# भाकृअनुप-केन्द्रीय भैंस अनुसंधान संस्थान

## ICAR-Central Institute for Research on Buffaloes

Hisar -125 001 (Haryana) | www.cirb.res.in

# वार्षिक प्रतिवेदन

# Annual Report

# 2019

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# Preface

The domestication of buffaloes in India goes back to at least 2500 BC. An ancient Indian folk saying 'Come my beloved, let us buy a buffalo. For then we, too, shall be opulent' which means buffaloes has been recognized as a foundation of economic affluence since ages. The 20th Livestock Census statistics show some interesting trends in our food animals population dynamics. India in the year 2019 has 535.78 million livestock - 192.90 million cattle, 148.88 million goats, 109.85 million buffaloes, 74.26 million sheep and 9.06 million pigs. All other animals taken together contribute just 0.23 per cent of the total livestock population in the country. The total population of buffaloes in the country has gone up from 108.70 million in 2012 to 109.85 million in 2019. States which have seen a rise in the buffalo population during this period include Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Bihar, Maharashtra and Telangana. However, some states including Andhra Pradesh, Haryana and Punjab have seen a decline in their respective buffalo populations. The population of female cattle (cows) during the period (2007-2012) rose 6.52% and that of female buffaloes rose 7.99%. With over 300 million bovine heads, the country is numerouno in milk producers making available 394 gm/day milk to the vast human population. Although the number of buffaloes is substantially lesser then cows, this species contributes half of total milk produced and the rest half is collectively contributed by cattle, goat and others. This amply explains the status and importance that buffaloes enjoys in our food security infrastructure.

The Central Institute for Research on Buffaloes, established in 1985, has made noteworthy accomplishments in improving buffaloes production performance through interventions in efficient nutrient utilization, assisted reproduction and extension technologies. The Scientists has crystallized some of the unique, indigenous and farmer friendly tools through continued research endeavors in conjunction with other centers of excellence in country. The Institute Murrah buffalo herd witnessed its highest improvement in milk production recording wet and herd averages of 9.53 and 6.70 kg/day, respectively. Continued support of the Council, Departments of Biotechnology, Science and Technology, International organizations like BMGF and other agencies has contributed immensely in carving a niche for CIRB in the top research fraternity. The Institute has been recognized as an important policy input

center for livestock improvement by several international agencies like ASEAN Secretariat, SAARC Agriculture Center and International Livestock Research Institute.

The network project on buffalo improvement is coordinated by the Institute through fifteen centers across the country. The projects boost of being among very few progeny testing programs operational at field levels in the home tracts of respective breeds. The five major buffalo breeds viz. Murrah, Nili Ravi, Jafarabadi, Surti and Bhadawari covered under this initiative, have been recognized as the improver breeds of buffaloes. The project so far has delivered more than ten lakh doses of elite Murrah buffalo bull semen, more than one lakh Nili Ravi bull semen, 441 Murrah bulls, 56 Nili Ravi bulls and directly benefitted more than one lakh farmers in terms of breed improvement. The Murrah herd maintained at Main Campus in Hisar and Nili Ravi breed maintained at Sub Campus, Nabha has registered wet average of 9.53 kg/day and 9.09 kg/day, respectively. This reflects overall improvement of 98.5% in Murrah herd and 55.1% in Nili Ravi herd since initiation of the project in the year 1993.

The Institute is determined to develop science driven technological innovations and solutions for efficient and sustainable buffalo production systems with reach to the neediest farmers. Conservation and propagation of most precious high producing elite buffalo germplasm though the cloning technique is a well-recognized and widely applauded feat of the Scientific fraternity at the Institute. Progress made in developing pregnancy and estrous diagnostics are overwhelming and promises great improvement in reproductive efficiencies of this otherwise considered poor breeder species. Innovative composite feed, herbal extracts and essential oils amalgams patented and improved by scientists working in the area of feed technologies are yielding virtuous results for mitigating methane production from large ruminant bovine population. Adoption of area specific mineral mixture by Haryana farmers and breed improvement initiatives under Tribal Sub Plan (TSP) in tribal areas of Rajasthan are the most perceptible examples of CIRB serving the livestock farming communities through science. Farmers across the states, varying education and entrepreneurial levels have reposed faith in the capacity building programs conducted by the Institute.

I take this opportunity to gratefully acknowledge the reassurances, care, impetus and direction from our worthy Dr. Trilochan Mohapatra, Secretory Department of Agricultural Research and Education, and Director General, ICAR and Dr. BN Tripathi, Deputy Director General (Animal Sciences) is gratefully acknowledged by the Institute. The whole CIRB team deserves my sincere gratitude for their wholehearted support and cooperation in completing yet another successful year.

**Satbir Singh Dahiya**
**Director**

# प्रस्तावना

भारत में भैंसों को 2500 ई.पू. से ही पालतू बनाने का कार्य किया जाता रहा है। एक प्राचीन भारतीय लोक कहावत है ''आओ मेरे प्यारे, हम एक भैंस खरीदते हैं फिर हम भी, समृद्ध हो जायेंगे'' जिसका अर्थ है कि भैंस को कई वर्ष पहले से आर्थिक संपन्नता की नींव के रूप में मान्यता दी गई है। देश की 20वीं पशुधन की जनगणना के आंकड़े हमारे जानवरों की आबादी की गतिशीलता में कुछ दिलचस्प रुझान दिखाते हैं। भारत में वर्ष 2019 के आंकड़ों के अनुसार, 535.78 मिलियन पशुधन हैं, जिसमें 192.90 मिलियन गायें, 148.88 मिलियन बकरियां, 109.85 मिलियन भैंस, 74.26 मिलियन भेड़ और 9.06 मिलियन सूअर हैं। देश में पशुओं की कुल आबादी का सिर्फ 0.23 फीसदी योगदान अन्य सभी जानवरों का है। देश में भैंसों की कुल आबादी 2012 में 108.70 मिलियन से बढ़कर 2019 में 109.85 मिलियन हो गई है। जिन राज्यों में भैंस की आबादी में वृद्धि देखी गई है, उनमें उत्तर प्रदेश, राजस्थान, गुजरात, मध्य प्रदेश, बिहार, महाराष्ट्र और तेलंगाना शामिल हैं। हालांकि, आंध्र प्रदेश, हरियाणा और पंजाब सहित कुछ राज्यों में उनके सापेक्ष भैंसों की आबादी में गिरावट देखी गई है। वर्ष 2007–2012 के दौरान मादा मवेशियों (गायों) एवं मादा भैंस की आबादी में क्रमश: 6.52 प्रतिशत एवं 7.99 प्रतिशत की बढ़ोतरी हुई है। 300 मिलियन से अधिक गौवंश के साथ, देश दुग्ध उत्पादकों में प्रथम स्थान पर है, जो विशाल आबादी के लिए प्रतिदिन 394 ग्राम दूध उपलब्ध कराता है। हलाँकि, भैंस की संख्या गायों की अपेक्षा काफी कम है, फिर भी, यह प्रजाति देश की कुल उत्पादित दूध में आधा योगदान देती है, और बाकी आधा सामूहिक रूप से मवेशियों, बकरी और अन्य पशुओं द्वारा योगदान दिया जाता है। यह स्पष्ट रूप से उस स्थिति और महत्व को बताता है कि भैंस हमारे खाद्य सुरक्षा बुनियादी ढांचे में कितना महत्वपूर्ण है।

1985 में स्थापित केंद्रीय भैंस अनुसंधान संस्थान ने प्रभावी पोषक तत्व उपयोगीकरण, प्रजनन सहायता और विस्तार की प्रौद्योगिकियों के माध्यम से भैंस के उत्पादन क्षमता में सुधार के लिये उल्लेखनीय उपलब्धियां हासिल की हैं। वैज्ञानिकों ने देश के अन्य उत्कृष्ट केंद्रों के साथ निरंतर अनुसंधान प्रयासों के माध्यम से कुछ अनोखे, स्वदेशी और किसानों के अनुकूल उपकरणों को विकसित किया है। संस्थान में मुर्रा भैंसों का वेट और हर्ड औसत क्रमश: 9.53 और 6.70 किलोग्राम प्रतिदिन के साथ दूध उत्पादन में सबसे अधिक सुधार देखा गया। परिषद् के निरंतर समर्थन, जैव–प्रौद्योगिकी विभाग, विज्ञान एवं तकनीकी विभाग, अंतर्राष्ट्रीय संगठन जैसे बीएमजीएफ और अन्य एजेंसियों ने सीआईआरबी को उच्च अनुसन्धान परिसर बनाने में महत्पूर्ण योगदान दिया है। ए.एस.इ.ए.एन सचिवालय, सार्क कृषि

केंद्र एवं अंतरराष्ट्रीय पशुधन अनुसंधान केंद्र द्वारा संस्थान को पशुधन के विकास हेतु महत्वपूर्ण नीतिगत निवेश केंद्र के रूप में मान्यता दी गयी है।

संस्थान द्वारा भैंस सुधार पर नेटवर्क परियोजना देश भर के पंद्रह केंद्रों के माध्यम से संचालित है। परियोजना संबंधित नस्लों के उनके गृह क्षेत्रों में संतान परीक्षण योजना को बढ़ावा देती हैं। इसी पहल में पांच प्रमुख भैंस की नस्लों यथा मुर्राह, नीली-रावि, जाफराबादी, सुरती और भदावरी को भैंस के सुधारक नस्ल की मान्यता दी गई है। इस परियोजना में अब तक कुल मुर्राह भैंस वीर्य की दस लाख हिमीकृत खुराक, कुल नीली-रावि भैंस वीर्य की एक लाख से अधिक हिमीकृत खुराक, 441 मुर्राह साँड़, 56 नीली-रावि साँड़ एवं एक लाख से अधिक किसानों को नस्ल सुधार कार्यक्रम के अंतर्गत सीधे फायदे पहुंचाए गये हैं। हिसार मुख्य परिसर में अनुरक्षित मुर्राह और उप परिसर नाभा में अनुरक्षित नीली-रावी नस्ल ने क्रमशः 9.53 किलोग्राम और 9.09 किलोग्राम प्रतिदिन का वेट औसत दर्ज किया है। यह वर्ष 1993 में परियोजना की शुरुआत के बाद से मुर्रा में 98.5% और नीली-रावी में 55.1% के समग्र सुधार को दर्शाता है।

संस्थान, कुशल और टिकाऊ भैंस उत्पादन प्रणालियों के लिए विज्ञान संचालित तकनीकी नवाचार और समाधान विकसित करने के लिए दृढ़ संकल्पित है जिसे जरूरतमंद किसानों तक पहुंचाया जा सके। अच्छी तरह से मान्यता प्राप्त क्लोनिंग तकनीक के द्वारा सबसे कीमती उच्च उत्पादक कुलीन भैंस के जर्मप्लाज्म का संरक्षण और प्रसार किया गया है जिसके लिए संस्थान के वैज्ञानिको की व्यापक रूप से सराहना की गई है। गर्भावस्था और मद अवस्था को जाँचने हेतु तकनीक विकसित करने में अच्छी प्रगति की गई जो कम प्रजनक नस्लों की प्रजनन क्षमता में बड़े सुधार को परिलक्षित करता है। अभिनव मिश्रित फीड, हर्बल अर्क और आवश्यक तेलों के अमलगम का पेटेंट कराया गया है और फीड प्रौद्योगिकियों के क्षेत्र में काम करने वाले वैज्ञानिक, गोजातीय द्वारा मीथेन उत्पादन को कम करने के लिए अच्छे परिणाम प्राप्त कर रहे हैं। क्षेत्र विशिष्ट खनिज मिश्रण को हरियाणा के किसानों द्वारा अपनाना और राजस्थान के आदिवासी क्षेत्रों में जनजातीय उप योजना (टीएसपी) के तहत नस्ल सुधार की पहल, सी.आई.आर.बी. द्वारा विज्ञान के माध्यम से पशुधन कृषक समुदायों की सेवा किये जाने के सबसे बोधगम्य उदाहरण हैं। संस्थान द्वारा संचालित क्षमता निर्माण कार्यक्रमों में विभिन्न राज्यों, विभिन्न शिक्षा और उद्यमशीलता स्तरों के किसानों ने विश्वास को दोहराया है।

मैं इस अवसर पर डॉ. त्रिलोचन महापात्र, सचिव कृषि अनुसंधान और शिक्षा विभाग, महानिदेशक भारतीय कृषि अनुसन्धान परिषद् व डॉ. बी एन त्रिपाठी, उप-महानिदेशक (पशु विज्ञान) का उनके द्वारा दिए गए पुनः आश्वासन, संरक्षण, प्रोत्साहन और मार्गदर्शन हेतु संस्थान की ओर से आभार व्यक्त करता हूँ। मैं सी.आई.आर.बी. की पूरी टीम को उनके समर्थन एवं सहयोग द्वारा एक और सफल वर्ष पूरा करने हेतु अपना पूर्ण आभार व्यक्त करता हूँ।

**सतबीर सिंह दहिया**
**निदेशक**

# Contents



# Executive Summary 2019

Buffaloes in India are primary dairy animal providing food security to vast vegetarian human population and economic security to the farmers, especially the women, marginal and landless category. During 2019 (April to December), the Central Institute for Research on Buffaloes had numerous achievements to prove its worth as an above class research establishment.

## Staff Position

| Category | Sanctioned Strength | Filled | Vacant |
|---|---|---|---|
| Scientist | 44 | 30 | 14 |
| Technical | 42 | 28 | 14 |
| Administrative | 19 | 16 | 03 |
| Skilled Supporting | 65 | 63 | 02 |

## Buffalo production improvements

| Criteria | Status | |
|---|---|---|
| | Murrah breed at main Campus Hisar | Nili Ravi breed at Sub- Campus Nabha |
| Total number of animals (as on 31.12.2019) | 529 | 511 |
| Age at First Calving (Months) | 44.00 | 41.61 |
| Mortality (%) | 3.45 | 2.69 |
| **Dairy buffaloes herd performance** | | |
| • Overall annual wet average (Kg) | 9.53 | 9.09 |
| • Overall total lactation milk yield (Kg) | 2673 | 2670 |
| • Overall SLMY (Kg) | 2607 | 2589 |
| • Service Period (days) | 149 | 160 |
| • Calving Interval (days) | 456 | 469 |
| • Conception rate (%) | 45.54 | 46.52 |
| **Male germplasm** | | |
| • Progeny tested bulls produced | 33 (1-13th set) * | 8 (1- 4th set)** |
| • Semen doses produced | 10,72,895* | 176180** |
| • Frozen semen supplied | 11,35,692* | 125997** |
| • Revenue generation (Rs. in Lakhs) | 182.28* | 18.81** |
| • Bulls disseminated in field | 441* | 56** |

*last ten years ** last nine years

## Agriculture farm production

| Fodder | Main Campus Hisar | Sub Campus Nabha |
|---|---|---|
| Dry (Quintals) | 820.25 | 2590.00 |
| Green (Quintals) | 26036.25 | 38772.50 |
| Grains (Quintals) | 1323.2 | 5393.90 |

## Revenue receipts (all values in Indian Rs.)

| Major/Minor/Detailed Head of Accounts | | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| **Sale of Farm Produce** | | | | | | | | |
| (i) | Sale of Milk | 19837011 | 24844089 | 21730861 | 26162116.88 | 27721409.65 | 33620226 | 153915714 |
| (ii) | Sale of Wheat Busa/ Mustard Bhusa/Green Fodder | 1470988 | 189775 | 12000 | 1781231 | 126430 | 505225 | 4085649 |
| (iii) | Sale of grain/wheat/paddy | 2479538 | 4181305 | 3377626 | 2561279 | 5500382 | 483343 | 18583473 |
| (iv) | Sale of Semen | 1772124 | 1218013 | 1956478 | 2130286 | 2846201 | 2753609 | 12676711 |
| (v) | Sale of Mineral Mixture | 45198 | 187642 | 560290 | 486825 | 125800 | 76800 | 1482555 |
| (vi) | Sale proceed of dry trees | 2050000 | 1180000 | 960000 | 600306 | 175000 | 0 | 4965306 |
| (vii) | Sale of Books | 14857 | 5925 | 29203 | 0 | 5800 | 65550 | 121335 |
| (viii) | Sale of Technology/Royalty | 0 | 25000 | 200000 | 0 | 0 | 75725 | 300725 |
| **Sale proceeds of** | | | | | | | | |
| (i) | Land & Building | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (ii) | Machine Tools & Plants Equipments/Vehicle etc. | 0 | 0 | 0 | 129000 | 0 | | 129000 |
| (iii) | Sale proceeds of Livestock. | 3919491 | 6747800 | 5349700 | 9109238 | 5959026 | 8412500 | 39497755 |
| (iv) | Rents (licence fee) | 357149 | 336715 | 353023 | 398091 | 467965 | 470209 | 2383152 |
| (v) | Application fees from Candidates Tuition Fees, diploma Charges etc. | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (vi) | Application fees from Candidates in connection with recruitment | 7500 | 97500 | 53250 | 25500 | 750 | | 184500 |
| (vii) | Receipts from Scheme | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (viii) | Receipts from Service rendered by Instt./receipt from students | 264800 | 370900 | 360400 | 371520 | 343700 | 296900 | 2008220 |
| **Misc Receipt** | | | | | | | | |
| (i) | Sale of Tender form | 197000 | 292000 | 337100 | 291500 | 169000 | 79000 | 1365600 |
| (ii) | Guest house charges | 205995 | 234510 | 261700 | 210024.53 | 262467.8 | 377280 | 1551977 |
| **Total** | | **32621651** | **39911174** | **35541631** | **44256917** | **43703931** | **47216367** | **243251672** |

## Salient Achievements

- At present, the Institute has sixty six buffaloes yielding more than 3000 kg, while five buffaloes are yielding 4000 kg milk (all on standard 305 days lacation). Highest peak yield recorded during 2019 is 23.9 kg/day.
- The Institute has successfully produced eight clones of superior bulls. All calves were born normal, healthy and performing at par calves born through artificial insemination in the animal farm.
- Prototype of urinary metabolite based pregnancy detection kit has been developed under the multicentric DBT funded project 'Development of early pregnancy diagnostic assay through discovery of biomarkers in cattle and buffalo'.
- Noteworthy progress has been made in stratergizing nutritional and physiological interventions for enhancing reproductive performance of buffaloes. Study conducted in field on 255 buffaloes in which CIDR with PMSG protocols was found most effective in successful pregnancies (64% pregnancy rate) under field conditions.
- Reduced sperm dose per straw from 20 million to 6 million had no significant difference in conception rate.
- During April-December 2019, a total of 3904 AI were performed under field progeny testing (FPT) programme. During this period, 2225 pregnancis were confirmed with a conception rate of 53.90%. A total of 1754 calvings (953 male ; 801 female) were recorded.

- As an alternate approach, a proof -of-concept dip-stick and lateral flow immunoassay (LFIA) has also been developed for progesterone based pregnancy diagnosis.
- The institute has initated IR Themographic research for developing novel, non-invasive and cost-effective applications in livestock patho-physiology, welfare and management.
- The institute has been advancing research for production of myostatin gene-edited buffalo bulls using CRISPR/Cas system. Three gRNAs were cloned into two CRISPR expression cassettes (PX-458 and PX-459). The correct sequence and ligation were confirmed by restriction enzyme analysis and Sanger sequencing. The transfection conditions (different current settings of electroporation, size of cuvettes, etc) were optimized to transfect the maximum of cells.
- The dietary composite feed additive prepared and patent filed by the institute for effectively mitigates enteric methane in wexhaled air (decrease of 44.6%), significantly improves nutrient utilization, milk production and immune status in Murrah buffaloes.
- The feeding value of brown midrib (*bmr*) sorghum cultivar, SPV-2018, developed by IIMR, Hyderabad and evaluated at CIRB, is higher in increasing nutrient utilization and milk production in buffaloes.
- Feeding trial was carried out to evaluate the supplementation of galactogogue herbal mixture (GHM), selected based on its proximate analysis, phenolic content and anti-oxidant properties. Supplementation of GHM showed significant effect on production performance of lactating buffaloes.
- The institute has developed three mobile apps *viz. Bhains janan , Bhains Poshahar* and *Buffhealth* for online knowledge dissemination for improved buffalo reproduction and production. These internet accessible tools are in addtion to the *E-Bhains* and *Buffalopedia* platforms.
- The Institute trained 413 famers in scientific buffalo husbandry and related activities by the Transfer of Technology and Entrepreneurship (TOTE) unit during April-December 2019. Among these, 70 farmers were trained under the SCSP program during this period.
- During the period April 1- December 31$^{st}$, 2019 the institute participated in six national exhibitions/kisan melas and other such platforms for highlighting ICAR's and CIRB's roles and demonstrated technologies to the farmers.
- The institute has provided 2650 doses of Murrah frozen straws and four bulls for natural service semen in the adopted villages under Tribal Sub-plan (TSP) during August 2015 – December 2019. Calves born out of insemination from this elite germplasm are now visible with the farmers. These calves have good acceptance among the farmers and are the most sought-after dairy animals in these villages. The farmers look at these animals as good milk yielder with early age of conception.
- The Animal Nutrition and Feed Technology (ANFT) division has achieved good success in the area of chelated mineral mixture including the key minerals Copper, Mangnese and Zinc. Earlier, the division has successfully developed and disseminated area specific mineral mixtures for adopted villages in the tribal areas of Udaipur and Haryana.
- The Farmers' FIRST program was successful in propagating diversified crop-livestock mixed farming through participation of 434 farmers, of which majority were women. Along with 'One health' goal, nutri-farm and unleashing entrepreneurship capabilities remained the focus of this program.
- A convergence model developed for mastitis prevention using a synergestic approach. The model is being testsed in one of the adopted villages.

# कार्यकारी सारांश 2019

भारत में भैंसें प्राथमिक डेयरी पशु हैं जो विशाल शाकाहारी मानव आबादी विशेष रूप से महिलाओं, सीमांत और भूमिहीन श्रेणी के लोगों को खाद्य सुरक्षा और आर्थिक सुरक्षा प्रदान करते हैं। वर्ष 2019 के दौरान, केंद्रीय भैंस अनुसंधान संस्थान द्वारा अपनी योग्यता साबित करने के साथ ही उच्च स्तरीय अनुसंधान स्थापित कर कई उपलब्धियां प्राप्त की गयी।

## स्टाफ की स्थिति

| श्रेणी | स्वीकृत | कार्यरत | रिक्त |
|---|---|---|---|
| वैज्ञानिक | 44 | 30 | 14 |
| तकनीकी | 42 | 28 | 14 |
| प्रशासनिक | 19 | 16 | 03 |
| कुल सहायक कर्मचारी | 65 | 63 | 02 |

## भैंस के उत्पादन में विकास

| मानदंड | स्थिति | |
|---|---|---|
| | मुर्रा नस्ल, मुख्य परिसर हिसार | नीली-रावि नस्ल, उप परिसर नाभा |
| पशुओं की कुल संख्या (31.12.2019 को) | 529 | 511 |
| प्रथम ब्यांत उम्र | 44.00 महीने | 41.61 महीने |
| मृत्यु दर (%) | 3.45% | 2.69% |
| **डेयरी भैंसों का प्रदर्शन** | | |
| ★ कुल मिलाकर वार्षिक औसत | 9.53 किग्रा | 9.09 किग्रा |
| ★ कुल मिलाकर दुग्ध उपज | 2673 किग्रा | 2670 किग्रा |
| ★ कुल मिलाकर एसएलएमवाई | 2607 किग्रा | 2589 किग्रा |
| ★ सर्विस अवधि | 149 दिन | 160 दिन |
| ★ ब्यांत अंतराल | 456 दिन | 469 दिन |
| ★ गर्भाधान की दर | 45.54% | 46.52% |
| **नर जर्मप्लास्म** | | |
| ★ प्रोजेनी टेस्टेड सांडों का उत्पादन | 33 (1-13$^{th}$ set)* | 8 (1-4$^{th}$ set)* |
| ★ हिमीकृत वीर्य टीके उत्पादित | 10,72,895* | 1,76,180** |
| ★ हिमीकृत वीर्य आपूर्ति | 11,35,692* | 1,25,997** |
| ★ राजस्व उत्पत्ति (रुपये, लाख में) | 182.28* | 18.81** |
| ★ क्षेत्र में बैल प्रसार | 441* | 56** |

* पिछले दस साल ** पिछले 9 साल

## कृषि फार्म उत्पादन

| चारा | हिसार, मुख्य परिसर | नाभा, उप परिसर |
|---|---|---|
| गेहूं का भूसा | 820.25 क्विंटल | 2590.00 क्विंटल |
| हरा | 26036.25 क्विंटल | 38772.50 क्विंटल |
| अनाज | 1323.2 क्विंटल | 5393.90 क्विंटल |

## राजस्व प्राप्ति (भारतीय रूपये में सभी आंकड़े)

| प्रमुख/लघु/खातों का विस्तृत विवरण | | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| **फार्म उत्पादों की बिक्री** | | | | | | | | |
| (i) | दूध की बिक्री | 19837011 | 24844089 | 21730861 | 26162116.88 | 27721409.65 | 33620226 | 153915714 |
| (ii) | गेहूं भूसा/सरसों भूसा/ हरा चारा की बिक्री | 1470988 | 189775 | 12000 | 1781231 | 126430 | 505225 | 4085649 |
| (iii) | अनाज/गेहूं/धान की बिक्री | 2479538 | 4181305 | 3377626 | 2561279 | 5500382 | 483343 | 18583473 |
| (iv) | वीर्य की बिक्री | 1772124 | 1218013 | 1956478 | 2130286 | 2846201 | 2753609 | 12676711 |
| (v) | खनिज मिश्रण की बिक्री | 45198 | 187642 | 560290 | 486825 | 125800 | 76800 | 1482555 |
| (vi) | सूखे पेड़ों की बिक्री प्रक्रिया | 2050000 | 1180000 | 960000 | 600306 | 175000 | 0 | 4965306 |
| (vii) | पुस्तकों की बिक्री | 14857 | 5925 | 29203 | 0 | 5800 | 65550 | 121335 |
| (viii) | प्रौद्योगिकी/रॉयल्टी की बिक्री | 0 | 25000 | 200000 | 0 | 0 | 75725 | 300725 |
| **बिक्री आय** | | | | | | | | |
| (i) | भूमि और भवन | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (ii) | मशीन टूल्स और प्लांट उपकरण/वाहन आदि | 0 | 0 | 0 | 129000 | 0 | | 129000 |
| (iii) | पशुधन की बिक्री आय | 3919491 | 6747800 | 5349700 | 9109238 | 5959026 | 8412500 | 39497755 |
| (iv) | किराए (लाइसेंस शुल्क) | 357149 | 336715 | 353023 | 398091 | 467965 | 470209 | 2383152 |
| (v) | अभ्यर्थी ट्यूशन फीस, डिप्लोमा शुल्क आदि से आवेदन शुल्क | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (vi) | भर्ती के संबंध में उम्मीदवारों से आवेदन शुल्क | 7500 | 97500 | 53250 | 25500 | 750 | | 184500 |
| (vii) | योजना से प्राप्तियां | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (viii) | संस्थान द्वारा प्रदान की गई सेवा से प्राप्त रसीदें/छात्रों से रसीद | 264800 | 370900 | 360400 | 371520 | 343700 | 296900 | 2008220 |
| **विविध प्राप्ति** | | | | | | | | |
| (i) | निविदा प्रपत्र की बिक्री | 197000 | 292000 | 337100 | 291500 | 169000 | 79000 | 1365600 |
| (ii) | अतिथि गृह शुल्क | 205995 | 234510 | 261700 | 210024.53 | 262467.8 | 377280 | 1551977 |
| **कुल** | | **32621651** | **39911174** | **35541631** | **44256917** | **43703931** | **47216367** | **243251672** |

- ★ संस्थान आठ क्लोन किए गए सांडों का उत्पादन करने में सफल रहा, जो कि संतति परीक्षित कुलीन सांडों की प्रतियाँ थी। सभी बछड़े जन्म के समय सामान्य, स्वस्थ एवं पशु फार्म में जन्मे अन्य बछड़ो की तरह ही प्रदर्शन करने वाले थे।
- ★ पोषण और शारीरिक-क्रियात्मक तरीकों की रणनीति से भैंस के प्रजनन प्रदर्शन को बढ़ाने में उल्लेखनीय प्रगति हुई है। फील्ड में 255 भैंसों पर किए गए अध्ययन में पाया गया कि फील्ड की परिस्थिति के अनुसार सी आई डी आर के साथ पी एम एस जी प्रोटोकॉल सफल गर्भधारण (64% गर्भावस्था दर) में सबसे प्रभावी है।
- ★ डीबीटी (DBT) परियोजना 'मवेशियों और भैंसों में बायोमार्कर की खोज के माध्यम से प्रारंभिक गर्भावस्था मूल्यांकन एस्से का विकास' के अंतर्गत मूत्र-मेटाबोलाइट आधारित गर्भावस्था जांच किट का प्रोटोटाइप विकसित किया गया।
- ★ एक वैकल्पिक दृष्टिकोण के रूप में, प्रोजेस्टेरोन-आधारित गर्भावस्था मूल्यांकन के लिए प्रूफ-ऑफ-कॉन्सेप्ट डिप-स्टिक और लेटरल फ्लो इम्यूनोएसे (LFIA) भी विकसित किये गये हैं।
- ★ संस्थान ने पशुधन रोग, शारीरिक क्रिया-विज्ञान और प्रबंधन हेतु एक नवीन, गैर-आक्रामक और लागत-प्रभावी अनुप्रयोगों के विकास के लिए आईआर थर्मोग्राफिक अनुसंधान शुरू किया है।
- ★ संस्थान CRISPR / Cas प्रणाली का उपयोग करके मायोस्टैटिन जीन-संपादित भैंस के बैल उत्पादन के लिए अनुसंधान को

आगे बढ़ा रहा है। तीन gRNAs को दो CRISPR एक्सप्रेशन कैसेट (PX-458 और PX-459) में क्लोन किया गया। प्रतिबंध एंजाइम विश्लेषण और सेंगर अनुक्रमण द्वारा सही अनुक्रम और बंधाव की पुष्टि की गई। अभिकर्मक की अवस्था (जैसे विद्युतीकरण की विभिन्न धाराओ की स्थापना, क्यूवेट का आकार आदि) को अधिकतम कोशिकाओं को संक्रमित करने के लिए अनुकूलित किया गया।

- ★ संस्थान द्वारा तैयार और पेटेंट किए गए आहार मिश्रित फीड, प्रभावी रूप से एंटरिक मीथेन (44.6% की कमी) को कम करता है, जिससे मुर्राह भैंसों में पोषक तत्वों के उपयोग, दूध उत्पादन और प्रतिरक्षा स्थिति में काफी सुधार होता है।
- ★ आईआईएमआर द्वारा विकसित और इस संस्थान द्वारा मूल्यांकित ब्राउन मिडरिब (बीएमआर) सोरघम कल्टीवर, एसपीवी-2018 की फीडिंग वैल्यू भैंस में पोषक तत्वों के उपयोग और दूध उत्पादन को बढ़ाने में अधिक पाई गयी है।
- ★ संस्थान में तैयार एक गैलेक्टागॉग हर्बल मिश्रण (जीएचएम) का दुधारू भैंसों के उत्पादन प्रदर्शन पर महत्वपूर्ण प्रभाव पड़ता है।
- ★ जीएचएम के पूरकता का मूल्यांकन करने के लिए फीडिंग ट्रायल किया गया, जिसे अनुमानित विश्लेषण, फेनोलिक सामग्री और एंटी-ऑक्सीडेंट गुणों के आधार पर चुना गया।
- ★ संस्थान ने ऑनलाइन ज्ञान प्रसार द्वारा बेहतर भैंस उत्पादन के लिए तीन वेब और मोबाइल ऐप क्रमशः भैंस प्रागंण, पशु आहार और बफहेल्थ विकसित किए हैं। ये इंटरनेट सुलभ उपकरण ई-भैंस और बफेलोपीडिया प्लेटफार्मों के अतिरिक्त हैं।
- ★ संस्थान ने अप्रैल-दिसंबर 2019 के दौरान प्रौद्योगिकी का हस्तांतरण एवम उद्यमिता (टीओटीई) इकाई द्वारा वैज्ञानिक भैंस पालन और संबंधित गतिविधियों में 413 किसानो को प्रशिक्षित किया। इनमें से 70 किसानों को इस अवधि के दौरान एससीएसपी कार्यक्रम के तहत प्रशिक्षित किये गया।
- ★ 1 अप्रैल से 31 दिसंबर, 2019 की अवधि के दौरान संस्थान ने आईसीएआर और सीआईआरबी की भूमिकाओं को उजागर करने के लिए छह राष्ट्रीय प्रदर्शनियों/ किसान मेलों और अन्य ऐसे प्लेटफार्मों में भाग लिया और किसानों के समक्ष प्रौद्योगिकियों का प्रदर्शन किया।
- ★ संस्थान ने अगस्त 2015 से दिसंबर 2019 के दौरान आदिवासी उप-योजना (टीएसपी) के तहत गोद लिए गए गांवों में मुर्राह की 2650 जमी हुई वीर्य स्ट्रॉ एवं प्राकृतिक सेवा के लिए चार बैल प्रदान किये। इस कुलीन जर्मप्लाज्म द्वारा गर्भाधान किये जाने से पैदा हुए बछड़े अब किसानो के साथ दिखाई दे रहे हैं। इन बछड़ों की ग्रामीणों के बीच अच्छी स्वीकृति है और इन गांवों में सबसे अधिक मांग वाले डेयरी जानवर हैं। ग्रामीण इन जानवरों को शुरुआती उम्र में गर्भाधान करने के साथ ही अधिक दुग्ध उत्पादक पशु के रूप में देखते हैं।
- ★ पशु पोषण और खाद्य प्रौद्योगिकी (ANFT) विभाग ने प्रमुख खनिज जैसे तांबा, मैंगनीज और जस्ता सहित चीलेटड खनिज मिश्रण के क्षेत्र में अच्छी सफलता हासिल की है। इससे पहले, विभाग ने उदयपुर और हरियाणा के आदिवासी क्षेत्रों में गोद लिए गए गांवों के लिए क्षेत्र विशेष खनिज मिश्रण का सफलतापूर्वक विकास और प्रसार किया है।
- ★ किसानों का फार्मर्स फर्स्ट कार्यक्रम 434 किसानों की भागीदारी के साथ विविध फसल-पशुधन मिश्रित खेती का प्रचार करने में सफल रहा, जिनमें से अधिकांश महिलाएं थीं। 'एक स्वास्थ्य' लक्ष्य के साथ, पोषक तत्व-क्षेत्र और उन्मुक्त-उद्यमिता क्षमताएं इस कार्यक्रम का केंद्र बिंदु रहीं।
- ★ एक सहक्रियात्मक दृष्टिकोण का उपयोग करके थनेला रोग की रोकथाम के लिए एक अभिसरण मॉडल विकसित किया गया। इस मॉडल का गोद लिए गए गांवों में से एक गांव में परीक्षण किया जा रहा है।

# Introduction

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

**Main building Hisar**

**Main building Nabha**

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

## Mandate

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

## The Vision

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

## The Mission

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

## The Focus Areas

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

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

## Divisions

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

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

II. **Division of Animal Nutrition and Feed 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 agro-industrial by-products. Feed and Forage Quality Control and Processing, Rumen Biome, Protein Nutrition, Toxicology and Mineral Nutrition laboratories are well-equipped and functional. Major studies include working out nutrient requirements of different categories of buffaloes for milk, meat and growth, with evaluation of different feed and fodder ingredient available in different regions.

III. **Division of Animal Physiology and Reproduction :** Facilities have been developed in the division for undertaking studies on semen technology, embryo biotechnology including 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, flow cytometry, fluorescent

microscope, DIC and Phase contrast microscopes, biofreezer for cryopreservation of Murrah semen. Frozen semen is provided to the developmental agencies, farmers and inseminators engaged in buffalo improvement program. The lab has current stock of more than four lakh doses of frozen semen from nearly 250 Murrah breeding bulls out of which more than sixty four thousand doses are from progeny tested bulls. Frozen semen doses are also prepared from farmers' champion/ superior bulls, which are available for introduction in organized herds and farmers' animals. Frozen semen production has significantly improved during recent years

## 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 adult buffaloes attached with covered calf pens together with open paddocks for loose housing. At Hisar, a mechanized and automated shed for buffalo feeding, cleaning, milking and data recording system has been created, which is being equipped with necessary facilities for automated slurry management and milking. It will have provision for housing of 200 buffaloes, 25 heifers and 10 down calvers besides 25 individual pens for young calves. Sub-Campus, Nabha is equipped with 12 unit cluster automatic milking machine for clean and hygienic milk production. The production performance viz. wet average and 305 days or less milk yield of Murrah herd has improved from 4.80 kg/day and 1508 kg during 1992-93 to 9.53 kg/day and 2607 kg in 2019. The reproductive performance of the herd also improved as reflected by decline in calving interval (from 502 to 456 days) and age at first calving (50.7 to 44 months).

### Elite Buffaloes at CIRB

| Buffalo No. | D.O.B. | Highest 305d or less MY (kg) /lactation no. | Highest Peak Yield (kg) | Sire No. | Set No. |
|---|---|---|---|---|---|
| 4316 | 31/03/11 | 4765/4 | 23.9 | R-11(Field) | 12 |
| 4817 | 12/10/14 | 4250/2 | 20.8 | 4100(CIRB) | 14 |
| 4605ET | 08/08/13 | 4168/2 | 19.0 | 2269 PT(GADVASU) | 13 |
| 4251 | 29/10/10 | 4138/3 | 22.0 | 2133 PT(GADVASU) | 11 |
| 4545 | 30/01/13 | 4069/3 | 20.0 | 4813 PT(NDRI) | 8 |
| 4462 | 03/06/12 | 4045/2 | 23.4 | R-10(Field) | 12 |
| 4978 | 25/10/15 | 3874/1 | 15.8 | 1693 PT(LUVAS) | 10 |
| 4899 | 01/05/15 | 3505/1 | 15.8 | 6044 PT(NDRI) | 14 |
| 4909 | 04/07/15 | 3449/1 | 20.3 | 4354(CIRB) | 15 |

Similarly, the production performance of Nili-Ravi herd at Sub-Campus, Nabha has improved significantly - wet average (5.86 kg/day in 1992-93 to 9.09 kg/day in year 2019) and 305 days or less milk yield (1921 kg during 1992-93 to 2581 kg in 2019). During the same period, age at first calving declined from 47.3 months during 1992-93 to 41.60 months in 2019.

## ICAR-CIRB Buffalo Herd status (1st April – 31st December 2019)

| S. No. | Category | Addition | | | | | | Disposal | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | NR |
| | | OB | OB | B | B | T | T | P | P | D | D | T | T | S | S | CB |
| **Female** | | | | | | | | | | | | | | | | |
| 01. | Female Calves below 3 months | 16 | 14 | 86 | 62 | - | - | - | - | 05 | 03 | 80 | 57 | 01 | - | 16 |
| 02. | Female Calves 3-12 months | 36 | 44 | - | - | 80 | 106 | - | - | - | - | 116 | 93 | - | - | 57 |
| 03. | Heifers | | | | | | | | | | | | | | | |
| | a) 1-2 years | 63 | 55 | - | - | 51 | 44 | - | - | - | - | 114 | 35 | - | - | 64 |
| | b) Above 2.0 years | 118 | 95 | - | - | 61 | 111 | - | - | 01 | - | 179 | 112 | 09 | 09 | 85 |
| 04. | Buffaloes in Milk | 112 | 106 | - | - | 73 | 124 | - | 03 | 02 | 03 | 163 | 83 | 18 | 24 | 123 |
| 05. | Buffaloes Dry | 45 | 61 | - | - | 30 | 83 | - | - | | - | 75 | 88 | 15 | 25 | 31 |
| | Sub Total | 390 | 375 | 86 | 62 | 295 | 468 | - | 03 | 08 | 06 | 727 | 468 | 43 | 58 | 376 |
| **Male** | | | | | | | | | | | | | | | | |
| 01. | Male Calves below 3 months | 24 | 10 | 78 | 62 | - | - | - | - | 08 | 04 | 77 | 45 | 01 | - | 23 |
| 02. | Male Calves 3-12 months | 29 | 53 | - | - | 77 | 75 | - | - | 01 | 02 | 102 | 74 | 03 | 10 | 42 |
| 03. | Male | | | | | | | | | | | | | | | |
| | 1) 1-2 years | 54 | 44 | - | - | 48 | 44 | - | - | - | 01 | 62 | 23 | 40 | 24 | 40 |
| | 2) > 2 years | 12 | 26 | - | - | 31 | 28 | - | - | 01 | 02 | 43 | 05 | 33 | 26 | 21 |
| 04. | Breeding bulls | 13 | 08 | - | - | 09 | - | - | - | - | - | 18 | - | 04 | - | 08 |
| 05. | Bullocks | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 06. | Teasers | - | 01 | - | - | - | - | - | - | 01 | - | - | - | - | - | 01 |
| | Sub Total | 132 | 142 | 78 | 62 | 165 | 147 | - | - | 11 | 09 | 302 | 147 | 81 | 60 | |
| | **Grand Total** | **522** | **517** | **164** | **124** | **460** | **615** | **-** | **03** | **19** | **15** | **1029** | **615** | **124** | **118** | **511** |

**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 P = Purchased

## ICAR-CIRB Calving statistics (1st April – 31st December 2019)

| Month | Male (number) | | Female (number) | | Abortions & Still Birth(number) | | Overall (number) | |
|---|---|---|---|---|---|---|---|---|
| | M | NR | M | NR | M | NR | M | NR |
| April | 5 | 02 | 2 | 11 | - | - | 7 | 13 |
| May | 3 | 03 | 1 | 03 | - | - | 4 | 06 |
| June | 2 | 02 | 1 | 04 | -- | - | 3 | 06 |
| July | 6 | 05 | 9 | 08 | 2 | - | 17 | 13 |
| August | 11 | 18 | 15 | 08 | - | 02 | 26 | 26 |
| September | 17 | 07 | 17 | 10 | - | - | 34 | 17 |
| October | 9 | 08 | 11 | 08 | - | — | 20 | 16 |
| November | 9 | 08 | 12 | 06 | - | - | 21 | 14 |
| December | — | 09 | 3 | 04 | 1 | - | 4 | 13 |

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

**Sex ratio Murrah** (Male: Female) = 47:53 **Sex ratio Nili Ravi** (Male: Female) = 50:50

## ICAR-CIRB Disposal of animals (1st April – 31st December 2019)

| Category | Surplus sold | | Udder Health | | Repd. problem | | Weak & old | | Death | | Expt. purpose | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR |
| **Female** < 6 months | 01 | - | - | - | - | - | - | - | 05 | 03 | - | - | 06 | 03 |
| 6-12 months | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Heifers** 1-2.5 yrs | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| > 2.5 yrs | - | - | - | - | 07 | 09 | 02 | - | 01 | - | - | - | 10 | 09 |
| Buffaloes Dry/ Milch | 11 | 33 | 09 | 13 | 08 | 03 | 05 | - | 02 | 03 | 01 | - | 36 | 52 |
| Sub Total | 12 | 33 | 09 | 13 | 15 | 12 | 07 | - | 08 | 06 | 01 | - | 52 | 64 |
| **Male** < 6 months | 01 | - | - | - | - | - | - | - | 08 | 05 | - | - | 09 | 05 |
| 6-12 months | 03 | 10 | - | - | - | - | - | - | 01 | 01 | - | - | 04 | 11 |
| >1 yr | 73 | 50 | - | - | - | - | - | - | 01 | 03 | - | - | 74 | 53 |
| Breeding bulls | 04 | - | - | - | - | - | - | - | - | - | - | - | | - |
| Bullock + Teaser | | - | - | - | - | - | - | - | 01 | - | - | - | 01 | - |
| Sub total | 81 | 60 | - | | - | - | - | - | 11 | 09 | - | - | 92 | 69 |
| **G. Total** | **93** | **93** | **09** | **13** | **15** | **12** | **07** | **-** | **19** | **15** | **01** | **-** | **144** | **133** |

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

## ICAR-CIRB Month wise mortality (1st April – 31st December 2019)

| Month | Details | 0-3 (female) | | 3-6 | | 6-12 | | >1yr | | >2yrs | | All | | 0-3 (male) | | 3-6 | | 6-12 | | >1yr | | >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 | No | 16 | 18 | 12 | 17 | 25 | 27 | 63 | 60 | 274 | 234 | - | 356 | 24 | 08 | 08 | 11 | 21 | 27 | 80 | 37 | - | 33 | 133 | 116 | 512 | 472 |
| | Died | - | - | - | - | - | - | - | - | - | 01 | 389 | 01 | 01 | - | - | - | - | - | - | - | - | - | 01 | - | 01 | 01 |
| | % | - | - | - | - | - | - | - | - | - | 0.43 | | 0.28 | 4.17 | - | - | - | - | - | - | - | - | - | 0.75 | - | 0.12 | 0.21 |
| May | No | 14 | 20 | 13 | 15 | 25 | 16 | 64 | 63 | 275 | 235 | | 359 | 23 | 09 | 12 | 09 | 22 | 30 | 80 | 38 | - | 33 | 137 | 119 | 528 | 478 |
| | Died | - | - | - | - | - | - | - | - | - | - | 391 | - | - | - | - | - | - | - | 01 | - | - | - | 01 | - | 01 | - |
| | % | - | - | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | 1.25 | - | - | - | 0.73 | - | 0.19 | - |
| Jun | No | 10 | 18 | 14 | 14 | 26 | 32 | 65 | 62 | 276 | 237 | | 363 | 17 | 07 | 16 | 10 | 28 | 28 | 79 | 41 | - | 35 | 140 | 121 | 531 | 484 |
| | Died | - | - | - | - | - | - | - | - | - | - | 391 | - | 01 | - | - | - | - | - | - | - | - | - | 01 | - | 01 | - |
| | % | - | - | - | - | - | - | - | - | - | - | | - | 5.89 | - | - | - | - | - | - | - | - | - | 0.71 | - | 0.19 | - |
| Jul | No | 10 | 14 | 14 | 18 | 26 | 36 | 65 | 63 | 278 | 233 | 393 | 364 | 17 | 10 | 16 | 08 | 28 | 29 | 78 | 34 | - | 24 | 139 | 105 | 432 | 469 |
| | Died | - | 01 | - | - | - | - | 01 | - | - | - | 01 | 01 | - | - | - | - | - | - | - | - | - | - | - | - | 01 | 01 |
| | % | - | 7.14 | - | - | - | - | 1.54 | - | - | - | 0.25 | 0.27 | - | - | - | - | - | - | - | - | - | - | - | - | 0.23 | 0.21 |
| Aug | No | 11 | 19 | 19 | 20 | 26 | 34 | 62 | 59 | 279 | 240 | | 372 | 11 | 25 | 22 | 09 | 22 | 26 | 73 | 36 | - | 25 | 128 | 121 | 520 | 493 |
| | Died | - | - | - | - | - | - | - | - | - | - | 392 | - | 01 | - | - | - | - | - | - | - | - | 02 | 01 | - | 01 | 02 |
| | % | - | - | - | - | - | - | - | - | - | - | | - | 9.10 | - | - | - | - | - | - | - | - | 8.00 | 0.78 | - | 0.19 | 0.41 |
| Sep | No | 25 | 25 | 10 | 18 | 23 | 31 | 61 | 61 | 288 | 247 | 407 | 382 | 18 | 30 | 16 | 07 | 25 | 23 | 55 | 42 | - | 26 | 104 | 128 | 511 | 510 |
| | Died | 01 | - | - | - | - | - | - | - | - | - | 01 | - | 04 | - | - | - | - | - | - | - | - | - | 04 | - | 05 | - |
| | % | 4.00 | - | - | - | - | - | - | - | - | - | 0.25 | - | 22.22 | - | - | - | - | - | - | - | - | - | 3.85 | - | 0.98 | - |
| Oct | No | 39 | 26 | 04 | 14 | 28 | 35 | 56 | 60 | 295 | 255 | 420 | 390 | 31 | 32 | 10 | 10 | 30 | 19 | 46 | 46 | - | 28 | 117 | 135 | 537 | 525 |
| | Died | 02 | - | - | - | - | - | - | - | 01 | - | 03 | - | - | 01 | - | - | 01 | - | - | - | - | - | 01 | - | 04 | 01 |
| | % | 5.13 | - | - | - | - | - | - | - | - | - | 0.71 | - | - | 3.13 | - | - | 3.33 | - | - | - | - | - | 0.85 | - | 0.74 | 0.19 |
| Nov | No | 40 | 23 | 11 | 19 | 27 | 35 | 56 | 59 | 293 | 235 | 429 | 371 | 35 | 21 | 09 | 24 | 33 | 17 | 47 | 40 | - | 27 | 124 | 129 | 533 | 500 |
| | Died | 01 | 01 | - | - | - | - | - | - | 01 | 01 | 02 | 02 | 01 | 02 | - | - | - | - | - | 01 | - | - | 01 | - | 03 | 05 |
| | % | 2.50 | 4.35 | - | - | - | - | - | - | 0.34 | 0.43 | 0.47 | 0.54 | 2.86 | 9.52 | - | - | - | - | - | 2.5 | - | - | 0.81 | - | 0.56 | 1.00 |
| Dec | No | 35 | 16 | 23 | 25 | 23 | 32 | 46 | 64 | 233 | 239 | 413 | 376 | 34 | 23 | 14 | 27 | 38 | 15 | 21 | 40 | - | 30 | 113 | 135 | 526 | 511 |
| | Died | 01 | 01 | - | - | - | - | - | - | - | 01 | 01 | 02 | - | 01 | - | 01 | - | 01 | - | - | - | - | - | 03 | 01 | 05 |
| | % | 2.86 | 6.25 | - | - | - | - | - | - | - | 0.42 | 0.24 | 0.53 | - | 4.35 | - | 3.70 | - | 6.67 | - | - | - | - | - | 2.22 | 0.19 | 0.98 |

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

## ICAR-CIRB Buffalo conception rate (1st April – 31st December 2019)

| Parity | I | | | | | | II | | | | | | III | | | | | | IV | | | | | | Overall | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Criteria | I | | C | | CR | | I | | C | | CR | | I | | C | | CR | | I | | C | | CR | | I | | C | | CR | |
| Breed | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR |
| Heifers | 160 | 44 | 74 | 21 | 46.25 | 47.73 | 79 | 26 | 35 | 16 | 44.30 | 61.54 | 30 | 10 | 13 | 03 | 43.33 | 30.00 | 35 | 27 | 16 | 05 | 45.71 | 18.52 | 304 | 107 | 142 | 45 | 46.71 | 42.06 |
| Adult | 55 | 136 | 28 | 70 | 50.91 | 51.47 | 34 | 70 | 17 | 38 | 50.00 | 54.29 | 13 | 26 | 06 | 14 | 46.15 | 53.85 | 20 | 37 | 05 | 07 | 25.00 | 20.00 | 112 | 267 | 52 | 129 | 42.62 | 48.31 |
| Overall | 215 | 180 | 102 | 91 | 47.44 | 50.56 | 113 | 96 | 52 | 54 | 46.02 | 56.25 | 43 | 36 | 19 | 17 | 44.19 | 47.22 | 55 | 64 | 21 | 12 | 38.18 | 18.75 | 426 | 374 | 194 | 174 | 45.54 | 46.52 |

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

## ICAR-CIRB Bull-wise conception rate (1st April – 31st December 2019)

| Sr. No. | Bull No. | | Set No. | | Total No. of AI | | Total Conceived | | CR% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Breed | M | NR | M | NR | M | NR | M | NR | M | NR |
| 1 | 2594 | 543 | 17th | 8th | 10 | 45 | 3 | 16 | 30.00 | 35.56 |
| 2 | 2607 | 480 | 17th | 8th | 5 | 50 | 1 | 22 | 20.00 | 44.00 |
| 3 | 4995 | 487 | 18th | 8th | 24 | 67 | 11 | 28 | 45.83 | 41.79 |
| 4 | 4905 | 511 | 18th | 8th | 30 | 57 | 7 | 33 | 23.33 | 57.89 |
| 5 | 2676 | 435 | 18th | 8th | 26 | 12 | 10 | 04 | 38.46 | 33.33 |
| 6 | 2677 | 507 | 18th | 8th | 17 | 24 | 8 | 16 | 47.06 | 66.67 |
| 7 | 2645 | 501 | 18th | 8th | 43 | 65 | 25 | 23 | 58.14 | 35.38 |
| 8 | 2269 | 516 | 18th | 8th | 43 | 22 | 21 | 14 | 48.84 | 63.64 |
| 9 | 2234 | 473 | 13 PT | 1st | 19 | 04 | 10 | 04 | 52.63 | 100.00 |
| 10 | 7147 | 411 | 18th | 1st | 19 | 05 | 10 | 03 | 52.63 | 60.00 |
| 11 | 7094 | 535 | 18th | 2nd | 18 | 08 | 9 | 05 | 50.00 | 62.50 |
| 12 | 2558 | 523 | 17th | 2nd | 1 | 04 | 0 | 01 | 00 | 25.00 |
| 13 | 2565 | 674 | 17th | 3rd | 11 | 04 | 5 | - | 45.45 | - |
| 14 | 7227 | 916 | 18th | 4th | 20 | 04 | 9 | 02 | 45.00 | 50.00 |
| 15 | 7263 | 905 | 18th | 4th | 18 | 03 | 10 | 03 | 55.55 | 100.00 |
| 16 | 4687 | | 17th | | 2 | | 0 | | 00 | |
| 17 | 183 | | 2nd PT | | 6 | | 3 | | 50.00 | |
| 18 | 2185 | | 12th PT | | 10 | | 5 | | 50.00 | |
| 19 | 1156 | | 18th | | 27 | | 13 | | 48.15 | |
| 20 | 1198 | | 18th | | 6 | | 5 | | 83.33 | |
| 21 | 1208 | | 18th | | 27 | | 12 | | 44.44 | |
| 22 | 1209 | | 18th | | 22 | | 9 | | 40.91 | |
| 23 | 1219 | | 18th | | 13 | | 6 | | 46.15 | |
| 24 | Dhanna | | Non-set | | 5 | | 1 | | 20.00 | |
| 25 | Heera | | Non-set | | 4 | | 2 | | 50.00 | |

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

## ICAR-CIRB Buffalo herds production status (1st April – 31st December 2019)

| Lact. No | 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 |
| 1st | 26 | 31 | 2447.58 | 2307±114.92 | 307.31 | 312±8.78 | 2369.77 | 2194±87.21 | 12.12 | 11.05±0.35 |
| 2nd | 23 | 12 | 2742.09 | 2933±203.75 | 305.04 | 311±15.67 | 2664.65 | 2813±168.33 | 14.15 | 13.83±0.59 |
| 3rd | 08 | 15 | 2750.50 | 2883±97.77 | 296.00 | 277±7.35 | 2679.37 | 2871±93.71 | 14.10 | 15.45±0.54 |
| 4th | 13 | 11 | 2690.31 | 2815±98.44 | 290.54 | 302±11.94 | 2641.92 | 2745±101.94 | 14.60 | 15.06±0.70 |
| 5th and above | 18 | 12 | 2861.17 | 2942±177.64 | 294.56 | 295±14.01 | 2818.79 | 2887±144.18 | 15.26 | 14.78±0.47 |
| Overall | 88 | 81 | 2672.55 | 2670±69.95 | 300.60 | 301±5.14 | 2607.03 | 2589±61.52 | 13.84 | 13.37±0.30 |

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

## ICAR-CIRB Buffaloes reproduction performance (1st April – 31st December 2019)

| Traits | Value | 1 | | 2 | | 3 | | 4 | | 5 & above | | Overall | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Breed | | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR |
| Av. Age at Calving (Months) | N<br>X<br>SE | 62<br>44.00<br>±0.86 | 33<br>41.61<br>±0.53 | | | | | | | | | | |
| Av. Service Period (Days) | N<br>X<br>SE | | | 22<br>144.13 | 38<br>179<br>±10.94 | 18<br>174.44 | 11<br>138<br>±21.53 | 09<br>195.56 | 11<br>120<br>±14.47 | 22<br>114.45 | 18<br>157<br>±16.16 | 71<br>149.14<br>±9.83 | 78<br>160<br>±7.74 |
| Av. Dry Period (Days) | N<br>X<br>SE | | | 22<br>154.59 | 38<br>169<br>±9.39 | 18<br>168.28 | 11<br>135<br>±12.91 | 09<br>197.67 | 11<br>140<br>±13.47 | 22<br>115.59 | 18<br>155<br>±12.13 | 71<br>151.44<br>±8.59 | 78<br>157<br>±6.07 |
| Av. Calving Interval (Days) | N<br>X<br>SE | | | 22<br>543.13 | 38<br>489<br>±10.98 | 18<br>482.78 | 11<br>448<br>±21.58 | 09<br>503.89 | 11<br>428<br>±15.08 | 22<br>418.77 | 18<br>465<br>±16.30 | 71<br>456.44<br>±10.07 | 78<br>469<br>±7.81 |

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

## ICAR-CIRB Month wise milk production and allocation (1st April – 31st December 2019)

| Month | Total Milk Produced (kg) | |
|---|---|---|
| | M | NR |
| Apr, 19 | 29389.4 | 24668.8 |
| May, 19 | 30397.0 | 23958.0 |
| Jun, 19 | 27300.0 | 23356.5 |
| Jul, 19 | 27376.5 | 22445.5 |
| Aug, 19 | 30126.5 | 24363.8 |
| Sep, 19 | 33548.0 | 28586.9 |
| Oct, 19 | 42582.0 | 31899.4 |
| Nov, 19 | 41838.5 | 32586.49 |
| Dec, 19 | 45062.0 | 34515.6 |

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

## ICAR-CIRB Buffalo herd production performance (1st April – 31st December 2019)

| Month | In milk | | Dry | | Total | | % in Milk | | Wet Av. (kg) | | Herd Av. (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Breed | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR |
| Apr | 105 | 97 | 47 | 50 | 152 | 147 | 69 | 66 | 9.26 | 8.50 | 6.41 | 5.57 |
| May | 102 | 91 | 53 | 56 | 155 | 147 | 66 | 62 | 9.53 | 8.73 | 6.33 | 5.43 |
| Jun | 98 | 91 | 58 | 60 | 156 | 151 | 63 | 61 | 9.26 | 8.52 | 5.86 | 5.16 |
| July | 95 | 87 | 58 | 69 | 153 | 156 | 62 | 56 | 9.27 | 8.36 | 5.74 | 4.65 |
| Aug | 104 | 92 | 57 | 64 | 161 | 156 | 64 | 59 | 9.51 | 8.69 | 6.12 | 5.08 |
| Sept | 123 | 101 | 50 | 60 | 173 | 161 | 70 | 63 | 9.32 | 9.45 | 6.53 | 5.92 |
| Oct | 144 | 106 | 45 | 59 | 189 | 165 | 76 | 64 | 9.65 | 9.7 | 7.32 | 6.25 |
| Nov | 144 | 107 | 39 | 42 | 183 | 149 | 78 | 72 | 9.74 | 10.17 | 7.64 | 7.29 |
| Dec | 147 | 116 | 39 | 36 | 186 | 152 | 79 | 76 | 9.93 | 9.56 | 7.85 | 7.30 |
| Overall | 118 | 99 | 49 | 56 | 167 | 155 | 70 | 64 | 9.53 | 9.09 | 6.70 | 5.83 |

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

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

| Year | In milk | | Dry | | Total | | % in Milk | | Wet Av. (kg) | | Herd Av. (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Breed | M | NR | M | NR | M | NR | M | NR | M | NR | M | NR |
| 1992-93 | | 165 | 98 | 111 | 53 | 276 | 151 | 60.60 | 64 | 4.80 | 5.86 | 2.833.42 |
| 1993-94 | 153 | 81 | 125 | 58 | 178 | 139 | 55.00 | 58 | 5.65 | 5.75 | 3.10 | 3.39 |
| 1994-95 | 181 | 92 | 85 | 44 | 266 | 136 | 68.10 | 67 | 6.09 | 6.01 | 4.15 | 4.18 |
| 1995-96 | 153 | 86 | 82 | 35 | 235 | 121 | 65.19 | 71 | 6.43 | 5.61 | 4.19 | 3.99 |
| 1996-97 | 122 | 81 | 83 | 52 | 205 | 133 | 59.56 | 61 | 5.62 | 5.71 | 3.35 | 3.49 |
| 1997-98 | 121 | 113 | 76 | 40 | 197 | 153 | 61.38 | 74 | 6.12 | 6.03 | 3.75 | 4.45 |
| 1998-99 | 133 | 104 | 73 | 42 | 206 | 146 | 64.52 | 72 | 6.77 | 6.13 | 4.37 | 4.26 |
| 1999-00 | 137 | 85 | 72 | 39 | 209 | 124 | 65.48 | 68 | 6.85 | 6.01 | 4.49 | 4.23 |
| 2000-01 | 148 | 96 | 78 | 33 | 226 | 129 | 65.39 | 74 | 6.68 | 6.31 | 4.37 | 4.69 |
| 2001-02 | 147 | 86 | 70 | 38 | 217 | 124 | 67.70 | 69 | 6.59 | 6.85 | 4.46 | 4.82 |
| 2002-03 | 143 | 106 | 71 | 38 | 214 | 144 | 67.00 | 73 | 6.27 | 6.56 | 4.20 | 4.83 |
| 2003-04 | 151 | 106 | 72 | 37 | 223 | 143 | 67.69 | 74 | 6.49 | 6.35 | 4.39 | 4.70 |
| 2004-05 | 154 | 100 | 69 | 47 | 224 | 147 | 68.97 | 67 | 6.39 | 6.86 | 4.40 | 4.65 |
| 2005-06 | 151 | 114 | 77 | 46 | 238 | 160 | 66.37 | 71 | 6.57 | 6.85 | 4.36 | 4.84 |
| 2006-07 | 137 | 119 | 92 | 48 | 229 | 167 | 59.81 | 71 | 6.45 | 6.20 | 3.86 | 4.40 |
| 2007-08 | 146 | 102 | 71 | 54 | 217 | 156 | 67.32 | 65 | 6.64 | 6.73 | 4.47 | 4.46 |
| 2008-09 | 133 | 122 | 66 | 44 | 199 | 166 | 66.00 | 73 | 6.50 | 6.91 | 4.35 | 5.03 |
| 2009-10 | 106 | 110 | 65 | 58 | 171 | 168 | 62.00 | 65 | 7.01 | 7.00 | 4.35 | 4.66 |
| 2010-11 | 109 | 98 | 64 | 43 | 173 | 141 | 62.97 | 70 | 7.45 | 7.11 | 4.69 | 4.93 |
| 2011-12 | 110 | 84 | 58 | 40 | 168 | 124 | 65.38 | 68 | 7.83 | 7.74 | 5.12 | 5.30 |
| 2012-13 | 109 | 90 | 69 | 49 | 178 | 139 | 62.24 | 65 | 7.74 | 8.26 | 4.76 | 5.34 |
| 2013-14 | 105 | 94 | 65 | 52 | 170 | 146 | 61.78 | 64 | 8.01 | 8.25 | 4.95 | 5.32 |
| 2014-15 | 116 | 99 | 50 | 41 | 166 | 140 | 69.97 | 71 | 8.25 | 8.48 | 5.77 | 5.98 |
| 2015-16 | 114 | 110 | 62 | 41 | 176 | 151 | 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 | 67.8 | 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 |
| 2019 | 118 | 99 | 49 | 56 | 167 | 155 | 70 | 64 | 9.53 | 9.09 | 6.70 | 5.83 |

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

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

| Year | Av. Lact. Yield (kg) | | Av. Lact. Length (days) | | Milk yield 305 days or less | |
|---|---|---|---|---|---|---|
| Breed | M | NR | M | NR | M | NR |
| 1991-92 | 1761 (154) | 2017 (68) | 374 (154) | 373 (68) | 1552 (154) | 1813 (68) |
| 1992-93 | 1804 (137) | 1974 (105) | 395 (137) | 309 (105) | 1508 (137) | 1921 (105) |
| 1993-94 | 1980 (148) | 1776 (70) | 419 (148) | 328 (70) | 1686 (148) | 1744 (70) |
| 1994-95 | 1930 (206) | 2043 (77) | 334 (206) | 350 (77) | 1787 (206) | 1944 (77) |
| 1995-96 | 1936 (147) | 2049 (70) | 313 (147) | 354 (70) | 1855 (147) | 1894 (70) |
| 1996-97 | 1879 (173) | 2092 (81) | 313 (173) | 392 (81) | 1775 (173) | 1807 (81) |
| 1997-98 | 1784 (123) | 2126 (67) | 304 (123) | 354 (67) | 1688 (123) | 2056 (67) |
| 1998-99 | 1762 (153) | 2153 (97) | 284 (153) | 341 (97) | 1702 (153) | 2056 (97) |
| 1999-00 | 2138 (141) | 1968 (99) | 313 (141) | 337 (99) | 2042 (141) | 1874 (99) |
| 2000-01 | 1997 (173) | 1890 (89) | 306 (173) | 305 (89) | 1914 (173) | 1812 (89) |
| 2001-02 | 1954 (152) | 1926 (86) | 290 (152) | 296 (86) | 1898 (152) | 1885 (86) |
| 2002-03 | 1987 (148) | 2007 (105) | 303 (148) | 293 (105) | 1902 (148) | 1941 (105) |
| 2003-04 | 1910 (148) | 1968 (93) | 299 (148) | 307 (93) | 1837 (148) | 1895 (93) |
| 2004-05 | 2017 (167) | 1974 (116) | 319 (167) | 315 (116) | 1886 (167) | 1848 (116) |
| 2005-06 | 2047 (149) | 2190 (102) | 321 (149) | 306 (102) | 1921 (149) | 2090 (102) |
| 2006-07 | 1995 (170) | 1921 (118) | 322 (170) | 304 (118) | 1882 (170) | 1795 (118) |
| 2007-08 | 1954 (169) | 1787 (122) | 299 (169) | 302 (122) | 1891 (169) | 1629 (122) |
| 2008-09 | 2076 (138) | 2036 (108) | 325 (138) | 289 (108) | 1926 (138) | 1929 (108) |
| 2009-10 | 2285 (102) | 1927 (146) | 361 (102) | 302 (146) | 1995 (102) | 1822 (146) |
| 2010-11 | 2471 (113) | 2042 (115) | 337 (113) | 292 (115) | 2247 (113) | 1972 (115) |
| 2011-12 | 2598 (116) | 2045 (88) | 338 (116) | 279 (88) | 2374 (116) | 1998 (88) |
| 2012-13 | 2478 (110) | 2048 (123) | 318 (110) | 264 (123) | 2335 (110) | 2017 (123) |
| 2013-14 | 2394 (98) | 2297(109) | 333 (98) | 285(109) | 2291 (98) | 2241(109) |
| 2014-15 | 2502 (110) | 2464(115) | 313 (110) | 303(115) | 2355 (110) | 2384(115) |
| 2015-16 | 2483 (152) | 2564(110) | 322 (152) | 305(110) | 2336 (152) | 2471(110) |
| 2016-17 | 2567 (133) | 2452(136) | 312 (133) | 298(136) | 2457 (133) | 2377(136) |
| 2017-18 | 2480(140) | 2363(110) | 295 (140) | 282(110) | 2424(140) | 2321(110) |
| 2018-19 | 2641 (123) | 2797 (111) | 305 (123) | 311 (111) | 2567 (123) | 2679 (111) |
| 2019 | 2673 (88) | 2670 (81) | 300.06 (88) | 301 (81) | 2607 (88) | 2589 (81) |

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

## Agricultural Farms

The institute at main campus has a total area of 780 acres at Hisar, out of which about 50 per cent land is arable and under fodder cultivation for institute livestock. The sub-campus has 516 acres of highly fertile land, which meets the requirements of green fodder, dry fodder and cereal grains for Nili-Ravi animals herd at Nabha. The institute is self-sufficient in meeting its grain and green fodder requirements for its herds, while majority requirement of dry fodder is also met from its own agricultural farms production. Excess grains are sold to earn extra revenue. During April to December 2019, the total green and dry fodder production was 26036.25 and 820.25 quintals, respectively, while grain production was 1323.2 quintals. Sowing of paddy plantation in 20 acres and mustard plantation in 42 acres land was done at CIRB, Hisar for land improvement and reclamation of soil. At Sub-Campus Nabha, the total green and dry fodder production during the year was 38772.5 and 2590 quintals, respectively, while grain production was 5393.90 quintals. Institute takes guidance from specialized agriculture institutes of ICAR and SAUs for land reclamation, advanced farming techniques and for meeting its requirements of quality seeds of fodder and grain crops.

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

### Area under Kharif Fodder production during 2019

| Crop | Area (in Acres) | |
|---|---|---|
| | Main Campus Hisar | Sub Campus Nabha |
| Jowar (Kela) | - | 60.0 |
| Maize | 03.0 | 118.5 |
| Cowpea + Bajra | 05.0 | 10.0 |
| Teosinte | - | 10.0 |
| MC Jowar | 141.0 | 25.0 |
| Nutrigold | 02.0 | 0.00 |
| **Total** | **151.0** | **249.5** |

### Area under Kharif seed/ grain production during Kharif 2019

| S.No. | Crop | | Area in acres | | Yield in (Q) | | Av. Yield(in Q/Acre) | |
|---|---|---|---|---|---|---|---|---|
| | Main Campus Hisar | Sub Campus Nabha | Main Campus Hisar | Sub Campus Nabha | Main Campus Hisar | Sub Campus Nabha | Main Campus Hisar | Sub Campus Nabha |
| 1 | Paddy PB-1509 | Paddy PR-124 | 20 | 50 | 145.70 Q | 1162.30 Q | 7.29 Q | 23.25 Q |

## Area under Rabi seed/ grain production and grain yield during 2019

| 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 | 50.0 | 125 | 724.55 | 2123.0 | 14.49 | 16.98 |
| Barley | 50.0 | 145 | 421.35 | 1945.3 | 8.43 | 13.42 |
| Sarson (Surplus | - | 05.0 | - | 16.80 | - | 3.36 |
| from fodder) | | | | | | |
| Oat | 06 | 20.0 | 31.60 | 146.50 | 5.27 | 7.30 |
| **Total** | **106.0** | **295** | **1177.50** | **4231.6** | | |

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

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

**Electrical section :** Electrical section of the institute is responsible for providing round the clock electric supply to the laboratories of institute with zero fault maintenance motto at lowest possible cost. It maintains 11 KV sub-station

comprising of 500 KVA transformer, OCB, ACB, LT panels and two DG sets of 250 and 110 Kva capacities for power backup. Section attends day to day electric maintenance related complaints of different labs, guest house and residential units. Repair, servicing and maintenance of more than 90 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 100% 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.

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

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

At Sub Campus Nabha, 16 acre land was improved by removing dried and uprooted trees and shrubs, 33 acre dhaincha was sown for green manuring that improved physical property of the land, 40 acre land was improved by spreading farm yard manure/compost. 1300 feet long chain link fences were created to protect farm from stray animals. No paddy straw burning is practised at CIRB farms since last 4 years. During the year, 72 acre and 3 Marla land was transferred to Animal Husbandry Department, Punjab as per approval of the ICAR.

**Shri Giriraj Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India and Dr. Sanjeev Kumar Balyan, Hon'ble Minister of State of Fisheries, Animal Husbandry and Dairying, Govt. of India during visit to the Institute on 16th August, 2019**

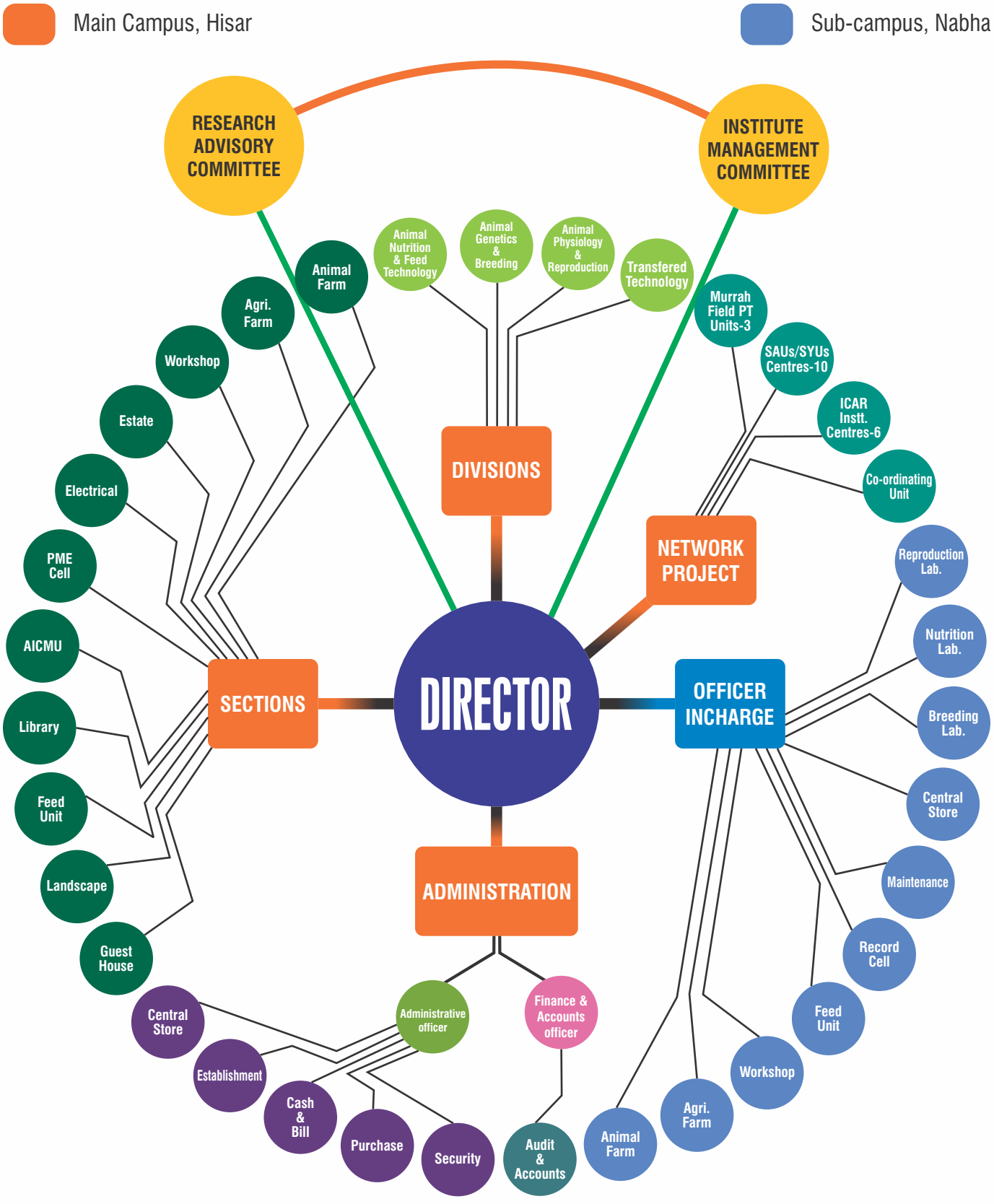
## National and International Collaborations

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, 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, DST, 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.

## Priority setting, monitoring and evaluation (PME) Cell

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

# Organizational Setup



# Research Achievements

As an important Institution in the buffalo research and extension, ICAR-CIRB is pushing boundaries in the development of science based solutions for sustainable buffalo production systems. The scientific workforce at the institute take part in conducting research, gaining professional experience and disseminating the acquired know-how to farmers, entrepreneurs, students, researchers, academicians, and policy makers. All the research is solution driven - for addressing issues related to buffalo breeding, health, nutrition, reproduction and welfare. The institute embrace scientific thoughts for making buffalo farming sustainable, environment friendly and beneficial for society.

## Genetic Improvement

Continued efforts are required to understand, characterize and take forward positivities for breed improvement programs. The buffaloes are often said to be superior converters of high roughage diets, have excellent adaptability to difficult environmental conditions, produce high quality milk but inefficient breeders. This entails a huge importance to the genetics of various traits in the large and diverse population of buffaloes in the country. The division of Animal Genetics and Breeding (AGB) at the Institute is the coordinating center for the network project on buffalo improvement, addressing five most important milch breeds i.e. Murrah, Nili Ravi, Surti, Bhadawari and Jaffrabadi and operating through centers across India. 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, quantitative genetics, population genetics and molecular genetics.

### Network Project on Buffalo Improvement

***KP Singh, SS Dahiya***

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

**Murrah Bull**

**Frozen Semen**

**Murrah Herd**

17th Annual Review Meet of ICAR- Network Project on Buffalo Improvement was organized by ICAR-CIRB, Hisar at ICAR-NASC Complex, New Delhi, 27-28 August 2019. Dr. S S Dahiya, Director ICAR-CIRB & Project Coordinator, welcomed the chair and other members present in Annual Review Meet. The Meeting was chaired by Dr. J K Jena, DDG (AS) who advised the Network centres for documentation on buffalo milk characteristics, quality and micro-molecule composition with details data of amino acid level particularly in Murrah, Nili-Ravi, Bhadawari and

Jaffarabadi breeds. Dr Jena also reviewed the progress of Network Project Centres and directed to coordinate unit for compilation of information on coverage of AI, requirement of breeding bulls and frozen semen production for breeding buffaloes through superior germplasm. Dr. R S Gandhi, ADG (AP&B) in his opening remarks, welcomed all the members, other participants and highlighted the pulsating role of buffalo in livestock sector, which is apparent from the significant contribution in country milk pool and also the exports earning through buffalo meat. Also advised to include more buffalo breeds like Mehsana, Pandharpuri and Banni for improvement under NPBI with the participation of State Agriculture / Veterinary Universities. Three publication on I. Network project on buffalo improvement: field progeny testing programe in Murrah buffalo, II. Registration of Banni buffalo: revitalize Maldharis economy and livelihood and III. Progeny testing programme in Jaffarabadi buffalo were released by Dr. J K Jena, DDG (AS).


**XVII Annual Review meet of NPBI at ICAR, New Delhi**

## Network Project on Buffalo Improvement

### Sub-project : Genetic improvement of Nili-Ravi buffalo

***Sanjay Kumar, M.H. Jan and Rajiv Mehta***

A total of 152 (76 female & 76 male) calves of high genetic merit were born during this period. Test mating (374 inseminations) were carried out during this period resulting in 174 pregnancies. A total of 50 daughters of 13 bulls under progeny testing programme completed 1st lactation. The wet average (9.18 kg, highest ever), herd average (6.25 Kg), 305 days lactation milk yield (2597 kg), total lactation milk yield (2688 kg), peak yield (13.38 kg) and lactation length (304 days) were achieved in Nili-Ravi herd. The reproductive traits viz., service period (157 days), calving interval (466 days), dry period (157 days) were achieved during the year 2019. Herd Life Production (up to 4$^{th}$ or more Lactation completed) of 24 buffaloes was estimated. The average productive days were 1430 and average milk yield per day of herd life was 3.99 litres. A total of 21,806 semen doses were produced at the Sub Campus or procured from semen station Nabha. Out of which, 1566 doses were used at farm for insemination and 2225 doses were sold to field inseminators. Overall motility of 2.69% and calf motility of 4.57% was recorded during this period. The overall conception rate of 46.52% was recorded. Milk production of 349240.6 kg was recorded during this year, and 281603.0 kg (highest ever) was sold. Total 120 animals were sold through public auction and on book value to farmers, universities and various developmental agencies.

## Field Progeny Testing of Bulls (FPT) at ICAR-CIRB

***A Bharadwaj , VB Dixit, H Tripathi***

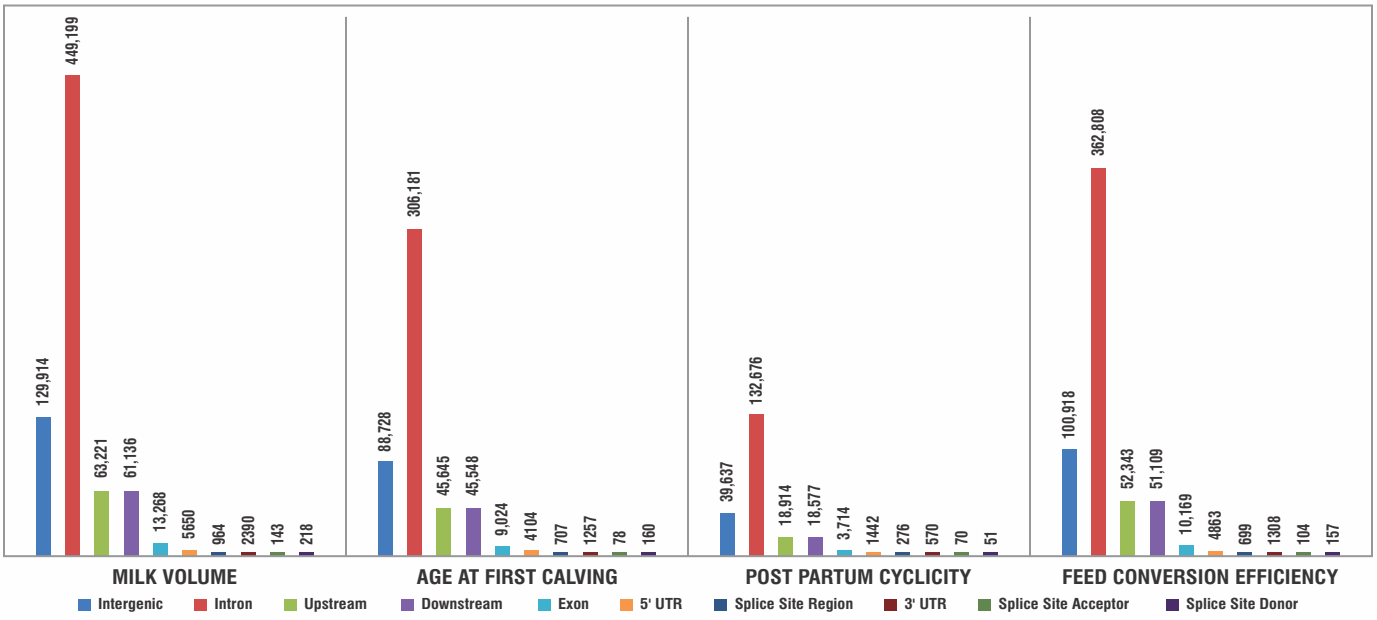
Under field progeny testing program (FPT) semen of test bulls is used for artificial insemination in the field, followed by pregnancy diagnosis, calving records and follow up of progenies till the completion of first lactation for milk records on the basis of monthly test day recording. During the period from April 2019 to December 2019, 3904

artificial inseminations were performed using test bulls of 18th set. The conception rate in the field was worked out to be 53.90%. In this period 2225 pregnancies were confirmed and 1754 calving (males 953, females 801) were recorded. In addition 172 progenies, 6 of 14th, 144 of 15th, and 22 of 16th set were also born and monthly test day milk yield were/ being recorded. The average age at first calving for these 172 daughters was 40.44 months. During the year 301 daughters were recorded, out of which 140 daughters completed the lactation, 60 daughters sold before the lactation was completed and recording of 101 daughters are in progress. The physical identification using ear tagging has been done in all female progenies born in the field. As on 31st December 2019, 1207 female progenies of 15th to 18th set of different age are standing at various field unit centres for future recordings.

## Identification and characterization of trait-specific SNPs using ddRAD sequencing in water buffalo

***DC Mishra, Poonam Sikka, Sunita Yadav, Jyotika Bhati, SS Paul, A Jerome, Inderjeet Singh, Abhigyan Nath, Neeraj Budhlakoti, AR Rao, Anil Rai and KK Chaturvedi.***

Restriction site–associated DNA sequencing (RAD-seq/ddRAD-Seq/ddRAD) is low input technique, but, tangible and viable as an alternative of Whole genome sequencing (WGS) for single Nucleotide Polymorphism (SNP) variants determination. It has been proven useful for selective genotyping, based on phenotype recording systems, scrutinizing more than 40% of the genome. SNP markers are widely used molecular tools for orchestrating improvement of any desirable genetic traits in existing animal breeding program. 85 samples of Murrah buffaloes were sequenced by ddRAD sequencing technique and vast resource of Genome-wide SNPs was generated identifying and annotating 246,495; 168,202; 74,136 and 194,747 SNPs in relation to milk volume, age at first calving, post-partum cyclicity and feed conversion efficiency traits, respectively, in Murrah buffaloes. SNP distribution remained highest (61.69%) in intron and lowest (1.78%) in exon regions. SNPs identified in coding regions over all the traits covered under study were further classified as synonymous (4697) and non-synonymous (3827). Gene Ontology (GO) terms and associated genes assigned to various traits indicate cellular mechanism for enhancing productivity of water buffalo aiming at faster genetic gain employing early selection in buffaloes. This is the first study to document functionally classified trait specific SNPs in buffaloes, genome-wide. The information deduced will provide a novel avenue for identification of superior germplasm and for molecular breeding in existing buffalo breeding programs.




*Number of SNP (Variant) effects w.r.t. to different genomic region (intergenic, introns, exons, untranslated region (5' UTR and 3' UTR), splice site] for milkvolume, age at first calving, post-partum cyclicity, and feed conversion efficiency based on their position in the annotated Bubalus bubalis genome.*

## Causes of buffalo calf mortality and its management

***SK Khurana, S Yadav, A Boora, Sanjay Kumar***

Major conditions which cause mortality in buffalo calves are diarrhea, pneumonia and septicemia caused mainly by several bacterial, viral and parasitic agents. 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 like housing, management, feeding and other parameters. Second proforma was regarding veterinarian's observations on calf mortality.

245 village buffalo farms in unorganized sector were surveyed. These were from 17 villages from Haryana including Gangwa, Ladwi, Bhuthan Kalan, Thuian, Cheemon, Rawalwas Kalan, Dhani Majua, Dabra, Hasanga, Dhabi Khurd, Jhalania, Dalher, Ruksana, Kaimri, Talwandi Rana, 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 done. Additionally, survey of 16 small peri-urban private buffalo dairy units at Hisar, Barwala and Adampur was also done. Survey of observations of 76 veterinarians regarding buffalo calf mortality was also done.

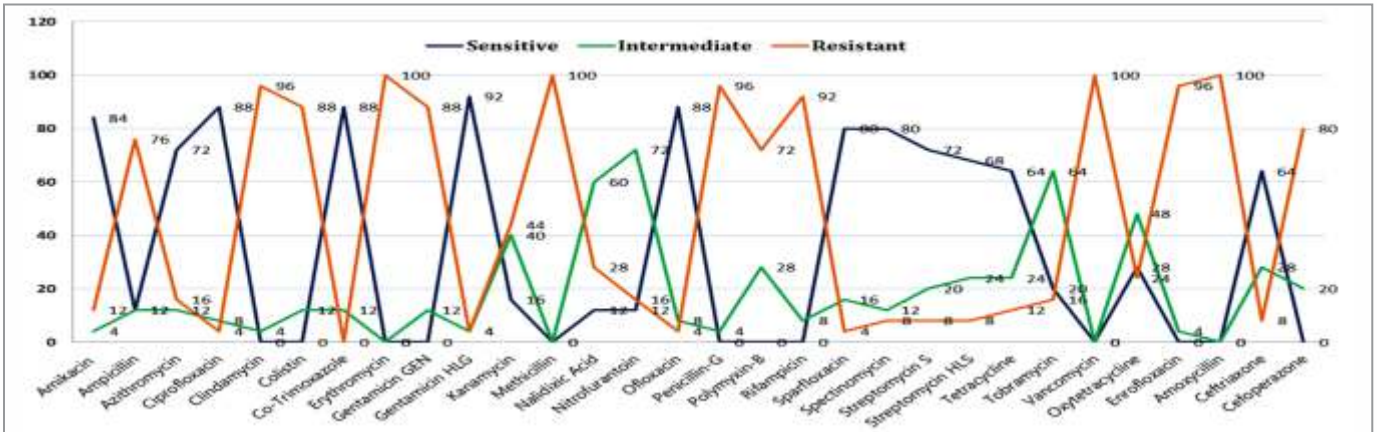
202 clinical biosamples including faecal samples, nasal swabs and abscess samples from diseased buffalo calves were subjected to bacterial analysis which yielded *E coli* (90), *Klebsiella pneumoniae* (30) and *Salmonella* spp. (20). None of the 104 samples from in contact apparently healthy buffalo calves yielded any bacteria of pathogenic significance.

All the isolates were subjected to invitro antimicrobial susceptibility testing against 30 antimicrobial agents. 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 (Hi Media). The percentage of *E coli* isolates coming under the category of sensitive, intermediate and resistant for antimicrobial agents were amikacin 30 mcg (76.6, 23.3, 0); ampicillin 10 mcg (0, 13.3, 86.6); azithromycin (76.6, 16.6, 6.6); ciprofloxacin 5 mcg (80, 3.3, 16.6); clindamycin 2 mcg (0, 3.3, 96.6); colistin 10 mcg (93.3, 0, 6.6); co-trimoxazole 25 mcg (70, 0, 30); erythromycin 15 mcg (0, 3.3, 96.6); gentamicin 10 mcg (50, 43.3, 6.6); gentamicin 120 mcg (100, 0, 0); kanamycin 30 mcg (3.3, 56.6, 40); methicillin 5 mcg (0, 0, 100); nalidixic acid 30 mcg (33.3, 36.6, 30); nitrofurantoin 300 mcg (76.6, 10, 13.3); ofloxacin 5 mcg (83.3, 3.3, 13.3); penicillin 10U (0, 0, 100); polymyxin B 300U (26.6, 0, 73.3); rifampicin 5 mcg (96.6, 0, 3.3); sparfloxacin 5 mcg (3.3, 0, 96.6); spectinomycin 100 mcg (80, 10, 10); streptomycin 10 mcg (13.3, 60, 26.6); streptomycin 300mcg (90, 0, 10); tetracycline 30 mcg (36.6, 33.3, 30); tobramycin 10 mcg (13.3, 73.3, 13.3); vancomycin 30 mcg (0, 0, 100); oxytetracycline 30 mcg (30, 0, 70); enrofloxacin 10 mcg (33.3, 0, 66.6); amoxicillin/ sulbactam 30/15 mcg (0, 0, 100); ceftriaxone 30 mcg (60, 16.6, 23.4); cefoperazone/ sulbactam 75/ 30 mcg (0, 0, 100).

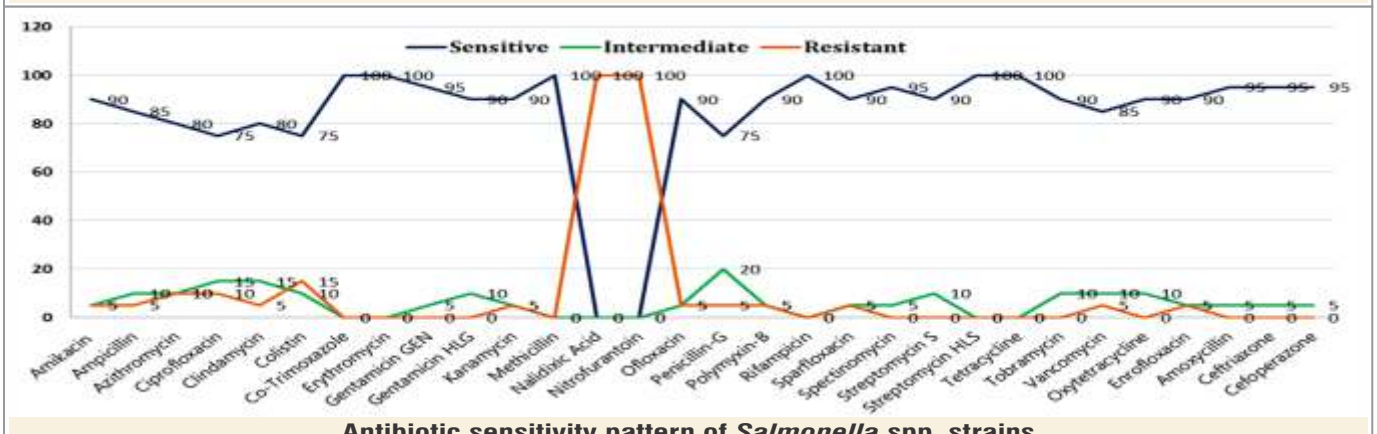
The percentage of *Klebsiella pneumoniae* isolates coming under the category of sensitive, intermediate and resistant for antimicrobial agents were amikacin 30 mcg (84, 4, 12); ampicillin 10 mcg (12, 12, 76); azithromycin (72, 12, 16); ciprofloxacin 5 mcg (88, 8, 4); clindamycin 2 mcg (0, 4, 96); colistin 10 mcg (0, 12, 88); co-trimoxazole 25 mcg (88, 12, 0); erythromycin 15 mcg (0, 0, 100); gentamicin 10 mcg (0, 12, 88); gentamicin 120 mcg (92, 4, 4); kanamycin 30 mcg (16, 40, 44); methicillin 5 mcg (0, 0, 100); nalidixic acid 30 mcg (12, 60, 28); nitrofurantoin 300 mcg (12, 72, 16); ofloxacin 5 mcg (88, 8, 4); penicillin 10U (0, 4, 96); polymyxin B 300U (0, 28, 72); rifampicin 5 mcg (0, 8, 92); sparfloxacin 5 mcg (80, 16, 4); spectinomycin 100 mcg (80, 12, 8); streptomycin 10 mcg (72, 20, 8); streptomycin 300mcg (68, 24, 8); tetracycline 30 mcg (64, 24, 12); tobramycin 10 mcg (20, 64, 16); vancomycin 30 mcg (0, 0, 100); oxytetracycline 30 mcg (28, 48, 24); enrofloxacin 10 mcg (0, 4, 96); amoxicillin/ sulbactam 30/15 mcg (0, 0, 100); ceftriaxone 30 mcg (64, 28, 8); cefoperazone/ sulbactam 75/ 30 mcg (0, 20, 80).

The percentage of *Salmonella* spp. isolates coming under the category of sensitive, intermediate and resistant for antimicrobial agents were amikacin 30 mcg (90, 5, 5); ampicillin 10 mcg (85, 10, 5); azithromycin (80, 10, 10); ciprofloxacin 5 mcg (75, 15, 10); clindamycin 2 mcg (80, 15, 5); colistin 10 mcg (75, 10, 15); co-trimoxazole 25 mcg (100, 0, 0); erythromycin 15 mcg (100, 0, 0); gentamicin 10 mcg (95, 5, 0); gentamicin 120 mcg (90, 10, 0); kanamycin 30 mcg (90, 5, 5); methicillin 5 mcg (100, 0, 0); nalidixic acid 30 mcg (0, 0, 100); nitrofurantoin 300 mcg (0, 0, 100); ofloxacin 5 mcg (90, 5, 5); penicillin 10U (75, 20, 5); polymyxin B 300U (90, 5, 5); rifampicin 5 mcg (100, 0, 0); sparfloxacin 5 mcg (90, 5, 5); spectinomycin 100 mcg (95, 5, 0); streptomycin 10 mcg (90, 10, 0); streptomycin 300mcg (100, 0, 0); tetracycline 30 mcg (100, 0, 0); tobramycin 10 mcg (90, 10, 0); vancomycin 30 mcg (85, 10, 5); oxytetracycline 30 mcg (90, 10, 0); enrofloxacin 10 mcg (90, 5, 5); amoxicillin/ sulbactam 30/15 mcg (95, 5, 0); ceftriaxone 30 mcg (95, 5, 0); cefoperazone/ sulbactam 75/ 30 mcg (95, 5, 0).

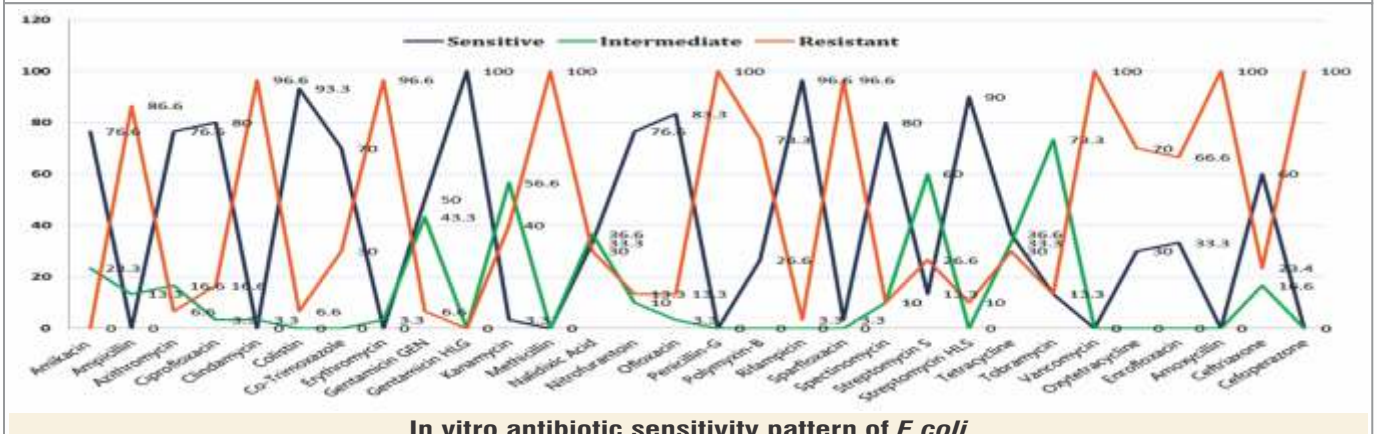
The results are also depicted in graphical format.




**Antibiotic sensitivity pattern of *Klebsiella pneumonia* strains**




**Antibiotic sensitivity pattern of *Salmonella* spp. strains**




**In vitro antibiotic sensitivity pattern of *E coli***

## Inferring relationship of blood metabolic changes with average daily gain and feed conversion efficiency in Murrah heifers: Machine learning approach

***Poonam Sikka, Abhigyan Nath, Shyam S. Paul, Jerome Andonissamy, Dwijesh C. Mishra, Aditya A. Rao, Ashok K. Balhara, Krishna Kumar Chaturvedi, Keerti K. Yadav and Sunesh Balhara***

Study revealed the differences in feed intake for comparable growth and rate of body weight gain (ADG), while comparing efficient and inefficient buffalo heifers (< 1 yr) illustrate the possibility of reducing feed costs, improving gains. A wide variation in Feed utilizing efficiency, a heritability associated trait, determined as a measure of residual feed intake (RFI) over Murrah heifers (n= 42), was recorded indicating scope of harnessing natural genetic difference in favour of selecting superior germplasm at early stage.

Genetic difference, existing in residue feed intake (RFI) was determined under organized farming systems at institute farm in Murrah heifers (n=42). Study revealed close association of buffalo heifers (n= 35) RFI with the underlying biology, i.e. biochemical and hormonal determinants related to energy metabolism of feed efficiency which can be used to develop biomarkers. Blood analytes determined were Urea, Total Protein, Albumin, Cholesterol, Low Density Lipoprotein, High Density Lipoprotein, Triglycerides, Lactate Dehydrogenase, Serum Glutamate Oxaloacetate Transaminase, Serum Glutamate Pyruvate Transaminase, Phosphorus, estimated using automated biochemical Analyser (Coralyzer 200, Tulips Diagnostics, India) and commercial kits (Coral Clinical Systems, India). Serum Insulin-like growth factor-1 (IGF-1), Triiodothyronine ($T_3$) & Thyroxine ($T_4$) levels were estimated using ELISA kits (Sincere Biotech Co., Ltd. Beijing). Machine learning algorithms were employed for predicting the Feed Conversion Efficiency (FCE), using the blood parameters and Average Daily Gain (ADG) as predictor variables and RFI as dependent variable. IGF-1 and its interactions with the other blood parameters were found highly influential for higher FCE measures. Strength of estimated interaction effects of the blood determinants, in relation to FCE, may unfold intricate dynamics of heifer's growth. Urea, LDH, HDL and Phosphorus were the proxy determinants of highest order for feed efficiency evaluation and are recommended to develop genetic markers to optimize feed efficiency in buffaloes. This study has useful implications to minimize the efforts entailing into individual animal performance evaluation trials for selection for higher feed conversant animals.

## 'BuffBol' and 'Calfcall' : understanding buffalo acostics

***Ashok Boora, Sarita Yadav***

With growing ecological threats, water buffaloes tend to change their behaviour. Ecological challenges include decreasing forest cover, increasing cropping intensity, increasing urbanization, encroachment of community pasture lands and ponds along with genetic selection, controlled mating and herding pattern. Due to these behaviourial shifts, heat detection in buffaloes is becoming difficult by traditional methods like bellowing. Farmers involved with Farmer FIRST programme noticed the phenomenon of bellowing after introducing new buffalo with bellowing tendency. Acoustic intervention by the voice of buffaloes helps in following ways :-

- Enhance bellowing tendency in buffaloes and signs of oestrus in buffalo become more overt
- Decrease bull reaction time
- Reduce milk somatic count
- Help in achieving buffalo welfare
- Faster let down of milk

## Improvement of Reproductive Efficiency

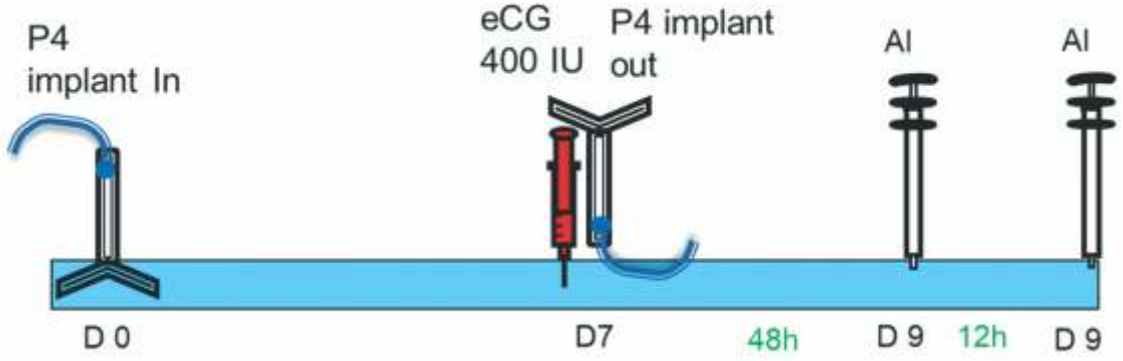
Realizing high pregnancy rates in high-producing animals in a timely and cost-effective way is one of the greatest management challenges in sustainable buffalo production systems. Productiveness is decidedly influenced by animal physiology, genetics, management and environmental factors. The Animal Physiology 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. While oestrus detection technology will help in early breeding of silent oestrus buffaloes, early pregnancy diagnosis will help in early re-breeding of non-pregnant animals and proper care of animals found pregnant. Overall, these two technologies have immense potential for farmers to improve reproductive efficiency of females by reducing calving interval and increasing lifetime production and net calf crop. 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 interactions for improved fertility.

### Nutritional and physiological interventions for enhancing reproductive performance in animals

***RK Sharma, SK Phulia, V Mudgal, Jerome A***

Different hormonal protocols were used considering cyclic status and suitability of animal for the treatment. Estrus induction and synchronization protocol was used in 255 buffaloes under field and farm conditions. Infertility treatment camps were organised in different villages: Choudhariwali, Mohabbatpur, Neoli Kalan, Kharkadi, Niyana and Neoli Khurad. Progesterone implant followed by 400 IU PMSG at the time of implant removal, has been found most effective as compared to progesterone implant alone or GnRH based protocols for oestrus induction in anovular anoestrus buffaloes timed insemination. Single prostaglandin injection was quite effective in silent oestrus buffaloes as indicated in results given below for total of 255 animals :

| S.No | Treatment | N (Total 255) | Estrus induction rate | Pregnant in first AI | Pregnant in two subsequent cycle | Animal sold/ Non-traceable | Pregnancy rate |
|---|---|---|---|---|---|---|---|
| 1. | Ovsynch Plus | 6 | 4 (67%) | 2 (33%) | 1 (17%) | 0 | 3 (50%) |
| 2. | CIDR without PMSG | 21 | 18 (86%) | 4 (19%) | 3 (15%) | 0 | 7 (33%) |
| 3. | CIDR with PMSG | 122 | 110 (90%) | 53 (43%) | 25 (20%) | 10 (8%) | 78 (64%) |
| 4. | PG (Silent Heat) | 106 | 90 (85%) | 47 (44%) | 17 (16%) | 10 (9%) | 64 (60%) |




Mineral Mixture developed for heifers for early puberty under AICRP was used for validation under field conditions. Mineral Mixture was given as treatment to delayed pubertal heifer during camps to the farmers not offering any mineral mixture. Twenty nine heifers were given test mineral mixture and twenty three heifers were provided CIRB normal mineral mixture. Each heifer received 50 g mineral mixture for a period of 40 days. Heifers exhibiting estrus were bred and those conceiving within 90 days were recorded.

| S.No. | Treatment | N | Heat induced | Av. Days at heat after start of Treatment (Mean±SD) | Pregnancy rate within 90 days | Av. Pregnancy days (Mean±SD) |
|---|---|---|---|---|---|---|
| 1. | Treatment | 29 | 14 (48.3%) | 63.3±11.0 | 8 (27.6%) | 76.4±12.2 |
| 2. | Control | 23 | 10 (43.5%) | 74.6±12.1 | 5 (21.8%) | 80±14.3 |

Sperm function tests were carried out using different doses of IGF-1. Supplementation of IGF-1 (150-250 ng/ml) resulted in increase in sperm total, progressive and rapid motility in addition to sperm mitochondrial superoxide status as well as mitochondrial membrane potential as summarized in tables below :

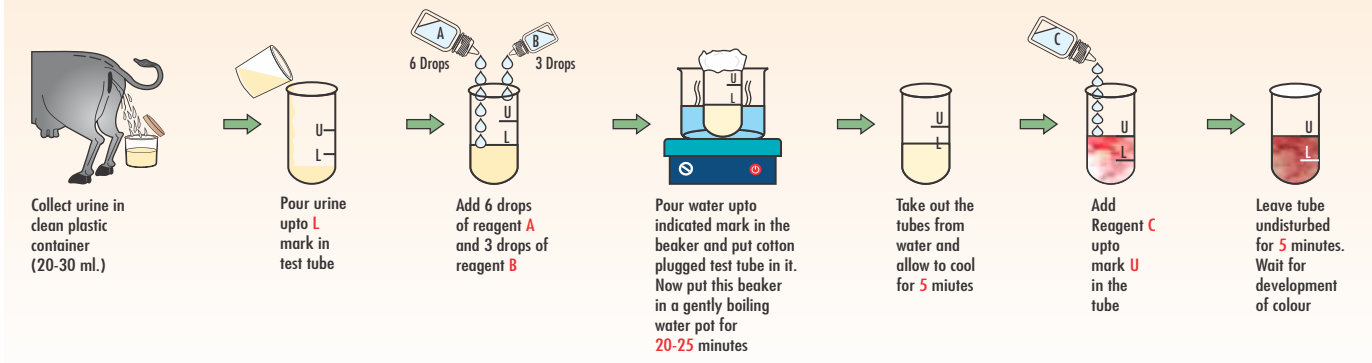
| Groups | High MMP (%) (n=24) | Mitosox positivity (%) (n=24) | VAP (μm/s) | VSL (μm/s) | VCL (μm/s) | ALH (μm) | BCF (Hz) | STR (%) | LIN (%) | Elon-gation | Total motility (%) | Prog-ressive motility (%) | Rapid motility (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | 39.4 ±2.39$^{A}$ | 58.96 ±2.9$^{A}$ | 103.3 ±2.53 | 88.14 ±2.18 | 175.1 ±6.2 | 7.46 ±0.35 | 27.7 ±0.62 | 84.73 ±0.9 | 53.1 ±1.47 | 0.47 ±0.01 | 37.79 ±3.34$^{A}$ | 36.69 ±3.74$^{A}$ | 37.33 ±3.78$^{A}$ |
| Group 1 (150 ng/ml) | 44.65 ±2.556$^{B}$ | 53.75 ±2.4$^{B}$ | 105.6 ±3.51 | 90.2 ±3.18 | 178.3 ±6.5 | 7.57 ±0.32 | 27.67 ±0.58 | 84.86 ±0.87 | 53.1 ±1.24 | 0.46 ±0.01 | 50.75 ±2.78$^{B}$ | 45.42 ±3.15$^{B}$ | 46.23 ±3.15$^{B}$ |
| Group 2 (250 ng/ml) | 42.14 ±2.367$^{AB}$ | 55.85 ±2.6$^{AB}$ | 107.7 ±3.20 | 92.2 ±3.24 | 181.9 ±5.6 | 7.64 ±0.27 | 27.86 ±0.65 | 84.94 ±1.01 | 52.83 ±1.33 | 0.46 ±0.01 | 48.81 ±2.68$^{B}$ | 38.69 ±2.67$^{B}$ | 39.53 ±2.66$^{B}$ |
| Group 3 (350 ng/ml) | 38.66 ±2.407$^{AC}$ | 57.16 ±2.23$^{AC}$ | 105.5 ±83 | 89.46 ±2.72 | 180.1 ±5.3 | 7.61 ±0.3 | 27.86 ±0.59 | 84.4 ±1.09 | 51.98 ±1.41 | 0.47 ±0.01 | 40.96 ±2.92$^{AB}$ | 36.25 ±2.87$^{C}$ | 37.1 ±2.84$^{C}$ |

## Preg D : Urine-based pregnancy diagnosis kit

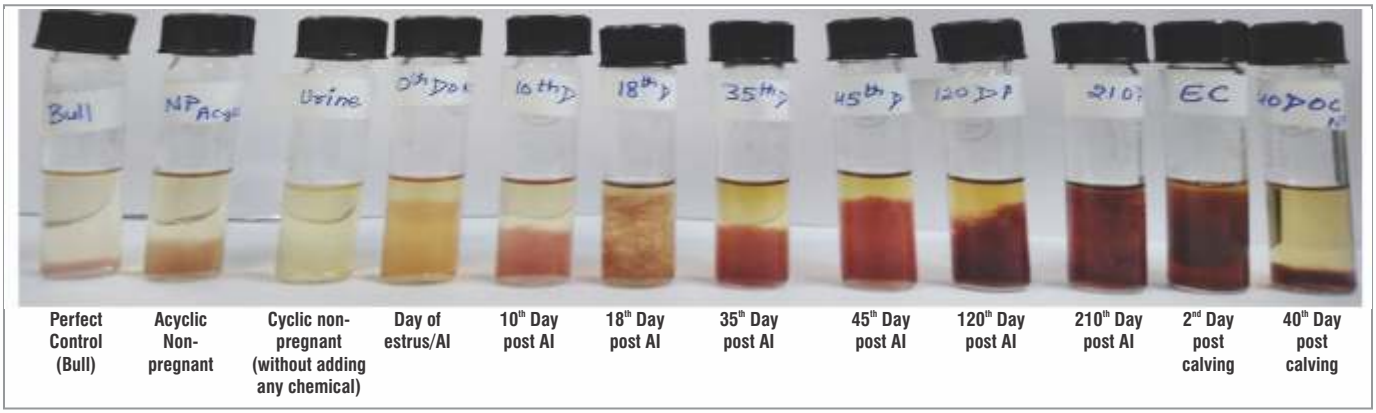
***ICAR-CIRB Patent application no. 202011013074***

***AK Balhara, SK Phulia, RK Sharma, Sunesh, P Sikka, I Singh and SS Dahiya***

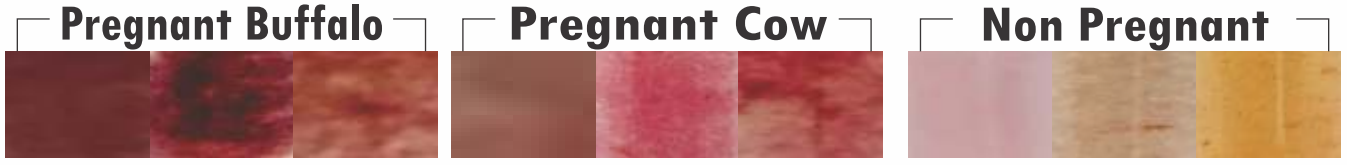
There are no field usable urine-based pregnancy diagnosis kits available for ruminant livestock especially in dairy buffaloes and cows. NMR studies of Urinary metabolites revealed that there are significant changes in levels of secreted metabolites during pregnancy. Some of these metabolites react to form red-violet colour complex of lactone derivative conjugates [(2,5-Dihydro-4-methyl-5-(2,6,6-trimethyl-4-oxocyclohex-2-enylmethylene) furan-2-one], which form the basis of this colorimetric test. Third party validation and field trials for the prototype kit have been initiated in different SAUs and other agencies .

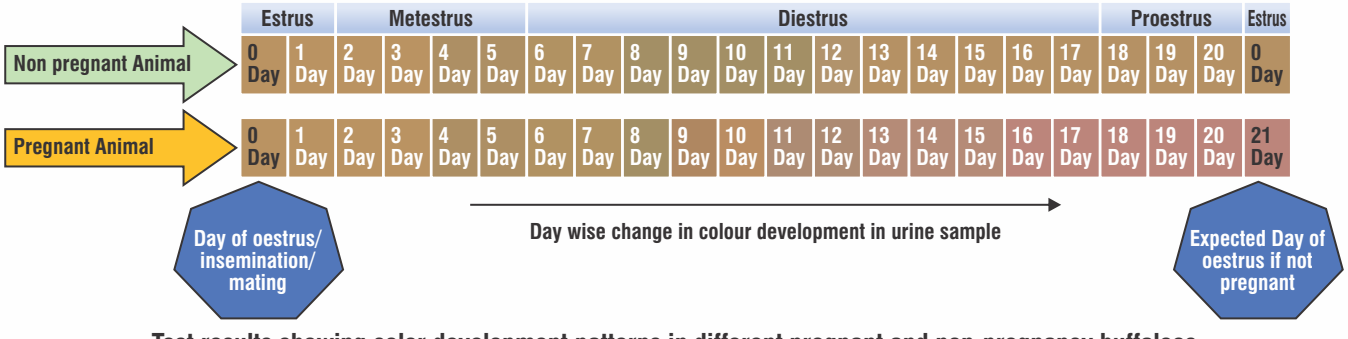



**Testing procedure for performing pregnancy diagnosis on urine using Preg D**




Perfect Control (Bull) | Acyclic Non-pregnant | Cyclic non-pregnant (without adding any chemical) | Day of estrus/AI | 10th Day post AI | 18th Day post AI | 35th Day post AI | 45th Day post AI | 120th Day post AI | 210th Day post AI | 2nd Day post calving | 40th Day post calving

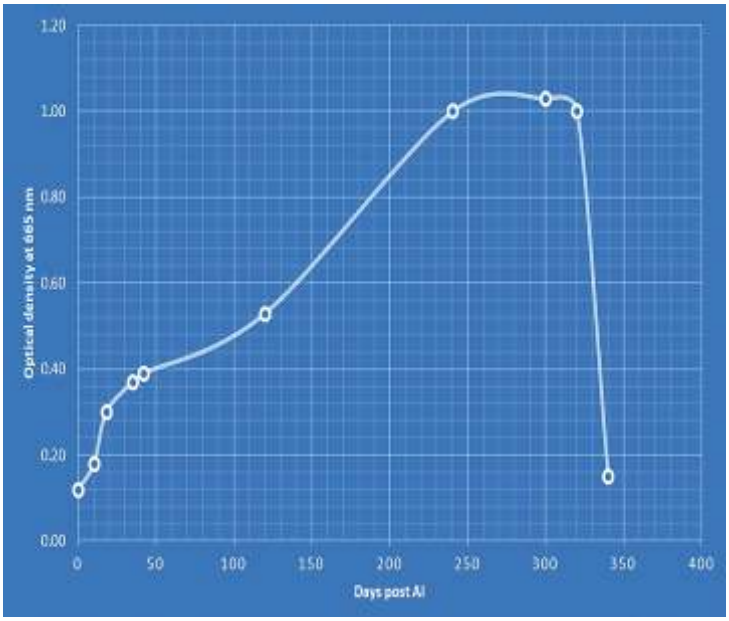



**Test results showing color development patterns in different pregnant and non-pregnancy buffaloes**

There are changes in colour intensity of the complex changes with progression of gestation period (Day 0 to Day 210 post AI). Optical density of the colour reaction mixture in urine was measured and was found to increase progressively as indicated in the graph.

| Day (post AI) | Optical Density(λ 665 nm) |
|---|---|
| 0 | 0.12 ± 0.017 |
| 10 | 0.18 ± 0.012 |
| 18 | 0.30 ± 0.022 |
| 35 | 0.37 ± 0.018 |
| 42 | 0.39 ± 0.010 |
| 120 | 0.53 ± 0.024 |
| 210 | 1.00 ± 0.027 |
| 300 | 1.03 ± 0.021 |
| 320 | 1.00 ± 0.018 |
| 340 | 0.15 ± 0.021 |




## Manipulation of follicular wave pattern to increase conception rate in buffalo

***MH Jan and Sanjay Kumar***

The pre-experimental trial examine the preponderance of 2- versus 3-wave patterns in 46 interovulatory intervals (IOIs) from 36 buffalo heifers, in which a subset of 10 heifers was scanned for 2 consecutive IOIs to record the repeatability of follicular wave pattern. It was observed that 2-wave pattern was detected in 63.0% and 3-wave follicular pattern in 27.0% IOIs. 3-wave cycles had smaller ($p < 0.05$) size of the dominant follicles (DF) of wave as well as the ovulatory wave as compared to 2-wave cycle. The mean duration of IOI was significantly shorter in 2-wave compared to three-wave cycles (20.5 ± 0.3 vs. 22.3 ± 0.2 days; $P < 0.05$). Out of 10 buffalo heifers, 7 displayed non-alternating patterns and 3 had alternating follicular wave patterns.

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. Progesterone treatment significantly increased the proportion of 3-wave cycles as compared to control ($p<0.05$). In the treated heifers, the mean maximum diameter of the DF of wave 1 was smaller ($p<0.001$) compared to untreated control. No significant difference was observed in the mean diameters of the ovulatory follicle and CL, and mean duration of IOI between progesterone treated and control heifers. Besides, no change in fertility was recorded in progesterone-treated heifers (7 pregnant out of 16; 43.8%) as compared to untreated control heifers (4 out of 10 heifers; 40.0%).

## Infra Red Thermography (IRT) applications – night grazing behaviour studies in Banni buffaloes

***AK Balhara, Sunesh, PC Lailer and KP Singh***

The natural behaviour of animals is disturbed by sear presence of man. The infrared thermal (IRT) imaging gives unique opportunities to identify and record such behaviours in environment as greater viewing distance is possible with an infra-red (IR) camera.

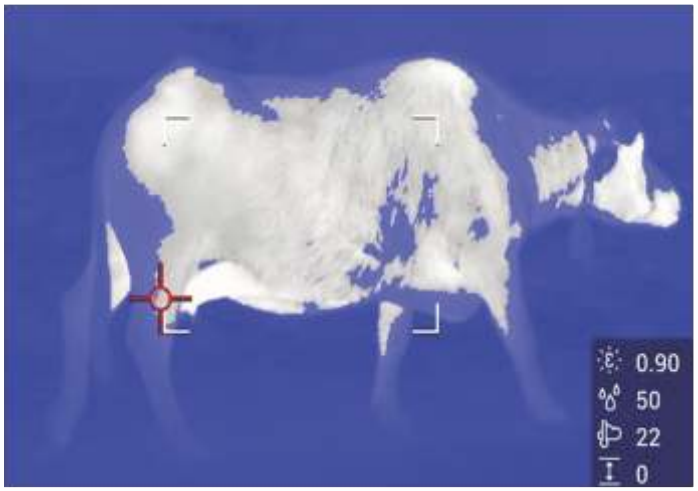
Herd being fed concentrate in the morning

Herd resting on community land during daytime

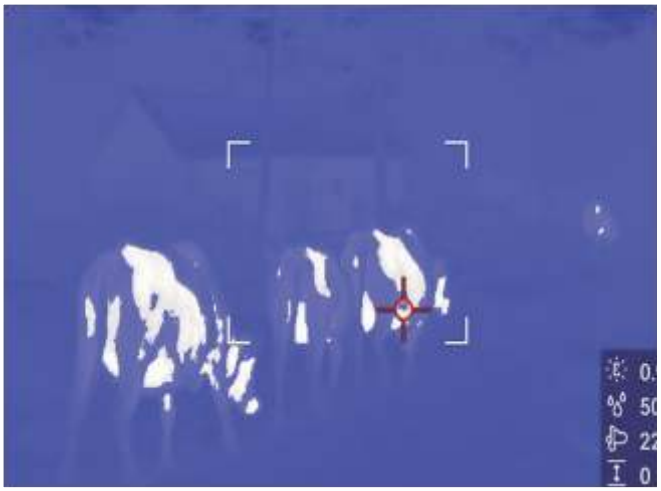
Herds moving out in forest for grazing after evening milking

Herds coming back in early morning (before sunrise) after night grazing

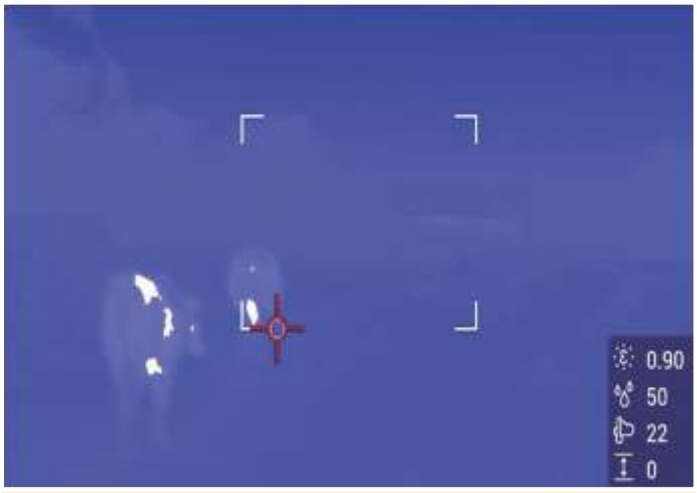
The night grazing is a unique feature of the banni buffalo production system, which evolved as a tool to offset severe daytime environmental heat and conserve energy and water for optimum productions. A typical banni dairy buffalo herd with a traditional 'Maldharis' (local name for pastoralist in Kachchh area of Gujarat) is organised into a social hierarchy. This hierarchy in an all-female herd is determined by age, weight and height at withers.




Leader buffalo



Buffaloes returning home following leader




Leader buffalo


Buffaloes returning home following leader

There is a leadership pattern in the banni herd, which is most visible during grazing. The herd leaves for grazing in the evening after milking under the leadership of a dominant female. This particular buffalo has a bell tied around its neck. The sound produced by the bell is distinct for each herd and is recognised by all animals in the herd. During movements for grazing and return thereafter, all animals follow their leader aided by the bell sound and visual cues. Interestingly, the buffaloes tread fixed, known paths for grazing. The buffaloes have sense of belonging for the herd and do not go beyond ten kilometres form the owners' house. Probably, motherly instinct for the calves and desire for the concentrate feed on return, are the drivers for returning after grazing in these buffaloes.

Attributes towards leadership in banni buffaloes herd (n=14) :

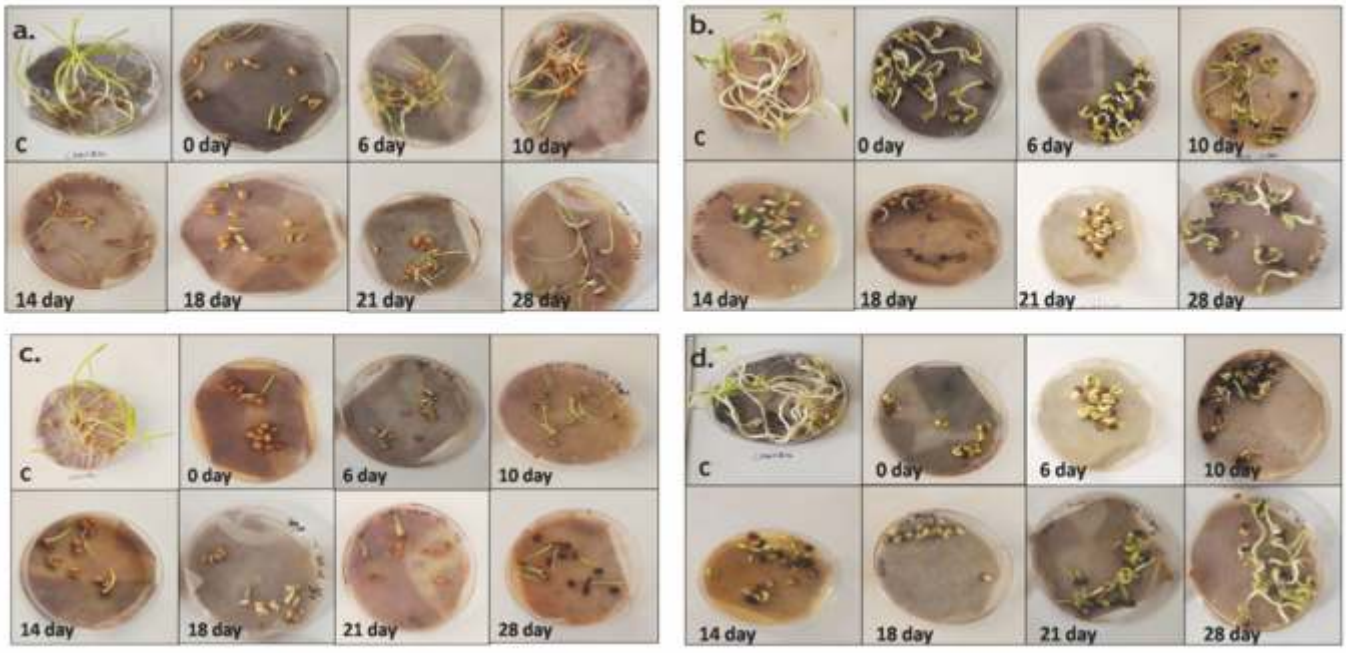
- Age (>5 years)
- Height at withers (>135cm)
- Body condition score (3-3.5)
- Dominating nature

The banni buffaloes spend approximately eight hours per day in grazing (n=100). Most of this time falls between sunset and dawn in the early morning next day.

## An alternative urine-based non-invasive early estrus test in buffalo using germinating seeds

***Varij Nayan, Anuradha Bhardwaj, R.K. Sharma, Anurag Bharadwaj***

Identification of buffaloes in estrus at an early stage is very important for farmers in dairy entrepreneurship. The present study was carried out to evaluate this test for early estrus identification for the first time in Murrah buffaloes, so that the farmers can predict the onset of estrus in their herd. The urine samples were collected from two Murrah buffaloes on day 0, 6, 10, 14, 18, 21 and 28 after detection of obvious signs of heat. Fifteen seeds each of wheat and mung bean were used for analysis. Two dilutions of urine sample with distilled water (namely, 1:2 and 1:4) as well as undiluted urine sample were added to the test plates. A significant inhibition of seed germination [Germination inhibition percentage (GI%)] after 48hrs and shoot length after 5 days as compared to control sample (distilled water only) was observed with 1:4 dilution of urine samples. Undiluted and 1:2 diluted urine inhibited the seed germination probably because of higher salt concentrations. It was observed that GI% and shoot length gradually increased up to $10^{th}$ day and $14^{th}$ day onwards, it suddenly decreased and again gradually increased from $18^{th}$ day onward. The starch and soluble protein content of different seeds is significantly decreased with the germination stage in many studies.

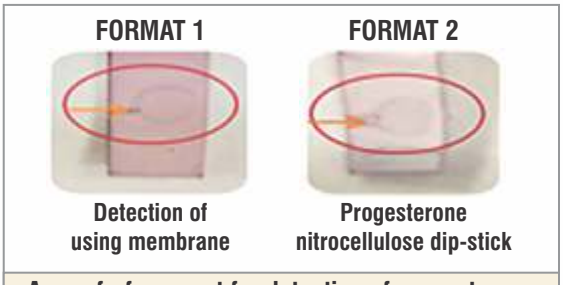



**Seed germination inhibition test of buffalo estrous cycle urine samples with (a) & (c) Wheat (b) & (d) Mung bean seed**

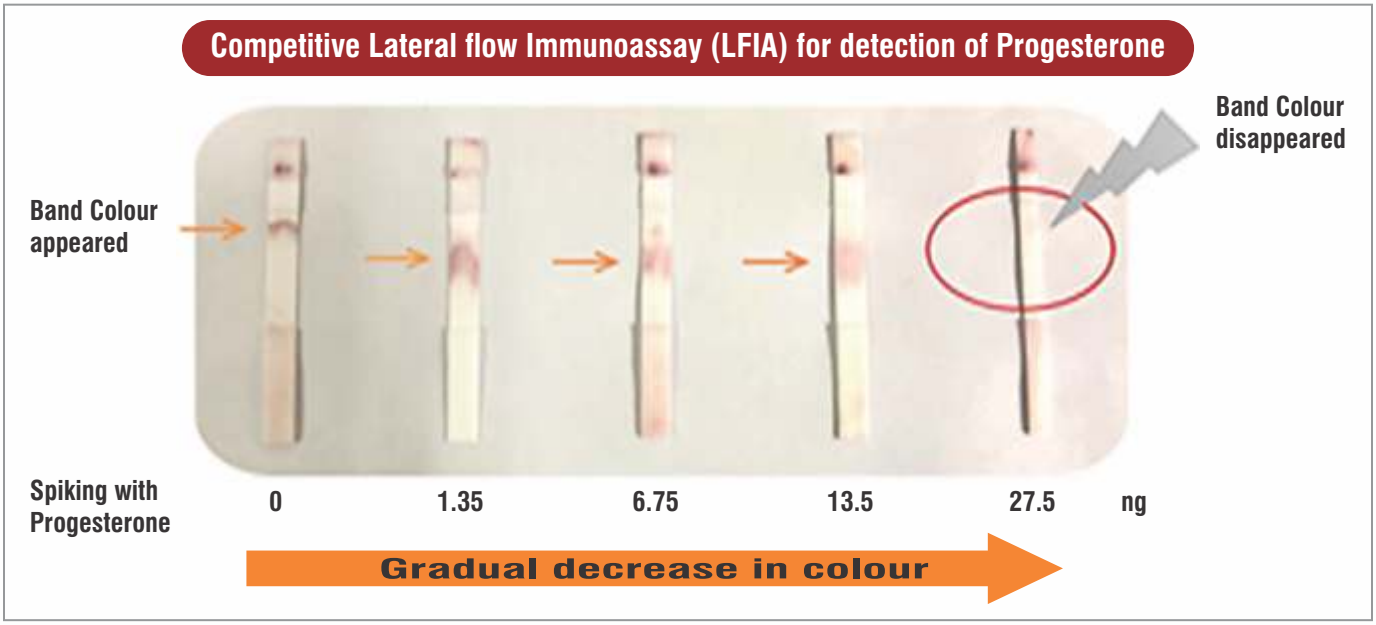
## An in-house developed proof-of-concept for detection of progesterone using LFIA

*Varij Nayan, Anuradha Bhardwaj, R.K. Sharma*

For pregnancy diagnosis in buffaloes and cattle, ELISA is a multistage complex process and difficult to conduct under non laboratory conditions, therefore, a rapid and portable method for detection of low molecular weight compounds like progesterone such as dip-stick and lateral flow immunoassay (LFIA) is more efficient. We have developed dipstick (2 formats) and a competive LFIA for detection of progesterone through spiking experiments.




**A proof-of-concept for detection of progesterone using nitrocellulose membrane based dip-stick**

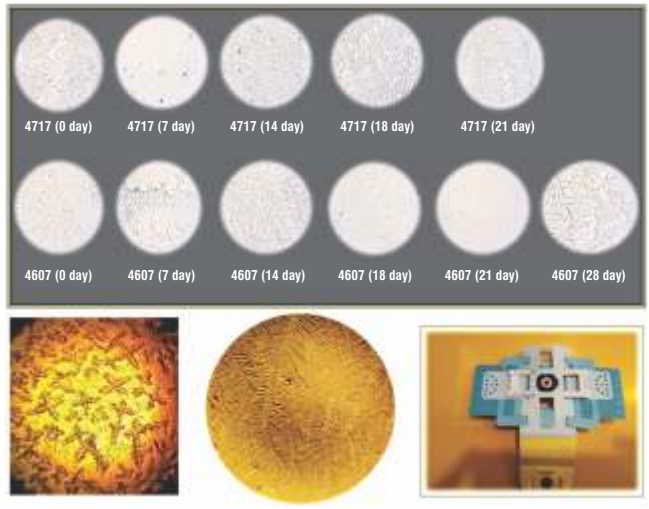



**A proof-of-concept for detection of progesterone using competitive lateral flow immunoassay**

## Topography of tears for understanding ferning landscape in buffalo estrus cycle

***Varij Nayan, Anuradha Bhardwaj, R.K. Sharma, Anurag Bharadwaj***

The fern patterns are evident in the cervicovaginal fluid which are used by many to confirm the estrus for a breeding decision. Our group has earlier presented the crystallization patterns of the saliva as an alternative method for estrus detection in buffaloes. We have searched other bio-fluids for their crystallization forming ability to be visualized under microscope. We present the first evidence of fern patterns from the buffalo tears. In this study, two female non-pregnant Murrah buffaloes (*Bubalus bubalis*) were considered during the estrous cycle. Clear fern patterns are evident and these results have potential for further examination under other reproductive events, such as pregnancy and it can be applied to other livestock species as well. Apart from this, we have been successful in adapting the Foldscope for visualization of tear fern patterns without the need of any expensive microscope. The foldscope lens was easily utilized to visualize the tear and saliva patterns using a mobile phone with camera.

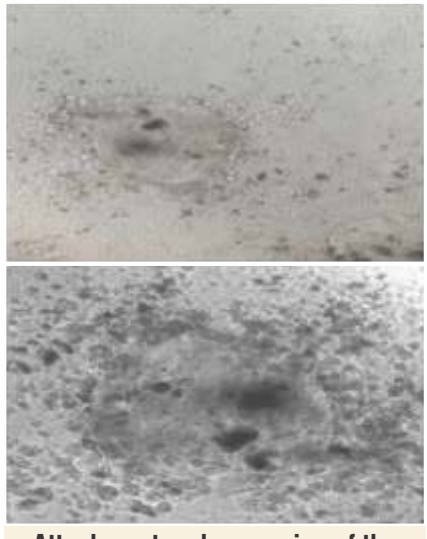



**Different tear crystallization/ fern patterns in buffaloes. Foldscope was also used for visualization**

## Synthetic endometrium for study of early embryonic development in ruminants

***Dharmendra kumar, Naresh L Selokar***

The aim of this study was to evaluate the interactions of synthetic endometrium with embryo and uterine pathogens/ pathogen associated molecular patterns. The most commonly studied pathogen associated molecule is lipopolysaccharide (LPS), secreted as endotoxin by infectious gram-negative bacteria such as *Escherichia coli* that affects the ovarian cycle and oocyte growth. To achieve the goal of the present study, immature quality oocytes (n=876) collected from buffalo ovaries were subjected to maturation (692, 78.9%) and fertilization *in vitro* in suitable medium with a cleavage rate (416, 60.1%) which subsequently led to development of hatched (61, 14.6%) and expanded (36, 8.6%) blastocyst stage of embryos by day 8-9 post-insemination. Total cell number (147.6) and apoptotic index (6.9%) was determined for healthy embryos using Hoechst 33342 and TUNEL assay, respectively. Differential staining of hatched blastocysts revealed 36.5% cells representing inner cell mass and rest 63.5% trophectoderm cells. Some of these embryos used for embryo-pathogen interactions and gene expression studies (P53, CASPASE3, OCT4, NANOG, FGF4, SOX2) with the developed 3D-ECC system at IVRI and NDRI centers. Effect of *E. coli* LPS on the developmental competence of buffalo oocytes *in vitro* revealed that LPS @ 10$\mu$g/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%). The confluent stromal culture treated with LPS (100 ng/mL) alone or in combination with lipoteichoic acidis (LTA; 1$\mu$g/mL) showed a marked up-regulation of proinflammatory cytokines (IL-8, IL-6 transcripts) and $PGE_2$ indicating expression of functional TLR2 and TLR4 which was modulated/ reversed by the Curcumin (30$\mu$M) treatment.



**Attachment and expansion of the buffalo embryo on endometrial cells**

## Production of multiple copies of elite buffalo using cloning technology

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

The aim of this project is to produce multiple clones of elite animals, improve cloning efficiency and study growth, and reproduction of produced clones. During the period under report work was conducted on all the three objectives. The selection of the bulls for cloning was made out of the breeding bulls at different centres under the network project on buffalo improvement. A committee with breeders, semen experts and cloning team members selected the bulls considering pedigree records and semen quality as major criterion of selection. During reporting period, somatic cells from 5 selected superior animals were established and used as donor cells for cloning of superior animals. Out of these cell lines, cells from a Nili-Ravi bull and a high yielding Murrah female were also used for cloning experiments.

During this period, a total of 654 embryos were reconstructed from doublet method and 184 from the singlet method resulting in 145 and 12 blastocysts respectively. The blastocysts formed through singlet method were used for research experimentation like epigenetic staining and molecular biology studies. The blastocysts generated through doublet method were used for transfer in synchronized female animals and total of 53 embryos were transferred. Out of total embryo transfers, 15 animals were found pregnant. Out of total 15 pregnancies 10 continued and 5 successfully calved upto 31$^{st}$ December, 2019 and rest likely to be calved (Animal number, date of birth, birth weight etc shown in the Table). Five pregnancies were lost at different stages of gestation.

**Telomere length of buffalo somatic cells and telomerase enzyme activity :** Length of telomere on chromosomes determines the age of the animals/cells. This depends on the telomerase enzyme activity; high telomerase activity maintains the telomere length and prevents cells aging. To study and maintain the aging of cloned embryos, we used cycloastragenol (CAG)-telomerase activator (also known as TA 65) to treat the somatic cells and evaluated relative telomere length by qPCR, estimation of telomerase activity and expression of TERT gene in normal and TA-65 treated somatic cells, determination of cellular viability and epigenetic markers (H3K9ac and H3K27me) and determination of apoptotic and epigenetic gene expression pattern in normal and TA-65 treated somatic cells. This study concluded that CAG increases telomere length of buffalo somatic cells at concentration of 10 uM by activating the telomerase enzyme activity. CAG has positive effect on cellular integrity and it alters epigenetic gene expression and also decreases apoptotic gene expression.

**Table 4 :** Cloned calves born at ICAR-CIRB during April 2019 to December 2019

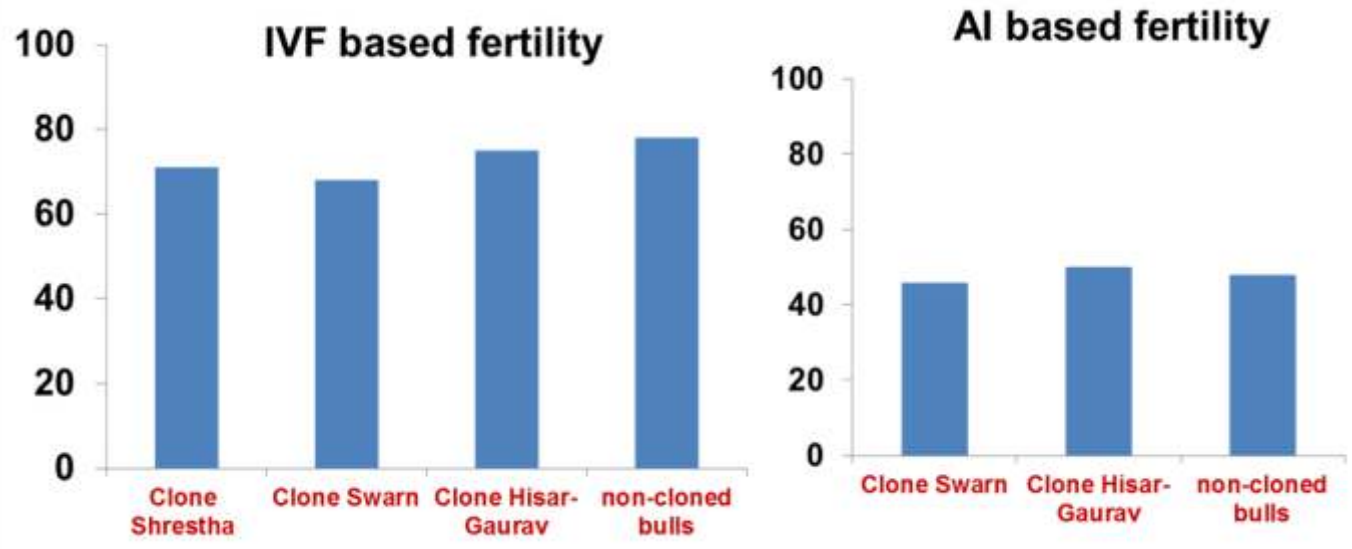
| S. No. | Calf No. | Date of birth | Birth weight (Kg) | Recipient No. | Donor bull No. | Status as on 31.12.2019 |
|---|---|---|---|---|---|---|
| 1 | E-263 | 18-10-2019 | 34.0 | E-210 | M-29 | Alive and healthy |
| 2 | E-264 | 21-11-2019 | 42.5 | E-230 | M-29 | Alive and healthy |
| 3 | E-265 | 28-11-2019 | 30.0 | E-245 | M-29 | Alive and healthy |
| 4 | E-266 | 24-12-2019 | 41.5 | E-244 | M-29 | Alive and healthy |
| 5 | E-267 | 27-12-2019 | 41.0 | E-214 | M-29 | Alive and healthy |

**Evaluation of chromosome number and genetically transmitting disease** : All cloned calves were evaluated for the chromosome number using karyotyping method and found normal chromosome number. All cloned calves are free from genetically transmitted diseases (factor XI deficiency syndrome (FXID), bovine leukocyte adhesion deficiency (BLAD), and bovine citrullinemia (BC). These tests were carried out by NDDB, Anand, Gujarat.

**Semen production of cloned bull :** Earlier produced cloned bulls namely- Hisar-Gaurav and Sach-Gaurav is growing well and routinely evaluated their health status. Hisar-Gaurav produced more than 10000 frozen semen doses and some of them used for fertility evaluation and for artificial insemination in interested farmer's animals. At present, ~9,000 frozen semen doses are available in stock for further use.

The Sach-Gaurav also started to donate semen and currently have 323 frozen doses of semen in stock. We recorded multiple semen parameters such as ejaculated volume, sperm concentration, and mass sperm motility, which were found similar to other non-cloned bulls, including the donor bull. In addition, morphometric analysis, viability, plasma membrane integrity, and computer-assisted sperm analyzer (CASA) indices of cloned bull sperm were found similar to that of non-cloned bulls.

**Evaluation of fertility of cloned bull's semen :** To predict the suitability of cloned bull for breeding schemes, we performed in vitro and in vivo fertilization studies using cloned bull semen. In vitro blastocyst production rate (18%) of cloned bull semen was comparable to the donor bull semen (16%). Following artificial insemination with frozen semen doses, the conception rate (55%) of cloned bull semen was comparable to non-cloned bulls, including donor bull (50-60%, conception rate recorded in our institute's buffalo farm). The progenies of cloned bull (n=12) are healthy and have normal growth. Apart from this we also evaluated the fertility parameters of cloned bull's semen produced at NDRI and result demonstrated that embryo production rate or quality of produced blastocysts did not differ between donors and cloned bulls. The pregnancy rate of cloned bulls was in range of 46-50%, which is within the expected normal pregnancy rates in buffalo (45 to 55%).




**Fertility of cloned bulls is similar to non-cloned bulls**

Freezing of Hisar-Gaurav semen is continued and 9000 semen doses are in stock. Sach-Gaurav the Assamese cloned bull was trained for semen collection, all the semen parameters were recorded and >300 semen doses were frozen as per MSP parameters. Hisar-Gaurav semen was used for artificial insemination and 20 established pregnancies are continuing at late stage of gestation. The twelve progenies have already been produced earlier from Hisar-Gaurav semen and all are in good health.

## Survey and dissemination of knowledge for hygienic AI practices for enhancing buffalo fertility

***A Jerome, MH Jan, VB Dixit, RK Sharma***

The present project was designed to conduct survey and disseminate of knowledge for hygienic AI practices for enhancing buffalo fertility. In this project, questionnaires were developed for inseminators as well as stakeholders with respect to standard artificial insemination practices under field conditions. Also, semen dose were distirubuted for field inseminations and recording of the conceptions rates of various inseminators is in progress.

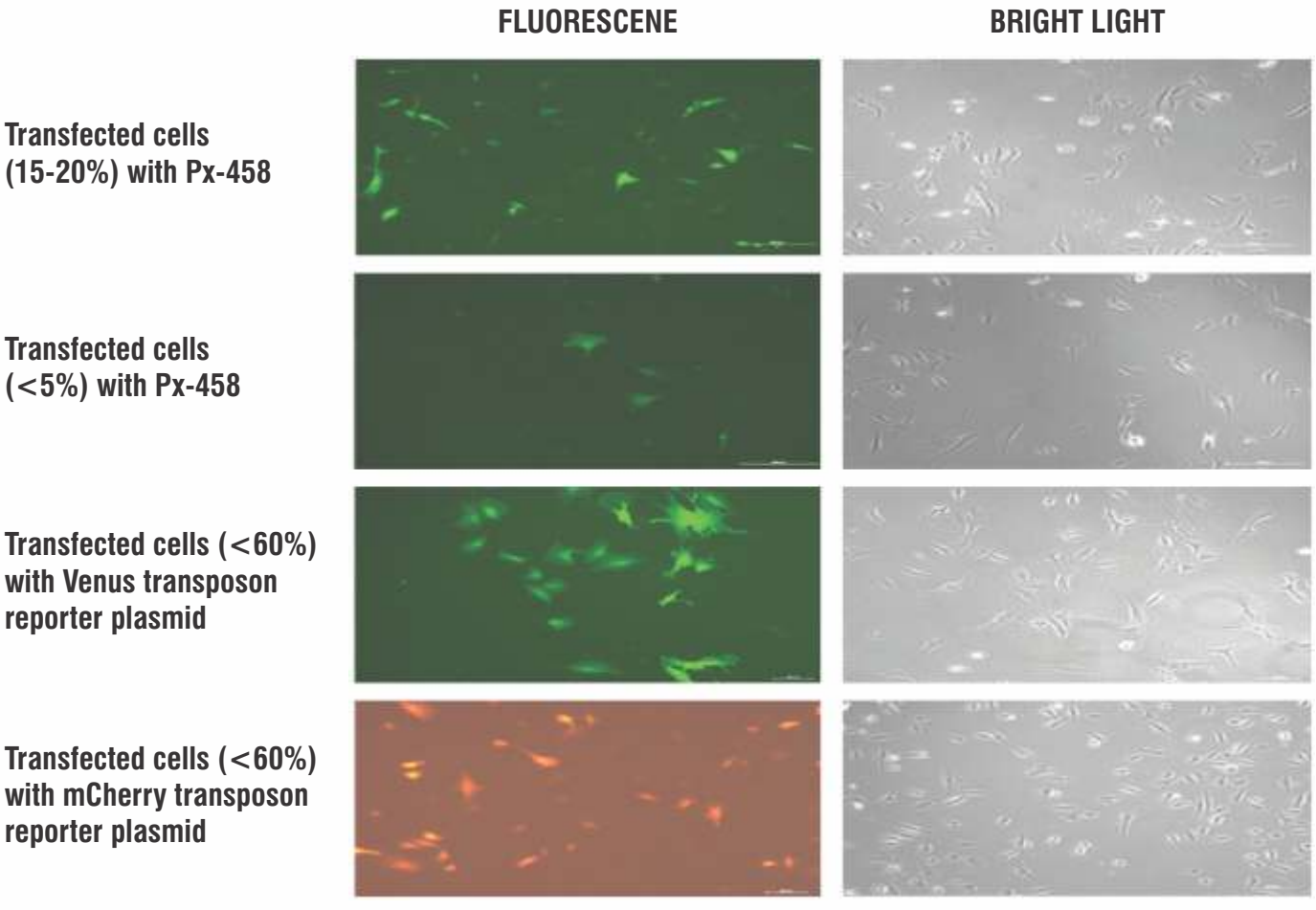
## Production of myostatin gene-edited buffalo bulls using CRISPR/Cas system

***Naresh L Selokar***

Advances in genome editing technologies, such as the CRISPR/Cas9 system, have facilitated gene manipulation and the generation of farm animals having improved production traits. This project aims to explore the CRISPR system to optimize conditions to produce the MSTN gene (the muscle growth controlling gene) knockout breeding bulls for improved meat production in buffalo, the farm animal called India's meat factory. For achieving this goal, somatic cells (skin-derived fibroblasts) of two bulls (their cloned copies have already been produced by our team) were selected for editing. Cloned copies of these two bulls will work as control cohort animals.

Three gRNAs were cloned into two CRISPR expression cassettes (PX-458 and PX-459). The correct sequence and ligation were confirmed by restriction enzyme analysis and Sanger sequencing. The transfection conditions (different current settings of electroporation, size of cuvettes, etc) were optimized to transfect the maximum of cells. At present, we achieved the highest 15% transfection rates with CRISPR plasmids and 80% transfection rates with reporter plasmids (GFP and m-Cherry). We optimized the protocol to generate colonies from single cells and the effective killing dose of puromycin for buffalo fibroblasts.

To confirm the gene knockout, the genomic DNA was isolated from PX-458 electroporated somatic cells after 72 hr. Genomic PCR was performed to detect indels using primers designed against target sites. PCR products were used to form hetero-duplexes and the T7E assay was performed. However, we could not found any differences in bands of transfected cells and control cells. This may be due to very poor transfection rates. The experiments are on-going to increase transfection rates, to establish cultures of edited cells having MSTN modifications.



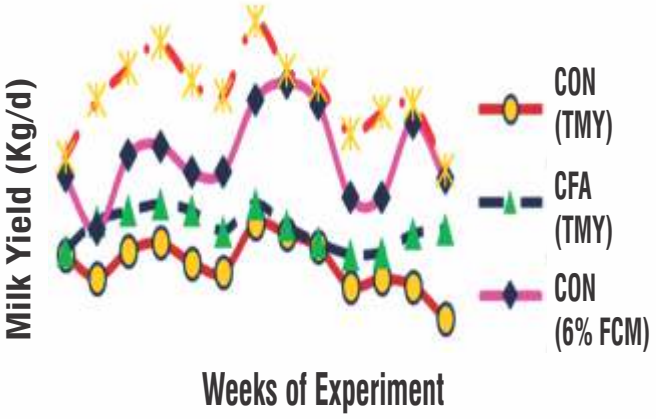
## Feed Resource Utilization and Improvement

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 offer 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. Keepings 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 and crop residues and processing industry by-products for animal feed and fodder.

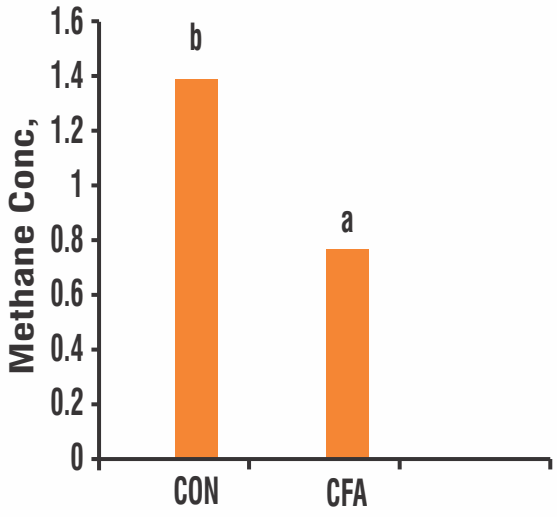
### Reducing enteric methane production from lactating Murrah buffaloes: Effects on production performance and immune status

***Avijit Dey, Kiran Attri, SS Dahiya, A Jerome, A Bharadwaj***

Ruminant livestock production processes are the major sources of methane production in agriculture sector triggering global environmental pollution. In this study, we examined the effect of dietary composite feed additive supplementation on ruminal methane production, nutrient utilization, milk production and immune status of buffaloes (*Bubalus bubalis*). Eighteen lactating Murrah (*Bubalus bubalis*) buffaloes at early stage of lactation were divided into two groups of nine animals. All animals were fed on basal ration consisting of green sorghum (*Sorghum bicolor*), wheat straw and concentrate mixture to meet the maintenance and milk production requirements. Animals in treatment group (CFA) were offered composite feed additive which contained an ideal combinations of methane inhibitors, alternate hydrogen sinks and rumen stimulating agents. The results showed a decrease (44.6%) in methane concentration in exhaled air of CFA group buffaloes with increase ($p<0.05$) in digestibility of feed in comparison to control (CON). Total digestible nutrient (TDN) content of the ration fed to buffaloes of CFA group was increased. The daily milk yield, 6% fat corrected milk (FCM) yield and immune response were also increased in CFA group. The study suggests that the supplementation of composite feed additive was effective to reduce enteric methane emissions and improvement in production performance and health status of buffaloes.




**Effect of dietary supplementation of composite feed additive on weekly averages of daily milk production (kg) in buffaloes**




**Influence of feeding composite feed additive on in vivo methane production (methane concentration in exhaled air, ppm) in buffaloes**

## Feeding value of bmr sorghum (Sorghum bicolor L.) fodder in lactating buffalo

***Avijit Dey, PC Lailer, SS Dahiya***

Sorghum (*Sorghum bicolor* L.) plays a significant role in global fodder production. Besides food grain and fodder crop production, it is also used for biofuels and alcoholic beverages manufacture. Several forage sorghum hybrids/varieties were developed by Indian Institute of Millets Research, Hyderabad. The cultivars have very high green forage yield with low lignin and HCN content. Among few cultivars, tested for fodder quality in buffalo calves earlier, feeding of brown midrib (*bmr*) sorghum (SPV 2018) variety resulted higher (14%) growth rate and nutrient digestibility in buffalo calves. In the present study, a feeding trial on mid-lactating buffalo was conducted for 90 days to examine the feeding value of *bmr* sorghum (SPV-2018) fodder over local variety (MFSH-4). The proximate analysis and fibre fractions of both the sorghum cultivars revealed lower fibre (both NDF and ADF) and lignin (ADL) content of *bmr* sorghum fodder, SPV-2018 than MFSH-4. The *in vivo* digestibility of DM, OM, NDF and ADF were higher ($p<0.05$) SPV-2018 fodder as compared to MFSH-4 fed buffaloes, suggesting better nutrient availability, which was also evident in milk production. There was increase ($p<0.05$) in daily milk yield (9.64%), 6% FCM (18.55%) and FPCM

**SPV- 2018 Sorghum fodder variety cultivated in agriculture field at CIRB Hisar**

**MFSH- 4 Sorghum fodder variety cultivated in agriculture field at CIRB Hisar**

**Measurement of fodder field for yield determination**

**Differences in the leaf's morphology of SPV-2018 and MFSH-4 sorghum fodders**

(11.53%) in SPV-2018 fodder fed buffaloes in comparison to buffaloes fed MFSH-4 sorghum fodder. It is concluded that feeding of novel *bmr* sorghum cultivar, SPV-2018 enhanced nutrient utilization and milk production in buffaloes thus confirming the superiority of SPV- 2018 variety.

## Effect of supplementation of galactogogue herbal mixture (GHM) on production performance

***N Saxena, Vishal Mudgal, P Sikka, ML Sharma, Krishan Kumar***

Feeding trial was carried out to evaluate the supplementation of GHM, selected based on its proximate analysis, phenolic content and anti-oxidant properties. 24 Lactating buffaloes (2-6 lactations) were selected & divided randomly in two groups of 12 each. The feeding was done as per ICAR (2013) feeding standards. Two percent wheat bran was replaced by GHM in the treatment group and all the other ingredients of concentrate mixture were same for both the groups. Supplementation was done in three phases of 10 days each at the gap of ten days between the two phases which incurred additional cost of Rs. 1320 per animal in total of 50 days in the treatment group over the cost incurred in control group. Milk yield and percent fat was recorded for these animals during the trial period and for the residual period thereafter. Milk production was higher during the residual period though non-significant. Body weights of the buffaloes were recorded at initial stage followed by initiation and end of the last phase feeding. No significant difference in body weights were observed between the groups. Blood samples analysis (day zero and before start of third phase and at the end of supplement feeding) revealed that there was no significant difference in the parameters studied viz. blood glucose, total protein, albumin and cortisol. The milk recording is continued for the complete lactation to see the effect of supplementation on whole lactation. Statistical analysis will be done after lactation of all the buffaloes completes.

### Feed ingredients (in percentage) of concentrate mixture offered to buffaloes in two groups

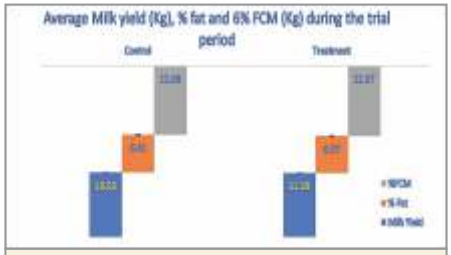
| S.No. | Ingredient | Control | Treatment |
|---|---|---|---|
| 1. | Barley | 40.0 | 40.0 |
| 2. | Groundnut Cake | 35.0 | 35.0 |
| 3. | Wheat bran | 22.0 | 20.0 |
| 4. | Galactogogue Herbal mixture (GHM) | - | 2.0 |
| 5. | ASMM | 2.0 | 2.0 |
| 6. | Salt | 1.0 | 1.0 |

### Weekly production performance of buffaloes in control and treatment groups during trial period

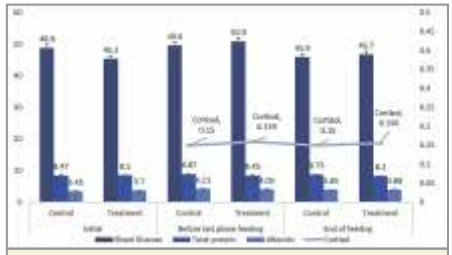
| Group | Parameter | Weeks | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Avg. |
| Control | Milk Yield (Kg) | 11.07 | 12.18 | 10.54 | 11.19 | 10.53 | 10.68 | 10.78 | 10.47 | 10.93 |
| | % Fat | 6.83 | 6.50 | 7.05 | 5.79 | 6.07 | 6.71 | 5.96 | 6.40 | 6.41 |
| | 6% FCM (Kg) | 12.60 | 13.18 | 12.38 | 10.80 | 10.65 | 11.95 | 10.71 | 11.16 | 11.68 |
| Treatment | Milk Yield (Kg) | 11.55 | 12.74 | 11.54 | 11.14 | 10.73 | 10.91 | 11.23 | 10.45 | 11.29 |
| | % Fat | 7.04 | 6.73 | 6.86 | 6.00 | 5.70 | 6.86 | 6.50 | 6.84 | 6.57 |
| | 6% FCM (Kg) | 13.56 | 14.28 | 13.20 | 11.15 | 10.19 | 12.47 | 12.17 | 11.92 | 12.37 |

(Non-significant at $p > 0.05$ level)

Average Milk yield, % fat and 6% FCM during the trial in control and treatment groups




Weekly milk production of experimental buffaloes in the two groups since conception



Blood parameters in buffaloes in control and treatment group during the trial period

## Aflatoxicosis in buffaloes (A Pilot Study)

***Ram Singh***

Aflatoxin level in animal feed and feed ingredients, collected from grain markets, feed selling agents, farmers keeping buffalo and animal feed retailers, was monitored during rainy season in Punjab (June end- Early Sept. 2019) and in Haryana (Nov. 2018 to May 2019). The samples were ground through 1 mm sieve using a willy mill and analyzed in duplicate 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. The level of aflatoxin B1 contamination in Punjab samples was higher than those of Haryana samples.

### Mycotoxin levels in feed ingredients and compounded feeds in Punjab and Haryana

| Feeds | Punjab | | | Haryana | | |
|---|---|---|---|---|---|---|
| | Aflatoxin B1 | | | Aflatoxin B1 and Ochratoxin A* | | |
| | % Contamination | Range of Contamination (mg/kg) | Mean Contami-nation | % Contami-nation | Range of (mg/kg) (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 | 0.01 to 0.51 | 0.27 | 60(40) | 0.00-0.09(0.00-0.03) | 0.04(0.01) |
| Groundnut cake | - | - | - | 100(70) | 0.06-0.11(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 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 parenthesis belong to ochratoxin A.

It was concluded that due to high level of mycotoxin contamination in animal feed and feed ingredients the situation is alarming as far as the carry-over of mycotoxins from feed to milk is concerned. The ochratoxin A level of contamination tended to be higher in cereals (maize, barley, sorghum) as compared to other feed ingredients and compounded feeds. Mycotoxin contamination of feed is a complex problem in buffalo production due to the

economics of decreased production performance; adverse effects on animal health and welfare; and the mycotoxin transfer into milk and meat of intoxicated animal. Based on the study, it was recommended that the monitoring of aflatoxin B1 in animal feed and aflatoxin M1 in buffalo milk, should be encouraged and data on the carry-over rate of aflatoxin into milk should be generated based on the modern production system for high producing buffaloes.

## Bypass nutrients for improving performance of high yielding Murrah buffaloes during early lactation

***V. Mudgal***

To assess the effects of supplementing rumen bypass nutrients, twenty lactating Murrah buffaloes (body weight 537±12kg, and milk production 7.73±0.51kg) were divided into two equal groups just after parturition and fed either control diet (ICAR, 2013) with about 25% protein of concentrate mixture as bypass protein or bypass protein rich concentrate mixture having about 40% protein as bypass protein with additional supplementation of 15g bypass fat per kg milk production for a period of 90 days. The results revealed that dry matter intake, body weight and body condition scores were not affected by feeding of protected nutrients, but about 14.6% improvement in milk production was observed during the study. Overall mean values of milk fat, SNF, protein, lactose and total solids were found to be high ($p<0.05$) in treatment group as compared to control group. No influence on haemato-biochemical parameters were observed, except the level of serum cholesterol and HDL cholesterol, which remained high ($p<0.05$) in bypass nutrient supplemented group without any adverse effects on reproduction. Simultaneously, serum total protein and albumin levels were high ($p<0.05$) in group fed bypass nutrient rich diet. The study revealed positive effects of bypass nutrient supplementation in lactating buffaloes.

## Area Specific Mineral Mixture for Tribal villages of Udaipur Rajasthan

The Tribal Sub-Plan (TSP) was adopted as a strategy for the socio-economical upliftment of tribal population. The institute has adopted four villages viz. Roba, Chatpur, Tulsiyon ka namla and Bhainsa ka namla under this programme in the Khera Gram Panchayat, Tehsil Salumber, District Udaipur, Rajasthan. A survey was conducted, and samples of feeds and fodders offered to dairy animals were collected from the tribal area. An analysis for different macro and micro minerals were done. Based on analysis report, the deficiency of mineral elements in the ration of dairy animals were calculated and a mineral mixture was prepared for supplementation. Under the plan mineral salt ingredients for preparation of area-specific mineral mixture were purchased and mineral mixture was prepared and distributed to rural farmers owning dairy animals. The prepared area specific mineral mixture was cheaper to that of normal available BIS specified mineral mixture in market.

## Assessment of chelated minerals on the performances of buffalo calves

Due to poor bio-availability of microminerals through their inorganic sources viz. Cu (about 5% through cupric sulfate, penta-hydrate), Mn (about 1% through manganese sulfate), Zn (about 20% through zinc sulfate), an extensive loss of elements through faeces occur. Therefore, chelation of these trace elements (Cu, Mn and Zn) separately with smallest amino acid glycine were done and examined for their supplementation effects in buffalo calves in an experimental trial of 180 days duration. The level of supplemental Cu, Mn and Zn through Cu-glycinate, Mn-glycinate and Zn- glycinate chelates, respectively in the ration of buffalo calves were half (50% i.e. Org50), three fourth (75% i.e. Org75) and same (100% i.e. Org 100) as that being used in their individual inorganic source group i.e. control (InOrg 100). The existence of Cu in four different rations was 7.73, 4.68, 6.07 and 7.42ppm in control (InOrg 100), Org50, Org75, and Org100 treatment groups, respectively. Similarly, the dietary Mn level used in four different groups were 59.20, 47.39, 52.38 and 57.28 ppm, respectively. The dietary Zn levels maintained in four different groups were 71.28, 49.23, 58.58 and 67.76 ppm, respectively. Supplementation of either chelated Cu, Mn or Zn was able to compensate the nutritional demand when given up-to-half of the amount through their inorganic sources without any adverse effect in buffalo calves either on blood levels of Cu, Mn and Zn, biochemical parameters, total antioxidant status and immune response. Plasma level of ceruloplasmin was improved ($p<0.05$) in the two groups fed highest levels of Organic Cu, remains indicative of superior bio-availability through organic

source over the period (i.e. at day 135 and 180 of the study). The antioxidant enzyme, superoxide dismutase (SOD) remained higher ($p<0.05$) in all three chelated mineral supplemented groups as compared to control. Fecal excretions of Cu, Mn and Zn were also reduced ($p<0.05$) in the chelated mineral supplemented groups, which is indicative of environment friendly nature of organic mineral supplementation.

## Critical micronutrient supplementation for peri-parturient Murrah buffaloes to enhance productivity

Twenty-two healthy Murrah buffaloes in an advanced stage of gestation (average 53 days prior to their expected date of parturition) were divided into two equal groups i.e. control and treatment, respectively. Buffaloes of both the groups were maintained on farm's standard feeding practices as per their requirement. Additional micronutrient supplementation of Zn, Cu, Co, Cr, Se, vitamin E, vitamin A, and niacin was carried out once in a week in buffaloes of the treatment group. Supplementation of critical micronutrient improved production performance of Murrah buffaloes in terms of total milk (18%) and fat corrected milk ($\approx$30%, $P<0.05$) in addition to improvement in fat and protein percentage ($p<0.05$). Critical micronutrient supplementation did not affect blood biochemical and micronutrient profile significantly, except for an improvement ($p<0.05$) in plasma inorganic phosphorus level in the treatment group on the day of parturition. At day of parturition high level of blood phosphorus may have a positive influence, as low phosphorus remains a critical predisposing factor for post-parturient disorder milk fever.

## Vitamin A and E supplementation to improve productive and reproductive performances in peri-parturient Murrah buffaloes

Twenty two Murrah buffaloes in their advanced stage of pregnancy (-30 day) served as either un-supplemented (control group, $n=8$); supplemented with vitamin A @ 75,000 /1,50,000 IU daily from -30 to +90 days, while vitamin E @ 1500/3000 IU from -30 to +30 days of study, followed by 500/1000 IU daily up to 90 days of calving in treatment group T1 ($n=7$) and T2 ($n=7$), respectively. No incidence of clinical mastitis, retained placenta, metritis, and prolapse of uterus were reported in group T2, while one buffalo each from group T1 was suffered for clinical mastitis and metritis, whereas buffaloes of control group showed all four reproductive disorders mentioned above in four different buffaloes. Supplementation of vitamin A and E at higher level (T2) were helpful to increase ($p<0.05$) the milk protein, fat and total solids percentage as compared to control, with 7% and 10% increase in fat corrected milk (FCM) production in T1 and T2 groups, respectively over control group. Higher ($p<0.05$) protein and total solids % was also reported in colostrum of group T2 as compared to control. At day 30 of the study plasma glucose values were high ($p=0.014$) in group T1 with reduced value of cholesterol in group T2 at day 90 ($p=0.004$) as well as overall mean ($p=0.012$) values as compared to control values. Overall mean values of plasma total antioxidant activity remained high ($p<0.05$) in group T2 only, with improvement ($p<0.05$) of total immunoglobulins in both the treatment groups at day 90 of the study. Blood parameters of calves born to vitamin supplemented dams had no effect on most of the studied parameters, except an improvement in overall mean values of plasma $\beta$-carotene ($p=0.016$) and vitamin E ($p=0.047$) in group T2 as compared to control. Supplementation of vitamin A and E were helpful in reducing the time of expulsion of placenta (4.02-4.09 Vs. 5.51 hr) with improvement in cyclicity % in buffaloes 85.71%, 42.86% and 37.5% in groups T2, T1 and Control, respectively.

## Azolla based concentrate mixture on nutrient digestibility in lactating buffaloes

Murrah buffaloes ($n=10$) were distributed randomly into two equal groups. Control group of buffaloes were fed concentrate mixture prepared by commonly available feed ingredients, while the concentrate mixture of the treatment group was prepared including 10% of the dried *Azolla* by keeping both the concentrate mixtures iso-nitrogenous and iso-caloric. Results of digestion trial indicated a positive ($p<0.05$) response on the digestibility of dry matter, organic matter, neutral detergent fiber and acid detergent fiber, while the digestibility of crude protein and ether extract remained unaffected. No significant ($p>0.05$) effect was apparent on total milk production during a feeding trial of 28 days, but fall in production of fat corrected milk was higher in the control group as compared to the fall in treatment group during the period of study. It may be concluded that *Azolla* based concentrate mixture was compartable in terms of nutrient utilization without affecting milk production.

# Transfer of Technology Unit

## Convergence for Dairy Development: A synergistic Approach

***VB Dixit, H Tripathi, Sajjan Singh, SK Khurana and R Chabra***

Convergence of all the concerned agencies/organizations was aimed at promoting integrated approach for dairy development in this project. To achieve this objective a model of convergence was developed and tested under field conditions. It helped in reaching large number of farmers and provided specialized services at a lower cost. As a result, it hastened the process of dairy development in the country. It lead to increase in the knowledge of farmers about clean milk production. The results indicated that quality of milk produced by the farmers improved. Ultimately, it helped in reducing the Somatic cell counts in the milk which lead to clean milk production by the farmer. Moreover due to regular testing of milk samples and treatment of infected animals milk yield also increased.

A training was planned under SCSP component and six visits were made to the 10 villages adopted under FPT programme of the institute to make preparation for this work.

- Identified 49 farmers belonging to SC community whose buffaloes were recorded for one lactation.
- These farmers were invited to the institute for an interaction meeting on 12th Sept., 2019. During this meeting, needs of the farmers to adopt dairy as an enterprise were identified.
- A training programme of these farmers was conducted under SCSP during 3-7, Dec., 2019. Steel drums of 40 litres capacity were distributed to participants to promote dairying as an enterprise in the 10 FPT villages along with other inputs like animal mats and 50 kg feed bags.


**TOTE unit conducting various programs with buffalo farmers at Institute and in the field**

## Development of need based mobile app

***H Tripathi, VB Dixit, D Kumar and S Singh***

Bufealth is an educational mobile app, designed and developed to impart knowledge and as a guide for buffalo owners VLDA and graduating veterinarians. The App provides basic information on different areas of buffalo Health by dividing the whole content into six distinct segments. The major areas and sub areas covered are; Basics of Buffalo feed health (Signs of sound animal health, General considerations for animal examination Precautions during collection, preservation and dispatch of samples for disease diagnosis). Major infectious diseases (Foot & mouth disease Haemorrhagicsepticaemia Black quarter Bovine ephemeral fever Mastitis Foot rot Navel ill Calf pneumonia Neonatal calf diarrhea), Major parasitic diseases (Endo-parasitic infestation Ecto-parasitic infestation Babesiosis /Tick fever Surra /Trypanosomosis), Major metabolic diseases (Milk fever, Ketosis, Downer syndrome), Major zoonotic diseases (Brucellosis/ Contagious abortion, Anthrax, Paratuberculosis /Johne's disease, Tuberculosis/TB, Rabies) and General rules for disease prevention and control (General information on prevention of infectious diseases, First aid Vaccination in animals & schedule Deworming schedule) with unique photographs.

The App is presently available in Hindi and English languages with voice facility. Complete App content has audio backup with download facility.

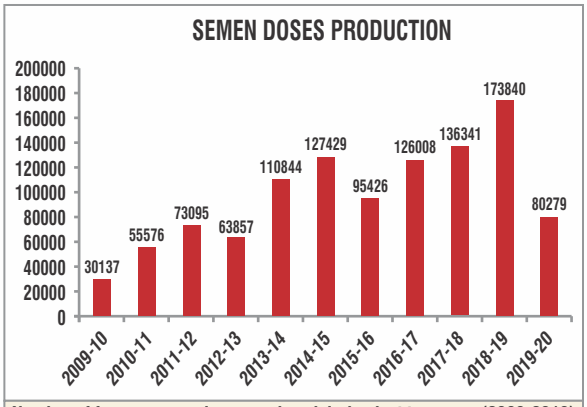

**Shri Giriraj Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India and Dr. Sanjeev Kumar Balyan, Hon'ble Minister of State of Fisheries, Animal Husbandry and Dairying, Govt. of India launching mobile app 'Bufealth' on 16th August, 2019**

# Development of Technologies and Their Transfer to End Users

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

**Impact of quality semen produced by institute :** Institute maintains a high pedigreed herd of Murrah and Nili-Ravi buffaloes. The institute has been undertaking breed improvement programme through selective breeding since its inception. The genetic potential of bulls is evaluated through progeny testing. Due to intense selection pressure, production performance of Murrah and Nili-Ravi herds improved from about 5.86 kg in 1991 to 9.09 kg in Nili Ravi and 4.80 to 9.53 kg in Murrah during 2019.

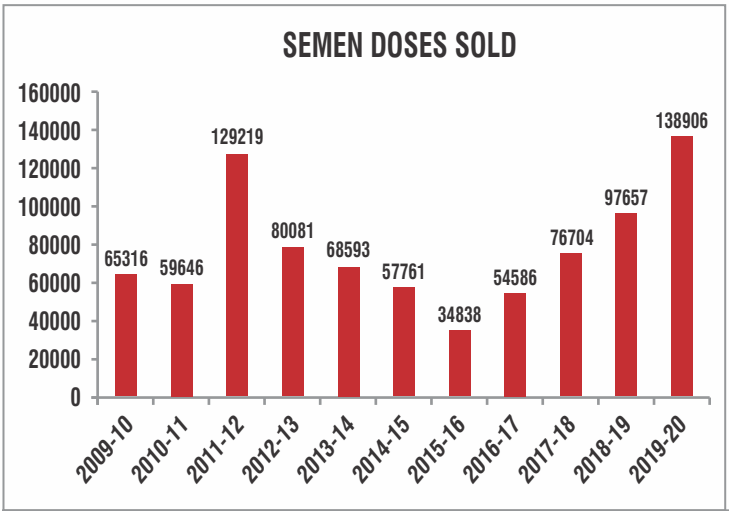
More than four lakh doses of frozen semen from test bulls and over sixty thousand doses from progeny tested bulls are available for Murrah breed improvement. About 444 Murrah and 302 Nili Ravi bulls of high genetic merit have been supplied to various developmental agencies and village panchayats in 12 States for increasing milk production through genetic improvement. Under field progeny testing program in adopted villages, more than one lakh AIs were done so far with frozen semen of test bulls with conception rate of 48%. Year wise frozen semen production from Murrah bulls are indicated in the figure.

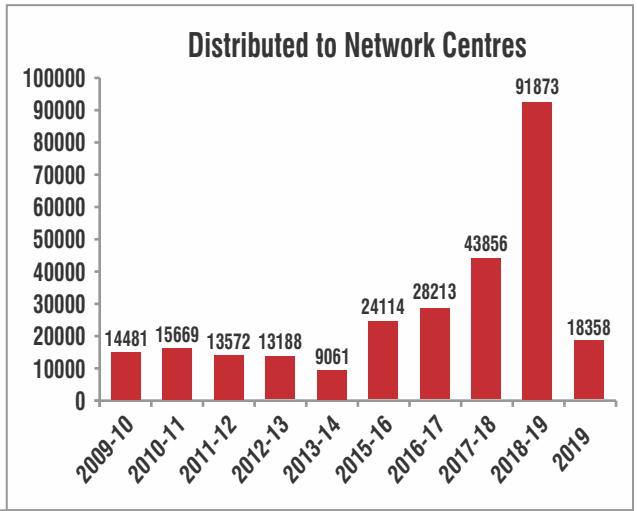


Number of frozen semen doses produced during last ten years (2009-2019)

## Dissemination of quality germplasm (semen) for breed improvement

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

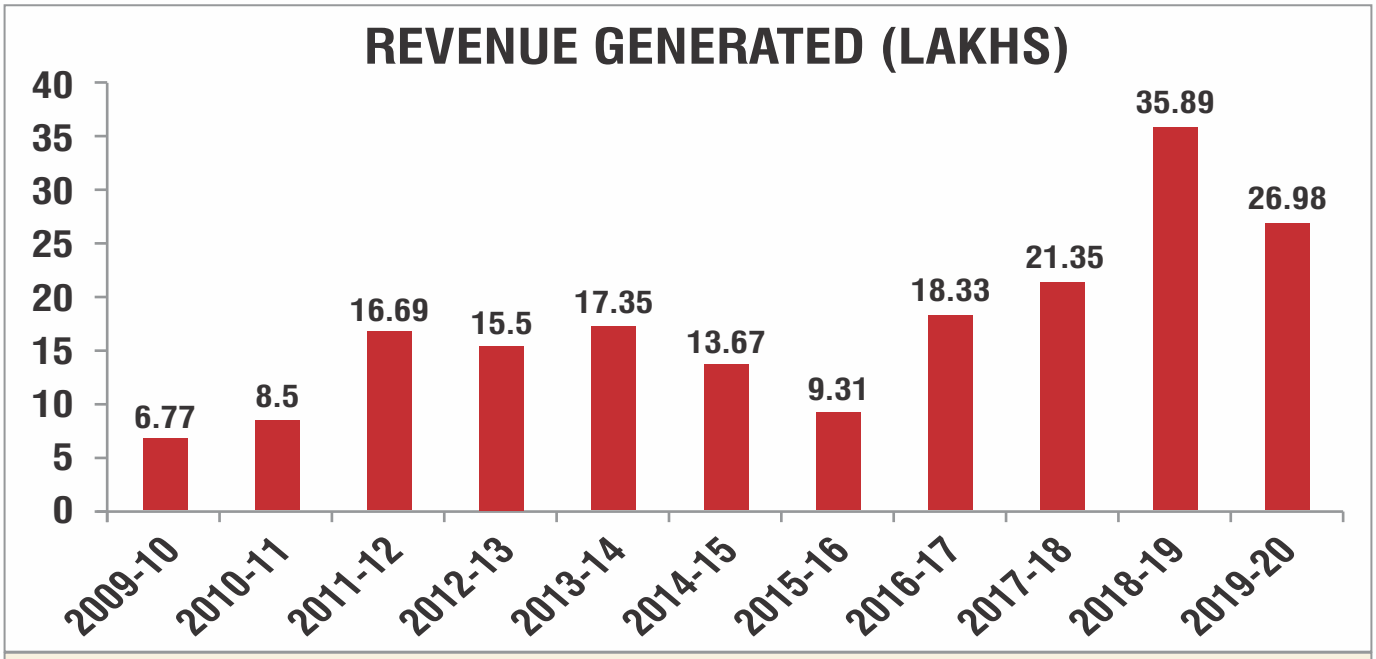


Number of frozen semen doses sold and distributed among network centers during last ten years (2009-2019)

## Revenue generated through sale of semen

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




**Revenue generation (Rs., lakhs) from sale of semen during last ten years (2009-2019)**

## Improved protocol for buffalo semen cryopreservation

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

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

## Sericin for improved semen freezing

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

## Ready to use buffalo semen extender

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

## Improved protocol for oocyte vitrification

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

## Area-specific mineral mixture

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

## Feeding standards for different categories of buffaloes

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

## Ultrasonographic fetal sex determination in buffaloes

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

## Method for estimation of gestational age

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

## Ultrasonography for monitoring ovarian activity

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

## Early pregnancy diagnosis in buffaloes

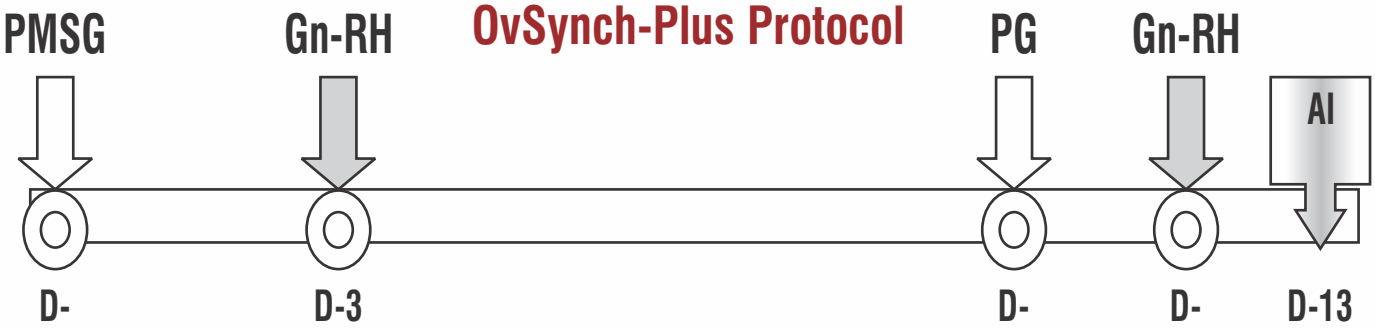
A protocol has been standardized for establishment of early pregnancy diagnosis in buffaloes. With ultrasonic scanning, pregnancy could be diagnosed as early as 26 days post insemination. The technique can be used to assess date of service in case of unobserved mating.

## Identification of molecular markers for MAS

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

## OvSynch plus protocol for estrus induction in buffaloes

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




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

## 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.

## Super ovulation with ablation of dominant follicle

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

## Sexing of IVF produced embryos

Sexing of *in-vitro* produced embryos was successfully done with PCR technique using bovine primers. Micromanipulation of the embryos was done for obtaining biopsy for sexing.

## Cloning of breeding bulls for semen production

Using cloning technology, it is possible to make multiple copies of outstanding bulls in the shortest possible time that could mitigate demand of proven semen. The institute produced Hisar-Gaurav, which is cloned of a superior breeding bull, in 2015. This cloned bull has started donating semen at the age of 22 months and qualifies all semen and fertility parameters. Using his semen, 25 progenies were produced that are healthy and normal. In addition to Murrah bull cloning, institute has cloned Assamese breeding bull, which is growing normal and healthy. The semen of this bull has also been collected and cryopreserved successfully with acceptable post-thawed sperm motility. Institute also produced seven cloned calf of M-29, superior bull and one re-clone of Hisar-Gaurav which is first report of its kind.

## Frozen repository of somatic cells

40 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 would be a viable biomaterial for long term maintenance of elite germplasm, which have wide range of applications including cloning even after death of animal, induced pluripotent stem cells production and unlimited DNA/RNA/protein source for any research purpose. Frozen somatic cells of four breeding bulls were shared with NDRI for cloning studies. These cell line is available for researchers on written consent.

## Induction of lactation

Farmers rear the dairy animals for milk production and livelihood but they are commonly facing the problems of conception failure, long calving interval, anestrous, cystic ovaries, specific abortions and repeat breeding. They can benefit by inducing such animals into lactation by induced lactation therapy. The buffalo is weighed and appropriate dose of hormones, Estradiol- 17b and progesterone @ 0.1 mg/kg body weight/day each, is calculated for seven days therapy, dissolved in absolute ethanol and stored. On the day of treatment, 1 ml of each hormone solution is

administered subcutaneously in the morning and evening at an interval of 12 hours, for seven consecutive days. Thereafter, on day 17,19 and 21 of treatment, 10 ml Largectil injection and on day 16, 18 and 20, injection of 20 mg of Dexamethasone are also given intramuscularly. Between 15th and 21st day of treatment, udder massage is given for fifteen minutes each in the morning and evening daily till the udder is turgid with milk, which is usually around 21st day when milking is started. The milk becomes normal in physical and chemical properties within 10 -15 days of start of milking and the amount of milk yield increases with time. Almost 60-75 percent of the buffalo's milk yield potential can be achieved following induced lactation.

## Colostrum feeding for higher growth and calf survival

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

## Antioxidants in survival and growth of neonates

Advanced pregnant (270 to 280 days' gestation), buffaloes are administered two doses of antioxidant micronutrients, consisting of vit A (Palmitate), vit D and vit E (dl- alpha 3 Tocopherol acetate, within 30 days before calving, at 15 days intervals. These buffaloes secreted 25-80% more Ig protein in colostrum than control buffaloes. Calves born to treated buffaloes were also supplemented with mineral mixture @ 5 g/calf/day, colostrum feeding @ 10% of birth weight, concentrate mixture started 10 to 15 days after birth and green folder offered after 3 weeks, in order to achieve high growth rate and survival. Calves born to vitamins administered buffaloes and further supplemented with mineral mixture gained 10 percent higher body weight and 30% better immunity status. Calves bearing higher body weight and better immunity are economically more rewarding for meat and milk industry.

## Uromol preparation

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

## Urea molasses mineral blocks (UMMB)

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

## Superior isolates of anaerobic fungus

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

## Enzyme supplementation

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

## Thermal stress management

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

## 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.

## Mobile based App

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

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

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

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

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

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

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

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

It is an internet accessible interactive instructional resource available free at the official website of the ICAR-Central Institute for Research on Buffaloes, Hisar (http://www.cirb.res.in). It is aimed at providing concise information on various aspects of buffalo statistics, breeds, health, reproduction, nutrition and management aspects. This web portal allows different stake holders in buffalo farming to use resources in an integrated and interactive learning manner on the internet. It presents facts, figures, demonstrations, examples, graphics and more regarding the

concepts, practices and vocabulary used in buffalo husbandry in user-friendly formats. 'Buffalo e-library' is the main repository of information on various facets of buffalo husbandry, covering the broad areas of buffalo breeds, health, reproduction, nutrition, meat production and extension activities. Buffalopedia is CIRB's contribution towards the broader goal of rural upliftment through popularization of buffalo farming in the most scientific manner. It is an effort to address the need of providing comprehensive information on different aspects of buffalo rearing through ICT tools for wider access. Additionally, it will also give a platform for contributions by different stakeholders to the buffalo farming community. This computer application software is a ready to use technology which can be used by all stake holders through internet. The Buffalopedia has already got lakhs of hits since it was made online and has recorded more than 7.3 lakh visits.

## Mobile based App 'ODK collect'

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

## Modified Artificial Vagina for semen collection from bulls

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

**Director ICAR-CIRB Hisar transferring modified AV technology to M/s Chemtron Analytical Pvt. Ltd.**

## Field Microscope (Spermoscope)

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

# Human Resource Development

| Name of Staff | | Subject Area | Duration and Training Institute |
|---|---|---|---|
| **SCIENTISTS :** | | | |
| 1. | Dr. BP Kushwaha<br>Pr. Scientist | Stress management | 26-29 June 2019,<br>ICAR-NAARM, Hyderabad |
| 2.<br>3.<br>4. | Dr. PC Lailer<br>Pr. Scientist,<br>ANFT Division<br>Dr. SK Phulia<br>Pr. Scientist,<br>APR Division<br>Dr. AK Balhara<br>Sr. Scientist,<br>APR Division |  | |
| 5. | Dr. SK Khurana<br>Pr. Scientist,<br>AGB Division | MDP on Priority setting, Monitoring and Evaluation (PME) of Agricultural Research Projects | 18-23 July 2019,<br>ICAR-NAARM, Hyderabad |
| 6. | Dr. AK Balhara<br>Sr. Scientist,<br>APR Division | Level I Thermography Course | 9-13 September, 2019<br>Conducted at N. Delhi by<br>Infared Training Center (ITC), Sweden |
| 7. | Dr. PS Yadav<br>Pr. Scientist,<br>APR Division | Program on Emotional Intelligence at Workplace for Scientists and Technologists | 05-09 August, 2019<br>Centre for Organization Development, Hyderabad |
| 8. | Dr. MH Jan<br>Scientist, Nabha | Current Knowledge and Future Challenges in Domestic Animal Theriogenology | 3-23 October, 2019<br>GADVASU, Punjab |
| 9. | Dr. N Saxena<br>Pr. Scientist,<br>AN & FT Division | Training workshop for Vigilance Officers of ICAR Institutes | 31 Oct. -1 Nov. 2019,<br>ICAR-NAARM, Hyderabad |
| **TECHNICAL OFFICERS :** | | | |
| 1. | Sh. Satpal, TO | Automobile Maintenance, Road Safety and Behavioural Skills | 24-30 Sept., 2019,<br>ICAR-CIAE, Bhopal |
| 2 | Sh. Bhim Raj TO | Training program Agricultural machinery for maintenance and repair | 14-18 October 2019,<br>NRFMTTI, Hisar |
| 3 | Sh. GD Tiwari<br>Technician | Motivation, Positive Thinking and Communication Skills for Technical Staff (T-1 to T-4) of ICAR | 5-11 Dec. 2019,<br>ICAR-NIANP, Bengaluru |
| **ADMINISTRATIVE STAFF :** | | | |
| 1. | Sh. Dharam Pal,<br>LDC | Training Programme on Assets Management | 6-8 Nov. 2019,<br>ICAR-IARI, New Delhi |
| 2. | Sh. Rajesh Kumar,<br>AAO | Improving Skills of Administrative Staff of ICAR dealing with Court Cases | 25 - 27 Nov. 2019,<br>ICAR-CAZRI, Jodhpur |

# Research and Review Articles

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Kavya KM, Sharma RK, Jerome A, Phulia SK, Singh I. 2019. Higher antral follicular count is associated with body weight in peri-pubertal Murrah buffalo heifers. The Indian Journal of Animal Sciences 89 (5):517-518.

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Kumar D, Anand T, Vijayalakshmy K, Sharma P, Rajendran R, Selokar NL, Yadav PS, Kumar D. 2019. Transposon mediated reprogramming of buffalo fetal fibroblasts to induced pluripotent stem cells in feeder free culture conditions. Research in Veterinary Science 123: 252-260.

Kumar P, Pawaria S, Dalal J, Ravesh S, Bhardwaj S, Jerome A, Kumar D, Jan MH, Yadav P S. 2019. Sodium alginate potentiates antioxidants, cryoprotection and antibacterial activities of egg yolk extender during semen cryopreservation in buffalo. Animal Reproduction Science, 209: 106166. https://doi.org/10.1016/j.anireprosci.2019.106166.

Kumar P, Suman, Pawaria S, Dalal J, Bhardwaj S, Patil S, Jerome A, Sharma RK. 2019. Serum and seminal plasma IGF-1 associations with semen variables and effect of IGF-1 supplementation on semen freezing capacity in buffalo bulls. Animal Reproduction Science 204:101-110.

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Balhara AK, Sunesh, Singh S. 2019. Heat stress management in buffaloes. In: Buffalo Scientific Husbandry-Package of Practices (Jan MH, Kumar S and Singh S. Eds), ISBN 987-93-5396-406-1, ICAR-Central Institute for Research on Buffaloes, Sub-campus, Nabha, Punjab, India, Chapter 15, pp. 69-72.

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Jerome A, Kumar P, Phulia SK, Sharma RK. Therapeutic strategies for reproductive disorders in buffaloes. In: Buffalo Scientific Husbandry-Package of Practices (Jan MH, Kumar S and Singh S. Eds), ISBN 987-93-5396-406-1, ICAR-Central Institute for Research on Buffaloes, Sub-campus, Nabha, Punjab, India, Chapter 7, pp-31-32.

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सुनेश, अशोक बल्हारा, सज्जन सिंह 2019, किसानों के लिए मोबाइल एप्लीकेशन और मोबाइल फोन विशेषताओं का उपयोग |किताब पशुधन प्रकाश|प्रकाशक: भाकृअनुप–राष्ट्रीय आनुवंशिक संसाधन ब्यूरो, करनाल, अंक–10 ISSN : 0976-4569

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## Technical/Popular articles/Leaflet/Miscellaneous

Dua S, Rawat N, Rajendran R, Saini M, Saini D, Selokar NL, Yadav PS, Kumar D. 2019. Empowering of reproductive health through gene editing technology in farm animals. ISSRF Newsletter, 23: 74-78.

Kumar D, Selokar NL, Kumar P, Sharma RK, Kumar R, Yadav PS. 2019. Buffalo cloning at a glance. Published by ICAR-Central Institute for Research on Buffaloes, Hisar, pp-1-2.

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Sharma RK, Phulia SK, Singh KP, Dahiya SS. 2019. Buffalo Calendar -2019, Pp-1-14.

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Singh KP, Balhara AK, Vohra V, Bharadwaj A, Chander R and Dahiya SS. 2019. Network Project on Buffalo Improvement: Field Progeny Testing Program in Murrah Buffalo (2001-2019). Published by ICAR-Central Institute for Research on Buffaloes, Hisar, Pp 1-9.

Singh KP, Sunesh, Balhara AK, Balhara S, Murti KS, Vijyta HP and Dahyia SS. 2019. Network Project on Buffalo Improvement: Progeny Testing Program in Jaffarabadi Buffalo (2003-2019). Published by ICAR-Central Institute for Research on Buffaloes, Hisar, Pp 1-8.

Singh R, Biswas A, Mandal AB. 2019. Impact of ochratoxin on poultry production. Poultry Punch 35 (5): 44-48.

Talluri TR, Selokar NL, Sharma P, Krishna A, Ravi SK, Kumar D. 2019. Interspecies somatic cell nuclear transfer: hopes and challenges. ISSRF Newsletter, 23: 21-23.

सज्जन सिंह, सुनेश बल्हारा, हेमा त्रिपाठी 2019, पशुओं की प्रजनन क्षमता बढ़ाने के लिए आहार व्यवस्था, कृषि जागरण, अक्टूबर 58–62

सुनेश, अशोक बल्हारा, सज्जन सिंह 2019, कृषि ज्ञान प्रसार में सोशल मीडिया की शक्ति, हरियाणा खेती, दिसम्बर 25–26

## Germplasm identified /registered

Breed Accession no. INDIA_BUFFALO_2600_CHHATTISGARHI_01016 for Chhattisgarhi Buffalo as 16th buffalo breed in India

Breed Accession no. INDIA_BUFFALO_1606_GOJRI_01017 for Gojri Buffalo as 17th buffalo breed in India

## Gene accession number submitted

Gene Accession no. SRA accession: PRJNA546485, link: https://www.ncbi.nlm.nih.gov/sra/PRJNA546485 by Sikka P (2019) SRA submission SUB5692555, "Bubalus bubalis Raw sequence reads, reference PRJNA546485.

## Abstracts in conference/symposium :

Bhatia T, Nayan V, Singh R, Kumar S, Swaroop N, Singh C, Bhardwaj A, Onteru SK, Bharadwaj A, Singh D & Mohanty AK. 2019. Wheat & mungbean seed germination test: An alternative urine-based non-invasive early estrus test in buffalo. In: 11th Annual Meeting of Proteomics Society, India and International Conference on Proteomics for System Integrated Bio-Omics, One Health and Food Safety (ICPBHF-2019) at ICAR-National Dairy Research Institute, Karnal (Haryana), December 2-4.

Dey A, Gonzalez LA, Possell M. 2019. Modulation of gas production, fermentation kinetics and methanogenesis of mulga (Acacia aneura) leaves by polyethylene glycol (PEG) and feed supplement. In: Golden Jubilee International Conference on 'New Millennia Agriculture- Novel Trends and Future Scenario' at CCS Haryana Agricultural University, Hisar, Haryana, India, November 6-8, Pp310-311.

Dey A, Paul SS, Umakanth AV, Bhat BV, Lailer PC, Dahiya SS. 2019. Newly developed low lignin sorghum cultivars enhance ruminal fermentation, growth and nutrient utilization in buffaloes. In: International Conference on Animal Nutrition on Nutritional Strategies for Improving Farm Profitability and Clean Animal Production at Kolkata, West Bengal, India, December 17-19, Pp207.

Dua S, Rawat N, Wakil AM, Bansal S, Surbhi, Madhuri, Kumar D, Sharma RK, Singh PS and Selokar NL. 2019. Establishment of mesenchymal stem cells from an aborted cloned fetus. In: 2nd Annual Meeting of APA and National Conference on Issues and Strategies for Physiological Capacity Building in Animals at College of Veterinary Science, Tirupati, AP, October 14-15 Pp152.

Jerome A, Kumar P, Bala R, Kumar A, Reddy A, Patil S, Singh S, Sharma RK. 2019. Buffalo sperm dosage in relation to its functional parameters and field fertility outcome. In: ISSAR International Symposium, December 18-20, Nammakal, Tamilnadu, pp160.

Khurana SK. 2019. Antibiotic resistance in mycoplasmas: Future prospects. In: International conference on human, plant and animal mycoplsamas at NCMR, Pune, Maharahtra, December 2-5, Pp27-28.

Khurana SK. 2019. Vector borne zoonosis: Impact of climate change. In: 36th IAVP Congress and National Symposium on Advances in veterinary pathology for fostering one health at COVS, CAU, Aizawl, Mizoram, November 6-8, Pp43-50.

Kumar K, Dey A, Rose MK, Dahiya SS. 2019. Modulating feed digestion and methane production by eucalyptus (*Eucalyptus citriodora*) leaf essential oils in water buffalo (*Bubalus bubalis*) In: International Conference on Animal Nutrition on Nutritional Strategies for Improving Farm Profitability and Clean Animal Production at Kolkata, West Bengal, India, December 17-19, Pp25-26.

Kumar K, Dey A, Rose MK, Jerome A, Dahiya SS. 2019. Essential oils rich phytogenic feed additives influence rumen function, methanogenesis and animal health in buffalo calves. In: International Conference on Animal Nutrition on Nutritional Strategies for Improving Farm Profitability and Clean Animal Production at Kolkata, West Bengal, India, December 17-19, Pp58.

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Balhara AK. 2019. Buffalo urinary metabotyping during early pregnancy. In: 11th Annual meeting of Proteomics Society, India and International Conference on 'Proteomics for system integrated bio-omics, one health and food safety' at ICAR-National Dairy Research Institute, Karnal (Haryana), December 2-4.

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Dey A, Paul SS, Lailer PC, Dahiya SS. 2019. Harnessing gut health for efficient buffalo production and abatement of environmental pollution. In: International Conference on Animal Nutrition on Nutritional Strategies for Improving Farm Profitability and Clean Animal Production, Karnal, India, pp31-42.

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**Peak yield 23.9 kg/day**
**Lactation yiled (kg)/ Lactation number 4765/4**

**Animal ID 0287, DOB 20.07.2011, Sire no. 0930**
**Peak yield 21.5 kg/day**
**Lactation yiled (kg)/ Lactation number 4247/3**

**Animal ID 4817, DOB 12.10.2014, Sire no. 4100**
**Peak yield 20.8 kg/day**
**Lactation yiled(kg)/ Lactation number 4250/2**

**Animal ID 0103, DOB 30.10.2008, Sire no. 0524**
**Peak yield 17.5 kg/day**
**Lactation yiled(kg)/ Lactation number 3436/6**

# Participation in Seminars/Conferences/Workshops/Meetings

| Event | Date | Venue | Participants |
|---|---|---|---|
| Meeting for uniform data recording of NBPI Centres | May 27, 2019 | NDRI, Karnal | KP Singh, A Bharadwaj, Sanjay Kumar, SS Dahiya |
| 49th Annual Group Meeting of Sorghum | May 28-30, 2019 | CCS HAU, Hisar | Avijit Dey |
| 1st meeting of ICAR metabolomics research group | July 8, 2019 | NASC Complex, New Delhi | N Saxena |
| Review and finalization of research schemes for the duration 2019-20 under different departments of LUVAS | August 26-September 6, 2019 | Directorate of Research, LUVAS, Hisar | AK Balhara, Sajjan Singh, SK Khurana, A Dey, P Sikka, H Tripathi, PC Lailer, VB Dixit |
| XVII Annual Review meeting of Network Project on Buffalo Improvement | August 27-28, 2019 | NASC complex, New Delhi | KP Singh, Anurag Bharadwaj, Sanjay Kumar, SS Dahiya |
| Brainstorming workshop on Use of cloned Bull Semen for Breed Improvement at National Agricultural Science Centre Complex by ICAR-Central Institute for Research on Buffaloes, Hisar & Indian Society for Buffalo Development | August 29, 2019 | NASC, New Delhi | SS Dahiya, PS Yadav, RK Sharma, KP Singh, Sajjan Singh, Dharmendra Kumar, Jerome A, Naresh L Selokar, Sanjay Kumar |
| 2nd Annual Meeting of APA and National Conference on Issues and Strategies for Physiological Capacity Building in Animals' | October 14-15, 2019 | College of Veterinary Science, Tirupati | Dharmendra Kumar, Varij Nayan |
| National Dialogue on land use for integrated livestock development organized by Trust for Advancement of Agricultural Sciences (TAAS) in collaboration with ICAR and ILRI | November 1-2, 2019 | NASC Complex, Pusa, New Delhi on | Avijit Dey |
| Indo US Genome Engineering /Editing Technology Initiative (GETin) Programme Workshop on CRISPR Editing in Mammalian Cells and Embryos (DBT, DST) | November 4-9, 2019 | CIRB Hisar | P Sikka |
| Golden Jubilee International Conference on 'New Millennia Agriculture- Novel Trends and Future Scenario (GINMA 2019)' | November 6-8, 2019 | CCS HAU, Hisar | Avijit Dey |
| Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII)- 'Statistics for Transformation of Agriculture to Achieve the Sustainable Development Goals (SDGs)' | November 18-21, 2019 | IASRI, New Delhi | Sunesh Balhara |
| National Seminar on 'Cultivation, conservation and sustainable utilization of medicinal plants for livelihood improvement' | November 20-21, 2019 | UBKV, Pundibari, Coochbehar | Avijit Dey |
| International workshop on buffalo genetics and reproduction biotechnology | November 24-30, 2019 | GXBRI, Anning, China | PS Yadav |

| Event | Date | Venue | Participants |
|---|---|---|---|
| 11th Annual Meeting of Proteomics Society, India 2019 and International Conference on Proteomics for System Integrated Bio-Omics, One Health and Food Safety (ICPBHF-2019) | December 2-4, 2019 | NDRI, Karnal, Haryana | AK Balhara, SK Phulia, Varij Nayan |
| 19th meeting of Animal Husbandry, Feeds and Equipment Sectional Committee, FAD 5 | December 13, 2019 | BIS, Manak Bhavan, New Delhi | Avijit Dey |
| International Conference on Animal Nutrition (INCAN-2019) on 'Nutritional strategies for improving farm profitability and clean animal production' | December 17-19, 2019 | WBUAFS, Kolkata | Avijit Dey, N Saxena, PC Lailer, P Sikka, SS Dahiya |
| ISSAR International Symposium 2019 | December 18-20, 2019 | Nammakal,Tamilnadu | Jerome A |

**High genetic merit Nili Ravi Bulls at CIRB, Nabha**

**High genetic merit Murrah Bulls at CIRB, Hisar**

# Research Projects

| S. No. | Project Title | Project Workers | Funding Source | Duration |
|---|---|---|---|---|
| 1. | 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-Mar 2019 |
| 2. | Lactation stress associated postpartum anestrus SNP array in Buffaloes- CIRB centre | **RK Sharma,** V Nayan | **NASF** | Jul 2015-Jun 2018 |
| 3. | 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-Dec 2019 |
| 4. | 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-Oct 2019 |
| 5. | 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-Mar 2019 |
| 6. | 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 |
| 7. | Causes of Buffalo calf mortality and its management | **SK Khurana,** A Boora, S Yadav, S Kumar | **IRC** | Dec 2017-Nov 2020 |
| 8. | Challenges of high yielding buffaloes: Identification and their management | **A Boora,** S Yadav, Inderjeet Singh (upto 4.11.2018) | **IRC** | Jul 2017-Jun 2020 |
| 9. | 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-Oct 2019 |
| 10. | Development of need based mobile apps to improve the performance and productivity of buffaloes | **H Tripathi,** VB Dixit, D Kumar, S Singh | **IRC** | Apr 2018-Mar 2020 |
| 11. | 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 |
| 12. | In vitro evaluation of efficacy of certain aflatoxin detoxifying agents | **R Singh** | **IRC** | Jan 2019-Dec 2021 |
| 13. | 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 |
| 14. | Development and supplementation of nano-minerals in buffalo | **V Mudgal,** N Saxena, SS Dahiya | **IRC** | Sep 2017-Aug 2020 |
| 15. | Buffalo sperm dosages in relation to its functional parameters and field fertility outcome | **S Singh,** P Kumar, Jerome A, RK Sharma | **IRC** | Mar 2018-Apr 2020 |
| 16. | Development of diagnostic platforms for sensing candidate bio-signatures of buffalo reproduction | **V Nayan,** RK Sharma, A Bhardwaj (NRCE) | **IRC** | Nov 2015-Oct 2019 |
| 17. | 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, S Balhara, PC Lailer, A Dey, Sanjay Kumar, S Kumar | **IRC** | Jun 2017-May 2020 |
| 18. | Manipulation of follicular wave pattern to increase conception rate in buffaloes | **MH Jan,** S Kumar, KL Mehrara | **IRC** | Aug 2016-Jul 2019 |
| 19. | Genetic improvement of Murrah buffaloes (Network project CIRB, Hisar Centre) | **KP Singh,** A Bharadwaj, P Kumar | **NWP-ICAR** | Jul 1991-Contd |

| S. No. | Project Title | Project Workers | Funding Source | Duration |
|---|---|---|---|---|
| 20. | Genetic improvement of Nili Ravi buffaloes (Network project, CIRB Sub-Campus Nabha Centre) | **S Kumar,** MH Jan, KL Mehrara, R Mehta | NWP-ICAR | Apr 1990-Contd |
| 21. | Performance recording and improvement of Bhadawari buffaloes (IGFRI centre) | **BP Kushwaha,** IGFRI:SB Maity, Sultan Singh | NWP-ICAR | Apr 2001-Contd |
| 22. | Progeny testing of bulls under field conditions (FPT) (CIRB Hisar) | **A Bharadwaj,** VB Dixit, H Tripathi | NWP-ICAR | Apr 2001-Contd |
| 23. | National Agricultural Innovation Fund (Institute Technology Management Unit) | **I/C ITMU** | ITMU | Apr 2008-Contd |
| 24. | 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 |
| 25. | 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 |
| 26. | Synthetic endometrium: A novel model to study early embryonic development and uterine health in ruminants - CIRB Centre (Lead Centre – IVRI – Bareilly) | **D Kumar,** N Selokar | NASF | Feb 2017-Dec 2019 |
| 27. | Development of early pregnancy diagnostic assay through discovery of biomarkers in cattle and buffalo | **AK Balhara,** SK Phulia, Varij Nayan | DBT | Jun 2018-May 2021 |
| 28. | 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 |
| 29. | 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,** SK Phulia, A Bharadwaj **IASRI :** MA Iquebal, D Kumar, Sarika | CABin | Jan 2019-Mar 2020 |
| 30. | Production of myostatin gene edited buffalo bulls using system | **N Selokar** | DBT | Jan 2019-Jan 2022 |
| 31. | Production of multiple copies of buffalo bulls using animal cloning technology - Lead Centre | **PS Yadav,** N Selokar, D Kumar, RK Sharma, P Kumar, R Kumar | NASF | Apr 2018-Mar 2022 |
| 32. | Integration of mastitis resistance gene (Lysozyme) into the beta-casein locus of buffalo/ bovine genomes using CRISPR/cas9. | **PS Yadav,** D Kumar, N Selokar | DST-DAAD | Feb 2017-May 2019 |
| 33. | Diversified uses of Azolla | **IARI :** G Abraham, P Jaiswal, **CIRB :** V Mudgal, SS Dahiya | ICAR | May 2018–March 2020 |

# ICAR-CIRB Among Farmers

| Date | Title | Beneficiaries | Coordinators |
|---|---|---|---|
| **Faculty/Field functionaries development programs** | | | |
| March 25 - April 08, 2019 | Induction training for stockman of CHRS | 18 | Sajjan Singh, H Tripathi, D Kumar |
| **General Training Programs on buffalo farming orgnaozed by ICAR-CIRB Main Campus** | | | |
| June 12-18, 2019 | Scientific Management of Buffaloes | 39 | H Tripathi, D Kumar, ML Sharma |
| July 16-22, 2019 | Package of Practices - Buffalo Husbandry | 24 | Sajjan Singh, NL Selokar, AKS Tomar |
| August 02-08, 2019 | Scientific Management of Buffaloes | 15 | SK Phulia, Jerome A, Raj kumar |
| September 19-25, 2019 | Scientific Management of Buffaloes | 39 | VB Dixit, P Kumar, ML Sharma |
| November 20-26, 2019 | Package of Practices - Buffalo Husbandry | 23 | RK Sharma, S Balhara, Raj Kumar |
| **General Training Programs on buffalo farming by ICAR-CIRB Sub Campus, Nabha** | | | |
| September 17-23, 2019 | "Introduction of Nili-Ravi Buffalo and its Management" under Schedule Caste Sub-Plan | 35 | MH Jan, Sanjay Kumar, Sajjan Singh |
| **Farmers First Project (FFP)** | | | |
| July - October, 2019 | Farm diversification and entrepreneurship: Livestock – Apiculture – Horticulture (NDRI, DMR, CCSHAU, CIRB, FF villages) | 168 | Ashok Boora, Sarita Yadav, Sunita, Sajjan Singh, Bharat Singh |
| **Trainings under SCSP Program** | | | |
| September 17-23, 2019 | Scientific Management of Buffaloes | **35** | VB Dixit |
| December 03-07, 2019 | Scientific Management of Buffaloes | **35** | VB Dixit |

## Outreach Programs organized

| Date | Details | Venue | Beneficiaries | Scientists involved |
|---|---|---|---|---|
| **Front line demonstrations/Trainings/Camps/Kisan Gosthis/Miscl. at farmers' doorstep** | | | | |
| March 31 - April 1, 2019 | Ration balancing and Use of Mineral mixture for optimum production | TSP villages Kherar, Udaipur, Rajasthan | 140 | AK Balhara, SK Phulia, PC Lailer, SS Dahiya |
| March 18 - April 27, 2019 | Silage making | Village Nyoli Khurd, Hisar | 50 | P Sikka, SK Phulia, A Dey, AK Balhara, Jerome A |
| June 07, 2019 | One day training program for Artificial Insemination | Veterinary Hospital village, Kharkhari Makhwan | 32 | P Kumar, Raj Kumar |
| August 06, 2019 | Infertility treatment camp cum kisan gosthi | Village Chaudharywali, Hisar | 102 | RK Sharma, SK Phulia, AK Balhara, S Balhara |

| S. No. | Date | Details | Venue | Number of Participants | Scientists involved |
|---|---|---|---|---|---|
| 5. | 25.05.2019 | Infertility treatment camp cum kisan gosthi | Village Nyoli Khurd, Hisar | 48 | Dr. RK Sharma, Dr. SK Phulia, Dr. P Sikka |
| 6. | 14.08.2019 | Infertility treatment camp cum kisan gosthi | Village Nayana, Hisar | 39 | Dr. RK Sharma, Dr. SK Phulia, Dr. AK Balhara |
| 7. | 22.08.2019 | Infertility treatment camp cum kisan gosthi | Village Mohabatpur, Hisar | 38 | Dr. RK Sharma, Dr. SK Phulia |
| 8. | 06.08.2019 | Vocational training programme for rural youths on the topic "Prevention and care of diseases in dairy animals" and "Control of ecto and endo parasites in dairy animals" | KVK Rauni Patiala | 85 | Dr. Sanjay Kumar, Dr. M H Jan |

## Mera Gaon Mera Gaurav (MGMG)

There are twenty six (26) villages adopted by six (6) teams of scientists and technical officers of the institute from three states viz. Haryana, Punjab and Rajasthan. During the year 2019, a total of 35 visits made in various villages and many activities such as 22 Interface meetings/kisan goshthis, 36 demonstrations, plantations of horticultural crops for encouraging diversification in agriculture, 8 trainings on improved and scientific buffalo husbandry and breed improvement strategies etc. were conducted by various teams benefitting over 3000 farmers. The teams have already developed repo amongst the farmers from the adopted villages and are in touch with them through electronic means. The farmers from these adopted villages participate actively in the events organized at the institute every year as an annual activity.

## Activities organised by CIRB – Hisar under MGMG

| S.No. | Name of activity | No. of activities conducted | No. of farmers participated & benefitted* |
|---|---|---|---|
| 1. | Visit to village by teams | 35 | 2348 |
| 2. | Interface meeting/Goshthies | 22 | 2417 |
| 3. | Training organized | 8 | 236 |
| 4. | Demonstrations conducted | 36 | 836 |
| 5. | Mobile based advisories (No.) | 482 | 1036 |
| 6. | Literature support provided | 1316 | 1582 |
| 7. | Awareness created | 78 | 3334 |
| 8. | Input support provided (q) | 3 | 176 |


**Farmer FIRST Integrated feed unit (Bovine) developed by FFP team for participatory ration balancing**

# Academic and Research Collaborations

| University/Institute/Organisation entering in MoU with ICAR-CIRB Hisar | Scope of Collaboration | Date of MoU |
|---|---|---|
| Rajasthan University of Veterinary and Animal Sciences, Bikaner (Rajasthan) | Academics (UG teaching and PG research) and Research | 18.05.2019 |
| Hitech Sach Dairy, Sirsa (Haryana) | Biotechnological reserch - buffalo cloning | 02.01.2019 |
| Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.) | PG Research | 01.09.2018 |
| Bihar Animal Sciences University, Patna (Bihar) | Academics - UG teaching and PG research | 05.07.2018 |
| Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar (Haryana) | Academics (UG teaching and PG research) and Research | 09.05.2014 |

## 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 |
| 1840/DEL/2013 | BUFCOL-A complete diet for enhanced survivability & growth of neonatal buffalo calves | Granted on 21.11.2019 | P Sikka, D Lal, S Khanna, RK Sethi |
| **Filed** | | | |
| 1451/DEL/2015 | Kalrump Scale - A device to measure Buffalo rump angularity for identification of dairy characters | 07.01.2017 | SN Kala |
| 201711039431 | Process for improving riverine buffalo sperm viability and uses thereof | 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 |

# Success Story

## Lab to Field : Buffalo Breed Improvement in Tribal Areas

*AK Balhara, SK Phulia, AK Boora, V Mudgal, PC Lailer and SS Dahiya*

The Tribal Sub-Plan (TSP) was adopted as a strategy for the socio-economic upliftment of tribal population. Since 2015, the Institute has adopted four villages *viz. Bhainson ka Namala, Tulsiyon ka Namla, Roba* and *Chatpur* under *Kherar Gram Panchayat*, Tehsil *Salumber*, District Udaipur, Rajasthan. These tribal villages have good number of dairy animals. However, majority of these animals were non-descript, poor milk producing buffaloes. The Institute identified this as a major deficiency requiring scientific intervention. Five educated unemployed youth were identified and trained in artificial insemination at the Institute under TSP program and were supported with necessary equipments (AI guns, LN2 cylinders etc.). Subsequently, the State Animal Husbandry department was appraised about planned interventions in improving buffaloes through use of CIRB's elite buffalo semen doses. The department authorized the Senior Veterinary Officer at Veterinary Hospital, *Kherar Gram Panchayat* to supervise AI with these semen doses and maintain proper record of it. The hospital was provided one large capacity (35 Ltrs) liquid nitrogen semen storage tank and the liquid nitrogen supply was ensured by the State Animal Husbandry department.

**ICAR-CIRB Scientists in TSP Area**

**ICAR-CIRB Director interacting with tribal farmers during Kisan Gosthi**

The farmers were sensitized about scientific husbandry practices through demonstrations of practices, trainings programs, kisan gosthis and animal health check-up camp. Literature in form of book, booklets, leaflets etc. was made available for interested farmers during these programs. Small farm implements – chaff cutter (25), feed grinders (5), kassi (30) etc. were distributed for improved feed and fodder management. The farmers were also apprised about basic feed-fodder storage for ensured round the year nutrient availability for livestock. For this, 66 grain bins and 160 rubber mangers were distributed. Draught tolerant high yielding fodder varieties seeds sourced from National Seed Corporation (NSC) were introduced. To make production sustainable, concentrate animal feed and area specific mixture was introduced to these farmers. For continued knowledge enhancement, subscriptions for ICAR magazine 'Kheti' was accomplished for 40 tribal youth.

Meanwhile, to expose these tribal families to good buffaloes, seven lactating Murrah buffaloes were distributed to BPL card holder, landless poor tribal widows and farmers in these four villages in 2015. These buffaloes performed

well and were an example for other tribal families to emulate. The families owing these animals registered good income from milk production leading to improved livelihood.

**A tribal women farmer (widow) with a lactating buffalo and a calf by ICAR-CIRB in 2016. The Buffalo has calved twice during 2016-19 and proudly owns these animals. The farmer has been using the rubber manger for feeding her buffaloes and reports it as a very good item for saving feed fodder from wastage.**

The Institute has provided 2650 doses of Murrah frozen semen for distribution in the field and four bulls for natural service during August 2015 – December 2019. Scientist during visit to the villages saw more than 50 calves born out of insemination from this semen. These calves have good acceptance among the villagers and are the most sought-after dairy animals. The villagers look at these animals as good milk yielder with early age of conception.

**Farmer Ram Singh has 3 buffaloes (only one lactating) – two heifers are progenies born of AI from Murrah bull semen provided by ICAR- CIRB under TSP. Many farmers come to Ram Singh to see these buffaloes.**


**Villages adopted under Tribal Sub-Plan (TSP) depicted on map of Udaipur district**

# Success Story

## Phenomenal Success in Buffalo Cloning Research Worldwide

*PS Yadav, NL Selokar, D Kumar, RK Sharma, P Kumar, R Kumar, M Saini and S Dua*

India possesses the best breeds of buffalo, particularly Murrah, which is famous all over the world for its ability to produce a high quantity of milk. India is the largest milk producer in the world. In 2018-19, 187.75 million tonnes (mt) of milk was produced in India, of which buffalo's contribution was 91.82 mt (49%), which is more than the milk obtained from crossbred/exotic cattle (51.26 mt) and indigenous/nondescript cattle (38.57 mt). Therefore, India's white revolution cannot be imagined without the contribution of buffalo. To sustain this level of milk production, elite high milk-producing buffaloes need to be multiplied at a fast pace through scientific interventions.

According to the livestock population census report 2019, India holds 109 million buffaloes, which account for over 56% of the world's buffalo population. The average milk yield of Indian buffalo is 5 Kgs per day, however, some buffaloes have high milk productivity of even 25 Kgs per day. Although performance can be augmented through balanced nutrition and appropriate management practices, the fundamental reason behind productivity is superior genetics. Farmers, engaged in buffalo husbandry, prefer breeding their female buffaloes with the semen of a superior bull that has a pedigree record of dam's high milk production. Therefore, there is an enormous demand for semen from quality bulls for breeding.

Cloning technology can be an effective means for producing genetically identical copies of elite bulls that have proven records to fulfil the demand of bulls for semen production and natural mating. Buffalo cloning is an assisted reproductive technology (ART) that can supplement other ARTs such as AI, Transvaginal Ultrasound-guided Ovum Pick-up, and in vitro fertilization (OPU-IVF), and embryo transfer (ET) for fast multiplication of the best genotype bulls for semen production. ICAR-CIRB has been working on buffalo cloning for more than 10 years for propagating the best buffalo germplasm in the country. Some of the remarkable achievements are mentioned below.

### Achievements

- Produced seven cloned copies of a superior Murrah bull (M-29) and one cloned copies of another superior bull (Mu-4354)
- Achieved re-cloning of the cloned Murrah bull, named Hisar-Gaurav
- Assamese buffalo cloned calf born at an organized dairy farm, translation of buffalo cloning technology at the field
- Fourteen cloned buffalo bulls available for study on different aspects.
- Established a somatic cell repository of elite buffaloes for cloning studies.
- The fertility of cloned bulls (n=3) is similar to non-cloned bulls.
- More than 25 progenies (>20 pregnancies established) produced from cloned bull semen.
- Offspring sired by cloned bulls have normal growth, physical and hematological parameters.

More than 11000 frozen semen doses from cloned Hisar Gaurav and more than 1200 frozen-semen doses from the Assamese cloned bull are produced, and semen production is continuing to cryopreserve more semen doses.


**(A) Cloned bull Hisar-Gaurav, (B) re-cloned calf of Hisar-Gaurav**


**Eight clones produced, in which seven clones from elite buffalo Bull M-29 (1-7, left to right) and re-cloned calf of cloned bull Hisar-Gaurav (rightmost)**

Buffalo cloning technique will lead to a new era in buffalo breeding for faster multiplication of superior germplasm. At present, under the ICAR-National Agricultural Science Fund (NASF) project, CIRB team is working to produce clones of elite males and females.

# Special Events Organized

| Event | Coordinator(s)/ Key Person(s) | Date | Venue |
|---|---|---|---|
| Brainstorming workshop on use of cloned bull semen for breed improvement | PS Yadav, D Kumar & Naresh L Selokar | August 29, 2019 | NASC Complex, New Delhi |
| Workshop on CRISPR editing in mammalian cells and embryos sponsored by Indo-US Genome Engineering/editing technology initiative (GETin) program | Naresh L Selokar, Charles R. Long (USA), Dharmendra Kumar, PS Yadav | November 4-9, 2019 | ICAR-CIRB, Hisar |
| Animal Health Checkup and Kisan Gosthi | AK Balhara, SK Phulia, PC Lailer, SS Dahiya | March 31 – April 01, 2019 | TSP villages Kherar, Udaipur, Rajasthan |
| 17th Annual Review Meet of Network Project on Buffalo Improvement | SS Dahiya, KP Singh | August 27-28, 2019 | ICAR-NASC Complex, New Delhi |
| Vigilance awareness week 2019 | AK Balhara, Dharmendra Kumar | October 28 - Nov. 02, 2019 | ICAR-CIRB Hisar |
| Institute Research Committee (IRC) meeting | SS Dahiya, N Saxena, SK Khurana | June 18-19, 2019 | ICAR-CIRB Hisar |
| XXIII Research Advisory Committee (RAC) meeting | K Pradhan, Ashok Kumar BG Mukhopadhya, KR Trivedi, Vineet Bhasin, Madan Lal, SS Dahiya, RK Sharma | July 30-31, 2019 | ICAR-CIRB Hisar |


**Dr. S S Dahiya – PC and Director-CIRB and Dr. K P Singh during monitoring and evaluation visit to the Surti buffalo main unit and FPT villages Navania, Menar and Rundera center, Udaipur**

**Dr. S S Dahiya, PC and Director CIRB distributing mineral mixture to farmers participating in FPT programmw during monitoring and evaluation visit to GADVASU-Murrah and Nili Ravi FPT Unit**

**(Left to right) Dr. Sanjay Kumar, KP Singh, VB Dixit, Sajjan Singh and Mustafa H Jan releasing book on buffalo husbandry duiring SCSP training program at Sub Campus Nabha**

**RAC Meeting of ICAR-CIRB under Chairmanship of Dr. K Pradhan**

# Awards

| Name of Scientist (s) | Details of award | Date |
|---|---|---|
| **Fellowship** | | |
| Dr. Pradeep Kumar | ICMR-DHR International Fellow - for advanced training and exposure to the latest advancements in knowledge through interaction with the international scientists in emerging areas of clinical/medicine/health sciences | 12.06.2019 |
| **Scientific Society/ Bodies Awards** | | |
| Dr. Dharmendra Kumar | APA Mid-Career Award 2019 from Animal Physiologists Association during APACON 2019 at Tirupati | 15.10.2019 |
| **Conference awards** | | |
| Dr. Varij Nayan | For the Best poster 'Graphene oxide modulates the steroidogenic and apoptotic pathway in a buffalo granulosa cell model' in the "Golden Jubilee International Conference on New Millennia Agriculture- Novel Trends and Future Scenario" at Chaudhary Charan Singh, Haryana Agricultural University, Hisar from 6th-8th November, 2019. | 08.11.2019 |
| **Journal Award** | | |
| Dr. Avijit Dey | Reviewer Excellence Award by the Indian Journal of Animal Research, Agriculture Research Communication Centre, Karnal | 26.06.2019 |
| Top downloaded paper for 2018-19 of Journal of Animal Physiology and Animal Nutrition (IF 1.71) by Wiley | Alagawany, M., El-Hack, M.E.A., Saeed, M., Naveed, M., Arain, M.A., Arif, M., Tiwari, R., Khandia, R., Khurana, S.K., Karthik, K. and Yatoo, M.I., 2019. Nutritional applications and beneficial health applications of green tea and l-theanine in some animal species : A review. Journal of Animal Physiology and Animal Nutrition. DOI: 10.1111/jpn.13219. (IF 1.71) | |

## FOREIGN VISITS

| Name of Scientist | Country visited | Duration |
|---|---|---|
| Dr. Pradeep Kumar | Germany | 13 January till date |

## DISTINGUISHED VISTORS

| Name of Visitor | Organisation | Dates / Duration |
|---|---|---|
| Dr. Bojon Peterson | FLI Germany | 28.3 - 05.04.2019 |
| Sh. Giriraj Singh | Union Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India | 16.08. 2019 |
| Dr. Sanjeev Kumar Balyan | Union Minister of Fisheries, Animal Husbandry and Dairying, Govt. of India | 16.08. 2019 |
| Dr. Sh. Mihir Kumar Singh | Joint Secretary(NLM/PC), Minsistry of Fisheries, Animal Husbandry and Dairying, Govt. of India | 16.08. 2019 |
| Dr. Inderjeet Singh | Director, Animal Husbandry, Govt. of Punjab | 16.08. 2019 |

# Students at CIRB

| Sr. No. | Name of the Scholar | Degree | Subject/ Discipline | University | Year | Guide/ Co-Major guide | Title of the thesis |
|---|---|---|---|---|---|---|---|
| **Completed during 2018-19** | | | | | | | |
| 01. | Dr. Archana Sarangi | Ph.D | Animal Physiology | NDRI, Karnal | 2016-2019 | Dr. Ashok Kumar Balhara | Identification and confirmation of early pregnancy associated urinary metabolites in murrah buffalo |
| 02. | Dr. Pooja Tamboli | Ph.D | LPM | NDRI, Karnal | 2016-2019 | Dr. Anurag Bharadwaj | Association of age at first calving and first lactation traits on lifetime productivity in buffaloes |
| 03. | N Ramesh | Ph.D | Vety. Extension | IVRI | 2017-2019 | Dr. Hema Tripathi | Multi-dimensional study on usage of antibiotics in livestock and poultry farming |
| 04. | Dr. Kamal Kumar | M V Sc | Extention | IVRI | 2019 | Dr. VB Dixit | An analysis of interaction of buffalo farmers with information providing stakeholders |
| 05. | Dr. Erica Lawai Lyngdoh | M.Sc. | Animal Biochemistry | NDRI, Karnal | 2018-2019 | Dr. Varij Nayan | Explorations into the nanomaterial-cellular interactions in buffalo granulose and sperm cells |
| 06. | Dr. Shivanagouda Patil | M.V. Sc | VGO | LUVAS, Hisar | 2018 | Dr. Pradeep Kumar | Studies on dilution effect on buffalo sperm functionality |
| 07 | Dr. M H jan | Ph.D. | VGO | IVRI | 2019 | Dr. R K Sharma | Effect of modulation of follicular wave and subclinical endometritis on reproductive perormannce in Nili-Ravi buffalo. |
| **Ongoing during 2018-19** | | | | | | | |
| 1. | Dr. Mala Singh | Ph.D | Animal Physiology | NDRI, Karnal | 2016-2018 | Dr. SK Phulia | Proteomic evaluation of uterine and vaginal cytology during early pregnancy in buffaloes |
| 2. | Dr. Ram Kumar Singh | Ph.D | Animal Nutrition | NDRI, Karnal | 2016-2019 | Dr. SS Dahiya | Modulation of Buffalo Milk Conjugated Linoleic Acid Content through Dietary Supplementation of Plant Secondary Metabolites |
| 3. | Dr. Muhammad Abubakar Wakil | Ph.D | Veterinary Physiology | LUVAS, Hisar | 2017-2019 | Dr. PS Yadav | Effect of telomerase activator on telomere length and telomerase activity of somatic cells and cloned embryos in buffalo |
| 4. | Dr. M. Naveen Swaroop | Ph.D | Animal Biochemistry | NDRI, Karnal | 2018-2019 | Dr. Varij Nayan | Prognostic blood miRNAs and lncRNAs during estrous cycle of buffalo |
| 5. | 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 |
| 6. | Dr. Sandeep | M.V. Sc | Veterinary Physiology | LUVAS, Hisar | 2018-2020 | Dr. A Dey | Evaluation of dietary cottonseed oil and eucalyptus leaf meal supplementation on milk fatty acids profile, methane production, nutrient utilization and production performance of Murrah buffalo |
| 7. | Dr. Amit Kumar | MVSc | VGO | LUVAS, Hisar | 2018-2020 | Dr. Jerome A | Deciphering peripheral IGF-1 variation across age-groups and the effect of seminal IGF-1 supplementation on sperm functionality in male buffalo |
| 8. | Dr. Arjun V | MVSc | Veterinary Gynaecology & Obstetrics | LUVAS, Hisar | 2020-2021 | Dr. Pradeep Kumar | Effect of seminal plasma, mitochondrial targeted antioxidant and mitochondrial uncoupler to mitigate 'dilution effect' in buffalo semen |
| 9. | Surya Pal Singh | PGD-ETM | Education technology | NAARM, Hyderabad | 2019-2020 | Dr. Ashok Kumar Balhara | To be decided |
| 10. | Harshita | PGD-ETM | Education technology | NAARM, Hyderabad | 2019-2020 | Sunesh Balhara | To be decided |

# Campus Happenings








# ICAR-CIRB Personnel

| General Administration | |
|---|---|
| **Dr. Satbir Singh Dahiya** | **Director** |
| Sh. Ravinder | Administrative Officer |
| Sh. Shammi Tyagi | Fin. & Accounts Officer |
| Sh. Joginder Singh | Private Secretary |
| Sh. Narender Kumar | Asst Adm. Officer |
| Sh. Rajesh Kumar | Asst Adm. Officer |
| Sh. Girdhari Lal | Asst Adm. Officer |
| Sh. Viksit Kumar | Assistant |
| Sh. Abdul Majid | Assistant |
| Sh. Ashok Kumar | Assistant |
| Smt. Indira Devi | Upper Div. Clerk |
| Sh. Satbir Singh | Upper Div. Clerk |
| Sh. Dharam Pal | Lower Div. Clerk |
| Sh. Sunil Kumar | Lower Div. Clerk |
| Sh. Mahabir Singh | Lower Div. Clerk |
| Smt. Savita | Lower Div. Clerk |
| **Sub- Campus, Nabha, Patiala** | |
| Dr. Sanjay Kumar | Sr. Scientist & Officer In-charge |
| Dr. Mustafa Hasan Jan | Scientist |
| Sh. Jagdish Prasad | Chief Tech. Officer |
| Sh. Rajiv Mehta | Chief Tech. Officer |
| Sh. RS Pippal | Asst. Chief Tech. Officer |
| Dr. AK Saini | Senior Tech. Officer |
| Sh. Daljit Singh | Tech. Officer |
| Sh. Mohan Singh | Tech. Officer |
| Sh. Tejinder Singh | Upper Div. Clerk |
| **Transfer of Technology and Entrepreneurship (TOTE) Unit** | |
| Dr. VB Dixit | Principal Scientist & In-charge |
| Dr. Hema Tripathi | Principal Scientist |
| Dr. Sajjan Singh | Principal Scientist |
| Sh. Gopaldat Tiwari | Technician |
| **Priority Setting, Monitoring and Evaluation (PME) Cell** | |
| Dr. SK Khurana | Principal Scientist (w.e.f. 18.06.2019) |
| Dr. N. Saxena | Principal Scientist (upto 18.06.2019) |
| Dr. Dhramendra Kumar | Senior Scientist |
| Smt. Sunesh | Scientist |
| Dr. Naresh Seloakr | Scientist |
| Sh. Raj Kumar | Asst. Chief Tech. Officer |
| **Agricultural Knowledge Management Unit (AKMU)** | |
| Smt. Sunesh Balhara | Scientist & In-charge |
| Sh. Raj Kumar | Asst. Chief Tech. Officer |
| **Human Resource Development (HRD) Cell** | |
| Dr. Hema Tripathi | Principal Scientist, Nodal Officer |
| Dr. Jerome A. | Scientist, Co-Nodal Officer |

| Network Project on Buffalo Improvement (NPBI) | |
|---|---|
| **Dr. Satbir Singh Dahiya** | **Project Coordinator (B)** |
| Dr. KP Singh | Principal Scientist & In-charge |
| Dr. BP Kushwaha | Principal Scientist (at IGFRI, Jhansi) |
| Dr. Sanjay Kumar | Sr. Scientist (at CIRB, Nabha) |
| Sh. Ram Chander | Technical Officer |
| **Animal Nutrition & Feed Technology (ANF&T) Division** | |
| **Dr PC Lailer** | **Principal Scientist & Head** |
| Dr. Navneet Saxena | Principal Scientist |
| Dr. Ram Singh | Principal Scientist |
| Dr. Avijit Dey | Principal Scintist |
| Dr. Vishal Mudgal | Senior Scientist |
| Dr. Sarita Yadav | Scientist |
| Dr. ML Sharma | Chief Tech. Officer |
| Sh. Krishan Kumar | Asst. Chief Tech. Officer |
| **Animal Physiology & Reproduction (APR) Division** | |
| **Dr RK Sharma** | **Principal Scientist & Head** |
| Dr. PS 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 |
| Sh. Ashrfi Shah | Technician |
| **Animal Genetics & Breeding (AGB) Division** | |
| **Dr Anurag Bharadwaj** | **Principal Scientist & Head** |
| Dr. (Mrs) Poonam Sikka | Principal Scientist |
| Dr. Sandeep K. Khurana | Principal Scientist |
| Dr. KP Singh | Principal Scientist |
| Dr. BP Kushwaha | Principal Scientist |
| Dr. Ashok Kumar | Scientist |
| Smt. Sunesh Balhara | Scientist |
| Sh. AKS Tomer | Asst. Chief Tech. Officer |
| Sh. Ramchander | Technical Officer |
| **Public Information (PI)** | |
| Dr. RK Sharma | PI Officer |
| Dr. Mustafa | Asst. PI Officer |
| Sh. Ravinder | Transparency Officer |
| Sh. Rajesh Kumar | Nodal Officer |
| **Vigilance Officer** | |
| Dr. Navneet Saxena | Principal Scientist |
| **Animal Farm Section** | |
| Dr. Anurag Bharadwaj | Overall In-charge |

| Public Relations Officer (PRO) | |
|---|---|
| Dr. Sajjan Singh | Principal Scientist |
| **Academic Coordinator** | |
| Dr. Ashok Kumar Balhara | Senior Scientist |
| **Estate section and Electrical Section** | |
| Dr. Sajjan Singh | Over all In-charge |
| Sh. BPSingh | ACTO In-charge, Estate |
| Sh. Rajesh Prakash | STO In-charge, Electrical |
| **Workshop Section** | |
| Dr. PC Lailer | Overall In-charge |
| Sh. Ramchander | Tech. Officer & In-charge |
| Sh. Kuldeep Singh | Tech. Officer |
| Sh. Bhim Raj | Tech. Officer |
| Sh. Sant Lal | Tech. Officer |
| Sh. Satpal | Tech. Officer |
| Sh. Ram Kumar | Senior Tech. Assist. |

| Landscape Section | |
|---|---|
| Sh. AKS Tomar | ACTO & In-charge |
| Sh. AKS Tomar | In-charge |
| Dr. Rajesh Kumar | Senior Technical Asst. |
| **Agriculture Farm Section** | |
| **Dr PC Lailer** | **Overall In-charge** |
| Sh. Surender Singh | In-charge |
| Sh. Baljeet Singh | Technical Officer |
| Sh. Satish | Senior Technician |
| Sh. Jagdeep | Technician |
| **Results-Framework Documents (RFD) Cell** | |
| Dr. Jerome A | Scientist |
| **Library** | |
| Dr. Sunesh Balhara | Overall In-charge |
| Sh. Rajkumar | In-charge |
| **Hindi section** | |
| Dr. Vishal Mudgal | Senior Scientist |
| Sh. Dharampal | LDC |

# Supporting Staff

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

| CIRB Sub Campus, Nabha (Punjab) | | | | |
|---|---|---|---|---|
| Sh. Shyam Dev | Sh. Ram Chander | Sh. Hans Raj | Sh. Ram Kewal | Sh. Jaswant Singh |
| Sh. Ram Anuj | Sh. Bhim Singh | Sh. Gurnam Singh | Sh. Ram Suraj | Sh. Mukhtiar Singh |
| Sh. Rajinder Singh | Sh. Balwant Singh | Sh. Rulda Singh | Sh. Jaspal Singh | Sh. Rajesh Kumar |
| Sh. Raju | Sh. Brij Mohan | Sh. Balkar Singh | Sh. Gurjant Singh | Sh. Shrinath |

## Promotions

- Dr. Sanjay Kumar, Scientist promoted to Sr. Scientist w.e.f. 07.01.2018
- Dr. Sarita Yadav, Scientist promoted w.e.f. 07.01.2018
- Dr. Dharmendra Kumar, Scientist promoted to Sr. scientist w.e.f. 21.04.2018
- Sh. Ashok Kumar, UDC promoted as Assistant w.e.f. 03.09.2019.

## Transfers

- Dr. Soumya Dash, Scientist transferred to ICAR-NBAGR, Karnal

## Retirements

- Dr. Satish Kakkar, CTO retired (Voluntary) on 31.05.2019
- Sh. Budh Ram, SSS retired on 31.08.2019
- Dr. K.L. Mehrara, CTO retired on 31.10.2019
- Sh. Virender Singh, CTO retired on 31.10.2019
- Sh. Mela Ram, SSS retired on 31.12.2019

## Sad Demise

- Sh. Krishan Kumar, Casual labour 240 days expired on 07.07.2019
- Shri Gopal Singh, Tech. Officer expired on 05.11.2019.


CIRB Family celebrating Independence Day

Bhadawari claves at IGFRI Jhansi under Network Project on Buffalo Improevement

Murrah Calf

Nili Ravi Calf

Bhadawari Calf

## CHHATTISGARHI

Accession no.: INDIA_BUFFALO_2600_CHHATTISGARHI_01016
Home tract : Chhattisgarh

## GOJRI

Accession no. INDIA_BUFFALO_1606_GOJRI_01017
Home tract : Punjab and Himachal Pradesh



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