



MITHUN DIGEST

मिथून डाइजेस्ट



Vol. 15 No. 2

ICAR - NATIONAL RESEARCH CENTRE ON MITHUN

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ISO 9001:2015 Certified ICAR Institution

The bi-annual panorama.....



Director's Desk



Mithun is a stocky and semi-domesticated animal with a unique triangular forehead having striking thick horns. The massive ridge on the back, white stocking on the legs, rippling muscles, and satiny skin are the characteristics, there is nothing else quite like it in the world of cattle. These animals play a central role in the cuisine, religion, and socio-economy of the North-Eastern Hill region of India. Presently mithun is primarily reared for meat however; the high-quality milk opens up an avenue for producing value-added milk products. Further more, leather obtained from this species is far more superior to cattle, and draught power can be used in hilly terrains. The potential of this animal can only be exploited by incorporating scientific animal husbandry as an entrepreneurial activity to the presently practiced traditional mithun rearing under a free-range forest ecosystem.

During this period, under Tribal Sub-Plan (TSP) inputs have been distributed for the benefit of farmers. We have organized various programmes *viz.* establishment of semi-intensive units, animal health cum vaccination camps, farmers' training, and workshops benefitting 221 farmers. The development of 'Mithun-Mitra' app has immensely helped mithun rearing farmers in day to day life. KVK Phek is upfront in technology dissemination

and organized 35 training programmes benefitting 827 farmers, 137 extension activities benefitting 1209 farmers, 2 vocational training, 2 sponsored training including several OFT and FLD.

Various training programmes were conducted to impart new skills and knowledge among students, faculties, and other professionals across the state. Under DBT-Sponsored Biotech Hub, students and faculties of various educational institutes were given a hands-on training programme on "Spreading Biotechnology Awareness among Science Graduates in the NEH Region" and "Biotech Awareness and Advanced Biotechniques for Analysis of Molecular Genetics Data".

The Institute has joined hands with the Central Agricultural University, Imphal and its constituent colleges such as Colleges of Veterinary Sciences & Animal

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Husbandry, Jalukie, Nagaland; Colleges of Veterinary Sciences & Animal Husbandry, Selesih, Mizoram, and College of Horticulture & Forestry, Pasighat, Arunachal Pradesh has been part of awareness campaign led by ICAR-NRC on Mithun. The Institute is highly indebted to the various visiting dignitaries and academicians for their encouragement, candid suggestions, and valuable inputs.

I take this opportunity to congratulate all the staff of the Institutes for their commitment, hard work, and dedication to achieve our target to conserve, improve, and propagate this magnificent species, Mithun.

Jai Hind!



(Abhijit Mitra)

Union Minister Shri Giriraj Singh's Visit

Hon'ble Shri Giriraj Singh, Union Minister of Fisheries, Animal Husbandry and Dairying on his maiden visit to Nagaland visited ICAR-NRC on Mithun on 09.11.2019. He was accompanied by Shri R. Khing, Hon'ble Advisor, Dept. of AH & Veterinary Services and Women Resource Development, Govt. of Nagaland and Shri L. Khumo, Advisor, Dept. of Fisheries. Dr. J. K. Jena, Deputy Director General (DDG), Fisheries & Animal Sciences also graced this occasion.

Speaking during inaugural programme at ICAR-NRC on Mithun, Shri Giriraj Singh described the mithun as unique social animal which may play a pivotal role in the economic development of mithun rearing states and also to generate employment to educated unemployed youths.

He emphasized on semi-intensive rearing of mithun which not only provides meat but also a good source of milk and dung, and stressed to open a sale outlet where packaged mithun milk can be sold. Shri Giriraj Singh also interacted with the KVK officials and demonstrated how to prepare vermicompost using soil, decomposed material of moringa and banana leaves, dried mithun dung and earthworm. This integrated system comprising of mithun-poultry bird and vermicompost model he stressed, not only will provide good source of protein feed to the poultry but also will help in domestication of mithun and improving livelihood security to the farmers economy.

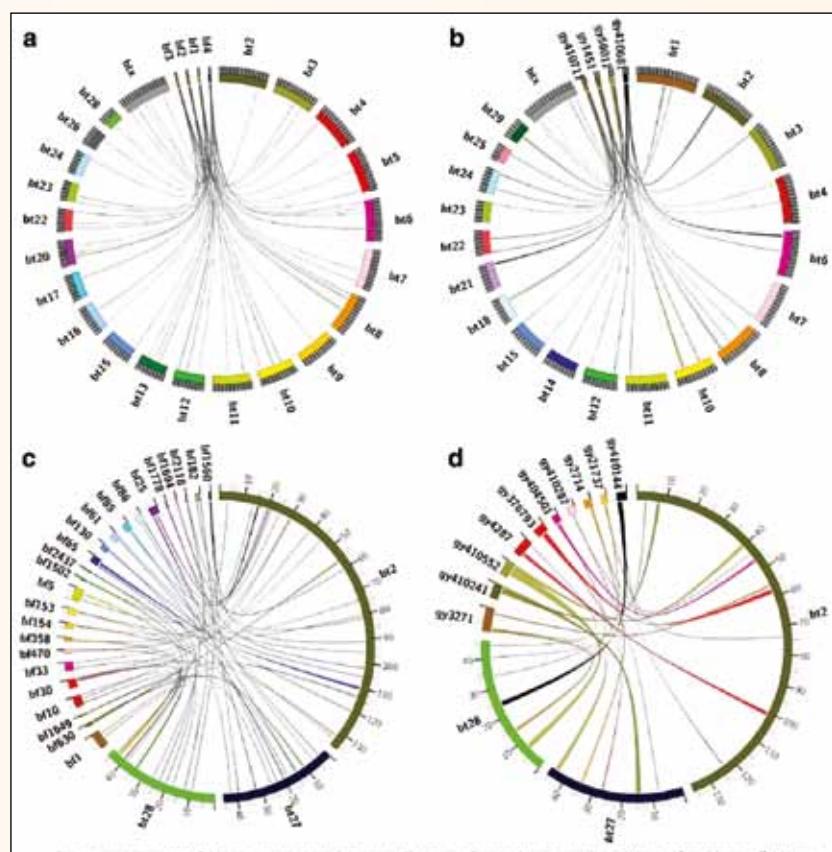




RESEARCH ACHIEVEMENTS

Mapping of Indian mithun genome

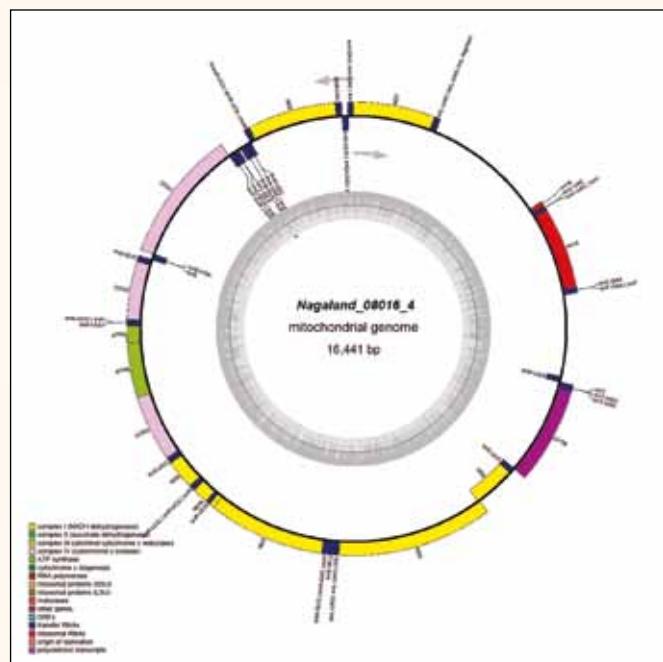
The Scientists generated 250 Gigabyte (GB) high quality reads from whole-genome deep sequencing platforms and assembled the sequence data using a hybrid assembly strategy. The final genome assembly constitutes a total length of 3.00 Gb. The 250 Gigabyte (Gb) high quality reads were generated from whole-genome deep sequencing platforms and assembled the sequence data using a hybrid assembly strategy to create a high quality de novo assembly of mithun with 96% recovered as per BUSCO analysis. Compared to the earlier report of Chinese gayal genome, the mithun genome, reported is reasonably far more complete (>95%) having a better coverage of 91.5% and gene annotation with 28,044 protein-coding genes. The genomic alignments showed a high degree of similarity between mithun and cattle than other bovine species.



The genome alignment of mithun genome to cattle genome. The name of cattle chromosome have "bf" as prefix, mithun scaffold have "M" as prefix. (a) The four longest scaffold of mithun and (b) gayal were drawn. The links in ring represent alignments which longer than 100 kb. (c) Mithun scaffolds and (d) gayal scaffolds which can map both cattle chromosome 2 and chromosome 27 or cattle chromosome 2 and chromosome 28 were drawn. The links in ring represent alignments which is longer than 100 Kb.

Genetic characterization of mithun population through mitochondrial genome sequencing

A study was conducted to characterize the mithun (*Bos frontalis*) populations, which is a unique Bos species of NEH region. Accordingly, whole mitochondrial genome sequencing and gene annotation of four mithun populations (n=16) was carried out, which revealed a closed circular DNA sizing approximately 17 kb (16441 bp) encoding 13 protein-coding polypeptides, 22 tRNA genes, 2 rRNAs and one control region, similar to other Bovine mt-Genomes. It was found that the arrangement of mitochondrial genes of mithun was at par with other Bovine species. Phylogenetic analysis using complete mt-Genome of the mithun samples revealed both genetic similarity and heterozygosity within and between populations.



Arrangement of genes in the mitochondrial genome map of mithun (*Bos frontalis*)

Mithun fodder plant collection, identification and documentation

The fodder plants were collected from two different districts of Nagaland, namely Kohima and Phek districts. From Kohima and Phek district 57 and 29 plant samples were collected, respectively and the local names were noted along with their photograph. The use and importance of plants were known by consulting village experts who have experience and traditional knowledge in using those plants for various purposes. The fodders were photographed and also herbariums were made for further identification from the expert.



Aconogonum molle



Amomum dealbatum



Musa spp.



Morus spp.



Cucurbita pepo

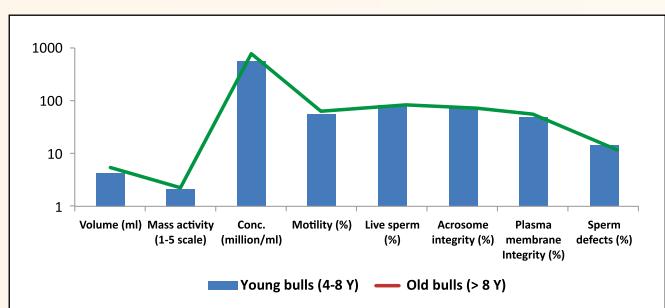


Sechium edule

Mithun fodder plants identified from different districts of Nagaland

Semen collection through electro-ejaculation in mithun bulls

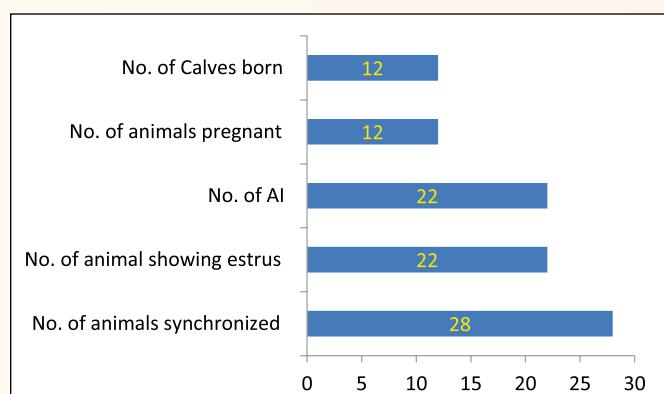
Electro ejaculation is of great value by providing a means of extending the use of valuable sires and also for routine estimation of the fertility of bulls. This technique also gives access to intractable herd or stud bulls, and it saves the time and labour needed to train the bull to an artificial vagina and eliminates the risk to the operator and his assistants. Therefore, study was designed to describe the response and characteristics of semen collected by electro-ejaculation from 8 mithun bulls. The results indicated that, semen characteristics were within the normal range of that collected by artificial vagina in mithun and it was suitable to incorporate for an assisted breeding programme in mithun.



Semen characteristics of younger and older mithun bulls collected through electro-ejaculation

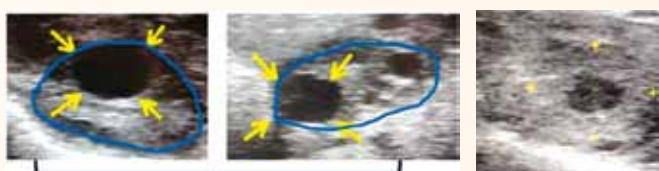
Estrous synchronization and timed AI (Fixed Time AI) in mithun

One of the limiting factors in the application of artificial insemination (AI) in mithun is the difficulty in estrus detection. Therefore, development of FTAI protocols eliminates the detection of estrus and is an attractive reproductive management tool. In the present study, 25 mithun cows were synchronized using Co-synch protocol (PGF₂ α is administered 7 days after GnRH, followed by a second GnRH injection and FTAI at 48 hr). Seventeen animals become pregnant after successful AI with frozen-thawed mithun semen and 12 calves were born during the period.



Follicular dynamics in pubertal mithun

Follicular dynamics is one of the most important subjects on ovarian physiology and its study in correlation with concentrations of steroids and gonadotropins during the estrous cycle is important for improving assisted reproductive efficiency and fertility. Ten mithun cyclic heifers of 3-4 years age maintained under semi-intensive and isomanagerial conditions were selected and follicular dynamics were studied.



Dominant follicle Corpus luteum
Ultrasound images of ovary representing different ovarian structures

Determination of milk flow rate of mithun cow

Mithun produces very high-quality milk. Therefore, a pilot study was conducted to study the milk flow rate of mithun cow. Five mithun cows were selected from Institute farm which were under lactation. Milk let-down was done through calf suckling with average let-down time of 58.47 ± 0.78 second. Milking time and

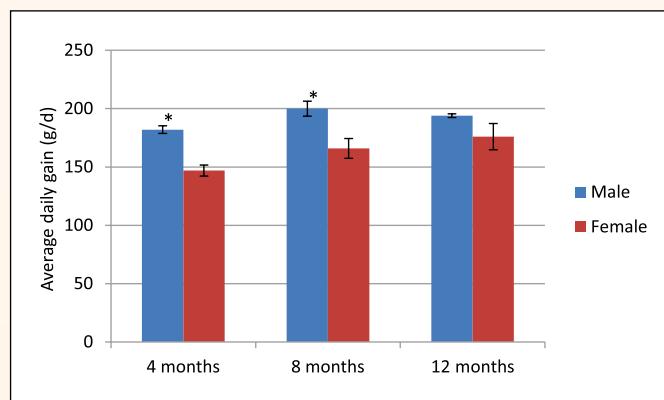


Milking of mithun cows

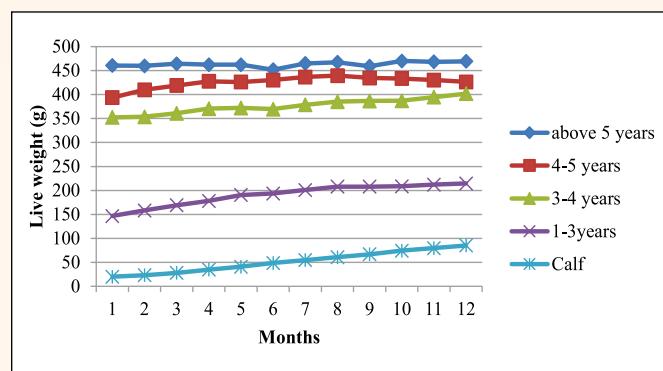
volume of milk were recorded for each animal daily during the morning hour and subsequently milk flow rate was calculated. The average milking time, milk volume and milk flow rate were observed to be 5.18 ± 0.19 minute, 0.94 ± 0.03 litre and 0.18 ± 0.01 kg/minute, respectively.

Growth and reproductive performance of mithun in different seasons

Mithun primarily being a meat animal, the emphasis was on studying the effect of genetic as well as non-genetic factors influencing the growth performance of mithun. All the available retrospective data (parity record: 2000 - 2017 and birth weight record: 2013 - 2017) were analyzed and observed that age at first heat (AFH), average weight at first heat (AWFH), age at first calving (AFC) and calving interval were 937.90 ± 28.51 days, 200.83 ± 7.36 kg, 1274.81 ± 29.01 days and 465.95 ± 17.68 days, respectively. Maximum number of calving was observed during winter followed by autumn. The average birth weight of calves (kg) during winter, spring, summer and autumn were 18.93 ± 0.43 , 18.95 ± 0.68 , 19.60 ± 0.55 and 20.03 ± 0.33 , respectively. In addition, the monthly live weight was recorded to find out the growth performance of calves and other category of animals.



Average daily gain (g/d) of calves



Growth curve of different category of mithun

Determination of different wholesale cuts of mithun from different age and sex

To determine the yield of different carcass cuts in 16 healthy mithuns of both the sexes. Mithun from four different age and sex groups such as G1- Male animals with age up to 4 years, G2-Male animals with age above 4 to 7 years, G3- Female animals with age up to 4 years, G4-Female animals with age above 4 to 7 years were compared. The proportion of wholesale cuts (forequarter and hindquarter) did not differ significantly ($P > 0.05$) among the groups. The yield (%) of chuck, rib, foreshank, brisket, short plate, round, short loin, sirloin, and flank was in the range of 28.51-30.08, 9.15-9.78, 6.79-6.88, 5.55-5.63, 4.99-5.21, 24.61-25.15, 8.06-8.35, 8.02-8.87 and 2.60-2.94, respectively.

Efficacy of oils against leech

In order to know the efficacy of oils against leech, we have used two type of oils mainly citranella oil and neem oil, which were procured from market and attempted against both land leech and aquatic leech. Efficacy was measured in terms of killing time of leech. From the experiment it was observed that citranella oil showed very good efficacy (4.25 ± 0.47 minutes killing time) in land leech as against aquatic leech (160.25 ± 3.68 minutes killing time). Neem oil was also moderately effective (113 ± 0.63 minutes) for land leech whereas it was not effective against aquatic leech during the experiment trials.



Land leech

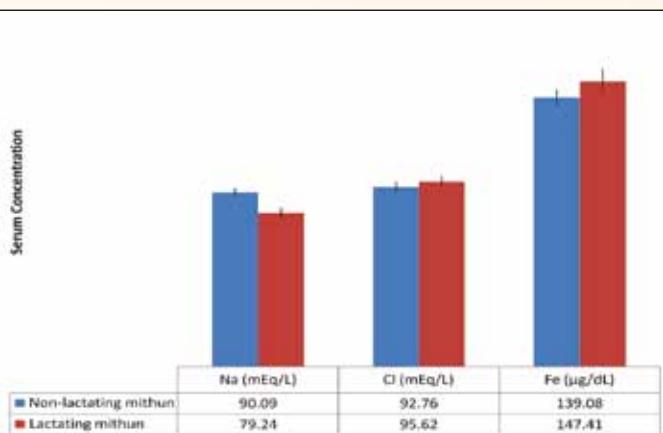
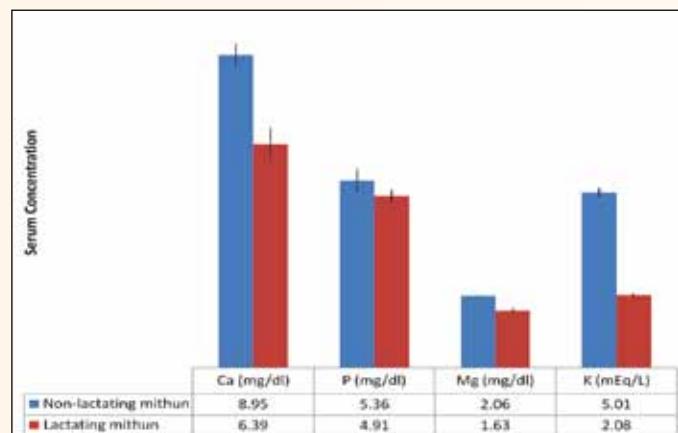


Aquatic leech

Mineral profiling of lactating semi-captive mithun (*Bos frontalis*) cows

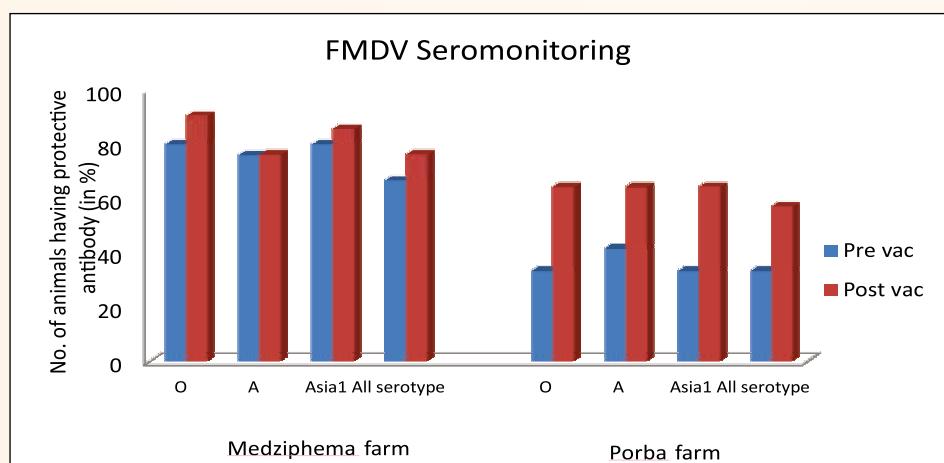
Recently, the milking potential of mithun has been explored for superior quality milk. However, no baseline data is available on serum mineral levels of lactating mithun cows reared in captivity. They may be extremely useful in long term conservation and efficient management of this unique animal. The present study revealed (n=15) significant differences ($P<0.05$) in

the levels of calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) between lactating and non-lactating mithuns. However, no significant differences were observed for serum inorganic phosphorus (P), iron (Fe) and chloride (Cl). Thus, lactation has effect on serum mineral balance and Ca, Mg, Na and K should be supplemented in the diet of mithun cows during lactation. Furthermore, early lactation (1-3 months) mithun cows exhibited more decrease in serum minerals than mid and late lactation cows.



FMDV Seromonitoring

Thirty and Fourteen pre vaccination sera were collected from NRCM Porba farm and Medziphema farm respectively. SPCE showed protection level of O=80%; A=76%; Asia1=80% from Medziphema farm and O=33%, A=41% and Asia1=33% from Porba farm. From Medziphema farm 66.7% animals are protected from all the serotypes whereas only 33% of animals are protected in Porba farm. Post vaccination sera from Medziphema farm showed 90%, 76% and 85% protection against O, A and Asia1, respectively. Whereas from Porba farm the protection levels are 64.3%, 64.3% and 64.3% respectively. Overall protections against the three serotypes from the two farms are 76% and 57%, respectively.



Socio-economic evaluation of mithun rearing

The research study emphasized on the systematic documentation of role of mithun in livelihood security, cost involvement in mithun rearing under free range and the constraints encountered in mithun rearing. Through this study, it was found that mithun due to its inherent socio-cultural and economic dynamism, plays a multidimensional role in the mithun-rearing society. Owning mithun gives social (leadership) and economic status to the households. They are also considered a common means of demonstrating wealth, cementing relationships through bride price payments and as social links, important in crises. Primary data revealed that all mithun rearing societies contribute some amount for the

health and welfare of the mithuns with respect to occasional salt lick, cost of fencing, labour involved in fencing the mithun rearing area, monthly wages to the herdsman and hiring of labour for capturing the mithuns from the forest for sale. The concept of zero input can be nullified as some amount of investment is required for rearing the animal in the community designated forest area specified by the village society.

EXTENSION ACTIVITIES

Under the Institute Tribal Sub-Plan scheme the following extension and outreach programmes were conducted:

S. No	Programme name	Village/District/ State	Total Beneficiaries
1.	Establishment of semi-intensive mithun rearing units	Khonoma, Kohima, Nagaland	21
2.	Animal Health cum Vaccination Camps (2 nos.)	Upper Khomi, Phek, Nagaland & Tening, Peren, Nagaland	86
4.	Training	Mai, Lower Subansiri, Arunachal Pradesh	9
5.	Awareness Workshop	Kalimpong, West Bengal	105

Establishment of semi-intensive system of mithun rearing units

Distributed 90 rolls of barb wire, 70 CGI sheets along with gumboots and raincoats on 2nd July, 2019 to the Khonoma Village Mithun rearing farmers in order to promote semi-intensive system of mithun rearing.



Animal health-cum-vaccination camp

Two Animal Health-cum-Vaccination Camp were organized in Upper Khomi village, Phek district and Tening village, Peren district of Nagaland. The camp at Upper Khomi was jointly organized by ICAR-NRC on Mithun and KVK-Phek on the 5th September, 2019. The camp was an effort of the Institute to control the mortality rate of poultry to Ranikhet disease that has become an epidemic in the village. Farmers were trained and demonstrated on how to administer vaccinations to the poultry. A total of 250 poultries and 8 Jersey cows were vaccinated against Ranikhet and Foot and Mouth Disease (FMD), respectively. Mineral mixtures,

antibiotics, anthelmintics and other medicines were distributed to the farmers for the health and welfare of the livestock in the village.

On 5th November, 2019 another camp was organized at Tening Village, Peren District, Nagaland. The camp was organized for the mithun rearing farmers of Tenning and Nzau village. As part of the camp, farmers were given hands on training on scientific mithun restraining and management. A total of 16 mithuns were vaccinated against Foot and Mouth Disease (FMD) and 2 mithun herding dogs were vaccinated against anti-rabies. Mineral mixtures, antibiotics, anthelmintics, and other medicines were distributed to the farmers for the health and welfare of the mithun in the village



Training

A 3 days hand on Training on Semi-intensive Mithun Farming was organized from the 17th -19th October, 2019 for the mithun farmers of MAI village, Yachuli block, Lower Subansari, Arunachal Pradesh. Through this training, farmers were educated on the potential and diversified use of mithun under Semi-Intensive farming. Milking capacity of mithun and draught power were demonstrated during the training. The Scientists delivered the lectures on various topics like care and management of young, pregnant and lactating

animals, selection of mithun breeding bull and breeding management, feeding management and fodder resources for mithun, health management, and entrepreneurship development. A total of 9 farmers participated in the programme. The farmers also had the unique experience of tasting mithun milk for the first time.



Awareness Workshop

A one-day Awareness Workshop on Semi-Intensive Mithun Farming was held at Kalimpong District of West Bengal. The workshop was jointly organized by ICAR-National Research Centre on Mithun, Nagaland

and West Bengal Comprehensive Area Development Corporation (WBCADC), Govt. of West Bengal. The workshop was part of the Institute's continued effort to propagate mithun rearing as a source of livelihood generation under Schedule-Tribe Component (STC) and to promote mithun farming beyond the four states of North East India. An exhibition stall displaying the information on what mithun is, what it usually feeds on and the various milk, meat and hide products that can be developed from mithun was set up to educate and create awareness about mithun farming. A total of 105 farmers participated in the workshop.



INSTITUTIONAL ACTIVITIES

Independence Day Celebration

The 73rd Independence Day was celebrated in the institute in presence of army officers, all staff members and their families. Dr. Haque, Pr. Scientist, ICAR-NRC

on Mithun unfurled the tricolor in the morning. The staff members and children actively participated in the programme organized during the day.



Hindi Week Opening Ceremony

Hindi week was inaugurated by honorable chief guest Dr. P. S. Pandey, ADG (EP & HS) on 13th September, 2019 in the presence of Dr. Abhijit Mitra, Director, ICAR-National Research Centre on Mithun. Dr. Pandey appreciated the works of Hindi Cell and stressed on adoption of maximum correspondence in Hindi in future. The 'Closing Ceremony' of Hindi Week was concluded



on 20th September, 2019 with distribution of prizes to winners of various Hindi competitions organized over a week. The staff members of ICAR-NRC on Mithun and school children participated in large numbers to make this event successful. Ten Hindi competitions were organized in which a total of 103 participants took part. The honorable Director, Dr. Abhijit Mitra presided over the function and congratulated all the winners.



150th Birth Anniversary of Mahatma Gandhi

The one-day long programme began with a Swachh Bharat Campaign organized by the Institute at Community Health Centre, Medziphema Town on 2nd October, 2019. This was followed by a cleanliness drive in and around the Institute, Medziphema campus. In the commemoration session, REV. FR. (Dr.) George V, MSFS, Principal of St Francis De Sales Higher Secondary School, Medziphema, Special Guest of the programme, emphasized on the need to be the change if we wish to see a change in others, particularly the children and youth who are the beacon of change. As part of the celebration, the Institute had also organized various competitions viz. essay, quiz, debate and painting for the school students from in and around Medziphema, Punglwa and Chumukedima. A total of 146 students participated in the four-day long programme. Prizes to the winners were distributed on the valedictory programme on 2nd October.





27th IMC Meeting

The institute conducted its 27th IMC Meeting on 4th October, 2019. Dr. Abhijit Mitra, Chairman of the IMC presided over the meeting. All the IMC members from various institutes and ICAR-NRC on Mithun attended the meeting.



Vigilance Awareness Week

The weeklong celebration of the Observance of Vigilance Awareness Week under the Vigilance Cell of the Institute at ICAR-NRC on Mithun ended on the 2nd November, 2019. The celebration was part of the Central Vigilance Commission initiative to promote the theme of public participation in promoting integrity and eradicating corruption. The theme of this year's Vigilance Week celebration was "Integrity- A Way of Life". As part of the celebration, the Institute had organized a number of competitions viz. essay writing, extempore speech, painting, etc. for the school and college students from public and private organization members in and around the Institute at Medziphema and the staffs of the Institute. As part of the Vigilance Week-2019, an Integrity Pledge was taken on 28th October, 2019 by all the staff members. The various competitions were organized and prizes to the winners were distributed on the valedictory programme. The programme ended with taking Integrity Pledge taken by all the school children and staff members present in the valedictory function and singing of National Anthem.



Celebration of Constitution Day of India

Constitution Day of India was celebrated at the Institute on 26th November, 2019 to commemorate the adoption of the Constitution of India and to honour and acknowledge the contribution of Founding Father of the constitution. The 'preamble' of the constitution was read to follow the ideals enshrined in the Indian Constitution.



Annual IAEC Meeting 2019

A meeting of IAEC of ICAR-NRC on Mithun was held on 18th December, 2019 in the presence of internal IAEC members and external CPCSEA nominees. All the projects were thoroughly reviewed and recommended for approval by CPCSEA. Dr. Gunjan Das, Main Nominee & Mr. L. Biswajeet Meitei, socially aware nominee visited Mithun farm and presented a lecture on CPCSEA guidelines.



Awards and Recognition

ICAR-NRC on Mithun has been awarded with the "Certificate of Appreciation" on 10th December, 2019 for proactively implementing ICAR Research Data Management Guidelines and Uploading of its all Technologies for the Last 6 years in Krishi Portal.

ACTIVITIES OF KRISHI VIGYAN KENDRA-PHEK

Krishi Vigyan Kendra- Phek is a grass root level organization engaged in imparting trainings, conducting on farm trials, frontline demonstrations on proven technologies in agriculture and allied sector and organizing various extension activities for the farmers, rural youth and extension personal of the district.

During this period, a total of 35 training programmes were conducted under different discipline for farmers, rural youths and extension personals benefiting 827 participants. For skill development, 4 numbers of vocational training were conducted for rural youth on vermiculture and vermicomposting, post-harvest management of fruits and vegetables,

scientific rearing and management of poultry and post-harvest management & value-added product of soybean comprising of 49 rural youths. Two skill-training programmes sponsored by MANAGE, Hyderabad were conducted on soil conservation and organic production of fruits and vegetables benefitting 54 rural youths.

Under 'Mera Gaon Mera Gaurav' programme, 4 training and demonstration programmes benefitting 119 beneficiaries were conducted at Yoruba, Khezakeno and Upper Khomi. Under National Initiative on Climate Resilient Agriculture (NICRA) project at Thipuzumi village, 9 training programme were conducted for practicing farmers with a total beneficiary of 323 farmers

and 2 field day programmes were conducted. For dissemination of latest technologies, on farm trials and frontline demonstrations were conducted in farmer's field on various crops and livestock.

Under extension activities, 11 field days with a total of 127 beneficiaries, 35 diagnostic visits comprising of 158 farmers and 32 scientist visits to farmer's field were carried out in different villages. Eight method demonstrations were conducted benefitting 70 farmers and 42 mobile advisory services provided through SMS to 420 farmers. Three numbers of Farmers-Scientist Interaction were conducted with a total of 89 participants and one group discussion was also conducted. Important days were celebrated in the Institute i.e. Independence

Day, Parthenium week, World Soil Day, Swachhta and webcasting programme where a total of 260 persons participated.

S. No	Activities	Number	Beneficiaries
1	Training conducted	35	827
2	Vocational Training	2	25
3	OFT	9	42
4	FLD	8	44
5	Fertilizer Awareness Programme	1	75
6	Nutri-sensitive Agriculture Research & Innovation (NARI) Programmes	5	127

ACTION PHOTOGRAPHS-OFT/FLD/TRAINING/EXTENSION ACTIVITIES



OFT on Assessment of organic sources on growth and yield of Broccoli var. Green Magic



FLD on Popularization of French bean seed treatment with biofertilizer



FLD on Popularization of dual-purpose chicken Srinidhi in backyard system



Method demonstration on vermicomposting for Assam Rifles at Phek



Fertilizer awareness programme



Training on package and practice on Field pea and Mustard at Phusachodu NICRA village

SKILL DEVELOPMENT

Training/Workshops/Seminars Organized

Interactive workshop on Open Water Fisheries Management in Nagaland

An interactive workshop on “Open water fisheries management in Nagaland” was held at ICAR-NRC on Mithun, Medziphema on 19th July, 2019. The workshop was organized by ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata in collaboration with Department of Fisheries and Aquatic Resources, Government of Nagaland, Kohima & ICAR-NRC on Mithun, Medziphema, Nagaland. The workshop stressed upon scope of fishery entrepreneurial activity in Nagaland.



Training-cum-awareness workshop on J-Gate @ CeRA

One day interactive workshop on J-Gate @ CeRA was organized by ICAR-NRC on Mithun on 19th August, 2019. The scientists from ICAR-NRC on Mithun, ICAR Research complex for NEH region, Nagaland Centre and ICAR-KVK, Phek participated in the program. Mr. Mahendranath Sarkar, Training Manager, CeRA, Informatics Publishing Ltd. was the invited expert. The workshop focused on efficient use of J-Gate.



ITMU workshop on Artificial Intelligence and Machine Learning

A workshop on ‘Artificial Intelligence and Machine Learning’ was organized by ICAR-NRC on Mithun, Nagaland on 28th August, 2019 as a part of capacity building activity of the Institute Technology Management Unit (ITMU) to educate and improve the technical and scientific know-how in the area of cutting-edge technologies.

Presentation in Conference/Symposium/Workshop

- Biam K P and Barman U. (2019). Effectiveness of research-extension-farmer linkages of agricultural technologymanagement agencies in Assam, India. *In:* VIII International Conference on Agricultural Statistics held at New Delhi from the 18-21st November, 2019.
- Perumal P, Khan M H, Chang S, Khate K and Vupru K. (2019). Flaxseed oil modulates semen production and its quality profiles and freezability in mithun. *In:* Compendium of XXXV Annual Convention of the ISSAR and International Symposium on Global Perspective to Enhance Livestock Fertility through Modern Reproductive Techniques for Doubling Farmers' Income. Organized by Veterinary College, Namakkal, Tamil Nadu, 18 – 20th December, 2019. Pp 161.
- Perumal P, Khan M H, Chang S, Khate K and Vupru K. (2019). Flaxseed oil endocrinological

profiles and scrotal biometric attributes in mithun. **In:** Compendium of XXXV Annual Convention of the ISSAR and International Symposium on Global Perspective to Enhance Livestock Fertility through Modern Reproductive Techniques for Doubling Farmers' Income. Organized by Veterinary College, Namakkal, Tamil Nadu, 18 – 20th December, 2019. Pp 162.

- Perumal P, Khan M H, Chang S, Khate K and Vupru K. (2019). Slow release exogenous melatonin on sexual behavior scores and antioxidants and oxidative stress profiles in mithun bulls. **In:** Compendium of XXXV Annual Convention of the ISSAR and International Symposium on Global Perspective to Enhance Livestock Fertility through Modern Reproductive Techniques for Doubling Farmers' Income. Organized by Veterinary college, Namakkal, Tamil Nadu, 18 – 20th December, 2019. Pp 20.
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DISTINGUISHED VISITORS

- A delegation of senior veterinary officials, led by Shri Alan Gonmei, Commissioner & Secy. Dept. of Vety & A.H. Govt. of Nagaland visited ICAR-NRC on Mithun, Medziphema on 12.07.2019
- Dr. B. K. Das Director ICAR - CIFRI Barrackpore, visited ICAR-NRC on Mithun, Medziphema on 19.07.2019
- A team of experts from CGIAR Research Centers, Dr. Habibar Rahman, ILRI regional representative, South Asia, and former Deputy Director General (Animal Science); Dr. V. P. Singh, Regional Representative for South Asia, CIAT and Dr. U. S. Singh, South Asia Regional Coordinator and India Country Representative, CIP visited ICAR-National Research Centre on Mithun, Medziphema, Nagaland on 1.08.2019
- Professor S. Venugopalan, eminent scientist and Director, National Institute of Technology (NIT), Chumukidema on 28.8.2019
- Dr. P. S. Pandey, ADG (EP&HS), ICAR Headquarter, New Delhi on 13.09.2019
- Dr. S. K. Dwivedi, Director, Defence Research Lab, Tezpur visited the Institute and Mithun farm on 16.09.2019.
- Dr. S. Ayyappan Chancellor, Central Agricultural University, Imphal Former Secretary, DARE & DG, ICAR, New Delhi Visited ICAR-NRC on Mithun on 17.12.2019



SEMI-INTENSIVE MITHUN FARMING /

.....*provides Livelihood Security*

.....*conserves Forest Cover*

.....*ensures Environmental Sustainability*

.....*preserves Cultural Heritage*



The Editorial Escapade

This period mithun digest covers the research achievements, extension outreach programmes of the Institute and its KVK carried out for the improvement of farmer's livelihood of the north-eastern region particularly in the mithun rearing states. Besides there is chronicle depicting activities of the Institute.

Chief Editors



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