ICAR-CIRB

भाकृअनुप - केन्द्रीय भैंस अनुसंधान संस्थान, हिसार

ICAR-Central Institute for Research on Buffaloes, Hisar

(ISO 9001:2015 certified institution for "Improved Buffalo Germplasm Production")

ICAR-CIRB NEWSLETTER

JULY - DECEMBER 2023

IN THIS ISSUE

Published by :

Dr. T.K. Datta
Director, ICAR-CIRB
Hisar - 125001

From The Director's Desk

It gives me great pleasure to present this edition of the newsletter from the ICAR-Central Institute for Research on Buffaloes, Hisar, which highlights our progress and achievements from July 2023 to December 2023. Buffaloes, particularly the Murrah breed maintained at our Institute, play a vital role in the agricultural economy of India, contributing significantly to both milk and meat production. Their resilience and adaptability make them invaluable assets to Indian farmers, and our Institute remains committed to enhancing buffalo production systems through innovative research and technological advancements.

Since its establishment in 1985, CIRB has consistently focused on multidisciplinary research aimed at improving buffalo productivity and well-being. During this period, we have initiated several new scientific endeavours aimed at deepening our understanding of buffalo biology. Noteworthy progress has been made in assisted reproduction, efficient nutrient utilization, and the development of extension technologies. Our dedicated scientists, through collaboration with other centres of excellence, have developed unique and farmer-friendly tools that have been well-received by buffalo farmers across the country.

The Murrah buffalo herd at our Hisar campus continues to set benchmarks for performance, and its germplasm is highly sought after both nationally and internationally. As we move forward, the Institute will continue to build on its strengths, expanding its research into areas that promise to further advance buffalo farming and enhance the livelihoods of farmers.

I extend my heartfelt thanks to Dr. Himanshu Pathak, Secretary of the Department of Agricultural Research and Education and Director General, ICAR, and Dr. Raghavendra Bhatta, Deputy Director General (Animal Sciences), for their continued support and guidance. I am deeply grateful to the entire CIRB team for their unwavering commitment and cooperation, which have been critical to our success.

I hope this newsletter serves as a platform to strengthen our connections with farmers, the scientific community, and development agencies, as we continue to work towards the betterment of buffalo farming in India.

Dr. TK Datta
Director, ICAR-CIRB

Research Insights

Establishment of buffalo MSTN gene-edited pregnancy using CRISPR-Cas9 ribonucleoprotein

D Kumar, M Punetha, P Kumar, RK Sharma, R Kumar, PS Yadav and TK Datta

Gene editing in livestock presents a range of promising opportunities for breeders, offering the potential to enhance desirable traits, improves animal health, and increase agricultural productivity. Unlike traditional breeding, which is time consuming in large animals, genetic alteration allows genetic traits to be introduced non-randomly in one generation. Somatic Cell Nuclear Transfer (SCNT) of gene-edited cells and zygotic electroporation are the two primary techniques presently employed for genetic modification of animals. Performing somatic cell gene editing followed by SCNT enables the screening of suitable mutant cells and guarantees that the animal carries the anticipated gene alterations or the exact allele replacements at the cellular level. Homozygous gene-edited animals can be produced by employing SCNT; however, this method is technically challenging due to its high embryonic lethality whereas direct zygotic genome alteration offers a technically simplified method for effective genome modification, which has been successfully used to target important genes, including the myostatin (MSTN) gene to increase muscle mass gain, in a variety of mammalian species. More recently, our laboratory has demonstrated an efficient method called CRISPR RNP electroporation of zygote (CRISPR-EP) for effective delivery of RNP complex into buffalo embryos without hampering their embryonic development with reduced mosaicism. However, there remains a scarcity of studies compared to the efficacy of SCNT and zygotic electroporation methods for producing gene-edited animals and their subsequent pregnancy outcomes. Therefore, we studied to delineates the methodology employed in producing MSTN-edited buffaloes and compared the processes of SCNT and zygotic electroporation, both employing the RNP approach of CRISPR.

Generation of MSTN edited embryo via SCNT and zygote electroporation

A total of 96 cloned embryos were produced by SCNT using MSTN edited fibroblasts and 279 embryos presumed to be MSTN mutated were generated *via* CRISPR-EP method. When we compared the developmental competence of both the group, the blastocyst rate was significantly ($p \leq 0.05$) higher in CRISPR-EP group as compared to SCNT. Out of 96 cloned embryos, eight blastocysts were transferred to the recipients, but none of the transferred embryos resulted in pregnancy. However, using CRISPR-EP method 21 embryos were transferred to 11 animals. A total of 3 pregnancies were diagnosed on day 30 post-estrus using ultrasound. One pregnancy was aborted unnoticed and two pregnancies continued which were aborted around 4-5 months of gestation. The genomic DNA from the aborted fetus was extracted and MSTN mutations were confirmed by Sanger sequencing (Fig.1).

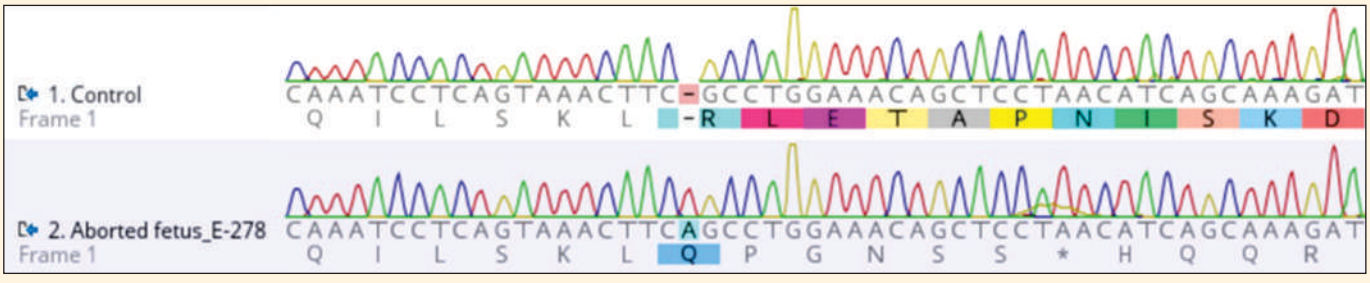


Fig. 1 Confirmation of MSTN editing via Sanger sequencing and alignment using Geneious Prime software, Version 2023.2.1

Effect of season, age, period and cryopreservation on semen quality traits in buffalo bulls

D Kumar, JS Mehta, A Jerome, P Kumar, D Kumar, S Bhardwaj, CS Patil, R Bala, N Verma, RK Sharma and P Singh

The present study was designed to evaluate the effect of season, age and period on buffalo bull semen quality traits, in addition to various sperm structural and functional traits following cryopreservation in buffalo semen. The study revealed that age and period had a significant effect on semen quality traits *viz*. volume (VOL), mass activity (MA),

concentration (SPC), post-thaw motility (PTM) and discard rate (DR). Season has effect on SPC, PTM, and DR. Likewise, year with season and age had significant effect on several semen quality traits *i.e.* VOL, MA, SPC, PTM, and DR. With respect to semen quality parameters, it was observed that no significant difference between seasons regarding seminal volume, mass activity, post-thaw motility and semen output with significant difference in sperm concentration across seasons. Sperm kinematics and motility parameters showed significant change with respect to season, stage of cryopreservation and/or both. Sperm acrosome integrity, intra-cellular calcium status, mitochondrial superoxide status and membrane potential differed with stage of cryopreservation. It was deduced that no significant difference was noticed between seminal plasma hormones. *i.e.* leptin, kisspeptin, HSP70 and testosterone as well as biochemical parameters (ascorbic acid, citric acid and total antioxidant capacity) across seasons.

Melatonin improving the quality of inferior buffalo oocytes for in vitro embryo production

N Kumari, M Punetha, P Kumar, RK Sharma, TK Datta, D Kumar and PS Yadav

In vitro maturation (IVM) of oocytes is one of the most important steps for in vitro embryo production (IVEP) either through in vitro fertilization (IVF) or somatic cell nuclear transfer (SCNT). The success of SCNT is intricately tied to factors such as oocyte quality, epigenetic reprogramming, and culture conditions. A critical stage of IVM is the selection of oocytes which is based on the presence of cumulus cell layers. Several reports suggested that 30-40 % of cattle and buffalo cumulus-oocyte complexes (COCs) collected from slaughterhouse ovaries were classified as C or D grade which is usually discarded as they are considered as inferior oocytes. Melatonin (N-acetyl-5-methoxytryptamine), a potent free radical scavenger and naturally-occurring antioxidant, has emerged as a candidate for enhancing oocyte quality and subsequent cloned embryo development. Therefore, we investigated the effect of melatonin (10^{-9} M) during IVM and subsequent cloned embryo production and unravel the molecular mechanisms underpinning melatonin's effects on inferior oocytes and cloned embryos.

We examined cumulus expansion and nuclear maturation in superior and inferior oocytes supplemented with 10^{-9} M melatonin in IVM medium. In inferior oocytes, melatonin treatment significantly increased cumulus expansion compared to the untreated group. Melatonin also boosted GSH levels and reduced ROS production in treated oocytes. Additionally, cloned blastocysts from melatonin-treated superior oocytes had a significantly higher total cell number than those from untreated oocytes. The apoptotic cell count in blastocysts from melatonin-treated superior oocytes was lower compared to the untreated group, while in melatonin-treated inferior oocytes; the apoptotic cell count was similar to that of untreated superior oocytes.

Melatonin supplementation with superior and inferior quality oocytes, the relative mRNA levels of genes related to oocyte maturation (BMP15, GDF9, ATPase6, ATPase8), apoptosis (Caspase 3, Caspase 9, BAX), and antioxidant (GPX, SOD) were evaluated using qPCR. Melatonin supplementation in IVM media significantly ($P<0.05$) increased the expression of BMP15, GDF9, ATPase6 and ATPase8 in treated groups as compared to non-treated groups (Fig. 2). In conclusion, the findings of this study indicate that the melatonin supplementation has a substantial positive impact on the maturation of inferior oocytes. This is achieved by mitigating oxidative stress. Furthermore, the administration of melatonin has been observed to augment the overall cell count and improve the rates of blastocyst formation in cloned embryos obtained from inferior oocytes.

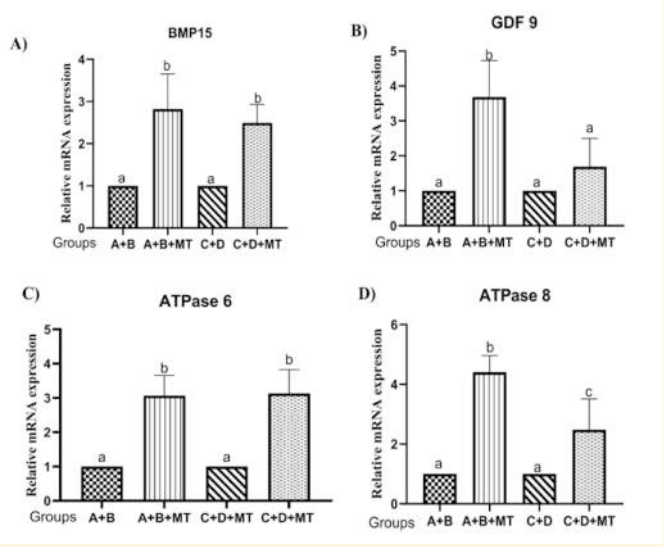


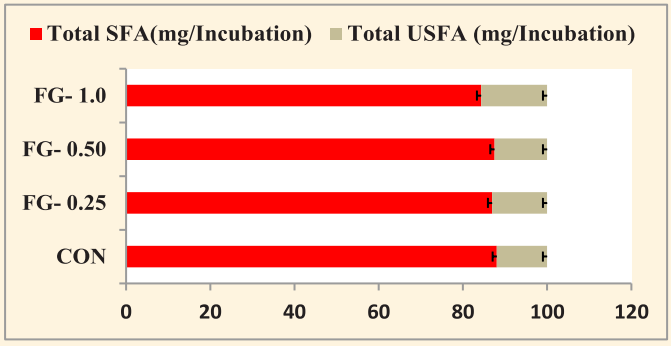
Fig. 2. : Effect of melatonin on expression of genes related to oocyte maturation (BMP15, GDF9, ATPase 6 and ATPase 8 in buffalo oocytes after in vitro maturation. Statistical significance ($p < 0.05$) between groups is denoted by different superscripts.

Modulating ruminal methane release and fatty acids biohydrogenation in buffalo through *Ficus glomerata* leaf tannins

RK Singh, A Dey and PC Lailer

Enteric fermentation is one of the largest contributors of methane release to the environment from the livestock sector. Plant bioactive compounds can modulate rumen fermentation for reduced methanogenesis and fatty acids biohydrogenation. The present study investigated the effects of tannin extract from *Ficus glomerata* (FG) leaves on the rumen fermentation, methanogenesis, feed digestibility and fatty acids biohydrogenation of a total mixed ration with the aim of developing a feed supplement for enhanced livestock production and product quality with lower methane emission. The tannin extract of FG leaves in the total mixed ration was studied at four graded dose regimens (0.0 (control), 0.25 mL (FG-0.25), 0.50 mL (FG-0.50) and 1.0 mL (FG-1.0) per 60 mL of buffered rumen fluid) in three replicates for each treatment in a radio-frequency-based automatic gas production system (ANKOM-RF) at 39 °C for 24 h following the standard in vitro gas production protocol. The total gas production (mL or mL/g incubated dry matter (DM)) was gradually reduced ($p < 0.01$) at dose levels of FG-0.50 and FG-1.0; however, it remained intermediary and comparable ($p > 0.05$) for FG-0.25 with the control and FG-0.50. Compared to the control, the methane concentration (%) in the head space gas, as well as the total methane production (mL or mL/g DM incubated, or mL/g DM digested), were found to be gradually reduced ($p < 0.01$) with increasing doses (0.25–1.0 mL) of FG extract. The reduced ($p < 0.05$) feed degradability at higher levels (0.50–1.0 mL) of FG extract supplementation and the comparative ($p > 0.05$) effects with the control at a lower level of supplementation (FG-0.25) are suggestive of the dose-responsive detrimental effects of tannins on fibrolytic microbes in the rumen.

Effects of the FG leaves extract supplementations with mixed feed on rumen fatty acids biohydrogenation



CON, FG- 0.25, FG- 0.50 and FG- 1.0 are treatment groups @ 0.0, 0.25, 0.50 and 1.0ml of FG leaves extract/60ml of buffered rumen fluid (BRF), respectively.

However, the ammonia concentration decreased ($p < 0.05$) in all of the incubations compared to the control. Among the volatile fatty acids, acetate remained comparable ($p > 0.05$) with enhanced ($p < 0.05$) propionate at a lower dose (FG-0.25); however, a dose-dependent reduction was evident at higher dose levels (FG-0.50 and FG-1.0). The production of stearic acid (C18:0), which is a product of the rumen biohydrogenation process, was reduced ($p < 0.05$), irrespective of the concentration of the FG extract. Compared to the control, the concentration of *t*-vaccenic acid (C18:1), which is a precursor of conjugated linoleic acid (CLA) in animal products, was increased in all the FG-extract-supplemented groups. It may be concluded that *Ficus glomerata* leaf tannins can modulate rumen fermentation for reduced methanogenesis and fatty acid biohydrogenation in a total mixed ration.

From field to screen : How MOOCs are transforming agricultural training for farmers?

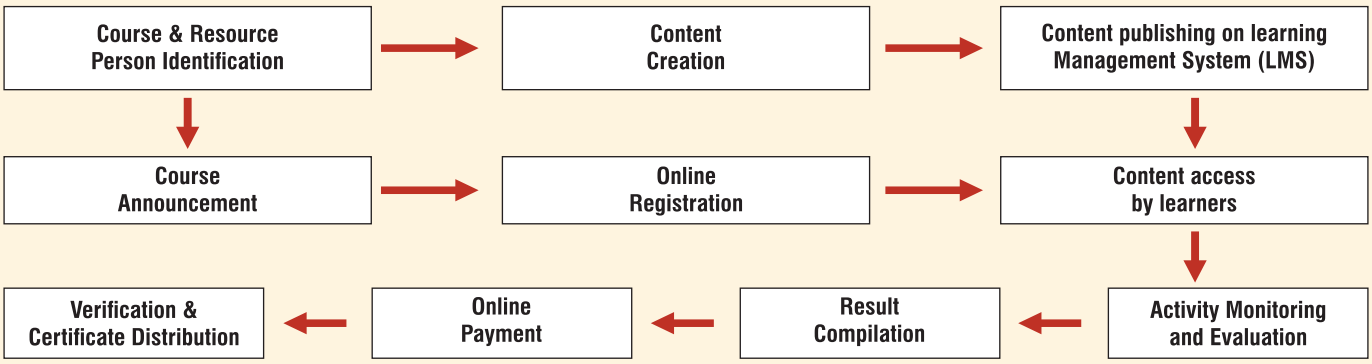
S Aiswarya, TK Datta, N Saxena, P Kumar, M Gururaj and S Chhhottaray

Agricultural training has undergone significant transformation over the years, evolving from traditional, in-person workshops to increasingly sophisticated digital formats. Historically, farmers relied on physical workshops for their training, which often involved travel and limited access to information. These methods, while effective, had inherent limitations in terms of reach and scalability. With advancements in technology, the landscape of agricultural training has expanded to include online learning platforms, among which Massive Open Online Courses (MOOCs) have emerged as a particularly influential tool. MOOCs are online educational platforms designed to offer high-quality learning experiences to a vast number of participants simultaneously. These courses, typically offered by universities, research institutions, or specialized organizations, provide content on a wide range of subjects.

Advantages	Disadvantages
Broad reach	Digital divide
Flexibility	Limited hands-on training
Cost-effective	Engagement issues
Certification	Technical challenges
Variety of courses	Self-motivation required
Up-to-date content	Language barriers
Scalability	Quality variability
Community building	Lack of local context

Several measures can be implemented to strengthen the impact of MOOCs for farmers' training. First, enhancing digital infrastructure and providing affordable internet access in rural areas are crucial steps to ensure that more farmers can benefit from online courses. Additionally, incorporating interactive elements such as virtual field trips, videos, practical simulations, and forums for peer interaction can help bridge the gap between theory and practice. While challenges remain, particularly regarding digital access and practical application, targeted efforts to address these issues can further enhance the effectiveness of MOOCs and their role in supporting farmers' education and development.

ICAR-CIRB has launched a new project titled "Creating a Comprehensive MOOC: Mastering Scientific Buffalo Management Practices for Sustainable Agriculture." The project aims to develop a thorough curriculum that covers all facets of buffalo husbandry, including feeding, breeding, health, economics, reproduction etc. An integral part of this project is to assess the impact of the MOOC on learners' knowledge and attitudes towards these scientific management practices. The project seeks to enhance understanding and implementation of best practices in buffalo management by providing a detailed and expansive learning platform contributing to more sustainable agricultural practices.



Process Flow Diagram of MOOCS

Dairy farmer's perception towards buffalo breeds in Amritsar & Gurdapsur districts of Punjab

N Saxena, M Gururaj, FC Tuteja and S Aiswarya

Agriculture dominates both the landscape and economy of Punjab. The state is endowed with natural resources and productive livestock breeds, particularly buffaloes, which support the livestock-cropping system in a well-managed way. In 2020-21, Punjab produced 13.31 million tonnes of milk, with buffaloes contributing about 57% of the total, followed by crossbred and indigenous cows. Despite their significant contribution, the buffalo population in the state declined by 22.16% between 2012 and 2019, with the highest decline reported in the Nili-Ravi buffalo breed, which is native to Punjab. The breeding tract of the Nili-Ravi buffalo is found in the districts of Firozpur, Amritsar, Tarn Taran, and Gurdaspur. The decline in the Nili-Ravi buffalo population is concerning. Therefore, a research study was planned to investigate the reasons for and dairy farmers' preferences for different breeds in the state.

Female Nili-Ravi buffaloes

Male Nili-Ravi buffalo

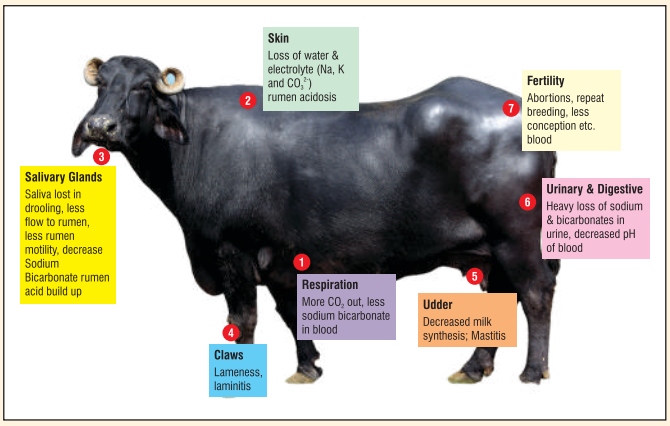
The study involved personal interviews with 60 farmers from both Gurdaspur and Amritsar districts, using a structured interview schedule. In Gurdaspur, farmers showed a preference for Murrah buffaloes for milk production due to the availability of quality Murrah buffaloes, availability of Murrah buffalo semen doses/straws, disease resistance, and their docile nature. Farmers in Gurdaspur also reported that pure Nili-Ravi buffaloes are scarce in the district, semen doses for the breed are irregularly supplied, and there is a lack of awareness about the breed. Additionally, they noted that Nili-Ravi buffaloes are aggressive, frequently suffer from mastitis, and are less favored for these reasons. In contrast, farmers in Amritsar expressed interest in rearing Nili-Ravi buffaloes due to their higher milk production during lactation, a longer lifespan with more calves (8-10), their docile temperament (even women and children can handle them), resistance to production-related diseases, and the availability of superior-quality semen doses through government programs. According to dairy farmers, pure Nili-Ravi buffaloes have distinct characteristics mainly including a pinkish tongue, head is bulging at top & depressed between the eyes, short legs (fore-legs), walled eyes, and white markings on the forehead, muzzle, face, legs, and tail. Farmers in both districts suggested increasing the supply of pure Nili-Ravi semen and bulls to promote faster multiplication of the population.

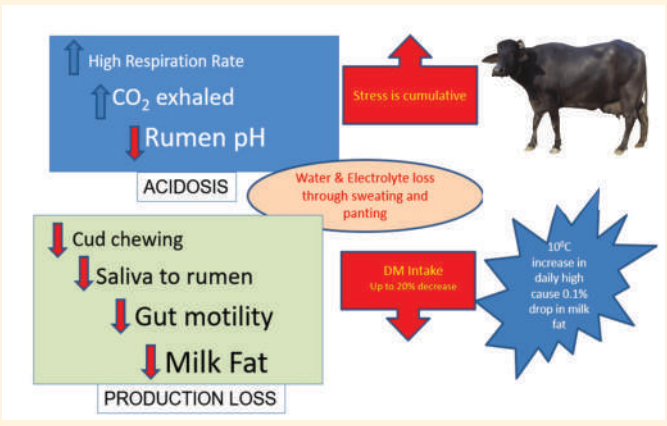
Buffalo Health & Welfare

Buffaloes and heat stress: Navigating extremes in the Indian subcontinent

AK Balhara, N Paul, A Boora, S Kumar, SK Phulia

Buffaloes, the cornerstone of India's livestock industry, thrive in extreme climates where temperature often range from 48°C in summer to as low as 2°C in winter. While buffaloes are generally well-adapted to such conditions, studies reveal that they are highly sensitive to heat stress due to their distinctive physical traits. Factors such as their black color, sparse hair, and fewer sweat glands hinder their ability to regulate body temperature effectively.





Effects of heat stress on different organs of buffaloes

Physiological and metabolic changes due to heat stress in buffaloes

Heat stress in buffaloes result in physiological changes like increased blood flow to the skin, hormonal shifts, and metabolic alterations, which collectively disrupt both production and reproduction. The redirection of blood flow from the digestive system to peripheral tissues further compromises nutrient absorption, leading to a decline in milk production. Hormonal changes, including decreased somatotropin and thyroxine levels, are buffaloes' adaptive responses to minimize heat production, contributing to lower milk yield.

Heat shock proteins (HSPs) and oxidative enzyme studies shed light on the molecular damage incurred during heat stress, providing a deeper understanding of how buffaloes cope with rising temperatures. Ongoing research continues to explore genetic responses to heat, aiming to develop strategies to enhance the resilience of buffaloes against climate change.

Buffalo grazing patterns: Why are they good for the environment?

E Hooda, S Sangwan, P Sharan, I Bala, N Verma, S Balhara, S Yadav and AK Balhara

Buffaloes, especially water buffaloes, are more than just icons of rural India – their unique grazing habits bring numerous environmental benefits that often go unnoticed. In India, where nearly 109 million buffaloes make up a staggering 56% of the world's buffalo population (as per the 20th Livestock Census), these gentle giants play a crucial role not only in agriculture but also in supporting ecosystems. Let's explore how buffalo grazing patterns contribute to a healthier environment, with a special focus on India's landscapes.

Promoting Biodiversity

Buffaloes are selective grazers. They don't munch their way through entire fields, leaving some plants untouched while they feast on others. This creates a rich tapestry of plant life, where different species thrive alongside each other. This selective grazing isn't just good for plant life, it is a defense against invasive species. When left unchecked, certain grasses can dominate, turning these rich ecosystems into monotonous monocultures.

Improving Soil Health

Buffaloes contribute to soil health by naturally aerating the soil as their hooves break compacted ground. This allows for better water infiltration and root growth. Additionally, their nutrient-rich dung, a traditional source of organic fertilizer in India, improves soil fertility by replenishing essential nutrients like nitrogen, phosphorus, and potassium. Research from the Indian Council of Agricultural Research (ICAR) reveals that buffalo dung can increase crop yields by up to 15%, a significant contribution to sustainable farming practices.

Preventing Overgrazing

Unlike some other livestock, buffaloes exhibit rotational grazing habits. Moving in herds, they graze in different areas, allowing previously grazed lands to regenerate. This natural cycle of rotation reduces the risk of overgrazing, preserving the productivity and health of India's overused grazing lands.

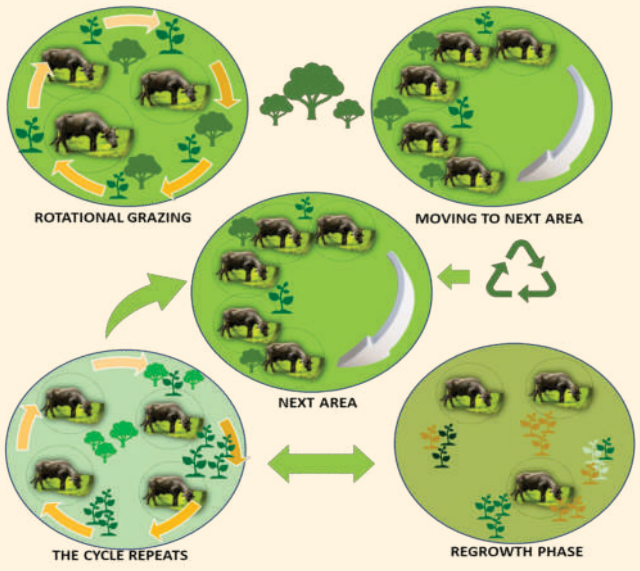
Supporting Wetlands and Water Systems

Water buffaloes, true to their name, are perfect for wetlands. By feeding on aquatic plants, they prevent overgrowth and ensure the survival of diverse species that depend on these ecosystems. In regions like the Sundarbans, Chilika Lake, and the Brahmaputra River Basin, buffaloes support the health of wetlands, which serve as crucial habitats for wildlife.

Carbon Sequestration

As buffaloes graze and encourage new plant growth, they help maintain ecosystems that absorb carbon dioxide from the atmosphere and store it in the soil – a process called *carbon sequestration*. According to a report by FAO, well-managed grazing by livestock can sequester up to 0.81 tons of carbon per hectare per year. By helping plants thrive, buffaloes indirectly contribute to capturing more carbon, making them unexpected allies in reducing the effects of climate change.

Buffaloes, often seen as symbols of rural life, are quietly working to sustain the environment. Whether by promoting plant diversity, improving soil health, supporting wetlands, or even helping fight climate change, their impact is both profound and vital. In a country like India, where buffaloes have deep cultural and economic significance, understanding their environmental contributions only strengthens our appreciation of these remarkable animals.

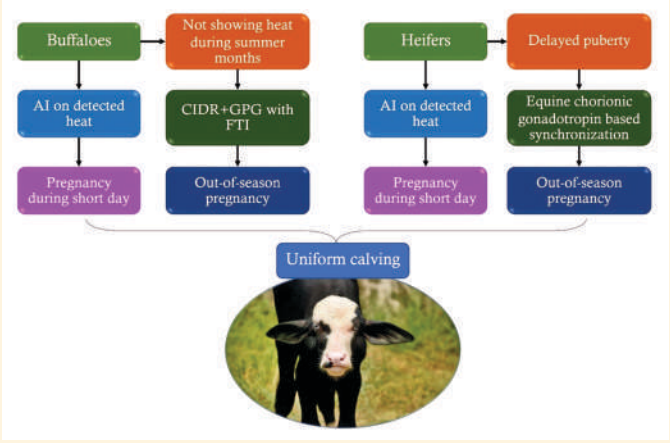


Uniform calving rate in buffaloes throughout the year: A practical approach

N Paul, MH Jan, A. Bhaladhare and AS Habbu

Uniform calving pattern in a well-established buffalo farm is still a challenge in tropical countries due to i) excess heat and humidity stress, ii) poor visualization of overt signs of estrus (poor sign of estrous) iii) lesser feed intake and iv) higher incidence of pregnancy loss. Like sheep, buffaloes are also considered as a 'short day' species. Estrous cycle in buffaloes continues throughout the year but higher fertility is observed when daylight hour decreases. As a result, the

percentage of animals in milk goes down and the production record decreases from June to September. One of the ideal solutions would be accurate heat detection during summer months by using advanced heat detection methods or by using vasectomized bull parade every evening. The animals identified in heat are thus subjected to artificial insemination in next morning by following AM-PM rule. Another aspect of obtaining calving throughout the year is to provide comfortable microenvironment to pregnant animals by mitigating thermal stress (wallowing twice a day and provision of automated cold-water sprinkler or fogger; this helps maintain lower temperature inside pregnant animal shed). One more practical aspect of achieving uniform calving pattern is synchronizing the eligible animals from July to September each year. However, those animals' reproductive tract and ovary should be checked by ultrasonography before estrus synchronization. For adult buffaloes, CIDR+ GPG protocol followed by fixed time insemination (FTI) and heifers equine chorionic gonadotropin-based protocols are effective in synchronizing estrous and ovulation. Veterinarians should make decisions regarding animal selection for estrous synchronization programs. This 'out-of-season' synchronization cum insemination technique can thus achieve higher success in conception following AI.



Sectorial Growth

राष्ट्रीय दूध दिवस : पोषण और श्वेत क्रांति के जनक का स्मरण

सुनेश बल्हारा, गुरप्रीत व सज्जन सिंह

हर साल 26 नवम्बर को, 2014 से, राष्ट्रीय दूध दिवस मनाया जाता है। यह दिन डॉ. वर्गीज कुरियन की जयंती का सम्मान करने लिए मनाया जाता है, जिन्हें ''भारत के मिल्कमैन'' और श्वेत क्रांति के जनक के रूप में जाना जाता है। इस दिवस को मनाने का मुख्य उद्देश्य लोगों को दूध के महत्व और उसकी आवश्यकता के प्रति जागरूक करना है।

दूध वह पहला आहार है जिसे एक शिशु जन्म के तरंत बाद ग्रहण करता है ओर जीवनभर किसी न किसी रूप में इसका सेवन किया जाता है। यह मानव जीवन के लिए पोषण का एक अनिवार्य स्रोत है, जो शरीरिक विकास और स्वास्थ्य को बनाए रखने में महत्वपूर्ण भूमिका निभाता है।

डॉ. वर्गीज कुरियन को 'भारत में श्वेत क्रांति के जनक' के रूप में जाना जाता है। वह एक दूरदर्शी सामाजिक उद्यमी थे जिन्होंने 'ऑपरेशन फ्लड' का नेतृत्व किया, जिसे विश्व का सबसे बड़ा डेयरी विकास कार्यक्रम माना जाता है। इस अभियान ने भारत को एक दूध-अभावी देश से दुनिया का सबसे बड़ा दुग्ध उत्पादक देश बना दिया। श्वेत क्रांति ने भारत में प्रति व्यक्ति दूध की उपलबधता को दोगुना कर दिया ओर कुल दूध उत्पादन को लगभग 30 वर्षों में चार गुना बढ़ा दिया।

दूध केवल एक प्राकृतिक आहार नहीं है, बल्कि इसमें कई महत्वपूर्ण पोषक तत्व भी होते हैं। यह ऊर्जा का पाँचवा सबसे बड़ा स्रोत और प्रोटीन और वसा का तीसरा सबसे बड़ा स्रोत है। दूध कैल्शियम, मैग्नीशियम, जिंक, फॉस्फोरस, आयोडीन, आयरन, पोटेशियम, फोलेट्स, विटामिन ए, विटामिन डी, राइबोफ्लेविन, विटामिन बी 12, प्रोटीन और वसा जैसे कइ आवश्यक पोषक तत्वों से भरपूर होता है। ये पोषक तत्व बच्चों की हड्डियों को मजबूत बनाने और उनके समग्र स्वास्थ्य को बनाए रखने में मदद करते हैं। विशेष रूप से गर्भवती महिलाओं और बच्चों के लिए, दूध कुपोषण को कम करने और स्वास्थ्य में सुधार करने में सहायक होता है।

राष्ट्रीय दूध दिवस न केवल दूध के महत्व को पहचानने का दिन है, बल्कि यह डॉ. कुरियन द्वारा भारत को आत्मनिर्भर बनाने के लिए किए गए प्रयासों को भी सम्मानित करने का अवसर है। उनके नेतृत्व में भारत ने न केवल दूध उत्पादन में आत्मनिर्भरता हासिल की, बल्कि लाखों किसानों को सशक्त किया और देश के पोषण और आर्थिक स्थिरता में योगदान दिया।

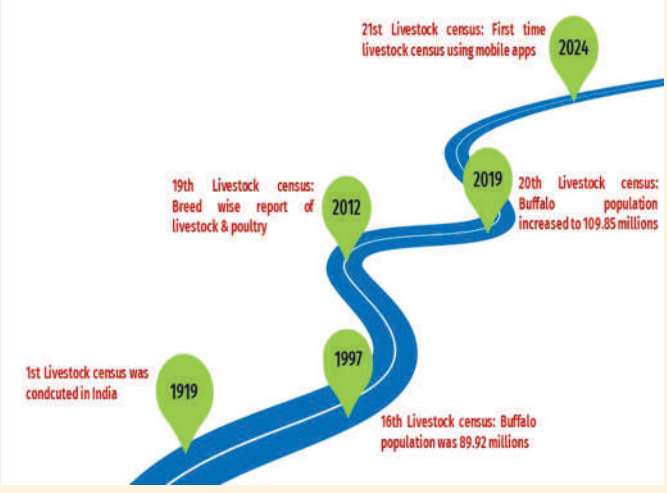
Glimpses of livestock censuses in India

M Gururaj, S Aiswarya, AK Balhara and V Kumar

The Livestock Census refers to a complete count of the livestock population and poultry at a pre-defined reference point in time. In India, the first livestock census was conducted in 1919. Since then, the livestock census has been conducted every five years. It includes cattle, buffaloes, sheep, goats, pigs, mithuns, yaks, horses & ponies, mules, donkeys, camels, and poultry birds (both backyard and commercial). The census is conducted under the supervision and guidance of the Animal Husbandry Statistics (AHS) Division of the Department of Animal Husbandry & Dairying (DAHD), Government of India. The most recent, i.e., the 20th livestock census, was conducted in 2019. The trend in the livestock population over the last five censuses is provided in Table 1. A positive change of 13.79 percent was reported in the livestock population (excluding poultry) over the last five censuses, while the poultry bird population witnessed a significant positive change of 145.05 percent during the same period.

Table 1: Trends in last five livestock censuses (16 to 20 censuses)

Census number & year	Cattle (in million)	Buffalo (in million)	Other livestock (in million)	Total (in million)	Change (%)	Poultry (in million)	Change (%)
16th LC & 1997	198.88	89.92	196.59	485.39	3.09	347.61	13.20
17th LC & 2003	185.18	97.92	201.90	485.00	-0.08	489.01	40.68
18th LC & 2007	199.08	105.34	225.28	529.70	9.22	648.83	32.68
19th LC & 2012	190.90	108.70	212.46	512.06	-3.33	729.21	12.39
20th LC & 2019	192.49	109.85	233.44	535.78	4.63	851.81	16.81



How the Livestock Census is Conducted : The census involves collecting breed-wise data on animals and poultry, including their age and sex composition for various species, using schedules (Schedule I to IV B). Enumerators are trained for data collection. The details of the different schedules are outlined below:

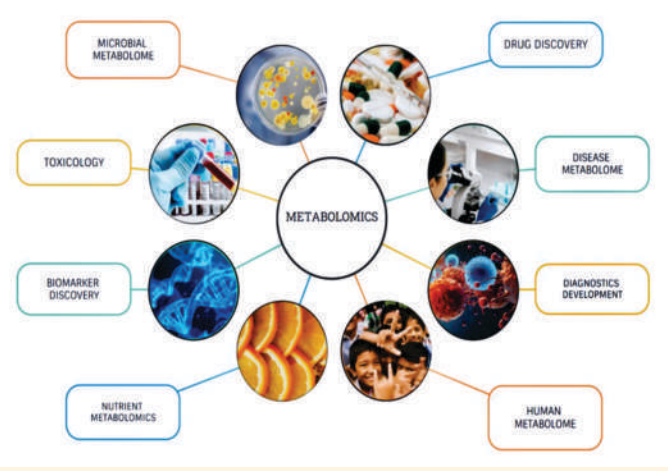
- **Schedule I**: Records the list of households, household enterprises, and non-household enterprises engaged in livestock, poultry rearing, and fishery-related activities within the enumerated area.
- **Schedule II**: Covers all entities in the villages/wards, regardless of their association with livestock, poultry, or fishery sectors.
- **Schedule III**: Collects breed-wise information on livestock forvarious species, including age, sex, and utility.
  - **Schedule IIIA**: For households and household enterprises.
  - **Schedule IIIB**: For non-household enterprises and institutions.
- **Schedule IV**: Designed to capture data related to fishery activities.
  - **Schedule IV A**: For households and household enterprises.
  - **Schedule IV B**: For non-household enterprises and institutions.

The livestock census provides vital information about the population growth of livestock and poultry, the reasons for population increase or decline, sectorial growth, and opens new avenues for planning and research.

Advancement of metabolomics in veterinary research

S Sangwan, E Hooda, G Kaur, R Choudhary, I Bala, P Sharan, S Balhara, SK Phulia and AK Balhara

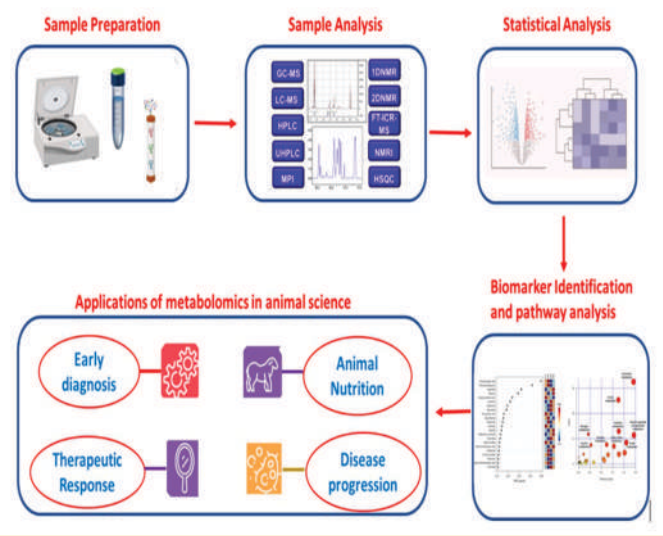
Application of metabolomics has been found in various fields of science, including plant sciences, toxicology, environmental analysis, clinical diagnostics, food sciences, gene function and organism genotypes. However, despite the potential of this new era of technology examples of the metabolomics in veterinary research are very rare. The purpose of this article is to summarize current status of animal metabolomics and to propose the emerging future aspects in animal health assessment, nutrition, disease diagnosis, reproduction status and growth potential. Metabolomics is an emerging branch of "omics" that is defined as the global analysis of small molecules (metabolites) which includes identification, characterization and quantification in a biological specimen such as a cell, tissue, biofluid, an organ or an organism at a specific point of time under given genetic and environmental conditions. The basis of disease diagnosis may span from visual symptoms to the extraction of minute details of organs, tissues and sub-cellular machineries through the employment of state-of-the-art diagnostic platforms. Irrespective of the diagnostic tools used, the aberrations in the biological system must be recorded in an interpretable manner to identify the deviations.



Application of metabolomics in multiple fields

Application of Metabolomics in Veterinary/Animal Sciences :

Current metabolomics approaches analyse hundreds to thousands of metabolites in biological fluids or tissues to diagnose complex metabolic and other systemic diseases. Besides endogenous metabolites, there are also exogenous metabolites derived from the metabolism of environmental molecules, xenobiotics, therapeutic agents and metabolites generated due to interaction of host and gut microbiome. Advancements in science and technology have made metabolomics a robust tool in potential biomarker discovery, investigating metabolic processes, gene-function analysis, systems biology, improvement in treatment regimen and development of diagnostic platforms. Moreover, metabolomics has the potential to link environmental and host factors for better understanding the pathogenesis of many diseases, along with identifying the therapeutic checkpoints to develop a broadly specific treatment regimen for multiple infectious agents. It can even assist in drug repurposing by identifying the common host metabolic pathways exploited by similar types of pathogens to combat sudden disease outbreak.



A workflow of metabolomics showing the progressive steps involved in study of metabolome

Future prospectus :

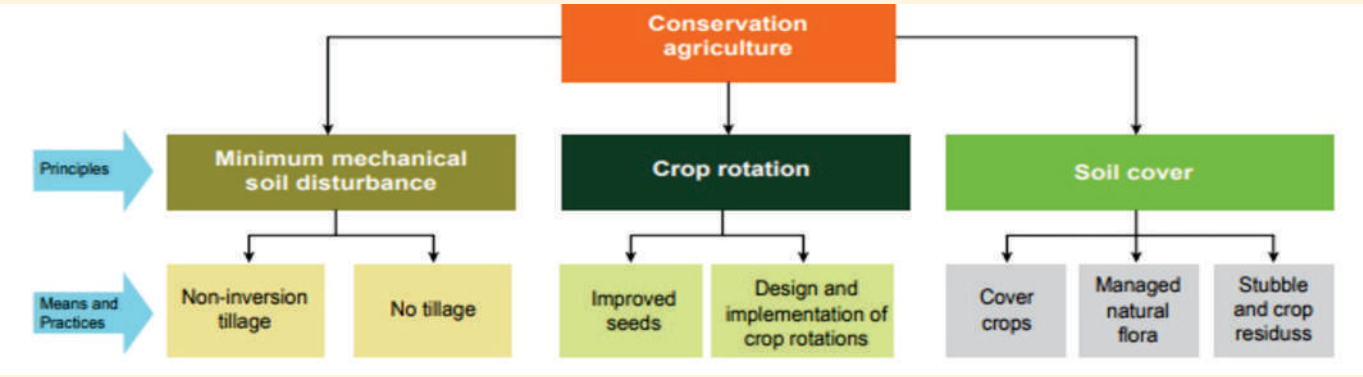
Exploring new and possible biomarkers for disease diagnosis using metabolomics techniques is opening up many exciting possibilities in the realm of animal health. The understanding of biomarker discovery, disease process, diagnosis, and treatment has increased over the past ten years as a result of considerable uses of metabolomics platforms. For the achievement of successful lab-to-land transition as strong and reliable early and specific detection, it will soon be a must to confirm the possible biomarkers in bigger populations with detailed examination of their limits.

Technology intervention

Conservation agriculture practices for fodder production in context to buffalo farming

SK Kakraliya, S Yadav, A Boora, FC Tuteja and AK Balhara

Conservation Agriculture (CA) offers significant potential for improving fodder production in buffalo farming in India, especially in regions where Rice-Wheat (RW) cropping systems are prevalent, such as the Indo-Gangetic Plains. Traditionally, rice is transplanted into puddled soils and wheat is sown after intensive tillage, but this approach has led to increased production costs, soil degradation, stagnation of yields, depletion of natural resources and significant environmental externalities. The efficiency and sustainability of a production system depends on system-based management optimization of crop yields, economic benefits, and environmental impacts. Conservation Agriculture (CA) being practiced globally under different production systems and ecologies has been shown to be a management strategy to address the emerging challenges of natural resource degradation, energy, water and labour shortages and climate change effects. Conservation Agriculture, characterized by minimal soil disturbance (no-till), maintaining crop residues on the soil surface and the introduction of more diversified and economically viable crop rotations, can help address these challenges.



The three principles of conservation agriculture and the main practices and means needed to achieve each principle

Important CA- based fodder cropping systems:

These CA-based systems enable effective management of crop residues, integration of legumes, and proper crop rotations, therefore, CA should be promoted to ensure year-round quality fodder production for buffaloes, enhance food and feed security, restore soil health, mitigate climate change, and contribute to achieving the Sustainable Development Goals (SDGs).

In the context of buffalo farming, integrating CA practices into fodder production systems can improve soil health, increase water retention, and enhance productivity, ensuring a more sustainable supply of high-quality fodder. Furthermore, CA practices can increase resilience against unpredictable weather events, ensuring year-round availability of feed for buffaloes while reducing the environmental carbon footprint of farming. This is particularly crucial as buffaloes play a central role in India's dairy and meat industries, and ensuring their access to nutritious fodder is key to maximizing productivity and sustainability.

Resource conservation agriculture practices for fodder production:

Zero Tillage: Eliminates the need for soil tillage, saving on field preparation costs, increasing soil health, and reducing biotic and abiotic stress

Demonstration of CA based fodder maize in the field

Raised Bed Planting : Helps save water, reduces flooding risks, and supports crop diversification by improving soil conditions.

Demonstration of sowing of maize through Raised Bed Planting method

Residue Management : Mulching with crop residues improves soil health and water retention, and tools like Turbo Happy Seeder allow direct planting without tillage.

Demonstration of rice residue management through happy seeder machine

Crop Diversification : Reduces climate risk by avoiding dependence on a single crop and enriches soil with organic matter, especially through legume rotation.

Demonstration of CA maize and rice in field

Water Management : (laser land leveller, furrow irrigation, drip irrigation, alternate wetting and drying), reduces water use and methane emissions, improving sustainability.

Land levelling through laser land leveller in field

Precision Nutrient Management : Optimizes fertilizer use by using sensor based nutrient management tools, improving crop productivity, reducing emissions, and boosting farm profitability.

Nitrogen management through green seeker

Production Performance

Animal farm

Institute maintains a high pedigree herd of over 500 Murrah and Nili-Ravi buffaloes at Hisar and Nabha, respectively. During the period (July to December, 2023), a total of 173357.05 kg of milk was produced with a wet average of 10.55 kg per buffalo per day and herd average of 6.99 kg per buffalo per day from Murrah at Hisar. Similarly, at Nabha campus, a total of 135866.60 kg of milk produced from Nili-Ravi breed with 7.93 and 5.01 kg per buffalo per day of wet and herd average of milk, respectively.

Agricultural farm

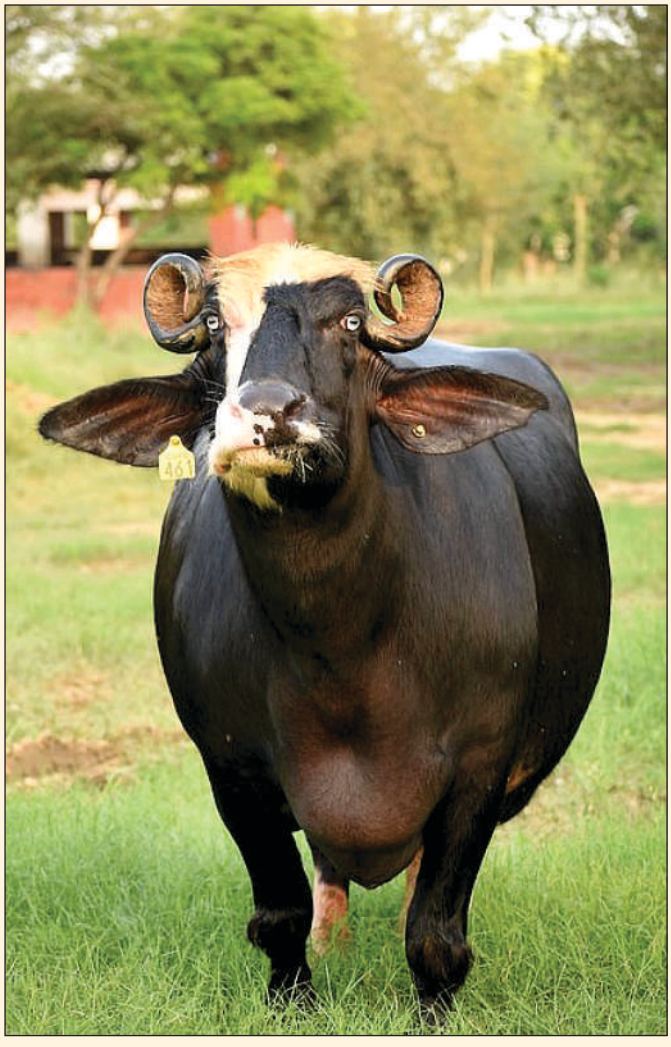
Institute at main campus Hisar has a total of approximately 780 acres of land, in which about 50% is arable and under fodder cultivation. During the year 2023-24, a total 480 acres was under fodder production. During the year, a total of 1392.8 quintals of grains were produced in which 1133.30 , 190 and 69.50 quintals of wheat, barley and oat, respectively were produced. In the same period, a total of 1217.40 quintals of wheat straw was also produced. During the July to December, 2023, at Hisar a total of 21214.10 quintals of green fodder were produced.

Breeds in focus

Unlocking dairy potential: Advancing Nili-Ravi buffaloes through sire selection

S Chhotaray, A Bhaladhare and N Paul

The name Nili is supposedly derived from the blue water of river Sutlej. Ravi buffaloes are mostly bred in Pakistan around the river Ravi, after which they are named. During 1960's, they were grouped into one breed as Nili-Ravi probably due to shared physical characters. These buffaloes are found in Fazilka, Ferozepur, Zira and Makhu tehsils of Ferozepur district; and Patti and Khemkaran tehsils of Amritsar district in Pujab. Nili-Ravi buffaloes are generally of black colour with walled eyes and white markings on forehead, face, muzzle, legs and tail. The most desired character of female is the possession of these white markings knowns as "Panch Kalyani". Horns are tightly curved, circular in cross-section, and small in size but when compared to Murrah, Nili-Ravi buffalo has large horn size and circumference. The forehead of Nili-Ravi is slightly convex in appearance. Production performance is similar to Murrah buffaloes. ICAR-CIRB's sub-campus Nabha is a dedicated Nili-Ravi unit where scientific and systematic breeding and genetic selection is practised. The sires are tested based on their progeny records and are evaluated based on the contemporary daughter average. Selection of the best sire is the key to success of any breeding program. This systematic selection has shown enormous impact in the improvement of milk yield in Nili-Ravi buffaloes. The 305 days' milk yield in the year 2001-02 was ~1885 kg which improved to 2624 kg in the year 2022-23. Dissemination of such improved germplasm to the Nili-Ravi farmers can boost the dairy industry significantly.



Dharwadi buffalo: A resilient breed shaping Karnataka's dairy economy

S Aiswarya, AK Balhara, S Chhotaray and Gururaj M

The Dharwadi buffalo, predominantly found in the northern districts of Karnataka, including Bagalkot, Belgaum, Dharwad, Gadag, and others, stands out for its adaptability and distinctive characteristics. This medium-sized breed thrives in low rainfall regions, playing a crucial role in the local dairy industry, particularly in the communities that rely on it for their livelihood.

Traditionally bred by the Gavali/Gowli community, which has deep roots in dairy farming, the Dharwadi buffalo has recently gained recognition as the 18th registered buffalo breed in India, with the accession number: INDIA_BUFFALO_0800 _DHARWADI_01018. Its strong black coat, straight head, and semi-circular horns that almost touch the withers give it a unique look, while its medium-sized udder and cylindrical teats make it an efficient milking animal.

Economically, the Dharwadi buffalo significantly contributes to the dairy industry. With an average lactation yield of 972 litres and daily milk production ranging from 1.5 to 8.7 litres, the breed provides high-quality milk with an average fat content of 6.9%. This high-fat milk is ideal for traditional dairy

products, such as the famed Dharwad Peda, which has been awarded a Geographical Indication (GI) tag.

The breed's resilience and adaptability to arid conditions make it a sustainable option for farmers in drought-prone regions, offering a stable source of income and nutrition. Its contribution to local dairy production not only supports regional economies but also preserves cultural traditions, reinforcing the vital role of indigenous breeds in India's agricultural landscape.

Gojri buffalo : A keystone species in the Himalayan ecosystem

S Aiswarya, S Chhotaray, S Balhara and Promila

The Gojri buffalo, native to the northern Himalayan region, particularly Himachal Pradesh and parts of Punjab, plays a pivotal role in the socioeconomic fabric of the region. Renowned for its adaptability to the hilly terrain, this hardy breed is valued by the Gujjar community for both milk production and its strength as a draught animal.

Physically, the Gojri buffalo stands out with a strong build, straight forehead, and medium to large ears. Its coat color ranges from black to brown, often with unique white markings, including a white tail tip and spots on the forehead. Calves are born with a lighter coat, which gradually darkens with age, a distinctive feature of the breed.

The breed's adaptability extends to surviving in the varied climates of Himachal Pradesh, where temperatures can soar to 40°C in summer and drop below freezing in winter. These buffaloes thrive on rough pastures, showcasing their resilience in challenging environments.

In terms of milk production, Gojri buffaloes are impressive, yielding between 3 and 8 kg of milk per day, with peak yields reaching up to 10 kg. The lactation period ranges between 250 and 305 days, contributing to a total lactation yield of 800 to 1000 liters over 305 days. Their milk is rich in nutrients, with a fat content of 6.5%, along with 4.5% lactose, 3.5% protein, and 9% solid non-fat (SNF). This superior milk quality ensures that Gojri buffaloes remain a sustainable choice for dairy farming in their native regions.

Recently recognized as India's 17th buffalo breed, with the accession number INDIA_BUFFALO_1606_GOJRI_ 01017, the Gojri buffalo is not only integral to the traditional livelihoods of the Himalayan communities but also offers promising potential for further development in sustainable dairy farming.

Events at CIRB

IRC meeting held on 20-21 July 2023

Independence Day celebration at the Institute

Know your mind : A collaborative program with Art of Living & CIRB

Celebrating Hindi Saptah during 15th to 22nd September 2023

Celebrating Hindi Saptah during 15th to 22nd September 2023

ICAR-CIRB handed over Murrah buffalo bulls to Govt. of Nepal on 6-8 November 2023

Vigilance Awareness Week Celebration 30 October to 5 November 2023

NPBI meeting under Chairmanship of DDG (AS) Dr. K Jena held on 12 December 2023

CIRB among farmers

CIRB organises extension activities mainly under SCSP scheme, TSP scheme, MGMG program and aspirational district program to uplift the socio-economic status of the resource poor farmers. During this period, the institute has organised a total of 6 training programs on scientific buffalo husbandry practices at Hisar and Nabha campus. About 239 farmers were participated, and of which approximately 67.78% are women. The institute also participated in pashu/kisan mela and other programs to exhibit technologies developed by the institute.

Dairy farmers training program at Kalarpuri (V), Nuh (D), Haryana (16-18 Oct, 2023)

Training on scientific buffalo management at the institute (25-31 Oct 2023)

Trainees taking oath during vigilance awareness week (31 Oct 2023)

Training program for women dairy farmers in aspirational district of Haryana (28-30 Nov 2023)

Training cum Kisan Gosthi with farmers in Nuh (D), Haryana (6-8 Dec 2023)

ICAR-CIRB technology exhibition at Fatehpur (V), Nuh (D), Haryana (07 Dec 2023)

भाकृअनुप ICAR

ICAR - Central Institute for Research on Buffaloes

Sirsa Road, Hisar – 125 001 (Haryana) India

01662-281601, 281602 director.cirb@icar.gov.in