.

New Technologies / Methodologies / Models / Protocols / Inventories / Repositories

- Patented 'An in vitro method for detection of postpartum anoestrus condition in buffaloes'. Application No. 2940/DEL/2013CBR No. 10352 Docket No. 16369 Granted on 05/02/2019.
- Four other patents on different research breakthroughs were filed with Indian patent office.
- Mobile App on Buffalo Reproduction (भैंस जनन) was developed and made online. Work on another app 'Buffalo Nutrition' has been initiated.
- Non invasive technology on infrared thermal imaging (IT Imaging) was indicated as a potential tool for assessment of udder health and mastitis management.
- Somatic cells frozen repository of 20 elite buffaloes established.
- Three technologies *viz*. modified artificial vagina with temperature sensor, field microscope and LDL based semen extender were submitted to Agroinnovate for commercialization.
- Induced pluripotent stem cells were generated from buffalo fetal fibroblasts using transposons system.
- Transgenic embryos upto morula and blastocyst stage were generated.

Extension and Outreach programs

- Identifying role of various agencies a model of convergence was developed for raising awareness about clean milk production by farmers.
- Under Farmer First program, three villages were

- उच्च स्तर पर विटामिन ए और ई की पूरकता का एक से ज्यादा बार ब्याने वाली मुर्रा भैंसों के प्रदर्शन पर सकारात्मक प्रभाव पड़ता है।
- खनिज मिश्रण में चिलेटिड तांबा, मैंगनीज और जस्ता को शामिल करने से इन तत्वों की आवश्यकता उनके अकार्बनिक समकक्षों की तुलना में आधी तक हो गई।

नई प्रोद्यौगिकियाँ / तरीके / मॉडल / प्रोटोकॉल / सूची / डेटा संग्रहण

- भैंस में ब्याने के बाद मद् में ना आने का बाह्य विधि द्वारा पता लगाने के लिए पेटेंट दिनांक 05/02/2019 को प्रदान किया गया है जिसका आवदेन सं. 2940 / DEC / 2013 CBR, नंबर 10352, डाकेट नं. 16369 है।
- विभिन्न शोध सफलताओं पर चार अन्य पेटेंट भारतीय पेटेंट कार्यालय में आवेदन दिए गए।
- भैंस प्रजनन पर 'भैंस जनन' नाम से मोबाईल एप्प बनाया और ऑन-लाइन किया गया। एक दूसरे ऐप 'भैंस पोषण' पर कार्य शुरू कर दिया गया है।
- अयन स्वास्थ्य व थनैला रोग के प्रंबधन के लिए इंफ्रारेड थर्मल इमेजिंग (आईटी इमेजिंग) पर आधारित गैर इनवेसिव तकनीक (सर्जरी/रसायन रहित) एक संभावित साधन के रूप में इस्तमोल किया जा सकता है।
- 20 अभिजात वर्ग की भैंसों की हिमीकृत दैहिक कोशिकाओं का संग्रह स्थापित किया गया।
- तीन प्रौद्योगिकी - तापमान संवेदक के साथ संशोधित कृत्रिम योनी, फील्ड इनसेमीनेटर के लिए माइक्रोस्कोप तथा एल.डी.एल. आधारित वीर्य विस्तारक को व्यवसायीकरण के लिए एग्रोइनोवेट को दिया गया।
- ट्रांसपोसॉन प्रणाली का उपयोग करके भैंस के भ्रूण के फाइब्रोब्लास्ट कोशिकाओं से प्रेरित प्लूरिपोटेंट स्टेम सेल उत्पन्न किए गए।
- मोरूला और ब्लास्टोसिस्ट चरण तक ट्रांसजेनिक भ्रूण उत्पन्न किए गए।

विस्तार एवं बाहरी पहुँच के प्रोगाम

- स्वच्छ दूध उत्पादन के लिए किसानों को जागरूक करने हेतू प्रत्येक संस्था की भूमिका को चित्रित करके एक अभिसरण का मॉडल विकसित किया गया।
- किसान प्रथम कार्यक्रम के तहत, किसानों की आय

adopted and integrated farming approach using apiculture, horticulture and livestock rearing was followed to increase the farmers' income.

- 876 farmers trained through 15 training programs at CIRB Hisar Campus, 210 at CIRB Sub Campus Nabha and 183 in villages.
- A total of 26 MGMG adopted villages were covered by 24 scientists grouped in six teams. During the period, 52 visits and 45 interface meetings/goshties were conducted covering 1950 farmers.
- 8 number of front line demonstrations in field covering fodder management and conservation through silage making, ration balancing, heat stress management and data recording.
- IT initiative by the institute 'Buffalopedia' has registered more than 6.7 lakh visits with more than 50,000 registered users.

Human resource development and trainings

- Eight scientists, four technical staff, five administrative staff and seven skilled supporting staff (SSS) were trained at various institutions under capacity building.
- 4 Doctoral students and 6 postgraduate students completed their research work and submitted thesis, while 7 doctoral and 3 postgraduate students are currently pursuing research work at the institute.
- 2 scientists completed their overseas research stay in Germany and 2 German scientist visited institute.

ICAR north zone sports tournament-2018

- Eight hundred and fifty participants from 24 ICAR institutes participated in this mega event during 14-16 November, 2018. Thirty four sports events including Kabaddi, Football, Volley ball (Smashing & Shooting), Basketball, Badminton, Table Tennis, Chess, Carrom and Track & Field events were organised.

बढ़ाने के लिए पशुधन पालन के साथ व्यवहार्यता की पहचान करने के बाद तीन गांवों को अपनाया गया और मधुमक्खी पालन इकाइयों की स्थापना की गई।

- 876 किसानों ने केन्द्रीय भैंस अनुसंधान संस्थान, मुख्य परिसर, हिसार में, 210 किसानों ने उपपरिसर नामा में तथा 183 ने गांवों में आयोजित प्रशिक्षण कार्यक्रमों के माध्यम से प्रशिक्षण प्राप्त किया।
- मेरा गाँव मेंरा गौरव (MGMG) योजना ने तहत, 26 गाँवों को 24 वैज्ञानिकों के छः समूहों द्वारा अपनाया गया। इस अवधि के दौरान 1950 किसानों को लाभान्वित करने के लिए गाँवों में 45 गोष्ठियाँ/इंटरफेस बैठकों तथा 52 दौरो का आयोजन किया गया।
- साइलेज के माध्यम से चारा प्रबंधन और संरक्षण, सतुंलित आहार, उष्मागत तनाव प्रबंधन, डेटा रिकॉडिंग पर ग्रामीण क्षेत्रों में 8 फ्रंट लाइन प्रदर्शनों का आयोजन किया।
- संस्थान द्वारा शुरू किया गया सूचना प्रौद्योगिकी प्रयास 'बफेलोपीडिया' को 6.7 लाख से अधिक लोगों की विजिट दर्ज किए और इसके 50,000 से ज्यादा रजिस्ट्रड प्रयोगकर्त्ता है।

मानव संसाधन प्रबंधन और प्रशिक्षण

- क्षमता निर्माण के तहत विभिन्न संस्थानों में आठ वैज्ञानिकों, चार तकनीकी कर्मचारियों और पांच प्रशासनिक कर्मचारियों और सात कुशल सहायक कर्मचारियों को प्रशिक्षित किया गया।
- चार डाक्टरेट के छात्रों और छः स्नातकोत्तर छात्रों ने अपने शोध कार्य को पूरा किया और शोधलेख के प्रस्तुत की। जबकि सात डाक्टरेट और तीन स्नातकोत्तर छात्र वर्तमान में संस्थान में शोध कार्य कर रहे है।
- दो वैज्ञानिकों ने जर्मनी में अपने विदेशी अनुसंधान प्रवास को पूरा किया और दो जर्मन वैज्ञानिकों ने संस्थान का दौरा लिया।

भाकृअनुप उत्तर क्षेत्र खेल-कूद प्रतियोगिता-2018

- संस्थान ने उत्तर क्षेत्र खेल-कूद प्रतियोगिता का आयोजन दिनांक 14-16 नवम्बर, 2018 को किया गया। इस प्रतियोगिता में भाकृअनुप के 24 संस्थानों से आठ सौ पचास प्रतिभागियों ने भाग लिया। कबड्डी, फुटबॉल, वॉली बॉल (स्मैश और शूंटिग), बास्केटबॉल बैडमिटन, टेबल टेनिस, शतरंज, कैरम और ट्रैक और फिल्ड खेलों समेत कुल चौतीस खेल प्रतियोगिताएं आयोजित की गई।

INTRODUCTION

To cater to the research and development of buffaloes- 'Black Gold'of the country, ICAR-Central Institute for Research on Buffaloes - country's premier ISO 9001:2008 certified animal science institute under the umbrella of Indian Council of Agricultural Research, was established on February 1, 1985 by acquiring the Progeny Testing Bull Farm from Haryana government at Hisar. It is the first of its type in the world, dedicated solely to the most important livestock species of the country. The location of the institute right in the home tract of the world renowned Murrah breed added importance to the institute. 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 the II World Buffalo Congress during 1988. 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. In collaboration with other ICAR institutes and the state agricultural universities, under 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.

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

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. Sound phenomic 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, quality meat and reproductive efficiency. 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 Technology

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 locally available 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, methane mitigation associated with fibre digestion improvement, increasing bio-availability of organic minerals, food safety, with evaluation of different feed and fodder ingredient available in different regions.

III. Division of Animal Physiology and Reproduction

Aiming at optimizing the reproductive efficiency of buffalos, facilities have been developed in the Division for undertaking studies on semen technology, embryo biotechnology including 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.

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, fluorescent, 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 4 lakh doses of frozen semen from nearly 250 Murrah breeding bulls out of which more than 64000 doses are from progeny tested bulls.

Animal Farms

Highly pedigreed herds of over 500 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 35-40 adult buffaloes each and attached covered calf pens together with open paddocks for loose housing. At Hisar, a new shed has been created, which is being equipped with necessary facilities for buffalo feeding, data recording and slurry management. It will have provision for housing of 200 buffaloes, 25 heifers and 10 down calvers besides 25 individual pens for young calves.

The production performance of the Murrah herd has improved from 4.80 kg (wet average) in 1992-93 to 9.1 kg in January 2019. The reproductive performance of the herd also improved as reflected by decline in calving interval (from 502 to 476 days), the overall wet average of 8.92 kg/day was achieved in Murrah herd.

Similarly, the production performance of Nili Ravi herd at sub campus, Nabha has improved from 3.42 kg (herd average) and 5.86 kg (wet average) in 1992-93 to 6.59 kg and 8.82 kg respectively, in 2018-19. The reproductive performance of Nili Ravi herd also improved as reflected by decline in calving interval from 518 to 438 days.

Buffalo herd status at CIRB 2018-19

S. No.	Category	Addition						Disposal							
		M OB	NR OB	M B	NR B	M T	NR T	M D	NR D	M T	NR T	M S	NR S	M CB	NR CB
FEMALE															
1.	Female calves below 3 months	14	22	61	64	-	-	7+6*	06	46	66	-	-	16	14
2.	Female calves 3-6 months	53	36	-	-	46	128	03	02	60	118	-	-	36	44
3.	Female calves 6-12 months														
4.	Heifers a) 1-2 years b) above 2.0 years	56 105	61 97	- -	- -	60 58	56 187	- -	01 -	58 33	61 186	01 12	- 03	63 118	55 95
5.	Buffaloes in milk	127	103	-	-	33	138	-	02	137	115	23	18	112	106
6.	Buffaloes dry	53	32	-	-	137	115	3+2	-	109	78	31	08	45	61
	Sub total	408	351	61	64	334	624	13+8	11	443	624	67	29	390	375
MALE															
1.	Male calves below 3 months	22	13	69	73	-		10+5	03	51	72	01	01	24	10
2.	Male calves 3-6 months	56	49	-	-	51	135	04	07	67	119	07	05	29	53
3.	Male calves 6-12 months														
4.	Male a) 1-2 years b) >2 years	28 15	18 29	- -	- -	67 20	56 29	- 02	01 01	20 04	15 22	21 17	14 09	54 12	44 26
5.	Breeding bulls	15	03	-	-	04	08	-	-	06	-	11	03	13	08
6.	Bulllocks	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	Teasers	-	01	-	-	-	-	-	-	-	-	-	-	-	01
	Sub total	136	113	69	73	142	228	16+5	12	148	228	57	32	132	142
	Grand total	**544**	**464**	**130**	**137**	**476**	**852**	29+13	**23**	**591**	**852**	**124**	**61**	**522**	**517**

M : Murrah (at Main campus, Hisar) NR : Nili Ravi (at Sub campus, Nabha)

OB : Opening Balance **D :** Death **S :** Sale **R :** Received

CB : Closing Balance **B :** Birth **T :** Transfer

Calving statistics at CIRB buffalo herd 2018-19

Month	Male (Number)		Female (Number)		Abortions & Still Birth (Number)		Overall (Number)	
	M	NR	M	NR	M	NR	M	NR
April 2018	0	10	02	07	01		03	17
May 2018	02	04	03	04	0	01	05	08
June 2018	00	07	04	02	0		04	09
July 2018	13	08	07	05	01	03	21	13
August 2018	05	09	10	03	0		15	12
September 2018	12	07	01	10	0		13	17
October 2018	03	08	08	07	01	01	12	15
November 2018	06	06	04	04	0	01	10	10
December 2018	02	03	05	08	0	01	07	11
January 2019	07	04	05	07	0		12	11
February 2019	10	03	05	01	01		16	04
March 2019	09	04	07	06	0		16	10
Overall	69	73	61	64	04	07	134	137

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha) **Sex Ratio :** (Male : Female) = 53:47

Disposal of animals from CIRB buffalo herd 2018-19

Category	Surplus		Sold		Regd. Problem		Weak & Old		Death		Expt. Purpose		Total	
	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Female <6 months 6-12 months	- -	- -	- -	- -	- -	- -	- -	- -	12 3	07 01	01 -	- -	13 03	07 01
Heifers 1-2.5 yrs > 2.5 yrs	01 01	- -	- -	 03	 08	- -	 03	- -	- -	01 -	- 01	- -	01 13	01 03
Buffaloes Dry/Milch	11	-	13/9	26	11	-	07	-	03	02	02	-	56	28
Sub Total	13	-	22	29	19	-	10	-	18	11	04	-	86	40
Male <6 months 6-12 months	01 03	- -	- -	02 04	- -	- -	- -	- -	13 04	09 01	02 -	- -	16 07	11 05
>1 yrs	19	-	-	23	01	-	01	-	02	02	-	-	23	25
Breeding Bulls	02	-	-	03	-	-	-	-	-	-	-	-	02	03
Bullock +Teaser	01	-	-	-	-	-	-	-	-	-	-	-	01	-
Sub Total	26	-	22	32	01	-	01	-	19	12	02	-	49	44
G. Total	**39**	**-**	**22**	**61**	**20**	**-**	**11**	**-**	**37**	**23**	**6**	**-**	**135**	**84**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Month wise mortality at CIRB buffalo herd 2018-19

Month	Details	0-3 female		3-6		6-12		>1yrs		>2yrs		All		0-3 male		3-6		6-12		>1yrs		>2yrs		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
Apr. 2018	No	14	20	21	14	32	28	56	56	285	239	408	357	22	18	14	12	42	39	58	21	-	33	127	125	514	486
	Died	01	01	01	-	0	-	0	-	0	-	2	01	0	-	0	-	01	-	0	-	-	-	02	-	03	-
	%	7.14	5.0	4.76	-		-		-		-	0.49	0.28		-		-	2.38	-		-	-	-	157	-	0.58	-
May 2018	No	10	19	23	15	33	31	53	55	259	241	378	361	13	20	20	12	36	40	58	20	-	33	127	125	514	486
	Died	0	0	01	-	0	-	0	-	0	-	1	-	0	-	2	-	0	-	0	-	-	-	02	-	03	-
	%	0	0	4.34	-		-		-		-	0.26	-		-	10	-		-		-	-	-	157	-	0.58	-
June 2018	No	07	13	21	21	38	30	53	57	262	242	381	363	09	21	22	13	23	40	63	24	-	33	127	131	517	494
	Died	0	0	0	-	0	-	0	-	0	-	0	-	01	-	0	-	0	01	0	-	-	-	01	01	01	01
	%	0	0	0	-		-		-		-		-	11.11	-		-		2.5		-	-	-	0.78	0.76	0.19	0.20
July 2018	No	09	10	13	20	44	36	54	57	265	244	385	367	10	19	21	17	39	32	65	36	-	34	126	138	520	505
	Died	0	01	0	-	0	-	0	-	0	-	0	01	01	-	0	01	0	-	0	-	-	-	01	01	01	02
	%	0	10.0		-		-		-		-		0.27	10	-		5.88		-		-	-	-	0.79	0.72		0.40
Aug. 2018	No	14	8	10	19	40	34	58	53	270	240	392	354	13	22	13	18	36	18	55	35	-	35	117	128	518	482
	Died	01	0	0	-	0	-	0	-	0	-	1	-	01	-	0	-	0	-	0	-	-	-	01	-	02	-
	%	7.14	0		-		-		-		-		-		-		-		-		-	-	-		-		-
Sep. 2018	No	20	16	07	12	39	35	58	49	279	251	403	363	17	23	07	19	31	19	64	37	-	37	119	135	530	498
	Died	02	0	0	-	0	-	0	-	0	-	2	-	0	-	0	-	0	-	0	-	-	-	0	-	02	-
	%	10.0	0		-		-		-		-		-		-		-		-		-	-	-		-		-
Oct. 2018	No	19	20	09	08	32	34	64	53	263	255	387	370	23	24	0	16	31	25	66	40	-	37	120	142	512	512
	Died	03	0	0	-	0	-	0	-	1	-	4	-	02	-	01	-	0	-	0	-	-	01	03	01	07	01
	%	15.7	0		-		-		-		-		-		-		-		-		-	-	2.70		0.70		0.20
Nov. 2018	No	18	20	12	07	32	33	54	53	272	257	388	372	14	21	12	22	29	28	72	37	-	40	127	148	520	520
	Died	05	01	0	-	0	01	1	-	0	-	6	02	01	-	0	-	0	-	0	-	-	-	04	-	10	02
	%	27.7	5.0		-		3.03		-		-		0.54		-		-		-		-	-	-		-		0.38
Dec. 2018	No	09	19	17	15	45	32	53	51	280	249	404	366	12	16	17	23	27	30	69	37	-	31	125	137	534	503
	Died	0	0	0	-	0	-	0	-	2	-	2	-	0	01	0	-	0	-	0	01	-	-	0	02	02	02
	%	0	0		-		-		-		-		-		6.25		-		-		2.70	-	-		1.46		0.40
Jan. 2019	No	12	18	15	19	22	27	62	50	279	257	390	371	09	12	22	22	19	33	77	38	-	34	127	139	522	510
	Died	0	01	0	-	0	-	0	-	0	01	0	02	02		0	02	0	-	0	-	-	-	02	02	02	04
	%	0	5.56		-		-		-		0.39		0.54				9.09		-		-	-	-		1.44		0.78
Feb. 2019	No	14	15	13	20	22	26	62	49	284	261	395	371	13	09	23	19	11	38	85	40	-	34	132	140	532	511
	Died	01	-	0	-	0	-	0	01	2	-	3	01	01	01	0	01	0	-	01	-	-	-	02	02	05	03
	%	0	-		-		-		2.04		-		0.27		11.11		5.26		-		-	-	-		1.43		0.59
Mar. 2019	No	14	14	09	17	24	27	65	55	271	262	383	375	16	10	11	13	23	40	74	44	-	35	124	142	510	517
	Died	0	-	0	01	0	-	0	-	0	01	0	02	0	-	0	02	0	-	01	-	-	-	01	02	01	04
	%	0	-		5.88		-		-		0.38		0.53		-		15.38		-		-	-	-		1.41		0.77

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Conception rate CIRB buffalo herd 2018-19

Parity	I						II						III						IV						Overall					
Criteria	I		C		CR		I		C		CR		I		C		CR		I		C		CR		I		C		CR	
Category	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	88	61	41	33	46.49	54.10	26	26	11	12	42.31	46.15	22	14	9	04	40.91	28.57	12	28	5	07	41.67	25.00	148	129	66	56	44.59	434.1
Adult	133	134	68	61	51.13	45.52	76	70	39	27	51.31	38.57	31	41	16	19	51.61	46.34	21	52	7	10	33.33	19.23	261	297	130	117	49.81	393.9
Overall	**221**	**195**	**109**	**94**	**49.32**	**48.20**	**102**	**96**	**50**	**39**	**49.02**	**40.63**	**53**	**55**	**25**	**23**	**47.17**	**41.82**	**33**	**80**	**12**	**17**	**36.36**	**21.25**	**409**	**426**	**196**	**173**	**47.92**	**406.1**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

I = No. of animals inseminated; C = No. of animals concevied; CR% = Conception rate (%)

Bull wise conception rate at CIRB buffalo herd 2018-19

S. No.	Bull No.		Set No.		Total No. of AI		Total Conceived		CR%	
	M	NR	M	NR	M	NR	M	NR	M	NR
1	2594	298	17th	7th	27	06	15	01	55.55	16.67
2	2558	308	17th	7th	27	10	16	03	59.26	30.00
3	2607	312	17th	7th	34	09	18	03	52.94	33.33
4	2565	411	17th	1st	26	04	14	02	53.85	50.00
5	29-M	Badshah	17th	Field bull	18	06	06	03	33.33	50.00
6	330-BI	Tank	17th	Field bull	38	02	14	01	36.84	50.00
7	4733	473	17th	1st	10	03	07	02	70.00	66.66
8	4687	359	17th	7th	22	107	13	48	59.09	44.86
9	4715	535	17th	2nd	13	10	07	04	53.85	40.00
10	4837	674	17th	3rd	19	14	09	06	47.37	42.86
11	7010	702	17th	3rd	21	17	10	06	47.62	35.29
12	Dara	Bullet	17th	Field bull	22	11	12	09	54.54	81.82
13	Sikander	352	17th	7th	06	97	02	35	33.33	36.08
14	3267	Raja	11thPT	Field bull	06	09	03	-	50.00	-
15	1354	523	3rd PT	2nd	01	02	0	-	00	-
16	183	487	2nd PT	8th	03	33	02	12	66.66	36.36
17	2185	435	12th	8th	12	11	04	04	33.33	36.36
18	220	501	12th	8th	15	14	05	05	33.33	35.71
19	6942	507	17th	8th	11	08	05	02	45.45	25.00
20	1148	511	17th	8th	18	20	10	09	55.55	45.00
21	2568	543	-	8th	02	12	0	08	00	66.67
22	Dhanna	905	Non set	4th	07	01	06	01	85.71	100.00
23	Heera	480	Non set	8th	14	07	03	03	21.43	42.86
24	Kohinoor	516	Non set	8th	13	13	05	06	38.46	46.15
25	R-24	-	Non set	-	04	-	01	-	25.00	-
26	R-25	-	Non set	-	15	-	06	-	40.00	-
27	R-14	-	Non set	-	27	-	15	-	55.55	-
Total					**409**	**426**	**196**	**173**	**47.92**	**40.61**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Production status at CIRB buffalo herd 2018-19

Lactation Number	Number		Av. 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
1	45	45	2378	2606	312.22	321	2303	2445	11.19	11.74
2	22	18	2826	2957	306.38	311	2732	2858	14.41	15.36
3	28	18	2935	3065	307.28	305	2834	2973	14.99	15.26
4	12	12	2637	2851	288.67	287	2580	2797	14.81	15.40
5 and above	16	18	2612	2809	286.62	308	2602	2717	14.09	14.48
Overall	**123**	**111**	**2641**	**2797**	**305**	**311**	**2567**	**2679**	**13.36**	**13.7**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Reproductive performance of CIRB buffalo herd 2018-19

Traits	Value	1st Lactation		2nd Lactation		3rd Lactation		4th Lactation		5th & Above Lactation		Overall	
Breed		M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Av. Age at Calving (Months)	N	31	55	-	-	-	-	-	-	-	-	31	55
	X	45.76	40.61	-	-	-	-	-	-	-	-	45.76	40.61
	SE	±0.80	±0.63	-	-	-	-	-	-	-	-	±0.80	±0.63
Av. Service Period (Days)	N	-	-	38	23	13	21	20	16	26	17	97	77
	X	-	-	149.29	139	101.18	147	133.45	92	137.31	128	136.35	129
	SE	-	-	±11.34	±14.35	±9.27	±17.12	±19.76	±13.73	±20.57	±21.38	±6.98	±8.55
Av. Day Period (Days)	N	-	-	38	23	13	21	20	16	26	17	97	77
	X	-	-	160.87	155	119.08	147	150.00	134	154.77	151	151.39	148
	SE	-	-	±12.31	±11.90	±12.52	±9.99	±11.23	±10.05	±15.63	±15.23	±6.41	±5.93
Av. Calving Interval (Days)	N	-	-	38	23	13	21	20	16	26	17	97	77
	X	-	-	459.08	447	407.31	456	445.05	402	447.88	439	446.25	438
	SE	-	-	±15.34	±14.31	±14.16	±16.81	±16.42	±14.56	±20.57	±21.41	±7.08	±8.54

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha), N : Number, X : Average, SE : Standard Error

Month wise milk production of CIRB buffalo farms 2018-19

Month	Total milk produced (kg)	
	M	NR
April 2018	30944.4	27170.8
May 2018	28691.1	30976.9
June 2018	25857.4	28317.4
July 2018	26083.5	28625.8
August 2018	27677.4	27735.5
September 2018	27557.9	27404.4
October 2018	26948.5	30631.4
November 2018	26288.1	30723.9
December 2018	26756.1	31816.80
January 2019	27202.6	31319.00
February 2019	25734.8	27855.10
March 2019	28843.2	27118.4
Overall 2018-19	**328585.0**	**349695.40**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Production performance of CIRB buffalo herd 2018-19

Month	Animal in milk		Animal dry		Total animal		% in milk		Wet Av. (kg)		Herd Av.(kg)	
	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
Apr. 2018	110	103	45	32	155	135	71	76	8.93	8.84	6.38	6.74
May 2018	105	107	50	37	155	144	69	74	8.76	9.28	6.01	6.91
June 2018	95	103	61	44	156	147	64	70	8.73	9.11	5.60	6.40
July 2018	103	96	57	46	160	142	61	68	8.94	9.60	5.40	6.49
Aug. 2018	110	98	55	45	165	143	64	69	8.71	9.38	5.57	6.46
Sept. 2018	105	104	44	44	149	149	67	70	8.92	8.81	5.96	6.17
Oct. 2018	104	114	51	41	155	156	69	74	8.49	8.62	5.83	6.35
Nov. 2018	103	124	55	36	158	159	65	72	8.67	8.25	5.66	6.43
Dec. 2018	99	120	59	26	158	145	63	82	8.75	8.55	5.51	7.03
Jan. 2019	95	117	69	26	164	143	59	82	9.33	8.66	5.52	7.07
Feb. 2019	101	113	50	33	151	146	63	77	9.62	8.80	6.10	6.81
Mar. 2019	110	106	43	46	153	152	66	70	9.30	8.22	6.18	5.76
Overall	**101**	**109**	**54**	**38**	**155**	**147**	**65**	**74**	**8.92**	**8.82**	**5.80**	**6.54**

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Production performance of CIRB buffalo herd since 1992-93

Year	In milk		Dry		Total		% in milk		Wet Av. (kg)		Herd Av.(kg)	
	M	NR	M	NR	M	NR	M	NR	M	NR	M	NR
1992-93	165	98	111	53	276	151	61	64	4.80	5.86	2.83	3.42
1993-94	153	81	125	58	178	139	55	58	5.65	5.75	3.10	3.39
1994-95	181	92	85	44	266	136	68	67	6.09	6.01	4.15	4.18
1995-96	153	86	82	35	235	121	65	71	6.43	5.61	4.19	3.99
1996-97	122	81	83	52	205	133	60	61	5.62	5.71	3.35	3.49
1997-98	121	113	76	40	197	153	61	74	6.12	6.03	3.75	4.45
1998-99	133	104	73	42	206	146	64	72	6.77	6.13	4.37	4.26
1999-00	137	85	72	39	209	124	65	68	6.85	6.01	4.49	4.23
2000-01	148	96	78	33	226	129	65	74	6.68	6.31	4.37	4.69
2001-02	147	86	70	38	217	124	68	69	6.59	6.85	4.46	4.82
2002-03	143	106	71	38	214	144	67	73	6.27	6.56	4.20	4.83
2003-04	151	106	72	37	223	143	68	74	6.49	6.35	4.39	4.70
2004-05	154	100	69	47	224	147	69	67	6.39	6.86	4.40	4.65
2005-06	151	114	77	46	238	160	66	71	6.57	6.85	4.36	4.84
2006-07	137	119	92	48	229	167	60	71	6.45	6.20	3.86	4.40
2007-08	146	102	71	54	217	156	67	65	6.64	6.73	4.47	4.46
2008-09	133	122	66	44	199	166	66	73	6.50	6.91	4.35	5.03
2009-10	106	110	65	58	171	168	62	65	7.01	7.00	4.35	4.66
2010-11	109	98	64	43	173	141	63	70	7.45	7.11	4.69	4.93
2011-12	110	84	58	40	168	124	65	68	7.83	7.74	5.12	5.30
2012-13	109	90	69	49	178	139	62	65	7.74	8.26	4.76	5.34
2013-14	105	94	65	52	170	146	62	64	8.01	8.25	4.95	5.32
2014-15	116	99	50	41	166	140	70	71	8.25	8.48	5.77	5.98
2015-16	114	110	62	41	176	151	65	72	8.04	8.51	5.21	6.22
2016-17	110	102	57	53	167	155	66	65	8.08	7.96	5.32	5.23
2017-18	115	97	54	45	169	142	68	68	8.71	8.52	5.90	5.84
2018-19	101	109	54	38	155	147	65	74	8.92	8.82	5.80	6.54

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha)

Production performance of CIRB buffalo herd since 1992-93 (Part-I)

Year	Av. Lact. Yield (kg)		Av. Lact. Length (days)		Milk yield 305 days or less	
	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)

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha);
Figures in parenthese are Number of observation

Production performance of CIRB buffalo herd since 1992-93 (Part-II)

Year	Av. AFC (months)		Av. SP (Days)		Av. CI (Days)	
	M	NR	M	NR	M	NR
1991-92	51.0±0.8 (26)	37.53 (39)	236±11(108)	312±24.0 (58)	502±12(74)	622±25.0 (58)
1992-93	50.7±1.5 (27)	47.30 (28)	304±15(96)	207±17.0 (68)	489±16 (42)	490±16.0 (67)
1993-94	59.1±1.6 (48)	44.60(28)	312±12(158)	211±22.0(58)	625±1 (161)	513±22.0 (58)
1994-95	55.3±1.3 (48)	48.55 (29)	202±15(105)	232±21.0 (63)	527±10(116)	527±19.0 (63)
1995-96	51.51.5 (22)	50.29 (24)	193±10(149)	243±20.0 (52)	501±9 (152)	539±19.0 (52)
1996-97	47.6±1.0 (23)	45.10 (31)	182±10(149)	260±14.0 (69)	473±9 (152)	561±15.0 (69)
1997-98	45.5±0.5 (49)	41.51 (32)	175±14(106)	246±51.0 (60)	491±10(118)	550±53.0 (59)
1998-99	50.0±0.1 (57)	40.46 (26)	137±9(121)	170±29.0 (89)	455±10(126)	481±30.0 (89)
1999-00	46.2±1.0 (54)	39.38 (22)	138±9(104)	134±09.0 (91)	451±8 (120)	467±10.0 (91)
2000-01	46.2±1.2 (45)	39.90(45)	146±9(151)	143±10.0 (80)	454±9 (154)	443±11.0 (80)
2001-02	49.8±0.8 (51)	41.64(31)	146±11(125)	137±09.0 (83)	456±11(135)	445±09.0 (83)
2002-03	47.83±0.51(61)	42.00(58)	133±9(126)	132±08.0 (90)	440±9 (130)	440±08.0 (90)
2003-04	50.52±0.84(77)	41.64(59)	151±10(142)	138±09.0 (78)	458±10(151)	443±09.0 (78)
2004-05	48.18±0.82(76)	42.96(39)	111±7(100)	155±10.1(89)	426±7 (101)	463±10.2 (89)
2005-06	47.89±0.73(76)	42.57(58)	184 ± 12 (112)	167±10.9 (72)	499±12(117)	474±10.6 (72)
2006-07	46.90±1.06(43)	39.93 (57)	183±10.11 (113)	165±14.7 (58)	495±10 (116)	478±14.3 (58)
2007-08	48.27±0.64	40.82 (43)	159 ± 11.55	165±11.2 (74)	482±12.06	458±11.1(74)
2008-09	47.66±0.97 (44)	39.67(69)	171± 12.31 (80)	172±11.8 (70)	469±12.20 (85)	489±16.3 (70)
2009-10	49.22±0.75 (51)	41.09(52)	212±16.64 (77)	170±14.0 (76)	520±16.21 (77)	478±14.1 (76)
2010-11	49.92±1.04 (35)	41.12 (47)	186±13.74 (80)	191±13.7 (71)	492±13.96 (83)	500±13.7 (71)
2011-12	51.91±0.98 (37)	39.70 (43)	181±13.24 (80)	136±20.2 (48)	485±12.65 (81)	464±23.0 (48)
2012-13	44.48±1.42 (37)	39.64 (52)	174±11.53 (72)	126±10.8 (75)	481±11.87 (73)	436±10.9 (75)
2013-14	45.62±10.78(37)	39.80(42)	190±11.27(86)	127±10.6(67)	495±11.64 (87)	447±8.53(97)
2014-15	42.84±0.79 (61)	39.90(36)	168.43± 8.31(88)	112±7.89(88)	472.92±8.45 (88)	420±8.09(88)
2015-16	44.96±1.23 (24)	40.03(56)	138.39±7.39(111)	145.3±9.20(88)	449.26±7.43(111)	453.3±9.20(88)
2016-17	44.91±0.81 (38)	41.45(28)	148 ± 9.01 (93)	140±7.00(118)	458±8.82 (93)	448±7.07(118)
2017-18	43.58±0.67 (67)	41.05(49)	167±9.82 (101)	135±8.46(95)	478±9.87 (101)	444±8.44(95)
2018-19	45.76±0.80 (31)	40.61(55)	136.35±6.98 (97)	129±8.55(77)	446.25±7.08 (97)	438±8.54(77)

M : Murrah (at Main campus, Hisar) **NR :** Nili Ravi (at Sub campus, Nabha);
Figures in parentheses are Number of observations

Agriculture 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 of Nili-Ravi 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 2018-19, Agriculture farm at main campus, Hisar produce more than 33000 quintals of green fodder, 1201.6 quintals grains and 820 quintals wheat straw. At subcampus Nabha, the total green and dry fodder production during the year was 38598 and 2991 quintals, respectively, while grain production was 6203.2 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.

Kharif fodder production CIRB 2018-19

Year	Area (in acres)	
	Main campus, Hisar	Sub campus Nabha
Jowar (Kela)	-	50
Maize	15.0	106
Cowpea + Bajra	-	10
Teosinte	-	10
Sugar graze	-	04
MC Jowar	170	25
Daincha	30	-
Total	215	205

Seed/ grain production CIRB 2018-19

Name of crop	Area (acre)		Total yield (qtls)		Av. yield qtls/acre	
	Main campus Hisar	Sub campus Nabha	Main campus Hisar	Sub campus Nabha	Main campus Hisar	Sub campus Nabha
Wheat	50	120	744.55	2119	14.89	17.65
Barley	50	107(100)	421.35	1352	8.43	12.3
Sarson	20	4	4.10	20.87	2.05	5.2
Oat	60	65		357	5.27	5.49
Barseem	60	60	31.60 (6 acres)	-	-	-
Paddy	20	70	145.7	1585.88	7.29	22.66

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 annually prepares about 600 tonnes of concentrate feed for feeding to farm animals. In addition, approx. 15 tonnes of area specific mineral mixture is being prepared

annually for farm animals as well as for sale to the farmers for its popularization. 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 (10Q/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

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.

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.

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 70 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.

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.

Landscape section

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 through out campus for a clean and healthy environment.

ICAR-CIRB staff position as on 31.03.2019

Category	Sanctioned strength	Filled	Vacant
Research management position	1	0	1
Scientific	44	30	14
Technical	42	33	9
Administrative	19	16	3
Skilled supporting staff	73	64	3
Total	**179**	**143**	**36**

Financial outlay 2018-19 (Rs. in lakhs)

Particulars	Sanctioned	Expenditure
CIRB grants including TSP & SCSP	3779.05	3694.37
Network project on buffalo improvement	0470.00	0459.55
Network project on buffalo improvement, scsp	0042.28	0020.00
AICRP on nutrition and physiology	0019.40	0017.00
NAIF project	0008.37	0006.11
NASF project	0141.70	0090.34
CABin project	0015.00	0014.88
FFP project	0032.85	0028.18
DST SERB	0010.88	0006.02
Contract research – sponsored Zoetis project	0012.77	0003.72
DBT project	0034.59	0013.95
BMGF project	0028.50	006.67

Revenue generation 2018-19 (Rs. in lakhs)

Sale of farm produce	335.23
Sale of other products	001.26
Sale of semen	35.89
Training programmes	003.44
Application fees for recruitment	000.01
Total	**375.83**

Priority setting, monitoring and evaluation (PME) Cell

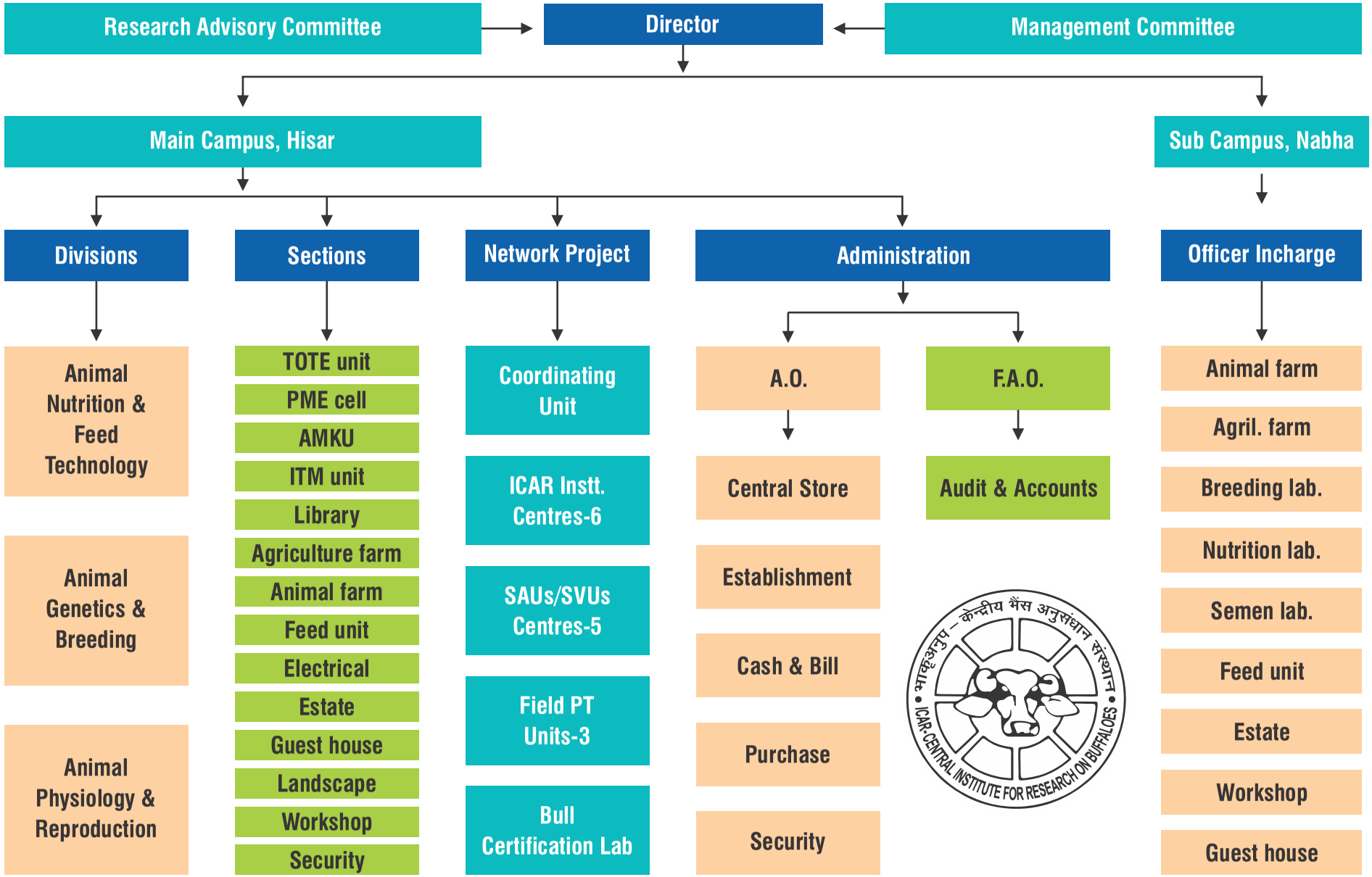
The institute has a Research Advisory Committee (RAC) comprising of eminent scientists who guide research agenda of the institute. The functioning of the institute is supervised by Institute Management Committee (IMC) headed by the Director and members drawn from different institutes and related agencies. A number of sections like Priority Setting, Monitoring and Evaluation Cell, RFD Cell, Institute Technology Management Unit and AKMU

have been created and assigned responsibilities for smooth functioning of research activities of the institute. For the XII plan period flagship programs and priority areas were identified to focus on strategic research in niche areas. This institute is coordinating Network Project on Buffalo Improvement with 10 centers across the country, addressing 7 important buffalo breeds. The institute is also carrying out technology transfer through conducting training for farmers, field days, web based extension activities besides traditional methods of extension in order to disseminate modern buffalo husbandry practices based on research and development in the area.

National and International Collaborations

Over the years, the institute has established collaborations with various national and international institutions. Projects were undertaken with Department of Biotechnology on Embryo Transfer Technology; Central Soil Salinity Research Institute, Karnal for reclamation of salinity affected land through subsurface drainage system; CCS Haryana Agricultural University, Hisar for postgraduate research in the field of buffalo husbandry, nutrition, physiology and reproduction, etc. Similar 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 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. Institute scientists have completed various externally funded projects at this institute and its sub-campus at Nabha sponsored by DBT, USAID, NAIP, NARP, NASF, Network / All India Coordinated projects and other external agencies. A new collaborative project with ILRI is in operation since 2016 on genomic techniques to profile and improve productivity and resilience in Murrah buffaloes.

ORGANIZATIONAL SETUP



RESEARCH ACHIEVEMENTS

Well planned management through addressing issues related to breeding, health, nutrition, welfare and reproduction will greatly increase resource utilization efficiency in animal production systems. ICAR-CIRB since its inception has been working on these aspects for an integrated approach to researchable issues in buffalo production.

GENETICS AND BREED IMPROVEMENT

Genetic variation in animals is the base for our activities at the Division of Animal Breeding and Genetics. India has a rich biological diversity of buffalo. The Institute is the coordinating center for the Network project on buffaloes addressing five most important milch breeds i.e. Murrah, Nili Ravi, Surti, Bhadawari and Jaffrabadi. Keeping pace with International developments made in the subject as well as looking into national priorities, significant contributions have been made through a number of research projects undertaken in different areas of Germplasm Conservation, Cytogenetics, Quantitative Genetics, Population Genetics and Molecular Genetics.

Network Project on Buffalo Improvement

KP Singh, Inderjeet Singh, SS Dahiya

The project was initiated in 1993 with the aim to produce progeny tested bulls for improvement in Murrah buffaloes. Thereafter, other breeds and field progeny testing units were added in 2001. At present five important breeds of buffalo are covered under fourteen (funded/non-funded/ICAR/SAU based) centres. Along with improvement, conservation of Bhadawari and Nili-Ravi is also going on under this program. Progeny testing, extended to field in 2001, includes CIRB, Hisar, NDRI, Karnal and GADVASU, Ludhiana units for Murrah while Surti, Jaffarabadi and Bhadawari are also undertaking FPT with the aim to produce more number of daughters per bull for evaluating bulls with more accuracy.

Progeny test evaluation 13th set Murrah bulls (January 2010 to June 2011)

Sr. no.	Bull no.	Location	Date of birth	Dam no.	Sire no.	Dam's best lact. 305 or less day yield(kg)	Sire index	Rank	No. of daughter recorded	% super-ioerity
1.	838	IVRI	09-07-08	701	2990 X	2850	2143.37	VI	27	-8.97
2.	851	IVRI	17-08-08	227	2045 X	3805	1956.66	IX	44	-19.98
3.	858	IVRI	31-08-08	358	2045 X	2882	2197.74	IV	22	-6.17
4.	2234	GADVASU	06-03-08	2138	5396 X	3114	2688.44	I	117	+14.80
5.	2269	GADVASU	17-12-08	2295	3631 X	3617	2618.87	II	87	+13.86
6.	2304	GADVASU	01-08-09	2138	3226 XI	3114	2573.79	III	154	+10.80
7.	3964	CIRB	01-08-08	1194	4371 PT-V	3369	2119.55	VII	37	-10.32
8.	4059	CIRB	29-05-09	3674	4393 PT-V	2510	2047.38	VIII	32	-14.29
9.	5943	NDRI	19-12-07	416	2583 PT	3232	2154.96	V	60	-8.61

Genetic Improvement of Murrah Buffalo

Test mating from 17th set of test mating initiated with 16 bulls (10 bulls from CIRB Hisar, 4 bulls from GADVASU Ludhiana and 2 bulls from NDRI Karnal) completed on 31st December 2018 and 18th set 15 bulls (3 bulls from CIRB Hisar, 4 bulls from GADVASU Ludhiana, 4 bulls from NDRI Karnal and 4 bulls from LUVAS Hisar) test mating started from 1st January 2019 and continue upto 30th June 2020 at associated centres of Murrah for genetic improvement under the Network Project on Buffalo Improvement.

Performance of participating Murrah herds

The herd strength of associated Murrah herds is 2041 from all the NPBI Murrah centres, which includes 1067 breedable buffaloes. The weighted average of standard lactation milk yield (305 days or less) in Murrah was reported highest (2587 kg) in 2018-19, since inception of the project and showed an overall improvement of 58.98 % since 1992-93 (2.27 % per year). Similarly, the weighted average for other performance traits viz. age at first calving and service period were 43.37 months and 140 days respectively. The weighted wet average of Murrah buffaloes was reported 8.35 kg and revealed overall improvement of 57.84 % (2.22% per year). Overall conception rate and calf mortality (0 to 3 months) reported as 48.28 % and 12.16 % respectively.

Weighted mean of performance traits in Murrah buffalo herds (1992-93 to 2018-19)

Year	305 LMY (kg)	AFC (Months)	SP (Days)	CI (Days)	Wet Av. (kg)
1992-93	1602 (309)	---	249 (204)	495 (250)	5.29 (403)
1997-98	1973 (455)	45.6 (162)	167 (325)	431 (338)	6.62 (509)
2002-03	2056 (511)	45.47 (166)	135 (408)	461 (383)	6.47 (470)
2007-08	2097 (453)	45.3 (217)	140 (391)	454 (351)	6.75 (470)
2012-13	2319 (304)	41.62 (107)	165 (244)	459 (246)	7.15 (346)
2017-18	2487 (416)	42.17 (171)	161 (287)	461 (287)	8.55 (416)
2018-19	2547 (430)	43.37 (151)	140 (379)	447 (370)	8.35 (430)

Improvement in Murrah buffalo productivity :

Traits	1992-93	2018-19	Overall improvement or per year change in %
305 days or Less LMY (kg)	1602	2547	58.98 % (@ 2.27 % / Year)
Wet Average (kg)	5.29	8.35	57.84 % (@ 2.22 % / year)
Calving Interval (days)	495	447	-9.70 %
Service Period (days)	249	140	-43.77 % (@ - 1.68 % / year)
Age at First Calving (month)	50.70	43.37	-14.46 %

Performance of NPBI Murrah centers (2018-19)

Traits/Herd information	Performance of Murrah buffalo at NPBI centers						Overall
	CIRB	NDRI	IVRI	BASU	LUVAS	GADVASU	
Herd strength	522	536	224	85	336	338	2041
Breedable buffaloes	275	302	117	56	161	156	1067
C R (%)	47.92	43.71	59.56	55.76	49.00	48.88	48.28
305 days or less LMY(kg)	2567 (123)	2319 (123)	2205 (40)	1985 (16)	3067 (66)	2771 (62)	2547 (430)
L L (days)	304.63 (123)	307 (123)	344 (40)	370 (16)	314 (66)	335 (62)	313 (430)
Peak yield (kg)	13.36 (123)	12.10 (123)	10.54 (40)	13.08 (16)	15.10 (66)	15.10 (62)	12.28 (430)
A F C (months)	45.76 (31)	44.39 (41)	43.59 (19)	--	42.50 (21)	40.74 (39)	43.37 (151)
S P (days)	136 (97)	119 (54)	169 (46)	157 (18)	145 (60)	136 (104)	140 (379)
C I (days)	446 (97)	415 (55)	496 (36)	463 (18)	454 (60)	441 (104)	447 (370)
Wet Av. (kg)	8.92	7.40	6.43	4.85	11.00	8.40	8.35
Herd Av.(kg)	5.80	3.90	4.40	3.08	8.00	5.38	5.09
Calf Mortality (0-3 month)	13.94 %	18.99 %	4.10 %	45.45 %	5.50 %	1.85 %	12.16 %

Performance of other breeds of buffaloes

Elite herd of Nili Ravi, Jaffarabadi, Surti and Bhadawari breeds of buffaloes have been established in their respective breeding tracts. Nili Ravi (Nabha) and Bhadawari breed centres are functioning as conservation and improvement units and Jaffarabadi, Surti breed centrs are concentrating on field progeny testing along with maintaining the herd for young bull production. A breedable herd of 669 (Nili Ravi –262 at CIRB, Nabha and 104 at GADVASU, Ludhiana, Jaffarabadi- 190 at JAU, Junagadh, Surti-62 at RAJUVAS, Vallabhnagar and Bhadawari -51 At IGFRI, Jhansi) is being maintained at the above five centres. Overall production and reproduction traits were observed better in Nili Ravi buffalo at ICAR-CIRB, sub-campus Nabha. The herd size of Jaffarabadi buffalo was maintained as per the technical program of NPBI, but comparatively small herd size maintained for Bhadwari, Surti breeds.

Performance of breeds other than Murrah (2018-19)

Traits/Herd information	Breeds				
	Jaffarabadi	Nili-Ravi CIRB	Nili-Ravi GADVASU	Bhadawari	Surti
Herd Strength	346	517	161	91	129
Breedable number	190`	262	104	51	62
C R (%)	34.84	40.61	45.83	55.88	43.08
305 days SLMY(kg)	2360 (57)	2679 (111)	2458 (39)	1224 (17)	1566 (22)
L L (days)	317 (57)	311 (111)	300 (39)	332 (17)	313 (22)
Peak Yield (kg)	14.7 (57)	13.70 (111)	13.54 (39)	6.70 (17)	9.60 (22)
A F C (months)	49.9 (22)	40.61 (55)	40.27 (15)	47.28 (13)	42.41 (7)
S P (days)	180 (35)	129 (77)	168 (40)	181 (22)	92 (30)
C I (days)	471 (35)	438 (77)	476 (40)	487 (22)	424 (26)
Wet Av. (kg)	5.80	8.82	7.97	3.67	5.38
Herd Av.(kg)	3.60	6.54	4.12	2.34	3.42
Calf Mortality (0-3 month)	5.82 %	5.23 %	6.30 %	4.17 %	26.47 %

Figures in parentheses indicate number of animals

Semen production and dissemination

During 2018-19, total 260659 frozen semen doses of Murrah bulls were produced, 189530 semen doses disseminated under NPBI/sold to farmers/NGOs/Developmental agencies. The closing balance of frozen semen doses from Murrah bulls was 592878. Other breed (Nili Ravi, Jaffarabadi, Bhadwari and Surti) bulls produced 58481 frozen semen doses, 63647 semen doses disseminated under NPBI/sold to farmers/NGOs/ Developmental agencies during 2018-19. Closing balance of frozen semen from other breed bulls are 272735.

Frozen semen production and dissemination at NPBI centers

Centre	Breed	Production	Dissemination NPBI/sold	Balance
CIRB, Hisar	Murrah	173840	106529	462153
GADVASU Ludhiana	Murrah	52467	67331	112043
NDRI, Karnal	Murrah	34352	15670	18682
Sub total (Murrah)		**260659**	**189530**	**592878**
CIRB Nabha	Nili-Ravi	4253	4069	65202
GADVASU Ludhiana	Nili-Ravi	9627	8856	1993
JAU, Junagadh	Jaffarabadi	29630	44010	99868
RAJUVAS, Bikaner	Surti	9511	2662	65714
IGFRI Jhansi	Bhadawari	5460	4050	39958
Sub total (other breeds)		**58481**	**63647**	**272735**
Grand total		**319140**	**253177**	**865613**

Field Progeny Testing (FPT)

Three field centers of Murrah buffalo were initiated in 2001 at ICAR-CIRB, Hisar, ICAR-NDRI Karnal and GADVASU, Ludhiana to record more number of daughters (progeny) per bull for increasing accuracy of evaluation and selection of bulls based on daughters first lactation milk yield. 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. About 14612 artificial inseminations were carried out in 2018-19 at farmers door in adopted villages under FPT program to produce daughters from XVII and XVIII sets of Murrah breeding bulls. For Jaffrabadi and Surati buffaloes, 2013 and 1719 AIs were carried out in the filed, respectively.

S. No.	Center	Artificial insemination (AI)	Pregnancies diagnosis (PD)	Conception rate CR%	Calving	Females calf born	Daughters recorded	Total daughters recorded
1	ICAR-CIRB, Hisar	3977	2150	55.83	1710	830	122	815
2	ICAR-NDRI, Karnal	2856	1343	47.02	1030	456	83	1129
3	GADVASU, Ludhiana	7779	3299	42.41	2468	1192	270	1109
4	JAU, Junagadh	2013	840	41.73	803	347	87	249
5	RAJUVAS Bikaner	1719	485	28.21	397	173	22	380
Total		**18344**	**8117**	**44.25**	**6408**	**2998**	**584**	**3682**

Progeny testing of Murrah bulls under field conditions-CIRB center

A Bharadwaj, VB Dixit, H Tripathi

Under field progeny testing program (FPT), semen of test bulls was 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 April 2018 to March 2019, a total of 3977 artificial inseminations were performed using test bulls of 17^{tha}nd 18th set. The use 18th set was initiated from January 2019. The conception rate in the field was worked out to be 55.64%. In this period, 2150 pregnancies were confirmed and out of that 1710 calving (880 males, 830 females) were recorded. In addition 183 progenies, 4 of 13th, 71 of 14th, and 108 of 15th set were also calved and monthly test day milk yield were / being recorded. The average age at first calving for these 183 daughters was 40.07 months. During the year 299 daughters were recorded, out of which 122 daughters completed the lactation, 43 daughters sold before the lactation was completed and recording of 134 daughters are in progress. The physical identification using ear tagging has been done in all female progenies born in the field till March 2019. As on 31st March 2019, 1302 female progenies of 14th to 17th set of different age are standing at various field unit centers for future recordings.

Genetic improvement of Nili-Ravi buffalo

Sanjay Kumar, Mustafa H Jan, KL Mehrara, Rajiv Mehta

A total of 137 (64 female & 73 male) calves of high genetic merit were born during this period. Test mating (426 inseminations) were carried out during this period resulting in 173 pregnancies. During this period, 22 daughters of 05 bulls under progeny testing programme completed 1st lactation. The overall best ever wet average (8.82 kg),

herd average (6.54), 305 days lactation milk yield (2679 kg), total lactation yield (2797 kg), peak yield (13.7 kg), percentage of animals in milk (74%) and lactation length (311 days) were achieved in Nili-Ravi herd. The reproductive traits viz., service period (129 days), AFC (40.61 months) calving interval (438 days), dry period (148 days) and 1st calving buffaloes (60) were achieved during year 2018-19. Herd life production (up to 4th lactation) of 32 buffaloes was estimated. The average productive days were 1434 and average milk yield per day of herd life was 4.09 litres. A total of 4253 semen doses were produced at the sub campus or procured from semen station Nabha. Out of which, 1453 doses were used at farm for insemination and 2616 doses were sold to field inseminators. Overall motility of 3.83% and calf motility of 5.23% was recorded during this period. The overall conception rate recorded was 40.61% and upto 3 inseminations it was 45.09%. Milk production of 349695.4 kg was recorded during this year, and 279044.0 kg was sold. Total 61 animals have been sold through public auction and on book value to farmers, universities and various developmental agencies.

Buffalo calf mortality and its management

SK Khurana, Ashok Boora, Sarita Yadav, Sanjay Kumar

Calf mortality in buffalo dairy farming is having great financial implications. Major conditions which cause mortality in buffalo calves are diarrhea, pneumonia and septicemia caused mainly by several bacterial, viral and parasitic agents. In this project two separate exhaustive proforma were prepared. First proforma was for survey of buffalo calf mortality/ health survey from buffalo farmers having unorganized farms and also from organized farms including several parameters related to calf mortality. Various aspects included were housing, management, feeding and several other parameters. Second proforma was regarding veterinarian's observations on calf mortality.

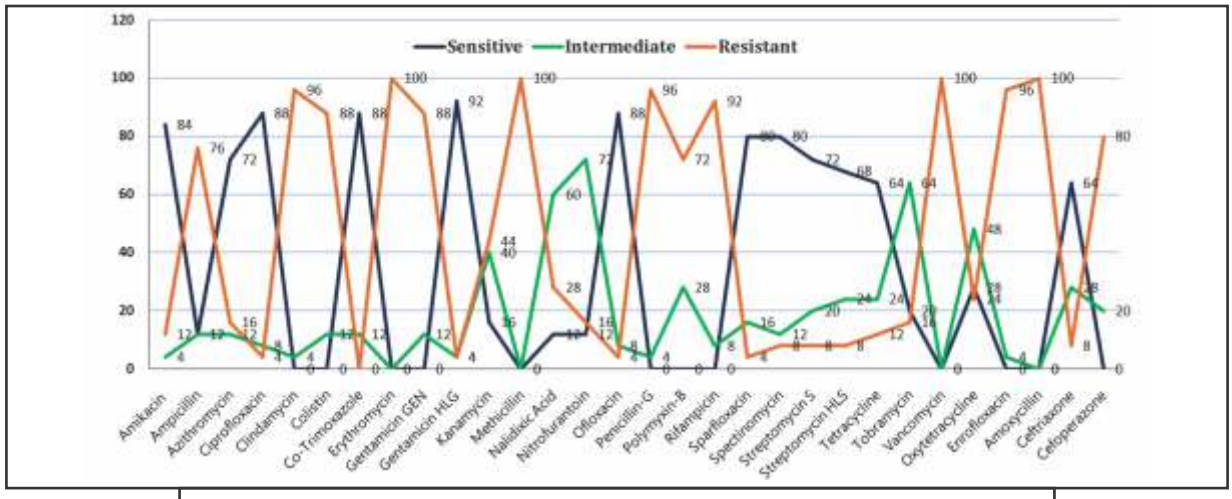
During reporting period, two hundred six (206) village buffalo farms in unorganized sector were surveyed. These were from 15 villages from Haryana including Gangwa, Ladwi, Bhuthan Kalan, Thuian, Cheemon, Rawalwas Kalan, Dhani Majua, Hasanga, Dhabi Khurd, Jhalania, Dalher, Ruksana, Kaimri, Dhanora and Chillar. From Punjab there were 6 villages including Valtoha, Khanpur Barring, Rajgarh, Bajidpur, Bhunsi and Harjou Kalan. Survey of buffalo calf mortality/ health from two organized farms of CIRB located at Hisar and Nabha was also included in this study. In addition survey of 12 small peri-urban private buffalo dairy units at Hisar, Barwala and Adampur was also done. Survey of observations of sixty seven (67) veterinarians regarding buffalo calf mortality was also taken into consideration. The process of survey is ongoing. After the process is complete, analysis will be done.

One hundred fifty five (155) clinical biosamples including faecal, nasal swabs and abscess samples from disead buffalo calves were subjected to bacterial analysis which yielded *E. coli* (60), *Klebsiella pneumoniae* (25) and *Salmonella spp.* (20). None of the 87 samples from in contact apparently healthy buffalo calves yielded any bacteria of pathogenic significance.

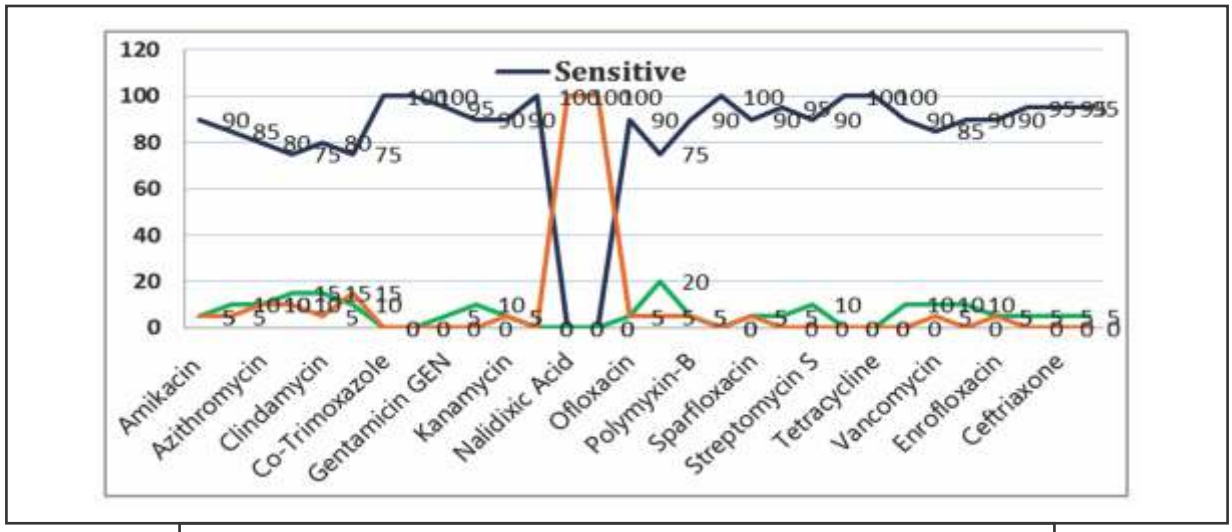
All the isolates were subjected to in vitro antimicrobial susceptibility testing against 30 antimicrobial agents following standard methods. The percentage of isolates coming under the category as sensitive, intermediate and resistant was calculated on the basis of zone size interpretative chart provided by the manufacturer.

Suitable advice was given to farmers for treatment as well as health management of buffalo calves directly as well as through field veterinarians and other field functionaries. Further MAR values will be calculated based on the drug resistance of the isolates against conventional antimicrobials.

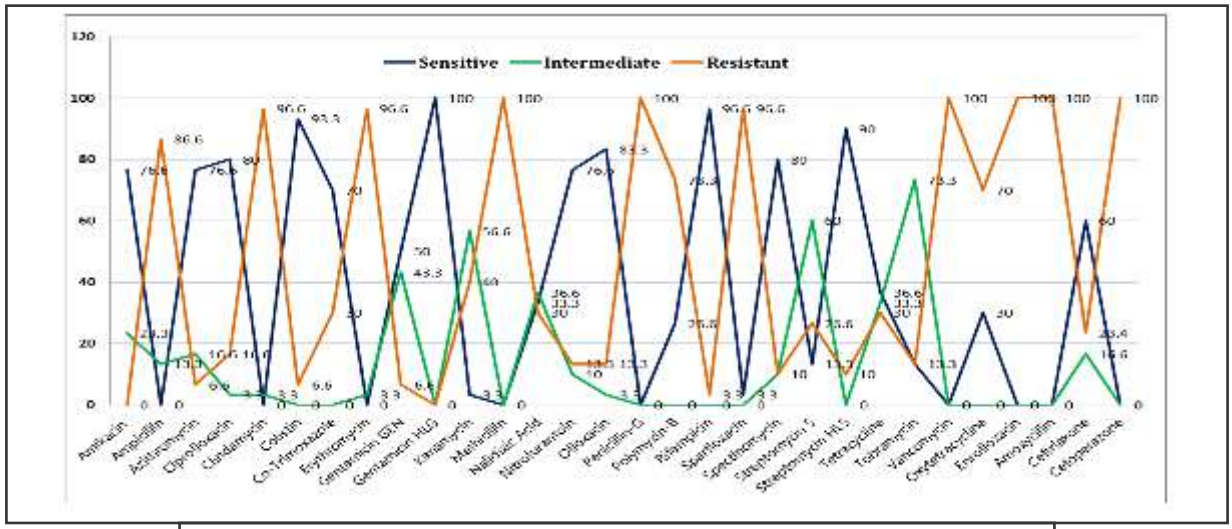
The bacterial analysis from clinical samples, samples from in contact animals and post mortem tissues will



Antibiotic sensitivity pattern of *Klebsiella pneumonia* strains



Antibiotic sensitivity pattern of *Salmonella spp.* strains



Antibiotic sensitivity pattern of *E.coli*

Antibiotic sensitivity patterns due to important bacteria causing calf mortality

S. No.	Center	*Klebsiella pneumonia* strains			*Salmonella spp.* strains			*E. coli* strains		
		Sensitive %	Inter-mediate%	Resistant %	Sensitive %	Inter-mediate%	Resistant %	Sensitive %	Inter-mediate%	Resistant %
1.	Amikacin	84	4	12	90	5	5	76.6	23.3	0
2.	Ampicillin	12	12	76	85	10	5	0	13.3	86.6
3.	Azithromycin	72	12	16	80	10	10	76.6	16.6	6.6
4.	Ciprofloxacin	88	8	4	75	15	10	80	3.3	16.6
5.	Clindamycin	0	4	96	80	15	5	0	3.3	96.6
6.	Colistin	0	12	88	75	10	15	93.3	0	6.6
7.	Co-Trimoxazole	88	12	0	100	0	0	70	0	30
8.	Erythromycin	0	0	100	100	0	0	0	3.3	96.6
9.	Gentamicin GEN	0	12	88	95	5	0	50	43.3	6.6
10.	Gentamicin HLG	92	4	4	90	10	0	100	0	0
11.	Kanamycin	16	40	44	90	5	5	3.3	56.6	40
12.	Methicillin	0	0	100	100	0	0	0	0	100
13.	Nalidixic Acid	12	60	28	0	0	100	33.3	36.6	30
14.	Nitrofurantoin	12	72	16	0	0	100	76.6	10	13.3
15.	Ofloxacin	88	8	4	90	5	5	83.3	3.3	13.3
16.	Penicillin-G	0	4	96	75	20	5	0	0	100
17.	Polymyxin-B	0	28	72	90	5	5	26.6	0	73.3
18.	Rifampicin	0	8	92	100	0	0	96.6	0	3.3
19.	Sparfloxacin	80	16	4	90	5	5	3.3	0	96.6
20.	Spectinomycin	80	12	8	95	5	0	80	10	10
21.	Streptomycin S	72	20	8	90	10	0	13.3	60	26.6
22.	Streptomycin HLS	68	24	8	100	0	0	90	0	10
23.	Tetracycline	64	24	12	100	0	0	36.6	33.3	30
24.	Tobramycin	20	64	16	90	10	0	13.3	73.3	13.3
25.	Vancomycin	0	0	100	85	10	5	0	0	100
26.	Oxytetracycline	28	48	24	90	10	0	30	0	70
27.	Enrofloxacin	0	4	96	90	5	5	0	0	100
28.	Amoxycillin	0	0	100	95	5	0	0	0	100
29.	Ceftriaxone	64	28	8	95	5	0	60	16.6	23.4
30.	Cefoperazone	0	20	80	95	5	0	0	0	100

continue. Further the isolates will be molecularly characterized with respect to various virulence genes. A total number of 196 faecal samples of different age group of male and female buffaloes were examined for GI parasite infection at Sub-Campus, Nabha. Master egg counting technique, floatation technique and sedimentation technique were used to see presence of parasitic eggs in faeces. All the faecal samples from the buffaloes of Nabha Sub-Campus, were found negative for GI Parasite infection. Total 40 faecal samples of buffalo calves and 58 of adult

buffaloes from surrounding villages (Saluwal, Dingi and Rajgarh) of Nabha, were examined for GI parasite infection. Eggs of Haemonchus sp. were detected in 4 calves and 3 adult buffaloes but EPG concentration was very less.

Genomic techniques to profile and improve productivity and resilience in buffalo

P Sikka, KP Singh, A Bharadwaj and Inderjeet Singh (ICAR-CIRB, Hisar)

Marshall Karen and Raphael Mrode (ILRI, Nairobi)

The Murrah buffalo breeding program was reviewed and a set of recommendations were made on how to further increase rates of genetic gain via the use of genomic selection. Development of a reference population for genomic selection (1000+ buffaloes with both genotypes and phenotypes); Digitization of breeding program data; Use of best linear unbiased prediction (BLUP) to estimate breeding values of the buffaloes; Incorporation of genomic selection and restructuring the breeding program to fully capitalize on genomic selection and development of a reduced genotyping (SNP) array for reducing the ongoing cost of genomic selection were key recommendations.

Study recommends the use of Axiom array for buffalo genotyping for generating buffalo reference population to implement genomic selection. Suitability of Axiom Buffalo genotyping array was ascertained. High number of informative SNPs (n=93,860), having a normal distribution of minor allele frequency (MAF, 0.2648) and expected observed heterozygosity were determined by genotyping a subgroup (n=165) of Indian Murrah genotypes. Based on quality parameters determined as sample QC threshold, dish QC call rate and plate QC, per cent samples passes were more than 95%, thus, indicating that the array is suitable for use in genomic selection of Murrah buffalo.

Android based software application "ODK Device" is developed for accurate filed sample and animal phenotype data recording of field progenies. Data extraction and processing was tested, using customized open device kit, ODK application forms, generated as per the field records (FPT, NPBI) information (Year 2016-17). Field unit in charges and associated field workers were trained to use it, thus, field data capturing activity strengthening FPT programme. Sire-Progeny relationship matrix is determined for Parentage testing based on the shared alleles of SNPs using IBD test method for 50 bull families as pilot-test of parentage to further strengthen FPT scheme, under study. It will facilitate accurate genomic estimates of filed progenies.

Database structuring of digitized records of Network Project on Buffalo Improvement into a database to harbor digitized data in a common format across the centers with regards to daugthers' first lactation records of 1 to 12 sets bulls, in particular and location records of 2000 Murrah buffaloes collected from various network centers. Database structure framing front- end development and apps programming was outsourced. Database structure preparation for all NPBI digitized data for NPBI centers is in place and its export modules installation was done at institute central portal (CIRB) for its further testing. implementation of an analytical platform to fully capitalize on genomic selection, however, BLUP EBVs, using WOMBAT software to estimate genomic breeding values is required to implement genomic selection, thus restructuring the evaluation of the breeding program.

Identification of genetic variants in genes related to oxidative status for fertility assessment in Murrah bulls

P Sikka, Pardeep Kumar, A Bharadwaj

Multiple sequence alignment analysis (*JalView* 2.10.5 software) revealed bi-allelic SNP markers were identified in Exon 1 (8 SNP markers) & Exon 2 (7 SNP markers) in reactive oxygen status (ROS) regulating glutathione peroxidase (GPX) gene, determined through Sanger method of sequencing of 30 Murrah bulls. Upto 30% dissimilarity ($p<0.5$) w.r.t. high and low performance (semen and its kinametic indices) was determined to segregate two subgroups of bulls. SNP markers identified in GPX gene enabled segregation of high and low performing genotypes of bulls, indicative of selection marker of bulls (n=30 bulls).

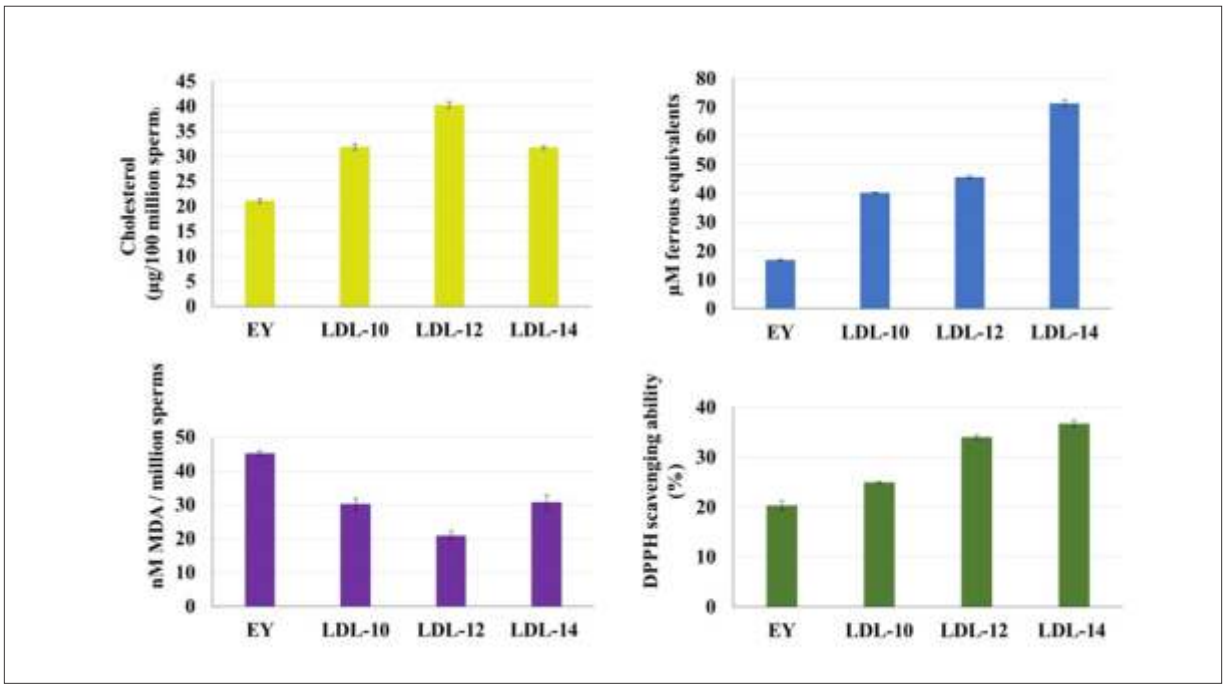
IMPROVEMENT OF REPRODUCTIVE EFFICIENCY

Optimum reproductive efficiency is a primary requirement for achieving sustainability of animal production systems. Getting a calf, a year is one of the most desirable aspects of large animal reproduction to get enhanced productivity from animal. The Animal Physiology and Reproduction (APR) Division at the Institute has been carrying out research and extension activities to help buffalo owners to achieve 'a calf a year' target. The Division has state-of-the-art instrumentation for buffalo cloning, making it among the harbingers in animal cloning technology. The institute has taken innovative initiatives in understanding molecular basis of semen freezing for improved sperm survivability and conception rate, mechanism for early detection of pregnancy diagnosis and estrus detection for addressing silent estrus and nutrition – hormone therapies for improved fertility.

A bad cholesterol LDL is good for sperm cryopreservation

Pradeep Kumar

The LDL based extender have less detrimental effects during semen cryopreservation processes as compared to egg yolk based extenders which have high concentration of progesteron and calcium. During cryopreservation cholesterol is removed from already compromised sperm membrane in the presence of EY because it contains HDL a strong cholesterol receptor. On the other hand LDL prevents cholesterol efflux and protects sperm membrane protein from denaturation which was evident by high quantity of CatSper proteins in sperm cryopreserved in LDL based extender. The cholesterol deficit cryoinjured sperm membrane, in presence of already existing progesterone in extender allows calcium influx as evident by high intracellular calcium. Further, LDL based extender had greater antioxidant potential that counter balance the ROS generated during cryopreservation which is evident by better sperm kinetic and motility, intact membrane and greater longevity of sperm. Further, LDL based extender protect sperm from phosphorylation of tyrosine containing proteins which is ultimate of chain reaction of capacitation and most potent indicator of capacitation. Overall, low number of sperm undergoes premature capacitation and acrosome reaction during cryopreservation in LDL based extender. This is the first report wherein LDL has been indicated to protect sperms against premature capacitation during cryopreservation process better than egg yolk.



Synthetic endometrium for study early embryonic development

Dharmendra Kumar, Naresh L Selokar

Immature oocytes collected from buffalo ovaries (n=1950), were subjected to maturation (n=1551, 79.53%) and fertilization in vitro led to a cleavage rate of 57.57% (n=893) and subsequently development of blastocyst stage embryos (15.34%, n=137). The total cell number and apoptosis index ranged between 147- 152 and 6.8-7.4%, respectively; indicating production of healthy embryos. More than 20 blastocysts were cryopreserved for embryo-pathogen interactions and gene expression studies (P53, CASPASE3, OCT4, NANOG, FGF4, SOX2) with the developed 3D-ECC system at IVRI and NDRI centres. Effect of LPS from E. coli on the developmental competence of buffalo oocytes in vitro revealed that LPS @ 10μg/mL added in the maturation medium significantly reduced cleavage rate and blastocyst development than healthy control (60.4 vs. 44.9; 9.5 vs. 6.1%). Set of primers (P53, CASPASE3, OCT4, NANOG, FGP4, SOX2) were customized and standardized PCR conditions for gene expression studies in the generated blastocysts.

Buffalo cloning for production of multiple copies of elite bulls

PS Yadav, Naresh Selokar, Dharmendra Kumar, R K Sharma, Pradeep Kumar, Rajesh Kumar

With successful cloning of Hisar-Gaurav- a Murrah male clone and Sach-Gauarav an Assemese buffalo clone in field at Sach Dairy, Sirsa, CIRB Hisar emerged as center of buffalo cloning in India. Recently, NASF granted a project on 'Production of multiple copies of elite buffalo bulls using animal cloning technology' to produce multiple clones of elite buffalo bulls, improve production efficiency of clones and evaluate clones for health and reproductive performance. With the purchase of 50 heifers for dedicated use as recipient for cloned embryo transfer, the project was started to achieve the objectives. For cloning elite bulls from Murrah and Nili-Ravi was selected based on performance of its parents, performance of its progeny and semen parameters.

To achieve this goal, buffalo oocytes were collected from abattoir ovaries and subsequently in vitro matured. Matured oocytes had been subjected to pronase treatment for removal of zona pellucidae. Zona free oocyte was placed at right angle to cut the portion having nucleus. The enucleated cytoplasm from oocytes was used for reprogramming of donor cell nuclear material for development of cloned embryo. Activation of oocytes with chemicals electro-fusion is required to produce cloned embryos.

Performance of Hisar-Gaurav and Sach-Gaurav cloned bull :

- Hisar-Gaurav attained 780 kg body weight and growing normal with good health. All the parameters of a breeding bull such as : reaction time (39.5 sec), mean semen volume (2.73 ml), means sperm concentration (1023 million/ml), mean mass motility (3.38) and other semen variables were found normal.
- Hisar-Gaurav cloned bull progenies (n=12) produced normally and their parentage verified (NDDB, Anand) (Both using Microsatellite sequencing and SNP markers (Axiom platfor, Affimatix) IBD based.
- Frozen semen doses from Hisar-Gaurav available in stock-9200.
- Sach-Gaurav, Assamese buffalo clone is gorwing well and have attained weight of 387 Kg and this clone was shifted to institute farm after weaning at the age of 12 months.

Integration of lysozyme into the beta-casein locus of buffalo/bovine genomes using CRISPR/Cas9

PS Yadav, Dharmendra Kumar, Naresh L Selokar (CIRB, Hisar)
Wilfried A Kues, B. Peterson (FLI, Germany)

Under this project personal exchange visits has been performed to achieve the project objectives. To amplify the β-casein sequence, specific primers to buffalo/ bovine β Casein were designed and procured. Further, the condition of PCR was also standardized for the same. Further, homologous recombination vector for insertion of lysozyme gene using CRISPR/Cas9 based approach has been developed and successfully ligated the guides RNA in puromycin CRISPR vector for selection. After construction of vector, verification of guide ligation was carried out using restriction enzyme digestions which confirm the required construct. Culture of the fetal fibroblast cells from bovine origin and maintained them into in vitro culture system. Actively growing fibroblasts cells were co-electroporated with CRISPR-Cas9 system containing sequence of beta casein locus. After electroporation, cells were maintained in the culture system for 2-3 days then selected the positive electroporated cells using puromycin antibiotic selection. Those cells resistant of puromycin, were clonally expanded and their DNA has been isolated for sequencing.

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

Sajjan Singh, Pradeep Kumar, A Jerome, RK Sharma

In this project, 10 inseminators was used for field fertility study. Around 2100 semen straws comprising of three sperm dose i.e. 20, 16 & 12 million/straw were distributed for field inseminations. Till date, the conception rates of 57.65% (20 million/straw), 57.92% (16 million /straw and 54.92% (12 million /straw) was obtained under field conditions.

Nutritional interventions during transition period for enhancing production and reproduction in buffaloes

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

A study was designed to evaluate the effect of supplementing vitamin A and E in peri-parturient buffaloes on production, reproduction, udder health and oxidative stress as well as performance of their calves using twenty-two multiparous Murrah buffaloes during their advance stage of pregnancy (-30 day). Buffaloes were divided into three groups control (C, n=8), treatment 1 (T1, n=7) and treatment 2 (T2, n=7) on the basis of most probable producing ability of milk, parity and body weights. They were fed either control diet (C) or supplemented with vitamin A @ 75,000 IU daily for whole study and vitamin E @ 1500 IU from prepartum 30 days to post-partum 30 days of the study, followed by reduced dose rate of 500 IU daily up to 90 days after calving in group T1 or vitamin A @ 1, 50,000 IU daily for whole study and vitamin E @ 3000 IU from prepartum 30 days to post-partum 30 days of the study, followed by a reduced dose rate of 1000 IU daily up to 90 days after calving in group T2.

In this study, no incidence of clinical mastitis, retained placenta, metritis and prolapse of uterus were reported in group T2, whereas buffaloes of control group showed all the four reproductive disorders in four different buffaloes. Supplementation of vitamin A and E at higher level (T2) were helpful to increase the overall mean milk protein, fat and total solids percentage, with 7% and 10% increase in FCM production in groups T1 and T2, respectively. Colostrum protein and total solids % were high at higher level of supplementation (T2). Somatic cell count in milk was numerically high in control group, but showed significant difference at day 96 only. Blood biochemical parameters did not show any variations at different post supplementation periods among three groups, except at day 30 when plasma glucose values were high in group T1 with reduced values of cholesterol in group T2 at day 90 as well as overall mean values as compared to control values. Overall mean values of plasma β-carotene were found higher in both the treatment groups, while plasma vitamin E remained high at day 30 only in group T2 as compared to control values. Overall mean values of plasma total antioxidant activity remained high in group T2 only with improvement of total immunoglobulin in both the treatment groups at day 90 of study. Supplementation of vitamin A and E were helpful in reducing the time for expulsion of placenta (4.02-4.09 Vs. 5.51 hrs) with improvement in cyclicity % in buffaloes (85.71 %, 42.86% and 37.5%) in groups T2, T1 and C, respectively.

Different estrus induction and ovulation synchronization protocols were also used to bring anestus buffaloes into cycle. The results are given below :

Treatment	Cases	Estrus induced	Pregnancy after 1st AI	Pregnancy after 2nd AI	Pregnancy after 3rd AI	Non-traceable	Overall Pregnancy
Ovsynch	6	4 (66.7%)	3 (50%)	-	-	-	50.0%
Ovsynch Plus	20	16 (80%)	7 (35%)	2 (10%)	-	1 (5%)	45.0%
CIDR	170	153 (90%)	59 (35%)	15 (9%)	12 (7%)	7 (4%)	50.6%
PG	144	123 (85.4%)	58 (40%)	12 (8%)	-	3 (2%)	48.6%
Total	**340**						

Manipulation of follicular wave pattern to increase conception rate in buffalo

Mustafa Hasan Jan and Sanjay Kumar

Shortening the dominance phase of wave 1 in 2-wave pattern will result in early emergence of 2-wave and the need for 3rd wave to emerge before luteal regression occurs, thereby transforming the 2-wave pattern into 3-wave pattern. The shorter dominance phase of wave 1 will be induced by early exposure of wave 1 DF to high progesterone environment that limits LH secretion necessary for its growth. Furthermore, it is believed that cows with two waves yield follicles that are older and larger at ovulation than cows with three waves. Prolonged growth and dominance of the ovulatory follicle is associated with decreased fertility in cattle. In a study conducted on 5 research station, it was found that pregnancy rate was higher in 3-wave pattern as compared to 2-wave pattern (81% vs 62%, respectively). The second hypothesis is that progesterone exposure during early growth phase of wave 1 will not only transform albeit majority of 2-wave pattern normally present into 3-wave pattern but will also result in an increased pregnancy rate.

To verify this hypothesis, thirty six (36) Nili-Ravi buffalo heifers were subjected to ultrasonographic examination. During each ultrasonographic examination, ovaries were scanned by transrectal ultrasonography. All the heifers were scanned daily till occurrence of ovulation. Individual follicular and luteal structures were recorded and identified using previous day records. A total of 46 cycles were monitored in which a subset of 10 heifers was

scanned for two consecutive inter-estrus intervals and follicular wave pattern in each IOI was recorded. Sixteen (16) heifers in estrus were selected and progesterone treatment was started from D0 (day of ovulation) in a decreasing dose up to D5 of 2nd IOI. Heifers received decreasing doses of progesterone in sesame oil vehicle (2 mL) by subcutaneous injection from day 0 (day 0 = day of ovulation) to day 5. The daily dose of 150, 150, 100, 75, 50 and 25 mg, respectively, were given. Ovarian ultrasonography was carried out to record the follicular wave pattern (number of follicular waves). Control heifers (n=10) received 2ml of sesame oil vehicle through subcutaneous injection using the same schedule. All the heifers were inseminated with good quality frozen semen at the end of IOI (2nd estrus) and were confirmed for pregnancy by ultrasonography at day 45 post-insemination. In a total 46 scannings conducted, 29 (63.04%) inter-oestrus intervals were 2-wave and 17 (26.96%) were 3-wave. The average duration of 2-wave interestrus interval was 20.2±0.3 and that of 3-wave pattern was 23.5±0.2 days. 10 heifers were scanned for two consecutive estrus cycles to determine the repeatability of follicular wave pattern. Non-alternating pattern (same follicular wave pattern in both scanning) was found in 6 (60.0%) animals and alternating pattern (different follicular wave in both scanning) was found in 4 (40.0%) heifers. 16 heifers were subjected to progesterone treatment from D0 (day of ovulation) in a decreasing dose till D5 and 10 heifers were kept as control. Post-treatment, 2-wave pattern was recorded in only 4 heifers and 12 heifers showed 3-wave pattern. Progesterone treatment significantly increased the proportion of 3-wave cycles as compared to control (P<0.05). Pregnancy rates of treated and untreated heifers did not differ (P>0.05). The pregnancy rate of treated heifers was 43.8% (7 pregnant out of 16), whereas that of control heifers was 40.0% (4 out of 10 heifers).

Modified artificial vagina (AV) for semen collection from bulls

Pradeep Kumar, Dharmendra Kumar, Jerome A, RK Sharma, P S Yadav

The temperature of artificial vagina is a critical factor for the semen collection of bulls. Due to lower AV temperature the bull fail to thrust, or fail to donate semen and if donates it has lower sperm concentration with high chances of contamination of semen with urine. On the other hand, due to high AV temperature sperms may be dead or there are chances of burning of penis and the bull in future may develop fear to donate semen in AV. Therefore AV was modified to protect from temperature fluctuations. This AV is ready for commercialization at Agrinovate India Ltd.

Ready to use semen extender

Pradeep Kumar, Dharmendra Kumar, Jerome A, R K Sharma, P S Yadav

Presently, egg yolk is being used for preparation of semen extender and these extender having limitations like wide variability of egg yolk composition, risk of microbial contamination, presence of high density lipoproteins and progesterone hormones. A ready to use indigenous semen extender without egg yolk was prepared and is available for commercialization at Agrinovate India Ltd.

Infra-red thermal (IRT) imaging for udder health management in buffaloes

AK Balhara, Sarita Yadav, Ashok Boora, Sunesh

Earliest possible detection of disease in udder is key to good prognosis with complete /near complete recovery of milk synthesizing tissue. The temperature variations in udder w.r.t. skin temperature are an important manifestation of the inflammatory pathways activated during onset and progression of mastitis. Infra-red thermal (IRT) imaging offers unique opportunity to investigate temperature variations in udder tissue for udder health assessment, detection of subclinical mastitis and effectiveness of therapeutics embraced.

In a typical case to validate this technology, an eight month pregnant Murrah buffalo heifer (born to very high yielder dam) with development of one abnormal teat, appearing shrunken with lesser growth (Fig. A & B). Few drops of milk were squeezed out which tested positive for commensal Coagulase Negative Staphylococcus (CNS) species indicating subclinical mastitis. IRT imaging after therapeutic intervention revealed growth in quarter with arrested growth with significantly high temperature differences (2-3 ^{0}C ; Fig. C) between affected and normal quarters. Thermogram of affected quarter had a high density red spot area indicating severe inflammation (Fig. D, Temperatures above 39 ^{0}C). This infrared thermography (IRT) is effective, non invasive, on-site diagnostic technology for assessment of physiological-pathological status. The technology can be very effective for mastitis management in high yielding buffaloes.

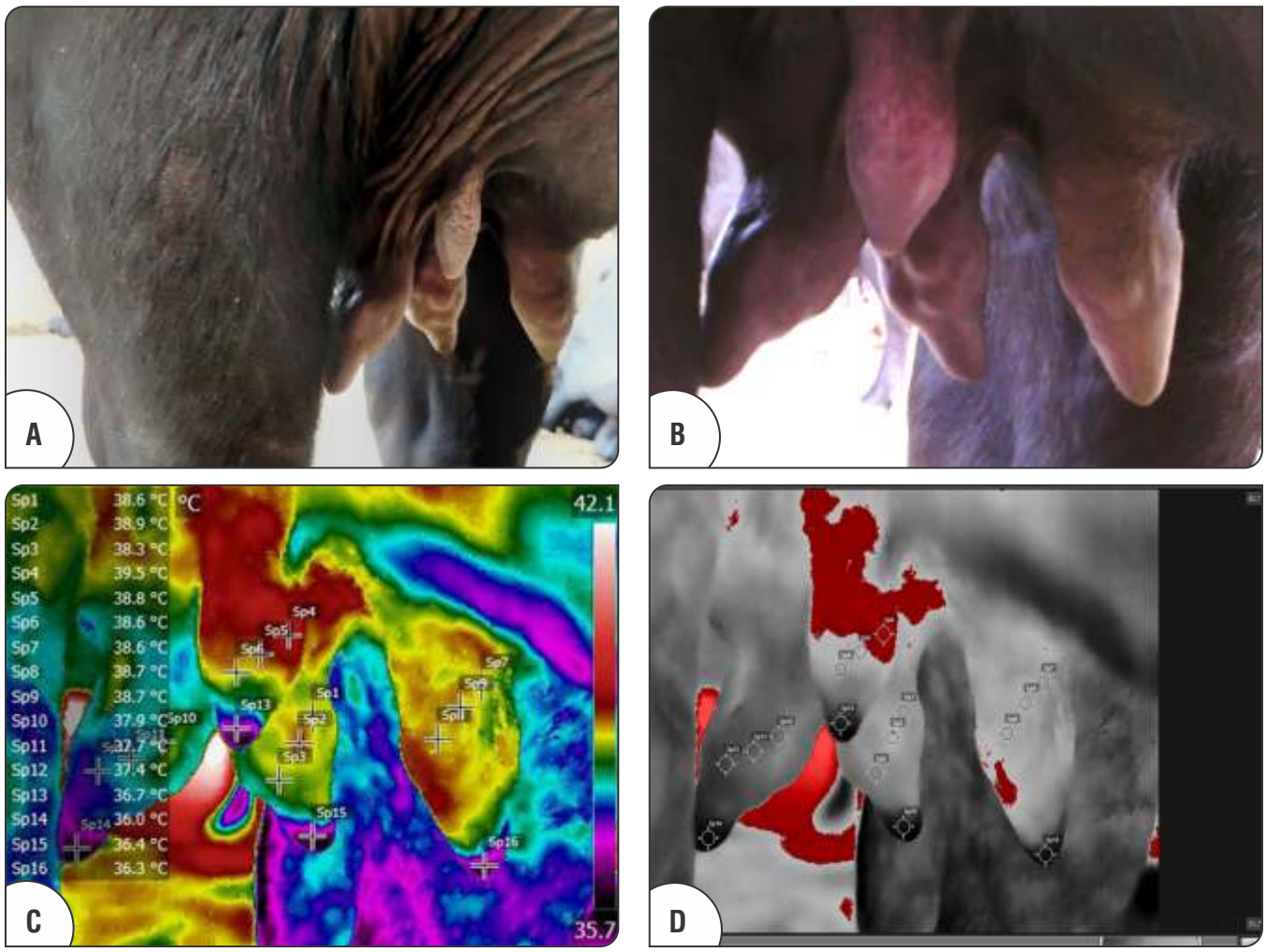


Fig. A : Normal image of udder during onset of subclinical mastitis in buffalo heifer; **B :** Normal image of buffalo heifer presented with development of inflammatory signs (later stage); **C:** Thermogram (all temperatures indicated); **D :**Thermograms with hot spots only (above 39^{0}C)

Field Microscope

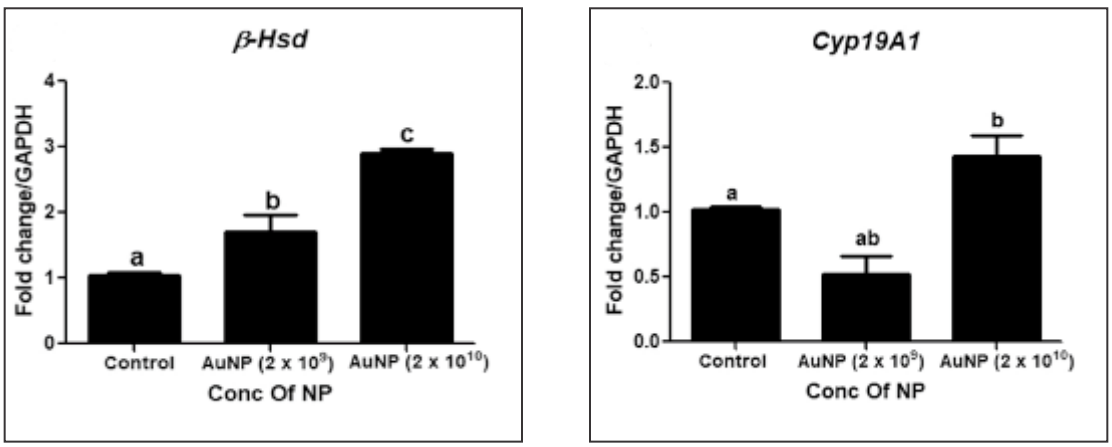
Pradeep Kumar, Dharmendra Kumar, Inderjeet Singh, R K Sharma, P S Yadav

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 a handy and portable microscope i.e. 'Field Microscope' was designed especially for the evaluation of sperm motility in field condition and ready to commercialization at Agrinovate India Ltd.

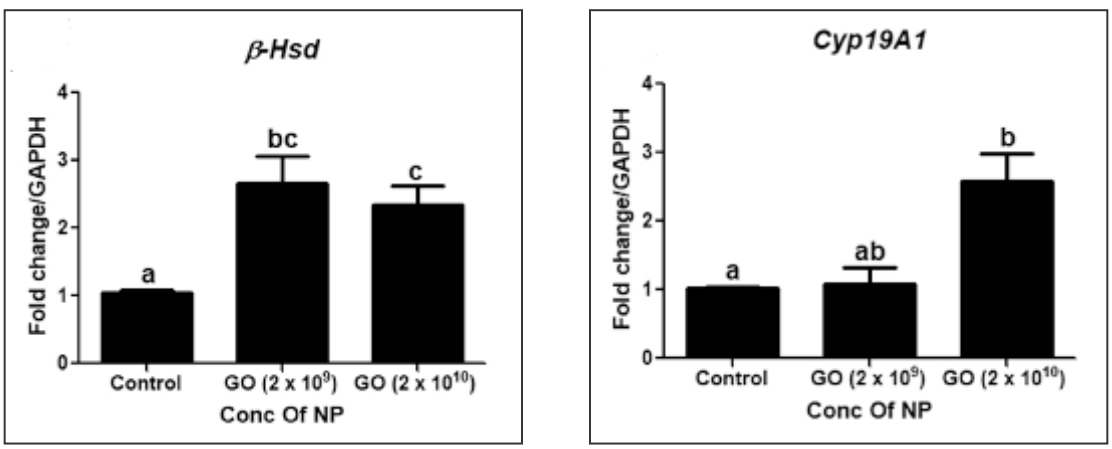
Effects of gold nanoparticles and graphene oxide nanomaterial on modulation of steroidogenesis and apoptotic pathway genes in granulosa cells

Varij Nayan, Anuradha Bhardwaj, P Sikka

A study was conducted to understand the effect of gold nanoparticle (AuNP) and graphene oxide (GO) on steroidogenic (β-Hsd & Cyp19A1) and apoptotic gene (Bcl-2, Bax, Bad and Caspase 3) and progesterone production in buffalo granulosa cells. Treatment of GC with AuNP and GO (2 x 109 NP/ml and 2 x 1010 NP/ml) for 24h significantly modulated the steroidogenic gene β-Hsd and Cyp19A1 gene expression and accumulation of progesterone in the culture fluid. AuNP affects apoptotic pathway in the buffalo GC by affecting the gene expression of Bad, Bax and Caspase-3. The study further suggested that the modulatory effects of AuNP and GO on buffalo granulosa cells should be extensively investigated.



GO NPs affects apoptotic pathway in the buffalo GC by affecting the gene expression of Bax and caspase-3.



AuNP and GO did not exert oxidative stress through anti-oxidant induction & lipid peroxidation in buffalo GC.

FEED RESOURCE UTILIZATION AND IMPROVEMENT

Most commonly in India, farmers feed their animals based on their traditional knowledge with crop residues, locally available one or two feed ingredients like brans, oil-cakes, chunnies, grains etc. and seasonally available green fodders with some amounts of mineral mixture. In most of the cases, the quantity of feed/fodder offered to animals is either more or less than the requirements leading to an imbalance of protein, energy and minerals in their ration. Ruminants like buffaloes maintained on such imbalanced ration results in incomplete feed digestion leading to low feed conversion efficiency, loss of nutrients causing lower milk production and poor health and fertility. Keeping these points in focus, the research in this Division is focused on feed and fodder modifiers/supplementations for improved feed utilization efficiency, methane mitigation strategies, nutraceuticals, mineral supplementations, rumen microbiology, processing, crop residues and industry by-products for animal feed and fodder.

Production performance and assessment of feeding practices of Banni buffaloes

SS Dahiya, PC Lailer, KP Singh, Avijit Dey, Vishal Mudgal

Banni is the best-largest grassland of Asia. Parallel to greater run of Kutch (106 km long and 16 - 26 km broad), it has potential to provide fodder to entire state. Banni grassland: A protected forest (1955), notified area and preserved as grazing land under land revenue code. Maldharies allow there livestock for grazing and cultivation of crops is not permitted. Maldharies in Banni have no occupancy right of the land under land revenue code. A Banni buffalo breeders association was established in 2008 with about 1000 Maldharis as members. This breed of buffalo got registered with NBAGR Karnal in the year 2010. A cooperative dairy and milk marketing network has been established by this breeder association since 2009.

Banni buffalo maintained under locally adapted traditional extensive production system. Selling of milk, milk products and animals are the main activity. Maldharis' follow extensive production system to reduced cost of production (Housing and fodder production cost almost zero). Buffaloes are trained in a typical grazing practice during night and come back to the villages in the morning for milking.

Banny buffalo production traits (based on 16 Maldharis' animals):

Average herd size:94 buffaloes (ranged 20 to 300)

Buffaloes in-milk	:	29.30 %	Dry Buffaloes	:	14.60 %,
Heifers	:	24.24 %	Calves	:	23.18 %
Breeding males	:	2.0 %			

Average daily milk supply to cooperative dairy : 174 kg / maldharis family

(Kachchh District Cooperative Milk Producers' union)

Milk price @ Rs. 40 to 42 per liter.

Production performance:	Wet average	:	6.35 kg/day	Herd average	: 4.61 kg/day
	Fat %	:	6.37 (morning) ; 7.10 (evening) 6.73 (Average)		

Behavioural traits of Banni buffalo : Banni buffaloes go for night grazing without any caretaker. In each group a bell is tied in neck to 4-5 buffaloes. These 4-5 buffaloes act as leader and others buffaloes of the group follows the

sound of ringing bells and graze within the reach of sound of ringing bells There is strong mother instinct in these buffaloes for their calves. An unknown person can go near and touch a buffalo in the presence of owner or buffalo boy. While feeding concentrate, buffalo remain calm and wait for their turn. For breeding, the owners prefer natural service with Banni bulls.

Feed and fodder samples : To estimate the nutritive value of feed and fodder and feeding and management system of Banni buffaloes in Kachchh region was studied. Samples of grass, concentrate and soil were collected and analyzed for soil mineral profile, proximate constituents and mineral content. All the four soil samples were deficient in Zn. Three soil samples were deficient in Fe. 39 samples of fodder, 2 samples of cotton seed cakes, 2 samples of wheat bran, 1 samples of concentrate mixture and 1 samples of cotton seed hulls were taken for chemical analysis. The protein content of some grasses was - Marilo (17.35), kotak (12.23),lolar (10.38), oin grass (10.08), chidia grass (10.9), sonewali grass (14.82), gandhir grass (10.76 %), dharab (15.85 %), sonwall full grass(15.57 %), draman safed (13.25%). There were 10 species of grasses that have more than 10.0% CP on DM basis. The CP content of cotton seed cakes samples was below than normal i.e. 19.89 and 20.78 % in samples 1 and 2, respectively. Concentrate mixture composition was in normal range. Wheat bran CP in both samples was 19.59 and 16.65 % in samples 1 and 2, respectively.

Aflatoxicosis in buffalo feed

Ram Singh

Aflatoxin level in animal feed and feed ingredients, collected form commercial shops and farmers' home, was monitored during rainy season in Punjab (June end – Early Sept. 2019) and in Haryana (Nov. 2018 to May 2019). The samples were ground and analysed for the presence of aflatoxin B1. Samples collected from Haryana were also analyzed for ochratoxin A.

The analysis of feed and feed ingredients collected from Punjab revealed that overall 95 per cent of the samples were contaminated with aflatoxin B1 with an overall contamination range of 0.00 to 0.71 mg/kg. High level of aflatoxin contamination could be due to the hot and humid climatic conditions during the period of study prevailing in the region. Due to high level of mycotoxin contamination in animal feed and feed ingredients the situation is alarming. The ochratoxin level of contamination tended to be higher in cereals (maize, barley, sorghum) as compared to other feed ingredients and compounded animal feeds.

Aflatoxin levels in feed ingredient collected from local markets in Punjab & Haryana

Feed Ingredient	Punjab			Haryana		
	Aflatoxin B1			Aflatoxin B1 (Ochratoxin A)		
	% Contamination	Range (mg/kg)	Mean (mg/kg)	% Contamination*	Range** (mg/kg)	Mean (mg/kg)
Maize	100	0.07 to 0.71	0.26	100 (60)	0.07-0.12 (0.00-0.08)	0.09 (0.04)
Barley	-	-	-	80 (50)	0.00-0.10 (0.00-0.07)	0.06 (0.03)
Sorghum	-	-	-	80 (50)	0.00-0.09 (0.00-0.07)	0.06 (0.03)
Rice bran	90	0.00 to 0.12	0.07	60 (40)	0.00-0.05 (0.00-0.04)	0.02 (0.01)
Wheat bran	90	0.00 to 0.21	0.11	60 (40)	0.00-0.06 (0.00-0.04)	0.02 (0.02)
Fish meal	90	0.00 to 0.35	0.11	- (-)	- (-)	- (-)
Soybean meal	100	0.00 to 0.51	0.27	60 (40)	0.00-0.09 (0.00-0.03)	0.04 (0.01)
Groundnut cake	-	-	-	100 (70)	0.00-0.11 (0.00-0.04)	0.08 (0.02)
Mustard cake	-	-	-	80 (50)	0.00-0.09 (0.00-0.04)	0.06 (0.01)
Sunflower cake	100	0.06 to 0.71	0.33	70 (50)	0.00-0.08 (0.00-0.03)	0.05 (0.01)
Cottonseed meal	90	0.00 to 0.25	0.16	90 (50)	0.00-0.10 (0.00-0.04)	0.07 (0.01)
Compounded animal feed	100	0.05 to 0.35	0.19	90 (60)	0.00-0.10 (0.00-0.04)	0.07 (0.02)

* Figures in parentheses indicate number of samples collected;** Figures in parentheses indicate acceptable limits

Formulation of galactogogue herbal mixture

N Saxena, V Mudgal, P Sikka, ML Sharma, Krishna Kumar

Six different herbs known for lactogenic properties were selected and were procured from the local market. The selected herbs were Shatavari (*Asparagus racemosus*) roots, Jivanti (*Leptadaenia reticulata*) roots, Methi (Fenugreek, *Trigonella foenum-graecum*) seeds, Kalaunji (Black cumin, *Nigella sativa*) seeds, Anise (*Pimpinella anisum*) and Safed Jeera (Cumin seeds, *Cuminum cyminum*). These herbs were first powdered and analysed for proximate principles and micro-nutrients to assess their feeding/nutritive value. The herbal powders were then extracted using methanol by taking 10g of samples and refluxing at 40°C for 2 hrs. The extracts were then filtered through Whatman no. 1 filter paper. The residue was taken again and the extraction was repeated twice using small volumes of methanol. Finally the filtrates were pooled and volume made up to 100 ml. The extracts so prepared were analysed for total tannins, total phenolic content (TPC) and total flavonoid content (TFC). These extracts were also analysed for their anti-oxidant properties using DPPH & FRAP method.

Proximate analysis of various ingredients (on DM basis)

S. No.	Ingredients	Dry matter (%)	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Total ash (%)
1.	Fenugreek seeds (Methi)	90.39±0.42	27.65±2.45	6.22±0.65	15.24±0.21	3.93±0.12
2.	Cumin seeds (Jeera)	93.58±4.43	20.04±3.52	12.18±0.51	18.95±1.13	5.22±0.19
3.	Jivanti roots	91.67±2.99	2.99±0.25	3.09±0.24	14.38±0.18	9.43±1.03
4.	Shatavari roots	86.93±3.49	7.25±0.51	0.80±0.06	7.68±0.43	6.91±0.25
5.	Anise seeds (Moti Saunf)	90.70±0.18	18.34±1.02	10.47±0.14	12.95±0.17	9.31±0.07
6.	Black cumin (Kalaunji)	88.93±0.51	15.36±1.22	9.89±0.33	17.32±1.59	4.98±0.11

Mineral contents of various galactogogues (on DM basis)

S. No.	Ingredients	ca (ppm)	p (mg/ml)	Fe (ppm)	Zn (ppm)	Cu (ppm)	Mn (ppm)
1.	Fenugreek seeds (Methi)	1.14±0.03	0.09±0.08	1.88±0.01	0.17±0.01	0.74±0.01	0.18±0.01
2.	Cumin seeds (Jeera)	1.31±0.19	0.19±0.02	1.97±0.09	0.23±0.03	0.97±0.12	0.26±0.03
3.	Jivanti roots	10.14±0.57	0.01±0.02	2.79±0.67	0.16±0.02	0.23±0.02	0.04±0.00
4.	Shatavari roots	65.08±0.20	0.02±0.00	34.09±0.05	0.13±0.03	0.77±0.06	0.20±0.02
5.	Anise seeds (Moti Saunf)	9.58±1.42	0.04±0.00	1.24±0.09	0.33±0.01	0.34±0.02	0.14±0.06
6.	Black cumin (Kalaunji)	2.95±0.04	0.05±0.00	1.24±0.11	0.20±0.05	0.35±0.04	0.10±0.01

Total tannin, phenolic and flavonoid contents in various galactogogues (on DM basis)

S. No.	Ingredients	Total Tannins (mgTAE/g)	Total Phenolic Contents (mgGAE/g)	Total Flavonoids (mgQueE/g)
1.	Fenugreek seeds (Methi)	0.76±0.07	0.69±0.14	0.30±0.08
2.	Cumin seeds (Jeera)	1.22±0.06	0.92±0.08	0.47±0.04
3.	Jivanti roots	4.95±0.10	4.16±0.55	1.98±0.02
4.	Shatavari roots	6.08±0.33	5.33±0.53	2.35±0.24
5.	Anise seeds (Moti Saunf)	0.64±0.09	0.62±0.17	0.39±0.17
6.	Black cumin (Kalaunji)	1.08±0.15	0.85±0.24	0.61±0.01

Four different galactogogue herbal mixtures (GHMs: C1-C4) were formulated on the basis of analysis of various parameters with special emphasis on its tannin content, TPC, TFC and anti-oxidant properties. These GHMs were then again analysed for the proximate principals, mineral content, Tannin, TPC, TFC and anti-oxidant properties. There was no significant difference in the proximate parameters, mineral contents, total tannin and phenolic contents. However, results of these combinations varied significantly for different GHM combinations. Anti-oxidant property for C4 GHM was highest with average value of 55.05% for DPPH and 83.65 μM Frap value followed by that of C3. This clearly indicated that C4 is the most suitable formulation. This formulation was thus selected for feeding trial on lactating buffaloes.

Anti-oxidant activity of extracts of various galactogogue

S. No.	Ingredients	% DPPH Scavenging activity	FRAP value (in μM)
1.	Fenugreek seeds (Methi)	13.22±1.34	5.56±0.32
2.	Cumin seeds (Jeera)	26.15±0.02	11.64±1.11
3.	Jivanti roots	37.68±0.25	15.90±0.79
4.	Shatavari roots	45.64±2.10	16.50±1.01
5.	Anise seeds (Moti Saunf)	11.04±0.93	3.86±0.79
6.	Black cumin (Kalaunji)	10.51±0.29	4.77±1.11

Proximate analysis of various galactogogue mixtures (on DM basis)

S. No.	Galaxtogogue Herbal Mixture	Dry Matter (%)	Crude Protein (%)	Ether extract (%)	Crude fibre (%)	Ash (%)
1.	C1	89.04±0.58	18.22±1.04	15.04±0.33	26.55±0.55	4.30±0.03
2.	C2	89.12±0.03	17.48±0.86	13.97±0.28	26.48±0.06	4.47±0.01
3.	C3	89.85±0.23	18.69±1.62	18.61±0.15	26.38±0.62	4.46±0.33
4.	C4	89.87±0.23	15.26±0.88	15.54±0.58	26.68±0.04	4.47±0.10

Mineral Contents of various galactogogue mixtures (on DM basis)

S. No.	Ingredients	Ca	Mg	Fe	Zn	Cu	Mn
1.	C1	16.77±0.84	0.06±0.01	8.39±0.55	0.21±0.01	0.55±0.14	0.11±0.02
2.	C2	19.97±0.35	0.07±005	9.85±0.13	0.18±0.03	0.62±0.06	0.15±0.01
3.	C3	16.95±0.02	0.06±0.02	8.32±0.28	0.19±0.02	0.56±0.02	0.14±0.01
4.	C4	20.42±0.67	0.05±0.01	10.04±0.33	0.22±0.12	0.60±0.09	0.17±0.05

Total tannin, phenolic and flavonoid contents in various galactogogue mixtures (on DM basis)

S. No.	Galactogogue Herbal Mixture	Total Tannins (mgTAE/g)	Total Phenolic Contents (mgGAE/g)	Total Flavonoids (mgQueE/g)
1.	C1	2.77±0.09	2.30±0.02	1.13±0.01
2.	C2	2.93±0.15	2.58±0.03	1.21±0.08
3.	C3	2.76±0.03	2.36±0.11	0.98±0.15
4.	C4	3.33±0.03	2.78±0.05	1.34±0.04

Anti-oxidant activity of extract of various galactogogue mixtures

S. No.	Galactogogue herbal mixture	% DPPH scavenging activity	FRAP value (in μM)
1.	C1	28.61±0.80	60.06±1.34
2.	C2	31.04±0.83	55.99±0.62
3.	C3	39.18±0.67	62.17±1.88
4.	C4	55.05±0.14	83.65±3.54

Synergistic effects of plant secondary metabolites in modulating in vitro methanogenesis and rumen fermentation in buffalo

Avijit Dey, RK Singh, SS Dahiya

Increasing interests in plant products and bioactive compounds as natural feed additives with the potential to enhance rumen fermentation towards reduced methanogenesis are due to public concern about the use of antibiotics and other chemicals in the animal diet for human health hazards. The present study was conducted to examine the plant bioactive compounds individually and in synergy for modulation of rumen fermentation in buffalo with the aim to develop phytogenic feed additive for enteric methane mitigation from ruminants. The extracts of Sapindus mukorossi (SMF) fruits (aqueous and ethanolic) as a source of saponins, Ficus bengalensis (FBL) leaves (aqueous and acetonic) as a source of tannins and Eucalyptus globulus oils (ECO) as a source of essential oils were prepared and evaluated individually and in association for their effect on feed fermentation and methanogenesis by four separate in vitro experiments. Each experiment was conducted as a completely randomized design using a control and various treatment groups with different concentrations of plant bioactive compounds and their blends. Rumen fluid inoculum was collected from four rumen fistulated Murrah (*Bubalus*

Methane reduction potential of plant extracts used in experiment

Plant samples	Extracts/ source	Dose incubated	Decrease in methane conc.,%	Decrease in DM digestibility,%
Sapindus mukorossi fruits (SMF)	Aqueous extract	0.5 mL	24.83	ns
		1.0 mL	34.62	ns
		2.0 mL	47.38	25.13
		4.0 mL	43.71	44.74
	Ethanol extract	0.5 mL	21.15	ns
		1.0 mL	29.55	ns
		2.0 mL	54.37	34.07
		4.0 mL	58.22	44.67
Ficus bengalensis leaves (FBL)	Aqueous extract	0.5 mL	ns	ns
		1.0 mL	ns	ns
		2.0 mL	ns	ns
		4.0 mL	ns	ns
	Ethanol extract	0.5 mL	17.94	ns
		1.0 mL	18.99	ns
		2.0 mL	33.28	21.59
		4.0 mL	54.88	32.71
Eucalyptus globulus oil (ECO)	Pure oil	20 μL	21.81	ns
		40 μL	62.78	44.84
		80 μL	82.60	47.01
		120 μL	85.30	49.24
Composite trial	Various blends	Blend-1	29.38	ns
		Blend-2	1.32	26.20
		Blend-3	31.49	23.72
		Blend-4	76.68	50.32

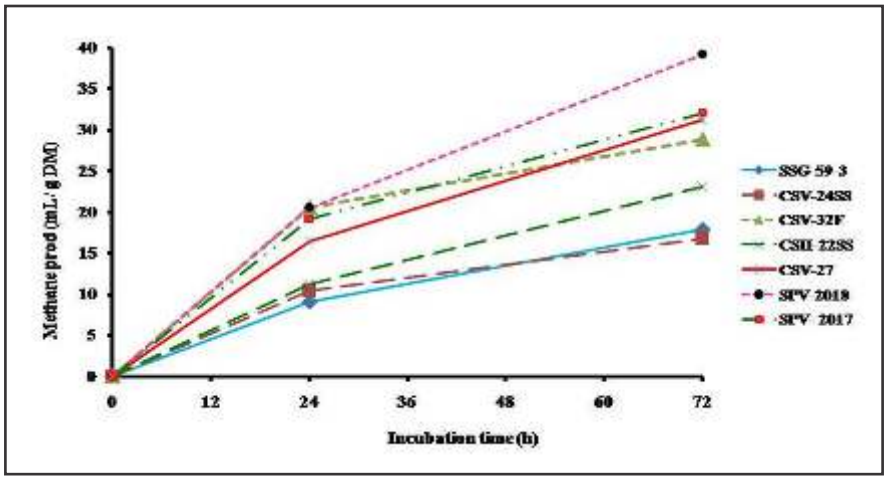
bubalis) buffalo steers. The in vitro incubations were carried out for a period of 24h with five replicates for each treatment. For SMF and FBL extracts, a concentration of 0, 0.5, 1.0, 2.0 and 4.0 ml were tested, whereas, ECO was tested at the levels of 0, 20, 40, 80 and 120 μl per 40 ml buffered rumen fluid with 0.4g of oats hay as substrate. Both aqueous or ethanol extracts of SMF, acetonic extract of FBL, and ECO showed linear decrease ($p<0.001$) in methane production with increasing concentrations of plant compound. Out of four blends tested, blend-1 (ECO, 125 μl; SMF aqueous extract and FBL acetonic extract, 6.25 ml each per ltr. rumen fluid) showed reduced methane production without affecting the rumen fermentation negatively at much lower individual doses, depicting positive associative effect. It is implied that the extracts from Sapindus mukorossi fruits, Ficus bengalensis leaves and Eucalyptus globulus essential oils and their blends have the potential to act as anti methanogenic agents. A positive associative effect in reducing enteric methanogenesis in their blends signifies their application as the phytogenic feed additive in ruminants.

Addition of increasing doses of various plant bio-active compounds and their blends reduced head space methane concentration and true degradability of dry matter

Methane production and rumen fermentation kinetics of sorghum (Sorghum Bicolor) stovers in buffalo

Avijit Dey, PC Lailer, SS Dahiya

Cereal crop residues provide important fodder resources for ruminants in developing countries of south Asia and Africa. Genetic improvement through plant breeding for quality crop residues besides grain yield is gaining demand among mixed crop-livestock farmers. The present study investigated the in vitro ruminal fermentation kinetics, gas production potential and methane production from stovers of newly developed cultivars of sorghum (Sorghum bicolor (*L. moench*) in buffalo. Seven sorghum stovers from various cultivars viz. brown midrib sorghum (SPV-2017, SPV-2018), normal grain sorghum (CSV-27), forage sorghum (SSG-59-3, CSV-32F) and sweet sorghum (CSH 22SS, CSV 24SS) were incubated with buffered rumen fluid in 100 ml calibrated glass syringes at 39^{o}C for 72h following standard *in-vitro* gas production protocol for their gas production and fermentation kinetics. The gas production in each syringe was recorded during incubation at 4, 8, 12, 24, 48 and 72 h intervals. Incubations were terminated at 24 and 72 h of fermentation, and methane concentration in the head space gas from syringes incubated with each stover sample was analysed. Supernatant of each syringe contents was analysed for volatile fatty acids estimation and truly degradable dry matter (TDDM) was determined after estimating residual substrate. Brown midrib sorghum cultivars (SPV- 2017 and SPV- 2018) showed higher ($p<0.001$) total gas production, truly degradable dry matter (TDDM), organic matter digestibility (OMD) and metabolizable energy (ME) content than others. However, as ME and OMD also depend on crude protein (CP) and OM of feed, forage sorghum stover CSV-32F was also found comparable to brown midrib sorghum stovers. Comparatively higher ($p<0.01$) methane production over time for brown midrib sorghum (SPV- 2018 and SPV- 2017) and forage sorghum (CSV-32F) was due to their low fibre and lignin content, which enhanced the rate of fermentation. On the other hand, sweet sorghum cultivars (CSH- 22SS and CSV-24SS) and forage sorghum, SSG- 59-3 produced lower amount of methane might be due to low rate of fermentation (gas production) and OMD. The study demonstrates that stovers from brown midrib sorghum cultivars (SPV- 2017 and SPV-2018) and forage sorghum (CSV- 32F) could be preferred over others as better animal feed due to their potential for enhanced utilization.



In vitro methane production (ml/g DM) over time on incubation of stovers of various sorghum cultivars with rumen liquor of buffalo

In vitro gas production kinetics of different sorghum stovers incubated with buffered rumen fluid

Sorghum stovers	Gas production (ml/g DM)					
	4h	8h	12h	24h	48h	72h
SSG-59-3	15.58a	24.24a	27.71a	60.60a	72.47a	90.58a
CSV-24SS	15.48a	18.92a	25.80a	63.64a	87.72ab	103.20a
CSV-32F	31.01c	44.79c	58.56b	124.03c	165.53cd	186.22c
CSH-22SS	15.66a	26.10a	33.05a	76.53a	112.00b	130.25b
CSV-27	17.42a	27.88a	36.59a	106.30b	153.82c	182.47c
SPV-2018	24.02b	36.12b	50.30b	141.48d	205.83e	231.89d
SPV-2017	29.52c	41.67bc	53.84b	132.01cd	182.39de	203.21c

Assessment of newly developed Sorghum cultivars on milk production and nutrient utilization in buffalo

Avijit Dey, PC Lailer, SS Dahiya

Afresh initiative has been taken to conduct a trial on lactating buffalo on feeding of SPV-2018 variety of sorghum fodder. During this period, the SPV-2018 variety of sorghum fodder has been sown at CIRB farm and feeding to lactating buffaloes is to be done in due course. IIMR, Hyderabad and CIRB, Hisar are in process to release the SPV-2018 variety of sorghum cultivar for large scale fodder production in collaboration with Govt. of India

Farmer FIRST Programme (FFP)

Sarita Yada, Ashok Boora, KP Singh, Sajjan Singh (CIRB)

The acronym FIRST stands for Farm, Innovations, Resources, Science and Technology (FIRST). In Indian context, mostly crop-livestock mixed farming model has been practiced since ages and the modern science has emphasized it as model for ensuing maximum resource utilization and livelihood security.

The project at ICAR-CIRB started in the year 2016-17, is being implemented in collaborations with IARI Delhi, IASRI Delhi and CCSHAU Hisar. The livestock (buffalo) module is addressed by CIRB and the crop farming activities are looked after in collaboration with other Institutes. During the year 2018-19, under programs aimed at improving buffalo health and reproductive efficiency, 256 buffaloes and calves from three villages (Khokha, Kharkari and Dhansu), were covered. Under this program, front line demonstrations, trainings and farmers visits were organised to make the farmers understand best practices in concerned agricultural and animal husbandry activities. The farmers were provided high producing Mustard seeds (RH0725 and RH0749 varieties (CCSHAU), nutritional garden (IARI, Pusa), vegetable kits (CCSHAU Hisar) and tissue culture plants - Pomegranate (Bhagwa), Kinnow, daisy, Lemon (PAU Ludhiana and IARI Pusa).

TRANSFER OF TECHNOLOGY UNIT

Development of need based mobile apps to improve the performance and productivity in buffaloes

H Tripathi, VB Dixit, Dharmendra Kumar, Sajjan Singh

At the first stage, data was collected from 100 buffalo owners from Haryana and Rajasthan through a bilingual interview schedule to understand their information needs in various areas as content of mobile on three point continuum i.e. most needed, needed and least needed with respective scores of 3, 2 and 2 respectively.

Based on the needs of the farmers contents were developed and an educational mobile app on buffalo reproduction was designed. The aim of the app is to impart knowledge to buffalo owners and a guide for para veterinary staff and graduating veterinarians. The App provides basic information on different areas of buffalo reproduction by dividing the

whole content into seven distinct segments. The major areas covered were; targets of reproduction, puberty and sexual maturity, heat symptoms and breeding methods, pregnancy diagnosis, peripartum care and management, bull selection and management for breeding. Special emphasis has been given by covering eleven major reproductive problems commonly found in buffaloes emphasizing on causes, preventive and control measures on each problem/disorder separately. It includes delayed puberty, anoestrus & silent estrus, repeat breeding, genital prolapse, dystocia, retention of placenta, cystic ovaries, venereal diseases, abortion, fetal mummification and fetal maceration with unique photographs. The App additionally provides answers on frequently asked questions by the farmers under each section of buffalo reproduction. The App is presently available in Hindi and English languages. Complete App content has audio backup with download facility.

Convergence for dairy development: A synergistic approach

VB Dixit, H Tripathi, Sajjan Singh

During the period under report information was collected from 108 members of milk corporative society in village Chindar. A standardized questionnaire was developed for collecting information about present status and history of mastitis; milking management practices and type of bedding, brief history: age of animal, stage and month of lactation, milk yield, shape of teat and udder etc. The questionnaire also included questions like how do you recognize mastitis; in which lactation the incidence of mastitis is more; after how many days you take your animal for treatment once diagnosed for mastitis; when is the highest probability of mastitis etc. The questionnaire also included questions on clean milk production and other related aspects from the members of the society. To screen the milk of selected animals, teat wise milk sample of all the animals were collected and analysed for somatic cell count.. A total of 308 quarter milk samples of 77 apparently healthy buffaloes were screened for sub clinical mastitis by following methods:

i. Somatic cell count ii. CMT iii. Milk culture analysis

Animals found positive in microbial culture were be treated according to ABST report.The range of somatic cell count was between 40000 to 840000. This analysis reported was repeated for these animals after treatment to evaluate the effectiveness treatment for mastitis.

California mastitis test kit was also distributed (19.03.2019) to 38 SC/ST farmers to analysis samples for mastitis on alternate day, weekly and subsequently after 15 days. This intervention enhanced their awareness about the mastitis significantly and educated the farmers regarding mastitis control, clean milk production etc. as part of extension activity).

Different programmes like women's day, kisan diwas and training exclusively on mastitis were also organized in the village in convergence mode with participating agencies. A brief report on the occurrence of different SCC, pathogens and antibiograms is being prepared and accordingly recommendations for mastitis control and prevention will be formulated. Thus under the project a new methodology was developed and the model is being tested.

TECHNOLOGIES DEVELOPED

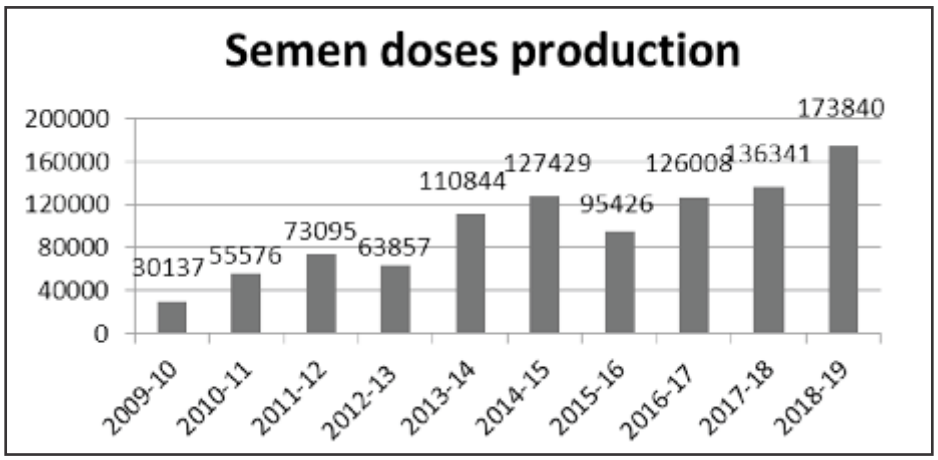
The institute has developed several technologies since its inception that were transferred to the farmers to increase the production and reproductive efficiency of their buffaloes. During the period under report 55 layman inseminators were trained in artificial insemination and animal husbandry in 3 training programs. Many of the farmers trained at this institute are achieving ~60 % conception rates with the frozen semen provided by 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.

Production, maintenance and dissemination of superior germplasm

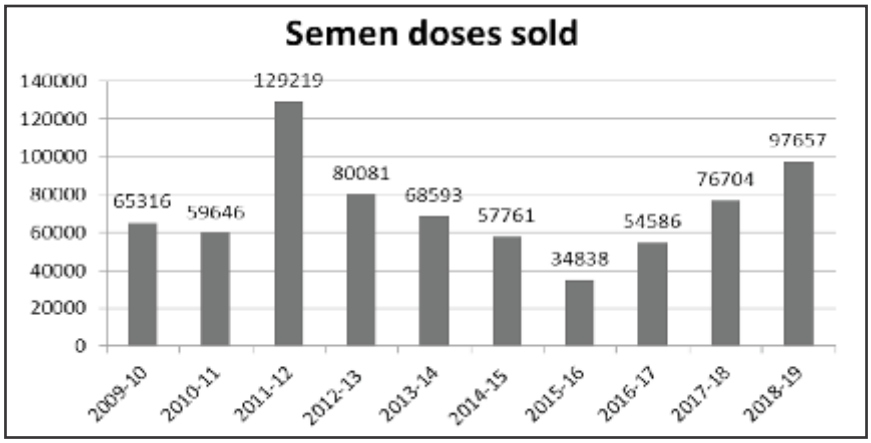
Institute maintains a high pedigreed herd of Murrah and Nili-Ravi buffaloes. The institute has been undertaking breed improvement programme through selective breeding since its inception. The genetic potential of bulls is evaluated through progeny testing. Due to intense selection pressure, production performance of Murrah and Nili-Ravi herds improved from about 5 kg in 1991 to 8.82 in Nili Ravi and 8.92 kg in Murrah during 2018-19.

More than four lakh doses of frozen semen from test bulls and over fifty thousand doses from progeny tested bulls are available for Murrah breed improvement. About 454 Murrah and 302 Nili Ravi bulls of high genetic merit 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, 17623 AIs were done so far with frozen semen of test bulls with conception rate of 48%.

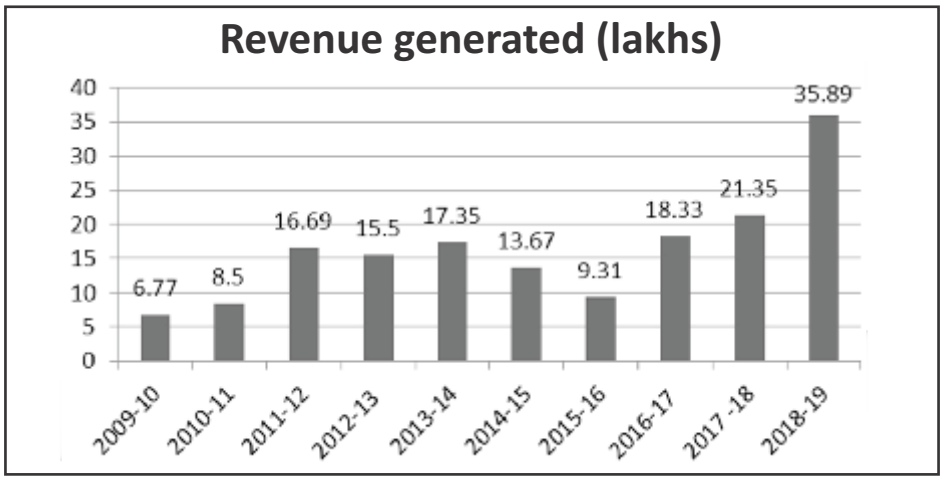
Semen production, dissemination and revue generation



The semen sale before 2009-10 was very low but gets momentum of sale of semen from 2009-10 and reached peak at 2011-12. Thereafter, down trend is semen sale was noticed due to opening of many private semen freezing lab. Due to better semen quality and conception rate the acceptability of semen from Institute improved in the field, as a result 97,657 semen dress were sold during this year.



The revenue generation (Rs 35.89 lakhs) from the sale of semen doses in comparison to previous year (Rs. 21.35 lakhs).



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. Thorough investigations about the phenomenon revealed that the stage of glycerolization was 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% 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.

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, straight line velocity, sperm elongation, total, progressive & rapid motility), live sperm percent, plasma membrane and acrosome integrity was obtained. Patent has been applied for the technology.

Sericin for improved semen freezing

Supplementation of sericin, a water-soluble globular protein (a protein hydrolysate) derived from silkworm *(Bombyx mori)* @ 0.25-0.5% in semen extender improves frozen-thawed semen quality probably due to protection of 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 in egg yolk composition, risk of microbial contamination, presence of high-density lipoproteins, calcium and steroid 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. The customized extender showed better performance in terms of sperm motility and freezability compared to whole egg yolk based extender.

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 (ASMM)

Surveys of feeding practices carried out in Haryana revealed deficiencies of essential minerals like copper, 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. ASMM is the first technology the commercialized and sold to M/s Titanic Pharma Pvt. Ltd. under non-exclusive license.

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.

Ultrasonographic determination of fetal sex, fetal age, ovarian activity and pregnancy 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. 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.

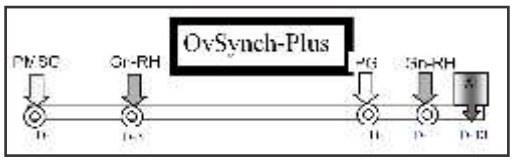
The non-invasive technique of ultrasonographic scanning has been standardized for diagnosis of ovarian activity. This technique is very useful for follicular dynamics studies. With the use of this technique, time of ovulation can be predicted very precisely to allow fixed time insemination.

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.

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 72 h later 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.



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.

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.

Superovulation with ablation of dominant follicle

Super ovulatory 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, 12 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. During reporting year, multiple clone pregnancies (n=15) of two breeding bulls, Murrah and Nili-Ravi were established, and a re-cloned pregnancy of Hisar-Gaurav has been established. These established pregnancies are ongoing.

Frozen repository of somatic cells

20 primary somatic cell lines were established and cryopreserved from adult elite buffaloes, which includes 4 from champion bulls. 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 will 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 of two breeding bulls were shared with NDRI for cloning studies.

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 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 supplementation for 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.

DNA Bank

DNA repository of about 3119 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.

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.

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 project is 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.

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

It is an internet accessible interactive instructional resource available free at the official website of the Central Institute for Research on Buffaloes, Hisar (http://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 6.7 lakh visits.

App on Buffalo Reproduction (भैंस जनन एप्प)

The App provides basic information on different aspect of buffalo reproduction - targets of reproduction, puberty and sexual maturity, heat symptoms and breeding methods, pregnancy diagnosis, peripartum care, bull selection and management for breeding. Major reproductive problems commonly found in buffaloes with causes, preventive and control measures are also listed - delayed puberty, anoestrus and silent estrus, repeat breeding, genital prolapse, dystocia, retention of placenta, cystic ovaries, venereal diseases, abortion, fetal mummification and fetal maceration with unique photographs. The app can be download from Google Play store (https://play.google.com/store/apps/details?id=com.cirb).

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.

HRD TRAINING PROGRAMS

S. No.	Name of Staff	Training Topic	Institute and period
Scientist			
1	Dr. VB Dixit	MDP on leadership development	NAARM, Hyderabad, 4-15 June 2018
2	Dr. Jerome A	Bioinformatics tools and techniques for genomic data analysis	ICAR-IASRI, New Delhi 11-15 Sept. 2018
3	Dr. Varij Nayan		
4	Dr. V Mudgal	Cell line: development, maintenance & applications	ICAR-NBFGR, Lucknow, 24 Sept -1 Oct 2018
Technical Staff			
1	Sh. J Prasad	Professional and personal skill development for technical and administrative staff of ICAR	ICAR-NBAGR, Karnal, 19-21 June 2018
2	Sh. Rajiv Mehta	Training program, motivation and positive thinking (T5 and above)	NAARM, Hyderabad, 21-26 June 2018
3	Sh. Kuldeep Singh	Training programme on "Automobile main--tenance, road safety and behavioural skills"	ICAR - CIAE, Bhopal, 17-23 July, 2018
4	Sh. SS Malik	Farm management	ICAR-IIFSR, Modipuram, 14-20 Sept., 2018.
5	Sh. RS Pippal	13th capacity building programme for technical personnel	Indian Institute of Public Administration, New Delhi, 04-15 February, 2019
Administrative Staff			
1	Sh. Narender	FMS/MIS and purchase procedures	ICAR-CIRB, Hisar 17 & 18 Sept. 2018
2	Sh. Abdul Mazid		
3	Smt. Indira Devi		
4	Sh. Sunil Kumar		
5	Sh. Tajinder Singh		
6	Sh. Jaspal Singh		
Skilled Supporting Staff			
1	Sh. Ramesh Chander	To improve skills and efficiency of skilled supporting staff	ICAR-CIRB, Hisar 14-16 March 2019
2	Sh. Dilbag Singh		
3	Sh. Satyavan		
4	Sh. Om Prakash		
5	Sh. Pralad		

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Research and Review Articles

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Germplasm Identified /Registered

Singh KP, Vohra V (2018) Chhattisgarhi Buffalo - registered as 16th buffalo breed of India with accession No: INDIA_BUFFALO_2600_CHHATTISGARHI_01016

Singh KP, Vohra V (2018) Gojri buffalo - registration applied with Director AH, Punjab Govt. dated: 20.02.2019.

Gene accession obtained:

Sikka P., Singh I., Bharadwaj, A., Kumar, P. and Nath, A. 2017. SNP Genotyping of GPX enzyme in Murrah bulls. 11 Accessions submitted to Genbank NCBI bearing sequence no. Bankit2045538 CIRB 17-1A MF817499, 1B MF817501, 1C MF817507, 1D-MF817508, 1EMF817509, 1FMF817510, 1G MF817511, 1HMF817512, 2AMF817500, 2BMF817502

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H Tripathi युवाओं में भैंस पालन सम्बंधित व्यवसायिक संभावानाएं on 14.06.2018 delivered through AIR Hisar.

Literature/Leaflet / posters developed

हेमा त्रिपाठी, वी बी दीक्षित, सज्जन सिंह एवं सूर्य पाल सिंह। मिट्टी की जाँच, उत्पादकता में वृद्धि सबकी समृधि (2018)

सज्जन सिंह, हेमा त्रिपाठी, वी बी दीक्षित एवं सूर्य पाल सिंह। पशुओं में वाह्य परजीवी से होने वाले रोग : कारण, लक्षण एवं रोकथाम (2018)।

वी बी दीक्षित, हेमा त्रिपाठी, सज्जन सिंह एवं सूर्यपाल सिंह। फसल अवेशष न जलाओ, मिट्टी उपजाओं बनाओ एवं पर्यावरण बचाओ (2018)।

Academic and research collaborations

University/Institute/Organisation entering in MoU with ICAR-CIRB Hisar	Scope of Collaboration	Date of MoU
Bihar Animal Sciences University, Patna (Bihar)	Academics – UG teaching and PG research	05.07.2018
Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.)	PG Research	01.09.2018
Hitech Sach Dairy, Sirsa (Haryana)	Biotechnological reserch – buffalo cloning	02.01.2019


PROMOTION OF
PERI-URBAN AGRICULTURE

Participation in Seminars/Conferences/Workshops/Meetings

Event	Date	Venue	Participants
Workshop during World Veterinary Day 2018	28.04.2018	NRCE, Hisar	Dr. Varij Nayan Dr. RK Sharma
Workshop on 'Bovine Genotyping'	19-20.07.2018	Imperial Life Sciences at Research Lab, ILS, Gurgaon	Dr. P Sikka
National Brainstorming workshop on "Role of buffalo in Indian economy"	20.07.2018	ICAR-CIRB Hisar	Dr. RK Sharma Dr. Sanjay Kumar Dr. Sarita Yadav Dr. Dharmendra Kumar Dr. AK Balhara Dr. Jerome A. Dr. A Dey Dr. SK Phulia Dr. Varij Nayan Dr. Ram Singh Dr. N Saxena Dr. SK Khurana Dr. VB Dixit Dr. PS Yadav Dr. KP Singh Dr. A Bhardwaj Dr. P. Sikka Dr. Hema Tripathi Dr. SS Dahiya Dr. Inderjeet Singh
			
Nili-Ravi Buffalo Farmers Meet	28.07.2018	ICAR-CIRB Sub Campus, Nabha	Dr. Inderjeet Singh Dr. SS Dahiya Dr. VB Dixit Dr. A Bhardwaj Dr. R K Sharma Dr. KP Singh Dr. SK Phulia Dr. AK Balhara Dr. A K Boora
			
National Conference of NADSI on "Challenges and opportunities for the New Generation Dairy Foods in India"	09-10.09.2018	Sri Venketeswara Veterinary University, Tirupati	Dr. A Dey Dr. H Tripathi
Brain Storming Workshop on 'The Way Forward for Genomic Selection and its Implementation in India'	17.09.18	Organized by ISAGB at IVRI Izatnagar, Barelly	Dr. I. Singh Dr. KP Singh Dr. P Sikka

Event	Date	Venue	Participants
Brainstorming workshop on “Foot and Mouth Disease”	14-15.09.2018	ICAR-CIRB Hisar	Dr. RK Sharma Dr. Naresh Selokar Dr. Mustafa H Jan Dr. Sanjay Kumar Dr. Dharmendra Kumar Dr. Sarita Yadav Dr. AK Balhara Dr. A Dey Dr. SK Phulia Dr. Ram Singh Dr. SK Khurana Dr. VB Dixit Dr. PS Yadav Dr. A Bhardwaj Dr. P. Sikka Dr. SS Dahiya Dr. Inderjeet Singh
			
Bill and Melinda Gates Foundation (BMGF) Project Launch Workshop	3.10.2018	NDRI, Karnal	Dr. Varij Nayan
Interactive meeting with BIS personnel regarding 'Sample analysis in laboratories'	26.10.2018	Manak Bhavan, Chandigarh	Dr. A Dey
3rd Convention of Veterinary Biochemists and Biotechnologists in India and National Symposium on "Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement"	02-03.11.2018	LUVAS Hisar	Dr. AK Balhara Dr. Varij Nayan Dr. A Dey
Workshop on “Historiography of science in India”	17.11.2018	NRCE, Hisar	Dr. Varij Nayan
16th Annual Review Meet of Network Project on Buffalo Improvement	19–20.11.2018	ICAR-NDRI, Karnal	Dr. KP Singh Dr. Sanjay Kumar Dr. P Sikka Dr. SS Dahiya Dr. A Bhardwaj Sh. Ram Chander
XI Biennial Conference of Animal Nutrition Association (ANACON-2018) on " Reorienting Animal Nutrition Research in the Perspective of Farmers Welfare"	19-21.11.2018	Bihar Animal Sciences University, Patna	Dr. A Dey Dr. N Saxena

Event	Date	Venue	Participants
2nd National workshop on ICAR- Broad subject matter area (BSMA) committee for veterinary clinical subjects.	16-17.11.2018	MAFSU, Mumbai	Dr. RK Sharma Dr. Ashok Boora
International Symposium and 8th Conference of Indian Meat Science Association (IMSACON-VIII) on "Technological Innovations in Muscle Food Processing for Nutritional Security, Quality and Safety"	22-24.11.2019	West Bengal University of Animal and Fishery Sciences, Kolkata	Dr. A Dey Dr. PC Lailer Dr. SS Dahiya
17th Convocation of NAVS (I) and Scientific Seminar on 'Livestock Sector toward one Health, Food Security and Safety'	19-20.12.2018	OUTI, Bhubaneswar	Dr. Hema Tripathi Dr. Dharmendra Kumar
Visit to Network Project Center- NDRI, Karnal	24.12.2018	NDRI, Karnal	Dr. SS Dahiya
ISSAR International Symposium on "Productive Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Reproductive Efficiency of Livestock for Sustainable Rural Economy"	28-30.12.2018	Anand Agricultural University, Anand Gujarat	Dr. Pradeep Kumar Dr. Jerome A
National Conference on Enhancing Rural Livelihood through Improved Buffalo Productivity and Health	17-19.01.2019	Veterinary College, NAU, Navsari, Gujarat	Dr. Sarita Yadav Dr. AK Balhara Dr. SK Phulia Dr. VB Dixit Dr. PS Yadav Dr. SK Khurana Dr. KP Singh Dr. SS Dahiya
XVI National Symposium on Animal Genetic Resources for Food and Social Security (Society for Conservation of Domestic Animal Biodiversity)	07-08.02. 2019	ICAR-NBAGR, Karnal	Dr. Mustafa H Jan Dr. Sanjay Kumar Dr. KP Singh Dr. Varij Nayan
XIV Agricultural Science Congress-2019	20-23.02.2019	NASC, New Delhi	Dr. Hema Tripathi Dr. N Saxena Dr. VB Dixit
Brain storming session on camel semen preservation freezing to effectively designing AI protocols.	10.03.2019	ICAR-NRCC, Bikaner	Dr. RK Sharma
Workshop on Unit level data repository for AICRPs / Network Projects	25-26.02.2019	IASRI, New Delhi	Dr. KP Singh
Visit to Network Project Center – Jaffarabadi buffalo	18-19.03.2019	JAU, Junagadh	Dr. KP Singh

RESEARCH PROJECTS

S.No.	Project Title	Project Workers	Funding Source	Duration
Completed Projects				
1.	Identification of genetic variants in genes related to oxidative status in relation to fertility in Murrah Bulls	P Sikka, P Kumar	IRC	Jul 2013-Oct 2018
2.	E-Bhains Vigyan Kendra (Nov 2013-Dec 2018)	Sunesh, AK Balhara, SK Phulia, PC Lailer, P Sikka	IRC	Jul 2013-Oct 2018
3.	Aflatoxicosis in Buffaloes (A Pilot study)	Ram Singh	IRC	June 2017- Dec 2018
4.	Simplification of nuclear transfer technique for the production of elite buffalo bulls	N Selokar	SERB	Nov 2015-Nov 2018
5.	Studies on antagonists/ inhibitors of signalling molecules to prevent cryo- capacitation & development of species specific semen extender for buffalo semen cryopreservation	P Kumar	SERB	Nov 2015-Nov 2018
Ongoing Projects				
6.	Identification of SNPs in genes related to meat production and their association with meat parameters in buffaloes *(Bubalus bubalis)*	AK Pandey, P Sikka, SS Dahiya	IRC	Oct 2010-Oct 2018
7.	Understanding production performance and assessment of feeding practices of Banni buffaloes under traditional extensive production system	SS Dahiya, KP Singh, A Dey, PC Lailer, V Mudgal	IRC	Aug 2017-Mar 2019
8.	Identification of genetic variants in genes related to oxidative status in relation to fertility in Murrah Bulls	P Sikka, P Kumar, A Bharadwaj, AK Pandey	IRC	Jul 2013 -Oct 2018
9.	Molecular analysis of methanogenic archaeal diversity in rumen of Murrah buffaloes fed different diets	S Yadav, SS Dahiya, PC Lailer, Avijit Dey, A Boora, SK Khurana	IRC	Nov 2018 –Oct 2021
10.	Causes of buffalo calf mortality and its management	SK Khurana, S Yadav, A Boora, Sanjay Kumar	IRC	Dec 2017- May 2020
11.	Challenges of high yielding buffaloes: Identification and their management	A Boora, S Yadav, Inderjeet Singh (upto 4.11.2018)	IRC	Jul 2017-Jun 2020
12.	Convergence for dairy development a synergistic approach	VB Dixit, H Tripathi, S Singh SK Khurana, A Bharadaj, ML Sharma, Rajesh Chahabra (LUVAS)	IRC	Dec 2015-Jan 2019

Ongoing Projects				
S.No.	**Project Title**	**Project Workers**	**Funding Source**	**Duration**
13.	Development of need based mobile apps to improve the performance and productivity of buffaloes	H Tripathi, VB Dixit, Dharmendra Kumar, S Singh	IRC	Apr 2018-Mar 2020
14.	Effect of supplementation of galactogogue herbal mixture to lactating buffaloes on production performance and blood biochemistry	N Saxena, P Sikka, V Mudgal, ML Sharma, K Kumar	IRC	Aug 2017-Mar 2020
15.	In vitro evaluation of efficacy of certain aflatoxin detoxifying agents	R Singh, A Dey, SS Dahiya	IRC	Jan 2019-Dec 2021
16.	Development of feeding module for increasing health promoting fatty acids in milk and reducing methane production in buffalo	A Dey, SS Dahiya	IRC	Apr 2018-Mar 2021
17.	Development and supplementation of nano-minerals in buffalo	V Mudgal, N Saxena, SS Dahiya	IRC	Sep 2017-Aug 2020
18.	Buffalo sperm dosages in relation to its functional parameters & field fertility outcome	S Singh, P Kumar, Jerome A, RK Sharma	IRC	Mar 2018-Apr 2020
19.	Development of diagnostic platforms for sensing candidate bio-signatures of buffalo reproduction	V Nayan, AK Balhara, RK Sharma, A Bharadwaj (NRCE)	IRC	Nov 2015-Oct 2018
20.	Climate Change and buffalo farming in India: risk assessment and vulnerability - adaptation studies for enhancing the resilience	AK Balhara, SK Phulia, RK Sharma, A Boora, PC Lailer, A Dey, V Nayan, S Balhara, Sanjay Kumar	IRC	Jun2017-May 2020
21.	Manipulation of follicular wave pattern to increase conception rate in buffaloes	MH Jan, S Kumar, KL Mehrara	IRC	Aug 2016-Jul 2019
22.	Genetic improvement of Murrah buffaloes (Network project CIRB, Hisar Centre)	KP Singh, A Bharadwaj, P Kumar, SK Khanna (upto Nov 2018)	NWP - ICAR	Jul 1991-Contd
23.	Genetic improvement of Nili Ravi buffaloes	S Kumar, MH Jan, KL Mehrara, R Mehta	NWP - ICAR	Apr 1990-Contd
24.	Performance recording and improvement of Bhadawari buffaloes (IGFRI centre)	BP Kushwaha, IGFRI: SB Maity, Sultan Singh	NWP - ICAR	Apr 2001-Contd
25.	Progeny testing of bulls under field conditions (FPT) (CIRB Hisar)	A Bharadwaj, VB Dixit, H Tripathi	NWP - ICAR	Apr 2001-Contd
26.	Lactation stress associated postpartum anestrus SNP array in Buffaloes	RK Sharma, V Nayan	NASF	Jul 2015- Jun 2018

Ongoing Projects				
S.No.	**Project Title**	**Project Workers**	**Funding Source**	**Duration**
27.	Genomic techniques to profile and improve productivity and resilience in buffalo [ICAR –collaborative Project]	P Sikka, I Singh, A Bharadwaj, KP Singh, AK Pandey (till 2017)	CGIAR	Apr 2016- Oct 2018
28.	National Agricultural Innovation Fund (Institute Technology Management Unit	SK Khurana, P Sikka, V Mudgal, AK Balhara, SK Phulia	ITMU	Apr 2008-Contd
29.	Diversified farming through livestock and agriculture – Farmers First Programme	CIRB: S Yadav (wef Jan 2, 2019) KP Singh (upto Jan 2, 2019), A Boora, S Singh CCSHAU: Bharat Singh, Sunita, Satpal Baloda IARI: Manjeet Singh IASRI: Anil Kumar, Sukanta Dash	ICAR	Feb 2016- Mar 2020
30.	Nutritional and physiological interventions for enhancing reproductive performance in animals	RK Sharma, SK Phulia, V Mudgal, Jerome A, P Kumar	AICRP	Nov 2014-Mar 2020
31.	Synthetic endometrium: A novel model to study early embryonic development and uterine health in ruminants	Dharmendra Kumar, N Selokar	NASF	Feb 2017-Dec 2019
32.	Development of early pregnancy diagnostic assay through discovery of biomarkers in cattle and buffalo	AK Balhara, Varij Nayan, SK Phulia	DBT	Jun 2018- May 2021
33.	Molecular markers for improving reproduction of cattle and buffaloes - CIRB Centre (Lead Centre – NDRI, Karnal)	V Nayan, RK Sharma, A Bharadwaj	BMGF	Jul 2018- Jul 2023
34.	Production of myostatin gene edited buffalo bulls using system	N Selokar	DBT	Jan 2019-Jan 2022
35.	An integrative trancriptomics and DNA methylomics approach to understand the dynamic features of biotic stress responses associated with mastitis in buffaloes – Lead Centre – CIRB (Cooperating Centre - IASRI, New delhi) Project	V Nayan, Dinesh Kumar, Sarika SK Phulia, A Bharadwaj IASRI: MA Iquebal, D Kumar, Sarika	CABin	Jan 2019 - Mar 2020
36.	Production of multiple copies of buffalo bulls using animal cloning technology – Lead Centre	PS Yadav, N Selokar, Dharmendra Kumar, RK Sharma, P Kumar, R Kumar	NASF	Apr 2018-Mar 2022

Ongoing Projects				
S.No.	Project Title	Project Workers	Funding Source	Duration
37.	Integration of mastitis resistance gene (Lysozyme) into the beta-casein locus of buffalo/ bovine genomes using CRISPR/cas9	PS Yadav, Dharmendra Kumar, N Selokar	DST-DAAD	Feb 2017- Jan 2019
38.	Diversified uses of Azolla	IARI: G Abraham, P Jaiswal, CIRB: V Mudgal, SS Dahiya	ICAR	May 2018 – March 2020)

Patents

Application/ Registration No.	Name of Innovation / Technology	Date of Grant/ Filing	Inventors
Granted			
2940/DEL/2013	An in vitro method for detection of post partum anestrus condition in buffaloes	Granted on 05.02.2019	Rajesh Kumar, AK Balhara, M Gupta, SK Phulia, RK Sharma and Inderjeet Singh
Filed			
1451/DEL/2015	Kalrump Scale - A device to measure Buffalo rump angularity for identification of dairy characters	07.01.2017	SN Kala
1840/DEL/2013	BUFCOL-A complete diet for enhanced survivability & growth of neonatal buffalo calves	21.06.2018	P Sikka, D Lal, S Khanna, RK Sethi
201711039431	Process for improving riverine buffalo sperm viability and uses there of	20.11.2018	Ravindra Kumar, Jerome A, Pradeep Kumar, Monika Saini, Dharmendra Kumar, Rakesh Kumar Sharma and Inderjeet Singh
201711046302	Composite feed additive for reducing methane emission and improving fibre utilization in ruminants	08.03.2019	Avijit Dey, SS Paul, SS Dahiya, AK Balhara, Jerome A, BS Punia and YM Chanu

TRAINING PROGRAMS ORGANIZED

Faculty/Field functionaries development programs organized

S.No.	Date	Title	Number of Participants	Coordinators
1.	25.03.2019-08.04.2019	Induction training for stockman of CHRS	18	Dr. Sajjan Singh Dr. Hema Tripathi Dr. Dhramendra Kumar Dr. S S Dahiya
2.	11 – 13.10.2018	ODK Device Usage	14	Dr. P Sikka Dr. KP Singh Dr. Bharadwaj Sh. Rajkumar Dr. Inderjeet Singh

Farmers Training Programs organized

S.No.	Date	Title	Number of Participants	Coordinators
General Training Programs on buffalo farming orgnaozed by ICAR-CIRB Main Campus				
1.	17 -23.04.,2018	Scientific Management of Buffaloes	61	Dr. S.S.Dahiya Dr. N L.Selokar Sh. Krishan kumar
2.	26-28.04.2018	Improved buffalo husbandry (Organized at village Badi Nyangal)	55	Dr. N Saxena Dr. VB Dixit Dr. M L Sharma
3.	19-25.05.2018	Scientific Management of buffaloes	70	Dr. V.B. Dixit Dr. Pradeep kumar Dr. M.L Sharma
4.	23-29.06.2018	Scientific Management of buffaloes	76	Dr. Poonam Sikka Dr. SK Phulia Sh. A K S Tomar
5.	21-27.07.2018	Package of practices of buffalo husbandry	79	Dr. A. Bharadwaj Dr. Dharmendra Kumar Sh. Raj kumar Chaudhary
6.	25-31.08. 2018	Scientific Management of buffaloes	57	Dr. Hema Tripathi, Dr. Varij Nayan Dr. M.L. Sharma
7.	22-28.09. 2018	Scientific Management of buffaloes	45	Dr. Hema Tripathi Dr. Ashok Boora Dr. S Khanna

S.No.	Date	Title	Number of Participants	Coordinators
8.	20-26 .10.2018	Scientific Management of buffaloes	43	Dr. P C Lailer Dr. AK Balahara Sh. Ram chander
9.	14-20 .11.2018	Package of practices of buffalo husbandry	54	Dr. N Saxena Dr. Vishal Mudgal Sh. Krishan Kumar
10.	15-21.12.2018	Scientific Management of buffaloes	41	Dr. R.K. Sharma Dr. A Dey Dr. M.L.Sharma
11.	19-25.01.2019	Scientific Management of buffaloes	63	Dr. K.P .Singh Dr. Jerome A. Dr. ML Sharma
12.	15-21.02.2019	Scientific Management of buffaloes	54	Dr. Sajjan Singh Dr. Ram singh Dr. Rajesh
13.	16-22.03.2019	Scientific Management of buffaloes	67	Dr. Sarita Yadav Dr. Sunesh Balhara Sh. Ram Chander
General Training Programs on buffalo farming orgnaozed by ICAR-CIRB Sub Campus, Nabha				
14.	22-26.10.2018	Scientific Buffalo Husbandry Practices	40	Dr. Sanjay Kumar Dr. Mustafa Hasan Jan
15.	14.02.2019	Nili-Ravi buffalo farming	30	Dr. Sanjay Kumar, Dr. MH Jan
16.	18.02.2019	Nili-Ravi buffalo farming	30	Dr. Sanjay Kumar, Dr. MH Jan
17.	09 & 20.08.2018	Prevention, care of diseases and control of ecto-endo parasites in dairy animals	60	Dr. Sanjay Kumar
18.	17.12.2018	Prevention and care of infectious diseases in dairy animals	30	Dr. Sanjay Kumar
19.	11.02. 2019	Buffalo husbandry practices	20	Dr. Sanjay Kumar
Farmers First Project (FFP)				
20.	14-21 December, 2018	Production and Marketing of Honey bee products and mass queen bee rearing techniques	30	Dr. Sunita Yadav, Dr. Bharat Singh (CCSHAU)
21.	11-16 January, 2019	Production technology and Post harvest handling of fruit crops	47	Dr. Satpal Baloda Dr. Bharat Singh Dr. Sunita Yadav (CCSHAU)

S.No.	Date	Title	Number of Participants	Coordinators
22.	16-21 February, 2019	भैंसपालन, उधमिता व नारी सशक्तिकरण	64	Dr. S Yadav Dr. KP Singh Dr. S Singh
23.	24-30 March, 2019	पशुपालन व डेयरी व क्षेत्र में आधुनिक प्रगति, सामूहिकता एवं कृषि विविधीकरण	43	Dr. S Yadav Dr. Bharat Singh (CCSHAU)

Outreach programs organized

S.No.	Date	Details	Venue	Number of Participants	Scientists involved
General Training Programs on buffalo farming organized by ICAR-CIRB Main Campus					
1.	05-12-2018	Mineral supplementation and ration balancing for good health of livestock	Village Budak, Dist. Hisar	67	Dr. AK Balhara Dr. PC lailer Dr. Hema Tripathi Dr. P. Sikka
2.	05-12-2018	Practices for preventing calf mortality in winter season	Village Budak, Dist. Hisar	67	Dr. AK Balhara Dr. PC lailer Dr. Hema Tripathi Dr. P. Sikka Dr. R Singh (CCS HAU, Hisar)
3.	05-12-2018	Soil Health management	Village Budak, Dist. Hisar	67	Dr. AK Balhara Dr. PC lailer Dr. Hema Tripathi Dr. P. Sikka Dr. R. Singh (CCS HAU, Hisar)
4.	01.02.2019	Crop residue management	Village Kharar, Hisar	21	Dr. AK Balhara Sh. Surender Singh (CTO)
5.	31. 03 - 01.04.019	Ration balancing and Use of Mineral mixture for optimum production	TSP villages Kherar, Udaipur, Rajasthan	140	Dr. AK Balhara Dr. SK Phulia Dr. PC lailer Dr. SS Dahiya
6.	15-16.03.2019	Silage for fodder conservation	Village Nayana, Hisar	25	Dr. Avijit dey Dr. Jerome A. Dr. AK Balhara Dr. SK Phulia Dr. P Sikka


जनजातीय उपयोजना के अर्न्तगत अंगीकृत गांवों


जनजातीय उपयोजना के अर्न्तगत अंगीकृत गांवों


विश्व मृदा दिवस

S.No.	Date	Details	Venue	Number of Participants	Scientists involved
7.	12-14.02.2019	उन्नत भैंस पालन एवं पोषण	Village Neoli-Khurd, Hisar	55	Dr. Jerome A. Dr. A. Dey Dr. S.K. Phulia Dr. P. Sikka
8.	15.02.2019	Celebration of the National Productivity Week : Theme-Swacch Bharat (15.02. 2019)	Rajkiya Varisth Madhyamik Vidyalaya, Kharkhari-Jhanwari, Bhiwani	100	Dr. P.S. Yadav Dr. Varij Nayan Dr. PC Lailer
9.	28.09.2018	Animal Infertility camp	Charkhi Dadari, Dadari	47	Dr. R K Sharma Dr. S K Phulia Dr. Ajit Verma Dr. Mala Singh Dr. A Sarangi
10.	02.10.18	Animal Infertility camp	Nimoth, Rewari	29	Dr. R K Sharma Dr. P S Yadav
11.	02.02.2019	Animal Infertility camp	Choudhariwali	37	Dr. R K Sharma Dr. S K Phulia Dr. Ajit Verma, Dr. Harum Mohammad
12.	15.03.2019	Animal Infertility camp	Nyoli Khurad, Hisar	21	Dr. R K Sharma Dr. P Sikka Dr. S K Phulia Dr. Ajit Verma
13.	31.3.2019	Animal Health checkup camp	Kherad, Udaipur	80	Dr. SS Dahiya, Dr. S K Phulia, Dr. A K Balhara
Farmers visits for participatory technology demos and Institute visits					
14.	19.07.2018	➤ Honey processing and farmer to consumer linkage development			ICAR – CIRB Hisar
15.	15-17.12.2018	➤ Honey, its composition, extraction, processing and storage ➤ Honey quality, grades, packing, AGMARK, Marketing and export of honey ➤ Production/ collection, composition, processing, uses of bee wax ➤ Bees wax purification and Comb foundations manufacturing			Dept. of Entomology, CCSHAU, Hisar
16.	15-17.12.2018	➤ Collection technology, processing and uses of propolis ➤ Collection technology, processing and uses of pollen ➤ Royal jelly, its composition, production, collection, storage and marketing ➤ Collection of bee venom			Dept. of Entomology, CCSHAU, Hisar

S.No.	Date	Details	Scientists involved
17.	18.12.2018	➤ Importance of bee breeding, queen bee and need for mass queen bee rearing ➤ Colony division and conventional methods of mass queen bee rearing ➤ Mass queen bee rearing : Doolittle and Conventional methods	Dept. of Entomology, PAU, Ludhiana
18.	19.12. 2018	➤ FPO and marketing skills ➤ Demonstration at honey Processing Plant, Comb foundation sheet manufacturing unit, value addition of hive products and honey quality control	Integrated beekeeping development centre at Ramnagar, Kurukshetra
19.	15.01. 2019	➤ Production technologies of Aonla, Guava, Ber ➤ Nursery management of fruit crops ➤ Nutritional/ Kitchen gardening	Dept. of Horticulture CCSHAU, Hisar
20.	16.01. 2019	➤ Grafting techniques of Guava ➤ Government policies and financial assistance for fruit growers	Centre for Development of Guava, Bhuna, Ftd.
21.	18.02. 2019	➤ Scientific buffalo production and technologies developed by institute ➤ Farmer to Farmer interaction (Progressive)	ICAR-CIRB
22.	24-25.03.2019	➤ Gola Ber variety cultivation technology suitable for Water scarcity or dryland regions ➤ Jalore seedless pomegranate for Water scarcity or dryland regions ➤ Date palm vaiety ADP-1 ➤ Napier Grass improved varieties and lucern intercropping with micro-drip irrigation for round the year fodder availability ➤ Thorn less cactus cultivation for fodder cultivation in Water scarcity or dryland regions ➤ Exposure of major activities and technologies developed by CAZRI for development of Arid Zone	ICAR - Central Arid Zone Research Institute, Jodhpur

S.No.	Date	Details	Scientists involved
23.	26 – 28.03.2019	➤ Sardar Patel museum visit for appraising the major technologies of SDAU ➤ Scientific dairy farming with special emphasis on indigenous breed- Kankrej at Live stock research station of SDAU ➤ Integrated Farming System model developed by SDAU comprising buffalo+crops +fruits+agroforesry+vermicompost unit ➤ Scientific technologies adopted by farmer under the guidance of SDAU in villages Rooppura and Chandisur. ➤ Along with functioning milk collection centres ➤ Horticultural technologies learning from farmer to farmer by visiting pomegranate orchard of Sh Genabhai Darghabhai Patel, Padma Shri Awardee	Sardarkrushinagar Dantiwada Agricultural University (SDAU), Dantewada, Banaskantha, Gujrat
24.	26 – 28.03.2019	➤ Technology of data processor based automatic milk collection unit at village level at milk collection centers of Banas Dairy ➤ Clean milk production, milk collection chain, quality control and small scale dairy processing in villages Rooppura and Chandisur (Gujrat) ➤ Field progeny testing unit by Banas dairy ➤ Dairy processing plant OF Banas Dairy for preparation of various milk and milk products ➤ Feed centre at Katarva village of Banas Dairy	Banaskantha District Cooperative Milk Producers' Unior Ltd. Palanpur, Gujarat, India
25.	29.03.2019	➤ Technologies and seeds developed by NRC seed spices ➤ Multitier farming of spices with fruits and vegetables ➤ Economic production technologies with seed spices like coriander, cumin, methi, funnel etc. ➤ Drill cultivation for gripe water preparation	ICAR - National Research Centre on Seed Spices, Ajmer

SUCESS STORIES AND MGMG

Success Story

Consequent upon a successful motivational attempt to salvage excessively available green fodder and its storage for further use as economical ration of buffaloes for normal milk production, especially, during summer months (May-June) due to non- availability of green fodder., our earlier attempt made in Village.-Ladwi, Distt.- Hisar, State-Haryana remained highly successful "Mera Gaon Mera Gaurav'' where, Sh. Subh Karan came forward to adopt the technology and arranged practical demonstration of silage making for benefit of fellow farmers. CIRB team demonstrated packaging of pit with cut green fodder, its opening after due fermentation and feeding silage of their six buffaloes and two cows successfully. Feeding of this silage improved the feed intake and increased the milk production by 1.5 kg/day/animal during summer months, which fetched a good income to him. He is now the leader in silage production and extending technical support to other farmers.

Second chapter was added in this chain of demonstration on May 16, 2019 when Sh. Sunil Kumar, 30 years old, Neoli Khurd, Hisar, Haryana involved in integrated livestock farming disclosed his inclination to receive training for skill development and self-employment in field of buffalo husbandry to the team of scientists at CIRB, Hisar after matriculation. He has four buffaloes and two cows at home. CIRB scientists took keen interest in guiding him towards ameliorating the problem of scarcity of available green fodder for buffalo feeding. Team visited this village, adopted under MGMG scheme and provided technical guidance, front line demonstration of silage preparation at his own farm. He developed silo- pit and produced silage from available quantity of oats, jowar and maize fodder under the guidance of scientific team. Feeding of silage improved the feed intake and sustained milk production of his animals during summer months, which fetched a good income to him. He is considered as an ambassador of institute for extending technical and motivational support for silage making to other farmers. He also has plans to sale ready silage to other beneficiaries.

Mera Gaon Mera Gaurav Program

Scientists of CIRB visited in MGMG villages with various team members for Extension activities. A total of 26 MGMG adopted villages were covered by 24 scientists grouped in 06 teams. During the period, 52 visits were conducted covering 1950 farmers and 45 interface meetings/goshties were organized. A total of 45 demonstrations on various to areas like; balanced ration & silage making, ration formulation and mineral mixture

etc were performed wherein 1166 farmers participated during visits, trainings, goshties. Scientists answered for 693 queries telephonically/personally during the year. About 3000 number of leaflets, folders was distributed and posters were displayed at prominent places for awareness. About 135 farmers were benefitted through various inputs like seed, semen doses, mineral mixture etc distributed on various occasions by the Institute at free of cost.

The major linkages developed with various agencies by scientists of MGMG team were - Atal seva Kendra, Animal husbandry department of Haryana and Rajasthan, Field veterinarians and VLDA working in Vet. hospitals, Anganvadi, Milk cooperatives, Luvas and HAU, Boruka Trust NGO, Krishi Vigyan Kendra, HAU Horticulture Department etc The major topics covered for creating awareness included; clean milk production, effects of residue burning, significance of feeding mineral mixture, swachhta & cleanliness drive, vaccination awareness, feeding of animals for optimal production at reduced cost, women empowerment, reproductive problems, breeding, nutrition and management of buffaloes in different seasons, importance of soil testing, government initiatives, significance of feeding mineral mixture, recognition of breeds identification of estrus in buffaloes, preventive measures of control of mastitis and endo and ecto parasitic infestation reproduction, prolapse problem in cows and buffaloes, symptoms of heat, right time of insemination, identification of Murrah buffaloes, characteristics of Nili Ravi and economics of rearing etc. Besides special days/week/campaigns were also celebrated in MGMG adopted villages like; soil health day, national productivity week, swatchtaa abhiyaan, krishak mahila diwas etc

SPECIAL EVENTS ORGANIZED/PARTICIPATED

Event	Coordinator(s)/ key person(s)	Date	Venue
State Agricultural Fair	Dr. Varij Nayan Sh. Rajkumar Sh. Joginder Nain	13-15.04.2018	Motihari, Bihar
Kisan Gosthis	Dr. N Saxena Dr. VB Dixit	31.05.2018 10.08.2018 07.08.2018 07.09.2018	Villages adopted under MGMG program - Badi Nyagal, Bhagela, Chhoti Nyagal, Gwalisar
International Yoga Day	Dr. PS Yadav	21.06.2018	ICAR-CIRB Hisar
National Brainstorming workshop on 'Role of Buffalo in Indian Economy' (sponsored by NADSI and ABA)	Dr. A Dey Dr. Varij Nayan Dr. Inderjeet Singh	20-07-2018	ICAR-CIRB Hisar
RAC Meeting	Dr. RK Sharma	23-24.07.2018	ICAR-CIRB Hisar
Nili-Ravi Buffalo Farmers Meet	Dr. Inderjeet Singh Dr. Sanjay Kumar	28-07-2018	ICAR-CIRB Sub Campus, Nabha
Sadhbhawana Diwas	Dr. SS Dahiya	20.08.2018	ICAR-CIRB Hisar
Brainstorming Workshop on Foot and Mouth Disease (sponsored by Asian Buffalo Association)	Dr. SK Khurana Dr. Sarita Yadav Dr. Ashok Kumar	14-15.09.2018	ICAR-CIRB Hisar
Meeting with Officials from CODST, GADVASU for discussing the possibilities to establish a small scale milk processing unit	Dr. Sanjay Kumar Dr. M H Jan Dr. AK Puniya Dr. Sunil Kumar	17-09-2018	ICAR-CIRB Sub Campus, Nabha
Kisan Mela	Dr. KP Singh Dr. Ashok Boora	20-21.09.2018	GADVASU / PAU, Ludhiana
Hindi Saptaah	Dr. Vishal Mudgal	17-22.09.2018	ICAR-CIRB Hisar
Rashtriya Kisan evam Bhed Mela	Dr. Sarita Yadav Dr. Ashok Boora Sh. Raj Kumar	29.09.2018	ICAR-CSWRI Avikanagar
Kisan evam Camel mela	Dr. Sarita Yadav Dr. Ashok Boora Sh. Raj Kumar	02.10.2018	ICAR-NRCC, Bikaner
150th Birth Anniversary of Mahatma Gandhi (Animal Health Camp cum Goshti)	Dr. Hema Tripathi, Dr. VB Dixit Dr. Sajjan Singh, Dr. Sudhir Khanna Dr. PS Yadav Dr. RK Sharma	02.10.2018	Village Bahbalpur, Hisar Village Kheri Sikander, Kaithal and Village Nimoth, Rewari

Event	Coordinator(s)/ Key Person(s)	Date	Venue
1st Meeting of Nili Ravi Breeders' Association	Dr. Inderjeet Singh Dr. Sanjay Kumar	29.09.2018	Village Rasidan, Tohana (Haryana)
Mahila Diwas in village Chinder on convergence mode	Dr. Hema Tripathi Dr. VB Dixit	15.10.2018	Village Chinder, Hisar
Swachta Pakhwara	Dr. PC Lailer Sh. BP Singh	16-31.10.2018	ICAR-CIRB Hisar
Vigilence week	Dr. Anurag Bharadwaj	29.10-03- 11.2018	ICAR-CIRB Hisar
North Zone sports Tournament – 2018	Dr. Navneet Saxena Dr. Sajjan Singh Dr. Vishal Mudgal Dr. SS Dahiya	14-16.11.2018	ICAR-CIRB Hisar & CCS HAU Hisar
World Soil Day and Kisan Gosthi	Dr. AK Balhara Dr. PC Lailer Dr. Hema Tripathi Dr. P. Sikka Dr. R Singh	05-12-2018	Village Budak, Hisar
Buffalo milk competition	Dr. N Saxena Dr. VB Dixit	18-21.12.2018	Badi Naygal, Dist. Churu, Rajasthan
Kisan Diwas	Dr. Ashok Boora Dr SK Phulia Dr PC Lailer Dr RK Sharma Dr. VB Dixit	23.12.2018	Village Chinder, Hisar
Enhancing Rural Livelihood through Improved Buffalo Productivity and Health (sponsored by Indian Society for Buffalo Development)	Dr. SS Dahiya Dr. B. P. Brahmkshtri Dr. G. M. Pandya Dr. N. S. Dangar	17-19.01.2019	Veterinary College, NAU, Navsari, Gujarat
Kisan Mela	Dr. VB Dixit Dr. AK Balhara Dr. Dharmendra Kumar	18-02- 2019	ICAR-CIRB Main Campus, Hisar
National Productivity week	Dr. Hema Tripathi Dr. VB Dixit	12-18.02.2019	At CIRB and in MGMG adopted villages
International Women's Day	Smt. Sunesh	08.03.2019	ICAR-CIRB Hisar
Animal Health Checkup and Kisan Gosthi	Dr. AK Balhara Dr. SK Phulia Dr. PC Lailer Dr. SS Dahiya	31.03 – 01.04.2019	TSP villages Kherar, Udaipur, Rajasthan

North Zone sports Tournament – 2018

Indian Council of Agricultural Research holds sports tournament annually for keeping physical and mental health of its employees fit. The Institute hosted the North Zone Inter-institutional Staff Sports Tournament 2018 during 14-16 November, 2019. The event was inaugurated by Dr. KP Singh, Vice Chancellor, CCSHAU Hisar on 14th November, 2018. Eight hundred and fifty participants from 24 ICAR institutes participated in this mega event, held in Hisar for only the second time. The event saw successful organisation of thirty four sports events including Kabaddi, Football, Volley ball (Smashing & Shooting), Basketball, Badminton, Table Tennis, Chess, Carrom and Track & Field events at the Giri Centre sports complex, CCS HAU, Hisar. Ms. Geetika Jakhar, internationally acclaimed women wrestler and Arjuna awardee, was the chief guest at the prize distribution function.

Overall Champion : ICAR-CPRI, Shimla

Best Athletes : Naresh Kumar, ICAR-IIWBR, Karnal (Men), Th. Bidya Lakshmi, CIPHET, Ludhiana (Women)

Event	Men			Women		
	First	Second	Third	First	Second	Third
100 m	IIWBR, Karnal	IIPR, Kanpur	IISWC, Dehradun	CIPHET, Ludhiana	VPKAS, Almora	CSSRI, Karnal
200 m	IIWBR, Karnal	IISWC, Dehradhun	IIFSR, Modipur	CIPHET, Ludhiana	VPKAS, Almora	CIPHET, Ludhiana
400 m	IISWC, Dehradun	VPKAS, Almora	IIPR, Kanpur	-	-	-
800 m	VPKAS, Almora	IISWC, Dehradun	NDRI, Karnal	-	-	-
1500 m	VPKAS, Almora	NDRI, Karnal	NDRI, Karnal	-	-	-
4x100m Relay	VPKAS, Almora	NDRI, Karnal	IISWC, Dehradhun		-	-
Shot-put	NDRI, Karnal	IISWC, Dehradun	CPRI, Shimla	CPRI, Shimla	DMR, Solan	NDRI, Karnal
Javelin throw	IICR, Lucknow	NDRI, Karnal	VPKAS, Almora	CPRI, Shimla	NDRI, Karnal	NDRI, Karnal
Discus throw	IISWC, Dehradun	NDRI, Karnal	VPKAS, Almora	CPRI, Shimla	NDRI, Karnal	DMR, Solan
Long jump	IIWBR, Karnal	NDRI, Karnal	IISWC, Dehradun	CSSRI, Karnal	CIPHET, Ludhiana	VPKAS, Almora
High jump	NDRI, Karnal	IISWC, Dehradun	VPKAS, Almora	VPKAS, Almora	-	-
Cycle Race 5000 m	NDRI, Karnal	CSSRI, Karnal	NBAGR, Karnal	-	-	-

Indoor & Outdoor Events

Event	Men		Women	
	Winner	Runner	Winner	Runner
Badminton (Team)	CPRI, Shimla	IIWBR, Karnal	-	-
Badminton (Doubles)	-	-	CIPHET, Ludhiana	CPRI, Shimla
Badminton (Singles)	-	-	CIPHET, Ludhiana	CSSRI, Karnal
Table Tennis (Singles)	CPRI, Shimla	NDRI, Karnal	IISR, Luckhnow	CPRI, Shimla
Table Tennis (Doubles)	-	-	CPRI, Shimla	IISR, Luckhnow
Chess	IIFSR, Modipuram	CISH, Luckhnow	VPKAS, Almora	IIVR, Varanasi
Carrom Board	NBFGR, Luckhnow	IISR, Luckhnow	DMR, Solan	VPKAS, Almora
Foot Ball	IIPR, Kanpur	NDRI, Karnal	-	-
Kabaddi	NDRI, Karnal	IIWBR, Karnal	-	-
Basket Ball	NDRI, Karnal	NBGAR, Karnal	-	-
Volley Ball (Shooting)	CPRI, Shimla	CSSRI, Karnal	-	-
Volley Ball (Smashing)	IIPR, Kanpur	CPRI, Shimla	-	-

AWARDS

Name of Scientist (s)	Details of award	Date
Best published paper		
Prasad M, Ranjan K, Brar B, Shah I, Lalmbe U, Manimegalai J, Vashisht B, Gaury M, Kumar P, Khurana SK, Prasad G, Rawat J, Yadav V, Kumar S, Rao R.	Virus-host interactions: new insights and advancements in drug development against viral pathogens. Curr. Drug Metab. 18 (10) 942-970. doi: 10.2174/ 1389200218666170925115132. (IF 2.7, NAAS rating 8.7). Editorial Board as Best out of all papers published in CDM in past 5 years (2013-2017).	Announced in 2017
Scientific Society/ Bodies Awards		
SK Khurana	Dr C. M. Singh-Salihotra Samman and citation, 2018 by Dr. CM Singh Endowment Trust for outstanding work in the field of Veterinary Public Health, Epidemiology and Zoonosis	28.4.2018
PS Yadav	Recognition certificate for buffalo cloning work by Chief Minister Haryana on Independence day 2018	15.08.2018
Hema Tripathi	Fellow of the National Academy of Dairy Science, India (NADSI)	10.09.2018
Avijit Dey	Associate Fellow of the National Academy of Dairy Science, India (NADSI)	10.09.2018
Jasmer Dalal for the research paper Co-authored by Kumar P, Chandolia RK, Pawaria S, Rajendran R, Sheoran S, Andonissamy J and Kumar D	Best Young Scientist Award-2018 in the session on Andrology, Frozen Semen and Artificial Insemination at 34th Annual Convention of ISSAR and International Symposoum on Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for sustainable Rural Economy, Anand Agricultural University, Anand, Gujarat,	28-30. 12. 2018
SS Dahiya PS Yadav	Distinguished Scientists Award 2019 by the Indian Society for Buffalo Development	17.01.2019
Dharmendra Kumar	Dr. S K Sirohi Young Researcher Award 2019 during 17th Convocation of ICAR-NDRI, Karnal	23.03.2019
Dharmendra Kumar	Associate member of National Academy of Veterinary Science (India)	19.12.2018
Conference awards		
Bhardwaj, A., Nayan, V., Chakarvarty, N., Kumar, S., Kumar, S., Pal, Y., Yadav, S.C.	Best Oral Presentation for the work "Expression studies of recombinant equine chorionic gonadotropin in three different host systems" in the Third Convention of Society of Veterinary Biochemists and Biotechnologists of India (SVBBI 2018) and National Symposium on "Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement" held at LUVAS, Hisar, Haryana	02-03.11. 2018

Name of Scientist (s)	Details of award	Date
Hema Tripathi	Third Best poster 'Knowledge and perception regarding antibiotic residues' in national seminar on 'One Health, Food Security and safety', Jointly organised by Odisha University of Agriculture and Technology and NAVS (India) at Bhuvaneshwar	19.12 2018
Jerome A, P Kumar, S Patil, S Singh and RK Sharma	Best poster award 'Sperm dosage in relation to field fertility outcome in buffaloes – A preliminary report' at ISSAR 2018 Conference, 28-30th Dec. 2018 AAU Anand Gujarat	30.12.2018
Pradeep Kumar	Young Scientist Award 'A new role for RU 486 in protecting buffalo sperm from premature capacitation during cryopreservation' at ISSAR 2018 Conference, 28-30th Dec. 2018, AAU Anand Gujarat	30.12.2018
AK Balhara, KP Singh and SS Dahiya	Best poster Technical Session 3 'Strategies for alleviating summer stress in buffalo production systems'. In : the National Conference on 'Enhancing rural livelihood through improved buffalo productivity and health' 17-19 Januray, 2019 organised by NAU, Navsari	19.01.2019
Saita Yadav, A Boora, KP Singh, Muley V, Dhamanaskar K, P Kumari and I Singh	Best presentation ' An open label study to access the efficacy of Spetramast LC and Pathocef combination in treatment of clinical mastitis	19.01.2019
Selokar NL, Sharma P, Krishna A, Kumar D, Sharma R, Khanna S, Saini M and Yadav PS	Best oral presentation award on 'Birth of India's first cloned Assamese buffalo at an India dairy farm'. In the technical session on 'Reproduction and Physiology 'of the National Conference of ISBD-2019 on 'Enhancing Rural Livelihood through Improved Buffalo Productivity and Health' at College of Veterinary Science and Animal Husbandary, NAU, Navsari	19.01.2019
Pradeep Kumar	Second best paper at the 47th Dairy Industry conference Patna Bihar on 7-9 February 2019	09.02.2019
Journal awards		
Varij Nayan	Reviewer Excellence Award from the Journal Indian Journal of Animal Research	18.03.2019

FOREIGN VISITS

Name of Scientist	Country visited	Duration
PS Yadav	Germany	08.11.2018- 27.11.2018
Naresh L Selokar	Germany	22.11.2018 to 20.12.2018

DISTINGUISHED VISITORS

Name of Visitor	Organisation	Dates / Duration
Dr. Rameshwar Singh	Vice Chancellor, BASU Patna	07.04.2018
Mr. Alok Gupta	Member, GB, ICAR	22.05.2018
Sh. Balbir Singh Sindhu	Punjab Animal Husbandry Minister	18.07. 2018
Dr. AK Srivastava	Member ASRB	20.07.2018
Dr. KP Singh	Vice Chancellor , HAU	31.08.2018
Dr. Trilochan Mohapatra	Secretary DARE & DG, ICAR	04.10.2018
Dr. JK Jena	DDG (Fisheries & AH), ICAR	04.10.2018
Mr. Eric	ILRI, Nairobi	11-13.10.2018
Mr. James Griffiths	Bullock Flats Fresh Meat Company / Taliston International, Australia	17-10-2018
Prof (Dr) Wilfried A Kues	FLI, Germany	01- 19.01.2019
Dr. Bojon Peterson	FLI, Germany	28. 3 - 05.04.2019

Visiting Faculty (Post-Docs)

Name of faculty	Fellowship program	University	Duration	Guide/Co-guide	Project title
D Eias Elzein Ibrahim	CV Raman International Fellowship for African Researchers	Gynecology and Obstetrics, Faculty of Veterinary Sci., University of Nyala, 155, Nyala, Sudan	16 Sept. 2018 - 15 Mar. 2019	Dr. RK Sharma Dr. Dharmendra Kumar Dr. Naresh L Selokar	Evaluation of ovarian potential for in vitro embryo production of Indian buffalo
Dr. Mohammad Harun-Or-Rashid	India Science and Research Fellowship	Bangladesh Agriculture University, Mymensingh, Bangladesh	19 Dec. 2018 - 30 Mar. 2019	Dr. R K Sharma Dr. Dharmendra Kumar Dr. Naresh L Selokar	Training on ultrasound of ruminants, multiple ovulation and embryo transfer (MOET) in buffalo for upgrading buffalo production in Bangladesh

STUDENTS AT ICAR-CIRB

Sr. No.	Name of the Scholar	Degree	Subject/ Discipline	University	Year	Guide/ Co-Major guide	Title of the thesis
Completed							
1.	Dr. Kiran Attri	M.V.Sc.	Animal Nutrition	NDRI, Karnal	2016-18	Dr. A Dey	Evaluation of composite feed additive on milk production, Methane emission and nutrient utilization in buffaloes
2.	Dr. Ram Narayan Patel	M.V.Sc.	LPM	NDRI, Karnal	2016-18	Dr. PC Lailer	Effect of feeding cation anion salt during transition period in buffaloes
3.	Dr. Vipin	M.V.Sc.	Animal Nutrition	IVRI, Bareilly	2016-18	Dr. V Mudgal	Effect of vitamin A and E supplementation during peripaturient period on performance of Murrah buffalo.
4.	Dr. Jyoti Shakya	M.V.Sc.	LPM	NDRI, Karnal	2016-18	Dr. Inderjeet	Effect of enzyme mix supp. on buffalo milk production, composition & feed digestibility
5.	Dr. Sonam Bhardwaj	M.V.Sc.	LPM	NDRI, Karnal	2016-18	Dr. PC Lailer	Studies on level of serum kisspeptin & its relationship with sexual behavior & semen quality
6.	Dr. Sandeep Chikkara	M.V.Sc.	Animal Nutrition	LUVAS, Hisar	2016-18	Dr. SS Dahiya	Effect of replacement of GNC with Guar Korma on rumen fermentation pattern and growth performance in buffaloes
7.	Dr. Kh. Ratika	Ph.D	Animal Nutrition	NDRI, Karnal	2014-2018	Dr. SS Dahiya	Performance of transition buffaloes fed diets supplemented with rumen protected methionine, lysine and choline
8.	Dr. Y. Mery Chanu	Ph.D	Animal Nutrition	NDRI, Karnal	2014-2018	Dr. SS Paul	Hyper ammonia producing bacteria from rumen of buffaloes and evaluation of additives for their inhibition
9.	Rekha Yadav	Ph.D	Extension	IVRI	2015 -2018	Dr. H Tripathi	Effectiveness of breeding services by state department of animal husbandry in Murrah breeding tract of Haryana-A perceptual study

Sr. No.	Name of the Scholar	Degree	Subject/ Discipline	University	Year	Guide/ Co-Major guide	Title of the thesis
Pursuing							
1.	Dr. Archana Sarangi	Ph.D	Animal Physiology	NDRI, Karnal	2016-18	Dr. Ashok Kumar Balhara	Identification and confirmation of early pregnancy associated urinary metabolites in murrah buffalo
2.	Dr. Mala Singh	Ph.D	Animal Physiology	NDRI, Karnal	2016-18	Dr. SK Phulia	Proteomic evaluation of uterine and vaginal cytology during early pregnancy in buffaloes
4.	Dr. Ram Kumar Singh	Ph.D	Animal Nutrition	NDRI, Karnal	2016-19	Dr. SS Dahiya	Modulation of Buffalo Milk Conjugated Linoleic Acid Content through Dietary Supplementation of Plant Secondary Metabolites
5.	Dr. Pooja Tamboli	Ph.D	LPM	NDRI, Karnal	2016-19	Dr. Anurag Bharadwaj	Association of age at first calving and first lactation traits on lifetime productivity in buffaloes
6.	Dr. Muhammad Abubakar Wakil	Ph.D	Veterinary Physiology	LUVAS, Hisar	2017-19	Dr. PS Yadav	Effect of telomerase activator on telomere length and telomerase activity of somatic cells and cloned embryos in buffalo
7.	N Ramesh	Ph.D	Extension	IVRI	2017 cont.	Dr. H Tripathi	Multi-dimensional study on usage of antibiotics in livestock and poultry farming
8.	Dr. Ajit Verma	M.V. Sc	VGO	LUVAS, Hisar	2018	Dr. S K Phulia	Seasonal comparison of progesterone-based protocol for induction of estrus and fertility in buffaloes under farm and field conditions
9.	Dr. Shivanagouda Patil	M.V. Sc	VGO	LUVAS, Hisar	2018	Pradeep Kumar	Studies on dilution effect on buffalo sperm functionality
10.	Dr. Erica Lawai Lyngdoh	M.Sc.	Animal Biochemistry	NDRI, Karnal	2018-19	Varij Nayan	Explorations into the nanomaterial-cellular interactions in buffalo granulose and sperm cells

PERSONNEL

General Administration

Dr. Satbir Singh Dahiya	Director (w.e.f 05.11.2018)
Dr. Inderjeet Singh	Director (30.4.2013 to 1.5.2018; 23.5.2018 to 4.11.2018)
Dr. B N Tripathi	Director (2.5.2018 to 22.5.2018)
Dr. Sanjay Kumar	OIC Sub campus Nabha
Shri Ravinder	Administrative Officer
Smt. Shammi Tyagi	Fin. & Accounts Officer
Shri Joginder Singh	Private Secretary
Shri Narender Kumar	AAO
Shri Rajesh Kumar	AAO
Shri Girdhari Lal	AAO
Shri Viksit Kumar	Assistant
Shri Abdul Majid	Assistant
Shri Ashok Kumar	UDC
Smt Indira Devi	UDC
Shri Satbir Singh	UDC
Shri Tejinder Singh	UDC Sub campus Nabha
Shri Dharam Pal	LDC
Shri Sunil Kumar	LDC
Shri Mahabir Singh	LDC
Smt. Savita	LDC

Agricultural Farm

Dr PC Lailer	PS & Officer In-charge
Shri Surender Singh Malik	CTO & Incharge
Shri Baljeet Singh	STO
Shri Satish	Sr. Technician
Shri Jagdeep	Technician

APR Division

Dr. R. K. Sharma	Principal Scientist & Head
Dr. P S Yadav	Principal Scientist
Dr. Sajjan Singh	Principal Scientist
Dr. SK Phulia	Principal Scientist
Dr. Varij Nayan	Senior Scientist
Dr. Ashok Kumar Balhara	Senior Scientist
Dr. Dharmendra Kumar	Senior Scientist
Dr. Jerome A	Scientist
Dr. Pradeep Kumar	Scientist
Dr. Solekar Naresh Lalaji	Scientist
Ashrfi Shah	Technician

ANFT Division

Dr. PC Lailer	Principal Scientist & Head
Dr. Navneet Saxena	Principal Scientist
Dr. Ram Singh	Principal Scientist
Dr. Avijit Dey	Senior Scientist
Dr. Vishal Mudgal	Senior Scientist
Dr. Sarita Yadav	Senior Scientist
Dr. ML Sharma	CTO
Shri Krishan Kumar	ACTO

TOTE Unit

Dr. VB Dixit	Principal Scientist
Dr. Hema Tripathi	Principal Scientist
Dr. Sajjan Singh	Principal Scientist
Dr. Satish Kakkar	CTO
Shri Gopal Dutt Tiwari	Technician

NP on Buffalo Improvement (NPBI)

Dr. SS Dahiya	Project Co-ordinator (B) (w.e.f 05.11.2018)
Dr. Inderjeet Singh	Project Co-ordinator (B) (30.4.2013 to 1.5.2018; 23.5.2018 to 4.11.2018)
Dr. BN Tripathi	Project Co-ordinator (B) (2.5.2018 to 22.5.2018)
Dr. KP Singh	I/C Network Project
Dr. BP Kushwaha	Principal Scientist (at IGFRI, Jhansi)
Shri Ram Chander	TO

Animal Genetics & Breeding Division

Dr. Anurag Bharadwaj	Principal Scientist & Head
Dr. (Mrs) Poonam Sikka	Principal Scientist
Dr. SK Khurana	Principal Scientist
Dr. K P Singh	Principal Scientist
Dr. BP Kushwaha	Principal Scientist
Dr. Ashok Kumar Boora	Scientist
Mrs. Sunesh Balhara	Scientist
Dr. (Mrs.) Soumya Dass	Scientist
Dr. Sudhir Khanna	CTO (up to 30.11.2018)
Shri AKS Tomer	ACTO
Shri Ramchander	TO

Animal Farm Section

Dr. Anurag Bharadwaj	Principal Scientist and Officer Incharge
Dr. SK Khanna Up to	CTO, Incharge (upto 30.11.2018)
Shri AKS Tomar	ACTO & Incharge From 01.12.2018
Dr. Rajesh Kumar	STA (on study leave)
Shri Joginder Singh	Technician

Sub campus Nabha (Punjab)

Dr. Sanjay Kumar	Senior Scientist & OIC
Dr. Mustafa Hassan Jan	Scientist
Dr. K L Mehrara	CTO
Shri Virender Singh	CTO
Shri Jagdish Prasad	CTO
Shri Rajiv Mehta	CTO
Shri TP Singh	CTO
Dr. RS Pippal	ACTO
Dr. A.K. Saini	STO
Shri Daljit Singh	TO
Shri Balwinder Singh	TO
Shri Mohan Singh	TO

PME Cell

Dr. Navneet Saxena	Principal Scientist
Dr. Varij Nayan	Senior Scientist
Dr. Sarita Yadav	Senior Scientist
Dr. Dhramendra Kumar	Senior Scientist
Dr. ML Sharma	CTO
Shri Raj Kumar	ACTO Up to 23.01.2019

AKMU

Mrs. Sunesh Balhara	Scientist & In-charge (w.e.f. 23.01.2019)
Dr. Avjit Dey	Principal Scientist & In-charge (w.e.f. 23.01.2019)
Shri Raj Kumar	ACTO

Academic Co-ordinator

Dr. SK Khurana	Principal Scientist
Dr. AK Balhara	Senior Scientist

RFD Cell

Dr. Dhramendra	Senior Scientist

HRD Cell

Dr. Hema Tripathi	Principal Scientist & Nodal Officer
Dr. Jerome A.	Scientist & Co-Nodal Officer

PIO/APIO

Dr. R K Sharma	Principal Scientist & CPIO Main Campus
Dr. Mustafa Hasan Jan	Scientist & CPIO Sub Campus
Shri Ravinder	AO & Transparency Officer
Shri Rajesh Kumar	AAO & Nodal officer

Guest House & Landscape section

Shri AKS Tomer	ACTO Incharge

Estate & Electrical Section

Dr. R K Sharma	Head APR & Officer All Incharge
Shri BP Singh	ACTO Incharge, Estate
Shri Rajesh Prakash	STO Incharge, Electrical
Shri Gopal Singh	TO

Hindi Section & PRO

Dr. Vishal Mudgal	Senior Scientist & In-charge ; PRO
Shri Dharampal	LDC

Library

Mrs. Sunesh Balhara	Scientist (w.e.f. 23.01.2019)
Dr. Avijit Dey	Principal Scientist (upto 22.01.2019)
Sh. Raj Kumar	ACTO & Incharge

Workshop Section

Dr. PC Lailer	PS & Officer In-charge
Shri Ramchander	TO & Incharge
Shri Kuldeep Singh	TO
Shri Bhim Raj	TO
Shri Sant Lal	TO
Shri Satpal	TO
Shri Ram Kumar	STA

Supporting Staff Main Campus Hisar (Haryana)

Shri Pooran	Shri Ram Het	Shri Rambir	Shri Jarinal Singh
Shri Ram Kumar	Shri Satish Kumar	Shri Raj Kumar	Shri Om Prakash
Shri Bheera	Shri Satbir Singh	Shri Anil Kumar	Shri Nakchhed
Shri Randhir Singh	Shri Satyawan	Shri Ashok Kumar	Shri Ram Kishore
Shri Jai Prakash	Shri Balwant Singh	Shri Jagdeep	Shri Mela Ram
Shri Gopi Ram	Shri Dilbag Singh	Shri Rajender	Shri Radhey Shyam
Shri Ram Kesh	Shri Rajbir Singh	Smt. Sarla Rani	Shri Hawa Singh
Shri Yam Bahadur	Shri Radhey Krishan	Shri Jitender Kumar	Shri Ramesh Chander
Shri Siri Ram	Shri Joginder Singh	Shri Hari Kishan	Shri Mahabir Singh
Shri Subhash	Shri Om Prakash	Shri Jai Kumar	Shri Sadhu Ram
Shri Chander	Shri Rati Ram	Shri Pahlad	

Supporting Staff Sub Campus Nabha (Punjab)

Sh. Shyam Dev	Sh. Balkar Singh	Sh. Rulda Singh
Sh. Ram Anuj	Sh. Ram Kewal	Sh. Jaswant Singh
Sh. Rajinder Singh	Sh. Ram Suraj	Sh. Mukhtiar Singh
Sh. Budh Ram	Sh. Jaspal Singh	Sh. Rajesh Kumar
Sh. Raju	Sh. Bhim Singh	Sh. Shrinath
Sh. Ram Chander	Sh. Balwant Singh	Sh. Hans Raj
Sh. Gurjant Singh	Sh. Brij Mohan	Sh. Gurnam Singh

Joinings

Name	Designation	Date
Dr. Soumya Dash	Scientist	10.10.2018
Smt Savita	LDC	31.10.2018
Smt. Shammi Tyagi	Finance & Accounts Officer	10.01.2019
Sh. Ravind	Administrative Officer	28.01.2019

Promotion

- Dr. R.S. Pippal, STO promoted to the next higher grade of ACTO w.e.f. 20.06.2015
- Sh. Girdhari Lal, Asstt. Promoted to the post of Asstt. Administrative Officer w.e.f. 27.10.2018 (AN).
- Dr. Avijit Dey, Sr. Scientist promoted to the next higher grade of Prinicipal Scientist w.e.f. 17.06.2017.
- Sh. B.P. Singh, ACTO promoted to the post of CTO w.e.f. 29.08.2018
- Sh. T.P. Singh, ACTO promoted to the post of CTO w.e.f.19.10.2017
- Sh. Rajiv Mehta, ACTO promoted to the post of CTO w.e.f. 01.01.2018
- Sh. Satish Kumar, Tech. promoted to the post of Sr. Tech. w.e.f. 15.09.2017

Retirements

- Sh. Sadhu Ram, DPL (TS) on 30.04.2018
- Sh. Ishwar Singh, CLTS retired on 30.6.2018
- Smt. Sheela, CLTS retired on 30.6.2018
- Smt. Kamla, Casual Labour retired on 30.6.2018
- Dr. Sudhir Khanna, CTO retired on 30.11.2018
- Smt. Santro, SSS retired on 31.01.2019
- Shri Sant Lal, TO retired on 31.05.2018
- Smt. Santosh, CLTS retired on 30.6.2018
- Sh. Chiranji Lal, Casual Labour retired on 30.6.2018
- Sh. Mewa Singh, CLTS retired on 31.7.2018
- Dr. T.P. Singh, ACTO retired on 31.01.2019
- Sh. Balwinder Singh, TO retired on 31.03.2019

Transfer

- Shri Narender Kumar, AAO transferred from CIRB Sub-Campus, Nabha to main campus, Hisar (Date 5.2.2019)

Sad Demise

- Shri Jai Narayan, CLTS expired on 29.12.2018
- Sh. Darshan Singh, CL (240 days) on 06.02.2019

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