

ICAR-CIRB

2016-17

Annual Report



ICAR-Central Institute for Research on Buffaloes

Hisar - 125 001 (Haryana) India



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ICAR-Central Institute for Research on Buffaloes

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The achievements and activities of the Institute from April 2016 to March 2017
are presented in this report.

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PREFACE

DR. INDERJEET SINGH
Director



The ICAR-Central Institute for Research on Buffaloes is witnessing transition from naive to a mature institute with its impact being registered in the areas of animal science research, development as well as extension. The institute has come to be recognized as a centre of elite buffalo germplasm having superior germplasm of not only Murrah but also Nili-Ravi breed, both of which have great potential to be used as improver breeds in the non-descript and low producing buffalo populations. Availability of progeny tested semen is hallmark of the institute through its Network Project on Buffalo Improvement, which added three other breeds - Nili-Ravi, Surti and Pandharpuri, to its Progeny Tested semen stock during the year. Analysis of 12th set Murrah breeding bulls, increased availability of frozen semen stock from proven Murrah bulls to over 1,00,000 doses. Besides high genetic merit semen, the institute is also committed to produce quality frozen semen as well, for which the process for accreditation of semen freezing facilities is in progress. The much awaited genomic selection aspect has been taken up in collaboration with International Livestock Research Institute (ILRI) so that a genomic tool becomes available for early selection of high genetic merit males and females.

The Murrah and Nili-Ravi germplasms maintained by the institute got a new stamp of merit with both the herds registering record peak yields of over 23 kg and standard lactation yields of 4000 kg plus with complete lactation recording. At the same time, average standard lactation milk yields approached 2500 kg in both the herds. A record number of 126,008 frozen semen doses were produced from elite Murrah bulls while the sale of superior quality semen earned record revenue for the Institute. The Institute also undertakes identification, authentication and improvement of superior germplasm in the field through its activities like annual Buffalo Mela and Championship, Monthly Milk Recording Competitions and Field Progeny Testing Projects. The dilemma of low success in the application of reproductive biotechnological tools in female buffalo like ETT and cloning is being investigated to be addressed in due course of time.



Scientific investigations of rumen microbial communities and development of feed additives for reducing methane (CH₄) emission and improved feed utilization are aimed at addressing the focussed objective of reduced feeding cost with minimal detriment to the environment. The highly promising results have the potential to be applied on large scale. The institute also lent its expertise to sister ICAR Institute IIMR for assessment of nutritional quality of various Sorghum cultivars.

Making use of the modern infrastructure facilities created in the Institute, nutrition-reproduction interaction, bioinformatics, induced pluripotent stem cells, early embryonic development on synthetic endometrium, transgenic embryo production, inter-species somatic cells nuclear transfer and nanobiotechnology in the discovery of bio-signatures for the development of diagnostics, are some of the new research ventures.

The institute also realized the merit of convergence with similarly mandated organizations and after a one-day meet, embarked upon practical implementation of the recommendations on convergence. Further, realizing miniscule existence of the institute in contrast to enormous needs of a wide spectrum of stakeholders, the Institute undertook unique initiatives in ICT applications like Buffalopedia, E-bhains Gyan Kendra, CIRB Youtube Channel and CIRB Facebook Group, which have become hugely popular especially among young educated farmers. This has further given a world-wide projection to the Institute. International recognition for the Institute also came in the form of two international trainings organized by the institute for SAARC and ASEAN countries, benefiting 33 researchers, academicians and senior level delegates from these countries.

The institute continued to generate revenue in excess of the Plan budget allocation for the fourth year in a row, which could perhaps be the solitary example in the ICAR. The increasing numbers and better quality of research publications are a reflection on our motivated scientists and well-equipped laboratory infrastructure. The contribution of graduate research students is indeed very significant besides providing a vibrant youthful ambiance. Banking upon the unstinted support of the technical, administrative and supporting staff, the institute is all geared-up to further eulogize the yeoman contribution of this 'Black Beauty' to the economy of this country, currently pegged around Rs. 500,000 crores annually.

(Inderjeet Singh)
Director





Executive Summary

- ISO 9001:2008 (Certificate No. BN16070/15880) was awarded to the Institute subsequent to the registration assessment conducted on 16th December, 2016 by BSCIC Certifications Pvt. Ltd.
- Highest ever SLMY of 2457 kg and TLMY of 2567 kg (n=133) was achieved. The highest ever individual lactation yield was recorded in Buffalo no. 4316 calved on 26/04/16 in 2nd lactation, which yielded 4063 kg milk in 305 days.
- The highest ever peak yield was also recorded this year in Buffalo no. 4462 calved on 04/01/2017, which produced 23.2 kg in a single day on 17/03/2017.
- A total of 64 breeding Murrah bulls and 07 Nili-Ravi breeding bulls were sold to developmental agencies, breeders, panchayats and progressive famers. 1,26,008 Murrah and 18790 Nili-Ravi semen doses were frozen out of which 54546 Murrah and 9450 Nili-Ravi semen straw were sold in the field for insemination.
- Fifteen bulls of 16th set were used in herd for test mating. In addition 6 bulls from CIRB Hisar herd were tentatively selected for 17th set for test mating under progeny testing.
- 3807 AI using 15 test bulls of 16th set were performed in 10 adopted villages. The conception rate in field was 55.48%. 2112 pregnancies were confirmed and 1661 calving (864 males, 797 females) were recorded. The average age at first calving for 170 daughters was 42.04 months.
- The physical identification using ear tagging has been done in all female progenies born in the field till December 2016. As on 31st March 2017, more than 1050 female progenies of 13th to 16th set of different age are standing at various field unit centres for future recordings.
- The overall wet average (8.08 kg), herd average (5.32 kg), 305 days lactation milk (2457 kg), total lactation milk yield (2567 kg), peak yield (12.22 kg) and lactation length (312 days) were achieved in Murrah herd.
- The overall wet average (7.96 kg), herd average (5.23 kg), 305 days lactation milk (2377 kg), total lactation milk yield, peak yield (2452 kg) and lactation length (298 days) were achieved in Nili-Ravi herd.
- The reproductive traits such as service period, calving interval and age at first calving were 148 and 140 days, 458 and 447 days, and 44.9 and 41.4 days, respectively for Murrah and Nili-Ravi herds.
- Genes related to carrier signal proteins and cell redox potential governing energy status, differentially expressed in Murrah bulls having high and low sperm motility, were identified using Illumina HiSeq platform by next-generation sequencing technology of RNA-Seq.
- More than 150 Murrah buffaloes were screened during postpartum period from 30 dpp at 10 days interval and 40 post-partum anestrus buffaloes and 25 normal cyclic were identified. Ovarian follicular fluid was isolated by ultrasonography guided follicular aspiration from 7 normal cyclic buffaloes and stored at -80°C for RNA isolation.
- Semen was collected from six bulls across different seasons was cryopreserved as per standard freezing protocol. Freezability, total sperms, concentration and consistency were lower in Monsoon and post-monsoon season as compared to other seasons.
- Reprogramming buffalo fetal fibroblasts into pluripotent stem cells by non-viral method, employing the piggyBac transposon system encoding the reprogramming factors OCT-4, SOX-2, KLF-4, C-MYC, LIN-28 and NANOG, each separated by self-cleaving peptide sequences and driven by the chimeric CAGGS promoter was studied.
- Cleavage and embryo production rate of cloned embryos made through handmade cloning method using semen derived cells was comparable with tail derived cells.
- Addition of Iodixanol to semen extender revealed cryoprotective effects whereas, cysteamine was detrimental to post-thaw semen quality. The protective



effect of iodixanol was due to its ability to protect spermatozoa against free radical induced damage by bolstering the antioxidant capacity of sperm.

- A total of 43 cloned blastocysts were transferred to synchronized female buffaloes and 2 pregnancies were recorded. Treatment of somatic cells with epigenetic modifier, sodium butyrate was also explored to understand reprogramming process.
- Buffalo fetal fibroblasts were isolated and cultured *in vitro* for optimization of conditions for gene transfer into somatic cells. Electroporation at 300 volt for 10ms with 1 pulse gave better results. ~40-50% cells integrated with GFP construct showed green fluorescence under the microscope.
- 14 primary somatic cell lines were established and cryopreserved. These includes 4 of adult bulls, 4 of adult females, 3 of champion females from field, 2 of fetuses and 1 of new-born buffalo. Primary somatic cells from adult female (Mu-3133) were used for exploring the use of Na-butyrate for improving cloning efficiency.
- Duration of Doka was significantly lower in Doka group (4.83 ± 0.24 days) as compared to the Gubhdoka (19.27 ± 2.46 days). Majority of buffaloes (64%) expressed estrus behaviour 1.97 ± 0.17 days after the end of Doka. Milk losses during Doka and Gubh doka were 6.8% and 7.0%, respectively.
- As an alternate to wet chemical method, attempts were also made to prepare gold nanoparticles by green route. Greener methods were also explored to produce the biogenic silver nanoparticles. The green synthesis of nanoparticles was developed as an economical and biologically gentle technique. In this study more than 30 plant sources were utilized.
- No difference in rumen population of total bacteria, archaea and fungi between straw based ration (80% straw and 20% concentrate) and Jowar fodder based ration (80% Jowar fodder and 20% concentrate). However, at genus level there was substantial difference. Fibre degrading and alternate hydrogen sink genera were higher in straw based diet as compared to Jowar based diet.
- A composite feed additive reduced methane emission

by 75% by reducing number of methanogenic archaea in rumen and promoting growth of alternate hydrogen utilizers like sulphate reducing bacteria. The feed additive did not affect number of useful microbes in rumen, stimulated rumen ecosystem by increasing microbial fibrolytic activity. Increased fibre digestion and reduced rate of ammonia production in rumen improved feed conversion efficiency by 15%.

- A number of newer sorghum cultivars developed at IIMR were cultivated at CIRB farm, fed to buffalo calves and compared with MP Chari variety. The chemical composition revealed low lignin (ADL) content in both the CSH 24 MF and SPV 2018 cultivars in comparison to MP Chari. Feeding of these varieties resulted in 9.65% and 14.0% more body weight gain with improvement in feed conversion efficiency in animals fed CSH 24MF and SPV-2018, respectively.
- Feeding modules were developed for improving growth of buffalo calves and heifers fed different level of concentrate and forage.
- Chelated copper, manganese and zinc were prepared and supplemented (50, 75 and 100% level to that of the inorganic salts) in the ration of growing male buffaloes for a period of six months. Level of ceruloplasmin, total immunoglobulin as well as total antioxidant status of buffaloes remained comparable among groups. SOD level remained high in all three groups received supplemented minerals in organic form as compared to inorganic one.
- The results of *in-vitro* studies of various herbs against *Hoemonchus spp.* indicated highest mortality of larvae in the combinations having all the four herbal products. However, the combination having solanum and embelia were equally effective.
- Thirty one constraints in convergence were identified and classified into administrative, functional, organizational, policy-related and operational groups using k-means cluster analysis after collecting data from 50 field veterinarians and 100 scientists working in CIRB, LUVAS and NDRI regarding important modes important modes of convergence.
- A workshop on convergence was conducted on January 7, 2017. CIRB, SDAH, LUVAS, HLDB, LEAD BANK, Director ATARI, ATMA & DRDA participated in



- the workshop.
- A study was conducted to investigate the factors influencing participation of rural youth in farming following ex-post facto and exploratory research design in the Hisar district of Haryana. Aspirations were categorized into 05 areas where economic aspirations got first rank followed by career and educational aspirations. About 81% of the respondents wished to migrate from rural to urban areas due to one or the other reason and preferred inter-district migration. The major constraints in farming perceived by the respondents were lack of institutional and extension support that ranked 1st, followed by profit is not in harmony with efforts (Rank II) and mechanization lacunae in agriculture sector secured 3rd rank.
 - Under Farmer First program, three villages were adopted and data were collected with respect to population status, land use pattern, animal husbandry practices and agriculture production system. Ten programs were organized related to farmers training, awareness programs, farmer's exposure visit, infertility and health camps and ASMM distributed to address mineral deficiency, infertility and udder health in buffaloes.
 - A study was undertaken to assess the impact of trainings on improved buffalo farming on the farmers' socio-economic dimensions. Positive changes were observed in participants' attitude, knowledge, skills and adoption. Significant increase in herd size, average monthly milk production and income of the participants were observed in the post training period.
 - Under '*Mera Gaon Mera Gaurav*' scheme, 30 villages were adopted by 07 teams covering 06 districts of three states including 2 in Haryana, 2 in Rajasthan and 02 in Punjab. A total of 59 visits were made for goshties and interface meetings to villages benefitting 2748 farmers. Twelve trainings were organised on improved buffalo husbandry and related aspects covering 447 farmers and farm women.
 - World Veterinary Day on theme 'Continuing Education with a One Health Focus' was organized through kisan goshti, animal health camp and Kisan Prashn Manch program. In addition, World Food Day 2016 on theme 'Climate is changing, food and agriculture must too' was celebrated wherein children from 10th to 12th standard were sensitized about the causes, harmful effects of climate change on livestock, agriculture, health, environment etc and also the simple strategies / measures to combat it.
 - A quiz competition on swachhta, poster competition on climate change and *ashu bhashan pratiyogita* were organized among the students and prizes were also distributed to winners. *Swachhata pakhwada* and cleanliness drive in schools (May 16-30, 2016 and October 16-31, 2016) along with sensitization program about the significance of cleanliness, quiz competition, slogan competition and extempore speaking competitions were also organized.
 - Under Tribal Sub Plan, trainings were provided to tribal farmers on buffalo husbandry from 6-9 March 2017 in the TSP adopted villages of Tehsil Slumber, Distt. Udaipur (Rajasthan). Distributed 66 grain bins to BPL tribal families.
 - A 6-day training programme on 'Herd Health Management of Dairy Buffaloes' sponsored by SAARC Agriculture center Dhaka, Bangladesh was organised for participants from 5 member countries – Bangladesh, Pakistan, Nepal, Sri Lanka and India. The training was inaugurated by Dr T. Mohapatra, Hon'ble Secretary DARE & DG, ICAR. Deliberations were made on various aspects of buffalo farming covering diverse areas including nutrition, reproduction, health, breeding and management.
 - A 10-day training programme on 'Buffalo production using reproductive biotechnology' for delegates from ASEAN countries. The program was sponsored by the ASEAN-India Joint Cooperation Fund. The program was inaugurated by Dr AK Srivastava member (AS) ASRB. The training was attended by sixteen participants from 8 ASEAN member countries – two each from Cambodia, Indonesia, Lao, Malaysia, Myanmar, Philippines, Thailand and Vietnam. During this training the participants were acquainted with the modern biotechnological tools for use in livestock production systems especially buffaloes.
 - Three trainings on 'Ultrasound and fertility management in large animals' were organized for 49



- field veterinarians of Uttar Pradesh with duration of four days each.
- One training program on '*Buffalo Husbandry and AI for Breed Improvement*' was conducted for 10 participants during. In addition, 9 (08 at main and 01 at subcampus) other training each of 07 days duration were organised on improved buffalo husbandry and related aspects benefitting 724 farmers, youth and women. Two off campus trainings, in village Landhri for 117 farmers and Ramayan for 114 rural youth, were organised on scientific nutritional and management practices and improved buffalo farming, respectively.
 - A total of 14 infertility treatment camps were organised in various villages of Haryana and Rajasthan wherein 380 animals were checked and treated for various reproductive and productive problems.
 - Institute organised annual buffalo mela cum exhibition at main campus, Hisar on the occasion of its 33rd Foundation day on February 4, 2017 at Institute premises wherein 300 elite animals including buffalo bulls, milch buffaloes, lactating buffaloes, dry buffaloes, heifers etc. from all over Haryana and adjoining states participated. On the occasion, cash prizes were given for milk recording competition held throughout the year to the owners whose animals yielded above 21 kg (Rs 21000 each to 06 owners), 18-21 Kg (10000 each to 16 owners) and 15-18 Kg (Rs 5000 each to 05 owners) of milk in a day. Haryana Kisan Ayog sponsored some of the prizes.
 - The Institute put up its stall and showcased its technologies in 5 melas organised by different organizations.
 - Milk recording for authentication of the high milk yielder buffaloes of the farmers were organized every month, wherein, 28 buffaloes participated in the competition and the highest yielder was Buffalo No. 16001377 yielded 23.953 kg milk in competition.
 - Institute celebrated Agriculture Education Day on December 03, 2016 for promoting the spirit of agriculture and allied subjects among the 80 students of XI & XII standard, from OP Jindal Modern School and Shri Krishna Pranami Public School, Hisar along with their teachers.
 - CIRB celebrated birth anniversary of cloned buffalo calf, Hisar Gaurav on 11.12.2016.
 - Four calf rallies were organised for female progenies born FPT project in 4 adopted villages. Competitions were held under three categories (calves <1 year, heifers 1-2 years and heifers >2 years) and prizes were distributed.
 - International Women's Day on the theme "Be Bold for Change", was organized in villages to support them for equality and empowerment. More than 150 women members of milk cooperative societies participated.
 - The scientists/ technical officers of the institute participated in about 12 programmes on different channels of TV/radio focussing on improved buffalo husbandry.
 - Three patent applications on 'Novel cryopreservation protocol for improving buffalo sperm post thaw viability & motility', 'A composite feed additive for reducing methane emission and improving fibre utilization in ruminants', and 'Kalrump scale-A device to measure buffalo rump angularity for identification of dairy characters' were submitted.
 - Area Specific Mineral Mixture was commercialized and the technology leased on non exclusive basis for a period of 10 years to Titanic Pharma on May 5, 2016 for Rs. 2.50 lakhs.
 - Twenty four research papers from studies carried out at CIRB and 15 research papers from studies carried out by our scientists at other institutes were published in international and national peer reviewed journals. In addition to these, 5 review papers, 4 books and technical bulletins were also published.
 - Six Institute funded projects were completed. Institute has 11 ongoing institute funded and 17 externally funded projects.
 - Scientist of Institute received 8 National and Societal awards including Bharat Ratna Dr C Subramaniam Award for Outstanding Teachers 2015 for promoting quality teaching in the field of Social Sciences, Jawaharlal Nehru Award for P.G. Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences-2015 and 6 other awards and recognition for presentations during conferences, seminar and symposia.



- Three scientists received overseas postdoctoral fellowship during this period.
- Nine Scientists, 10 technical staff and 20 administrative staff were trained at various institutions under capacity building.
- Two doctoral students and 10 postgraduate students completed their research work and submitted the thesis, whereas, 5 doctoral and 8 postgraduate students are currently pursuing research work at CIRB.
- Four workshops at main campus and one workshop at subcampus Nabha on a wide range of topics were organized for various stakeholders.
- During the period, 104 hours were dedicated to Swachh Bharat Mission and work was carried out at 22 different activities by employees.
- Agriculture farm at main campus, Hisar produced a total of 33526.00 quintals of green fodder, 1305 quintals grains and 689 quintals wheat straw.
- Total green and dry fodder production in subcampus Nabha during the year was 46889.3 and 3365 quintals, respectively, while grain production was 6203.2 quintals.
- At main campus, fifteen acres of saline soil was reclaimed by growing paddy followed by barley crops.
- At sub campus Nabha, 1300 feet long chain link fence was created to protect farm from stray animals. During the year, 72 acre and 3 marla land was transferred to Animal Husbandry Department, Punjab as per approval of the ICAR.
- Straw making reaper, zero tillage seed drill machine, chaff cutter, harrow and a laser leveller were purchased to improve the farm efficiency.
- Feed unit prepared 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.
- Revenue generation during the year (2016-17) was Rs. 440.68 Lakh at main campus including Rs. 173.48 Lakh at subcampus Nabha.





Introduction

Central Institute for Research on Buffaloes (CIRB) was established in the year 1985 and started functioning from 1st February, 1985. A sub-campus was later added in December, 1987 at Bir Dosanjh, Nabha, District Patiala, Punjab. A highly pedigreed breeding herd of Murrah is established at main campus in Hisar and that of Nili-Ravi buffaloes at sub-campus Nabha. The institute carries out research on various aspects of buffalo improvement including conservation, improvement and propagation of germplasm, development of optimum rations and feeding systems for different categories of buffaloes, enhancement of reproductive efficiency, health management practices for augmenting milk, meat and draught performance of the species.

The institute is aiming 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 Mandate

- To undertake research and transfer of technology on all aspects of buffalo production.
- To establish nucleus breeding herds of important buffalo breeds.
- To act as repository of information on all aspects of buffalo production and development.

Financial Statement /Outlay (Rs. In lacs)

Heads	Sanctioned Budget 2015-16	Expenditure 2015-16
Plan including TSP	321.23	319.30
Non-Plan	2350.00	2308.45
Network Project on Buffalo Improvement	554.00	550.53
AICRP on improvement of feed resources	9.95	9.62
IPR & Commercialization of technology (NAIF)	6.40	3.41
DBT Project (Total outlay)	31.20	11.52
Bioinformatics Project (CABin)	16.86	15.69
Revenue generated	780.31 (Target)	440.68 (Achieved)

Staff position as on 31st March 2017

Category	Sanctioned strength	Filled	Vacant
RMP	1	1	0
Scientific	40	31	9
Technical	44	38	6
Administrative	20	16	4
Skilled	73	59	14
Total	178	145	33

Priority setting and management

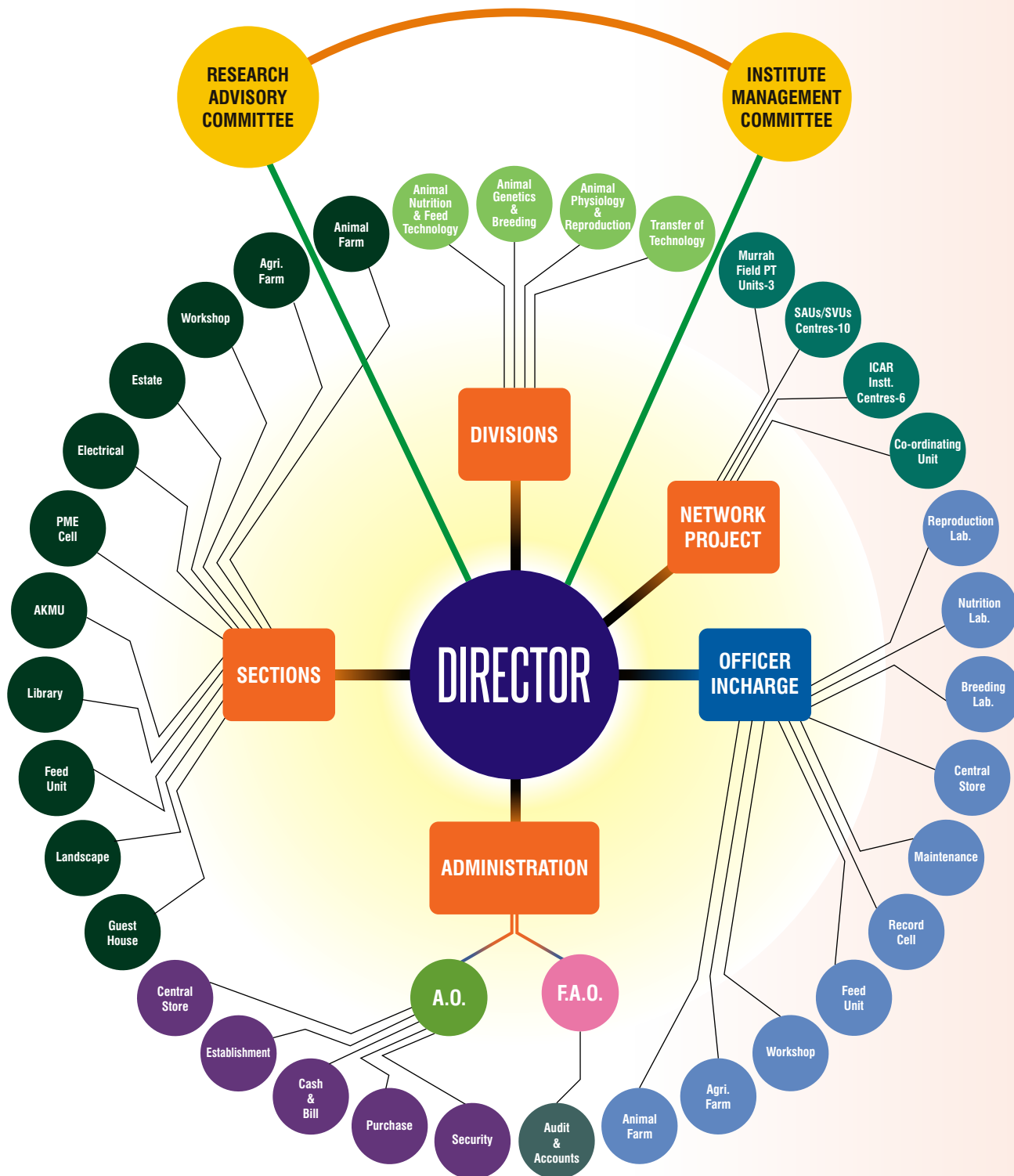
The institute has a Research Advisory Committee (RAC) comprising of eminent scientists who guide research agenda of the institute. The functioning of the institute is supervised by Institute Management Committee (IMC) headed by the Director and members drawn from different institutes and related agencies. A number of sections like Priority Setting, Monitoring and Evaluation Cell, RFD Cell, Institute Technology Management Unit and AKMU have been created and assigned responsibilities for smooth functioning of research activities of the institute. For the XII plan period, flagship programs and priority areas focussed on strategic research in niche areas. This institute is coordinating Network Project on Buffalo Improvement with ten centers across the country, addressing seven important buffalo breeds. The institute is also carrying out technology transfer by conducting training for farmers, field days, web based extension activities besides traditional methods of extension in order to disseminate modern buffalo husbandry practices based on research and development in the area.



Organogram

■ Main Campus, Hisar

■ Sub-campus, Nabha





Research Achievements

Genetic Resource Improvement**Feed Resource Utilization & Improvement****Improvement of Reproductive Efficiency****Transfer of Technology**

Genetic Resource Improvement

Country requires large number of improved high merit germplasm in order to accelerate the pace of improvement in water buffalo. However, at present a wide gap exists between the availability and the requirement of superior buffalo bulls and semen. To bridge this gap, more emphasis is being given to include the farmers' buffaloes in the progeny testing programme. Traditional selection tools are slow and need to be combined with biotechnological tools to increase pace of selection. Institute has initiated an integrated approach involving phenomics, genomics, proteomics and bioinformatics tools in buffalo breeding programs for improvement of desired traits.

Information of the participating Murrah herds

The herd strength of associated Murrah herds is 1990, which include 1071 breedable buffaloes. During this period 15 bulls of 16th set were used in herd for test mating. In addition 6 bulls from CIRB Hisar herd were tentatively selected for 17th set for test mating under progeny testing.

Centre	Herd strength	Breedable buffaloes	Percent calf mortality (0-3 months)	A.I. done/ conceived	Conception rate (%)
NDRI, Karnal	520	332	13.55	357/144	40.34
CIRB, Hisar	523	255	9.20	408/186	45.59
GADVASU, Ludhiana	218	103	9.43	217/101	46.54
LUVAS, Hisar	308	150	6.30	288/137	47.60
IVRI, Izatnagar	202	110	4.48	74/55	74.32
LRS, Mamnoor	147	86	0.00	57/29	50.88
ICAR-RC for ER, Patna	72	35	6.57	59/14	23.7



Production and reproductive performance of participating Murrah herds

Standard lactation yield (305 day or less milk yield) of all the seven participating herds was above 2300 kg except IVRI Izatnagar, RCER Patna and LRS Mamnoor. NDRI Karnal, CIRB Hisar, GADVASU Ludhiana and LUVAS Hisar produced

>2400 kg average 305 day or less day milk yield during the period, while LUVAS Hisar recorded the highest 305 or less day milk yield (2967 kg) among all centres.

Centre	Reproductive performance			
	305 day or less day milk yield, kg (n)	Wet Average, kg (n)	Average age at first calving in month (n)	Average calving interval in days (n)
NDRI, Karnal	2535 (87)	8.39 (105)	43.21 (21)	428 (27)
CIRB, Hisar	2457 (133)	8.08 (110)	44.91 (38)	458 (93)
GADVASU, Ludhiana	2561 (53)	7.92 (53)	42.5 (27)	472 (27)
LUVAS, Hisar	2967	9.7 (80)	42.0 (34)	435 (43)
IVRI, Izatnagar	2194	6.00 (46)	38.99 (19)	458 (40)
LRS, Mamnoor	2028	5.67 (36)	58.50 (3)	530 (22)
ICAR-RC for ER, Patna	1736 (19)	6.39 (19)	-	481 (12)

Participating herds of other breeds

Centre	Herd strength	Breedable buffaloes	Percent calf mortality (0-3 months)	AI done	Conception rate (%)
Nili-Ravi, CIRB Sub-campus, Nabha	507	243	9.46	392/184	46.94
Surti, LRS Vallabhnagar, RAJUVAS	115	61	29.03	86/36	41.86
Pandharpuri, MPKV, Kolhapur	66	29	11.11	24/13	54.16
Jaffarabadi, JAU, Junagardh	272	167	6.94	96/41	42.7
Bhadawari, IGFRI, Jhansi	92	51	3.70	37/24	64.86
Swamp, AAU, Khanapara	51	29	0.00	21/10	47.62

Production and reproduction performance of other breeds

Centre	Productive performance		Reproductive performance	
	305 day or less day milk yield, kg (n)	Wet Average, kg (n)	Average age at first calving in month (n)	Average calving interval in days (n)
Nili-Ravi, CIRB Sub-campus, Nabha	2377	7.96 (102)	41.45 (28)	447 (118)
Surti, LRS Vallabhnagar, RAJUVAS	1583	5.22	46.21 (4)	483 (32)
Pandharpuri, MPKV, Kolhapur	1412	4.11 (11)	42.0 (1)	517 (13)
Jaffarabadi, JAU, Junagardh	1985	7.4 (42)	49.8 (12)	493 (33)
Bhadawari, IGFRI, Jhansi	1368	4.62 (23)	50.6 (4)	478 (18)
Swamp, AAU, Khanapara	293.23	1.28 (7)	61.00 (2)	522 (4)



CIRB Murrah and Nili-Ravi buffalo herds

Murrah: During the period Sixty four breeding males were sold for breeding. During the period total 1,26,008 semen doses were frozen out of which 54,546 semen straws were sold in the field for insemination. At CIRB Hisar, highest ever (since inception of the Institute) 305 days or less Lactation Milk Yield of 2457 kg (n=133) and Total Lactation Milk Yield of 2567 kg (n=133) was achieved. The highest ever lactation yield was recorded in Buffalo no. 4316 calved on 26/04/16 in 2nd lactation, which yielded 4063 kg milk in 305 days. The highest ever peak yield was also recorded this year in Buffalo no. 4462 calved on 04/01/2017, which produced 23.2 kg in a single day on 17/03/2017.

Nili-Ravi: During the period 101 surplus animals were sold

through public auction and 07 breeding bull were sold to the progressive farmers on book value. Total 62 males were sold. During the period total 18790 semen straws were produced out of which 9450 semen straws were sold in the field for insemination. MoU was signed between ICAR-CIRB and the Department of Animal Husbandry, Punjab for transfer of Nili Ravi bulls to semen station Nabha to produce quality Nili Ravi semen straws for CIRB farm as well as for Animal Husbandry Deptt. Punjab to supply in the Nili Ravi tract of Punjab.

The overall wet average, herd average and lactation yield during the period were much improved or comparable as compared to previous years. The reproductive traits viz. age at first calving, service period and calving interval had shown significant improvement over the year.

Performance of CIRB Murrah and Nili-Ravi buffalo herds

Traits	Murrah herd, Hisar	Nili Ravi herd, Nabha
Herd strength	523	507
Breedable buffaloes	255	243
Conception rate (%)	45.59	46.94
Calf mortality (%) 0-3 months	9.20	9.46
Overall mortality (%)	3.95	4.10
Wet average (kg/d)	8.08 (110)	7.96 (102)
Herd average (kg/d)	5.32 (166)	5.23 (155)
Peak yield (kg)	12.22±0.15 (133)	12.3±0.24 (136)
Lactation length (d)	312±4.44 (133)	298±4.6 (136)
TLMY (kg)	2567±49.75 (133)	2452±51.9 (136)
305dMY (kg)	2457±39.61 (133)	2377±46.8 (136)
Service period (d)	148±9.01 (93)	140.4±7.00 (118)
Dry period (d)	143±6.44 (93)	146.6±4.66 (118)
Calving interval (d)	458±8.82 (93)	447.5±7.07 (118)
Age at first calving (months)	44.91±0.81 (38)	41.45±0.62 (28)
Bulls sold	64	62
Milk sold (kg)	280950	247797

Field Progeny Testing of Bulls (FPT)

Under field progeny testing program (FPT) semen of test bulls is used for artificial insemination, followed by pregnancy diagnosis, recording of calving, tagging of female progenies

and follow up of progenies till the completion of their first lactation for milk records on the basis of monthly test day recording. During the period from April 2016 to March 2017, 3807 artificial inseminations, using 15 test bulls of 16th set



were performed in 10 adopted villages under CIRB, Hisar. The conception rate was worked out to be 55.48%. In this period 2112 pregnancies were confirmed and 1661 calving (864 males, 797 females) were recorded. In addition, 170 progenies, 15 of 12th, 152 of 13th, and 3 of 14th set calved during this period and monthly test day milk yield were recorded. The average age at first calving for these 170 daughters was 42.04 months. During the year, 235 daughters were recorded, out of which 84 daughters completed the lactation, 35 daughters sold before the lactation was completed and recording of 116 daughters is in progress. The physical identification using ear tagging has been done in all female progenies born in the field till December 2016. As on March 31, 2017, more than 1050 female progenies of 13th to 16th set of breeding bulls are standing at various field centres for future recordings.

AI done at Murrah FPT centres and progeny born

Parameter	Observations
AI done	3807
Pregnancies confirmed	2112
Calvings recorded	1661
Conception rate (%)	55.48
Female born	797
Male born	864

OTHER PROJECTS

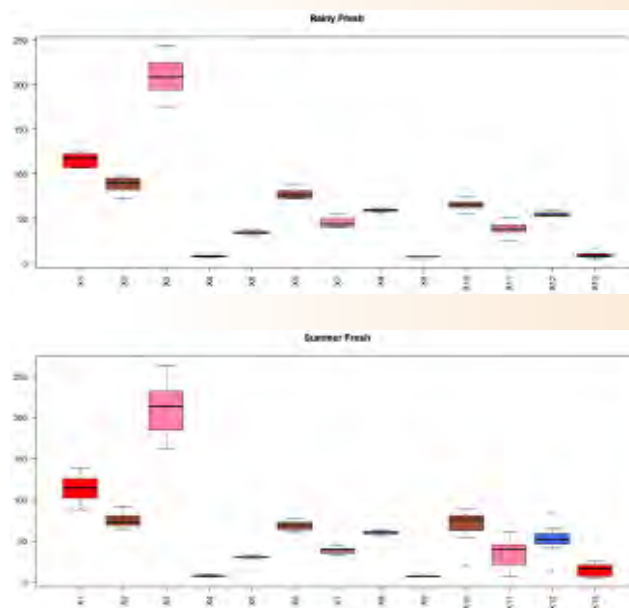
SNPs in genes related to meat production

Demand of the Indian buffalo meat is gradually growing in export markets due to its cost competitiveness, perceived organic nature and proportion of less fat. Growth and carcass traits, which are under the control of multiple genes, are economically important traits in livestock. Selection of animals with higher growth rate and better carcass composition is of great significance to breeder and consumers. Genetic polymorphisms that are significantly associated with certain traits of interest are very useful for livestock improvement. The objectives of this study are to identify SNPs in meat quality genes in buffalo, develop the SNP typing protocol and to elucidate the association of these SNPs with the carcass yield and meat quality. Sire-wise, 70 male calves were selected from the Nili Ravi herd at sub-campus such that each sire has five or more calves in study

group. Calf body wt. was recorded periodically and DNA preparation was done for SNP genotyping for THRSP, GH, GHR and Calpastatin genes with respect to growth and pre-collected data on meat production in terms of decrease in bone percentage with increase in animal weight and meat. Mean dressing percentage of 48.14 ± 0.49 and mean dressing weight of 169.61 ± 9.12 kg recorded for animals of average body weight of 350.92 ± 16.29 kg, having average bone weight of 36.70 ± 1.43 kg i.e. 10.46 percent of live weight.

Genetic variants of oxidative status in relation to fertility in Murrah bulls

Oxidative stress interferes with normal sperm function via membrane lipid peroxidation and fragmentation of nucleic acids, resulting in sperm dysfunction. Sperms are known to possess major antioxidant defense systems including catalase, SOD, GPX and GR, which repair oxidative stress induced damages, however, their effectiveness is impaired by their limited concentration and distribution. Genetic variation in the genes coding for these enzymes alter the ROS production, therefore, may provide a mechanism for the relationship between OS and fertility of bulls. The objectives of this study are to elucidate the relationship between genetic variation with respect to oxidative status and bull performance.

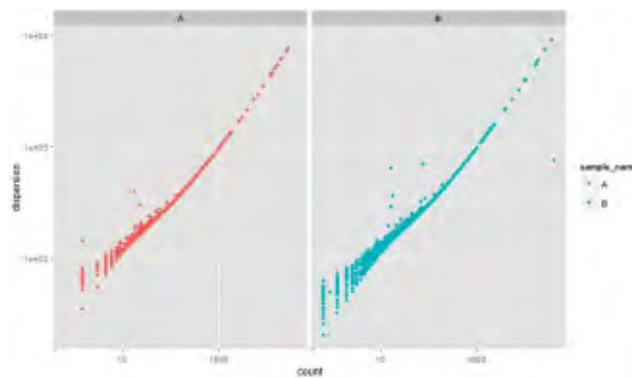
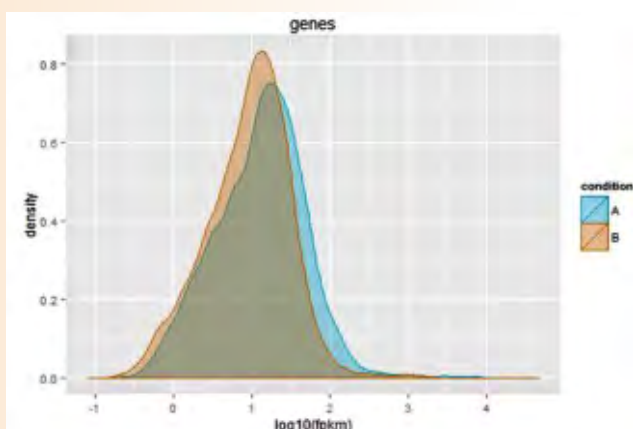


X1 to X13: VAP, VSL, VCL, ALH, BCF, STR, LIN, Head Elongation, Size, % Motile, % Progressive, % Rapid, % Slow
Three factor ANOVA & Multiple regression analysis Boxplot representation of Fresh & Post Thaw Semen Quality determinants in Summer.

Decline in sperm kinetics due to cryo-stress is associated with decrease in recorded sperm head size, elongation, mass progressive and rapid motility estimates of CASA. A large variation (26.98 to 42.88 percent) in post-thaw HOST was recorded while analyzing 180 semen ejaculates, collected from seven bulls during dry- summer and rainy seasons. It indicated variation in resistance to cryo-stress in sperms at level of individual animal.

Sperm motility emerged as significant ($p < 0.01$) determinant for selective genotyping of bulls deduced by fresh and post-thaw progressive (declining 31.5 to 58.6 per cent) and rapid (30.6 to 55.9 % decline) sperm motility. CASA based sperm

quality parameters differ ($p < 0.05$) w.r.t. seasons and frozen/thawed state of semen. Sperm transcriptome data generated using Illumina HiSeq platform by next-generation sequencing technology of RNA-Seq for more than 30 million reads ($> 90\%$ data at Q 30) revealed differentially expressed genes in Murrah bulls under category of high and low sperm motility. Notable variation over FPKM values of down or up regulated genes related to carrier signal proteins, cell redox potential governing energy status has been recorded by sequence aligning method, considering UMD 3.0 as reference. It indicates different energy levels of bulls under study. Buffalo specific sequences are discovered in RNA seq. analysis.



Gene expression distribution plot

The differential gene expression analysis of sperm with respect to semen quality and field performance of bulls using cuffdiff [cufflink package]

Glutathione peroxidase, the major antioxidant in sperm, is sequenced using cattle sequence reference ($> AC_000179.1$, length 1100 bp). Nearly, 810 base pair length of Murrah GPX gene is sequenced and SNP genotyping of 30 bulls is done to deduce gene variants with respect to semen quality and bull fertility performance.

Application of pedigree information and BCS for development of buffalo breeding herd analyser

The objectives of the study were to predict measures for calculation of body weight using digital image processing techniques at pixel level and to predict production performance on the basis of body weight through algorithm processing.

Digit Marker Ball (DMB) was used as a device for buffalo digital image analysis and continued with referential points specific to intensity of Red+Green+Blue (RGB). Self-designed “F” type instrument, as per convenience, was modified and utilized on buffaloes maintained at Institute farm, Hisar and sub campus, Nabha.

Observations on Daily Milk Yield (Kg) in Morning and Evening hours were recorded from animal farm records, maintained at CIRB, Hisar, for the period 1993-2000. Fitting of Lactation curves of daily milk yield was conducted using open source on statistical model available at the MilkBot® (DairySight LLC, Argyle, NY; <http://milkbot.com>). Quantification of both magnitude and shape of lactation curves in a consistent and repeatable way, based on the simple observation of milk records and looking into various influence occurred by genetics, environment, and health were carried out. Main data were formatted as per required JSON-1. Novel designed tool under the name of Kalrumpscale were designed for measuring 3D angular and linear orientation of buffalo external rump/ pelvic surface, complete patent for the same is awaited.



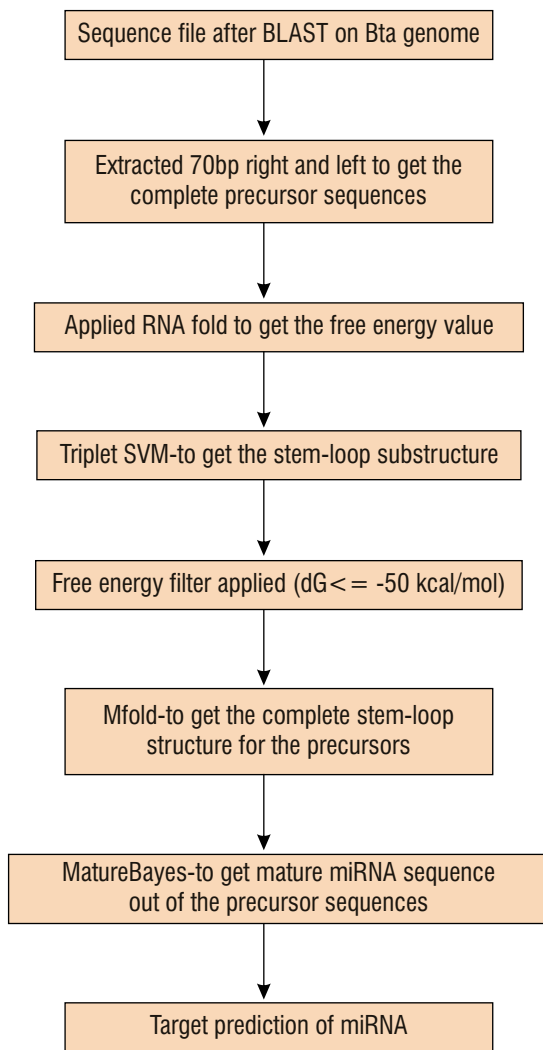
Deducing SSRs in miRNA data resource

Different improvement programs undertaken at various organized farms and even with associated herd progeny testing under AICRP on buffalo and network project of buffalo could not achieve desired results due to limited infrastructure in field and limited number of daughters per sire. The genomics tool especially the genome wide association studies using Next Generation Sequencing can enhance the rate of genetic gain and reduce the generation interval in species like buffalo. The objectives of the project extend across a wide range of species of agricultural, livestock and fisheries importance.

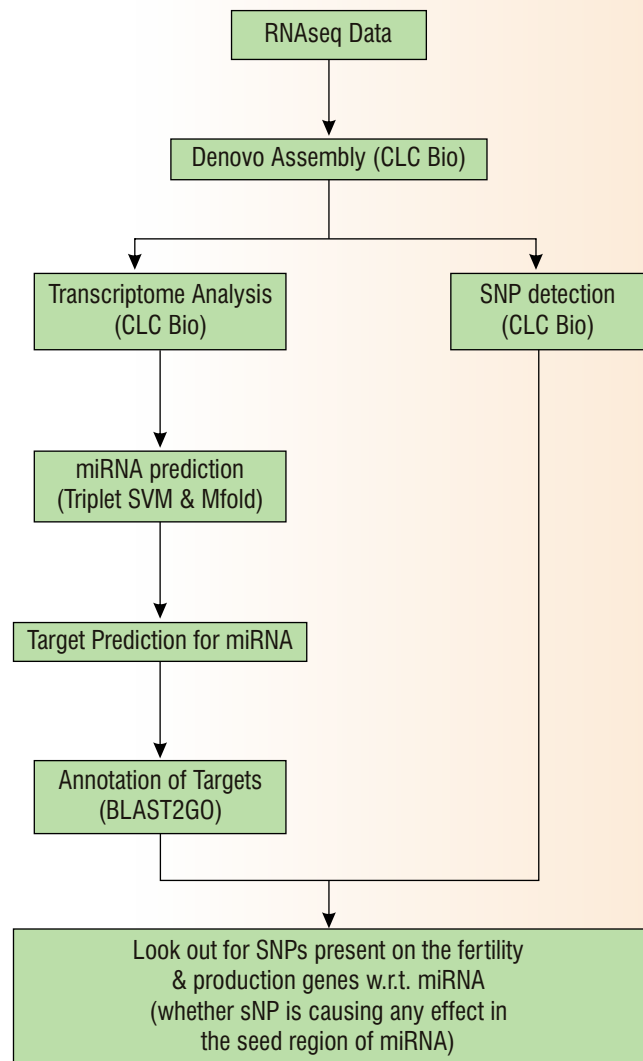
The objective is to conduct basic research into structural and functional genomics in species with commercial potential to

discover new genes from hitherto unexplored species. The long term goal in buffalo genomics shall be the estimation of Genomic Breeding values for the selection of sires and ultimately replacing the conventional progeny testing for selection of sires. Four buffalo specific SSR sequences were identified using SRIT [EST/GSS datasets (NCBI/EMBL/DDJB)] in vicinity of buffalo cyclicity genes regulating microRNA in collaboration with IASRI, New Delhi. miRNA data resource was generated from RNA libraries developed from corpus luteum of cyclic, acyclic and pregnant buffaloes obtained from abattoir for SSR identification. These highly polymorphic regions are identified based on SNPs identification using Target scan are for referring affected functions in Corpus luteum.

Setting Pipeline for miRNA validation (A) and prediction of Target gene sequences harboring SNPs (B)



(A)



(B)

SSRs Identification in precursor miRNA sequences

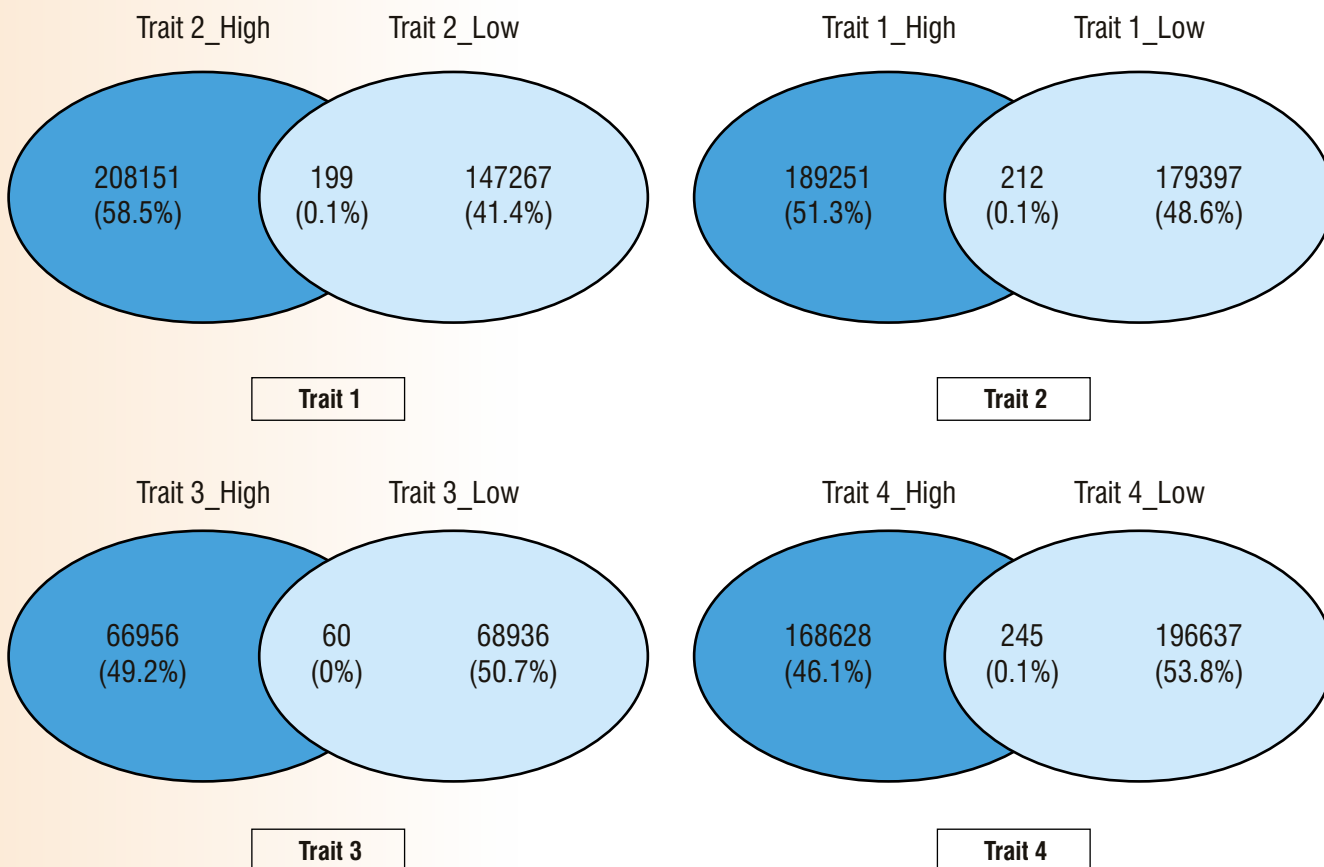
ID	SSR No.	SSR type	SSR	Size	Start	End
seq113	1	p1	(T)13	13	12	24
seq118	1	p1	(T)10	10	5	14
seq122	1	p1	(T)10	10	11	20
seq234	1	p1	(G)10	10	121	130

SNP detection using reduced representational sequencing

Attempt is made to identify buffalo genetic variants through selective genotyping by reduced representational sequencing [ddRAD] sequencing of differentially performing genotypes with respect to Milk yield, early maturity/AFC, calving interval and feed utilizing efficiency traits. 80 selected buffaloes based on phenotype data are sequenced. Data of 38 to 60 million reads per animal is generated using Hi-Seq. Illumina platform Data analysis pipeline was set-up with the

help of IASRI, New Delhi as collaborators, using STACKS. Generation of de novo output files, SNP correction/filtering (rx STACKS), followed by c & ss Stacks is attempted trait-wise, in 4 study groups. More than 50 K SNPs were detected by GBS [ddRAD]. Their annotation (using Bowtie) with reference alignment (UMD 3.3), genotype clustering [Vcf files obtained from SNP analysis subjected to alignment and Newick tree formulation] to cluster alike individuals based on phenotype followed by GO analysis is underway for different traits.

Comparison of SNPs by venny tool in High and Low performance w.r.t. Milk volume, FCE, AFC and calving interval traits





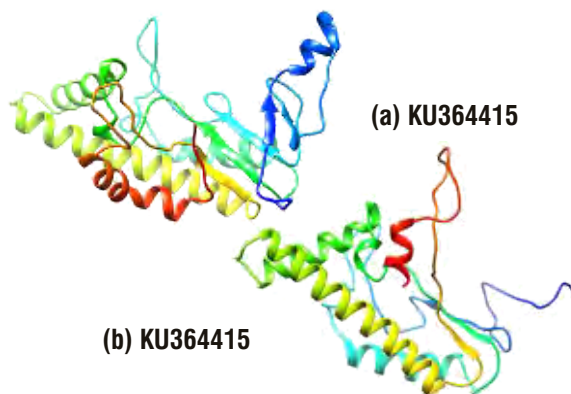
Elucidating tertiary structure of PH20 protein deduced by partial nucleotide sequence of *Bubalus bubalis* by Homology modelling

PH20, a spermatozoa associated protein, has hyaluronidase activity which is required during fertilization for facilitating the sperm penetration. The other function attributed to the PH 20 is the Sperm-Zona binding. PH 20 belongs to the Glycoside hydrolase family 56, which are a group of enzymes that are involved in the hydrolysis of glycosidic bond present between two or more carbohydrates, or between a carbohydrate and a

non-carbohydrate moiety. It has been found to be located on both the acrosomal membrane and sperm plasma membrane. Physicochemical properties and functional annotation of the protein, consisting of 221 and 189 amino acid residues, respectively, deduced from novel PH20 hyaluronidase partial nucleotide sequence of *Bubalus bubalis* [KU364415 and KU364416] obtained from sanger dideoxy sequencing method. Homology modeling of *Bubalus bubalis* PH20 hyaluronidase has been attempted using Swiss-Model server of expasy platform in reference to human hyaluronidase (2PE4).

Percent identity based sequence analysis of *Bubalus bubalis* PH20 nucleotide sequences with other members of the ZPBP family

KU364415	100%										KU364415- <i>Bubalus bubalis</i> PH20 Hyaluronidase
KU364416	84.65%	100%									KU364416- <i>Bubalus bubalis</i> PH20 Hyaluronidase
XP_586790.5	82.35%	80.42%	100%								XP_586790.5- <i>Bos taurus</i> Predicted PH20 Hyaluronidase
NP_001008413.3	68.32%	63.49%	69.09%	100%							NP_001008413.3- <i>Bos taurus</i> Sperm Adhesin Molecule 1Precursor
AAM60770.1	42.08%	40.21%	38.27%	39.01%	100%						AAM60770.1- <i>Homo sapiens</i> Hyaluronidase 1 variant 1
XP_005205168.1	12.21%	10.58%	12.28%	11.14%	10%	100%					XP_005205168.1- <i>Bos taurus</i> ZPBP isoform X1
AAM98378.1	9.5%	10.05%	10.13%	8.53%	9.6%	9.71%	100%				AAM98378.1- <i>Bos taurus</i> Beta actin
XP_002703276.3	6.89%	6.89%	5.51%	7.58%	6.89%	6.2%	9.65%	100%			XP_002703276.3- <i>Bos taurus</i> AQN1
	KU364415	KU364416	XP_586790.5	NP_001008413.3	AAM60770.1	XP_005205168.1	AAM98378.1	XP_002703276.3			



Homology models of (a) KU364415 and (b) KU364416 of *Bubalus bubalis* PH20 as predicted by Swiss-Model server

Two models were compared for structural variation between the two theoretical models, TM-align server, based on TM-score (template matching score) rotation and dynamic programming to assess the quality of modelled protein structures. A TM score of 0.80016 and 0.99886 was determined for the two PH20 proteins when compared to each other [TM score in between 0.5-1 represents structural

similarity]. ProSA-Z-score plots depict the values of Z-score for the theoretical models. Study infers the determined Z-scores are in acceptable range i.e. the predicted model structures are structurally stable. The modelled structures are submitted to Protein Model Database (Castrignano *et al.*, 2006) with identifiers: PM0080458 and PM0080459 for *Bubalus bubalis* PH20 sequences KU364415 and KU364416, respectively. Possible glycosylation and mannosylation patterns were also predicted in both the PH20 hyaluronidase sequences which may be responsible for its hyaluronidase activity. Physicochemical characterization revealed that the *Bubalus bubalis* PH20 hyaluronidases are more stable and more hydrophobic than that of the cattle PH20 hyaluronidase. The predicted gene ontology terms indicated towards both enzymatic activity as well as protein binding. This protein has been identified as polymorphic in *Bubalus bubalis* Murrah bulls having polymorphic nucleotide sequences (acc. no. KU364415 & KU364416).

Improvement of Reproductive Efficiency

High reproductive efficiency is must for realizing the true productive potential of dairy animals. In management terms, this implies an ideal age at first calving (AFC) and short postpartum barren interval in multiparous animals—practices which can lead to 'a calf– a year' situation. In addition to management, good nutrition and proper breeding strategies also account for good reproduction and an economically viable dairy enterprise. Buffaloes are well adapted to harsh environmental conditions prevailing in countries like India. An integrated approach of balanced feeding, improved management, early diagnosis of infertility and use of aided reproductive technologies can bring buffalo farming at par with any good dairy farming in the world.

Lactation stress associated postpartum anestrus SNP array in buffaloes (NASF Project)

More than 150 buffaloes were screened at ICAR-CIRB buffalo farm for identification of postpartum animals. Buffaloes available in field or with farmers were also screened and several post-partum anoestrus buffaloes were identified. The examinations were done from 30 days postpartum at 10 days interval. 40 post-partum anoestrus and 25 normal cyclic buffaloes were identified. The collection of blood was done from heifers and post-partum anoestrus animals. A high quality genomic DNA was isolated. Ovarian follicular fluid was aspirated by ultrasonography guided follicular aspiration from 7 normal cyclic buffaloes and stored at -80°C for RNA isolation. It will be used for identifying the differential genes and proteins involved in postpartum lactation stress and their

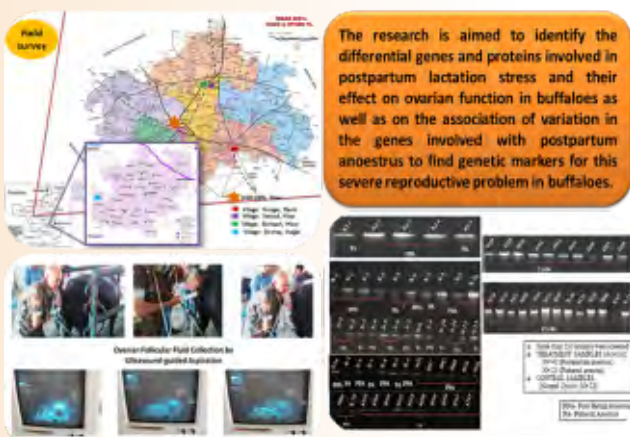
effect on ovarian function in buffaloes. Also, attempts were made to study the genetic polymorphism of HSP70, TLR 4 and IGF-1 genes in relation to anoestrus conditions in Murrah buffaloes. Different exonic regions of HSP70, TLR4 and IGF1 were amplified and sequenced for discovery of SNPs.

Nutrition and Reproduction (AICR Project)

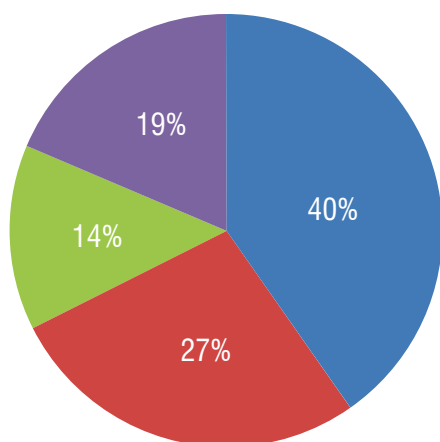
Stress and reproduction

- *Blood biochemical/ Hormonal parameters related to stress during summer and winter in anoestrus and fertile females to find relationship with fertility:* Post-partum buffaloes (n=102) were ultrasound scanned at 10 days interval starting from day 25 post-partum (Aug-March). These buffaloes were managed as per standard feeding practices at farm. Blood samples corresponding to D0 (day of calving), 10, 20 and 30 post-partum were collected to establish relation between metabolic hormonal profile (IGF-I, BHBA, Leptin, AMH, blood urea, total protein and glucose) & resumption of cyclicity. Biochemical parameter (albumin) and hormones (BHBA, IGF-1, leptin & AMH) were significantly correlated with each other in cyclic post-partum buffaloes, but not in acyclic group. No relationship between AMH and resumption of cyclicity in buffaloes was observed, while AFC was correlated with body weight in heifers. Thus levels of BHBA, IGF-1, leptin and AMH can be considered for predicting cyclicity in post-partum buffaloes.

- *Effect of season on Semen production quality during summer and winter seasons :* Semen was collected from six bulls during winter season (October to February 2015) and cryopreserves as per standard routine procedure. Colour, volume, mass motility and freezability of each ejaculate were evaluated. Sperm kinetics and motility were assessed using CASA. Freezability, total sperms, sperm concentration and consistency were lower during Monsoon and post-monsoon season as compared to other seasons.



Isolated DNA from different animals Amplified DNA (PCR products)



■ cyclic 30d PP ■ cyclic 31-60d PP
 ■ cyclic 61-90d PP ■ Acyclic till 90d PP

Resumption of post-partum cyclicity in Murrah buffaloes till day 90 (n=102)

Improving semen quality and production of breeding bulls by mineral mixture supplementation

Murrah buffalo breeding bulls (n=5) maintained at bull shed of Semen Freezing Laboratory, Central Institute for Research on Buffaloes, Hisar, Haryana, were compared - ~ 2 months on 'CIRB Mineral mixture' and ~ 3 months 'NIANP bull specific mineral mixture'. Semen quality (consistency, volume, concentration, total sperm/ejaculate) were recorded of all bulls. Semen consistency, volume, mass motility, concentration and total sperm remained comparable before and after feeding of NIANP bull specific mineral mixture.

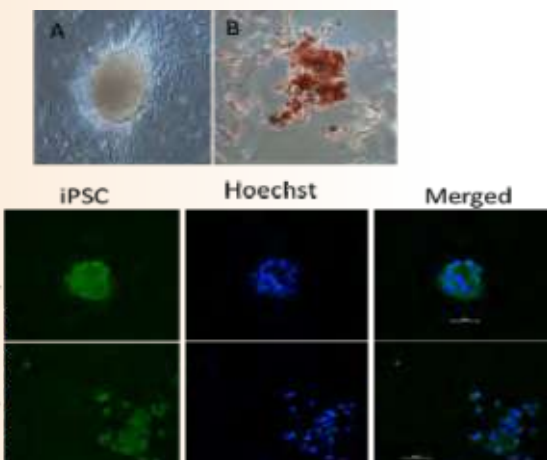
Relationship between temperament with estrus behavior, resumption of cyclicity and milk

Postpartum Murrah buffaloes (n=102) were observed for temperament in open paddock and during milking. Based on the temperament score (1-5 score), they were classified into docile, slightly restless, restless, aggressive and nervous. Estrus behaviour was monitored twice daily in all buffaloes along with milk yield (weekly), body weight (BW) and body condition score (BCS) at day 0, 30, 60 and 90 postpartum. Based on the temperament score, the number of buffaloes classified as docile, slightly restless, restless and aggressive were 37 (36.27%), 28 (27.45%), 30 (29.41%) and 7

(6.86%), respectively. - Number of buffaloes resuming cyclicity in various temperaments groups were: docile (n=35; 94.59%), slightly restless (n=22; 78.57%), restless (n=20; 66.67%) and aggressive (n=7; 85.71%). Temperament was non-significantly correlated ($P=0.128$; $r=-0.152$) with estrus behaviour. Temperament of buffaloes was weakly correlated ($P=0.0017$; $r=-0.306$) with milk production groups.

Induced pluripotent stem (iPS) cells through non-viral approaches

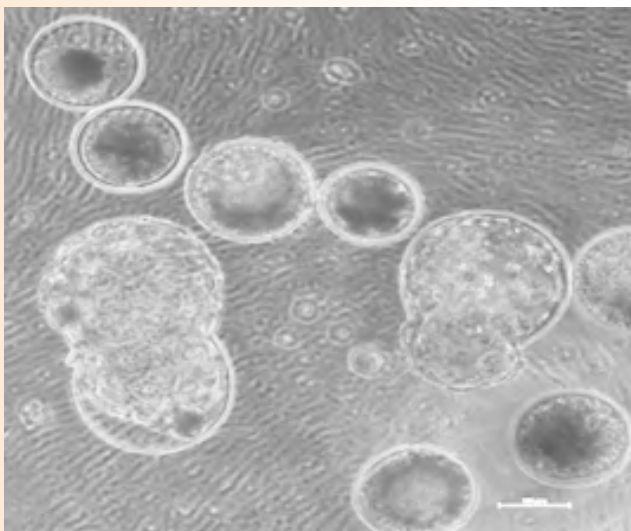
Reprogramming buffalo fetal fibroblasts into pluripotent stem cells by non-viral method, employing the piggyBac transposon system encoding the reprogramming factors OCT-4, SOX-2, KLF-4, C-MYC, LIN-28 and NANOG, each separated by self-cleaving peptide sequences and driven by the chimeric CAGGS promoter was studied. Upon co-electroporation (at 300 volt, single pulse for 10 ms in 2 mm cuvette) of buffalo fetal fibroblasts with 4:1 ratio of transposon transposase concentration, buffalo fibroblasts reprogrammed to iPS-like cells. The derived buffalo iPS cells displayed typical morphological characteristics of pluripotent stem cells. These cells were cultured in DMEM/F12 nutrient mixture, knockout serum replacement, L-glutamine, penicillin and streptomycin, β -mercaptoethanol and non-essential amino acids supplemented with bFGF (10 ng/ml) and hLIF (1000 U/ml) and without feeder cells at 5% CO₂ at 38.5°C and 95% humidity in air. Under these conditions, buffalo iPS-like cells survived up to 10th passage. These cells showed the positive staining of alkaline phosphatase, and expressed pluripotent markers including Oct-4, Sox-2 and Nanog which was evaluated through RT-PCR and also exhibited the positive expression of SSEA-1, and SSEA-4 analyzed through immune-staining. This study provides insights into viral-free iPS cell culture technology and will facilitate genetic modification of the buffalo genome, and be helpful for production of transgenic animals using genetically modified iPS cells in future.



Morphology of buffalo iPS cells (A), buffalo iPS cells expressing alkaline phosphatase (B) and expression of surface markers (C)

Synthetic endometrium to study early embryonic development

Buffalo ovaries (n=582) obtained from slaughterhouse yielded oocytes (n=848) which were subjected to in vitro maturation. 76% (n=572) matured after 24 hrs. These matured oocytes were subjected to in vitro fertilization and 275 oocytes were found cleaved (cleavage rate 48%). When these cleaved embryos were subjected to in vitro culture for up to 8-9 days post insemination, around 10% cleaved embryos developed to blastocyst stages. These blastocysts were stored at -80°C in RNA later for gene expression studies.

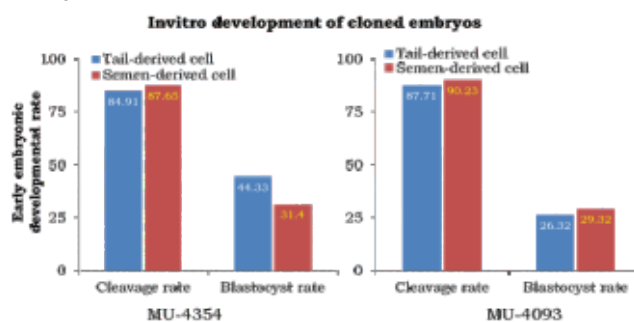


Hatching blastocysts generated through IVF

Simplification of nuclear transfer technique

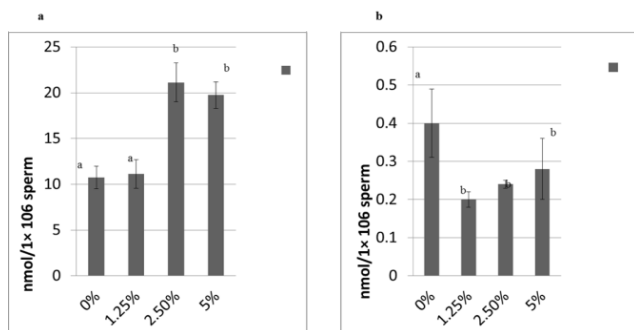
Retrieval of somatic cells from semen is always the challenging task and highly specific culture conditions are

required for culture of retrieved cells. In principal, percoll gradient method with 20%, 50% and 90 % percoll layers and culture medium supplemented with high dose of antibiotics were used for isolation of somatic cells from semen. However, 15% of percoll layer was used over 30%, 60% and 90 % layer of percoll with logic that small particles such as bacteria may travel slowly and sediment less quickly as compared to large particles such as sperm and cells. In the present study semen derived cells used for cloned embryo production was not compromised when compared with traditional used skin derived fibroblast cells as indicated in the figure below.

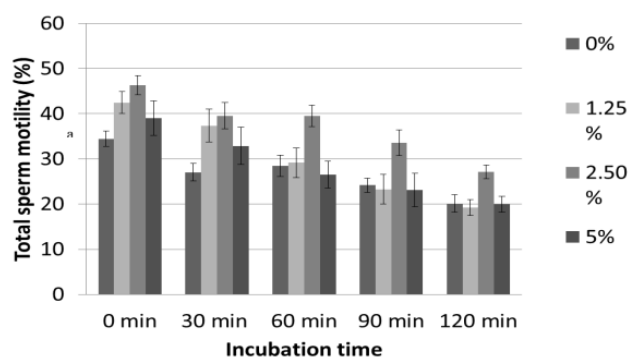


Prevention of cryocapacitation and development of buffalo specific semen extender

Cysteamine was used as an additive in semen cryopreservation and found detrimental effect on post-thaw semen quality instead of beneficial effect. We hypothesized that cysteamine cannot stimulate synthesis of glutathione (GSH) intracellularly in sperm to combat free radicals due to inability of cysteamine to stimulate synthesis of GSH intracellularly in sperm, since mature sperm discard most of their cytoplasm during the terminal stages of differentiation, and lack the significant cytoplasmic component that containing different enzymes for the synthesis of GSH. A separate study was performed to evaluate the effect of iodixanol (OptiPrep™) on cryosurvival of buffalo spermatozoa. A total of thirty ejaculates (n=5) were used for this experiment. Each ejaculate was divided into four aliquots and diluted in freezing extender supplemented with different concentrations of OptiPrep™ (0, 1.25, 2.5 and 5%) and then cryopreserved. The semen quality variables were evaluated before and after freezing of semen. The present study shown that iodixanol has the ability to protect spermatozoa against free radical induced damage by bolstering the antioxidant capacity of sperm (measured through total antioxidant capacity and malondialdehyde concentration) as indicated below.



Effect of OptiPrep™ on total antioxidant capacity (a) and malondialdehyde concentration (b) of sperm.



Total sperm motility after incubation test

Cloning for conservation and multiplication of superior buffalo Germplasm

During 2016-17, total 43 cloned blastocysts were transferred to synchronized female buffaloes. Out of them, 26 cloned embryos were transferred at Hi-Tech dairy farm Sirsa and rest of the embryos was transferred at CIRB farm. There were two pregnancies recorded upto March 31, 2017. Treatment of somatic cells with epigenetic modifier, sodium butyrate was also explored to understand reprogramming process. Apart from this, embryos generated through cloning and IVF were used for apoptosis, epigenetics and several gene expression studies for comparisons. Health of cloned calf 'Hisar Gaurav' was monitored throughout the year for standard physio-biochemical parameters which were found normal.

Transgenic embryo production

For optimization of conditions for gene transfer into somatic cells, buffalo fetal fibroblasts were isolated and cultured in vitro. The buffalo fibroblasts were electroporated with green fluorescent protein (GFP) expressing vector at different voltage and time intervals. Electroporation at 300 volt for 10ms with 1 pulse gave best results compared to other conditions used. By using standardized procedure ~40-50%

cells integrated with GFP construct, which showed green fluorescence under the microscope. When transfected cells were enriched through selective passage and single cell culture method, ~80-90% GFP expressing cells were obtained. These cells were used as donor cells for handmade cloning as per established protocol. Transgenic cloned embryos were expressing green fluorescence support up to 8-16 cells and morula stage in culture, indicating ingress of the GFP gene in transfected cell of the cloned embryos.



8-16 cells stage

Morula stage

Cryopreservation of somatic cells and cloned embryos






During reporting period, total 14 primary somatic cell lines were established and cryopreserved. These include 4 of adult bulls, 4 of institute females, 3 of champion females from field, 2 of fetus and 1 of new-born buffalo. These primary cell lines were characterized using expression of cytoskeleton markers including vimentin for fibroblast origin and cytokeratin for epithelial origin. Minimum 25 cryovials were preserved in liquid nitrogen for banking. In this period, primary somatic cells from champion female buffalo were used for cloning experiments and fetal cells were used for generation of buffalo iPSC and GFP expressing cells. Also, primary somatic cells from adult female (Mu-3133), were used for exploring use of Na-butyrate for improving cloning efficiency. All these primary cell lines were characterized through microsatellite DNA test for validation of parentage in future.

Optimization of interspecies somatic cell nuclear transfer techniques

Skin tissue biopsies from 2 foals and one adult horse were taken aseptically and transported to ICAR-CIRB laboratory within 24h for isolation and culture of somatic cells. The fibroblast cells were sub-cultured till they attained confluence following which they were passaged up to 10 times. Aliquots of cells at early passages (passage 2-3) were cryopreserved and were stored in liquid nitrogen for future use. For

production of interspecies horse cloned embryos, buffalo oocytes collected from slaughterhouse ovaries were processed for enucleation, and subsequently fused with horse somatic cells.

In-vitro developmental competence of horse cloned embryos produced using recipient oocytes of buffaloes

Buffalo ooplasm volume	No of fused embryos	Stage achieved
Doublet 	66	16 cell stage 
Triplet 	33	32 cell stage 
Quadruplet 	22	

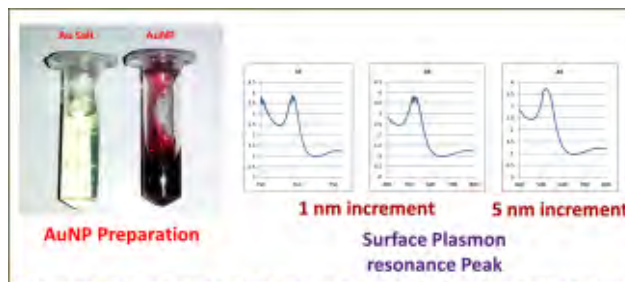
Scientific validation of 'Doka' in buffaloes for improvement of reproductive performance under field and farm conditions

Fat%, lactose%, SNF% and SCC (*1000/ml) were found non-significantly higher in Doka (non-pregnant cyclic) and Gubh Doka (Pregnant) group as compared to the control. Recently calved buffalo (21.91±1.98 days) were also showing signs of Doka. Dominant follicle size was significantly (p<0.05) larger in Doka animals (11.06±0.27 mm) as compared to control (9.92±0.62 mm) and other groups. Numbers of large follicles were significantly (p<0.05) higher in Doka and Gubhdoka as compared to control. Majority (81%) of buffaloes that were showing Doka were cyclic while 19% buffaloes were acyclic. Duration of Doka was significantly (p<0.01) lower (4.83±0.24 days) as compared to the Gubhdoka (19.27±2.46 days). Majority of buffaloes (64%) expressed estrus behaviour 1.97±0.17 days after the end of Doka. However, in some cases estrus was not observed. Milk losses during Doka and Gubh Doka were 6.8% and 7.0%, respectively.

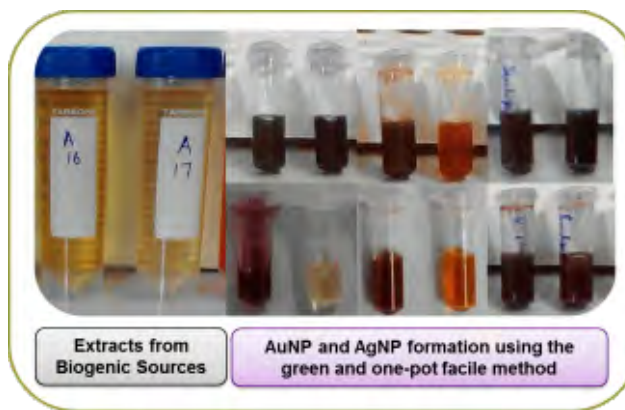
Bio-signatures of buffalo reproduction for development of diagnostics

Gold nanoparticles (AuNPs) were prepared in colloidal form ("wet chemical method") by reduction of gold salt through a "nucleation" process. The prepared wine red coloured colloidal gold nanoparticles exhibited the characteristic properties of AuNPs. The structural and optical properties of colloidal gold nanoparticles prepared by this wet chemical route were characterized by UV-Vis spectrophotometry measurements. As an alternate for the wet chemical method, attempts were also made to prepare gold nanoparticles by green route. Greener methods were also explored to produce the biogenic silver nanoparticles. The green synthesis of

nanoparticles was developed as an economical and biologically gentle technique. It was explored with commitments towards environmental sustainability and based on our understanding that development of an eco-friendly alternative via green synthesis of gold nano-materials can be an important aspect in laboratory as well as field conditions. In this study more than 30 plants were chosen for the green synthesis. Several of them exhibited reduction; however, on prolonged incubation they lacked stability. The sample numbers A4, A16 and A17 have shown promise for preparation of Ag, Au and Ag nanoparticles. These plant sources could be used for preparation of stable gold and silver nanoparticles.



Preparation of colloidal Gold Nanoparticles by wet chemical method



Preparation of colloidal Gold Nanoparticles by green and one-pot facile method



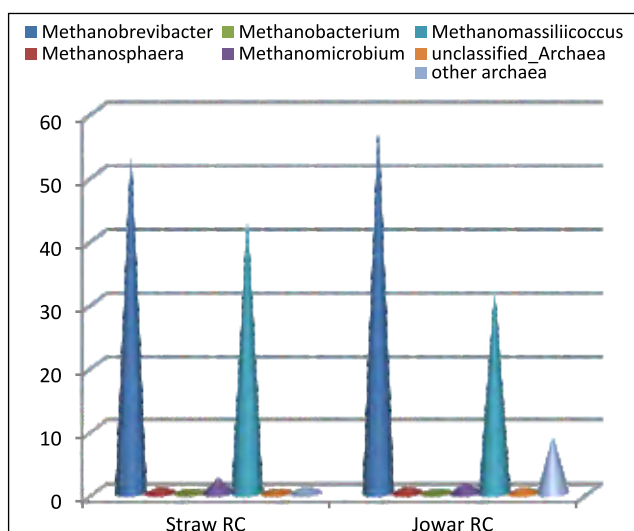
Feed Resource Utilization & Improvement

The limited feed resources available in our country are affecting the overall productivity of our livestock. The growing feed shortage, shrinkage of area under green fodder cultivation and diversion of grains for bio-fuel production are pushing the feeding cost higher and higher. In order to develop economic and balanced ration for buffaloes through utilization of locally available feed resources and strategic supplementation of critical nutrients, the institute has been working on various research projects. In addition, mitigation of methane production/emission both by the dietary and rumen microbial modification, rearing of male and female buffalo calves for higher production, improving bioavailability of minerals are the other focused areas being researched by the scientists.

Integrated investigation of rumen microbial communities involved in methane production and fibre digestion

The rumen microbial ecosystem comprises of diverse population of microorganisms and the microbial diversity may be affected by the type of diet provided to the animals. Effect of jowar vs. straw based diet on the diversity and composition of microbial community in rumen of buffalo was assessed. Two types of ration were provided, a straw based ration (80% straw and 20% concentrate) and Jowar fodder based ration (80% Jowar fodder and 20% concentrate). Four fistulated buffaloes utilized for the study were adapted to each diet for 28 days and then rumen content was sampled for 3 consecutive days. Rumen microbial genomic DNA was used for high throughput sequencing of 16S rRNA of bacteria and archaea and ITS of anaerobic fungi using Illumina MiSeq platform. The population size of methanogenic archaea, bacteria and gut anaerobic fungi were quantified using SYBR Green based quantitative real time PCR. The study indicated

Population of different genera of archaea in rumen of buffaloes fed straw vs. jowar fodder based diet (values are as percent of total archaea)



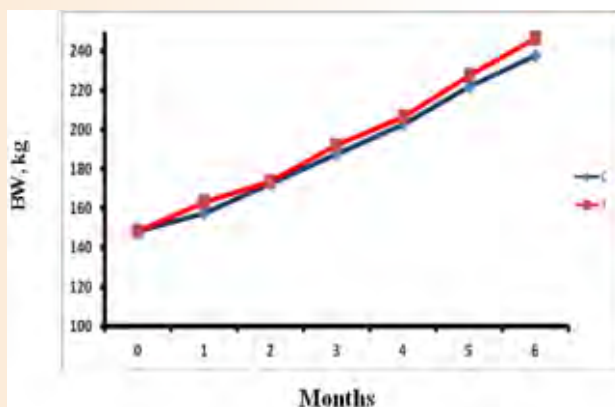
that although there were no difference in number of total bacteria, archaea and fungi between the two diets but at genus level there were substantial difference. Fibre degrading and alternate hydrogen sink genera were higher in straw based diet as compared to Jowar based diet.

Effect of diet on population of different groups of rumen microbes as determined by real time PCR assay (copy number per 30ng DNA)

Organism	Straw based diet	Jowar based diet
Total archaea	107.00	107.39
Anaerobic fungi	106.72	106.51
Total bacteria	109.20	109.00
Fibrobacter succinogenes	105.26	105.61
Ruminococcus albus	106.70	104.87

Development of feed additives for reducing methane emission and improving feed utilization

Livestock contributes substantially to the global methane emission through enteric methanogenesis, which also represents loss of feed energy to the ruminants. A composite feed additive has been developed for reducing methane emission and improvement in fibre utilization by ruminants. The feed additive was fed to buffalo calves for a period of six months to study the growth rate, feed intake and nutrient utilization. Methane concentration in the exhaled air was also estimated. Further, the additive was fed to rumen fistulated animals for a period of five months and rumen fermentation pattern and rumen microbial community structure were studied. It was observed to reduce methane emission by 75% (0.50 vs. 2.07 ppm) by reducing number of methanogenic archaea (105.31 vs. 107) in rumen and promoting growth of alternate hydrogen utilizers like sulphate reducing bacteria (Desulfuromonadales and Desulfobacteriales). The long term study showed that the beneficial effect is not affected by microbial adaptation/resistance over time. The feed additive



Effect of feeding composite feed on growth rate of buffalo calves

does not affect number of useful microbes in rumen (bacteria and fungi) and stimulates rumen ecosystem by increasing microbial fibrolytic activity and thus increases fibre digestion, reduces rate of ammonia production in rumen with concomitant improvement in feed utilization and performance in buffaloes resulting in 9.7% higher growth rate and 15% higher feed conversion efficiency.

Effect of composite feed additive on archaeal, bacterial and fungal population in buffalo rumen on different days as estimated by real time PCR (each data is average of 4 animals)

Copy number/30 ng genomic DNA	Pre-dosing	1 Month post-dosing	5 month post-dosing
Archaea	107.00	105.06	105.31
Bacteria	109.20	108.95	108.96
Anaerobic fungi	106.72	106.68	106.15

Effect of composite feed additive supplementation on nutrient digestibility (%) by buffalo calves

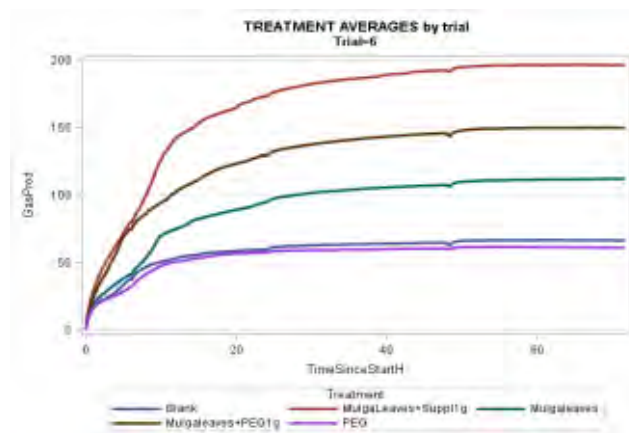
Attributes	Treatments	
	Control	RESMI
Dry Matter	53.41 ^a ± 2.27	61.27 ^b ± 4.05
Organic Matter	57.28 ^a ± 1.87	64.34 ^b ± 3.59
Crude Protein	59.09 ^a ± 2.82	68.93 ^b ± 3.36
Ether Extract	66.07 ^a ± 4.47	74.75 ^b ± 2.38
Neutral Detergent Fibre	55.78 ^a ± 1.19	62.54 ^b ± 4.62
Acid Detergent Fibre	53.30 ^a ± 1.99	58.69 ^b ± 6.04

a,b means with different superscripts within a row differ significantly (p<0.05)

Tannin concentrations in tree leaves & their effects on methane emissions

Under AAERF 2016 at The University of Sydney (Australia), various tanniferous tree leaves viz. Mulga, Dogwood, Spinifex etc. from different strata of trees were collected and processed for tannins estimation and in vitro fermentation kinetics studies. Different fractions of tannins (total phenolics, tannins phenolics, non-tannins phenolics,

In vitro Gas production kinetics of Mulga (*Acacia aneura*) leaves with or without supplement



condensed tannins) were estimated. Continuous monitoring of gas production by various feed stuffs including tree leaves were recorded by newer in vitro gas production technique (ANKOM RF Gas production technique). Supplementary strategy was developed for maximum utilization of tanniferous leaves with reduction in methane production. The study indicates the application of tanniferous leaves in reducing methane production in ruminants. Faecal samples were collected from the cattle grazed on mulga (*Acacia aneura*) trees and were analysed using NIR Spectroscopy to predict feed intake and nutrient digestibility. The faecal NIRS technique for predicting feed quality and nutritional status of animals is useful for developing feeding strategies in large scale for various physiological stages.

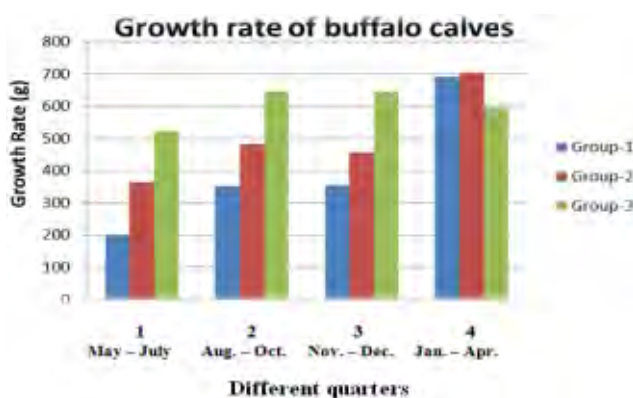
Development of feeding modules for Buffalo meat production

It is well known that the male buffalo calves are being neglected in feeding and thus a precious resource is largely being wasted. The study was planned to develop the feeding modules for economical rearing and optimum growth of buffalo calves fed on different level of concentrate. Eighteen male buffalo calves were divided into three groups and given rations as follows in two different phases. In first phase (of 8 month duration), the animals in group-1 were given all forage diets comprising of green and dry fodder *ad lib* while animals in group-2 and group-3 were offered diets comprising of roughage: concentrate (70:30) and roughage: concentrate diet (30:70), respectively. In second phase (of 4 month duration), the animals were maintained on diets comprising roughage: concentrate ratio of 30:70 in all the three groups with an idea to finish the animals for meat production. DM intake, average daily gain, nutrient utilization and economics of growth production were studied during the experimental period of 360 days. The feed intake per 100 kg body weight in different groups was 2.56, 2.60, 2.63 kg/day.

The digestibilities of different nutrients for the corresponding



groups were DM: 62.69 ± 1.56 , 61.19 ± 1.62 and 65.56 ± 0.97 ; OM: 63.92 ± 1.57 , 62.85 ± 1.47 and 67.25 ± 1.04 ; CP: 54.14 ± 0.79 , 58.63 ± 0.97 and 67.90 ± 1.94 ; CF: 64.61 ± 1.19 , 63.43 ± 0.83 and 61.63 ± 1.97 ; NFE: 65.08 ± 1.63 , 61.76 ± 2.19 and 67.99 ± 1.75 in G-I, G-II and G-III, respectively. The growth rate was 318.50, 435.69 and 647.21 g/d in G-I, G-II and G-III during first eight months and 692.37, 704.95 and 595.17 g/day during last four months, respectively. The overall growth rate in different groups was 442.88, 528.02 & 628.25 g/day in G-I, G-II and G-III, respectively. The economics of production was calculated taking the prevailing cost of the feed ingredients and the values for cost of feeding per animal per day were Rs. 42.10, 56.10 and 85.92 in group-I, II and III, respectively. The cost per kg body weight gain in corresponding groups were Rs. 95.05, 106.24 and 123.32, respectively. Study indicated that buffalo calves for meat production can be reared economically on all forage diets initially followed by a finisher ration in roughage to concentrate ratio of 30:70.



Effect of different feeding regimen on AFC

Dairy farmers invariably are not practising scientific feeding to heifers, resulting in poor growth. Lower growth rate results in higher age at puberty and thus higher age at first calving. The present project was undertaken with an objective to decrease the age at first calving along with economics of feeding. 24 heifers were divided into two groups of 12 each paired for body weight and age. In group-I, heifers were fed as per Paul and Lal (2010) standard and in group-II heifers were fed 15% more of CP and TDN than group-I. After one year of study, average daily gain (ADG) was 532.20 and 538.90 gm in group-I and II, respectively and average daily intake of concentrate was 2.59 and 2.58 kg; green fodder 8.82 and 8.83 kg and wheat straw 1.20 and 1.19 kg in group-I and II, respectively. Average age at first AI was 26 months 22 days in group I and 26 months in Group II. Average weight at first AI was 364.4 kg in group I and 377.0 kg in group II. Total concentrate mixture consumed per heifer after one year of experiment was 113.44 and 113.00 qtls in group I and II. Similarly green fodder consumption was 386.54; 386.97 qtls and wheat straw consumption was 52.56 and 52.16 qtls in

group I and II, respectively. Total feed cost per heifer during the one year of experiment was Rs. 22276.80 and 22681.95 in group I and II, respectively. Feed cost per heifer per day was Rs. 61.00 and 62.10 in group I and II and feed cost per kg live weight gain was Rs. 114.65 and 115.30 in group I and II, respectively for one year of experiment. Age at first calving was 37 months 19 days in group-I and 37 months 20 days in group-II.

Studies on development and supplementation of chelated minerals

Availability of minerals through inorganic sources is low and thus large amount of minerals get excreted through faeces and remain a cause of environment pollution. Attempt in this project was to reduce the amount of minerals excretion through introduction of organic minerals, having less interaction among them due to change of mode of absorption as organic moiety as compared to inorganic one. Chelated copper, manganese and zinc were prepared and supplemented (50, 75 and 100% level to that of the inorganic salts) in the ration of growing male buffaloes for a period of six months. Control was fed these three trace minerals as per recommendations (100%) through their inorganic source. Feed intake and average daily body weight gain remained comparable ($p > 0.05$) among groups. Average plasma Cu, Mn and Zn levels remained comparable among groups, except that Zn level was high in group IV as compared to control. Level of ceruloplasmin, total immunoglobulin as well as total antioxidant status of buffaloes remained comparable ($p > 0.05$) among groups. SOD level remained high in all three groups received supplemented minerals in organic form as compared to inorganic one. Faecal excretion level of Cu, Zn and Mn was reduced in all groups supplemented with organic form of mineral as compared to inorganic form.

Nutritional Evaluation of Newly Developed Sorghum (*Sorghum bicolor*) Cultivars

A number of newer sorghum cultivars have been developed at IIMR, Hyderabad which have the potential of early maturity, high grain and forage yield, less susceptibility to insects and pests, low in hydro cyanic acid and lignin content. The seeds of three varieties viz. MP Chari, CSH 24 MF and SPV 2018 of sorghum were supplied by IIMR, Hyderabad and cultivated at CIRB farm. They were fed to buffalo calves in 3 groups for two months and feed intake, growth rate, nutrient digestibility were studied. The chemical composition revealed significantly low lignin (ADL) content of both the CSH 24MF and SPV 2018 cultivars in comparison to MP Chari. Feeding of these varieties resulted in 9.65% and 14.0% higher body weight gain with improvement in feed conversion efficiency in animals fed CSH 24MF and SPV-2018, respectively. The digestibility of nutrients (viz. DM, OM, NDF, ADF) were improved ($p < 0.05$) in SPV-2018 fed calves than the other ones.

Nutrient digestibility (%) of three different sorghum cultivars fed to buffalo calves

Attributes	Treatments			p-value
	MP Chari	CSH 24 MF	SPV 2018	
Dry matter	66.92 ^a ± 2.11	68.14 ^a ± 1.16	73.70 ^b ± 0.38	0.002
Organic matter	68.79 ^a ± 2.07	69.99 ^a ± 1.01	75.75 ^b ± 0.90	0.002
Crude protein	68.37 ± 4.60	67.91 ± 2.65	73.89 ± 1.03	0.103
Ether Extract	65.25 ± 7.53	64.30 ± 2.88	64.37 ± 4.18	0.891
Neutral Detergent fibre	59.15 ^a ± 2.61	60.16 ^a ± 1.20	67.05 ^b ± 0.74	0.003
Acid detergent fibre	55.38 ^a ± 3.09	54.31 ^a ± 0.74	62.61 ^b ± 1.19	0.004

^{a,b}Mean values with different superscripts within a row differ significantly

Chemical composition of different sorghum cultivars (%DM)

Attributes	Sorghum fodder Cultivars		
	MP Chari	CSH 24MF	SPV 2018
Organic Matter	93.40 ± 0.10	93.13 ± 0.64	93.51 ± 0.47
Crude Protein	8.54 ± 0.06	8.84 ± 0.05	8.32 ± 0.03
Ether Extract	2.22 ± 0.17	1.70 ± 0.04	1.73 ± 0.07
Total Ash	6.6 ± 0.10	6.94 ± 0.65	6.50 ± 0.47
Neutral Detergent Fibre	61.48 ± 0.04	58.71 ± 0.04	57.18 ± 0.07
Acid Detergent Fibre	32.63 ± 1.61	30.47 ± 1.73	30.22 ± 2.38
Acid Detergent Lignin	6.51 ± 0.11	3.23 ± 0.06	4.21 ± 0.01

Growth rate and feed conversion efficiency of buffalo calves fed different sorghum cultivars for two months

Attributes	Treatments			p-value
	MP Chari	CSH 24 MF	SPV 2018	
Body weight (kg)				
Initial	199.08 ± 26.58	198.78 ± 28.45	198.38 ± 20.16	0.99
Final	223.22 ± 27.08	225.25 ± 21.62	225.91 ± 18.49	0.98
Total weight gain	24.13 ± 1.50	26.47 ± 3.70	27.52 ± 4.23	0.23
ADG (g)	402.22 ± 25.08	441.11 ± 61.59	458.75 ± 70.50	0.23
Dry matter intake (kg/d)				
Groundnut cake	0.73	0.73	0.73	-
Sorghum fodder	5.86 ± 0.30	5.75 ± 0.21	5.57 ± 0.44	0.348
Total	6.59 ± 0.30	6.48 ± 0.20	6.30 ± 0.43	0.342
FCR	16.43 ^a ± 1.37	14.93 ^{ab} ± 2.01	13.90 ^a ± 1.28	0.045
FE (%)	6.12 ^a ± 0.48	6.81 ^{ab} ± 0.94	7.24 ^a ± 0.67	0.050

^{a,b}Mean values with different superscripts within a row differ significantly

Validation of ITK known herbs against gastro-intestinal parasites

An experiment was conducted to validate and identify active ingredients in ITK known herbal plants traditionally used as anthelmintic agent. Four ITK known herbal plants and their parts were identified from literature which are available in and around Haryana. The plant parts identified were either collected from local area or procured from the local market. The mass spectra of the separated peaks was analysed and few active ingredients were identified. The compounds identified active against GI parasites were Embilin, β -sitosterol, diisooctyl phthalate, solasonine, arboreside A and luteolin in four different herbal effective extracts. The extracts prepared were mixed in 11 different combinations and the efficacy was tested against *Haemonchus* sp. for determining synergistic/antagonistic properties in order to find the most suitable combination for the development of herbal feed supplement. The results indicated highest mortality of larvae in the combinations having all the four herbal products. However, the combination having solanum and embelia were statistically equally effective. Thus the herbal supplement having these herbs alongwith essential mineral ingredients were prepared for its effectiveness *in vivo*. The field experiment on buffalo calves could not be taken as the incidence of *Toxocara* in calves could not be traced in the samples collected from the local peri-urban dairies and from the nearby villages. The field experiment was then conducted on the sheep as test animal and *Hoemonchus contortus* as test parasite. The experiment was conducted in two stages viz. one in the village Talwandi Rana where incorporation of 10% of herbal product was tested for its efficacy. However the results were not encouraging hence another experiment was conducted with the help of larger sheep herds. In this experiment, the level of incorporation was increased to 20% but the results obtained were again not very promising. It was thus inferred that active ingredients in these herbal agents are getting degraded in the rumen and thus there is loss of activity *in vivo*.



Transfer of Technology

Institute is engaged in extension activities for propagation of knowledge on buffalo breeding, feeding, reproduction, health and management to the farmers through regular visits by the scientists/technical personnel to adopted villages, organizing trainings, demonstrations, lectures, calf rallies, treatment camps etc. Animal health checkup camps are regularly organized in different districts of Haryana. The Institute is also working on Field Progeny Testing Programme in 10 villages around Hisar under Network Project on Buffalo Improvement.

Convergence for Dairy Development

Need of convergence between different agencies working for dairy development has been identified as one of the key factors in improving the efficiency of dairy extension at grassroots level. The existing and desired status, constraints and ways to ensure effective convergence despite its importance has not been studied so far systematically. Studying this area would bring forward the level of convergence and the way forward for effective convergence. Developing and testing convergence model, if found effective, may be replicated at higher level. During the period, data were collected from 50 field veterinary officers of Haryana regarding their modes and intensity of interaction with different entities in dairy development. Data were analyzed and their most important modes of interaction along with existing and desired intensity were identified. Questionnaires were also distributed to 100 scientists working in CIRB, LUVAS and NDRI to get their response elicited and analyzed for most important modes along with their existing and desired frequency. Data on roles and expectations of stakeholders from each other were also collected from field veterinary surgeons, ATMA officials, cooperatives, DRDA personnel, scientists, banks officers, etc. and analyzed. Thirty one constraints in convergence were identified and classified into five categories viz., administrative, functional, organizational, policy-related and operational using k-means cluster analysis. A workshop was also conducted on convergence on 7th January, 2017 under



the chairmanship of Director, CIRB. Dr VV Sadamate (Former advisor, Planning commission, GOI) was the chief guest on the occasion. Representatives of CIRB, SDAH, LUVAS, HLDB, LEAD BANK, Director ATARI, ATMA & DRDA participated in the workshop.

Attracting Rural Youth in Agriculture

The study is carried out to investigate the factors influencing participation of rural youth in farming following ex-post facto and exploratory research design in the Hisar district of Haryana. Two separate interview schedules (each for rural youth and parents) have been developed bilingually covering the identified variables under study for data collection as per the technical program after wide range of discussions with experts in the field of Extension. Data were collected from 270 youth covering nine blocks, tabulated and analysed. Majority of the respondents were between 21–29 years of age category and had qualification of upto Inter level with agriculture farming as their main occupation. Majority of the respondents were unmarried and came from small and nuclear family system. Family land holding pattern was almost evenly distributed among various categories. Majority belonged to small and marginal farmer categories, while about 23% were landless. About 70% of the respondents had more than 3 animals. Majority of the respondents were students (41.48%), while 18.15% were unemployed. Major localite sources of information revealed by majority of respondents were fellow farmers with highest mean score





(2.53) and paravets as major formal sources of information for animal husbandry. The participation of youth in any organization as a member or office bearer was very poor. Majority of the youth (62.59%) were viewing television regularly followed by newspaper (54.81%) and internet (43.33%) to receive farming related information. The attitude of rural youth towards farming was found to be at medium level (75.19%). More than 71% respondents were less cosmopolite in nature and had medium orientation towards credit. About 70% of the respondents had high decision making ability and high economic motivation. Innovation proneness and risk orientation were the two socio psychological parameters wherein majority of the rural youth (60% in each) fell under the medium level category. A large number of respondents (80%) were highly oriented towards the market to sell their produce at high prices. Aspirations were categorized into 05 areas and economic aspiration got first rank followed by career and educational aspirations. About 81% of the respondents wished to migrate from rural to urban areas due to one or the other reason and preferred inter-district migration. The major constraints in farming perceived by the respondents were lack of institutional and extension support that ranked I, followed by profit is not in harmony with efforts (Rank II) and mechanization lacunae in agriculture sector secured III rank. Covering of crops under weather insurance, raising agricultural productivity per unit of land and support of private players to spread the extension services for better awareness and adoption of improved practices were the most important suggestions that ranked I, II and IIIrd, respectively, for reducing migration of youth to urban areas.

Farmer FIRST: Diversified Farming through Livestock and Agriculture

Farmer FIRST Project (FFP) was sanctioned from Agricultural Extension, ICAR, New Delhi vide letter No: F. No. A. Extn. 20.3 / 2011 – AE – I, Dated: 28/10/2016 and implemented from November 2016 with objectives of increasing productivity and round the year employment opportunity through scientific livestock production system (Buffalo and indigenous cattle) and honey bee farming to augment the farmers' income under diversification of agriculture farming system through Horticulture. Zonal Group Meeting of Farmer FIRST Project was conducted at CIRB, Hisar on November 4, 2016. During this period, three villages (Dhansu, Kharkhadi and Khokha) were adopted and data were collected with respect to population status, land use pattern, animal



husbandry practices and agriculture production system. Ten awareness programs were organized for farmers training which included farmer's exposure visit, infertility and health camps, etc. ASMM was also distributed to address the problem of mineral deficiency, infertility and udder health in buffaloes.

Impact Assessment of Trainings

Different committees constituted to review the progress of research and extension activities of the institute emphasized the need of comprehensive study of their impact assessment. Therefore, the study was undertaken during the to assessthe impact of trainings on improved buffalo farming on the farmers' socio-economic dimensions. Impact analysis was done for the trainings conducted during 2014-15, wherein 17 trainings of 6-9 days duration were organized in CIRB premises, Hisar. Five trainings were randomly selected wherein 395 farmers and youth attended the training. Data were collected through telephonic survey. The results showed that only 88 (22%) beneficiaries established their dairy units with different herd sizes. Beneficiaries initiated dairy enterprises belonged to 73 villages from 10 different districts of four states- Haryana, Rajasthan, Punjab and Maharashtra. The impact of these trainings on improved buffalo husbandry practices was studied using Bennett's Hierarchy which included seven steps from inputs to outcomes. Positive changes were observed in participants' attitude, knowledge, skills and adoption. Significant increase in herd size, average monthly milk production and income of the participants were observed in the post training period.

Mera Gaon Mera Gaurav Scheme

Work has been carried out in 30 villages adopted by 07 teams covering 06 districts of three states (2 in Haryana, 2 in Rajasthan and 02 in Punjab). A total of 59 visits were made



for goshties and interface meetings to villages benefitting 2748 farmers. Twelve trainings were organised on improved buffalo husbandry and related aspects covering 447 farmers and farm women. One hundred and fifty one messages were sent to farmers through mobile and WhatsApp group. Literature support was provided to 1458 farmers by distributing 11 different type of folders, leaflets, booklets on calving calendar, record keeping sheets, institute profile, cultivation of green fodder, clean milk production, vaccination calendar, silage making, importance of feeding mineral mixture and salt in animal feed, etc.

Awareness was created on 17 different topics for 4149 farmers and students of the adopted villages. Linkages were developed with 17 other agencies and programs were organised benefitting 1975 farmers. Eighteen demonstrations were laid down in field attended by 1462 farmers on silage



making, preparation of balanced feed, preparation of mineral mixture, clean milk production, milk testing process, cord removal, colostrums feeding and precaution in placenta disposal etc. Thirteen Kg mustard seed to 13 beneficiaries, 115 Kg mineral mixture to 180 farmers and 160 planting material were distributed to 60 farmers. World Veterinary Day was organized through kisan goshti, animal health camp and Kisan Prashn Manch program. World Food Day 2016 was celebrated wherein children from 10th to 12th standard were

sensitized about the causes, harmful effects of climate change on livestock, agriculture, health, environment etc and also the simple strategies / measures to combat it. Massive awareness was also created on sanitation, cleanliness in schools, home, streets etc to make a habit of hygiene among the students. A quiz competition on swachhta, poster competition on climate change and ashu bhashan pratiyogita was organized among the students and prizes were also distributed to winners. Swachhata pakhwada and cleanliness drive in schools (May 16-30, 2016 and October 16-31, 2016) along with sensitization program about the significance of cleanliness, quiz competition, slogan competition and extempore speaking competitions were also organized.

Interventions in Rajasthan villages under Tribal Sub Plan

The Institute has adopted four villages under Tribal Sub Plan (TSP) viz., BhainsonkaNamala, TulsiyonkaNamla, Roba and Chatpur under Kherar Gram Panchayat, Tehsil Salumber, District Udaipur, Rajasthan. Since 2015, the institute is providing support to the tribal community in these villages through buffalo germplasm distribution (1500 doses of frozen semen, 4 Nilli Ravi bulls and 7 Murrah Buffaloes), 5 feed grinder and 25 chaff cutters. As an outreach program the Institute is continuously involved in different aspects of animal husbandry and cleanliness, farm economics, general animal health through training program on buffalo improvement, farmers welfare and skill development were held in respective villages from March 6-9, 2017. More than 200 farmers attended this training program and were hugely popular. A total 66 Grain bin were distributed to the BPL tribal families. The scientists of ICAR-CIRB, Hisar visited the schools to raise the awareness about cleanliness.





TRAINING ACHIEVEMENTS

SAARC training on Herd Health Management of Dairy Buffaloes: A 6-day training programme on 'Herd Health Management of Dairy Buffaloes' sponsored by SAARC Agriculture center Dhaka, Bangladesh from August 22-27, 2016 was organised by CIRB with Dr Inderjeet Singh as course Director, while Dr A Bharadwaj, RK Sharma and SS Phulia and KP Singh were co-coordinators. The training was attended by 17 participants from 5 member countries— Bangladesh, Pakistan, Nepal, Sri Lanka and India. Deliberations were made on various aspects of buffalo farming covering diverse areas including nutrition, reproduction, health, breeding and management. The training was inaugurated by Dr T Mohapatra (Hon'ble Secretary DARE & DG, ICAR) and Dr H Rahman (DDG AS) was also present. On conclusion of the training, certificates were distributed to the trainees.



ASEAN training on Reproductive Biotechnology: Institute organised 10-day training programme (Jan 31 – Feb 9, 2017) on 'Buffalo production using reproductive biotechnology' for delegates from ASEAN countries. The program was sponsored by the ASEAN-India Joint Cooperation Fund. The program was inaugurated by Dr AK Srivastava (Member ASRB). Dr Rameshwar Singh (Project Director DKMA, ICAR) also interacted with participants. The training was attended by sixteen participants from 8 ASEAN member countries – two each from Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam. During this training the participants were acquainted with the modern biotechnological tools for use in livestock production systems especially buffaloes. Various topics and practicals were covered by experts from CIRB and other leading institutes. Dr Inderjeet Singh was course coordinator while Dr PS Yadav, RK Sharma and AK Balhara were co-coordinators.





Training on Ultrasonography in large Animal

Reproduction: Three trainings on 'Ultrasound and Fertility Management in Large Animals' were organized for 49 field veterinarians of Uttar Pradesh with duration of four days each with Dr RK Sharma as Course Director.



Training on Artificial insemination: One training on was held for 10 participants during October 15-21, 2016 on 'Bhains paalan and nasl sudhaar hetu kritrim garbdhan'.

On campus training programmes for farmers:

Nine (08 at main and 01 at subcampus) on campus trainings (each of 07 days' duration) were organised on improved buffalo husbandry and related aspects benefitting 724 farmers, youth and women.



Off campus training programmes: Two off campus trainings, in village Landhri for 117 farmers and Ramayan for 114 rural youth, were organised on scientific nutritional and



management practices and improved buffalo farming respectively. These trainings are in addition to the trainings organised under MGMG, TSP and Farmer First programs.

OTHER EXTENSION ACTIVITIES

Infertility treatment and animal health camps: A total of 14 infertility treatment camps were organised in various villages of Haryana and Rajasthan wherein 380 animals were checked and treated for various reproductive



and productive problems. The villages were Ladwi, Kungar, Ramgarhia, Jhoju, Sarsod, Bichpari, Birohar, Kuleri, Badi Nangal, Badchhappar, Kharkari, etc.

Buffalo mela cum exhibition: Institute organised annual buffalo mela cum exhibition at main campus, Hisar on the occasion of its 33rd Foundation day on February 4, 2017 at Institute premises wherein about 300 elite animals including buffalo bulls, milch buffaloes, lactating buffaloes, dry buffaloes, heifers etc. from all over Haryana and adjoining states participated. The competitions for breed characteristics were held under seven categories and prizes were distributed to the winning animals in each category.

National Institutes like NDRI, NRCE, Central Sheep Breeding Farm and Tractor Training Centre and various private





companies participated and put up their stalls. More than 5000 farmers participated in this event. Dr AK Srivastava (Member ASRB) was the Chief Guest and inaugurated the mela while Dr Rameshwar Singh (Director DKMA, ICAR) was the Guest of Honour. Sixteen participants of the ASEAN training from 08 countries also enjoyed the occasion and gave their feedback. Prizes were distributed to the owners of



winning buffaloes by Dr Ramesh Kumar Yadav (Chairman Haryana Kisan Ayog) who graced the closing ceremony as Chief Guest. Dr B N Tripathi (Director, NRCE) and Dr BS Punia (Former Director, CIRB) were also present as Guests of Honour on the occasion. Dr Inderjeet Singh, Director of the institute presided over the function and highlighted the need for faster dissemination of improved buffalo technologies and practices on a wider scale in the field. On the occasion, cash prizes were given for milk recording competition held throughout the year to the owners whose animals yielded above 21 kg (Rs 21000 each to 06 owners), 18-21 Kg (10000 each to 16 owners) and 15-18 Kg (Rs 5000 each to 05 owners) of milk in a day. Haryana Kisan Ayog sponsored some of these prizes.

Participation in various melas: The institute actively participated in 5 melas organised by different organizations. It includes GADVASU, Ludhiana; CII Agro Tech at Chandigarh; Regional Agriculture Fair at Muzafarnagar (UP); IX-National Livestock Championship at Sri Mukatsar Sahib (Punjab) and Krishi Mela at CCS HAU, Hisar. The Institute put up its stall and showcased technologies like Area Specific Mineral



Mixture, Balanced Feeding, Complete Feed Block etc, besides banners of other technologies. Models of different breeds of buffaloes were also depicted on the occasion.

Milk recording competition of farmers' buffaloes:

The Institute organised milk competitions of farmers' high yielding buffaloes on every first Sunday of the month in order to document to authenticate high milk producing germplasm





available in the field. About 28 buffaloes participated in the competition and the highest yielder Buffalo (No. 16001377) yielded 23.953 kg milk in competition which belonged to Sh. Ashok Kumar of village Sorkhi, Hisar.

Celebration of World Veterinary Day: World Veterinary Day was celebrated on April 30, 2016 in village Ramgarhia, Tehsil Bhadra District Hanumangarh, Rajasthan on the theme for 2016: 'Continuing Education with a One Health Focus'. Kisan Goshti, Animal Health Camp and Kisan



Prashn Manch program were organized. A short quiz competition was held for male and female livestock farmers on different aspect of livestock farming. For every right answer, 1 Kg mineral mixture was given as prize. In camp, different livestock species were treated for different health ailments and mineral mixture and deworming tablets/bolus/syrup were distributed to livestock farmers free of cost and made the farmers aware about deworming schedule, economic importance of parasitic diseases, infertility in buffaloes, importance of minerals in preventing infertility, etc. About 178 farmers, farm women and rural youths participated in the goshti and more than 110 animals were treated for infertility and other health problems.

Celebration of World Food Day: The day was celebrated on October 16, 2016 on the theme 'Climate is changing'. Food and Agriculture must too" in two



Government Senior Secondary schools of village Sarsod and Karkhadi, Hisar.

The Swachhta Pakhwada was also launched at village level. About 250 children from 10th to 12th were sensitized by the scientists about the causes, harmful effects of climate change on livestock, agriculture, health, environment etc and also the simple strategies / measures to combat it. Massive awareness was also created on sanitation, cleanliness in schools, home, streets etc to make a habit of hygiene among the students. A quiz competition on swachhta, poster competition on climate change and ashu bhashan pratiyogita was organized among the students and prizes were distributed to winners. In the beginning, students, teachers and scientists took the cleanliness pledge. Plantation was also done in both the schools.

Celebration of International Yoga Day: Two yoga sessions were held on June 21, 2016 under the guidance of



Yoga teachers Sh Shyam Singla from Bihar School of Yoga and BK Manju, BK Sudesh, Dr Ravinder Kaushik and Dr RK Malik from Prajapita Brahma Kumari Ishwaria Vishvidlaya, RajYog Kendra, Hisar. All scientists, students and staff pledged to make Yoga an integral part of their daily life for good health and peace.

Celebration of Agriculture Education Day: Institute celebrated Agriculture Education Day on December 3, 2016 for promoting the spirit of agriculture and allied subjects among the 80 students of XI & XII standard, from OP Jindal Modern School and Shri Krishna Pranami Public School, Hisar along with their teachers. Students visited buffalo dairy



farm and received information on buffalo cloning, reproduction and nutrition. Motivational lectures were delivered to inspire students on careers opportunities in Agriculture by Dr Hema Tripathi, and career prospects and scientific scope in Animal Science by Dr P S Yadav. A quiz was also organised for students and prizes were distributed.



Calf Rallies: The institute organised calf rallies for female progenies born out of the Artificial Insemination under FPT project in 4 adopted villages; Bichpari (07/02/2017), Jevra (10/02/2017), Sarsod (03/03/2017), and Juglan (07/02/2017). Competitions were held under three categories (calves <1 year, heifers 1-2 years and heifers >2 years). In all 262 farmers benefitted and were given prizes. The calf rallies were organized to observe the impact of technologies transferred in the field and interest of farmers for rearing quality buffaloes.



Celebration of International Women's Day: On March 8, 2017 International Womens' Day, on theme "Be Bold for Change", was organized to support them for equality and empowerment. The initiative was taken to sensitize the rural women for increasing their access to productive assets and employment opportunities, eliminating gender biases at workplace and supporting technological innovations that may reduce the time burden of agriculture and domestic

work. On this occasion, more than 150 women members of milk cooperative societies of village Hindwan and Rawalwas Khurd participated. This event was celebrated on the convergence mode. Representatives of different institutions including LUVAS, CCSHAU and ATMA, State Animal Husbandry departmets, dairy milk cooperative, school teachers and officers from agriculture development participated, who stressed on the importance of empowering rural women as agents of change for transforming food production and consumption. Dr Inderjeet Singh (Director CIRB) graced the occasion and highlighted the need of education, nutrition and health for women. The whole event was coordinated by Dr Hema Tripathi, VB Dixit and Sajjan Singh. The day was marked with a call to act for accelerating gender parity.

Doordarsan /Radio Talk: The Scientists/ technical officers of the institute participated in about 12 programme on different channels of TV/radio focussing on improved buffalo husbandry.



Technologies & their transfer

Over the years the Institute has developed numerous technologies for improved buffalo production. The technologies developed are simple, friendly to end user and have wide applications in field. Listed below are proven technologies of the Institute:

Antioxidants in survival and growth of neonates

Advanced pregnant (270 to 280 day gestation) buffaloes, administered two doses of antioxidant micronutrients, consisting of Vit. A (Palmitate), Vit. D and Vit. E (dl- alpha 3 Tocopherol acetate) at 15 days intervals, secreted 25-80% more IgG 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 starting 10 to 15 days after birth and green fodder offered after 3 weeks, in order to achieve high growth rate and survival. These calves gained 10% higher body weight and had 30% better immunity as compared to non-supplemented calves.

Dry Colostrum for better calf survival

Prevalent farmers' practice of feeding colostrum only after placenta expulsion remains one of the major causes of low calf survival rates in buffaloes. Higher calf mortality is a loss of germplasm which affects replacement heifer availability for profitable buffalo breeding. Drying of colostrum to achieve ready to feed powder form, without loss of its immunogenic property has been developed by spray drying of colostrum. It can ameliorate low passive immunity acquisition related health problems in neonatal calf. Surplus colostrum was salvaged at farm and transported to Spray Drying machine in cold chain. Drying was done under controlled temperature and air pressure to ensure nutrient quality of colostrum. Nutrient composition and protein quality was determined. Powder comprised of 95% DM. Dry colostrum powder is a 'supplementary diet' for calf health and survival. Weaned calves, kept segregated from dams were fed on this powder for four days, starting immediately after a five minutes of suckling (just sufficient for developing suckling- instinct in calves and milk let-down) for trial by reconstitution of powder and bottle feeding.

Molecular markers for MAS

Seminal acidic fluid protein gene, known to govern sperm stability and thus the fertilization efficiency in bulls has been

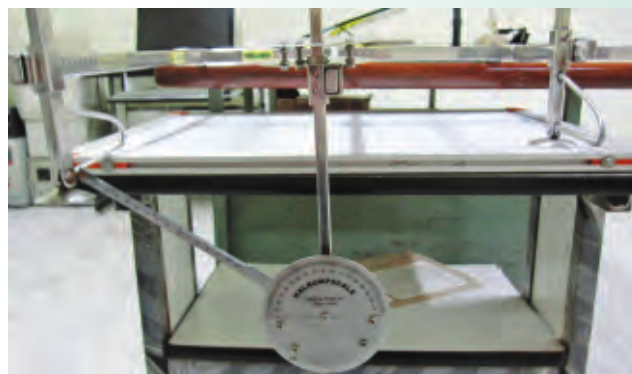
partially sequenced in 35 Murrah bulls, recorded for high and low field conception rates. SNP genotyping and sequencing revealed nucleotide polymorphism across exon 4-5. Four haplotypes were identified from sequence analysis. Relation between occurrence of SNPs and mean sperm motility and other estimated semen quality parameters by CASA were analysed w.r.t. high and low conception rate bulls. Identified SNPs are suggestive markers for bulls screening w.r.t. conception rate.

Phenotypic markers for identification of Nili-Ravi and Murrah Buffaloes

Tongue colour pattern revealed that pink colour in Nili-Ravi and black tongue colour in Murrah buffalo are governed by incomplete dominance of genes. The mix type or gray or spotted colour of tongue might be due to the incomplete dominance gene interaction, which dilutes the basic colour of tongue. The findings on tongue colour conclude that pure bred Nili-Ravi buffaloes have pink tongue and pure Murrah animals have black tongue as an added breed characteristic. The mixed tongue colour (pink and black), grey, pink in Murrah graded and black mixed tongue colour in Nili Ravi graded animals indicates inter-mixing in these breeds.

'KALRUMPSCALE' for predicting milk production potential in buffaloes

This uniquely designed device is helpful in measuring body conformations already established to be good indicators of milk production performance. This has a novel design which





is mounted on rump surface area of buffalo to measure vertical and horizontal angles with all possible linear measurements under 3D orientation.

Production, maintenance and dissemination of superior buffalo germplasm

Institute maintains highly pedigreed herds of Murrah and Nili-Ravi buffaloes for at breed improvement through selective breeding particularly aimed at production of superior breeding bulls and bull mothers. 413,887 doses of frozen semen from test bulls and 62,399 doses from progeny tested bulls are available for Murrah breed improvement. Since inception about 845 Murrah and 305 Nili Ravi bulls of high genetic merit have been supplied to various developmental agencies, village panchayats and breeders in different States for improvement of production performance of buffalo genetic resources. During the year 2016-17, total 64 breeding Murrah bulls were sold to various developmental agencies, breeders, panchayats and farmers, while Nili-Ravi bulls were sold primarily to Punjab State Animal Husbandry Department for frozen semen production and natural mating in breeding tract of the breed. Two top ranking bulls (Mu-3267 and Mu-3591) from 11th set were identified based on progeny testing and are being used for nominated mating in elite buffaloes. During the period, 125,508 frozen Murrah semen doses were produced, 28,703 doses supplied and 54,077 doses sold, and 3,807 A.I. were done in ten adopted villages. The conception rate in the field was 55.48%. In this period, 2,112 pregnancies were confirmed and 1,661 calving (864 males, 797 females) were recorded for the purpose of bull evaluation. Similarly, frozen semen doses are also produced from Nili-Ravi bulls of high genetic merit for breed improvement.

Improved protocol and supplement for buffalo semen cryopreservation

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

Sericin is a water-soluble globular protein (a protein

hydrolysate) derived from silkworm *Bombyx mori*. Supplementation of 0.25-0.5% sericin in semen extender improved frozen-thawed semen quality through protecting sperm from oxidative stress.

Scrotal circumference for bull selection

Scrotal circumference (SC) of 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. According to this study, mean SC value was 35.23 ± 3.00 cm for mature Murrah bull (>600 Kg). It is recommended that, bull having scrotal circumference < 29 cm should not be used for breeding programme, while males with SC of over 41 cm should qualify as the best option.

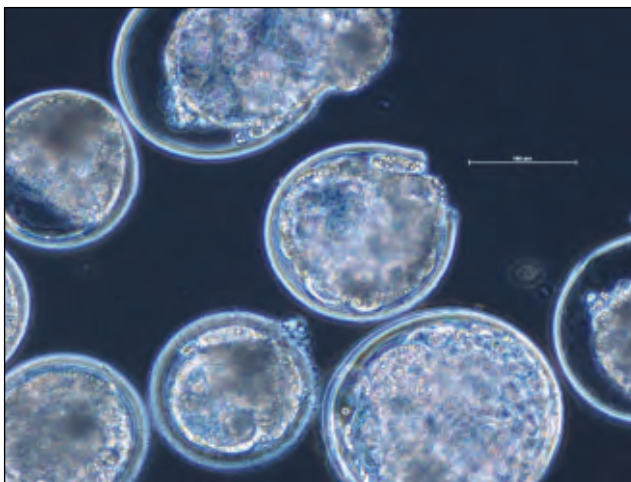
Somatic cell lines from superior animals

Total 14 primary somatic cell lines were established and cryopreserved from adult elite buffaloes, which include 4 from champion bulls. These primary cell lines were characterized using expression of cytoskeleton markers include vimentin for fibroblast origin type and cytokeratin for epithelial origin type. Cryopreserved cell lines would be viable genetic material for long term maintenance of elite germplasm, which have wide range of applications include cloning even after death of animal, induced pluripotent stem cells production and unlimited DNA/RNA/protein source for research purpose.

In-vitro fertilization (IVF), Superovulation and Embryo transfer technology

Poor retrieval of oocytes from live superior dams through ultrasound guided ovum pick up technique precludes suitability of this technique in buffaloes, therefore in-vitro abattoir oocytes is practicable option for IVF or cloning, though genetic potential of ovum donor remains obscure. Technology for large scale production of in-vitro fertilized (IVF) and cloned embryos using slaughter house ovaries have been standardized together with the embryo cryopreservation technique. The technique of IVF and cloning is of immense use in faster multiplication of elite germplasm.

Protocol was developed using progesterone implant that requires minimum handling and examination of donors for superovulation. Protocol consists of examination of donors and administration of norgestomet subcutaneous ear implant (Crestar, Intervet) to all donors having a well-developed CL on day 0 of examination. Five days FSH treatment is initiated



between day 2-5 of Crestar insertion. Crestar is removed and prostaglandin injection is given on day 4 of super-ovulatory FSH treatment. Buffaloes are inseminated thrice at 12 h intervals, starting at 48h after Crestar removal. Embryo recovery is made on day 5/6 post-insemination. Using this protocol, only 12 to 17 days are required for programming, superovulation, insemination and embryo recovery. This protocol effectively reduces the programming to embryo recovery period by 50% as against conventional protocol.

Ovsynch plus protocol for estrus induction

Anestrus is major infertility disorder, which delays calving interval and decrease life time productivity of a female. Such buffaloes can be induced to estrus with Ovsynch plus protocol developed at CIRB. In this protocol, an injection of PMSG is administered 72 h prior to the first GnRH injection of Ovsynch treatment, in order to support ovarian follicular development so that at least one large follicle is available 72 h later for responding to the GnRH injection with ovulation/luteinization. Resulting luteal structure in the ovary is then subjected to luteolysis by PGF 2- alpha given 7 days later.

Further administration of GnRH 48 h later 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 many of them get pregnant within one month of treatment, if initiated during breeding season.

Ultrasonography for monitoring ovarian activity, pregnancy diagnosis, fetal age and sex

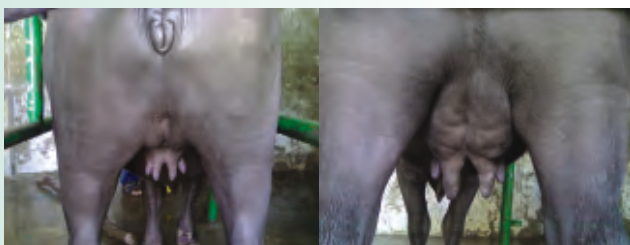
The non-invasive technique of ultrasonographic scanning has been standardized for monitoring ovarian activity with respect to turnover of different sized follicles, development and regression of corpus luteum, presence of cystic ovarian structures and ovarian quiescence. Through this technique, time of ovulation can also be predicted very precisely to allow fixed time insemination and useful for follicular dynamics studies.

Pregnancy can be diagnosed as early as 26 days post insemination using ultrasound scanning of genitalia. A standard chart was developed for crown-rump length of buffalo fetus on different days post insemination for determining the age of fetus in pregnant buffaloes. The exact date of mating could be predicted very precisely (± 1 day) using this chart and it can help in better management.

Ultrasonography for fetal sex determination has been standardized. Based on location of the genital tubercle, an accurate diagnosis can be made at 55 day of gestation in buffaloes as against 50 days reported in cattle. The technique is useful in progeny testing as well as for production of breeding bulls in bull mother farms. Farmers can also check the fetal sex to help them in sale/ purchase of dams.

Induction of lactation

Farmers are commonly facing the problems of conception failure, long calving interval, anestrus, cystic ovaries, abortions and repeat breeding. Such farmers can benefit by inducing their non-pregnant infertile animals into lactation with induced lactation therapy. In this therapy an appropriate dose of hormones such as Estradiol-17 beta and progesterone @ 0.1 mg/kg body weight/day is given for seven days. In brief, on the day of treatment, 1 ml of each hormone solution is administered subcutaneously in the morning and evening at 12 hourly intervals for seven



Before treatment

After treatment

consecutive days. Thereafter, on day 17, 19 and 21, 10 ml Largectil injection and on day 16, 18 and 20, injection of 20 mg Dexamethasone are also given intramuscularly. Between 15th and 21st day of treatment, udder massage is given for fifteen minutes each in 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 the start of milking and the amount of milk yield increases with time.

Thermal stress management

Buffaloes have poor thermoregulatory system and are much vulnerable to extreme climatic conditions particularly in summers. Buffaloes are more sensitive to direct solar radiation than cattle due to their black body color, which is conducive to heat absorption. Relatively small number of sweat glands per unit area of skin, and thick epidermal layer of the skin are other limiting factors in heat loss by conduction and radiation. Heat stress results from inability of animals to dissipate sufficient heat to maintain homeothermy. Microclimate modifications together with supplementation of niacin @6 gms/day/animal, yeast @10 gms/day/animal and mustard oil @150 gms/day/animal lead to enhanced milk production of lactating buffaloes by reducing thermal stress. Another recommendation is to feed major part of ration during early morning (6-8 AM) and late night (8-10 PM) and also increase the frequency of feeding. It is also advisable to feed partially mixed wet ration (sanni), but moisture content should not exceed 50% in total ration. Wallowing at least twice daily or water sprinkling during hot period of the day also helps in heat dissipation and lessen the impact of heat stress.

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. Among 165 isolates studied, the

isolate *Neocallimastix* sp. CF 17 showed the highest CMCase and xylanase activity in pure culture medium containing straw. Growing buffaloes fed with encapsulated culture of the fungus resulted in 20% increase in growth rate.

Composite feed additive for methane mitigation

A composite feed additive was developed for reducing methane emission and improvement in fibre utilization by ruminants. The feed additive can reduce methane emission by 75% (by reducing number of methanogenic archaea in rumen) and simultaneously promote growth of alternate hydrogen utilizers like sulphate reducing bacteria. Its beneficial effects are not affected by microbial adaptation/resistance over time. The feed additive does not affect number of useful microbes in rumen (bacteria and fungi) and stimulate rumen ecosystem by increasing microbial fibrolytic activity. Thus, there is increased fibre digestion and reduced rate of ammonia production in rumen. Overall, the feed conversion efficiency increase by 15% and production performance (growth rate) increase by 10%. Patent has been applied for this novel technology.

Feeding standards for different categories of buffaloes

Feeding standards have been developed for different categories of buffaloes, viz. growing males, growing heifers, breeding bulls, lactating buffaloes and pregnant buffaloes by taking into account the nutrient requirement for growth and production as well as gestation.

Area-specific mineral mixture

Surveys of feeding practices carried out in Haryana revealed deficiencies of essential minerals like calcium, phosphorus, zinc, copper and manganese. On the basis of analysis of mineral intake versus requirement, an area specific mineral mixture (ASMM) was developed. With the supplementation of this mineral mixture in the ration of anestrus buffaloes, seventy per cent buffaloes conceived within a period of 4 weeks. The mineral mixture improves feed intake, milk production and reproductive efficiency. Institute has been preparing and selling mineral mixture to the farmers for encouraging adoption of this technology. Area specific mineral mixture for the adopted villages in Udaipur district of Rajasthan under Tribal Sub Plan (TSP) was developed and distributed. The technology for preparation of ASMM has been licensed to a private firm.



Enzyme supplementation

Fibrolytic enzyme supplementation is used 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). For this purpose, a study was undertaken on mixed supplementation of xylase and cellulose (cellulase and xylanase @ 6000 and 15000IU / Kg DM of substrate) in the diet of growing calves, which resulted in increased digestibility of DM, OM and CF digestibility. It resulted in significantly higher growth rate in supplemented group (486.42 ± 25.28 g/d) as compared to control group (411.23 ± 17.85 g/d). Their supplementation also increased the DMI/d in treatment group or in other words it increased the appetite. Supplemented group calves get more energy per unit of fodder with higher DMI. However, individual enzyme supplementation could not reach up the significant level. The inclusion level of this mixed enzyme is around 1 kg/ton of concentrate. The cost of commercial enzymes i.e. xylase and cellulose vary between Rs 200 to 250/kg and are usually used in huge quantities in textile industry (cellulose) and paper industry (xylanase).

Uromol and Urea molasses mineral block (UMMB) 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 liters milk/day.

Urea molasses mineral blocks are prepared in the same way as Uromol, except the addition of mineral mixture, salt and binder. By ad lib feeding of 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 yielded even better results.

Technologies commercialized

The Institute entered into an agreement for a period of ten years on non-exclusive basis with Titanic Pharmaceuticals Pvt. Ltd. on May 5, 2016 by commercialization of Area Specific Mineral Mixture (ASMM) developed by the scientists of the Institute. Under this agreement, ICAR-CIRB provided the know-how of the said ASMM technology to Titanic Pharmaceuticals Pvt. Ltd. Use of ASMM is very important for scientific feeding of buffaloes to meet their nutritional requirements. Supplementation of rations with ASMM helps



to improve production, as well as helps to reduce reproductive problems in buffaloes.

Patents filed (2016-17)

Kumar R, Jerome A, Kumar P, Monika Saini, Kumar D, Sharma RK, Singh I (2016) Novel cryopreservation protocol for improving buffalo sperm post thaw viability & motility. IP36395 dated 09.03.2017.

Dey A, Paul SS, Dahiya SS, Balhara AK, Jerome A, Punia BS and Yendrembam MC (2017) RESMI- a composite feed additive for reducing methane emission and improving fibre utilization in ruminants. IP36394 dated 30.03.2017.

Kala SN (2017) KALRUMPSCALE - a device to measure buffalo rump angularity for identification of dairy characters. 1451/DEL/2015 dated 22.11.2016.



Awards, Recognition & Fellowship



Dr Hema Tripathi (Principal Scientist) received Bharat Ratna **Dr C. Subramaniam Award for Outstanding Teachers 2015** for promoting quality teaching in the field of Social Sciences On the occasion of 88th ICAR Foundation Day, Krishak Goshthi and ICAR Award Ceremony on July 16, 2016 at Vigyan Bhavan, New Delhi. The award consists of ₹1.00 lakh in cash, a citation and ₹ 1.0 lakh as travel grant.



Dr. Inderjeet Singh, Director, CIRB receiving fellow of National Academy of Dairy Sciences (NADS) at NDRI, Karnal

Dr Naresh Selokar (Scientist) at CIRB received **Jawaharlal Nehru Award for P.G. Outstanding Doctoral Thesis Research** in Agricultural and Allied Sciences-2015 in field of Animal Science & Biotechnology. The award consist ₹ 50,000/- in cash plus a citation and gold plated silver medal.



Dr Monika Saini (Young Professional II, CIRB) received **Jawaharlal Nehru Award for P.G. Outstanding Doctoral Thesis Research** in Agricultural and Allied Sciences-2015 in field of Animal Science & Biotechnology.

Dr Rakesh Kumar Sharma (Principal Scientist) received **CR Sane Oration Award 2016** at 32nd Annual Convention of ISSAR and National Symposium on 'Animal Fertility and Fecundity at Crossroads: Addressing the issues through conventional and advanced reproductive technologies' organized by SVVV, Tirupati, December 6-8, 2016.



Dr Pradeep Kumar, Monika Saini, Dharmendra Kumar, A Bharadwaj and P S Yadav received **Best Research Paper Presentation Award** on “Estimation of osteopontin and total antioxidants in seminal plasma help in identification of subfertile bulls in the scientific session on “Andrology and Artificial insemination” at XXXII Annual Convention of ISSAR and National Symposium on Animal Fertility and Fecundity at Crossroads: Addressing the issues through conventional and advanced reproductive technologies organized by SVVV, Tirupati, December 6-8, 2016.

Dr Prem Singh Yadav (Principal Scientist) was awarded **SAPI Fellow 2015** on December 21, 2016 at the XXV Annual Conference



of Society of Animal Physiologists of India held at Veterinary College, MHOW, MP.

Dr Naresh Selokar (Scientist) received **Prof. SS Guraya Young Scientist Award** from Indian Society for Study of Reproduction and Fertility (ISSRF) for his outstanding contributions in the field of somatic cloning and assisted reproduction techniques in buffalo during the International Conference on 'Reproductive Health with Emphasis on Strategies for Infertility, Assisted Reproduction and Family Planning', ICMR, New Delhi, January 23-25, 2017.

Dr Monika Saini (Young Professional II) received **Dr (Mrs.) Mridula Kamboj Young Scientist Award** from Indian Society for Study of Reproduction and Fertility (ISSRF) for her outstanding contributions in the field of somatic cloning and assisted reproduction techniques in buffalo during the International Conference on 'Reproductive Health with Emphasis on Strategies for Infertility, Assisted Reproduction and Family Planning', ICMR, New Delhi, January 23-25, 2017.

Dr Dharmendra Kumar, P Sharma, NL Selokar, K Vijayalakshmy, K Ananth and PS Yadav received **Best Poster Presentation Award** on 'PiggyBac mediated reprogramming of buffalo foetal fibroblasts to generate induced pluripotent stem cells' from ISSRF during International Conference on 'Reproductive Health with Emphasis on Strategies for Infertility, Assisted Reproduction and Family Planning', ICMR, New Delhi, January 23-25, 2017.

OVERSEAS FELLOWSHIPS

Dr A Dey (Senior Scientist, AN&FT Division) received prestigious **Ēndevour Research Fellowship – 2016** by Department of Education and Training, Australia for Post–Doctoral Research at University of Sydney, Australia, July 5, 2016 to January 4, 2017.

Dr Sadeesh EM (Scientist, APR Division) was awarded **Indo-Australian Career Boosting Gold Fellowship 2014-15** by DST, Govt. of India for the post-Doctoral Research at University of Adelaide, Australia, APR Division from October 2015 to October 2016.

Dr Naresh L Selokar (Scientist) received **SERB Overseas Postdoctoral Fellowship: 2015-16** conferred by SERB, Department of Science & Technology, Government of India for Post-Doctoral research at Friedrich-Loeffler Institute, Federal Research Institute for Animal Health, Germany from February 2017 to January 2018.

Workshops/ Meet Organised

Workshop on research & innovation opportunities in Europe for higher studies and research grants

EURAXESS information session on 'Research & Innovation Opportunities in Europe' was organized at CIRB, Hisar on 30th August 2016 in association with EURAXESS Links India. More than 70 researchers from CIRB, NRC-Equine, LUVAS, CCSHAU and GJUS&T participated and took keen interest and interacted with European Union funding agency representatives. This session provided platform for researchers to know about various opportunities offered by European Union for them such as European Research Council Grants, MSCA Individual Fellowships, Erasmus+, Horizon 2020, CNRS, CEFIPRA and many more. Diverse young participants appreciated the initiative of CIRB in this regard.



Redefining the Phenotypic Characters of Nili-Ravi Buffalo

One day workshop on 'Redefining the Phenotypic Characters of Nili-Ravi Buffalo' was organised on October 8, 2016 at ICAR-CIRB, sub campus Nabha under the chairmanship of Deputy Director General (Animal Sciences). ADG, Director CIRB, Director NBAGR, Director Research-GADVASU, Advisor animal health to Punjab besides experts, scientists, state AH official and farmers participated in the workshop.



Workshop on strengthening extension services on convergence mode for dairy development

A meeting cum workshop on 'Strengthening Extension Services on convergence mode for dairy development' was organized under the chairmanship of Director, CIRB on 7th January, 2017 to delineate the roles and expectations of various agencies working for dairy development on convergence mode. Dr VV Sadamate, former Advisor Planning Commission, GOI was the Chief Guest and also presented a key note address on the subject. Stakeholders of dairy development representing research, extension, line departments, development agencies, cooperatives, universities, ATARI, banks etc were present on the occasion.

Workshop on scientific writing, e-Books and publication Process

One day workshop on 'Scientific writing, e-Books and Publication Process' was organised jointly by CIRB and ICAR-Directorate of Knowledge Management in Agriculture, New Delhi on November 16, 2016 at CIRB. Dr Rameshwar Singh, Project Director, DKMA, New Delhi explained the various roles and activities of DKMA and encouraged the participants to use various portals of ICAR for effective dissemination of the research and technological innovations to the end users. Resource persons from DKMA interacted regarding scientific, technical and text books publication of the DKMA. Dr Sangeeta Mehta, Sales Director, Elsevier South Asia explained about the Elsevier activities and provided some tips for effective planning, writing and promoting scientific research article and awareness about plagiarism and other ethical concerns in scientific writing. More than 60 participants including scientists, students, research associates and senior research fellows from NRCE and CIRB participated in this workshop.





Publications

Research papers (Work done at CIRB)

- Balaraju BL, Tripathi H, Kumar S, Verma MR and Yadav R (2016) Preferential traits for rearing indigenous cattle under low input production system in Karnataka. *Int. J. Sci. Environ. Technol.*, 5(4): 2454-2458.
- Balhara AK, Nayan V, Dey A, Singh KP, Dahiya SS and Singh I (2017) Climate change and buffalo farming in major milk producing states of India - present status and needs for addressing concerns. *Indian J. Anim. Sci.*, 87(4): 403-411.
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- Kumar L, Phogat JB, Pandey AK, Phulia SK, Kumar S and Dalal J (2016) Estrus induction and fertility response following different treatment protocols in Murrah buffaloes under field conditions. *Vet. World*, 9(12): 1466-1470.
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Application for fertility assessment in buffalo (*Bubalus bubalis*) bulls. *Reprod. Domestic Anim.*, 51(1): 1-6.

- Kumar R, Ghosh M, Kumar N, Balhara AK, Gupta M, Sharma RK and Singh I (2017) Polymorphism in 5' untranslated region of heat-shock protein 70 gene as marker of post-partum anoestrus in Murrah buffaloes. *Reprod. Domestic Anim.*, 52(3): 505-512.
- Mohan C, Saxena N, Fozdar BI, Kumar R, Sharma ML, Mudgal V, Dey A and Punia BS (2016) *In-vitro* evaluation of few indigenously known herbal plants for their anthelmintic property. *Asian J. Chem.* 28(5): 1001-1003.
- Paul SS, Dey A, Baro D and Punia BS (2016) Comparative community structure of archaea in rumen of buffaloes and cattle. *J. Sci. Food Agric.*, Doi: 10.1002/jsfa.8177.
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- Ravinder R, Kaipa O, Baddela VS, Singh SE, Singh P, Nayan V, Velagala CS, Baithalu, RK, Onteru SK and Singh D (2016) Saliva ferning, an unorthodox method for oestrus detection in water buffalo (*Bubalus bubalis*). *Theriogenol.*, 86(5): 1147-55.
- Selvam RM, Onteru SK, Nayan V, Sivakumar M, Singh D and Archunan G (2016) Exploration of luteinizing hormone in murrh buffalo (*Bubalus bubalis*) urine: Extended surge window opens door for estrus prediction. *General Comparative Endocrinol.*, doi: 10.1016/j.ygcen.2016.12.002.
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- Singh RK, Kumaresan A, Mir MA, Kumar P, Chhillar S, Tripathi UK, Rajak SK, Nayak S and Mohanty TK (2016) Computer assisted sperm analysis: Relationship between the movement characteristics of buffalo spermatozoa and sire fertility. *Indian J. Anim. Res.*, doi:10.18805/ijar.10768
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- Yadav SC, Kumar J, Gupta AK, Jerome A, Kumar P, Kumar R, Tehri K, and Kumar R (2016) Parasitological, biochemical and clinical observations in ponies experimentally infected with *Trypanosoma evansi*. *J. Exptl. Biol. Agril. Sci.*, <http://dx.doi.org/10.18006/2016.4> (Spl-4-EHIDZ).S144.S150.
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Review Papers

- Choudhary KK, Kavya KM, Jerome A, Sharma RK (2016) Advances in Reproductive Biotechnologies. *Vet. World*, 9(4), 388-395.
- Frazzoli C, Gerrardi P, Saxena N, Belluzi G and Mantovani A (2017) The hotspot for (Global) One health in primary food production: Aflatoxin M1 in dairy products. *Frontiers in Public Health*, 4; article 294 (doi: 10.3389/fpubh.2016.00294)
- Kumar D, Anand T, Kues WA (2017) Clinical potential of induced pluripotent stem cells. *Cell Biol. Toxicol.*, 33(2): 99-112.
- Paul SS, Chanu YM and Dey A (2016) Options for improving nitrogen utilization efficiency in ruminants. *Indian J Anim. Nutr.*, 33(1):1-10.
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- Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK (2016) Herd Health Management of Dairy Buffaloes: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping. Compendium of SAARC training published by ICAR-CIRB.
- Singh KP, Chaudhary M, Mehrara KL, Singh S and Singh I (2016) Bulletin on "Phenotypic Characters and Performance Traits of Nili-Ravi: A Superior Improver Breed for Non-descript Buffaloes".
- Singh I, Yadav PS, Sharma RK and Balhara AK (2017) Buffalo Production using Reproductive Biotechnology. Compendium of ASEAN training published by ICAR-CIRB.

Book Chapters

- Balhara AK, Mohanty AK and Singh I (2016) Methods of early pregnancy diagnosis in dairy animals. In: Herd Health Management of Dairy Buffalo: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping (Eds. Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK). Compendium of Training for SAARC Countries. Pp 100-105.
- Balhara AK, Mohanty AK and Singh I (2017) Novel approaches to early pregnancy detection- study of molecular markers. In: Buffalo production using reproductive biotechnology (Eds. Singh I, Yadav PS, Sharma RK, Balhara AK). Compendium of training for ASEAN countries. Pp17-21.
- Bharadwaj A and Khanna S (2016) Buffalo Herd Management and Farm Records. In: Herd Health Management of Dairy Buffalo: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping (Eds. Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK). Compendium of Training for SAARC Countries. Pp. 35-42.
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- Kumar P and Kumar D (2016) Frozen semen production and bull management. In: Herd Health Management of Dairy Buffalo: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping (Eds. Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK). Compendium of Training for SAARC Countries. Pp.130-136.
- Kumar P, Kumar D, Pawaria S and Vijayalakshmy K (2017) The art and science in frozen semen technology and artificial insemination. In: Buffalo production using reproductive biotechnology (Eds. Singh I, Yadav PS, Sharma RK, Balhara AK). Compendium of training for ASEAN countries. Pp.32-41.
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- Nayan V, Bharadwaj A, Balhara AK, Phulia SK and Sharma RK (2016) An overview of estrus detection in buffaloes. In: Herd Health Management of Dairy Buffalo: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping (Eds. Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK). Compendium of Training for SAARC Countries. Pp. 92-99.
- Nayan V, Onteru SK and Singh D (2016) Gene Regulation I: Transcriptional Regulatory Networks (TRNs) and co-expressed genes. In: Compendium of short course on "Advances in functional genomics and proteomics for farm animal biology (Eds. Singh D. et al.), at NDRI, Karnal (July 1-21). Pp. 24-28.
- Nayan V, Onteru SK and Singh D (2016) Loop Mediated Isothermal Amplification (LAMP): An Overview. In: Compendium of short course on "Advances in functional genomics and proteomics for farm animal biology (Eds. Singh D. et al.), at NDRI, Karnal (July 1-21). Pp. 49-57.
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- Paul SS (2016) Nutrient Requirements of Cattle and buffaloes: A comparative Approach. In: Recent Trends in comparative animal Nutrition: An Advanced Short Course (Eds. Asit Das, Putan Singh, VB Chaturvedi, N Dutta and AK Verma), Sept16-Oct. 06. Pub: IVRI, Bareilly. Pp. 67-73
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- Phulia SK, Sharma RK, Balhara AK, Jerome A and Nayan V (2017) Ultrasonography in early pregnancy, fetal age, sex determination and udder health in buffaloes. In: Buffalo production using reproductive biotechnology (Eds. Singh I, Yadav PS, Sharma RK, Balhara AK). Compendium of training for ASEAN countries. Pp. 22-31.
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- Singh I and Singh KP (2016) Buffalo Breeding Programs and Strategy for conservation. In: Conservation of Indigenous Domestic Animal Diversity, ICAR-NBAGR, Karnal. Pp. 123-134.
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- Singh P, Kumar P and Kumar D (2017) CASA application for semen evaluation. In: Buffalo production using reproductive biotechnology (Eds. Singh I, Yadav PS, Sharma RK, Balhara AK). Compendium of training for ASEAN countries. Pp. 49-60.
- Singh, I and Jerome A (2016) Role of assisted reproductive techniques to enhance bovine production. In: Advances in Scientific interventions to enhance bovine production. Pp. 119-137.
- Sikka P (2016) Molecular and Genomic Selection Tools for Superior Cattle and Buffaloes In: Herd Health Management of Dairy Buffalo: Nutrition, Breeding, Reproduction, Diseases, Management and Record Keeping (Eds. Singh I, Bharadwaj A, Paul SS, Singh KP and Sharma RK). Compendium of Training for SAARC Countries held at CIRB Hisar. Pp: 14-21.
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- Tripathi H (2016) Women empowerment through Livestock entrepreneurship. In: Compendium of model training course on extension strategies for sustainable entrepreneurship in Livestock sector, GADVASU, Ludhiana. Pp 14-21
- Yadav PS and Sharma A (2017) In Vitro fertilization and stem cell technology In: Buffalo production using reproductive biotechnology (Eds. Singh I, Yadav PS, Sharma RK, Balhara AK). Compendium of training for ASEAN countries. Pp-77-90.

Presentation in Conferences/Seminars/Workshop

- Balaraju BL and Tripathi H (2016) Role of indigenous cattle in the rural livelihood. ISEE seminar from November 28-30 at RVSKVV Gwalior.
- Balaraju BL, Tripathi H and Yadav J (2016) Malnad Gidda: A Unique Dwarf Cattle Breed for Sustainable Production in Western Ghats. ISEE seminar from November 28-30 at RVSKVV Gwalior.
- Balaraju BL, Tripathi H and Manjunatha L (2017) Rearing indigenous cattle: a way to achieve household nutritional security. VIII National Extension Education congress, from January 28-31 at ICAR-NAARM, Hyderabad.
- Basunathe VK and Tripathi H (2017) Effectiveness of project functionaries in livestock information delivery services under ICT projects. VIII National Extension Education congress, from January 28-31 at ICAR- NAARM, Hyderabad.
- Bharadwaj A (2016) Field Unit Report, CIRB Hisar 2015-16. XIV Annual Review Meet of Network Project on Buffalo Improvement, from July 4-5 at GADVASU, Ludhiana.
- Bhardwaj A, Nayan V, Kumar D (2016) Intellectual property protection for bioinformatics and genetic databases. ICAR sponsored short course on "Recent models and methods for analysis of farm animal data for devising suitable breeding and management strategies" from July 11-21 at ICAR-CSWRI, Avikanagar.
- Boya S, Onteru SK, Nayan V and Singh D (2016) Demonstration of Microarray Data Analysis by PAP and DAVID Functional Annotation Software. Short course on "Advances in functional genomics and proteomics for farm animal biology" from July 1-21 at NDRI, Karnal.
- Dahiya SS, Dey A, Lailer PC, Mudgal V and Ritika K (2016) Growth, nutrient utilization, economics of production of buffalo calves fed rations in different roughage: concentrate ratios. Agric. Science Congress, Bangalore.
- Dey A, Das AK and Gonzalez LA (2016) Plant bioactive compounds - potential benefits in animals and environment. UGC sponsored National Seminar on 'Plants, the natural wonder- issues and concerns' from October 4-5 at Sonamukhi College, The University of Burdwan, Bankura.
- Dey A, Paul SS, Dahiya SS, Punia BS and Gonzalez LA (2016) Effects of vegetable oils supplementation on in vitro rumen fermentation and methane production in buffaloes. 18th International conference on animal and veterinary sciences (ICAVS 2016), from December 15-16 at Sydney, Australia.
- Tripathi H, Dixit VB, Singh I and Tripathi BN (2016) Climate variability and rural livelihood through livestock. National Seminar of ISEE on Information and communication management concerning climate smart agriculture for sustainable development and poverty alleviation from November 28-30 at RVSKVV, Gwalior.
- Janmoni S, Tripathi H and Balaraju BL (2016) Ethno-veterinary



- practices and socio cultural values associated with backyard piggery among tribal communities of Assam. National seminar of ISEE on Information and communication management concerning climate smart agriculture for sustainable development and poverty alleviation from November 28-30 at RVSKVV, Gwalior.
- Kumar J, Kumar P, Honparkhe M, Malik VS, Singhal S, Kaur S and Brar PS (2017) Improvement in cryosurvival of buffalo bull sperm by altering freezing rate within critical temperature range. ISSAR 2017, at SVVU Tirupati.
- Katiyar GS, Mudgal V, Sharma RK, Bharadwaj A, Phulia SK, Jerome A and Singh I (2016) Effect of rumen protected nutrients supplementation intake, body weight, milk yield and composition in Murrah buffaloes during early lactation. X Biennial Animal Nutrition Association Conference, from November 9-11 at SVVU, Tirupati.
- Krishna A, Sharma P, Vijayalakshmy K, Kumar D, Saini M, Yadav P S, Nanda T, Das GopalCh, Singh I and Selokar N (2017) Successful production of swamp buffalo cloned embryos using recipient oocytes of riverine buffaloes. International Conference on Reproductive Health with Emphasis on Strategies for Infertility, Assisted Reproduction and Family Planning (ISSRF 2017) from January 23-25 at AIIMS, New Delhi.
- Kumar D, Kumar D, Sharma P, Selokar NL, Vijayalakshmy K, Ananth K and Yadav PS (2017) PiggyBac mediated reprogramming of buffalo fetal fibroblasts to generate induced pluripotent stem cells. International Conference on Reproductive Health with Emphasis on Strategies for Infertility, Assisted Reproduction and Family Planning (ISSRF 2017) from January 23-25 at AIIMS, New Delhi.
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हेमा त्रिपाठी, सुरेन्द्र सिंह तोमर, सज्जन सिंह, वीबी दीक्षित एवं इन्द्रजीत सिंह (2016) जलायें नहीं खाद बनाएं फसल अवशेषों से। खेती आईसीएआर।

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Blog

Dixit V, Tripathi H, Duhan A and Singh I (2016) Convergence for Synergistic effect for dairy development Agriculture Extension in South Asia. Aesa Blog 62

Literature/Leaflet/posters

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Gene accessions obtained

Sikka P, Nath A, Singh I, Yadav PS, Singh P and Khanna S (2015) Genetic variants of Murrah bulls with respect to male fertility. Sequences accepted in Genebank with accession no. KU364415 & KU364416)

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Research Projects

Projects	Investigators	Duration
COMPLETED INSTITUTE RESEARCH PROJECTS		
Application of pedigree information and body condition	SN Kala	July 2011 - July 2016
Development of modules for buffalo meat production	SS Dahiya, A Dey, PC Lailer, V Mudgal	January 2013- July 2016
Effect of different feeding regimen on age at first calving	PC Lailer, V Mudgal, SS Dahiya, AK Boora, BS Punia	April 2012- July 2016
Validation of ITK known herbs against gastro-intestinal parasites in buffalo calves	N Saxena, A Dey, V Mudgal, BS Punia, ML Sharma, R. Kumar (NRCE)	November 2012- March 2017
An integrated investigation of microbial communities involved in methane production and fibre digestion	SS Paul, A Dey, BS Punia, A Jerome, P Sikka	April 2014- June 2017
Cloning for conservation and multiplication of superior buffalo germplasm	PS Yadav, D Kumar, RK Sharma, Sadeesh EM, N Selokar, S Khanna	September 2010- March 2017
Sub-Project 1: Cryo-preservation of somatic cells and cloned embryos for providing future reproductive opportunities in buffaloes.	NL Selokar, PS Yadav, RK Sharma, D Kumar	October 2015- March 2017
Sub-Project 2: Optimization of conditions for efficient gene transfer into buffalo somatic cells for transgenic embryo production	D Kumar, NL Selokar, PS Yadav	November 2015- March 2017
Development of diagnostic platforms for sensing candidate biosignatures of buffalo reproduction	V Nayan, AK Balhara, RK Sharma Collaborating centre: NRCE, Hisar	November 2015- November 2018
Scientific validation of 'Doka' in buffaloes for improvement of reproductive performance under field and farm conditions	SK Phulia, RK Sharma, AK Balhara, I Singh, Sunesh, PC lailer, A Bharadwaj	November 2013- October 2017
ONGOING INSTITUTE RESEARCH PROJECTS		
Factors influencing participation of rural youth in farming- an exploratory study	H Tripathi, VB Dixit, S Singh	November 2015- December 2017
Convergence for Dairy Development - A synergistic approach	VB Dixit, H Tripathi, S Singh	November 2015- December 2019
e—BhainsVigyan Kendra -CIRB's virtual centre for training in buffalo husbandry and platform for scientist-farmer interaction	S Balhara, AK Balhara, SK Phulia, PC Lailer, P Sikka	November 2013- December 2018
Identification of SNPs in genes related to meat production and their association with meat parameters in buffaloes (Bubalus bubalis)	AK Pandey, P Sikka, SP Yadav, SS Dahiya	October 2010- December 2017
Identification of genetic variants in genes related to oxidative status in relation to fertility in Murrah bulls	P Sikka, P Kumar	July 2013- October 2017
Studies on development and supplementation of chelated minerals in buffaloes.	V Mudgal, N Saxena, SS Dahiya, BS Punia, K Kumar, ML Sharma	April 2013- September 2017
Effect of stimulants on fibre degradation, methane emission and fungal population in buffaloes	A Dey, SS Dahiya, BS Punia, PC Lailer, N Saxena, SS Paul	April 2012- May 2017
Evaluation of sorghum cultivares on growth rate and feed utilization in buffalo	A Dey, PC Lailer, SS Paul Collaborating centre IIMR, Hyderabad	April 2015- December 2017
Manipulation of follicular wave pattern to increase conception rate in buffaloes	MH Jan, MK Tripathi, S Singh, RS Pippal	August 2016- July 2019



Projects	Investigators	Duration
EXTERNALLY FUNDED/AICRP/NETWORK PROJECTS		
Network project on buffalo improvement	I Singh, AK Pandey	July 1991-Continuing
Genetic Improvement of Murrah buffaloes (Network project CIRB, Hisar centre)	KP Singh, A Bharadwaj, A Boora, P Kumar, S Balhara, S Khanna	July 1991-continuing
Genetic improvement of Nili Ravi buffaloes (Network project CIRB, Sub-Campus Nabha).	S Singh, KP Singh, MH Jan, KL Mehrara, R Mehta	April 1991-continuing
Genetic Improvement of Bhadawari buffaloes (Network project IGFR, Jhansi centre)	BP Kushwaha, SB Maity, A Bharadwaj, VB Dixit, H Tripathi, S Singh	2001-continuing
Progeny testing of bulls under field conditions (Network Project FPT CIRB Unit)	A Bharadwaj, VB Dixit, H Tripathi	2001- continuing
National Agricultural Innovation Fund	VB Dixit, P Sikka, V Mudgal, AK Balhara, SK Phulia	2008- continuing
Lactation stress associated postpartum anestrus SNP array in buffaloes (NASF)	Lead center: ICAR-NDRI Collaborating Center I: ICAR-CIRB - RK Sharma, V Nayan Collaborating Center II: IOB, New Delhi	July 2014- June 2019
Nutritional and physiological interventions for enhancing reproductive performance in animals (AICRP)	Lead Centre: NIANP Bangalore Collaborating centre: ICAR-CIRB -RK Sharma, SK Phulia, V Mudgal, A Jerome, P Kumar	November 2014- March 2017
Computational identification and modelling of genetic variation in relation to performance traits (NABG CABin scheme)	P Sikka, KP Singh, SS Paul, A Jerome, S Balhara, AK Balhara, V Nayan	July 2015- September 2017
An open label study to assess the efficacy of spectramast in the therapy and control of clinical and sub-clinical mastitis in buffaloes (Zoetis India Sponsored)	A Boora, S Yadav, KP Singh	September 2015- March 2017
Simplification of nuclear transfer technique for the production of elite buffalo bulls (SERB)	NL Selokar	October 2015- September 2018
Studies on antagonists/inhibitors of signaling molecules to prevent cryocapacitation and development of species specific semen extender for buffalo semen cryopreservation (SERB)	P Kumar	October 2015- November 2018
Optimization of interspecies somatic cell nuclear transfer technique for production of horse (<i>Equus caballus</i>) cloned embryos Interinstitutional)	Lead Center NRCE, Hisar Collaborating Center: ICAR-CIRB NL Selokar, D Kumar, PS Yadav	November 2015- October 2018
Generation of induced pluripotent stem (iPS) cells from buffalo fetal fibroblasts through non-viral approaches (DBT)	D Kumar, NL Selokar, PS Yadav	February 2016- August 2017
Diversified farming through livestock and agriculture (Farmers First Programme)	Lead Centre: ICAR-CIRB KP Singh, A Boora, S Singh Collaborating Centre I: CCSSAU, Hisar, Collaborating Centre II: IARI, New Delhi	February 2016- January 2018
Synthetic endometrium: A novel model to study early embryonic development and uterine health in ruminants (NASF) – CIRB Centre	Lead Centre: IVRI, Bareilly Collaborating Centre: ICAR-CIRB D Kumar	February 2017- January 2020
Genomic techniques to profile and improve productivity and resilience in buffalo (ICAR-ILRI Collaborative project)	Lead Centre: ICAR-CIRB P Sikka, A Bharadwaj, AK Pandey, KP Singh, I Singh Collaborating Centre: ILRI, Nairobi, Kenya	2016-2018



Meetings of Various Committees

Institute Management Committee (IMC)

The XXV meeting of the Institute Management Committee (IMC) was held at CIRB, Hisar on November 15, 2016 under the chairmanship of Director of institute, Dr Inderjeet Singh. Progress made by the institute in research and extension activities particularly towards infrastructure development, herd performance, agricultural farm report, trainings for farmers and overall management including administration



and accounts was highlighted. The projects being undertaken at the institute were also briefed to the house. Institute Management Committee approved the proposed agenda items after due deliberations.

Quinquennial Review Team (QRT)

Two meetings of QRT were held, one at Nabha Campus on October 24, 2017 and other at CIRB, Hisar on October 25-26, 2016, to review the work of CIRB and its network centres. The QRT visited all the units and facilities at CIRB, Hisar and Nabha Campus. The discussions were held with scientists of CIRB, Project Coordinator of Network project, Officer In-charge of Nabha campus, administrative and finance



officers. Dr KM Bujarbaruah, VC, AAU and former DDG (AS) is the chairman and the members include Dr CS Prasad, former VC, Maharashtra Animal and Fishery Science University, Nagpur and former Director, NIANP; Dr JS Bhatia, former ADG (Edu); Dr BK Joshi, Former Director, NBAGR; Dr SVN Rao, Retd. Prof and Head, Extension Dept., Rajiv Gandhi Institute of Veterinary Education and Research, Pudukcherry. Dr SS Paul served as Member-Secretary. During the meeting, presentations were made by Dr Inderjeet Singh, Director CIRB about institute activities. The section incharges and HODs also briefed about achievements over the last 5 years under review of meeting.

Research Advisory Committee (RAC)

The XVIII RAC meeting was held on April 29-30, 2016 under the chairmanship of Dr UK Mishra, Vice Chancellor, Chhattishgarh Kamdhenu Vishwavidyalaya, Durg. On April 29, all the members observed the activities of animal farm, agriculture farm, modern animal shed and various laboratories of the institute. The members had discussions with individual scientists who apprised them about the projects, facilities and research achievements in respective divisions/laboratories.

On April 30, 2016, the deliberations started with a welcome address by Dr Inderjeet Singh, Director CIRB. He welcomed the Chairman and other members of RAC including Dr BS Prakash, ADG (AN&P) as well as the special invitees to the meeting. Chairman in his opening remarks described buffalo as a 'Black Diamond' which produces healthier milk containing A2 casein and is backbone of farmers' economy. He congratulated the scientists associated with the birth of 1st cloned calf 'Hisar Gaurav' at CIRB and also lauded the high conception rate of inseminators trained at CIRB. He also appreciated the efforts put in to improve institute's landscaping, agriculture farm, animal farm and other infrastructure and shown satisfaction for the overall development of the institute as well as its projection at National level. Dr BS Prakash was of the view that this institute must strive hard to build on the platform provided by birth of a cloned calf on research front and with prominent projection of



institute in the Krishi Unnati Mela 2016 on extension front. A farmers' hostel and a vehicle are essentially needed to cater to the needs of the extension activities such as Mera Gaon Mera Gaurav programme, training, field visits etc.

The action taken report on the recommendations of the XVIII RAC was presented by Dr SS Dahiya (Member Secretary, RAC) which was approved after discussion. This was followed by presentations by Heads / In-charges on research activities and achievements of respective divisions/ sections. Sh Ved Pal, a representative of farmers on RAC, while endorsing the views of the Chairman, showed satisfaction for the work and research being undertaken at CIRB and hoped that the farmers will surely be benefited by this. After thorough discussion, RAC made recommendations and some general suggestions for improving the management of herd and improvement in the on-going research projects. Recommendations of RAC were approved by the Council and are being addressed by the Institute through its research agenda.

Annual Review Meet of Network Project on Buffalo Improvement (NPBI)

XIV Annual Review Meet of Network Project (NPBI) was conducted on July 4-5, 2016 at GADVASU, Ludhiana under the Chairmanship of Dr RS Gandhi (ADG AB&P, ICAR) in the presence of Dr Inderjeet Singh (Director ICAR-CIRB Hisar cum Project Coordinator NPBI) and Dr Vineet Bhasin (Principal Scientist). Dr AS Nanda (Hon'able Vice Chancellor, GADVASU) and Dr HK Varma (Director Extension, GADVADU). At the outset, Dr Inderjeet Singh presented the salient achievements of the centres in brief. He also emphasized to promote Nili Ravi as an improver breed in the country along with Murrah as its performance is comparable to Murrah and quality germplasm can be made available from Nabha. He informed that weighted wet average of Murrah crossed 8.0 kg mark for the 1st time. The 305 or less day weighted average milk yield showed an improvement of >43 kg over the last year. Overall 21.3% improvement was evidenced since 1993-94. Dr RS Gandhi ADG (AB&P)

appreciated the improved performance of most of the centres and urged PI's to put sincere efforts to further improve the performance of their centres. All PI's presented the progress of their respective centres for the year 2015-16. The progress of each of the centre was discussed in view of the presentation made by the scientists and the Project Coordinator's report. Based on these, specific recommendations w.r.t. respective centres were drawn for necessary action.

Review meetings of CIRB-ILRI Collaborative Research Project

Two review meetings of ICAR- CIRB -ILRI Collaborative Research project: "Genomic techniques to profile and improve productivity and resilience in buffalo" under Feed Project grant for ILRI scientists were organised at CIRB Hisar, during November 14-17, 2016 and February 6-10, 2017. ICAR-CIRB and ILRI, Nairobi will jointly work to incorporate the latest advances in breeding technology—including genomic selection to further enhance the rate of genetic gain and the cost-effectiveness of the ongoing breeding program. Plan includes genotyping of bulls, evaluated and ascribed with breeding values under PT programme by employing commercially available buffalo specific high throughput platform. Project will generate a buffalo reference population of a few thousands of genotyped and phenotyped animals having informative SNPs, required for estimating genomic breeding values. Study will be able to determine predictive equations to implement more accurate and early selection for economic traits in Murrah buffaloes.

Institute Research Council (IRC)

XXXII IRC was held at ICAR-CIRB on July 20-21, 2016 and continued on August 4, 2016. The meeting was attended by scientists of the main and sub-campus and chaired by the Director. Progress of research projects was presented by respective Principal Investigators of various institute funded projects and suitable new project proposals were finally approved in this meeting. A total of 36 projects were discussed that included new proposals, ongoing, external funded and completed projects.

Important Events Organised

ISO Certification

Subsequent to the registration assessment conducted on December 16, 2016 by BSCIC Certifications Pvt. Ltd, the institute was adjudged to be operating a Quality Management System which complies with the requirements of ISO 9001:2008 under the scope "Improved Buffalo Germplasm Production". Accordingly ISO 9001:2008 (Certificate No. BN16070/15880) was awarded to the Institute.

Vigilance Awareness Week

The institute observed Vigilance Awareness Week from October 31-November 5, 2016. A pledge was administered by the Director, CIRB to all officers/officials of the Institute on October 31, 2016. Director sensitized the staff about the zero tolerance towards corruption and transparency in day-to-day working. He also emphasized the importance of public participation in eliminating corruption. Essay-writing competition on the topic "Public Participation in Promoting Integrity and Eradicating Corruption" in English and अखंडता को बढ़ावा देने और भ्रष्टाचार को समाप्त करने में जनता की भागीदारी in Hindi were conducted amongst the employees of the institute and their family members. Different posters related to anti-corruption were displayed at prime locations in the office.

National Unity Day/Rashtriya Ekta Diwas Celebration

National Unity day (also known as Rashtriya Ekta Diwas) was celebrated on October 31, 2016 at CIRB to commemorate the birth anniversary of Sardar Vallabhbhai Patel who was instrumental in unifying the country post independence. Scientists and staff of the institute paid rich tributes to the



great leader, Sardar Vallabhbhai Patel, on his birth anniversary by remembering his extraordinary contribution to the country. The pledge was administered by Director, CIRB.

Swachh Bharat Mission

The scientists, technical, administrative and supporting staff of CIRB, Hisar and Sub campus, Nabha undertook 'Swachh Bharat Mission' as a weekly activity whole heartedly. During the period, 154 hours were spent in 25 different activities by employees at main campus carried out to clean Institute and residential premises, labs, offices, weeding out of old records, animal shed, feed stores. Renovation/construction was also done for dung collection pits, parking shed, roads, paddocks etc.



Independence Day Celebration

Seventieth Independence Day was celebrated on August 15, 2016 with great zeal and enthusiasm. Dr Inderjeet Singh, Director, ICAR-CIRB, unfurled the National Flag. The event was witnessed by scientists, staff and their family members, who also participated in the competitions of patriotic songs and poem recitation. Director addressed the gathering and cited the



sacrifices of the Martyrs for making the country independent and emphasized on the sincerity, devotion, honesty and integrity to serve the institute and the nation to realize the dreams of our martyrs.

Republic Day Celebration

With great patriotic enthusiasm, ICAR-CIRB celebrated the Republic Day of India on January 26, 2017 which marked the 67th anniversary of the adoption of the Constitution of India. The event commenced with the flag hoisting by Dr Inderjeet Singh, Director, ICAR-CIRB followed by the National Anthem sung by one and all. The staff and children delivered speeches in Hindi and English. Director CIRB greeted the scientists and administrative staff and their families with his



motivational address and laid emphasis upon the role of every staff in the progress of the institute and thus country. Later on sweets were distributed amongst the staff and their families.



हिन्दी सप्ताह का आयोजन

हिन्दी सप्ताह का आयोजन संस्थान में सितम्बर 14 से 21 तक किया गया। इस अवसर पर हिन्दी की निबन्ध प्रतियोगिता संस्थान के कर्मचारियों के बच्चों के लिए तथा संस्थान एवं अन्य

केन्द्रों के कर्मचारियों के लिए परिच्छेद अनुवाद (अंग्रेजी से हिन्दी) हिन्दी शब्दानुवाद (अंग्रेजी से हिन्दी) हिन्दी निबन्ध प्रतियोगिता एवं हिन्दी टंकण प्रतियोगिताओं का आयोजन किया गया। हिन्दी सप्ताह में संस्थान के अलावा हिसार के अन्य संस्थान के कर्मचारियों ने भी भाग लिया तथा कर्मचारियों के स्कूल में पढ़ने वाले बच्चों ने भी विभिन्न प्रतियोगिताओं में बढ़-चढ़ कर हिस्सा लिया व आयोजन को सफल बनाया।

हिन्दी सप्ताह का समापन समारोह दिनांक 21 सितम्बर को आयोजित किया गया जिसके दौरान कृषि मंत्रालय एवं किसान कल्याण भारत सरकार के संस्थान उत्तरी क्षेत्र कृषि मशीनरी परीक्षण और प्रशिक्षण संस्थान हिसार के निदेशक डॉ. पी.के. पाण्डेय की गौरवमय उपस्थिति में पुरस्कार वितरण किया गया। समापन समारोह के दौरान वाद-विवाद, आशुभाषण एवं कविता पाठ की प्रतियोगिताएं आयोजित की गईं तथा इस अवसर पर मुख्य अतिथि द्वारा हिन्दी में सर्वाधिक कार्य करने वाले एवं विभिन्न प्रतियोगिताएं के विजेताओं को पुरस्कार प्रदान किये गए। डॉ. हेमा त्रिपाठी को संस्थान द्वारा आयोजित हिन्दी सप्ताह (14-21 सितम्बर, 2016) कार्यक्रम के अवसर पर हिन्दी में सर्वाधिक कार्य करने वाले अधिकारियों की श्रेणी में पुरस्कृत कर रूपए 5000/- प्रदान किये गए।



Distinguished Visitors

- Sh Mohan Bhai Kundariya, Minister of State for Agriculture & Farmer's Welfare, New Delhi
- Dr Trilochan Mohapatra, Secretary, DARE & Director General, ICAR
- Dr H Rahman, Deputy Director General (Animal Science), ICAR Hqr. New Delhi
- Dr AK Srivastva, Member ASRB and Former Director cum Vice Chancellor NDRI, Karnal
- Dr KM Bujurbaruah, Vice-Chancellor, Assam Agricultural University, Jorhat – Assam
- Prof Gaya Prasad, Vice Chancellor Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut
- Prof PK Uppal, Advisor, Animal Husbandry Fisheries & Dairy Department, Government of Punjab
- Dr VV Sadamate, Agriculture Extension Specialist and Former Adviser Agriculture, Planning Commission, New Delhi, India
- Dr CS Prasad, Former Vice Chancellor, Maharashtra Animal and Fishery Science University, Nagpur and former Director, NIANP
- Dr UK Mishra, Vice Chancellor, Chhattishgarh Kamdhenu Vishwavidyalaya, Durg.
- Dr AS Nanda, Vice Chancellor, GADVASU, Ludhiana
- Dr SN Maurya, Former Vice Chancellor U.P. Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Ansundhan Sansthan, Mathura
- Dr Ramesh Yadav, Chairman, Haryana Kissan Ayog, Panchkula
- Dr BK Joshi, Former Director, NBAGR, Karnal
- Dr BN Tripathi, Director, ICAR-NRCE, Hisar
- Dr Rameshwar Singh, Project Director (DKMA), ICAR Hqr. New Delhi
- Dr SM Bokhtiar, Director, SAARC Agriculture Centre, Dhaka, Bangladesh,
- Dr TR Gurung, Sr. Programme Manager, SAARC, Agriculture centre Dhaka
- Dr SVN Rao, Retd. Prof and Head, Extension Dept., Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry
- Dr ML Madan, Former DDG (AS), ICAR, New Delhi
- Dr JS Bhatia, Former ADG (Edu), ICAR, New Delhi
- Dr DN Kamra, ICAR National Professor, at ICAR-IVRI, Izatnagar
- Dr SK Ranjhan, Former Joint Director, IVRI, Bareilly
- Dr MV Subba Rao, Former Dean & FAO Expert, ANGR Agriculture University, Hyderabad.



Infrastructure Development

Agriculture Farm

Fodder and grain production: During the year Fodder and grain production: During the year, Agriculture farm at main campus, Hisar produced a total of 33526.00 quintals of green fodder, 1305 quintals grains and 689 quintals wheat straw. At subcampus Nabha, the total green and dry fodder production during the year was 46889.3 and 3365 quintals, respectively, while grain production was 6203.2 quintals.



Land improvement

At main campus, fifteen 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 Ag 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.

At sub centre 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. During the year, 72 acre and 3 Marla land was transferred to Animal Husbandry Department, Punjab as per approval of the ICAR.

Animal farm

The institute is maintaining a Murrah herd of 523 buffaloes out of which 255 are breedable buffaloes. The overall wet average of 8.08 kg/day and herd average of 5.32kg/d were achieved during the period. The Standard Lactation Milk Yield of 2457 kg and Total Lactation Milk Yield of 2567 kg were attained, which are the highest ever since inception of the Institute. The reproductive traits viz service period, calving interval and dry period were 148d, 458d and 143d, respectively. Besides, 2.81 lakh kg of milk and 64 breeding bulls were sold during the year. Besides works including installation of 8 unit milking machine, ventilators, automatic milk chiller cum dispenser, etc carried out at sub-campus Nabha.

Farm Machinery and workshop

Straw making reaper, zero tillage seed drill machine, chaff cutter, chopper, harrow and a laser leveller were purchased to improve the farm efficiency. A tractor driven rain gun system for irrigation was also installed.



Feed Unit

Feed unit is engaged in preparation of concentrate feed for feeding to farm animals by formulating feed for different categories of animals. Feed unit prepared about 600 tonnes of concentrate feed for feeding to farm animals. In addition, approx. 15 tonnes of area specific mineral mixture is being prepared annually for farm animals as well as for sale to the farmers for its popularization. Feed processing unit and attached grain / cake store cover an area of about 4500 square feet together with an open drying place of about 1500 sq. ft. This unit is equipped with automatic feed grinder cum mixer of capacity (10Q/hr) with lifts for grinding and mixing of concentrate mixture.

Agriculture Knowledge Management Unit (AKMU)

AKMU provides internet connectivity to labs and offices in the Institute. Maintenance and updation of institute website, biometric system, CCTVs, EPABX are the other activities carried out by this unit. ICAR- FMS -IMS has been fully functional at Institute. Personal information of the Institute employees is also regularly updated at Permisnet of ICAR.

Library

The institute library is subscribing selected foreign journals and has 1211 books on various disciplines. Good collection of journals for the past 30 years as bound volumes is also available to the scientists and students. The library also subscribes to newspapers, periodicals and magazines to keep the staff updated about the happenings. The photocopying facility is also available in the library. CIRB library is member of CeRA consortium for e-resources in Agriculture. Under CeRA, the institute gets access to full text online journals, which is available to the researchers 24x7.



Engineering section

Electrical section of the institute is responsible for providing round the clock electric supply to the laboratories of institute. It maintains 11 KV sub- station comprising of 500 KVA transformer, OCB, ACB, LT panels and two DG sets of 250 and 110 Kva capacities for power backup. Section attends day to day electric maintenance related complaints of different labs, guest house and residential units. Repair, servicing and maintenance of more than 70 air conditioners, geysers, electric motors upto 25hp, street lights, different size underground LT cables and HT and LT overhead lines of the agriculture farm of the institute are part of the day to day activity. Operation and maintenance of audio visual equipment of the seminar hall like; power amplifiers, audio mixer, dbx- complete sound management system and LCD projections are taken care of.

Estate Section

Estate Section of this institute is responsible for construction, modification and repairs works in all the residential, office building, animal shed 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 assigned to 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.

Guest house

Institute guest house has fourteen well furnished rooms for accommodating 28 guests at a time. It has separate reception with attached well furnished lounge and dining hall to cater to the requirements of visitors as well as get together for institute fraternity. During the period, revenue of Rs 1,77,375 has been generated with occupancy by 725 guests. Dr T Mohapatra (Hon'ble DG and Secretary DARE) laid the foundation stone of trainee students hostel at CIRB on August 22, 2016 in presence of Dr H Rahman (DDG AS, ICAR).



Central Laboratory

A central laboratory facility has been developed at ICAR-CIRB after merging of laboratories from Animal Physiology and Reproduction (APR) & Animal Nutrition & Feed Technology (ANFT) divisions that provides optimum conditions for scientific or technological research, experiments, and measurements. The CLF facilitates interdisciplinary research by supporting the re-use and accessibility of hardware and software, developing and maintaining research platforms, improving methods and tools for measuring interaction, and making research results sustainable. Central laboratory facility is open to every eligible person, scientists and students. In this laboratory, all the necessary facilities are available related to biochemistry, proteomics, genomics and other '-omics' research. Available instruments include picodrop, gel documentation system, thermal cycler (PCR), gel electrophoresis systems, IEF system for 2DGE, ELISA Reader, refrigerated centrifuge, laminar flow, shaking incubator, TFF system, freezers and analysis softwares etc. It is suitable for experiments being performed in a single bench system. The central laboratory at ICAR-CIRB is committed for providing operational excellence in the researchable areas concerning buffalo, the 'black gold' and our farmers.

Semen Freezing Lab

Semen freezing laboratory is an important constituent of the institute and is equipped with ultramodern facilities like CASA, fluorescent and DIC microscope and biofreezer for cryopreservation of Murrah buffalo bull's semen. Production and maintenance of quality frozen semen and its dissemination is primary aim of this lab. The lab is engaged with semen collection, evaluation, dilution, equilibration, cryopreservation, maintenance and distribution of frozen semen from genetically superior Murrah bulls. Frozen semen is provided at a nominal price to the developmental agencies, farmers and inseminators engaged in buffalo improvement programme in the country. The lab has a stock of more than four lakh doses of frozen semen from about 230 breeding bulls out of which more than sixty thousand doses are of progeny tested bulls. Frozen semen doses prepared from farmers' prize winning superior bulls are also available with the institute and these are available to the inseminators for buffalo improvement programme. The performance of the semen freezing lab further excelled this year as compared to the previous year in terms of production (1, 26008 vs. 95426 doses), sale (54586 vs. 34838 doses) and revenue generation (RS 18.33 vs. 9.31 lakhs). The frozen semen production rate has been improved.

Gender Mainstreaming & Women Empoerment

The only way to solve the problem of women's subordination is to change people's mindset and to plant the new idea of gender equality into every mind.

-Qingrong Ma

Gender equality is a precondition to overcoming starvation, poverty and epidemics.

-Khalid Malik

All over the world women make a significant contribution to agriculture and allied sectors. In Indian scenario, she plays a key role in animal, farm and home management. A successful dairy husbandry enterprise not only improves her socio-economic status, but also assures a sustained and assured means of income to supplement their income from the main enterprise. Empowering women through capacity building programs not only generates various employment opportunities for enhancement of the income for livelihood security of their families.

Efforts of ICAR-CIRB: The efforts of CIRB are aimed at assisting farmers and farm women through awareness and trainings to improve dairy farming methods and techniques, strengthen the infrastructure to increase production efficiency and income for enabling them to enhance their quality of life. Here extension services are delivered through various methods including participatory group approaches, mass media, buffalo mela, calf rallies, on and off campus trainings, demonstrations and promotion of improved buffalo farming using ICT tools. During the period under report, 236 rural women were covered under various capacity building and sensitization programs in villages on buffalo farming. Apart from these, approximately 300 rural girl students benefitted during various programs held at their schools. More than 250 women/ school girls were trained as part of the training programs at campus. Under 'Mera Gaon Mera Gaurav' scheme awareness was created among the women farmers on health, hygiene, sanitation and nutritional aspects besides the improved buffalo farming. Opportunities were provided to discuss their farm and household problems during

women scientist's interaction programs. Literature was also distributed on vaccination schedule of animals, clean milk production, colostrum feeding, advantages of artificial insemination in animals etc. Eight demonstrations were also made for women farmers on silage making and preparation of mineral mixture.

International Women's Day was celebrated on 8th March on theme "Be Bold for Change" to create awareness and support them for equality and empowerment. The initiative was taken to sensitize the rural women for increasing their access to productive assets and employment opportunities, eliminating gender biases at workplace and supporting technological innovations that may reduce the time burden of agriculture and domestic work. On this occasion, more than 150 women members of milk cooperative societies of village Hindwan and Rawalwas Khurd participated. This event was organised on convergence mode with representatives of different institutions including LUVAS, CCS HAU, ATMA, state department of animal husbandry, education and agriculture departments, dairy milk cooperative were invited who stressed on the importance of empowering rural women farmers as agents of change for transforming food production and consumption. The day was marked a call to action for accelerating gender parity. Under 'Farmers First' program one day women training was organised in village Kharkari for 24 women farmers and mineral mixture was distributed after making them aware of the need and benefits of mineral supplementation.





Trainings & Capacity Building

Name & Designation	Training program / Topic	Date	Institute /Organization
Scientific			
Dr H Tripathi	Impact assessment of agriculture extension	June 6-10, 2016	NAARM, Hyderabad
Dr N Selokar	SAARC regional training on advances in animal reproduction biotechnology	July 15-30, 2016	ICAR-NDRI, Karnal
Dr SK Phulia	SAARC training on herd health management of dairy buffaloes	Aug. 22-27, 2016	ICAR-CIRB, Hisar
Dr AK Balhara	Formulation of projects under climate change	Sept. 5-9, 2016	NABARD, Hyderabad
Dr N Saxena	Bioactive compounds from medicinal plants. A wealth of novelties & opportunities	Dec. 1-21, 2016	DMAPR, Anand
Dr SS Dahiya	MDP on leadership development	Dec. 19-30, 2016	NAARM, Hyderabad
Dr A Boora	Role of scientists in natural resources and environment management	Jan. 30-Feb. 3, 2017	IIFM, Bhopal
Dr Jerome A	competence enhancement for HRD nodal officers	Feb. 16-18, 2017	NAARM, Hyderabad
Dr P Sikka	Next generation data analysis on transcriptome	Mar. 22-24, 2017	M/S Bioinvid. Tech Pvt. Ltd, Bangalore
Technical			
Dr Rajesh, Dr A Saini, Krishna Kumar	Use of computer & research data management for technical officers	June 23-25, 2016	ICAR-CIRB In House training
Ashrafi, Jagdeep, Joginder Nain, Satish	Improving the skills and efficiency of technical and supporting staff-	Sept. 26-30, 2016	ICAR-CIRB In House training
Dr Rajesh Kumar	Reproductive health management on domestic animals	Dec. 15-21, 2016	ICAR-NDRI
Dr TP Singh, Nishan Singh	Dairy farm & milk processing plant management	Feb. 22-Mar. 3, 2017	ICAR-NDRI, karnal
Administrative			
Sh Raj Kumar, Narinder Kumar, Abdul Majid	Implementation of NIC e -procurement solution through CPPportal	June 16-17, 2016	IARI, New Delhi.
Raj Kumar, IS Kundu, Rajesh Kumar, Viksit Kumar, Girdhari Lal, Abdul Majid, Ashok Kumar, Indira Devi, Satbir Singh, Dharam Pal, Sunil Kumar, Mahabir Singh, Joginder Singh	Establishment rules and purchase procedures for administrative staff	Mar. 21-23, 2017	ICAR-CIRB , Hisar (In House training)
Supporting			
Radhey Krishna, Rajbir	Improving skill s and efficiency of technical (T-1&2) and supporting staff	Sept. 26-30, 2016	ICAR-CIRB, Hisar (In House training)

HRD fund allocation and utilization:

Funds allocated: Rs. 2.0 lakhs,

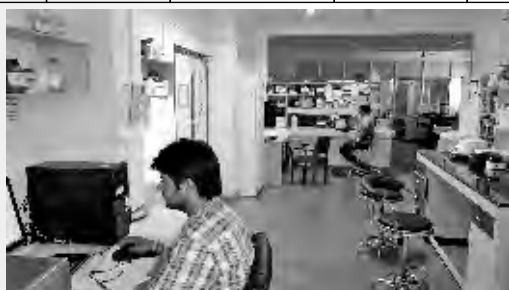
Funds utilized: Rs. 1.99 lakhs



PG Research Students

COMPLETED

Student Name	Degree program	University	Year	Thesis title	Major Advisor/ co-advisor
Balaraju BL	PhD	ICAR-IVRI, Izatnagar	2014-16	Role of indigenous cattle in livelihood security of resource poor farmers: an exploratory study in Karnataka	H Tripathi
Ranjeet Verma	MVSc	ICAR-IVRI, Izatnagar	2015-2016	Age at first calving in Murrah buffaloes: Genetic variations and subsequent reproductive performances	Inderjeet Singh
Kavya	MVSc	ICAR-IVRI, Izatnagar	2015-2016	Fertility prediction and Metabolic hormones in relation to early resumption of cyclicity in postpartum Buffaloes.	RK Sharma
Ram Kumar Singh	MVSc Karnal	ICAR-NDRI	2015-2016	Effect of some plant bioactive compound on methane production, growth and nutrient utilization on buffalo calves	BS Punia
Kamlesh Chaudhary	MVSc	ICAR-NDRI Karnal	2015-2016	Heat detection efficiency and postpartum ovarian cyclicity in Murrah buffaloes	A Bharadwaj
Mala Singh	MVSc	ICAR-NDRI Karnal	2015-2016	Proteomic analysis of saliva during early growth in buffalo calves	AK Balhara
Ravindra Kumar	MVSc	ICAR-NDRI Karnal	2015-2016	Effect of freezing rates on buffalo sperm during cryopreservation	Jerome A
Deepak Kumar	MTech	ICAR-NDRI Karnal	2015-2016	Transposon- mediated reprogramming of buffalo fibroblasts to generate induced pluripotent stem cells	D Kumar
Papori Sharma	PhD	LUVAS, Hisar	2014-2016	Studies on epigenetic characteristics of somatic cells in water buffaloes	PS Yadav
Lokesh Kumar	MVSc	LUVAS, Hisar	2015-2016	Evaluation of efficacy of different treatment protocol of estrus induction in buffaloes under field conditions	SK Phulia
Maninder Sheoran	MVSc	LUVAS, Hisar	2015-2016	Analysis of Haryana cow urine for presence of various proteins/peptides in comparison to Murrah buffaloes	V Nayan
Dheer Singh Swami	MVSc	LUVAS, Hisar	2015-2016	Studies on buffalo (Bubalus bubalis) semen quality following supplementation of male specific mineral mixture in feed and semen additives in freezing extender	P Kumar





CONTINUING

Student Name	Degree program	University	Year	Thesis title	Major Advisor/ co-advisor
K Ratika	PhD	ICAR-NDRI, Karnal	2014-2017	Performance of transition buffaloes fed diet supplemented with rumen protected methionine, lysine and choline	SS Dahiya
Y Mary	PhD	ICAR-NDRI, Karnal	2014-2017	Hyper ammonia producing bacteria from rumen of buffalo and evaluation of additives for their inhibition	SS Paul
Rekha Yadav	PhD	ICAR-IVRI, Izatnagar	2015-17	Effectiveness of breeding services by state department of animal husbandary in Murrah breeding tract of Haryana – a perceptual study	H Tripathi
Ankaj Thakur	PhD	ICAR- NDRI, Karnal	2014-2018	Effect of weaning on the performance of buffaloes and their calves	Inderjeet Singh
Chander Mohan	PhD	IGNOU, New Delhi	2012-2016	Identification of active ingredients against gastro intestinal parasites in indigenously known angiospermic plants	N Saxena
Jasmer	PhD	LUVAS, Hisar	2015-18	Studies on minimization of cyocapacitation of buffalo (Bubalus bubalis) sperm during cryopreservation	P Kumar
Pratibha Singh	MVSc	ICAR –NDRI, Karnal	2017-18	Behavioural, morphology and endocrinological studies during DOKA in Buffaloes	SK Phulia
Rashmi	MVSc	ICAR- NDRI, Karnal	2017-18	Genetic polymorphism of Serpine 2, IGF-1, TLR-4 and HSP70 genes in anestrus murrah buffaloes	AK Balhara
Rahul Kumar	MVSc	LUVAS, Hisar	2015-16	Comparative analysis of some of the trace minerals in bovines in various districts of Haryana	V Nayan
Krishan Kumar	MVSc	LUVAS, Hisar	2016-17	Effects of feed additives rich in essential oils on rumen fermentation, methanogenesis and nutrient utilization in Buffalo	A Dey
Vijayalakshmy K	MVSc	LUVAS, Hisar	2016-17	Transcriptome analysis of buffalo bull spermatozoa for identification of fertility associated gene(s)	D Kumar
Ananth K	MVSc	LUVAS, Hisar	2016-17	Production of cloned embryos using somatic cells from swamp buffalo and oocytes from riverine buffalo	N Selokar
Pankaj Gunwant	MVSc Hisar	LUVAS,	2016-17	Study on melatonin receptor gene polymorphism and its association with reproductive seasonality in Murrah buffaloes	Inderjeet Singh
Kavita	MVSc	LUVAS, Hisar	2016-17	Efficacy of melatonin with ovsynch protocol for induction of estrus in anestrus in Murrah buffalo heifers during summer season	AK Balhara



Participation in Conferences, Workshops, etc.

Name	Program	Place	Date
P Sikka	Livegene programme and strategic review & planning meeting- on appropriate livestock genetics used under prevailing climate changes and suitable production systems by rural population	ILRI Nairobi, Kenya	May 16-17, 2016
AK Pandey, KP Singh, A Bharadwaj and S Khanna	XIV annual review meet of network project on buffalo improvement	GADVASU, Ludhiana	July 4-5, 2016
VB Dixit	Brainstorming session (BSS) on strengthening agricultural extension research and education	National Academy of Agricultural Sciences, New Delhi	July 9, 2016
D Kumar and P Kumar P Sikka, RK Sharma, PS Yadav, S Singh, SK Phulia, V Nayan, AK Balhara, P Kumar, Jerome A, Sadeesh EM, NL Selokar	Workshop on computer assisted semen analyzer (CASA) Workshop on Euraxess Information	IMV, N. Delhi ICAR-CIRB, Hisar	July 26, 2016 August 30, 2016
P Sikka and Jerome A	III steering committee meeting on network project on agricultural bioinformatics and computation biology [CABin Scheme]	CAB, IASRI, New Delhi	October 5, 2016
KP Singh	Workshop on animal husbandry – a new perspective	NIAH, Baghpat (UP)	October 9, 2016
D Kumar and PS Yadav	VII International conference on stem cells and cancer: proliferation, differentiation and apoptosis	Goa	Oct. 21-23, 2016
D Kumar and P Kumar	Conference on advancement in bovine reproductive biotechnologies to increase breeding efficiencies	IMV, N. Delhi	Oct. 17-18, 2016
RK Sharma, PS Yadav, VB Dixit, H Tripathi, S Singh, AK Pandey, SK Phulia, N Saxena, V Nayan, AK Balhara, P Kumar, D Kumar, Jerome A, Sadeesh EM, NL Selokar	Workshop on Scientific writing, e-books and publication	ICAR-CIRB, Hisar	Nov. 16, 2016
I Singh, KP Singh and A Boora	Zonal group meeting of 'Farmer FIRST' Project	ICAR- CIRB, Hisar	Nov. 4, 2016
N Saxena, PC Lailor and V Mudgal	X Biennial Animal Nutrition Association Conference on newer perspective in animal nutrition research for augmenting animal productivity	SVU, Tirupati	Nov. 9-11, 2016



Name	Program	Place	Date
A Dey	VII biennial Australasian dairy science symposium	University of Sydney, Camperdown, NSW, Australia	Nov. 16-18, 2016
V Nayan and AK Balhara	International workshop on milk: naturally nano structured food	NDRI, Karnal	Nov. 30, 2016
I Singh, RK Sharma, Jerome A, S Khanna, P Kumar	XXXII annual convention and national symposium on Animal Fertility and Fecundity at Crossroads: Addressing the issues through conventional and advanced reproductive technologies of ISSAR	SVVU, Tirupati	Dec. 6-8, 2016
I Singh, SS Dahiya, VB Dixit, H Tripathi, P Sikka, RK Sharma, PS Yadav, AK Pandey and AK Boora	Workshop on strengthening extension services on convergence mode for dairy development	CIRB, Hisar	January 7, 2017
AK Pandey	XIII National conference of ISAGB on challenges in quantitative genetics for improvement of indigenous animal genetic resources	ICAR-IVRI, Izatnagar	Jan. 19-20, 2017
VB Dixit	II workshop of nodal officers of KRISHI	NASC Complex, New Delhi	Jan. 24-25, 2017
D Kumar	International conference on reproductive health with emphasis on strategies for infertility, assisted reproduction and family planning and XXVII annual meeting of ISSRF	ICMR, New Delhi	Jan. 23-25, 2017
P Kumar	Group monitoring workshop of SERB project	KIIT University, Bhubaneswar	February 2-3, 2017
KP Singh	National symposium on biodynamic animal farming for the management of livestock diversity under changing global scenario” and XIV annual convention of society for conservation of domestic animal biodiversity (SOCDAB)	Veterinary College, Mannuthy, Thirssur	Feb. 8-10, 2017
N Saxena and V Nayan	International conference on emerging areas of environmental science and engineering (EAESE-2017)	GJUS&T, Hisar	Feb. 16-18, 2017
AK Pandey	Brain Storming session on phenotypic characterization of AnGR	ICAR-NBAGR, Karnal	March 16, 2017
AK Pandey and V Nayan	Workshop on bioinformatics for genomics & proteomic analysis	ICAR-NDRI, Karnal	March 17, 2017
KP Singh	National review-cum-sensitization workshop of ‘Farmer FIRST’ Project	ICAR-NAARM, Hyderabad	March 18-19, 2017
N Saxena	National conference on analytical techniques and their applications	GJUS&T, Hisar	March 16-17, 2017



Personnel

General Administration

Dr Inderjeet Singh	Director
Sh Chetan S Issar	AO (up to 07.12.2016)
Sh Ashok Barapartre	AO (additional charge)
Sh Mahesh Kumar Meena	F&AO (up to 28.05.2016)
Sh Ram Avtar Parashar	F&AO w.e.f. 01.06.2016
Sh Raj Kumar	AAO
Sh Ishwar Singh Kundu	AAO
Sh Joginder Singh	Private Secretary
Sh Rajesh Kumar	Assistant
Sh Viksit Kumar	Assistant
Sh Girdhari Lal	Assistant
Sh Abdul Majid	Assistant
Sh Ashok Kumar	UDC
Smt Indira Devi	UDC
Sh Satbir Singh	UDC
Sh Dharam Pal	LDC
Sh Sunil Kumar	LDC
Sh Mahabir Singh	LDC

Animal Genetics & Breeding Division

Dr (Mrs) P Sikka	Principal Scientist & Head
Dr A Bharadwaj	Principal Scientist
Dr AK Pandey	Principal Scientist
Dr KP Singh	Principal Scientist
Dr SN Kala	Senior Scientist
Dr A Kumar	Scientist
Mrs S Balhara	Scientist (on study leave)
Sh AKS Tomar	ACTO

Animal Nutrition & Feed Technology Division

Dr BS Punia	Principal Scientist & Head (upto 31.01.2017)
Dr SS Dahiya	Principal Scientist & Head (w.e.f. 01.02.2017)
Dr PC Lailer	Principal Scientist
Dr N Saxena	Principal Scientist
Dr SS Paul	Principal Scientist
Dr A Dey	Senior Scientist
Dr V Mudgal	Senior Scientist
Sh K Kumar	ACTO
Sh GD Tiwari	Technician

Animal Physiology & Reproduction Division

Dr PS Yadav	Principal Scientist & Head (up to 26.08.2016)
Dr RK Sharma	Principal Scientist & Head (w.e.f. 27.08.2016)
Dr S Singh	Principal Scientist
Dr SK Phulia	Principal Scientist
Dr V Nayan	Scientist
Dr AK Balhara	Scientist

Dr D Kumar	Scientist
Dr Jerome A	Scientist
Dr P Kumar	Scientist
Dr Sadeesh EM	Scientist
Dr N Selokar	Scientist
Sh J Singh	Technician
Sh A Shah	Technician

Transfer of Technology and Entrepreneurship

Dr SS Dahiya	Principal Scientist & Incharge
Dr VB Dixit	Principal Scientist
Dr (Mrs) H Tripathi	Principal Scientist
Dr ML Sharma	ACTO (w.e.f. 13.09.2016)

Network Project on Buffalo Improvement

Dr Inderjeet Singh	Project Coordinator
Dr AK Pandey	Incharge
Dr BP Kushwaha	Principal Scientist (IGFRI, Jhansi)
Dr S Yadav	Scientist (on study leave)
Sh Ram Chander	TO

Other Sections, Units, Cell, etc.

Dr Inderjeet Singh	Chairman, ISO Management
Dr A Bharadwaj	Vigilance officer & Overall Incharge, Animal Farm
Dr Sudhir Khanna	Incharge, Animal Farm
Dr PC Lailer	Overall Incharge, Agricultural Farm & Workshop
Sh Surender Singh Malik	Incharge, Agricultural Farm
Sh Baljit Singh	Incharge, Workshop
Dr SK Phulia	Overall Incharge, Estate and Electricity section
Sh Brij Pal Singh	Incharge, Estate
Sh Rajesh Parkash	Incharge, Electricity section
Dr (Mrs) H Tripathi	Overall Incharge, Library & AKMU
Sh Raj Kumar	Incharge, Library
Dr SS Paul	Incharge, PME
Dr D Kumar	Incharge, RFD
Dr AK Balhara	PRO
Dr RK Sharma	CPIO (RTI cell)
Sh Raj Kumar	APIO (RTI cell)
Dr N Saxena	Incharge, Feed unit and Chairman, Innovation cell
Dr V Mudgal	Hindi Officer
Dr P Sikka	Chairperson, Women cell
Sh Joginder Singh	Incharge, Internal Security
Sh AKS Tomer	Incharge, Landscape and Guest house



CIRB SUB-CAMPUS NABHA

Scientific Staff

Dr Sajjan Singh	Principal Scientist & Officer Incharge (upto 19.3.2017)
Dr Ram Singh	Principal Scientist & Officer Incharge (w.e.f. 20.3.2017)
Dr G Singh	Principal Scientist (on leave)
Dr MH Jan	Scientist
Dr MK Tripathi	Scientist (up to 14.03.2017)

Technical Staff

Dr Krishan Lal Mehrara	CTO
Sh Virendra Singh	CTO (On deputation)
Sh Jagdish Prasad	CTO
Sh Rajiv Mehta	ACTO
Dr Tresh Pal Singh	ACTO
Dr Radhay Shyam Pippal	STO
Dr Ashwani Saini	STO
Sh Daljit Singh	TO
Sh Balwinder Singh	TO
Sh Mohan Singh	TO (Driver)
Sh Nishan Singh	Technician
Sh Santokh Singh	Technician
Sh Dalbara Singh	Technician

Administrative Staff

Sh Narender Kumar	AAO
Sh Tejinder Singh	UDC
Sh Jaspal Singh	SSS

Joinings

- Sh Ram Avtar Parashar, FAO on 01.06.2016 on transfer from ICAR-NIASM, Baramati
- Dr Ram Singh, Principal Scientist on 20.03.2017 on transfer from ICAR-CARI, Izatnagar

Promotions

- Dr Vishal Mudgal, Sr. Scientist (Animal Nutrition) to the next higher grade pay wef 18.08.2015
- Mrs Sunesh Balhara, Scientist to the next higher Grade Pay wef 04.11.2015

- Sh Krishna Kumar to the next higher grade of ACTO wef 30.03.2015
- Sh Joginder Singh as Technician wef 06.08.2016
- Sh Asharfi Shah as Technician wef 06.08.2016
- Sh Baljit Singh to the next higher grade for Technical Officer wef 08.08.2016
- Sh Kuldeep Singh to the next higher grade of TO wef 29.06.2016
- Sh Bhim Raj to the next higher grade of TO wef 29.06.2016
- Sh Sant Lal to the next higher grade of TO wef 29.06.2016
- Sh Satpal to the next higher grade of TO wef 29.06.2016
- Sh Mohan Singh to the next higher grade of TO wef 29.06.2016
- Sh Ram Kumar to the next higher grade of STA wef 29.06.2016

Transfers

- Sh Mahesh Kumar Meena, FAO to ICAR-NBPGR on 28.05.2016
- Sh Chetan S. Issar, AO to ICAR-IARI, New Delhi on 7.12.2016
- Dr Manoj Kumar Tripathi, Scientist to ICAR – RC for Eastern Region, Patna on 14.03.2017

Superannuation

- Sh Mahender Singh, SSS on 30.04.2016
- Sh SubhashChander, TO on 01.05.2016
- Sh Om Parkash S/o Sh. Khushi Ram, CLTS on 30.06.2016
- Sh ShyamLal S/o Sh. Lal Chand, CLTS on 31.07.2016
- Dr B.S. Punia, Principal Scientist on 31.01.2017
- Sh Raghubir Singh, Casual Labourer on 31.03.2017

Sad Demise

- Sh Chandi Ram, CLTS expired on 16.04.2016
- Sh Ram Kaul, SSS expired on 03.08.2016
- Sh Amar Chand, CLTS expired on 19.08.2016
- Sh Sushil Kumar, STO expired on 08.10.2016
- Sh Suchha Singh, CLTS, CIRB Sub Campus, Nabha expired on 25.06.2016
- Sh Tehal Singh, CLTS, CIRB Sub Campus, Nabha expired on 20.02.2017





Sectoral News

Dairy sector to witness robust growth this year: experts

Source: <http://www.thehindu.com/news/national/kerala/Dairy-sector-to-witness-robust-growth-this-year-experts/article17008703.ece>

During the last 10 years, the annual growth rate in Indian dairy industry is 4.6 per cent as compared to the global growth rate of 2.2 per cent. During this period, per capita consumption of milk in the country was 340 g a day as against 299 g globally. India's milk production has touched 155.499 metric tonnes during 2015-16. Experts predict huge demand for dairy products in the country this year. The prices of milk and milk products will increase by more than 10 per cent, which will facilitate more income for dairy farmers. Educated unemployed youths may emerge as entrepreneurs and venture into dairying. The country will witness spectacular growth in dairy processing units. By the end of March 2017, the country will have only half the amount of the required milk powder, which will increase the requirement of fluid milk and, in turn, benefit dairy farmers. The number of commercial dairying units will increase this year in the urban and peri-urban areas of metros and big cities. These dairies mainly cater to the needs of urban consumers.

Global warming to hit Indian dairy sector hard: Experts

Source: <http://www.tribuneindia.com/news/nation/global-warming-to-hit-indian-dairy-sector-hard-experts/365524.html>

The flourishing dairy sector stands to lose a whopping three million tonnes of milk in the next three years as average temperatures increase, with wide fluctuations in day and night temperatures—observation made at 45th Dairy Industry Conference at Mumbai. The dairy industry in India employs over 16 million farmers, including 4.60 million women. The Indian farmers are adding around 10 million tonnes of milk annually with a compounded annual growth of around 6.5 per cent in the sector. The primary reason is deficient rains for three consecutive years especially in Maharashtra and Madhya Pradesh. It is expected by experts that the

temperatures will rise between 2 degrees and 7 degrees by 2070-2090 which will pose grave threat to dairy production in the country.

India heading towards medium-scale dairy farms

<http://www.thehindu.com/news/cities/mumbai/business/india-heading-towards-medium-scale-dairy-farms/article8444336.ece>

According to Rabobank, India's dairy farming sector is headed for significant change- the increasing demand for high-quality milk from the consumers, procurers and processors. In the coming years, milk procurement will become the single most critical link in the dairy supply chain. Medium-scale dairy farms (50 to 300 animals) will be the one of the key growth drivers in Indian dairy. Moreover, to keep pace with the strong growth in branded milk and dairy products, direct milk sourcing will gradually replace agent-based sourcing as a dominant model. This will help them secure consistent supply of superior quality raw milk. The share of milk procured from small and marginal farmers will decline. At present, 75-80 per cent of milk is procured from these farmers. Large dairy farms have faced issues such as the availability of land and fodder, a paucity of professional workers, and a ban on import of cattle.

Australian Buffalo Farming

<http://www.buffaloaustralia.org/web/farming.html>

Water Buffalo have been present in Northern Australia since the 1820's. They have been used for many years for meat and hides. A new domesticated industry has emerged following the destruction of much of the feral buffalo herd in northern territory in the 1980's. Buffalo are currently being farmed in all states of Australia. Riverine and riverine cross buffalo have been introduced and are doing well especially in the Southern States. Buffalo dairies have been set up in Queensland and Victoria, and buffalo milk and dairy products are in high demand. New Zealand has been importing dairy buffalo from Australia to create a new industry in New Zealand.

Success Story

Sh. Subh Karan (Vill.-Ladwi, Distt.-Hisar, State- Haryana; Age: 35 years, Educational qualification: 10+2), came to contact with CIRB, Hisar two years ago. His village Ladwi is one of the adopted villages under MGMG program implemented at CIRB. During one of the visits of MGMG team, he expressed the difficulties in feeding and maintaining milk production during summer months (May-June) due to non - availability of green fodder, hence, showed his inclination towards silage making. He has six buffaloes and two cows at his farm. CIRB scientists provided technical support and demonstrated technology of silage preparation and feeding. Sh. Subh Karan keenly observed the demonstration as well as its results. Good acceptability of silage by his animals prompted him to adopt the technique. He developed silo-pit in his field and produced silage from oats, jowar, maize fodders etc. Feeding of this silage improved the feed intake of both young and lactating buffaloes. An increase in milk production was also recorded by approximately 1.5 kg/day/animal during summer months, which improved his income. He is now the leader in silage production and extending technical support to other farmers. He has also planned to sale silage to other farmers. Many farmers have also been motivated from his success.



Forthcoming Events

9th Asian Buffalo Congress (1-4 Feb., 2018)

The 9th Asian Buffalo Congress (ABC) will be held at ICAR-CIRB Hisar during 1-4th Feb, 2018 coinciding with 34th Annual Foundation Day of the Institute.

The prestigious Congress, to be jointly organized with ICAR, Asian Buffalo Association (ABA) and Indian Society for Buffalo Development (ISBD), will be held in India for the second time after 4th ABC hosted during 2003 in New Delhi.



Model Training on 'Climate Smart Buffalo Husbandry' sponsored by Department of Agriculture and Farmers' Welfare (November. 13-17, 2017)

Model Training on 'Modern Dairy Farm Management, Production, Reproduction, Health and Nutrition' sponsored by Department of Agriculture and Farmers' Welfare (October 9-13, 2017)

International collaborative training of ICAR-CIRB and ILRI on 'Traditional and Genomic Selection Tools in Livestock' (November 20-24, 2017)



<http://www.facebook.com/groups/214246328623862>



http://www.youtube.com/channel/UCLCLbQZduEsR6MM42BtUg_w



<http://www.cirb.res.in>



<http://www.buffalopedia.cirb.res.in>



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