वार्षिक प्रतिवेदन

Annual Report

2010 -11

भाकृअनुप
ICAR

राष्ट्रीय मिथुन अनुसंधान केन्द्र

(ाारतीय कृषि अनुसंधान परिषद)

झरनापानी, मेड्जीफेमा, नागालैन्ड - 797 106 ाारत

I.C.A.R. N.R.C. MITHUN-NAGALAND

NATIONAL RESEARCH CENTRE ON MITHUN

(Indian Council of Agricultural Research)

Jharnapani, Medziphema, Nagaland - 797106, India

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Glimpses of our previous Annual Reports

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प्राक्कथन

मुझे राष्ट्रीय मिथुन अनुसंधान केन्द्र के 2010 – 2011 के वार्षिक प्रतिवेदन को प्रस्तुत करते हुए अत्यन्त गर्व महसूस हो रहा है। इस वर्ष में राज्य सरकार के साथ महत्पूर्ण दो बैठकें हुई, एक इंटरफेस बैठक 4 फरवरी 2011 को आयोजित कि गई, जिसमें नागालैंड के कई अधिकारी भी शामिल थे। इस बैंठकों में माननीय श्री टी. आर जेलीयन, पशुपालन मंत्री भारत सरकार, माननीय डॉ. चुंबीन मोरे कृषि मंत्री नागालैंड, माननीय डॉ. एस. अय्यपन, सचिव, डेयर और महानिदेशक, भारतीय कृषि अनुसंधान परिषद, उप महानिदेशक डॉ. कमल पाठक (पशु विज्ञान), डॉ. ए.के सिंह (राष्ट्रीय अनुसंधान प्रबंधन), डॉ. अरविंद कुमार (शिक्षा), डॉ. के. डी. कोकाते, (विस्तार), डॉ. (श्रीमती) मीना कुमारी (मत्स्य) उपस्थित थे। इनके साथ-साथ डॉ. एस. एन. पुरी, कुलपति केंद्रीय कृषि विश्वविद्यालय, इम्फाल, और असम कृषि विश्वविद्यालय, जोरहट के कुलपति डॉ. के. एम. बजर बरूवा ने इस बैठक में भाग लिया। इनके अलावा पूर्वी क्षेत्र के विभिन्न आई.सी. ए. आर संस्थान के निदेशक भि इसमे भाग लिया था। डॉ.दिलीप रथ, संयुक्त सचिव, भारत सरकार, डॉ. वेंकट सुब्रहमण्यम् अपर महानिदेशक के साथ हमारे संस्थान का दौरा किया। इन दो बैठकों में हमें मार्ग दर्शन करने के लिए हमारा ध्यान निर्धारित किया है।

PREFACE

It is my proud privilege to place this valuable document of Annual Report of our Institute depicting the different activities of year 2010-11. In this year we had the opportunity of having important activities including two interface meetings with State Govt. officials of Nagaland. .In one interface meeting held on 4 February, 2011, Sri T. R. Zeliang, Hon'ble Minister for Animal Husbandry, Govt. of Nagaland; Dr. Chumben Murry, Hon'ble Minister for Agriculture, Govt. of Nagaland; Dr.S.Ayyappan, Hon'ble Secretary, DARE and Director General, ICAR along with respected DDG's Dr.K.M.L.Pathak, Animal Science; Dr. A. K. Singh, NRM, Dr. Arvind Kumar, Education; Dr. K. D. Kokate, Extension; Dr. (Mrs.) Meena Kumari, Fishery visited our Institute along with others digniteries of ICAR Headquaters as well as Vice Chancellors Dr. S.N. Puri of Central Agri. University, Imphal and Dr. K. M. Bujarbaruah of Assam Agri. University, Jorhat and Directors of various ICAR Institutes of North East Region. In another interface, Dr. Dilip Rath, Jt. Secretary, Govt. of India along with Dr. Venketa Subramanium, ADG (Ext.) visited our Institute. These two meetings have helped us to revisit our programmes and to guide us to set

इस वर्ष पशु अनुवांशिकी और प्रजनन अनुभाग में काफी सराहनीय काम हुआ। अनुसंधान संस्थान फार्म के सभी मिथुन के बारे में आनुवांशिक जानकारी एक "डिजिटल एलबम" के रूप में उपलब्ध है। इसके साथ ही दांत निकलने के तरीके के आधार पर उम्र का निर्धारण करने के तरीके को विकसित किया गया। संस्थान के मिथुन फार्म का केप्पा कैसीन जीनोटाइप के आधार पर विभाजन काफी उल्लेखनीय है।

पशु पोषण विभाग में बीवरीस द्वारा प्राप्त अनाज के प्रयोग पर अनुसंधान का काम बहुत ही उत्साहजनक कदम है, और इस प्रकार के आहार यदि यह आहार उत्तम गुणवत्ता के साथ उपयोगी साबित होता है, तो इस प्रकार के लगत में कमी की जा सकती है। मैं इस अध्ययन से जुड़े हुए सभी वैज्ञानिकों को बधाई देना चाहता हूँ ।

मिथुन के एक अध्ययन में रूमेन माइक्रोफलोरा की पहचान एवं शुद्ध रूप में निकालना और उनका परिलक्षण किया गया। मिथुन के चमड़े को गाय की चमड़े की अपेक्षा बेहतर पाया गया और यह इस बात की संकेत देता है, कि मिथुन पालकों को मिथुन के चमड़े से व्यवसायिक उत्पादन किया जा सकता है।

पशु कार्यिकी विभाग में ऑक्सीटोसिन का नसीका में स्प्रे करके गाय एवं बछड़े के मध्य एक अत्यंत भावनात्मक एवं सरल अपनाने की तकनीकी विकसित की गई। जिसके द्वारा गाय बछड़े की देखभाल की प्रतिशतता में बढोतरी की गई है। नागालैंड में मिथुन पालकों के मध्य कृत्रिम गर्भाधान से बछड़ा पैदा भविष्य में कृषि के क्षेत्र में सम्पूर्ण मिथुन जनन द्रव्य रूप से बेहतर बनाया जा सकता है।

एक अन्य अध्ययन में विस्तार विभाग द्वारा की गई पहल में परंपरागत मिथुन पालन के बारे मे कुछ जानकारी एकत्रित करके परंपरागत पशुपालन प्रणाली के बारे में और अधिक जानकारी के लिए सतत प्रयास किए गए।

संस्थान द्वारा जनसाधरण का ध्यानाकर्षण संस्थान में कार्यरत वैज्ञानिक गण एवं समस्त कर्मचारी द्वारा किए गए असीमित एवं परीक्षण एवं शक्ति का फल है। मैं इन सभी our focus points.

The researh work of the Animal Genetics and Breeding section was quite commendable where they have screened all the Mithuns of the Institute farm cytogenetically and made one 'digital album' where all cytogenetic information are avaliable. The procedure to determine the age of a Mithun on the basis of its dentition patterns was also quite valuable particularly in the field condition. Screening of the Institute Mithun herd in relation with kappa casein genotypes was also remarkable.

The research work initiated by the Animal Nutrition section using spent grains from brewaries is a very encouraging step and if we could prove it to be useful, we will be able to cut down the cost of feed with quality inputs. I want to congratulate all the scientists associated with this project for initiating such an innovative study.

The identification of rumen microflora of Mithun was a very useful programme, and the isolation and characterization of rumen bacteria having superior fiber degrading capability was a very intresting finding. Characterizing the Mithun leather as superior one to that of cattle is a very valuable finding. It will help the Mithun farmers to promote the hides of Mithun in commercial field.

In the Animal Physiology section, use of intra-nasal spray of oxytocin to enhance the cow-calf bonding was a very intresting yet simple technology to enhance the efficiency of calf care by the cows. The birth of AI calf of Mithun in the field of Nagaland was a revolutionary achivement for going ahead with the programme for overall genetic improvement and spread of Mithun germplasm in the field condition.

Another initiative taken by the Extension section to collect some baseline information on traditional Mithun rearing will help us to know more about the traditional rearing system.

को उनके द्वारा किए गए परिश्रम के लिए मैं बधाई देता हूँ और उम्मीद करता हूँ, कि इस दस्तावेज में संस्थान की विभिन्न गतिविधियों को संकेतीक तरीके द्वारा प्रस्तुत किया गया है, एवं इसमें एकत्रित सभी जानकारी मिथुन पालन से संबंधित कृषि एवं शोधकर्ता के लिए उपयोगी साबित होगी।

संस्थान की प्रगति एवं विकास के लिए डॉ. एस. अय्यपन ,सचिव डेयर और महानिदेशक, आई. सी .ए. आर एवम डॉ. के. एम. एल. पाठक, उप महानिदेशक (पशु विज्ञान) एवं डॉ. सी. एस. प्रसाद, सहायक महानिदेशक (पशु पोषण एवं कायिकी) के आशीर्वाद, सहायता एवं निरंतर मदद का परिणाम है और मैं, इन सभी का हृदय से आभारी हूँ और धन्यवाद देता हूँ।

मैं, डॉ. राजन गुप्ता प्रधान वैज्ञानिक (पशु पोषण) एवम डॉ. विनीत भसीन प्रधान वैज्ञानिक (पशु अनुवांशिकी प्रजनन) को धन्यवाद देता हूँ, जिन्होंने इस संस्थान की निरंतर प्रगति के लिए हर संभव मदद की है।

मैं, इस वार्षिक प्रतिवेदन के सम्पादकों को विशेष धन्यवाद देना चाहता हूँ, जिन्होंने इस प्रतिवेदन को वर्तमान समय में इस रूप में लाने के लिए अथक परिश्रम किया है। मैं, अध्यक्ष डॉ. एस. मुखर्जी वरिष्ठ वैज्ञानिक, को विशेष धन्यवाद देना चाहता हूँ, जिन्होंने इस प्रतिवेदन को सही समय पर प्रकाशित करने के लिए अत्यंत मेहनत किया है। मैं, डॉ. (श्रीमती) अनुपमा मुखर्जी एवं श्रीमती कामिनी वर्मा को कार्यकारी सारांश एवं प्राक्थथन का हिन्दी में अनुवाद एवं टंकण करने के लिए विशेष धन्यवाद देता हूँ।

अन्त में मैं, माँ सरस्वती से प्रार्थना करता हूँ कि, इस संस्थान के वैज्ञानिकों एवं स्टाफ के सभी सदस्यों को एवं मुझे शक्ति एवं बुद्धिमता प्रदान करें, जिससे मैं, मिथुन पशु प्रजाति के लिए एवं देश के इस क्षेत्र के गरीब कृषकों के खुशी और मुस्कान लाने के लिए प्रयासरत है।

"जय हिन्द"

चन्दन राजखोआ

(चन्दन राजखोआ)

The Institute could attract the attention of the public due to untiring and self-less efforts and energy put by every scientists along with other staff members of the Institute. I want to congratulate all of them for their hard work. I hope this document will be able to depict the various activities of the institute in a focussed way and the information contained here-in will be able to help the farmers and research workers engaged in the field of Mithun husbandry.

The progress and development of the Institute would not have been possible without constant support, guidance and blessings of Dr.S.Ayyappan, Secretary, DARE & DG ICAR; Dr.K.L.M. Pathak, DDG (AS) and Dr. C.S. Prasad ADG (AN&P). I offer my deep sense of gratitude to all of them.

The help and advice rendered by Dr Rajan Gupta, PS, Animal Nutrition; Dr. Vineet Bhasin, PS, Animal Genetics &Breeding; and Dr (Mrs) Neelam Gupta, PS, Animal Genetics & Breeding was also acknowleged with gratitude.

Special thanks go to Dr.Sabyasachi Mukherjee, Sr. Scientist and Chairman with others members of the Editorial Board for their pain-staking efforts to bring this document to the present shape. I must express my thanks to Dr. (Mrs) Anupama Mukherjee and Mrs. Kamini Verma for their translation of the Excutive Summery and the Preface in Hindi.

Lastly, I pray at the lotus feet of the Lord Almighty for showering blessings and love to all the scientists and staff members of this Institute so that we all can put more efforts to bring happiness and smile for the poor Mithun rearers of this country.

Jai Hind.

(Chandan Rajkhowa)

कार्यकारी सारांश

राष्ट्रीय मिथुन अनुसंधान केन्द्र (एन.आर.सी.एम.) का उद्देश्य अमूल्य मिथुन जननद्रव्य का संरक्षण एवं नामांकन करना तथा अनुसंधान के विभिन्न क्षेत्र जैसे पशु अनुवांशिकी एवं प्रजनन, पशु शरीर क्रिया विज्ञान, पशु पोषण, पशु स्वास्थ्य, पशु प्रबंधन एवं विस्तार का अध्ययन करना है। इस दिशा में संस्थान द्वारा किए अनुसंधान के विभिन्न प्रयास संरक्षित तरीके से निम्नलिखित हैं।

न्यूक्लियोलर आरगेनाजर क्षेत्र (एन. ओ. आर.) बैंडिग और चांदी नाइट्रेट द्वारा मिथुन मेटाफेस गुणसूत्रों को रंग प्रदान करने की प्रतिक्रिया को मानकीकृत किया गया। चांदी नाइट्रेट द्वारा रंग प्रदान करने के लिए स्लाइड्स को उष्मायन कक्ष में 24 घंटे से 36 घंटे तक रखा गया और सबसे अच्छे परिणाम 30 घंटे तक रखी स्लाइड्स में थे। उष्मायन के 30 घंटे पर चांदी नाइट्रेट के साथ किए गए कई मेटाफेस गुणसूत्रों के विश्लेषण से पता चला है, कि एन. ओ. आर. बैंड के आकार काफी बड़े थे। हालाँकि कुछ गुणसूत्रों में सामान्यतः से अधिक और दूसरों में अत्यंत सूक्ष्म दिखाई दिया । इस प्रजाति में एन.ओ. आर. बैंड की संख्या नियत नही पायी गई और उनकी जगह भी सेंट्रोमेरिक अथवा टिलोमेरीक क्षेत्र तक सिमित थी।

सभी स्टेशन फार्म में मौजूद वयस्क और नवजात बछड़ो सहित पशुओं की आनुवांशिकी जांच की गई। इन पशुओं का आनुवांशिक प्रोफाइल पारंपरिक जीम्सा, सी- एवं आर- बैंडिग तकनीक द्वारा निर्मित किया गया है। सभी पशुओं की आनुवांशिक जानकारी एक "डिजिटल एल्बम" के रूप में एकत्रित की गई है। मिथुन गुणसूत्र की संरचना और गुणसूत्रों के अन्य मापदंडों की भी गणना की गई।

परीक्षण के लिए दो अलग अलग गौजातीय प्राइमरों के साथ लेप्टीन जीन का पी. सी. आर. प्रवर्धन अध्ययन शुरू किया गया । प्राइमरों का पी. सी. आर. विधि द्वारा प्रवर्धित किया गया, और पी. सी. आर. उत्पादों को आगे के लिए पी. सी. आर. - आर.एफ.एल.पी. विधि द्वारा जीन के भागों में बहुरूपता का अध्ययन किया गया। 94 बी.पी. भाग का आर.एफ.एल.पी.- Kpn 2 I आर ई. के साथ कई पशुओं में बार-बार बहुरूपता का अध्ययन किया गया, इस असफलता की संभवतः वजह इस एम्प्लीकान (94 बी पी) का सूक्ष्म आकार है, एवं इस प्रकार के परीक्षण करने के लिए लम्बे समय तक जेल को जारी रखना चाहिए एवं इसी अनुसार इस दिशा में सतत प्रयास जारी है। एक अन्य अध्ययन में (पोम एवं सहयोगी 1997) द्वारा जुड़ाव तापमान के मानकीकरण के बाद सफलता पूर्वक परीलक्षित किया गया। इसमें डी एन ए भागो में बहुरूपता Sau 3AI आर ई के साथ अध्ययन की गयी। पी. सी. आर. आर.एफ.एल.पी. द्वारा काफी उत्साहजनक परिणाम पाए गए और अद्वितीय बैंड कुछ विशिष्ट क्षेत्र से संबंधित पशुओं में देखे गए। इस दिशा में विश्लेषण अध्ययन प्रक्रिया सतत जारी है। मिथुन के जीनोटाइप की पहचान करके उन्हें विभिन्न समूहों में विभाजित किया गया। मिथुन की केप्पा कैसीन जीन को पी. सी. आर. विधि द्वारा सफल प्रर्वधन के पश्चात बाद, Hind III आर ई इंजाईम का उपयोग करके आर.एफ.एल.पी. विधि द्वारा संस्थान फार्म में उपस्थित मिथुन जनसंख्या जीनोटाइप के संबंध में विभाजित किया गया। कुल 86 नमूनों का परीक्षण किया जिसमें से 78 पशुओं को निश्चित समूहों में समावेश संभव हो पाया है। अधिकांश मिथुन में ए.ए जीनोटाइप थी एवं अधिकांश नमूनों में 271 बीपी भाग में Hind III के द्वारा ए अलील के लिए कोई जगह नहीं थी। लेकिन बी अलील में Hind III द्वारा 181 बीपी और 90 बीपी भाग में विभाजित किया गया था। इनका 2 % जेल वैदयुक्त कण संचलन (इथीडियम ब्रोमाइड सहित) पी. सी. आर. उत्पादों से जीन और जीनोटाइप आवृत्तियों का प्रत्यक्ष गिनती पद्धति से गणना की गई।

एक अन्य अध्ययन में मिथुन दांत निकलने के तरीके को रिकार्ड करने उस आधार पर मिथुन के उम्र का निर्धारण करने की कोशिश कि गई, एवं इसका तुलनात्मक अध्ययन गौ पशुओं द्वारा किया गया। इस अध्ययन की एकत्रित जानकारी विश्लेषण के पश्चात उम्र का निर्धारण करने के लिए पेरामीटर को विकसित किया गया। इन पेरामीटर को सत्यापन संस्थान के फार्म में उपस्थिति मिथुन के साथ -साथ कृषकों के द्वारा रखे गये मिथुन में भी किया गया।

वयस्क मिथुन के भोजन में इनसाईलड अनाज को शामिल करने के प्रभाव का अध्ययन किया गया था। शुष्क चारे का सेवन 70.6, 72.5 एवं 45. 2 ग्रा प्रतिदिन प्रति उपापचय प्रति शरीर भार प्रथम, द्वितीय एवं तृतीय में क्रमशः था। मिथुन के भोजन में अनाज मिश्रित करने से (p =0. 021) चारे का उपभोग काफी कम हो गया। हालांकि पाचन शाक्ति 60.5, 52.2, 53.9% (p =0 .154) प्रथम द्वितीय एवं तृतीय में क्रमशः थी। इस

अध्ययन से यह निष्कर्ष निकलता है, कि मिथुन के भोजन में इनसाईलड अनाज के उच्च स्तर को शामिल करने से संपूर्ण आहार सेवन पर एक नकारात्मक प्रभाव पड़ता है। इनसाईलड अनाज को कैल्शियम हाड्रोऑक्साइड और यूरिया से उपचारित करके जीवाणु भार को निर्धारित किया गया।

एक अन्य अध्ययन में धान पुआल का उपयोग करते हुए पेड़ के पत्तियों, (सीसीमा वेलीची) अनाज, मक्का, सरसों केक,गेहू की भूसी, चावल की भूसी, खनिज मिश्रण द्वारा आहार ब्लॉक के 6 प्रकार तैयार किए गए है, और इसमें सामान्य नमक मिश्रित किया गया था। धान पुआल, पेड़ की (सीसीमा वेलीची) पत्तियों, अनाज, बारीक मक्का,सरसों केक,गेहू की भूसी, चावल की भूसी की नमी 15,73-82,72-76%10-14,11-15,9-13 और 10-16% क्रमशः थी । पेड़ के पत्तियों और अनाज को सूरज की धूप अथावा दबाव द्वारा सुखाया गया। पेड़ के पत्तों और धान पुआल को कम से कम 2 सेमी की लम्बाई के इस सामग्री को मिश्रित करके तीन मिनट के लिए 300 psi में संकुचित किया गया।

मिथुन में कुल और मिथेन गैस उत्पादन तरीके का अध्ययन अंतः पात्र किण्वन विधि द्वारा किया गया। जिसमें एक कांच की सीरींज में रूमेन का बफर इनोकोलम स्थानीय रूप से उपलब्ध चारा की उपस्थिति में किण्वित विधि किया गया ।

मिथुन की रूमेन से तीस (30) रेशे विभाजित करने वाले जीवाणु को क्रमवार तनुता एवं चुनिंदा समृद्ध सूक्ष्मजीवी कल्चर के द्वारा को अलग किया गया । इसे विश्लेषण करने के लिए अंतः पात्र गैस विधि द्वारा (मेनके और स्टेंगास 1988) उत्पादन सी एम सेल्यूलेस और जाइलेस (कामरा और अग्रवाल, 2003) अलग किया गया। इनमें से फाइबर विभाजित करने वाले 3 रूमेन जीवाणु बेहतर पाए गए ।

एक अन्य अध्ययन में प्रोटीन के विभिन्न स्तरों के विशेषताओं वाले आहार का मिथुन के कारकस गुणवत्ता पर अध्ययन किया गया। इन विभिन्न समूहों में अलग-अलग अंगों के भार निर्धारित कारकस, गुर्दे, हृदय, जिगर, आँत और तिल्ली समूहों के बीच अलग नही थे। हालाँकि अधिक उच्च प्रोटीन आहार खिलाये गए पशुओं में वसा का जमाव अधिक था। कम प्रोटीन आहार खिलाये गए पशुओं की अपेक्षाकृत में कम प्रोटीन आहार खिलाये पशुओं में ड्रेसिंग प्रतिशत उच्च प्रोटीन खिलाया पशुओं की अपेक्षाकृत ज्यादा था। मांस के नमूने के विश्लेषण में यह देखा गया कि वसा के अलावा प्रोटीन के विभिन्न स्तरों पर खिलाने के अलावा कारकस की रासायनिक संरचना में कोई महत्वपूर्ण अंतर नहीं था। यह इस बात का संकेत देता है कि प्रोटीन के निचले स्तर के रूप में बेहतर कारकस गुणवत्ता प्रोटीन का एक उच्च स्तर की तुलना में विशिष्ट थी ।

एक अन्य अध्ययन में कारकस मिथुन (*बॉस फ्रौंटेलिस*) के मांस की गुणवत्ता में स्थानीय पशु के साथ तुलना किया गया था। यद्यपि नागालैंड मिथुन के लिए मांस कि ड्रेसिंग प्रतिशत 58.82% और उच्च मवेशियों में यह 55.96% थी। मिथुन में संकोचन का प्रतिशत और स्थानीय पशुओं की तुलना में अधिक पाया गया। मिथुन मांस की गुणवत्ता (0.05 पी) अन्य मांस की तुलना में रंग, स्वाद, रसता, कोमलता और सम्पूर्ण स्वीकार्यता के मामले में आरगेंनोलेपटिक मूल्यांकन से उत्तम थी । मिथुन और पशुओं के चमड़े के सूक्षम गुण भी अध्ययन किया गया।

शारीरिक अध्ययन में मिथुन वीर्य को ग्लिसरॉल की विभिन्न सांद्रता Tris अंडे की जर्दी एवं साइट्रेट का उपयोग कर, सफलतापूर्वक हीमशीत किया गया। हीमशीत वीर्य नमूने की प्रभावकारिता की जांच एक मिथुन गाय में खोनूमा गाँव में परीक्षण किया गया था। पशुओं के 10 से 12 घंटे में गर्मी की शुरूआत के बाद गर्भावित गायों की गर्मी पर वापस के द्वारा और प्रति 60 दिनों में गर्भधान का परीक्षण किया गया । इस तकनीक द्वारा खोनूमा गाँव में 2010 में दो मिथुन बछड़ों पैदा हुए थे।

एक अन्य अध्ययन में GnRH और LH की उपयुक्त खुराक एच सी जी द्वारा मिथुन में अंडोत्पादन के शामिल करने के लिए मानकीकृत किया गया। इस संबंध में मद की शुरूआत और मिथुन गायों में बाद LH शीर्ष अंडोत्पादन के समय की भी निर्धारित किया गया था। अल्ट्रा सोनोग्राफी द्वारा अध्ययन में सहज मिथुन में तक के दौरान डिम्बग्रंथि मिथुन में कूप परिपक्वता तरीके फोलीक्यूलोजेनेसिस विशेषताएँ निर्धारित की गयी।

मिथुन गायों में जन्म कार्य व्यवहार का ऑक्सीटोसिन का सरल नासिका स्प्रे का उपयोग कर के तुरंत बाद गाय बछड़े का मादा संबंध से प्रेरित पाया गया।

रोगजनक जीवाणु अर्थात साल्मोनेलला और *ई. कोलाई* को मिथुन मांस और दूध के नमूनों से पृथक अध्ययन किया गया। 30 मिथुन और दूध के प्रत्येक नमूने की कुल रोग जनक जीवाणु की उपस्थिति (*इस्चीरीया कोलाई,*

साल्मोनेलला प्रजाति, क्लोस्ट्रीडियम प्रजाति और *स्टेफाइलोकोकस प्रजाति*) के लिए जांच की गई। यह पाया गया कि मिथुन मांस से 30 नमूने में से 15 *इस्चीरीया कोलाई* एवं 8 नमूने *साल्मोनेलला प्रजाति* के लिए सकारात्मक थे। मिथुन दूध के 30 नमूने भि जांच किए गए। इन नमूनों में से 10 *ई. कोलाई*, 10 *साल्मोनेलला प्रजाति*, 20 *स्टेफाइलोकोकस प्रजाति* एवं 14 *क्लोस्ट्रीडियम प्रजाति* के लिए सकारात्मक पाया गया है।

एक अन्य अध्ययन में गौपशुओं में मांस पेशियों की वृद्धि को नियंत्रित करने वाले और मारबलिंग वाले 11जीन को चयनित करके मिथुन में अध्ययन किया गया। रिवर्स ट्रांसक्रिपटेस पी. सी. आर. और जेल वैद्युत कण संचलन को इस्तेमाल करते हुए इन 11 चयनित मांस पेशियों की वृद्धि को विनियमित करने के जीन, अभिव्यक्ति तरीके (GH1,GHR IHF2 IGF1R,और MSTN), (FABP4और FABP5) मारबलिंग अध्ययन किया गया और मांस पेशियों विभिन्न विकास दर के बढ़ते मिथुन में फाइबर विकास (MYF5MATR3, और TCAP) यह पाया गया कि GH1,GHR IGF2, और IGF1R जीन की अभिव्यक्ति उन पशुओं में है जो कि तेजी से बढ़ने की मांस पेशियों में वृद्धि अधिक थी। MSTN जीन की अभिव्यक्ति इसके विपरित, धीमी वृद्धि दर के साथ पशुओं में वृद्धि हुई है, FABP4 और FABP5 के उच्च अभिव्यक्ति पशुओं कि बेहतर मांस के मारबलिंग जीन मांस पेशियों फाइबर विकास (MYF5MATR3, और TCAP) से संबंधित जीन की अभिव्यक्ति मिथुन कि उच्च विकास प्रदर्शित शरीर में अधिक थी। यह सुझाव दिया है कि GH1/GHR/ IGF1R/ MATR3/ TCAP और MSTN वृद्धि के नकारत्मक जीन मिथुन के चयन के लिए इस्तेमाल किया जा सकता है। मांस के लिए एक कम उम्र में (जो मांस पेशियों की वृद्धि के लिए सकारत्मक नियामक है।) (5FABP4) मिथुन पेशी के मारबलिंग की संकेत के रूप में इस्तेमाल किया जा सकता है।

पशुधन उत्पादन और प्रबंधन में मिथुन एवं गाय के दूध की कैसीन भागों का ट्राईसाइन तरीके से तुलनात्मक अध्ययन किया गया। प्रजातियों और नमूना प्रकार (शुष्क गीला) तीन साधरण विशिष्ट बैंड सभी आणविक 65.62 ± 2.6536.1 ±0.94 27.2± 0.69 के रूप में गणना के वजन के साथ की पहचान की गई। के डी ए बैंड तरीके में अंतर सूखे और गीले कैसीन बीच पाया गया बैंड सब गीली कैसीन मे प्रजातियों के 13.94 ± 0.68 ±0.17.24 ± 0. 76 के डी ए की आणविक भार के साथ एक और बैंड कि उपस्थिति सूखे कैसीन में पायी गयी।

अन्य अध्ययन में मिथुन, याक और गौ पशुओं में घी का कुल फास्फोलीपीड सामग्री कार्बनिक सॉल्वैंट्स द्वारा निर्धारित की गयी। अनुमानित मिथुन घी में कुल फास्फोलीपीड वसा की मात्रा मि. 10 ग्राम/100 ग्राम सामग्री (14.42 ± 0.80) (P<0. 5) याक की तुलना में कम (17.24 ± 0.76) पायी गयी थी।

पशु स्वास्थ्य विभाग द्वारा एक अध्ययन में किलनी का प्रकोप स्वाभविक रूप से पीडित मिथुन (*बॉस फ्रौंटेलिस*) में किया गया। इन पशुओं के शरीर की सतह के परीक्षण करने पर सिवाय इक्सोडिड किलनी के अलावा अन्य कोई भी नही पायी गयी।

पशुओं के शरीर का अध्ययन करने पर सिर्फ बोवपिलस माइक्रोप्लॉक्स किलनी पायी गयी। किलनी की साधारण पसंदीदा जगह पंख का, पैर ,पेट और गर्दन भीतर की ओर थे, कुल 176 पशुओं में से जांच में मुक्त चरण मिथुन में 103(58.52% जो शायद जंगल में जंगली पशुओं के साथ संपर्क के कारण हो सकता है। किलनी प्रकोप की तीव्रता बड़े पशुओं में सबसे ज्यादा केवल 4.(2.27%) छोटे पशुओं की तुलना में थी ।

नागालैंड फेक जिले से मुक्त चरण मिथुन (*बॉस फ्रौंटेलिस*) में हेलमिंथनेस परजीवी के प्रसार का भी अध्ययन किया गया था। संक्रमित मल निमेटोड के समूह के स्ट्रानगाइल परजीवी के लिए सकारात्मक पाए गए और इनकी अनुवांशिक पहचान कोप्रोकल्चर विधि द्वारा किया गया। परजीवी की कुल दर्ज संख्या (23.65% *ट्राईकोस्टोमगाइलस*)10.75% *कूपीरियो* (10.75%), *हीमोंकस* (9.67%) *इसीफेगोस्टोमम* (6.45%), *टोक्सोकारा वियूलोरम* (2.15%) और *निमेटो डइरस* (1.07%) थे। कछ मामले में टेप कृमि संक्रमण में *मोनिजिया* (7.5%), *मेक्सफेसा* (2.15%) के दोनों प्रजातियां दर्ज की गई। इस अध्ययन में ट्रेमाटोड संक्रमण की उपस्थिति नहीं पायी गई । इस अध्ययन में कुल संक्रमण में (11.82%) विभिन्न जीनस का देखा गया था।

एक अन्य अध्ययन में नागालैंड मिथुन से (*बॉस फ्रौंटेलिस*) में माइक्रोप्लस संक्रमण के खिलाफ कच्चे तेल का हर्बल एकारीडाल प्रभावकरिता का अध्ययन किया गया। एक तुलनात्मक अध्ययन करने के लिए संस्थान फार्म में प्रबंधन की अर्द्ध गहन प्रणाली के तहत पाले गए मिथुन में किलनी के संक्रमण के खिलाफ साइपरमेथ्रिन, नीम,

तम्बाकू और आइवरमेक्टिन की एकारीसीडाल प्रभावकरिता का परीक्षण किया गया। विभिन्न उपचार की क्षमता का उपचार के 0,7,14 और 21 दिनों बाद विश्लेषण किया गया। नीम के प्रभाव कम से कम 21 दिनों के बाद आइवरमेक्टिन 7 से 14 दिनों के बाद प्रभावी हो गया था। तम्बाकू और साइपरमेथ्रिन 14 एवं 21 दिनों बाद प्रभावी पाए गए और यह निष्कर्ष निकाला गया कि मिथुन में माइक्रोप्लस प्रकोप के खिलाफ आइवरमेक्टिन सबसे अधिक प्रभावी एकारीसाइड था।

एक दूसरे अध्ययन में मिथुन (*बॉस फ्रौंटेलिस*) में पेपिलोमटोसिस (मौसा) के इटीयो पैथालॉजी अध्ययन किया गया। संस्थान के दो फार्म में सब मिथुन की जांच की गई है और छह पशुओं के लिए क्यूटेनिस पेपिलोमा और एक मिथुन में कुपी पेपिलोमा से संक्रमित होना पाया गया । इसके अलावा पशुओं के 200 नंबर क्षेत्र में फेक जिले के पोरबा और थीयोपीसु गाँव में स्वास्थ्य शिविर के दौरान जांच की गई ।जंगल में मुक्त चरण के पांच पशुओं में 10 मौसा के नमूने एकत्रित किया गया और नमूने की ऊतक विकृति विज्ञान सूक्ष्म संरचना अध्ययन और वायरस के आणविक लक्षण वर्णन के लिए एकत्र किए गए।

क्षेत्र में तीन पशु स्वास्थ्य व टीकाकरण करने के लिए शिविर आयोजित किए गए है । पशुओं के स्वास्थ्य की स्थिति की जांच करने और मिथुन के विभिन्न रोगों के जांच के लिए नमूनें एकत्रित किए गए। 340 परीक्षण नमूनें लिए गए जिसमें मिथुन के कुल 140 संस्थान में स्थिर और क्षेत्र 200 पेपिलोमटोसिस का मेड्जीफेमा और फेक में (मौसा) प्रसार के लिए रक्त और सीरम के नमूने कुल 226 मिथुन का (फील्ड की स्थिति इस संस्थान से फार्म और 86) से एकत्र किया गया है ।

इसके अलावा संस्थान के मेड्जीफेमा फार्म में 10 मिथुन की मेक्रोस्कोपी का अध्ययन उनकी मृत्यु के कारण के लिए किया गया था। मिथुन मृत्यु के कारण रक्तस्रावी आंत्रशोध (6), ट्रामा (2) , पीलिया (1), हीमोंकस (1) जिम्मेदार पाए गए । एकल त्वचा के अन्दर परीक्षण द्वारा मिथुन की जांच किया गया। चार पशुओं में सकारात्मक और तीन पशु संदिग्ध पाए गए, इन पशुओं को छह सप्ताह की अवधि के बाद फिर से जांच की गई । एक अन्य अध्ययन में 40 मिथुन की योनि स्वाब्स प्रजनन पथ में एरोबिक जीवाणु के लिए जांच की गई । नमूनों के विशलेषण से *स्यूडोमोनास प्रजाति, इन्टरोकोकस प्रजाति, क्लेबसिएला निमोनिया, बुडवि सीया, इस्चीरीया कोलाई, इन्टीरोबेक्टर हारमेचाई, एरोमोनस हाइड्रोफिला, एरोमोनस स्चूवरटी, एरोमोनस यूक्रेनोफीलिया, एरोमोनस सल्मोनोसीडा, सीट्रोबेक्टर फ्रूरोन्डाइ, कलाइवेरा स्चूवरटी , प्रोटियस मिराबिलिस, प्रोटियस पीनेन, प्रोटियस वलगारीस, सीट्रोबेक्टर अमालोन्टिकस, हाफनिया अलबीइ* इत्यादि जीवाणुओं पाए गए एवं आइसोलेटस प्रतिरोध संवेदनशीलता के लिए जांच से पता चला है, कि अधिकांश एटीबायोटिक के प्रति संवेदनशील थे। इनमें 50% से अधिक एम्पीसिलीन के लिए प्रतिरोधी है और कुछ को कौरीमोजोल के प्रति संवेदनशील पाया गया।

पशु चिकित्सा विस्तार विभाग में नागालैंड में मिथुन पशुपालन की स्थिति अर्थशास्त्र साक्षात्कार कार्यक्रम विकसित करने के लिए एक अध्ययन किया गया । साक्षात्कार कार्यक्रम विकसित किए गए एवं प्रारंभिक रूप से समान उत्तरदाताओं पर गैर नमूना क्षेत्र में जांचा गया और इसमें एकत्रित किया एवं इन जानकारीयों के उपयुक्त विधि द्वारा जांचा गया और इसके परिणामों को संकेतीक किया गया। इस सर्वेक्षण यह पाया गया कि मिथुन पालको जिनकी उम्र 50 साल से अधिक उनका सामाजिक, एवं आर्थिक स्तर माध्यम है, शिक्षा हाई स्कूल तक थी, कृषि उनका मुख्य व्यवसाय है एवं पशुपालन से उनको माध्यम आय होती है। यह पाया गया कि मिथुन पाये जाने वाले जगह में घेराव करने से अन्य पशुओं को पृथक रखने में सहायक होता है, जंगल में खाद मिलता है। कई पौधों एवं वृक्षों के विकरण में सहायक होता है एवं पौधे की। वृद्धि (42.90 %) के साथ- साथ चारागाह एवं पशुचारा (57.10) में सहायक होता है।

मिथुन द्वारा प्राप्त खाद तालाब, पोखर और जंगलों में मत्स्यपालन बागवानी एवं अन्य कृषि प्रणाली (14.30%) में सहायक होती है। यह पाया गया कि जहाँ पर मिथुन की जनसंख्या अधिक होती है। वहाँ पर पौधे की संख्या (औषधीय पौधे आरचीड इत्यादि) अधिक होते है जिसकी संभवतः वजह मिथुन उर्वरक का पौधे की वृद्धि में सहायक होता है। इस क्षेत्र में जहाँ पर मांस अधिक खाया जाता है। मांस को संरक्षित एवं एकत्रित पारंपरिक प्रणाली जैसे स्मोकिंग एवं अचार और अन्य पदार्थ बनाये जाते है। हालाँकि इस क्षेत्र में मांस के साथ- साथ चमड़े को भी खाया जाता है और कभी- कभी ऐसे मांस को संरक्षित किए जाते है।

EXECUTIVE SUMMARY

The National Research Centre on Mithun was established in 1988 with the main objectives of conservation and genetic improvement of Mithun germsplasm, development of Mithun nutrition, management, health and products processing technologies related to Mithun. The Institute has made inroad deep inside the Mithun habitat among the tribal rearers of this unique bovine speice found only in the North Eastern Hilly regions of this country through its commitment of service for overall benefit of tribal populace. Efforts were made to depict these research and other endeavour in a summary form.

The NOR banding and silver nitrate staining was standardized with the Mithun metaphase chromosomes. The exposure and incubation of slides with silver nitrates stains were tried in the moist chamber from 24 hrs to 36 hrs and the best results were obtained in the 30hrs incubation. For further analysis with the silver nitrate staining 36 hrs of incubation was performed. The analysis of several NOR banded metaphase showed that the size of NOR bands was quite variable being almost imperceptible in some cases and large in others, with the bands projecting out of the chromatids. The maximum number of NOR bands was not constant in this species and their location was also not placed near centromeric region or telomeric region.

All the animals present at the station farm has been screened cytogenetically including the adults and newly born calves. The cytogenetic profile of these animals has been constructed by conventional Geimsa, C- & R- banding techniques. All the cytogenetic information has been compiled and condensed in the form of a "Digital Album" for the animals. Measurement of chromosome morphology and other parameters of Mithun chromosomes were also calculated.

Trials were started to study the PCR amplification of leptin gene with two different bovine primers. Three reported primers were successfully amplified by PCR method and the PCR products are then further studied to find out the polymorphisms in the fragment of gene by PCR-RFLP method. RFLP was tried with Kpn2I RE's repeatedly in several animals, but were not successful probably due to very small amplicon size (94 bp), thus trials were now being continue to visualize the bands in long run gels. Another reported primer from the exonic region (Pomp et al., 1997) was successfully amplified after standardizing the annealing temperature. The polymorphisms in the the DNA fragment in this region was studied with Sau 3AI R.E. The result found after RFLP was quite encouraging and unique, as some of the unique band is noticed in animals belonging to a specific region. The analysis is this regard in process. The result found after RFLP was quite encouraging and unique, as some of the unique band was noticed in animals belonging to a specific region. The analysis in this regard was in process.

After successful amplification, PCR-RFLP using Hind III was used to screen the Mithun population of the Institute herd for identifying the genotypes in the population with respect to the kappa casein gene of Mithun. Out total 86 samples tested, 78 animals could be genotyped properly. It was found that out of 78 Mithuns, 3 belonged to AA, 66 belonged to AB and 9 belonged to BB genotypes. It was found that majority belonged to AB genotype.

In the A allele, this 271 bp fragment contained no site for Hind III. But the B allele was cleaved by Hind III into two fragments of 181 bp and 90

bp as separated in ethidium bromide stained 2% gel electrophoresis from 271 bp PCR products. The gene (allele) and genotype frequencies were calculated by direct count method.

In another study, the dentition patterns in Mithun were recored and it was compared with the cattle. After that, validation of dentition patterns was done in the field condition and age of Mithun could be estimated reasonably accurate from dentition patterns.

The effect of incorporation of ensiled spent grain in the diet of adult Mithun was studied. The dry matter intake was 70.6, 72.5 and 45.2 g per kg metabolic body size per day in groups I, II and III, respectively. The dry matter intake decreased quadratically (P=0.021) due to incorporation of graded level of spent grain in the diet of Mithun. However, dry matter digestibility was 60.5, 52.2 and 53.9% in groups I, II and III, respectively showing no specific trend (P=0.154). It was concluded that incorporation of higher level of ensiled spent grain in the diet of Mithun has a negative effect on total feed intake. The microbial load in calcium hydroxide and urea treated ensiled spent grain was determined.

In another study, six types of feed blocks have been prepared using paddy straw, tree leaves *(Schima wallichii)*, spent grain, crushed maize, mustard cake, wheat bran, rice bran, mineral mixture and common salt. The moisture content of paddy straw, tree leaves *(Schima wallichii)*, spent grain, crushed maize, mustard cake, wheat bran, rice bran varied between 11 – 15, 73 – 82, 72 – 76, 10 – 14, 11 – 15, 9 – 13 and 10 – 16%, respectively. The tree leaves and spent grains were sun dried with or without application of graded levels of pressure. The tree leaves and paddy straw were chaffed at a length of 2 cm or less. The ingredients were mixed and compacted at 300 psi for three minutes.

The total gas and methane production pattern in Mithun was studied through in vitro fermentation studies in glass syringes in locally available fodders in the presence of buffer and inoculum of rumen liquor.

Thirty (30) fibre degrading bacteria were isolated from the rumen of mithun using techniques of serial dilutions and repeated tubing of the selectively enriched microbial cultures. Isolates were subjected to analysis for in vitro gas production (Menke and Steingass, 1988), CM Cellulase and Xylanase (Kamra and Agarwal, 2003) for selection of superior isolates for fibre degradation. Three isolates of rumen bacteria found to be superior in fibre degradation were characterized

In another study, carcass characteristics of mithun fed on different levels of dietary protein was determined. The weight of different organs like kidney, heart, liver, intestine and spleen did not differ significantly between different groups. However, there was more fat deposition in animals on high protein fed diet. There was minimum fat deposition in the animals on low protein fed diet. The dressing percentage was highest for low protein fed animals and lowest for high protein fed animals. The meat samples when analyzed, it was observed that, there was no significant difference in the chemical composition of carcass except fat when fed on different levels of protein. This indicated that, lower level of protein as used in this experiment is having better carcass characteristics compared to high level of protein.

In another study, carcass characteristics, and meat quality of Mithun *(Bos frontalis)* was compared with local cattle (Tho-tho) of Nagaland. Mithun was found to have higher dressing percentage of meat than cattle. The dressing percentage of mithun was 58.82% whereas for cattle it was 55.96%. This was again confirmed from the shrinkage percentage of

the animals where the shrinkage was more in mithun compared to cattle. Organoleptic evaluation in terms of color, flavor, juiciness, tenderness and overall acceptability showed that the mithun meat had better quality ($P<0.05$) compared to cattle meat. Microscopic Properties of mithun and cattle leather were also studied.

In physiological study, cryopreservation of mithun semen using Tris-Egg yolk-citrate extender with different concentrations of glycerol was carried out successfully. In order to check the efficacy of the cryopreserved semen sample, AI was done in Mithun cows at Khunoma village. The animals were inseminated at 10 to 12 hours following the onset of oestrous. Pregnancies were determined by non-return to oestrous of the inseminated cows and by per rectal examination at 60 days following insemination. Two Mithun calves were born in 2010 under field condition.

In another study, the suitable doses of GnRH and LH/hCG were standardized for induction of ovulation in mithun. Timing of Ovulation in Relation to Onset of Estrus and LH Peak in Mithun Cows was also determined. Study was also conducted to characterize the ovarian folliculogenesis/follicle maturation pattern in mithun during spontaneous estrous cycle in mithun by ultra-sonography.

It was also found to induce cow-calf attachment/bonding immediately after birth in Mithun cows that exhibit mismothering behaviour using simple intranasal spray of oxytocin.

Pathogenic bacteria namely *Salmonella spp.* and *E. coli* were isolated from meat and milk samples of Mithun. A total of 30 samples each of mithun meat and milk were examined for the presence of pathogenic bacteria *(Escherichia coli, Salmonella spp., Clostridium spp.* and *Staphylococcus spp.)*. It was found that out of 30 samples from mithun meat, 15 were positive for *Escherichia coli*, 8 samples were positive for *Salmonella spp.*, 12 samples were positive for *Clostridium spp*. And 12 samples were positive for *staphylococcus spp.* , Out of 30 mithun milk samples, 10 were positive for *E.coli,* 10 for *Salmonella spp.*, 20 for *staphylococcus spp.* and 14 for *Clostridium spp*.

In another study, 11 genes that regulate muscle growth and marbling in other bovines were selected and expression patterns were studied in Mithun using reverse transcriptase PCR and gel electrophoresis. The expression patterns of 11 selected genes regulating muscle growth (GH1, GHR, IGF2, IGF1R and MSTN), marbling (FABP4 and FABP5) and muscle fibre growth (MYF5, MATR3 and TCAP) in growing mithun of different growth rates. It was found that the expression of GH1, GHR, IGF2 and IGF1R genes were higher in muscle of those animals that grow faster. On the contrary, increased expression of MSTN gene was found in the animals with slower growth rate. Higher expression of FABP4 and FABP5 were recorded in the animals that showed better marbling of the meat. Expression of the genes related to muscle fibre growth (MYF5, MATR3 and TCAP) were higher in mithuns that exhibited higher body growth. It is suggested that GH1/GHR/IGF1R/MYF5/MATR3/TCAP (which are positive regulator for muscle growth) and MSTN (negative regulator of growth) genes may be used for selection of mithun to be used for meat at an early age. FABP4/5 may be used as indicator of marbling of mithun muscle.

In Livestock Production And Management, Comparative Tricine SDS-PAGE pattern of milk casein fractions of mithun and cow was studied. Irrespective of species and sample type (dry vs. wet) three common distinct bands were identified in all the lanes with molecular

weight calculated as 65.62 2.65, 36.1 0.94 and 27.2 0.69 kDA. Nevertheless differences in band pattern were observed between dry and wet casein lanes. Irrespective of species in all the wet casein lanes the band with molecular weight of 13.94 0.68 kDa was present whereas another band with molecular weight of 17.24 0.76 kDa was found only in the dried casein lanes.

In another study, total phospholipids content in mithun, yak and cattle ghee was determined by extracting the fat with organic solvents. The estimated total phospholipids content (mg/100g of fat) in mithun ghee (14.42 ± 0.80) was found significantly ($p<.05$) lesser than that of yak (17.19 ± 0.87) and cow ghee (17.55 ± 3.03) (table1).

In Animal Health, studies was conducted on tick infestation in naturally infested mithuns *(Bos frontalis)*. Examination of body surface of the animals revealed no ectoparasites other than Ixodid tick of the species Boophilus microplus . The common predilection sites of ticks were inner side of pinna, legs, belly, abdomen and neck. Out of the total 176 animals examined, 103 (58.52%) had tick infestation. Infestation was higher in free range mithuns which might presumably due to contact with wild animals in the forest. Intensity of infestation was highest in older animals and only 4 (2.27%) in younger animals.

Prevalence of Gastrointestinal Helminthes parasites in free ranging mithun *(Bos frontalis)* from Phek district of Nagaland was also studied. The infected faecal samples positive for strongyle group of nematode parasites were subjected to coproculture for generic identification. The overall recorded incidence of gastrointestinal parasite was highest in case of *Trichostorngylus spp.* (23.65%), followed by *Cooperia spp.* (10.75%), *Haemonchus spp.* (9.67%), *Oesophagostomum spp.* (6.45%), *Toxocara vitulorum spp.*(2.15%) and *Nematodirrus spp.* (1.07%). Among tape worm infection, both species of *Moniezia benedeni* (7.52%) and *M. expansa* (2.15%) was recorded. However trematode infection couldn't be noticed during the present investigation. A total of 11.82% was noticed as a mixed infection comprising of different genus.

In another study, acaricidal efficacy of crude herbal against *Boophilus microplus* infestation in mithuns from Nagaland was estimated. A comparative study was undertaken to test the acaricidal efficacy of Cypermethrin, Neem, Tobacco and Ivermectin against the infestation of ticks in mithuns reared under semi-intensive system of management at the institute farm. Efficiency of various treatments was analysed at 0, 7, 14 and 21st days after treatment. Among various treatment neem was was found to be least effective even after 21 days where as Ivermectin was found to be effective on 7 and 14th day of post treatment. Tobacco and Cypermethrin were found to be effective on 14 and 21th day of post treatment. It was concluded that Ivermectin was most effective acaricide against *B. microplus* infestation in mithun.

In another, etiopathology of Papillomatosis (warts) in Mithun *(Bos frontalis)* was studied. All the Mithuns at the two farms of the Institute have been examined and six animals were found to be infected with cutaneous papilloma and Teat papilloma was found in one Mithuns. Besides, 200 numbers of animals were examined in field condition during animal health camps in Porba and Thupuvisu villages of the Phek district. Warts were observed in five animals in the free ranging condition in the forest. A total of 10 warts samples were collected from mithun affected with warts. The samples were collected for histopathology, Ultrastructural study and molecular

characterization of the virus.

Three animal health cum vaccination camps have been organized in field condition to examine the health status of the animals and collect samples for screening of various diseases of Mithuns. A total of 340 Mithuns were surveyed (140 from the institute farm and 200 from field condition) for the prevalence of papillomatosis (warts) in Medziphema and Phek. Blood and Serum samples have been collected from a total of 226 Mithuns (140 from the Institute Farm and 86 from field conditions) for carrying out disease surveillance in Mithuns.

Besides, complete necropsy was done for 10 Mithuns at the Medziphema farm of the Institute and the cause of their death were attributed to haemorrhagic gastroenteritis (6), trauma (2), taundice (1), Haemonchosis (1). Screening of Mithuns for tuberculosis (Single Intradermal Test) was also carried out at the Medziphema farm and four animals were tested positive and three were found to be doubtful. These will be re-examined again after period of six weeks. In another study, vaginal swabs of 40 Mithuns were screened for aerobic bacteria in the lower reproductive tract. Analysis of samples revealed presence of *Pseudomonas sps. Enterococcus sps. Klebsiella pneumonia, Budbicia acquatics, Escherchia coli, Enterobacter hormaechei, Aeromonas hydrophilla, Aeromonas schubertii, Aeromonas eucranophila, Aeromonas salmonicida, Citrobacter freundii, Kluyvera cryoscens, Proteus mirabilis, Proteus penneri, Proteus vulgaris, Citrobacter amalonaticus, Hafnia albei,* etc. Bacterial isolates were examined for antimicrobial sensitivity. Most of the isolates were sensitive to majority of the antibiotics tested. However, more than 50% were resistant to ampicillin and a few to cotrimoxazole.

In Veterinary Extension, a study was undertaken to find out status and economics of Mithun Husbandry in Nagaland. Interview schedules were developed and pre-tested on similar respondents in non-sample area and suitable modification were made in the schedules accordingly. Data were collected with the help of interview schedule from selected village. Analysis and interpretation of data was done after collection of information. Survey work on Mithun farmers revealed that they were of the age group of above 50 years with medium to high socio-economic status, education status up to high school, agriculture as their main occupation and medium level of income from Animal Husbandry. It was also observed that the Mithun farmers raising more Mithuns had more income from Animal Husbandry, had more total income and had high socio-economic status. It was found that fencing of Mithun rearing area helped other livestock in that place (57.10%) and manured the forest, spread the seeds of many plants and trees and also helped in plant growth (42.90%) as well as grassland and fodder production (57.10%).

Regarding Integrated farming system the farmers told that their Mithuns manured the pond and forest with faeces that helped in fishery, horticulture and others farming system (14.30%). It was also found that where Mithuns were raised, plant population (including medicinal plant, orchid etc) increased and manure of Mithuns helped in better plant growth. In this region with high meat consumption, meat were preserved and stored by their traditional system i.e. by smoking of meat. The people of this region also prepared Mithun meat pickle and others items from meat, although in this region skin was consumed along with meat and sometimes preserved with meat to eat.

INTRODUCTION

The National Research Centre on Mithun was established in June, 1988 with the main objectives of conservation and genetic improvement of Mithun germsplasm, development of Mithun nutrition, management, health and products processing technologies related to Mithun. The Centre, which started its functioning from Barapani near Shillong during the initial days, grew considerably over the years in its present location of Nagaland despite some socio-political and logistic difficulties. The Institute has made inroad deep inside the Mithun habitat among the tribal rearers of this unique bovine speice found only in the North Eastern Hilly regions of this country through its commitment of service for overall benefit of tribal populace.

Mithuns which are thought to be originated in the Indo-Myanmar border area are now restricted only in the hilly parts of four North East States (Nagaland, Arunachal Pradesh, Manipur and Mizoram) and found a loving relation with their tribal owners since antiquity. Inspite of this, decreasing population of Mithuns in three of the four states (Nagaland, Manipur and Mizoram) has been a concern even if there is increasing trend of Mithun population in Arunachal Pradesh. We are deeply concerned for this declining trend of Mithun population even though this is a fact to be realized and similar to other well-known livestock breeds in Inda. Mithuns are part of tribal life in their rugged and hilly terrains and hence, any improvement programme for Mithuns will be a natural and correlated sign of benefit for tribal population because Mithun is a source of food as well as companions of tribals.

The Annual Report of this Institute is not only the treasure of information related to different aspects of research on Mithun *(Bos frontalis)* of a particular year, but also this contains all those nitty-gitty news in nutshell. Every effort is made to show case the whole panorama of work carreid out by this Institute in all its hues. It will be a matter of satisfaction for us if these efforts could benefit the people in any way in this Mithun country!

जनादेश

- देश में उपलब्ध मिथुन के जननद्रव्य की पहचान, मूल्याँकन एवम गुणवर्णन करना।
- दुग्ध एवं मांस उत्पादन के लिए मिथुन का गुणवर्धन एवम संरक्षण करना।
- मिथुन के जननद्रव्य का संग्रह एवम सूचना केन्द्र के रूप में कार्य करना।

MANDATE

- Identification, evaluation and characterization of Mithun germplasm available in the country.
- Conservation and improvement of Mithun for meat and milk.
- To act as repository of a germplasm and information centre on Mithun.

FINANCIAL STATEMENT (2010-11)

Plan

(₹ in lakh)

Sl.no	Head of Account	Revised Estimate	Expenditure Incurred
1	Esstt. Charges	-	-
2	OTA	-	-
3	TA	5.00	5.00
4	Contingency	166.97	166.96
5	Equipments	18.00	17.99
6	Works	98.00	97.99
7	Library	10.00	10.00
8	Vehicle	8.88	8.88
9	HRD	3.00	3.00
10	Furniture and fixtures	2.50	2.50
11	Livestock's	2.00	2.00
12	Maintenance	4.00	4.00
	TOTAL	318.35	318.32

Non Plan

(₹ in lakh)

Sl.no	Head of Account	Revised Estimates	Expenditure Incurred
1	Esstt. Charges	195.00	195.00
2	Wages	2.00	2.00
3	OTA	0.30	0.30
4	TA	2.00	1.99
5	Other charges	10.50	10.50
6	Works -annual repair & maintenance		
	i. Office building	1.65	1.65
	ii. Residential building	4.75	4.75
	iii. Minors works	1.80	1.80
	TOTAL	218.00	217.99

RESOURCE GENERATION (2010-11)

(₹ in lakh)

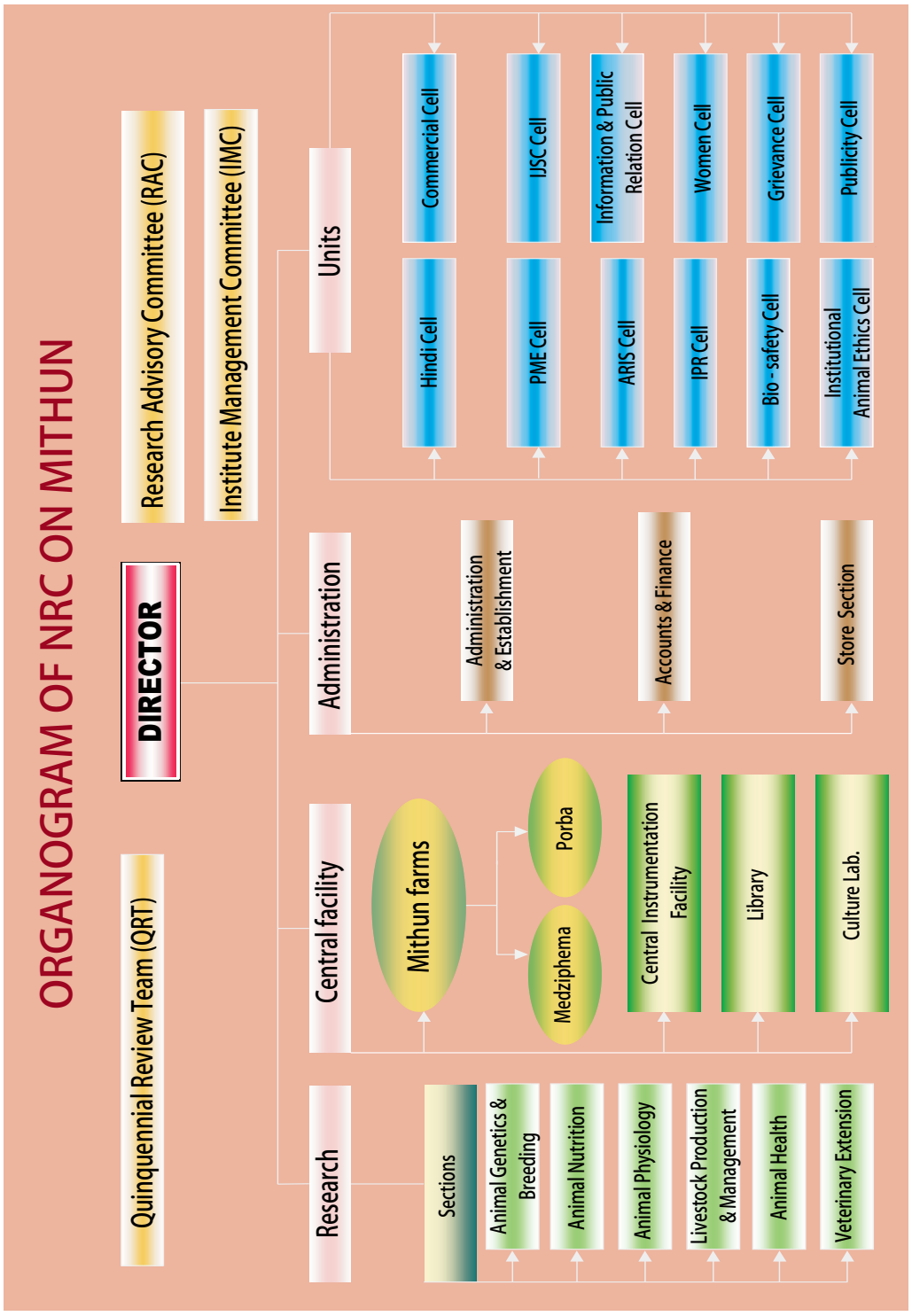
Sl. no.	Items	Resource Generation	
		Target	Actual
1.	Sale of farm produce, others sales	9.00	12.07

STAFF POSITION

Category	VIIth	IXth	Xth	XIth	Redeployment/ Revision of cadre strength	Present Strength after redeployment' Revision	Present Position	Vacant
RMP	1	-	-			1	1	-
P.S	1	-	-			1	2	-
Sr.Scientist	3	-	-		1	4	3	1
Scientist	7	-			3	10	6	4
T6	3	-	-			3	3	-
AO	-	-	-		-	1	-	1
AAO	1	-	-		-	2	1	1
AFAO	-	1	-		-	1	-	1
Assistant	1	-	-		-	4	2	2
UDC	1	1*				1		1
LDC	1	1*	-		1	4	3	1
Jr.Steno	1	-	-		-	1	-	1
T2	-	5*	-		-		-	-
T1	2	5*	-		-	2	2	-
Supporting	8	7*	3**		-	8	7	1
Total	30	20(19*+1)	3**		5	43	30	14

*IXth Plan post not created. **Xth Plan post not created.

The man and his Mithuns


ORGANOGRAM OF NRC ON MITHUN
Quinquennial Review Team (QRT)
DIRECTOR
Research Advisory Committee (RAC)
Institute Management Committee (IMC)
Research
Sections
Animal Genetics & Breeding
Animal Nutrition
Animal Physiology
Livestock Production & Management
Animal Health
Veterinary Extension
Central facility
Mithun farms
Porba
Medziphema
Central Instrumentation Facility
Library
Culture Lab.
Administration
Administration & Establishment
Accounts & Finance
Store Section
Units
Hindi Cell
Commercial Cell
PME Cell
IJSC Cell
ARIS Cell
Information & Public Relation Cell
IPR Cell
Women Cell
Bio - safety Cell
Grievance Cell
Institutional Animal Ethics Cell
Publicity Cell

Research Achievements

"I don't know what I may seem to the world, but as to myself, I seem to have been only like a boy playing on the sea-shore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me" – *Issac Newton (1642-1727)*

ANIMAL GENETICS AND BREEDING

Genetic studies on Mithun

Ag-NOR banding

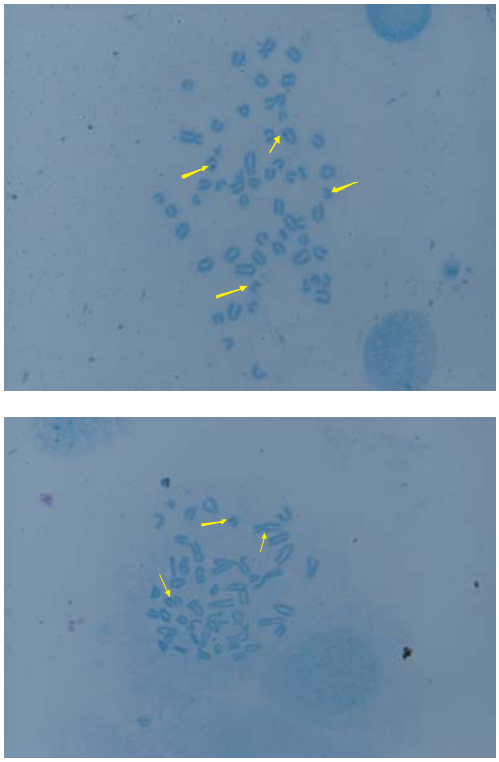
Chromosome banding methods are either based on staining chromosomes with a dye or on assaying for a particular function. Silver nitrate stains chromosomal proteins associated to active ribosomal cistrons (18S+28S). The borate pretreatment with a high pH facilitates the silver reaction, especially useful when sequential banding procedures are used.

Chromosomes are treated with silver nitrate solution which binds to the Nucleolar Organizing Regions (NOR), i.e., the secondary constrictions (stalks) of acrocentric chromosomes. NOR banding has been employed principally in the localisation of nucleolar organizing regions. It has been suggested that these bands represent certain structural non-histone proteins specifically linked to nucleolar organizers in different eukaryotic chromosomes. This technique was first applied by Matsui & Sasaki, 1973 for human chromosomes.

The NOR banding and silver nitrate staining was standardized with the Mithun metaphase chromosomes. The exposure and incubation of slides with silver nitrates stains were tried in the moist chamber from 24 hrs to 36 hrs and the best results were obtained in the 30hrs incubation. For further analysis with the silver nitrate staining 36 hrs of incubation was performed.

The figure showed some NOR banded chromosomes associated with one or other nucleolar organizer region. The analysis of several NOR banded metaphase showed that the size of NOR bands was quite variable being almost imperceptible in some cases and large in others, with the bands projecting out of the chromatids.

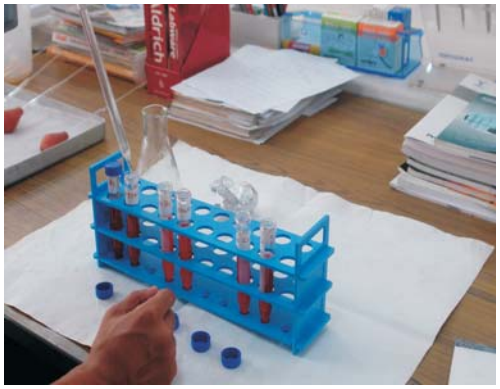
The maximum number of NOR bands is not constant in this species and their location is also not placed near centromeric region or telomeric region. This is perhaps owing to the temporary inactivation of 18S+28S r RNA at the particular moment. Or this may reflect the presence of different r DNA amount in the NOR's and the occurrence of r DNA polymorphisms (Evans *et al.*, 1974). Some of the animals didn't show any NOR is a band, thus interpretation difficult for the race and species in question.



Silver nitrate staining showing black spots (arrow pointed) in some autosomes of Mithun

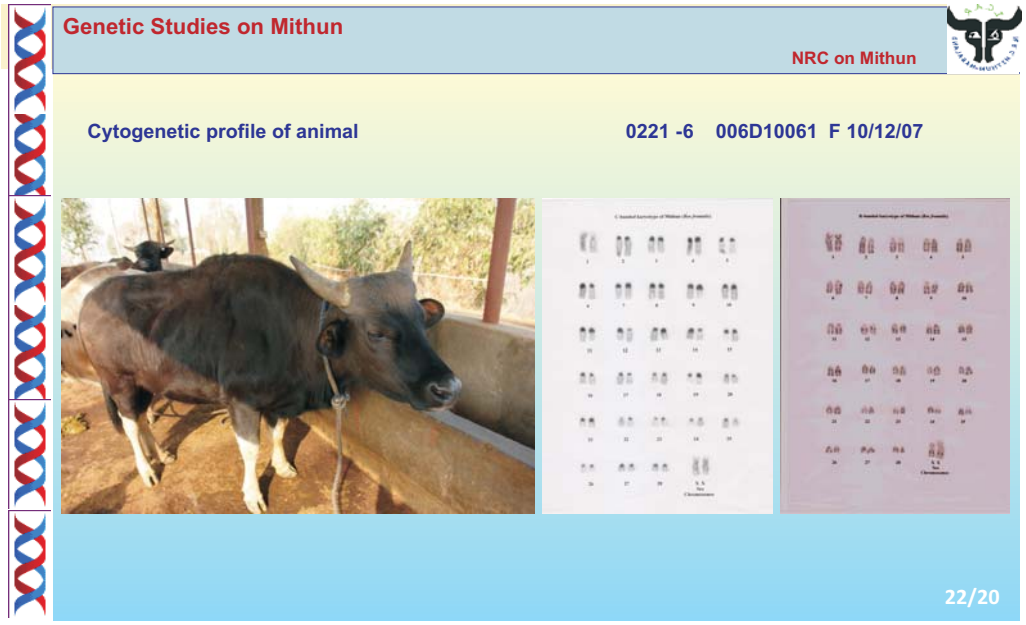
Cytogenetic analysis of animals

All the animals present at the station farm has been screened cytogenetically including the adults and newly born calves. The cytogenetic profile of these animals has been constructed by conventional Geimsa, C- & R- banding techniques.



Lymphocyte culture harvesting for preparation of metaphase chromosome

All the cytogenetic information has been compiled and condensed in the form of a "Digital Album" for the animals.



"Digital Album" showing cytogenetic profile of the animals present at the Institute Farm.

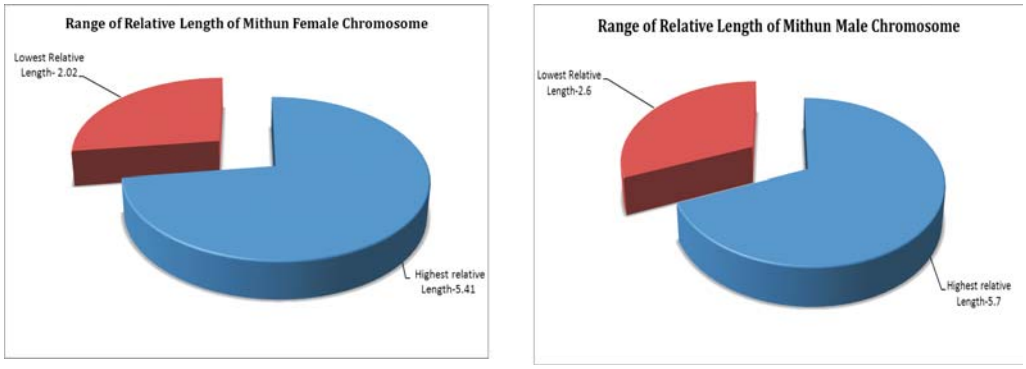
C-Banding in Mithun Metaphase chromosome

The C-banding was done to study the position of centromere, with this technique the centromere are darkly stained and is very clearly visible in acrocentric chromosomes. All the animals have been screened by the C-band patterns and the pattern has been recorded in the Digital Album.

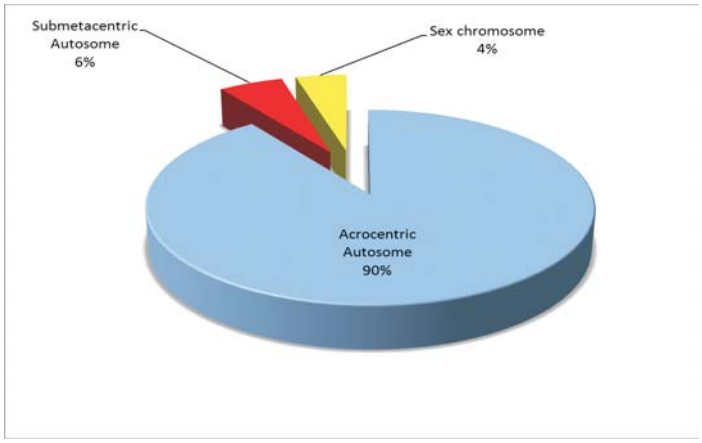
Measurement of chromosome morphology

The various parameters estimated for the chromosome morphology were summerised and presented below:

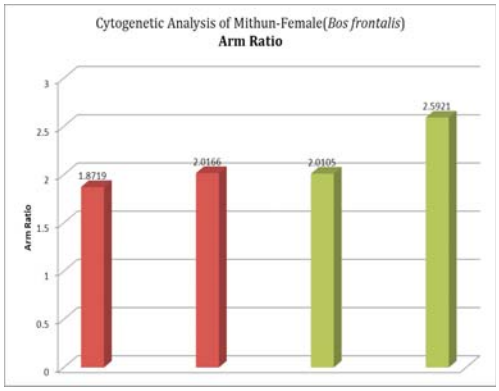
S.No.	Parameter	Autosomes		Sex Chromosome		
		Female	Male	Female	Male	
				X	X	Y
1.	Relative Length					
	a) Mean RL	1.75 -5.7	1.76 -5.51	4.47	4.79	1.57
	b) Contribution to total genome					
	i) Submetacentric	21.20	19.63	-	-	-
	ii) Acrocentric	78.80	78.80	-	-	-
	iii) Metacentric	-	-	-	-	1.57
2.	Arm Ratio					
		2.20	2.59	1.85	2.03	1.12

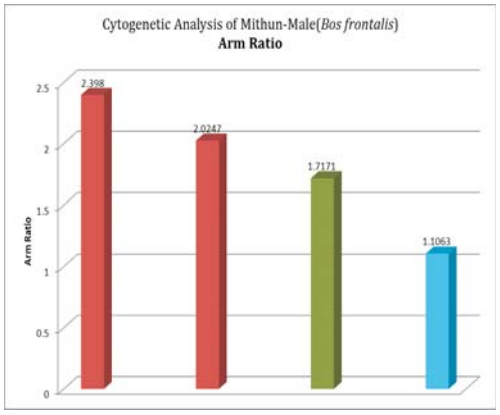


Range of Relative Length of female and male Mithun chromosome

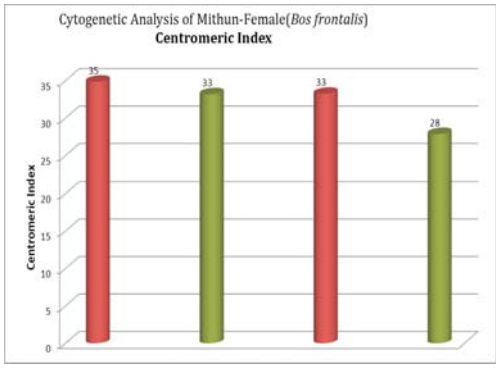


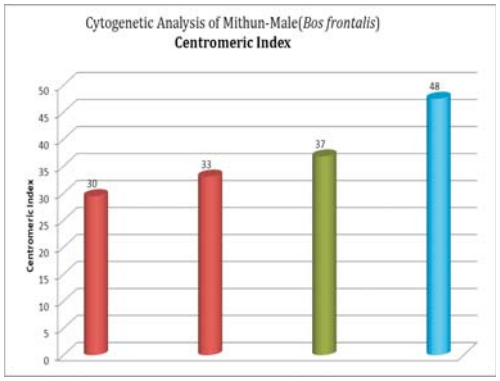
Contribution to the total Genome by various types of chromosomes



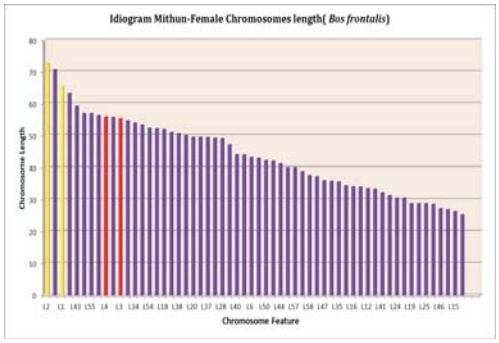


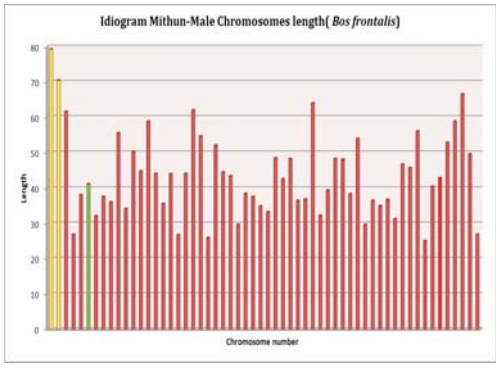
Arm ratio of female and male Mithun chromosome





Centromeric index of female and male Mithun metaphase chromosome





Ideogram of female and male Mithun metaphase chromosomes

Genetic Stduy on Leptin gene and its association with growth and nutritional performance traits in Mithun *(Bos frontalis)*

An array of new markers has been developed to carry out the genetic variation studies at DNA level. Among these, one of the candidate genes for marker assisted selection (MAS) is leptin (Fruhbeck et al., 1998). Leptin is a 16- kDa protein that circulates in the serum in free and bound forms and functions as a lipostatic signal (Geary *et al.*, 2003). In farm animals, control and prediction of fatness is of a high economic interest. The exaggerated adipose tissue development in farm animals negatively affects whole body metabolism and meat quality (Taouis *et al.,* 2001). Leptin polymorphisms have significant effect on alterations in energy balance, milk production, fertility traits and live weight (Buchanan et al., 2002; Lagonigro *et al.*, 2003; Almeida et al., 2003; Nkrumah et al., 2005). Variations at DNA level contribute to the genetic characterization of livestock populations and this may help to identify possible hybridization events as well as past evolutionary trends (Vivek *et al.*, 2005). In ruminants, leptin receptor expression seems to be affected by high and low nutrition levels (Chilliard et al., 2005) and blood leptin concentrations seem to interfere in luteinizing hormone secretion (Kadokawa *et al.*, 2006) and to stimulate growth hormone release (Nonaka *et al.*, 2006). In cattle, the leptin gene is located on Chr 4 (Stone *et al.*, 1996) and consists of three exons. The last two exons contain the coding sequence and are separated from the promoter and first exon by a large intron of 14 kb (He *et al.*, 1995; Gong *et al.*, 1996).

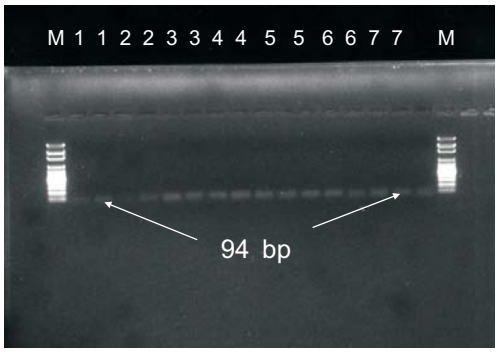
Trials were started to study the PCR amplification of leptin gene with two different primers. Three reported primers were successfully amplified by PCR method and the PCR products are then further studied to find out the polymorphisms in the fragment of gene by PCR-RFLP method.

One of the primers for the exonic region reported by Buchanan *et al.* (2002) was successfully amplified, after standardization for the annealing temperature.

RFLP was tried with Kpn2 I RE's repeatedly in several animals, but were not successful probably due to very small band size, thus trials are now being continue to visualize the bands in long run gels.

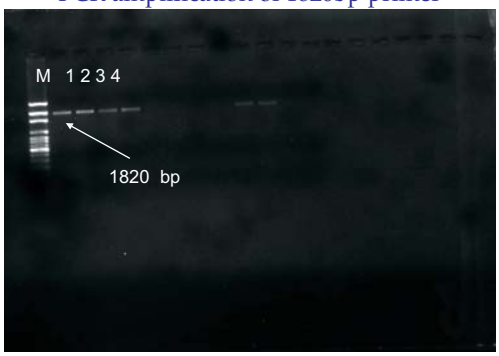
Another reported primer from the exonic region (Pomp et al., 1997) was successfully amplified after standardizing the annealing

94bp amplicon of leptin gene



Ethidium bromide stained Agarose gel of PCR amplified region of Mithun leptin gene. Lane M: 100 bp DNA ladder; Lane 1-7: PCR amplified 94 bp products

PCR amplification of 1820bp primer



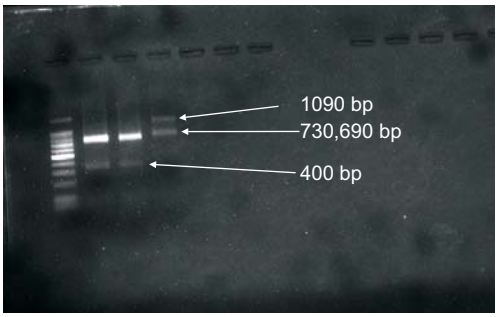
Ethidium bromide stained Agarose gel of PCR amplified region of Mithun leptin gene. Lane M: 2000 bp DNA ladder; Lane 1-4: PCR amplified 1820 bp products

temperature. The polymorphisms in the the DNA fragment in this region was studied with Sau 3AI R.E. The result found after RFLP was quite encouraging and unique, as some of the unique band is noticed in animals belonging to a specific region. The analysis is this regard in process.

The result found after RFLP was quite encouraging and unique, as some of the unique band is noticed in animals belonging to a specific region. The analysis is this regard in process.

The unique band found in Mithun may be due to another variant of the gene and till date only heterozygous (marked as AC or BC in green) but none of the homozygous (marked as CC in red) animal possessing this allelic variant have been noticed (Table 1).

New bands in Nagaland strains (Tuensang) animals



Ethidium bromide stained Agarose gel of RFLP generated fragments of Mithun leptin gene. Lane M: 2000 bp DNA ladder; Lane 1-3: RFLP products (730, 690bp) heterozygous animals

Table 1. Analysis of RFLP fragments generated in 1820 primer

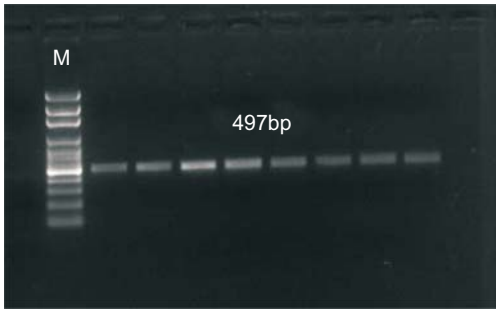
S.No	Fragment Size (bp)	AA	AB	AC	BB	BC	CC
1	1090			√		√	√
2	730	√	√	√	√	√	√
3	690	√	√	√	√	√	
4	400	√	√	√			
5	310		√		√	√	
6	90		√		√	√	

Genetic Characterization of kappa casein gene of Mithun

Genetic polymorphism in CSN3 gene of Mithun was identified by using PCR-RFLP-Hind III technique with 271 bp and 874 bp PCR products (between exon 4 and intron 4 region of CSN3 gene of Mithun). Mithuns from the Institute farm were screened by using a number of RE's viz. HindIII, EcoRI, MboII and Sau3AI. However, only HindIII produced definite restriction endonuclease patterns in Mithun yielding approximately 181bp & 90bp fragments for 271 bp product and 521 bp & 353 bp fragments for 874 bp PCR products, respectively.

Two more bovine primers were utilized to successfully amplify 497 bp and 350 bp regions of the part of exon IV and intron IV of Mithun Kappa casein gene. Genomic DNA isolated from blood using standard protocol and PCR amplification was standardized using these two sets of reported bovine primers.

Ethidium bromide stained 2% Agarose gel showing 350 bp PCR amplicon of Mithun CSN3 gene. M: 100bp DNA ladder.



Ethidium bromide stained 2% Agarose gel showing 497 bp PCR amplicon of Mithun CSN3 gene. M: 100bp DNA ladder.

After successful amplification, PCR-RFLP using Hind III was used to screen the Mithun population of the Institute herd for identifying the genotypes in the population with respect to the kappa casein gene of Mithun. Out total 86 samples tested, 78 animals could be genotyped properly. It was found that out of 79 Mithuns, 3 belonged to AA, 66 belonged to AB and 9 belonged to BB genotypes. It was found that majority belonged to AB genotype.

In the A allele, this 271 bp fragment contained no site for Hind III. But the B allele was cleaved by Hind III into two fragments of 181 bp and 90 bp as separated in ethidium bromide stained 2% gel electrophoresis from 271 bp PCR products.

The gene (allele) and genotype frequencies were calculated by direct count method and given below. Further work was in progress to cover more samples for genotyping in respect of kappa casein gene of Mithuns.

Species	N	Allele frequencey		Genotype frequency		
		A	B	AA	AB	BB
Mithun	78	0.67	0.33	0.04	0.85	0.11

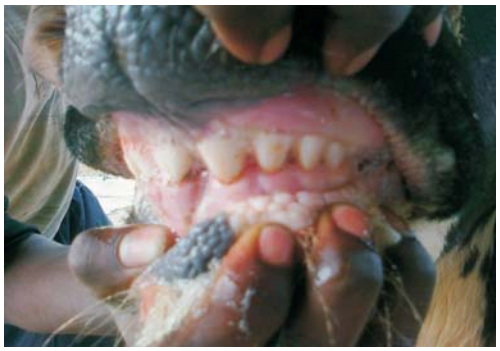
Maidens of the Mithun Country

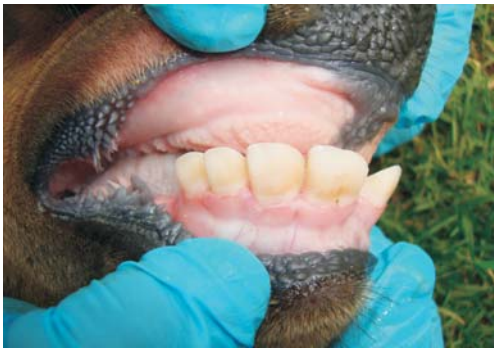
Morphometric and Genetic characterization of Mithun

The dentition patterns in Mithun were recored as per format developed previously starting with the Mithuns kept in the institute farm and it was compared with the cattle. After that, validation of dentition patterns was done in the field condition. The observed dention patterns of Mithun in comparion with cattle has been presented below.

Temporary teeth eruption in Mithun in comparison to Cattle

	Mithun	Cattle
Temporary Incisors		
First, second and third pairs of incisors	Birth to one week	Birth to two weeks
Four pairs of incisors	3 months & above	Birth to two weeks



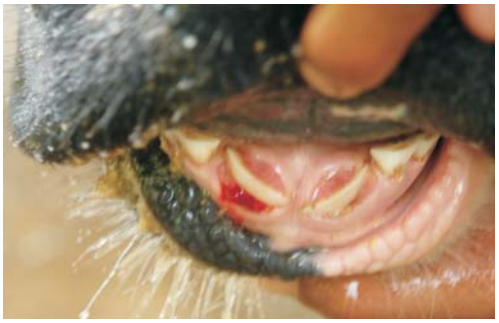


Temporary incisors of Mithun

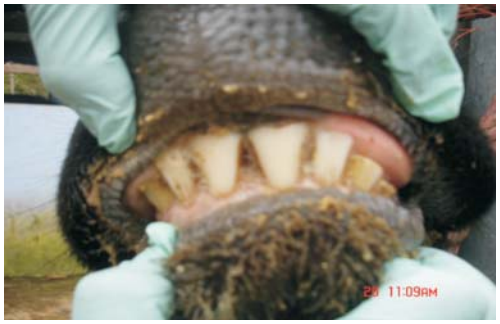
Permanent teeth eruption in Mithun

	Mithun	Cattle
One pair of incisors	22 mths to 3 yrs	1½ to 2 yrs
Two pairs of Incisors	3 to 4 yrs	2 to 2 ½ yrs
Three pairs of incisors	4 to 6 yrs	3 yrs
Four pairs of incisors (Full mouth condition)	6 yrs and above	3 ½ to 4 yrs

Wearing off of temporary incisor

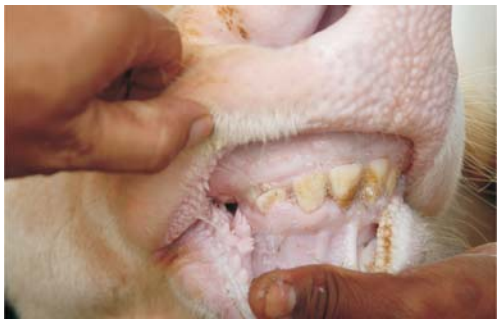


Erruption of 1st pair of permanent incisor



Erruption of 2nd pair of permanent incisor

Erruption of 3rd pair of permanent incisor



Erruption of 4th pair of permanent incisor

Morphometric measurements of different phenotypic traits of adult Mithun as well as Mithun calves were recorded as per proforma developed previously. The phenotypic traits measured included body weight, heart girth, height at weithers, body length (point of shoulder to pin bone), head length, face length, horn length and shape, horn circumference at base, neck circumference, tail length, coat colour patterns, hooves color, color of tail-switch and its behaviour (docile, semi-docile and aggressive). The resutls of these morphometric measurements were presented (Table 2).

The man, the trumpet and the Mithuns

Table 2. Means with Standard errors of different Morphometric Parameters of Mithun

	Sex		Adlt Wt kg	Ht at With cm	Body Length cm	Heart Girth cm	Face Length cm	Tail Length cm	Neck Circum cm	Neck Length cm	Ear Length cm	Horn Length cm	Horn Circ cm
NAGALAND	Female	n	8	21	21	21	21	21	21	21	21	21	21
		MEAN	354.25	125.80	179.25	174.62	39.97	80.60	84.67	42.46	21.66	24.05	26.41
		STDV	56.70	6.17	16.65	14.30	4.03	12.13	12.51	5.15	2.03	5.69	5.47
		Error	20.04	1.35	3.63	3.12	0.88	2.64	2.73	1.12	0.45	1.24	1.19
	Male	n	9	21	20	21	21	21	21	20	21	21	21
		MEAN	372.50	125.40	177.15	179.87	43.20	86.95	99.27	40.54	20.56	30.93	37.08
		STDV	61.62	6.89	12.93	11.79	3.17	7.28	15.61	4.95	1.74	7.62	5.63
		Error	20.54	1.49	2.89	2.57	0.69	1.59	3.40	1.10	0.38	1.62	1.22
ARUNACHALI	Female	n	5	11	11	11	11	11	11	11	11	11	11
		MEAN	339.40	124.06	184.13	178.35	40.68	83.30	84.13	44.09	22.23	23.22	26.22
		STDV	31.37	3.20	10.66	8.05	1.67	6.91	14.80	3.85	3.68	5.57	3.44
		Error	14.03	0.96	3.21	2.42	0.50	2.08	4.46	1.16	1.12	1.68	1.03
	Male	n	1	4	4	4	4	4	4	4	4	4	4
		MEAN	335	127	184	184.25	40.5	82.25	121.25	43.75	19.5	27.5	32.25
		STDV	---	3.26	16.24	7.93	4.35	2.98	30.34	4.12	3.31	9.97	10.78
		Error	---	1.63	8.12	3.9	2.17	1.49	15.17	2.05	1.65	4.97	5.39
MIZORAM	Female	n	8	10	10	10	10	10	10	10	10	10	10
		MEAN	363.93	130.02	182.78	173.93	40.21	83.23	81.40	44.61	20.20	22.35	27.13
		STDV	32.67	12.56	10.90	7.87	2.26	9.95	19.33	5.67	2.74	5.12	4.88
		Error	11.55	3.97	3.44	2.49	0.71	3.14	6.12	1.79	0.86	1.61	1.54
	Male	n	1	2	2	2	2	2	2	2	2	2	2
		MEAN	398.5	130.5	184	182	43.5	81.5	112	41.5	19	29	32.5
		STDV	---	2.12	11	4	0.7	0.7	43.84	2.12	2.82	2.82	6.36
		Error		1.5	15.56	5.65	0.5	0.5	31	1.5	2	2	4.5
MANIPUR	Female	n	4	7	7	7	7	7	7	7	7	6	6
		MEAN	334.00	124.28	185.50	181.15	40.97	82.21	76.07	47.85	19.64	22.50	25.00
		STDV	14.37	4.12	5.59	10.24	2.57	3.13	8.81	14.90	1.74	3.13	4.85
		Error	7.18	1.55	2.11	3.87	0.97	1.18	3.33	5.63	0.66	1.27	1.98
	Male	n	6	6	6	6	6	6	6	6	6	6	6
		MEAN		127.33	183.33	183.66	43.00	85.50	117.00	42.50	20.50	28.16	35.50
		STDV		5.12	12.45	7.73	1.26	2.94	23.51	6.37	1.64	5.67	12.67
		Error		2.09	5.08	3.15	0.51	1.20	9.6	2.60	0.67	2.31	5.17

Adlt Wt: Adult weight, Ht at With: Height at wither, Body Len: Body length, Heart Girt: Heart girth, Face Len: Face length, Tail Len: Tail lengh, Neck Circ: Neck circumference, Neck Len: Neck length, Ear Len: Ear length, Horn Len: horn length, Horn Circ: Horn length.

ANIMAL NUTRITION

Development of economically viable feeding strategy for rearing Mithun in intensive system using spent grains from breweries industries

Effect of incorporation of ensiled spent grain in the diet of Mithun

Twelve adult non-lactating non-pregnant Mithun cows weighing 318 kg were divided into 3 groups of 4 animals in each in a completely randomized design. Animals in group I fed on 40 (ad lib), 35 and 10 kg of napier grass on fresh basis supplemented with 0, 5 and 15 (ad lib) kg of ensiled spent grain (a by-product from breweries industries) in groups I, II and III, respectively to determine the effect of feeding ensiled spent grain on total feed intake and dry matter digestibility. The feeding trial was continued for 2 months followed by a metabolism trial. The dry matter intake was 70.6, 72.5 and 45.2 g per kg metabolic body size per day in groups I, II and III, respectively (Table 3). The dry matter intake decreased quadratically (P=0.021) due to incorporation of graded level of incorporation of spent grain in the diet of Mithun. However, dry matter digestibility was 60.5, 52.2 and 53.9% in groups I, II and III, respectively showing no specific trend (P=0.154). It was concluded that incorporation of higher level of ensiled spent grain in the diet of Mithun has a negative effect on total feed intake.

Table 3. Dry matter intake and digestibility of napier grass based ration supplemented with spent grain in Mithun

	Group I	Group II	Group III	SEM	Contrast Linear	Quadratic
Number of animals	4	4	4	-	-	-
Live weight of animals (kg)	327	303	319	-	-	-
Napier intake (kg/d)	5.4	4.5	0.8	0.62	<0.001	0.006
Spent grain intake (kg/d)	0	0.7	2.6	0.35	<0.001	0.031
Total DM intake (kg/d)	5.4	5.2	3.4	0.30	<0.001	0.034
DM intake (g)/ kg $W^{0.75}$/d	70.6	72.5	45.2	4.37	0.002	0.021
DM digested (kg)	3.3	2.8	1.9	0.20	<0.001	0.502
DM digestibility (%)	60.5	54.2	53.9	1.90	0.154	0.213

Determination of microbial load in calcium hydroxide and urea treated ensiled spent grain

Twenty four types of treatments either with graded levels of calcium hydroxide or urea or with both have been given to spent grain having moisture content of 73.66% with one month of ensilation in high density polythene bags (Table 4) for determination of effect of treatment on microbial load after opening the polythene bags at specific time intervals. On plate count after serial dilution of spent grain in peptone water and growth study in nutrient agar at different time intervals after opening the bags it was observed that there was some positive effects on reducing microbial growth in spent grains (Table 4). It was concluded that there was a decreasing trend in microbial count due to treatment either by calcium hydroxide or urea or combination of both. There was no definite change in microbial count up to 3rd day of opening the silo. However, it showed a decreasing trend on 10th day.

Table 4. Method of treatment (g / per 8 kg of spent grain)

Treatment	Urea (g / per 8 kg of spent grain)				
Calcium hydroxide (g / per 8 kg of spent grain)		0	40	60	80
	0	$T^{0,0}$	$T^{0,40}$	$T^{0,60}$	$T^{0,80}$
	20	$T^{20,0}$	$T^{20,40}$	$T^{20,60}$	$T^{20,80}$
	40	$T^{40,0}$	$T^{40,40}$	$T^{40,60}$	$T^{40,80}$
	60	$T^{60,0}$	$T^{60,40}$	$T^{60,60}$	$T^{60,80}$
	80	$T^{80,0}$	$T^{80,40}$	$T^{80,60}$	$T^{80,80}$
	100	$T^{100,0}$	$T^{100,40}$	$T^{100,60}$	$T^{100,80}$

Table 5. Load of bacteria and yeast (CFU/ml)

Treatment	Days of opening		
	1^{st} day	3^{rd} day	10^{th} day
$T_{0,0}$	1000×10^5	1200×10^5	920×10^5
$T_{40,0}$	600×10^5	460×10^5	420×10^5
$T_{60,0}$	390×10^5	232×10^5	210×10^5
$T_{40,40}$	300×10^5	280×10^5	150×10^5
$T_{60,60}$	410×10^5	440×10^5	400×10^5

Preparation of feed blocks using spent grain as one of the ingredient components

Six types of feed blocks have been prepared using paddy straw, tree leaves (Schima wallichii), spent grain, crushed maize, mustard cake, wheat bran, rice bran, mineral mixture and common salt. The moisture content of paddy straw, tree leaves (Schima wallichii), spent grain, crushed maize, mustard cake, wheat bran, rice bran varied between 11 – 15, 73 – 82, 72 – 76, 10 – 14, 11 – 15, 9 – 13 and 10 – 16%, respectively. The tree leaves and spent grains were sun dried with or without application of graded levels of pressure. The tree leaves and paddy straw were chaffed at a length of 2 cm or less. The ingredients were mixed and compacted at 300 psi for three minutes. The composition of feed blocks on dry matter basis was presented here.

Paddy straw – 53%, wheat bran – 24%, spent grain – 20%, mineral mixture – 2% and common salt – 1%.

Paddy straw – 50%, tree leaves (Schima wallichii) – 30%, concentrate mixture (crushed maize 50%, mustard cake – 30%, wheat bran – 20%) – 17%, mineral mixture – 2% and common salt – 1%.

Paddy straw – 50%, spent grain – 47%, mineral mixture – 2% and common salt - 1%.

Paddy straw – 53%, rice bran – 24%, spent grain – 20%, mineral mixture – 2% and common salt – 1%.

Paddy straw – 55%, crushed maize 21%, mustard cake – 13%, wheat bran – 8%, mineral mixture – 2% and common salt – 1%.

Paddy straw – 70%, spent grain – 27%, mineral mixture – 2% and common salt - 1%.

Isolation and characterization of botanicals from NEH region for their antibacterial or antimethanogenic activities

Determination of total gas and methane production pattern in Mithun

In vitro fermentation studies in glass syringes were conducted in locally available fodders in the presence of buffer and inoculum of rumen liquor for determination of methane production. 0.25g samples of Thysanolaena agrostis, Sourauvia napaulensis, Ficus infectoria, Ficus hookeri, Artocarpus lakoocha, Ficus nemoralis, Artemisia vulgeris or Eupatorium was introduced in 50 ml glass syringe in triplicate, added 20 ml of buffer, 5 ml of inoculum in each syringe and kept in incubator at 39C for 72 hours. One set (triplicate) of blank was also run simultaneously without fodder. Total gas production was recorded at 72 h and at the end 2 ml of saturated potassium hydroxide was introduced in each syringe for absorption of carbon dioxide and recording of methane production. Total gas production in Thysanolaena agrostis, Sourauvia napaulensis, Ficus infectoria, Ficus hookeri, Artocarpus lakoocha, Ficus nemoralis, Artemisia vulgeris and Eupatorium was 117, 77, 156, 88, 151, 143, 150 and 78 ml/g dry matter, methane production was 11, 11, 22, 21, 32, 55, 49 and 23 ml/g dry matter in 72 h, respectively (Table 5). It was concluded that Thysanolaena agrostis, Sourauvia napaulensis might be the potent fodders for reduction of methane production in Mithun. However, further validation with in vivo studies is needed.

Table 6. Gas production from fodders (ml/g DM)

Name of the Fodder	Type	Total gas production	Carbon dioxide	Methane
Thysanolaena agrostis	Grass	117	106	11
Sourauvia napaulensis	Tree	77	66	11
Ficus infectoria	Tree	156	134	22
Ficus hookerii	Tree	88	67	21
Artocarpus lakoocha	Tree	151	119	32
Ficus nemoralis	Tree	143	88	55
Artemisia vulgeris	Shrub	150	101	49
Eupatorium sp	Shrub	78	55	23

Effect of supplementation of chloroform extract of *Artemisia vulgeris* on total gas production pattern in Mithun

In vitro fermentation studies in glass syringes were conducted with ground samples of spent grains (a by-product from breweries factory) in the presence of buffer and inoculums of rumen liquor of Mithun to determine the effect of supplementation of graded levels of chloroform extract of Artemisia vulgeris on total gas production. 0.25 g ground sample of spent grains was introduced in 50 ml glass syringe in triplicate, added 20 ml of buffer, 5 ml

of inoculum in each syringe and kept in incubator at 39□C for 72 hours. Graded levels @ 2, 4, 8, 0 or 0 (without ground spent grain) mg of chloroform extract of Artemisia vulgeris supplemented to sets I, II, III, IV and V, respectively. The relative total gas production was observed to be 3.6, 1.3, 0.3, 14.0 and 0 ml in sets I, II, III, IV and V, respectively and it decreased linearly (P=0.001) with increase in the level of chloroform extract of Artemisia vulgeris.

Veterinary type culture: Rumen microbes

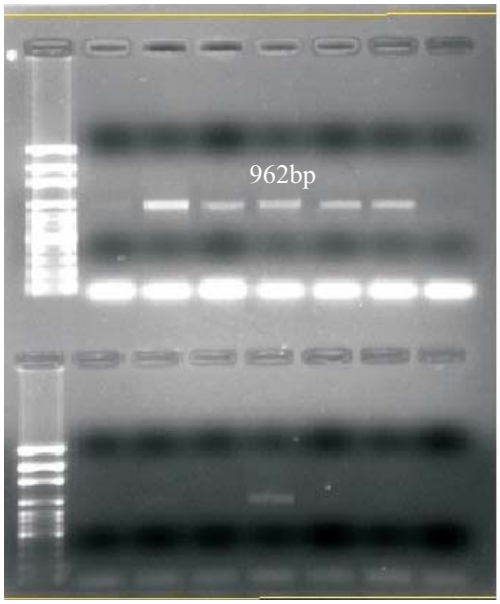
Rumen liquor has been collected from two adult male fistulated Mithun fed on paddy straw, green grass and concentrate mixture. Twelve pure cultures of bacteria have been isolated using roll tube method. Faecal samples from freely browsing Mithun have also been collected. Characterization and identification of those bacteria is under progress.

Growth of tannin degrading bacteria in Hungate roll tubes

Growth of rumen bacteria in media containing tannic acid

Isolation and characterisation of superior fibre degrading bacteria in mithun *(Bos frontalis)* for improved fibre digestion

Thirty (30) fibre degrading bacteria were isolated from the rumen of mithun using techniques of serial dilutions and repeated tubing of the selectively enriched microbial cultures. Isolates were subjected to analysis for in vitro gas production (Menke and Steingass, 1988), CM Cellulase & Xylanase (Kamra and Agarwal, 2003) for selection of superior isolates for fibre degradation. Three isolates of rumen bacteria found to be superior in fibre degradation were characterized. Genomic DNA was extracted from the bacteria using the standard kit for DNA isolation (Genei). The gene fragment of bacterial DNA was successfully amplified by universal/specific primer for bacteria and PCR product was purified and sequenced. The sequences were queried online in the NCBI BLAST database. Phylogenic analysis was carried out by using PHYLIP package and phylogenic tree was constructed.



Band showing PCR amplification of DNA using specific primer *(B. fibrisolvens)*

The ranges of CM Cellulase and Xylanase activity of fibrolytic bacterial isolates in pure culture were 2.39 to 7.18 and 7.84 to 46.62 mIU/ml respectively. On addition of the isolates to rumen fluid of mithun, there were 20.00 to 21.57 % increases in gas production indicating stimulation of fibrolytic activity. Three isolates showed higher gas production, CM Cellulase & Xylanase activity. The isolate BF4 had the highest increase in gas production compared to the control. All the three superior isolates were homologus to *Butyrivibrio fibrisolvens* species (genbank accession number EU 684229). Results showed that *Butyrovibrio fibrisolvens* are highly fibrolytic and probably play key role in fibre digestion in mithun and that the isolate *Butyrivibrio fibrisolvens* BF4 has highest potential to be used as a microbial feed additive in mithun.

Carcass characteristics of mithun fed on different levels of dietary protein

The experiment was conducted in the Mithun farm located at Medziphema, Nagaland. Twenty-one male mithun (Bos frontalis) of about 10 months of age were dewormed, vaccinated against infectious diseases and conditioned for a period of one month. The calves were divided into three groups randomly and one dietary treatment was allocated to each group. The animals of each group were fed on rice straw based diet containing three levels of dietary proteins i. e 80. 100 and 120 g/kg DM in low, medium and high protein fed animals. The energy content of three diets was equal and expressed as total digestible nutrient. The concentrate mixture contained 16.06, 20.01, 23.65 percent CP and 71.00, 70.83, 70.75 percent TDN (on DM basis) in low, medium and high protein diet respectively. The concentrate mixture of three different diets consisted of maize, wheat bran, ground nut cake, mineral mixture, vitamin and the roughage part of the ration consisted of paddy straw only. The fortnightly body weight gain and daily dry matter intake were recorded in all the animals. The DM percentage of both offered and residue paddy straw were recorded to find out the daily dry matter intake. The water was available at all times. Before the start of the experiment, the animals were treated for external and internal parasite with Ivermectin®, and given vitamins A, D3 and E. After 1 year of feeding, experimental animals were slaughtered to evaluate carcass characteristics and meat quality.

Three animals from each group were slaughtered at the slaughter house of the NRC on Mithun, Nagaland. Animals were transported to the slaughter house one day prior to slaughter and were given free access to water, without any feed. Slaughtering was done by conventional method by jugular vein puncture. Immediately after slaughter body organs like liver, kidney, spleen, heart, lungs were separated and weight of each organ was taken. Edible portions were separated from inedible portions and carcass weight of each animal was recorded to find out the dressing percentage. Dissectable fat was recorded after separation of visible fat for each animal and the relationship was developed between the level of feeding and fat deposition.

The weight of different organs like kidney, heart, liver, intestine and spleen did not differ significantly between different groups (Table 7). However, there was more fat deposition in animals on high protein fed diet. There was minimum fat deposition in the animals on low protein fed diet. The dressing percentage was highest for low protein fed animals and lowest for high protein fed animals. The meat samples when analyzed, it was observed that, there was no significant difference in the chemical composition of carcass except fat when fed on different levels of protein (Table 8). This indicated that, lower level of protein as used in this experiment is having better carcass characteristics compared to high level of protein.

Table 7. Organ weight (kg) and carcass characteristics of mithun fed on different levels of protein

Items	Low	Medium	High
Liver	3.46± 0.03	3.56± 0.03	3.61± 0.07
Kidney	0.43 ± 0.07	0.41 ± 0.04	0.58 ± 0.15
Heart	1.00 ± 0.17	1.23 ± 0.14	1.16 ± 0.14
Spleen	1.60± 0.20	1.66 ± 0.24	1.63± 0.18
Lungs	2.33 ± 0.26	2.53 ± 0.14	2.57±0.12
Body fat	6.23 ^{a}± 0.14	7.23 ^{b}± 0.15	8.20^{c}± 0.11
Dressing percentage	53.00^{b}± 0.57	50.80^{a}± 0.58	49.90^{a}± 0.35

Different superscripts within each row differ significantly (P<0.05)

Table 8 : Chemical composition(% on DM basis) of carcass fed on different levels of protein

Items	Low	Medium	High
DM	23.37 ± 0.58	24.05 ± 0.31	23.56 ± 0.34
CP	84.62 ± 1.10	85.93 ± 0.46	87.07 ± 1.49
EE	2.66^{a}± 0.08	2.86 ^{b}± 0.14	3.23^{c}± 0.02
NFE	7.84 ± 0.20	6.45 ± 0.24	4.89 ± 0.18
TA	4.81 ± 0.18	4.75 ± 0.03	4.80 ± 0.12

DM: Dry Matter; CP: Crude Protein; EE: Ether Extract; NFE: Nitrogen Free Extract; TA: T Ash. Different superscripts within each row differ (P<0.05)

Comparison of different feeding system on basis of requirement and its conomics

The experiment was conducted in the Mithun farm located at Medziphema, Nagaland. Fifteen male mithun *(Bos frontalis)* of about 2.5 years of age were dewormed, vaccinated against infectious diseases and conditioned for a period of one month. The animals were divided into three groups randomly and one dietary treatment was allocated to each group. The animals of each group was fed on either of three types of diet i.e paddy straw(T1), paddy straw + mixed tree leaves(T2) and paddy straw+ mixed tree leaves + napier (T3) as per standard developed in this institute (Das, *et al*, 2010). Limited quantity of concentrate mixture was also fed to animals of each group, but feeding of concentrate mixture was reduced drastically in groups fed with green fodders/tree leaves compared to groups fed on paddy straw based ration. All the diets were iso-nitrogenous. The concentrate part of diets consisted of maize, wheat bran, mineral mixture and vitamin. The animals were fed

individually on diets comprising ad lib roughage and a fixed quantity of concentrate mixtures. The quantity of roughage offered to the animals was adjusted at fortnightly intervals depending on dry matter intake of the preceding fortnight. The residual roughage were removed daily, weighed and sampled for dry matter (DM) estimation along with the offered samples. The offered and residue samples of roughage and concentrate mixture were pooled at monthly intervals for chemical analysis. The fortnightly body weight gain and daily dry matter intake from concentrate and rice straw were recorded in all the animals. After 3 months of feeding experiment, a metabolic trial of 6 days duration was conducted to know the digestibility of nutrients, nutritive value of ration and balance of nitrogen. The experiment was continued for 12 weeks. The water was available at all times. Before the start of the experiment, the animals were treated for external and internal parasite with Ivermectin®, and given vitamins A, D3 and E.

After a feeding experiment of twelve weeks, the average daily gain (ADG) of animals did not differ significantly. The average daily gains (gm) of three groups of animals were 436, 448 and 444, respectively (Table 9). The intake of concentrate, roughage and total intake of animals in the groups fed on green roughage (T2 and T3) were almost similar , while the intake of roughage and total intake were less in the group fed on paddy straw based diet(T1). This was because of offering higher level of concentrate in paddy straw based diet which ultimately reduced the intake of paddy straw. Similarly, the digestibility of DM in T2 and T3 groups was similar but the digestibilities of DM in groups fed on paddy straw based diets were higher than other two groups. The improvement of digestibility of animals fed on paddy straw based diet compared to green roughage based diet was because of reduction in total intake as reduced intake increases the digestibility. Though growth performance was similar in three types of diet, this indicated that, mithun can be reared on mixed tree leaves based ration with limited quantity of concentrate mixture. The expenditure for concentrate mixture may be reduced to half on feeding of mixed tree leaves based ration compared to paddy straw based ration.

Tree leaves used for feeding of mithun

Local name : Thumero (*Lagerstroemia speciosa)*

Local name: Temichidie/Tote (*Ficus hirta)*

Local name: Keromite/katosh *(Quercus polystachya)*

Table 9 : Comparison of different feeding system and its economics

Items	paddy straw	paddy straw + mixed tree leaves	Paddy straw+ tree leaves+ napier
Initial body weight (kg)	395± 20.74	398 ± 9.93	399± 14.84
Final body weight (kg)	431 ± 23.36	436 ± 3.21	436 ± 17.80
ADG (gm)	436 ± 32.52	448 ± 47.51	444 ± 43.66
Total conc. Intake (kg)	4.00	2.00	2.00
Roughage intake (kg)	4.230^{a} ± 0.03	7.58^{b} ± 0.05	7.910^{b} ± 0.02
Total intake (kg)	7.830^{a} ± 0.03	9.383^{b} ± 0.05	9.710^{b} ± 0.02
Total cost (Rs)	63.28 ± 0.05	34.49 ± 0.04	41.32±0.03
Cost/kg gain (Rs)	145.1	76.98	93.06
DM digestibility	56.22^{b} ± 0.12	52.14^{a} ±1.43	50.07^{a} ± 1.21

Similar superscripts within each row did not differ significantly (P<0.05)

Body confirmation and organ weight of mithun and its comparison with local cattle

The body confirmation of mithun and cattle was presented (Table 10). Four numbers of each mithun and cattle were slaughtered after 1 year of feeding experiment and it was observed that the measurement of body parts like head weight, horn length, horn circumference, limbs weight and tail length were significantly higher (P<0.05) in mithun than cattle. Higher body size of mithun than cattle may be due to better genetic potential for growth of mithun which is related to nutrition. Higher intake of nutrients in mithun than cattle was responsible for higher body weight gain (Das *et al.,* 2009a). In the comparison between buffaloes and cattle, similar results were reported (Robles *et al.,* 1971). Horn length and circumference were more in mithun and this phenomenon is a special characteristics of the mithun by which it is well distinguished from other species. Interestingly, the tail length was more in cattle than mithun, which is the important characteristic of Tho-tho cattle.

Organ weight of mithun and cattle during the slaughter experiment was presented (Table 11). Body organs like liver, kidney, spleen, heart, lungs with trachea and skin were separated and weight of each organ was taken. There was no statistical difference between different organs except skin weight which was significantly more (p< 0.05) in mithun compared to cattle. High quality leather products can be prepared from mithun hides (Das et al., 2009b) and higher weight of mithun skin compared to cattle skin in this experiment may be one of the explanations for preparation of quality leather products in mithun.

Table 10. Body confirmation of mithun and cattle

Items	Mithun	Tho -tho cattle
Live weight (kg)	367.7 ^{a}± 10.91	352.7 ^{b}± 10.68
Head with horn (kg)	25.23^{a}± 0.22	15.73 ^{b}± 0.77
Horn length(cm)	26.56 ^{a}± 1.23	8.300 ^{b}± 0.51
Horn circumference(cm)	35.68 ^{a}± 0.65	15.20 ^{b}± 0.58
Feet(fore +hind) with hooves (kg)	9.20 ^{a}± 0.20	6.80 ^{b}± 0.20
Tail length(cm)	91.10 ^{b}± 1.69	114.0 ^{a}± 1.36

Different superscripts within each row differ significantly (P<0.05)

T able 11. Organ weight (kg) of mithun and cattle during slaughter experiment

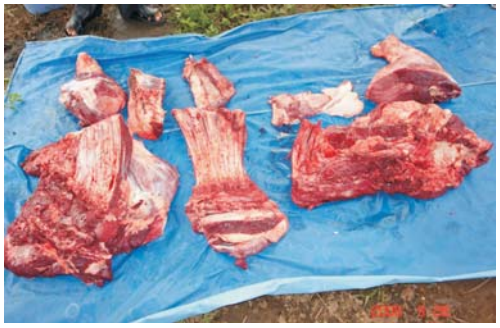
Items	Mithun	Tho-tho cattle
Liver	5.37± 0.28	5.53 ± 0.14
Kidney	0.93 ± 0.07	0.73 ± 0.07
Heart	1.90 ± 0.21	1.40 ± 0.06
Spleen	1.100 ± 0.10	1.233 ± 0.29
Lungs with trachea	3.733 ± 0.38	3.333 ± 0.22
Skin	28.07 ^{a}± 0.70	20.37 ^{b}± 1.66
S.I. length (ft)	92.97 ± 10.84	97.53 ± 11.60
L.I. length (ft)	19.37 ± 2.89	22.83 ± 2.68

Different superscripts within each row differ significantly (P<0.05)

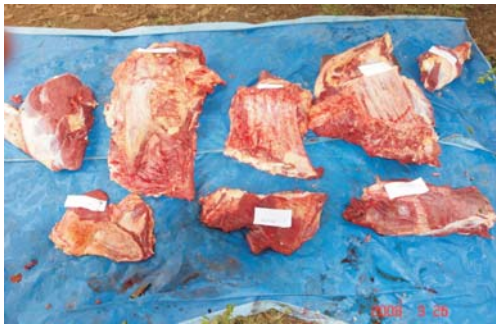
Carcass characteristics and meat quality of Mithun *(Bos frontalis)* and its comparison with local cattle (Tho-tho) of Nagaland

Carcass characteristics and meat quality of mithun and cattle were presented (Table 12). As far as carcass characteristics ware concerned, mithun had higher dressing percentage of meat than cattle. The dressing percentage of mithun was 58.82% whereas for cattle it was 55.96%. The dressing percentage of mithun was similar to that reported by Mondal *et al.* (2001). However, dressing percentage of meat depends on the sex, age, breed and nutritional status of animals (Młynek & Guliński, 2007). In the present experiment, the higher dressing percentage in mithun meat showed that it has good opportunity to develop this animal for meat purpose. The dissectable fat in the body was higher in cattle than mithun reducing its quality and this may be because of higher efficiency of utilization of nutrients in mithun than cattle. Paul *et al.* (2003) also reported that, nutrient utilization efficiency of buffaloes was higher than cattle. Lower efficiency increased fat deposition in buffalo calves with the increase in the level of dietary

energy (Baruah *et al.,*1990). The colour of the meat was not appealing in cattle meat as colour reduces the acceptability by consumers and reduces carcass value (BIF, 1990). The Pearson correlation coefficient was calculated for various carcass traits. There was positive relationship of carcass weight with rib eye in both mithun and cattle. There was positive relationship of rib eye area with fat thick ness in cattle where as the relationship was negative in mithun. This showed that cut yield of muscles was better in mithun meat. This was again confirmed from the shrinkage percentage of the animals where the shrinkage was more in mithun compared to cattle. Organoleptic evaluation in terms of color, flavor, juiciness, tenderness and overall acceptability showed that the mithun meat had better quality ($P<0.05$) compared to cattle meat.



Different commercial cuts of mithun meat



Different commercial cuts of cattle meat

Table 12. Carcass characteristics and meat quality of mithun and Tho- tho.

Items Carcass characteristics	Mithun	Tho -tho cattle
Slaughter weight	349.3 ± 11.59	344.8 ± 10.08
Shrinkage %	$4.96^{a} \pm 0.62$	$2.20^{b} \pm 0.15$
Carcass length	48.50 ± 2.02	43.50 ± 0.50
Dressin g percentage, meat	$58.82^{b} \pm 0.62$	$55.96^{a} \pm 0.60$
Dissectable fat (Kg)	$12.93^{a} \pm 1.89$	$28.47^{b} \pm 1.09$
Adjusted fat thickness (cm)	$0.26^{a} \pm 0.41$	$0.32^{b} \pm 0.92$
Rib eye area (REA) (sq cm)	84.3 ± 5.84	75.1 ± 14.08
Organoleptic evaluation		
Colour	$6.17^{a} \pm 0.17$	$5.08^{b} \pm 0.30$
Flavor	$6.25^{a} \pm 0.17$	$5.75^{b} \pm 0.11$
Juiciness	$6.92^{a} \pm 0.20$	$6.25^{b} \pm 0.17$
Texture	5.83 ± 0.10	5.67 ± 0.10
Tenderness	$6.08^{a} \pm 0.24$	5.25 b ± 0.25
Overall palatability	$6.92^{a} \pm 0.20$	6.33 b ± 0.17

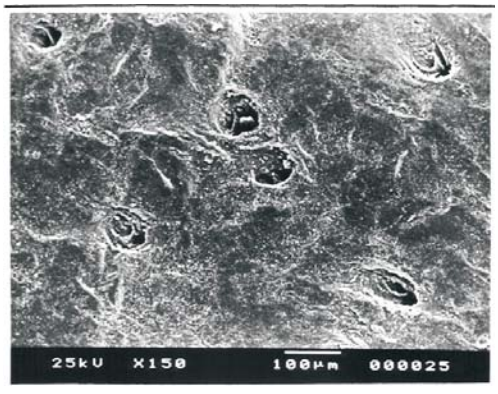
Different superscripts within each row differ significantly ($P<0.05$)

The present research work showed that, the carcass characteristics and meat quality were found to be better than local cattle. So mithun rearing is beneficial in providing quality meat for the poor farmers of NEH region. This information will definitely help the research workers and farmers for exploiting the potential of mithun for better meat production.

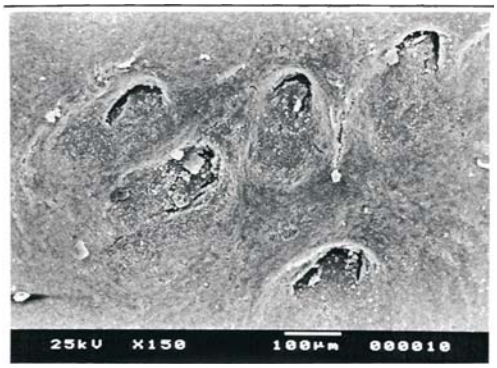
Studies on microscopic Properties of mithun leathers *vis-a-vis* cattle leather

Scanning electron photomicrographs of crust leather samples from crusts made in conventional chrome tanning methodology from mithun and tho-tho cattle hides showing the grain surface of the leathers at different magnification levels are shown in following figures

Both the mithun and cow leather samples exhibited a clean grain surface, which indicates that there is no physical deposition of chromium and the surfaces are free from keratinous debris. Higher magnification scanning electron micrographs (x3500) also confirm the above observation. The hair follicles look clean without any foreign materials in both the cases. Micrographs at higher magnifications in the case of mithun hides show highly opened up fibre structure which can explain the high percentage area yield in the case of mithun chrome tanned leather and also higher thickness which is the principal asset to our leather industry which is now ridden with the problems of tiny raw materials. The fibre bundles also seem to be evenly dispersed (separation of fibres) better in the case of mithun hide. Opening up feature also come out to be better in the case of innovative one.



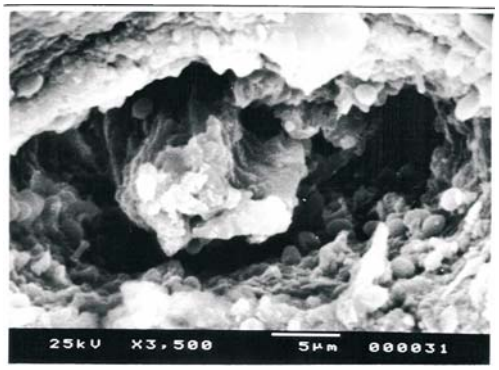
Scanning electron micrograph of chrome Tanned mithun hide surface at 3500X Magnification (conventional chrome tanning method)



Scanning electron micrograph of chrome Tanned cattle hide surface at 150X magnification (wet blue tanned)

The scanning electron photomicrographs (3500x magnification) of grain surface of leathers processed from mithun and cattle hides were studied. These manifested features accounted for higher physical strength, higher yield, and more thickness in the case of mithun

Scanning electron micrograph of chrome tanned mithun hide surface at 3500X magnification



Scanning electron micrograph of chrome tanned cattle hide surface at 3500X magnification

hide when processed with conventional chrome tanning methodology. Thus, tanning society can get rid of the acute crisis of availability of raw hide of substantial thickness. So, scanning electron micrographs of both mithun and cattle hides tanned in conventional methodology firmly corroborate the earlier findings on superior properties of leathers prepared from tanned mithun hides.

The present research work showed that the mithun had better growth performances compared to native tho-tho cattle. The leather produced from mithun is superior in quality compared to leather of cattle. So mithun leather can be a potential source of raw materials for leather industry in future. Taken together, mithun rearing is beneficial in improving the socio economic conditions of poor farmers of NEH region. This information will definitely help the research workers in future for exploiting the potential of mithun for better growth and production.

ANIMAL PHYSIOLOGY

Cryopreservation of mithun semen using Tris-Egg yolk-citrate extender with different concentrations of glycerol

Mithun is one of the important animals of Nagaland. Due to denudation of free range habitat along with the biotic and abiotic stress, there is an urgent need of scientific intervention for proper management as well as conservation of this beautiful hill animal through implementing an effective conservation programme. Frozen semen technology offers a very potent means of in vitro conservation of male germplasm and artificial insemination (AI) has become one of the most important techniques ever devised for the genetic improvement of farm animals

Considering the importance of Mithun in the socio-economic and cultural life of the local tribal population, the present research programme has been carried out not only for conservation but also for propagation of this animal through modern biotechnological tools such as cryopreservation of semen, coupled with artificial insemination.

In order to obtain the optimum glycerol level required for mithun semen cryopreservation, the samples were preserved into liquid nitrogen using Tris-egg yolk–glycerol (3, 4, 5, 6 and 7%) extender and then evaluated (progressive motility, live and dead, acrosomal integrity and sperm abnormalities) in fresh semen samples, in diluted samples after cooling (at 5°C for 4h) and in cryopreserved samples. Field level artificial insemination (AI) trials were also continued with the cryopreserved-thawed mithun semen.

Semen was collected from five adult Mithun bulls. A total of 50 ejaculates (mass activity $\geqslant$ + + +) were collected from these experimental animals over six months. The samples were kept in a water bath at 37oC immediately after collection and evaluated for colour, consistency, volume, and mass activity. Mass activity of fresh semen sample was determined by using a 5+ scale (0 - 5; 0 = no motility and 5 = vigorous motility in a wave like pattern) by analyzing 5 - 6 fields of a view of a neat semen drop placed on a pre-warmed slide (37oC)

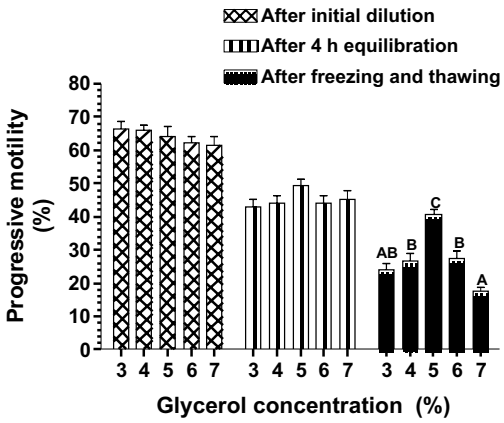
using bright field optics (Dewinter binocular microscope, magnification 100×). The samples were subjected to the initial dilution with pre-warmed (37oC) 1 ml of tris–egg yolk citrate buffer (Tris–hydroxymethyl aminomethane 3.028 % w/v, sodium citrate 1.655 % w/v, fructose 1.250 % w/v and egg yolk 20% v/v; 100,000 IU penicillin G sodium salt and 100 mg dihydroxy streptomycine were added in 100ml of buffer). Spermatozoa concentration was determined in partially diluted semen samples by haemocytometer method. Following the determination of spermatozoa concentration, final dilution of the semen samples was done with Tris–egg yolk buffer and glycerol in such a way that diluted samples contained 3, 4, 5, 6 or 7% glycerol (v/v) and 30×106 spermatozoa/ 0.50 ml. The entire quantity glycerol was added in a single dose during the final dilution. The diluted semen samples were loaded into 0.5 ml straws and were sealed with polyvinyl alcohol (PVA) powder. The straws were then equilibrated at 5°C for 4 h. After equilibration, straws were frozen in liquid nitrogen vapour, 5 cm above the liquid nitrogen level for 10 min and then plunged into liquid nitrogen for storage. Progressive motility, count of live sperm, acrosomal integrity and morphological abnormalities were determined in fresh semen samples, in diluted samples after cooling (at 5°C for 4h) and in cryopreserved samples. The cryopreserved samples were evaluated after minimum 7 days of storage. Thawing of the frozen semen samples was carried out by immersing straws into a water bath at 37oC for 5 min. The count of live sperm, acosomal integrity and morphological abnormalities were determined by the trypan blue-Giemsa staining technique. The total morphological abnormality was determined by adding the portion of head abnormalities, mid piece abnormalities and tail abnormalities. Sperm were classified into four categories namely a) live, intact acrosome b) live, damaged acrosome c) dead, intact acrosome and d) dead, damage acrosome.

AI at Khunoma village

In order to check the efficacy of the cryopreserved semen sample, AI was done in Mithun cows. The animals were inseminated at 10 to 12 hours following the onset of oestrous. Pregnancies were determined by non-return to oestrous of the inseminated cows and by per rectal examination at 60 days following insemination. Two Mithun calves were born in 2010.

The colour, consistency, volume, mass activity and spermatozoa concentration of fresh Mithun semen samples were found to be creamy white, medium, 1.5± 0.09 ml, 3.7 ± 0.08 (5 point scale) and 468 ± 15 (106/ ml) respectively.

While taking into consideration the progressive motility, acrosome integrity and different types of sperm abnormalities, use of glycerol at the level of 5% in tris-egg yolk-citrate extender resulted better sperm post-thaw performance than other concentrations of glycerol used for cryopreservation of mithun semen and was presented here (Table 13,14 & 15).



Variations (Mean ± SE) in progressive motility during different stages of freezing. Semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A,B on error bar indicates a significant difference (P<0.01)

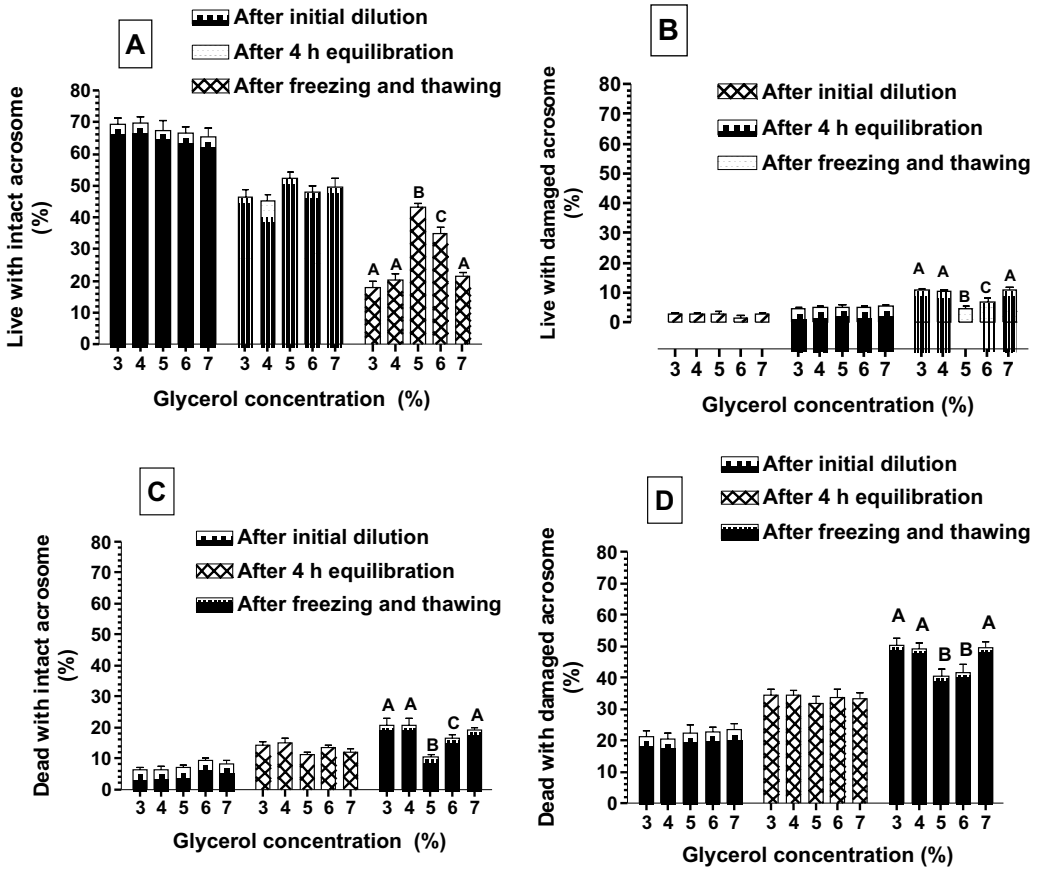
Table 13. Variations (Mean ± SE) in progressive motility during different stages of freezing. Semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A, B indicates values with different superscript within column differ significantly (P<0.01)

Glycerol concentration (%)	Progressive motility (%) After initial dilution	After 4 h equilibration	After freezing and thawing
3	66.5 ± 1.9	43.0 ± 2.1	24.0 ± 1.9^{AB}
4	66.0 ± 1.6	44.0 ± 2.2	26.5 ± 2.6^{B}
5	64.0 ± 3.1	49.5 ± 1.9	40.5 ± 1.6^{C}
6	62.0 ± 2.0	44 ± 2.2	27.5 ± 2.3^{B}
7	61.4 ± 2.61	45.0 ± 2.7	17.5 ± 1.3^{A}

Table 14. Variations (Mean ± SE) in liveability and acrosomal integrity of mithun spermatozoa during different stages of freezing. Semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A, B, C indicates values with different superscript within column under a particular freezing stage differ significantly (P<0.01)

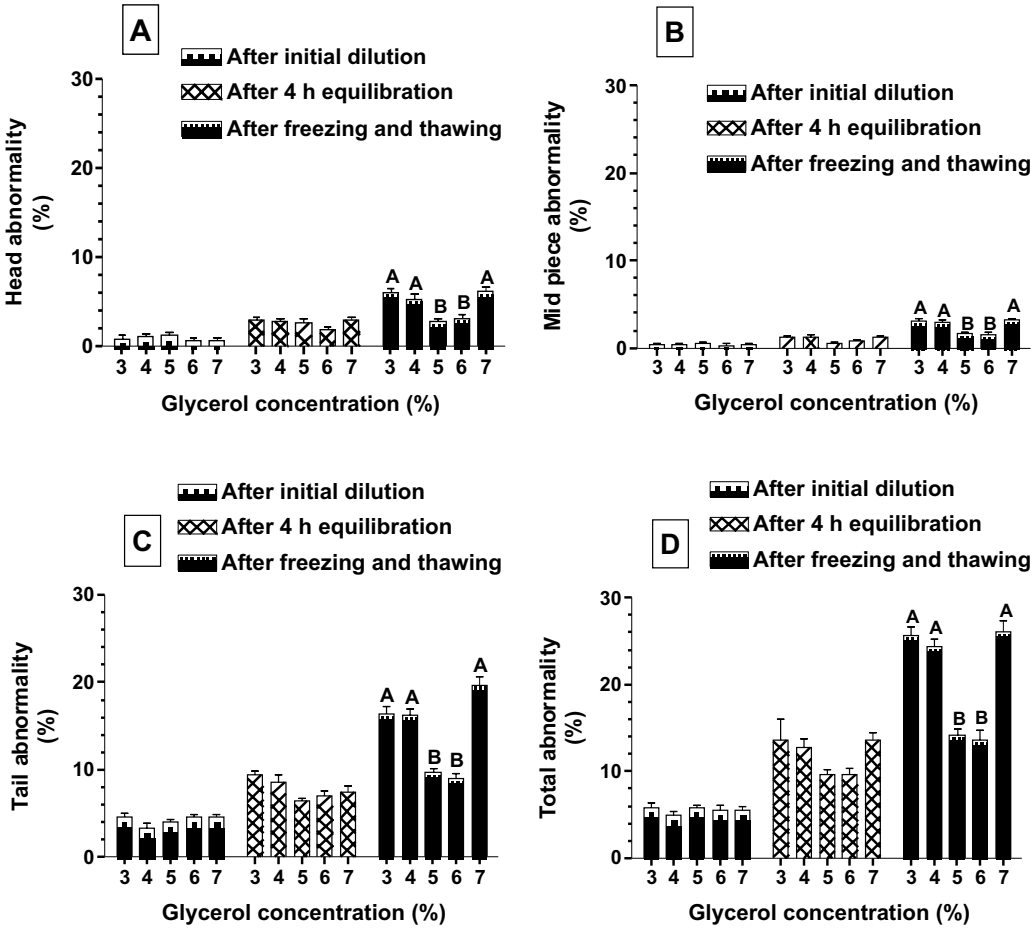
Stage and glycerol concentration (%)	Status of spermatozoa			
	L-I	L-D	D-I	D-D
After initial dilution				
3%	69.5 ± 1.9	2.9 ± 0.3	6.2 ± 0.8	21.4 ± 1.7
4%	69.9 ± 1.7	3.0 ± 0.3	6.5 ± 0.9	20.6 ± 1.7
5%	67.6 ± 3.0	3.0 ± 0.6	6.9 ± 0.9	22.4 ±2.7
6%	66.5 ± 1.9	1.7 ± 0.5	9.3 ± 0.8	22.7 ± 1.6
7%	65.4 ± 2.6	2.9 ± 0.4	8.4 ± 0.8	23.3 ± 2.1
After 4 h equilibration				
3%	46.4 ± 2.3	4.7 ± 0.5	14.4 ± 1.2	34.5 ± 1.9
4%	44.0 ± 2.2	5.0 ± 0.6	15.2 ± 1.3	34.4 ± 1.4
5%	52.4 ± 1.9	5.2 ± 0.8	11.1 ± 1.0	31.8 ± 2.2
6%	48.0 ± 2.1	4.9 ± 0.5	13.6 ± 0.7	33.8 ± 2.6
7%	45.0 ± 2.7	5.6 ± 0.4	12.1 ± 0.9	33.2 ± 1.8
After freezing thawing				
3%	18.1 ± 1.7^{A}	10.7 ± 0.4^{A}	20.8 ± 2.1^{A}	50.4 ± 2.1^{A}
4%	20.3 ± 2.2^{A}	10.5 ± 0.5^{A}	20.6 ± 2.2^{A}	49.1 ± 2.1^{A}
5%	43.2 ± 1.4^{B}	4.8 ± 1.0^{B}	10.3 ± 1.0^{B}	40.6 ± 2.0^{B}
6%	35.0 ± 1.8^{C}	7.0 ± 1.2^{C}	16.5 ± 1.3^{C}	41.5 ± 2.6^{B}
7%	17.5 ± 1.3^{A}	11.0 ± 0.6^{A}	19.0 ± 0.9^{A}	49.6 ± 2.0^{A}

L-I: Live sperm with intact acrosome; L-D: Live sperm with damaged acrosome;
D-I: Dead sperm with intact acrosome ; D-D: Dead sperm with damaged acrosome



Variations (Mean ± SE) in live spermatozoa with intact acrosome (Panel A), live spermatozoa with damaged acrosome (Panel B), dead spermatozoa with intact acrosome (Panel C) and dead spermatozoa with damaged acrosome (Panel D) during different stages of freezing. Semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A, B, C on error bar indicates P<0.01

First AI born Mithun Calf at Khonoma Village



Variations (Mean ± SE) in head (Panel A), mid piece (Panel B), tail (Panel C) and total abnormality (Panel D) of spermatozoa during different stages of freezing. The semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A, B on error bar indicates P<0.01

The Majestic

Table 15. Variations (Mean ± SE) in head, mid piece, tail and total abnormality of spermatozoa during different stages of freezing. Semen samples were cryopreserved with 3, 4, 5, 6 or 7% glycerol. A, B indicates values with different superscript within column under a particular freezing stage differ significantly (P<0.01)

Stage and glycerol concentration (%)	Spermatozoa abnormalities			
	Head	Mid piece	Tail	Total
After initial dilution				
3%	0.9 ± 0.3	0.4 ± 0.1	4.7 ± 0.3	5.8 ± 0.5
4%	1.1 ± 0.3	0.4 ± 0.1	3.4 ± 3.5	4.9 ± 0.5
5%	1.2 ± 0.3	0.5 ± 0.3	4.1 ± 0.3	5.8 ± 0.3
6%	0.7 ± 0.2	0.3 ± 0.2	4.6 ± 0.4	5.6 ± 0.4
7%	0.6 ± 0.3	0.4 ± 0.1	4.6 ± 0.3	5.6 ± 0.4
After 4 h equilibration				
3%	3.0 ± 0.3	1.2 ± 0.2	9.4 ± 0.5^{A}	13.6 ± 2.4^{A}
4%	2.8 ± 0.3	1.3 ± 0.3	8.6 ± 0.8^{AB}	12.7 ± 1.1^{AB}
5%	2.6 ± 0.4	0.5 ± 0.2	6.5 ± 0.3^{C}	9.6 ± 0.6^{B}
6%	1.9 ± 0.4	0.8 ± 0.2	7.1 ± 0.6^{BC}	9.7 ± 0.7^{B}
7%	2.9 ± 0.3	1.2 ± 0.2	7.5 ± 0.6^{A}	13.6 ± 0.8^{A}
After freezing thawing				
3%	6.1 ± 0.4^{A}	3.1 ± 0.3^{A}	16.4 ± 0.9^{A}	25.6 ± 1.0^{A}
4%	5.3 ± 0.6^{A}	2.9 ± 0.3^{A}	16.2 ± 0.8^{A}	24.4 ± 0.9^{A}
5%	2.8 ± 0.4^{B}	1.6 ± 0.2^{B}	9.7 ± 0.5^{B}	14.1 ± 0.8^{B}
6%	3.2 ± 0.5^{B}	1.5 ± 0.3^{B}	9.0 ± 0.6^{B}	13.7 ± 1.0^{B}
7%	6.2 ± 0.4^{A}	3.2 ± 0.2^{A}	16.7 ± 0.9^{A}	26.1 ± 1.2^{A}

Standardization of suitable dose of GnRH and LH/hCG for induction of ovulation in mithun

a)To standardize the suitable dose of GnRH for induction of ovulation in mithun

A total of 12 cyclic mithun cows were selected for the present experiment. Before going to standardize the suitable dose of GnRH for induction of ovulation in mithun, the selected animals were used to characterize the normal ovulation pattern post estrus and its relationship with endocrine events during spontaneous estrus (without using GnRH). To determine the timing of ovulation in relation to onset of estrus and the preovulatory LH surge, the blood samples collected at 15 min intervals for 9 h period following onset of estrus and thereafter at an interval of 2 h till 4 h post ovulation for three consecutive cycles from twelve mithun cows were assayed for plasma LH and progesterone. Ovulation was confirmed by palpation of ovaries per rectum at hourly intervals. Various signs of behavioral estrus were also recorded.

After getting the normal pattern of ovulation and its relationship with endocrine events in mithun during spontaneous cycle without any treatment on the day of estrus, ovulation was induced in these animals with different concentrations of GnRH. Three different doses of GnRH analogue (Buserelin Acetate) viz., a low (10μg), medium (20μg) and high (30μg) doses were administered i.m. on the day of estrus (heat; day 0) in 12 numbers of normal cycling mithun cows to induce ovulation. To determine the timing of ovulation in relation to onset of estrus/GnRH administration and the preovulatory LH surge, the blood samples were collected at 15 min intervals for 9 h period following onset of estrus/GnRH administration (0h) and thereafter at an

interval of 2 h till 4 h post ovulation. Plasma samples were assayed for plasma LH and progesterone. Ovulation was confirmed by palpation of ovaries per rectum at hourly intervals. Various signs of behavioral estrus were also recorded.

b) To standardize the suitable dose of GnRH and LH/hCG for induction of ovulation in mithun

To standardize the suitable dose for induction of ovulation, LH/hCG, a low (1500IU), medium (3000IU) and high (4500IU) doses of Chorulon® (hCG; Intervet, India) were administered on the day of estrus (day 0) in 12 normal cycling mithun cows. To determine the timing of ovulation in relation to onset of estrus/hCG administration and the preovulatory LH surge, the blood samples were collected at 15 min intervals for 9 h period following onset of estrus/hCG administration (0h) and thereafter at an interval of 2 h till 4 h post ovulation. Blood samples were centrifuged at 1500xg for 30 minutes and plasma was separated. Plasma samples thus obtained were stored at -200C for estimation of progesterone and LH. Ovulation was confirmed by palpation of ovaries per rectum at hourly intervals. Various signs of behavioral estrus were also recorded.

Timing of Ovulation in Relation to Onset of Estrus and LH Peak in Mithun Cows (controls)

To determine the timing of ovulation in relation to onset of estrus and the preovulatory LH surge in mithun, the blood samples collected at 15 min intervals for 9 h period following onset of estrus and thereafter at an interval of 2 h till 4 h post ovulation for three consecutive cycles from twelve mithun cows were assayed for plasma LH and progesterone. Ovulation was confirmed by palpation of ovaries per rectum at hourly intervals. Various signs of behavioral estrus were also recorded. The preovulatory LH surges consisted of several pulses (2.92± 0.26 pulses/animal; range, 1-4). The mean (±SEM) peak level of LH for individual mithun varied from 6.99±0.44 to 12.69±2.10 ng/mL and the mean pooled LH peak concentration was 8.10±0.60 ng/mL. The highest peak (highest amplitude of LH during LH surge) was 10.83±0.76 ng/mL (range, 8.07 to 16.49 ng/mL). The duration of LH surge was 6.98±0.22 h (6 to 8 h). Onset of LH surge was at 1.23±0.17 h post estrus onset (range, 0.25 to 2.25 h). Mean plasma progesterone stayed low (<0.24 ng/mL) during the entire duration of sampling. Ovulation occurred at 26.92±0.31 (range, 26 to 29 h) after the onset of estrus and 18.63±0.35 h (range, 17 to 20.75 h) after the end of LH surge. The occurrence of the highest LH peaks within a narrow time frame of 2 to 5 h post estrus onset in mithuns could have contributed to the animals ovulating within a narrow time interval. These results are very promising from a practical standpoint of potential success when AI program in this species will be implemented in a big way. Furthermore, the results of the occurrence of LH pulses during preovulatory LH surges, which are required for ovulation in this species of animal, is unique and species specific.

Standardization of suitable dose of GnRH for induction of ovulation in mithun

With 10μg GnRH analogue

The mean (±SEM) peak level of LH for individual mithun varied from 11.82±2.83 to 15.56±2.24 ng/mL and the mean pooled LH peak concentration was 11.62±0.97 ng/mL. The highest peak (highest amplitude of LH during LH surge) was 12.76±0.86 ng/mL (range, 10.43 to 17.57 ng/mL). The duration of LH surge was 5.78±0.33 h (5.25 to 7.5 h). Onset of LH surge was at 0.5±0.09 h post estrus onset (range, 0.25 to 1.25 h). Mean plasma progesterone stayed low (<0.22 ng/mL) during the entire duration of sampling. Ovulation occurred at 22.9±0.41 (range, 22 to 25 h) after the onset of estrus and 17.6±0.25 h (range, 16 to 21h) after the end of LH surge.

With 20μg GnRH analogue

The mean (±SEM) peak level of LH for

individual mithun varied from 14.35±2.51 to 18.66±1.87 ng/mL and the mean pooled LH peak concentration was 15.45±0.93 ng/mL. The highest peak (highest amplitude of LH during LH surge) was 16.31±2.14 ng/mL (range, 12.45 to 19.32 ng/mL). The duration of LH surge was 6.12±0.22 h (5.0 to 7.5 h). Onset of LH surge was at 0.5±0.08 h post estrus onset (range, 0.25 to 1.25 h). Mean plasma progesterone stayed low (<0.23 ng/mL) during the entire duration of sampling. Ovulation occurred at 22.2±0.44 (range, 21 to 24 h) after the onset of estrus and 16.7±0.57 h (range, 15 to 20h) after the end of LH surge.

With 30μg GnRH analogue

The mean (±SEM) peak level of LH for individual mithun varied from 14.11±2.33 to 18.27±1.76 ng/mL and the mean pooled LH peak concentration was 15.01±0.97 ng/mL. The highest peak (highest amplitude of LH during LH surge) was 16.02±1.94 ng/mL (range, 13.5 to 19.8 ng/mL). The duration of LH surge was 6.4±0.27 h (5.5 to 7.25 h). Onset of LH surge was at 0.5±0.05 h post estrus onset (range, 0.25 to 1.25 h). Mean plasma progesterone stayed low (<0.24 ng/mL) during the entire duration of sampling. Ovulation occurred at 22.5±0.45 (range, 21 to 24 h) after the onset of estrus and 15.9±0.70 h (range, 14 to 20h) after the end of LH surge.

Ovulation occurs in all animals from all groups. Highest peak concentration of LH (ng/ml) increased significantly (P<0.01) in all treated groups than controls. Highest LH peak concentrations also increased (P<0.01) in 20- and 30-μg GnRH group than the animals treated with 10-μg GnRH. No difference (P>0.05) in highest LH peak was found between 20- and 30-μg group. Time of onset of estrus to ovulation decreased (P<0.01) in all treated animals than the controls. The time of ovulation post onset of estrus/GnRH administration was similar (P>0.05) among the treated groups. Hence, it is recommended that 10μg GnRH may be used for induction of ovulation and to get early ovulation in mithun cows.

Standardization of suitable dose of LH/hCG for induction of ovulation in mithun

Different concentrations of hCG has been administered at estrus in 12 mithun cows to get suitable dosage of hCG for induction of ovulation in this species. Animal experimentations are completed. Plasma samples have been stored at -200C for hormone analysis.

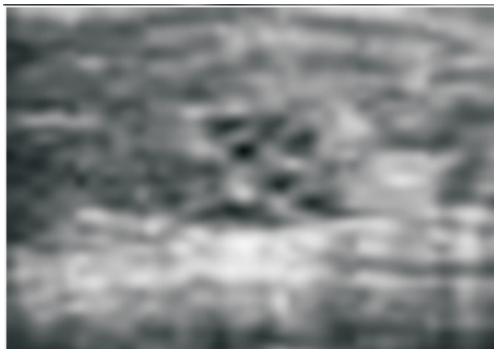
To characterize the ovarian folliculogenesis/follicle maturation pattern in mithun during spontaneous estrous cycle in mithun

A total of 12 cyclic mithun cows were selected for this experiment to study the ovarian follicle maturation pattern in normal cycling mithuns. Follicular dynamics for each cow were studied at least for three consecutive cycles. Ovaries in each cow were scanned with a linear array trans-rectal probe (7.5MHz transducer). To standardize counting of follicles, each ovary was scanned from end to end to identify the positions of the corpus luteum and antral follicles. Video images for different ovarian sections were also captured on a computer monitor and the locations of the corpus luteum and each antral follicle 3 mm or greater in diameter in each section were drawn on an ovarian map. Two separate measurements of diameter were averaged for each follicle and recorded next to the appropriate follicle on each ovarian map. The scanning procedure was repeated to confirm the locations of follicles on each ovarian map. Total number of antral follicles 3 mm or greater in diameter per pair of ovaries for each animal were determined by counting the number of follicles 3 mm or greater in diameter on each map for each animal. Blood sample (3ml) from each animal was collected daily by jugular venipuncture for estimation of hormones (Estradiol-17β and Progesterone) to correlate the changing pattern of follicular dynamics with endocrine events.

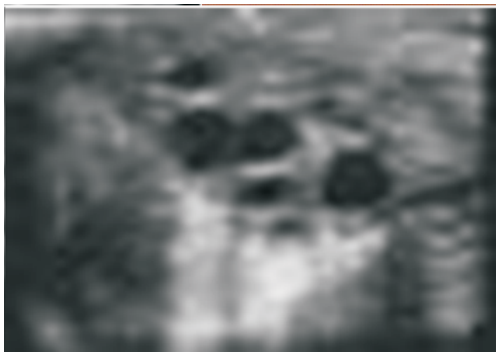
It was found that out of the 24 inter-ovulatory cycles studied, 70.8% was two-wave cycles. The

two-wave inter-ovulatory cycles differed from three-wave cycles in a) shorter in length, b) later emergence of dominant follicles, and c) longer interval from emergence to ovulation. Progressive increase in follicular size and estradiol production was observed during growth phase of each wave. A decline in estradiol concentration was recorded during the static phase of anovulatory dominant follicles. Irrespective of two- or three-wave cycle, the size of ovulatory follicle was always greater and produced higher concentrations of estradiol compared with the anovulatory follicle. In conclusion, there was a predominance of two- than three-wave follicular activity in Mithun. A static anovulatory dominant follicle may probably initiate the emergence of a subsequent wave. Follicular size and estradiol concentration may be the contributing factors controlling follicular development and deciding whether an estrous cycle will have two- or three-waves in Mithun.

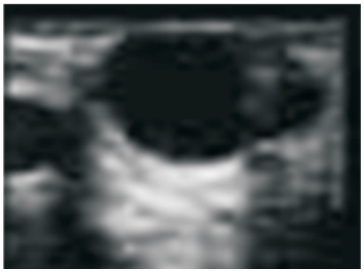
Ultrasound imaging of follicles of different growing stage in mithun cows.



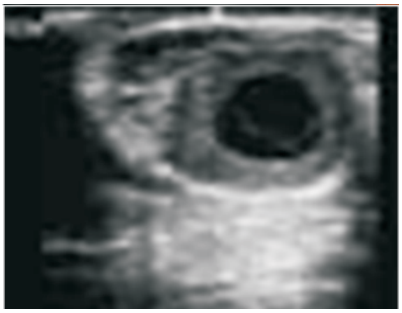
Follicles of 4-5 mm



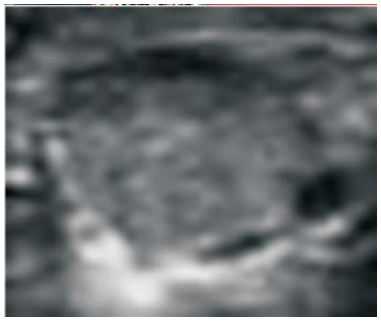
Follicles of 6-8 mm



Follicles of 18.20 mm



Cavitary Corpus luteum



Compact Corpus luteum

Induction of cow-calf attachment/bonding immediately after birth in cows that exhibit mismothering behaviour using simple intranasal spray of oxytocin

After being confirmed that oxytocin is required for induction of maternal behaviour and maternal-offspring bonding in cows where oxytocin was blocked chemically, we were interested to see whether exogenous intranasal oxytocin can also induce maternal behaviour i.e. mother-neonate bonding/attachment in mithun cows that naturally exhibit mismothering behaviour immediately after postpartum. All three mismothered mithun cows tested for induction for mother-neonate bonding using 56IU oxytocin through intranasal route responded to the treatment. The intensity of maternal behaviour in these treated cows was significantly higher than those of control cows (n=2; Figure 1). We found significantly lower ($P<0.01$) blood oxytocin levels in the cows that exhibited mismothering behaviour than those normal cows.

Intranasal oxytocin was tested for induction of maternal behaviour in the mithun cows that exhibited mismothering behaviour naturally immediately after birth. Out of five cows exhibited mismothering behaviour, three were treated with intranasal spray of oxytocin and the rest two animals were administered with normal saline through intranasal route. The dose was 56 I.U. oxytocin (7 puffs per nostril, each with 4IU oxytocin). All behavioural parameters (sniffing, lcking, suckling and approach behaviour) were recorded for 2-hour period following oxytocin or saline administration. Blood samples were also collected for 2h prior to (at an interval of 15 min) and 5h post parturition at every 5-min interval till 2h and then at every 15 min interval till 5h post parturition from each animal. Plasma samples were assayed for oxytocin.

Isolation of pathogenic bacteria namely *Salmonella* and *E. coli* from meat and milk samples of Mithun

A total of 30 samples of mithun meat were examined for the presence of pathogenic bacteria (*Escherichia coli, Salmonella spp., Clostridium spp. and Staphylococcus spp.*), similarly 30 milk samples from mithun were also examined for the presence of bacteria.

It was found that out of 30 samples from mithun meat, 15 were positive for *Escherichia coli*, 8 samples were positive for *Salmonella spp.,* 12 samples were positive for *Clostridium spp.* And 12 samples were positive for *Staphylococcus spp.* Out of 30 mithun milk samples, 10 were positive for *E.coli,* 10 for *Salmonella spp.,* 20 for *Staphylococcus spp.* and 14 for *Clostridium spp.* (Table16).

Table 16 – Prevalence of pathogenic bacteria from Mithun meat and milk

Bacteria	Meat	Milk
Escherichia coli	15 (50%)	10 (33.33%)
Salmonella sp.	8 (26.67%)	10 (33.33%)
Staphylococcus sp.	12(40%)	20 (66.67%)
Clostridium spp.	12 (40%)	14 (46.67%)

Collection of samples

a) Milk samples – The milk samples were collected from Institute farm, milk samples were collected in sterile plastic vial and brought immediately to the laboratory for isolation of the bacteria.

b) Meat samples- The stored meat samples at -180Cfrom mithun which were collected from the Institute farm were used for isolation of the bacteria.

Escherichia coli

E. coli is the abbreviated version of *Escherichia*

coli, a bacterium found in the lower intestines of mammals and birds. Although *E. coli* is a necessary intestinal bacterium that helps with the digestion of food, it can be very dangerous if ingested. If a person inadvertently ingests the bacteria, the resulting infection is called *E. coli* enteritis, which causes the small intestine to become inflamed.

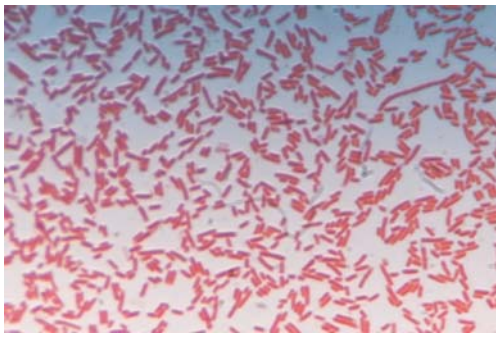
People can contract an *E. coli* infection by drinking contaminated water, eating fruit or vegetables that have been watered with contaminated water, drinking unpasteurized milk, or eating undercooked ground meat. The *E. coli* infection can also be caught by coming into contact with others who are infected or by working in environments where one might come into contact with human or animal feces, such as farms, day care centers, nursing homes, or hospitals. The most common way to contract an *E. coli* infection is by eating hamburgers that are not fully cooked. The symptoms of *E. coli* infection are primarily acute diarrhea that may or may not be bloody, severe stomach cramps, bloating, and gas. While these are the most prevalent symptoms, many people infected with *E. coli* might also experience continuous abdominal pain, loss of appetite, fever, and in rare cases, vomiting.

Media – Nutrient Broth
Mac Conkey's Lactose agar (MLA)
Eosin Methylene blue agar (EMB)

1ml of milk / 1gm of meat samples were put in nutrient broth in test tube and incubate for 37^{0}C for 24 hrs. Then the next day one loopful of inoculums was transferred to MLA plates by streaking on it and incubated for 37^{0}C for 24 hrs. Pink coloured smooth colonies on the plate indicate *E.coli* , for confirmation the colonies were further isolated in EMB presence of black coloured colonies with metallic sheen indicate the presence of *E.coli.*

Microscopic examination

The *E.coli* bacteria are aerobic gram negative pink rod shaped organism.



E. coli **are Gram negative aerobic rods shaped bacteria**

Salmonella spp.

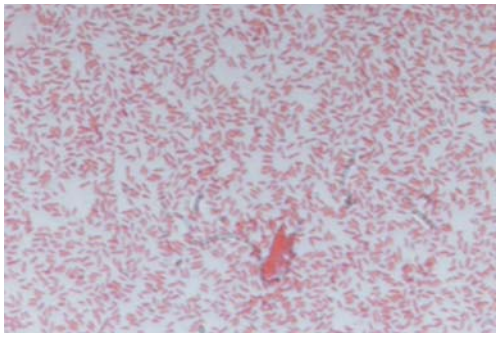
Salmonella is closely related to the *Escherichia genus* and are found worldwide in cold- and warm-blooded animals (including humans), and in the environment. They cause illnesses like typhoid fever, paratyphoid fever, and the foodborne illness. Salmonella infections are zoonotic and can be transferred between humans and nonhuman animals. Many infections are due to ingestion of contaminated food. A distinction is made between enteritis Salmonella and typhoid/paratyphoid Salmonella, where the latter — because of a special virulence factor and a capsule protein (virulence antigen) can cause serious illness, such as *Salmonella enterica subsp. enterica serovar typhi.*

Media – Tetraethionate broth
Brilliant green sulpha agar (BGA)

1ml of milk / 1gm of meat samples were put in Tetraethionate broth in test tube and the samples were incubated for 37^{0}C for 24hrs. Then the next day one loopful of inoculums was transferred to BGA media by streaking and the plate is incubated at 37^{0}C for 24hrs. The presence of pink coloured small smooth colonies indicate the presence of *Salmonella spp.*

Microscopic examination

They were gram negative small rod shaped pink coloured aerobic organism.



Gram negative pink colour small rod shaped bacteria (Salmonella sp) in microscopic examination

Biochemical test

KB001 HiIMVic TM Biochemical test Kit, which consists of four conventional biochemical tests and eight carbohydrate utilization tests. It was used for differentiation of gram–negative *Enterobacteriaceae species.*

Preparation of inoculums- The organisms to be identified have to be first isolated and purified, only pure cultures should be used. Isolate the organism to be identified on a common medium like Nutrient agar. Pick up single well isolated colony and inoculate in 5ml Brain heart infusion broth and incubate at 37°C for 4-6 hours until the inoculums turbidity was 0.1 OD at 620nm or 0.5 Mcfarland standard.

Inoculation of the strip- Open the kit aseptically. Inoculate each well with 50µl of the above inoculums.

Incubation - Temperature of incubation 37°C for 24hrs.

Interpreted result as per the standard given in chart with this kit. Addition of reagents was done in well nos 1, 2, and 3 after incubation which is supplied along with this kit. The result of the test for *E. coli* and *Salmonella* was shown (Table 17).

Table 17. Biochemical test for *E.coli* and *Salmonella*

S.No	Biochemical test	*E.coli*				*Salmonella*			
		Meat=15		Milk=10		Meat=8		Milk=10	
		Positive %	Negative %	Positive%	Negative %	Positive %	Negative %	Positive %	Negative %
1	Indole	100	-	100	-	-	100	-	100
2	Methyl red	100	-	100	-	100	-	100	-
3	Voges Proskauer's	-	100	-	100	-	100	-	100
4	Citrate utilization	-	100	-	100	100	-	100	-
5	Glucose	100	-	100	-	100	-	100	-
6	Adonitol	-	100	-	100	-	100	-	100
7	Arabinose	100	-	100	-	100	-	100	-
8	Lactose	100	-	100	-	62.5 (5)	37.5 (3)	60 (6)	40 (4)
9	Sorbitb	100	-	100	-	100	-	100	-
10	Mannitol	100	-	100	-	100	-	100	-
11	Rhamnose	73.33 (11)	26.67 (4)	70 (7)	30 (3)	100	-	100	-
12	Sucrose	100	-	50 (5)	50 (5)	50 (4)	50 (4)	80 (8)	20 2)

Staphylococcus spp.

The best-known species are present in great numbers on the mucous membranes and skin of all humans and other warm-blooded animals. The cells characteristically group together in grapelike clusters. *Staphylococci* are gram-positive and stationary and do not require oxygen. Of significance to humans is

the species *S. aureus,* an important agent of wound infections, boils, and other human skin infections, and one of the most common causes of food poisoning. It also causes udder inflammation in domestic animals and breast infections in women. The largest cause of hospital infections (accounting for almost 15%), "staph" is often difficult to treat because of its increasing resistance to antibiotics.

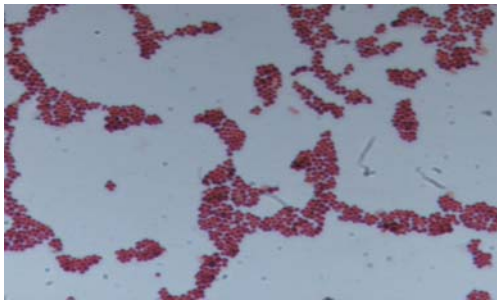
Method

Media – Nutrient broth
Mannitol salt agar
Nutrient agar

1ml of milk/ 1gm of meat samples were put in Nutrient broth and incubated at 37^{0}C for 24 hrs, next day transfer one loopful of inoculums in nutrient agar media and incubate at 37^{0}C for 24 hrs presence of creamy yellowish white colonies indicate presence of Staphylococcus. For further isolation transfer the colonies to mannitol salt agar media and incubate at 37^{0}C for 24hrs, presence of small whitish colonies indicate staphylococcus.

Microscopic examination

The organism was gram positive coccus arranged in clusters or group.



Gram positive coccus arranged in clusters

Clostridium spp.

The clostridia are widely distributed in nature, and are present in the soil and in the intestinal tracts of humans and animals. They usually live a saprophytic existence, and play a major role in the degradation of organic material in the soil and other nature environments. A number of clostridia release potent exotoxins and are pathogenic for humans and animals. Among the human pathogens are the causative agents of botulism *(Clostridium botulinum)*, tetanus *(C. tetani)*, gas gangrene *(C. perfringens),* and an antibiotic-associated enterocolitis. The endospores produced by clostridia are dormant structures capable of surviving for prolonged periods of time, and have the ability to reestablish vegetative growth when appropriate environmental conditions are provided. The spores of clostridia are oval or spherical and are wider than the vegetative bacterial cell. Among the distinctive forms are spindle-shaped organisms, club-shaped forms, and tennis racket-shaped structures.

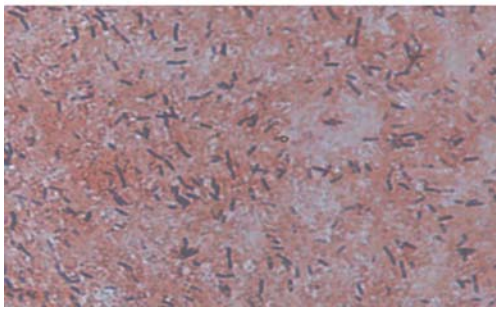
Method

Media- Robertson cooked meat medium
Anaerobic agar media

1ml of milk/ 1gm of meat samples were put in Robertson cooked meat medium broth as the *Clostridium* need anaerobic condition so the broth were put in anaerobic jar and incubated at 44^{0}C for 48 hrs, transfer one loopful of inoculums in anaerobic agar media by streaking and incubate at 37^{0}C for 24 hrs. The presence of small pin point white colonies in media indicates the presence of *clostridium spp.*

Microscopic examination

The bacteria were gram positive bacillus and spores can be seen in the terminal, subterminal region.



Gram positive bacillus with spores in terminal and subterminal region

Serotyping of the *E.coli* isolates from meat and milk samples

The *E.coli* isolates were sent to Kasauli, Himachal Pradesh for serotyping. Out of which 15 isolates were from meat. The serogroup which was more prevalent in meat samples were O52 (3), O14 (2), O10 (1), O59 (1), O21 (1) and 5 were rough colonies (Table 18).

Serotypes from milk samples were O52 (3), O21 (3), O92 (1) and 3 were rough strain (Table 18).

Table 18 Serotypes of E.coli from Mithun meat and milk

Serotypes	*E.coli* from meat samples (15)
O52	3
O14	2
O10	1
O59	1
O21	1
	5 rough colonies
	E.coli from milk samples (10)
O52	3
O21	3
O92	1
	3 rough colonies

Antibiotic sensitivity pattern of *E.coli, Salmonella, Staphylococcus* and *Clostridium spp.* from Mithun meat and Milk samples

The principle used here was that antibiotic will diffuse from a paper disc or small cylinder into an agar medium that contains test organisms. Inhibition was observed as a failure of the organism to grow in the region of the antibiotic. A common application of this method was the Kirby Bauer test, developed in the 1960s.

The procedure was used to determine the sensitivity of an organism isolated from a patent to a series of antibiotics. The results might serve as a guide to physician to prescribe a drug. An agar medium such as Mueller Hinton medium was inoculated with the organism and poured to the plate. Paper discs containing known concentrations of antibiotics were applied to the surface, and the plate was incubated. The appearance of a zone of inhibition surrounding the disc was indicative of sensitivity. Paper discs containing known concentrations of antibiotics were applied to the surface, and the plate was incubated. The appearance of a zone of inhibition surrounding the disc was indicative of sensitivity. By comparing the diameter of the zones to a standard table, one may determine if the test organism was susceptible, or resistant to the antibiotic.

The antibiotic sensitivity pattern of the *E.coli* isolates both from milk and meat samples showed highest sensitivity towards ciprofloxacin, nalidixic acid and chloramphenicol. Medium sensitivity towards Gentamicin, streptomycin, ceftriaxone, amoxicillin, erythromycin and resistance pattern towards amikacin, furazolidone, kanamycin and nitrofurantoin (Table 19).

The antibiotic sensitivity pattern of *salmonella* isolates showed highest sensitivity towards Ciprofloxacin, streptomycin , ciprofloxacin,erythromycin, chloramphenicol and nalidixic acid and lower sensitivity towards Gentamicin, amoxicillin , kanamycin, amikacin, ceftriaxone, nitrofurantoin and furazolidone (Table 19).

The antibiotic sensitivity pattern of *Staphylococcus* showed highest sensitivity towards Chloramphenicol, ceftriaxone, amoxicillin, tetracycline, nalidixic acid and erythromycin while medium sensitivity towards, gentamicin , nitrofurantoin and lowest sensitivity towards, kanamycin, ceftriaxone streptomycin and furazolidone (Table 20).

Antibiotic sensitivity pattern of *Clostridium spp.* showed highest sensitivity towards ceftriaxone, erythromycin, gentamicin, streptomycin medium sensitivityto chloramphenicol, nalidixic acid while lowest sensitivity towards kanamycin,nitrofurantoin, furazolidone and amoxicillin (Table 20).

Table 19. Antibiotic sensitivity pattern of *E.coli* and *Salmonella sp.*

Antibiotic Disc	*E.coli* (%)						*Salmonella sp.* (%)					
	Meat			Milk			Meat			Milk		
	H	M	L	H	M	L	H	M	L	H	M	L
Ciprofloxacin (CF30)	100			100			100			100		
Nalidixic acid (NA 30)	100			100			100			100		
Chloramphenicol (C30)	100			100			80	20		100		
Gentamicin (G30)		55	45		80			100			100	
Streptomycin (S25)		95	5.0		100		100			100		
Ceftriaxone (Cl30)		100				100		60	40		62.5	37.5
Amoxycillin (AM30)			100					100			37.5	62.5
Enrofloxacin (EX30)		50	50		30	70		100			100	
Amikacin (Ak30)			100			100			100			100
Furazolidone (FR50)			100			100			100			100
Kanamycin (K30)			100			100			100			100
Nitrofurantoin (NR100)			100			100			100			100

Table 20. Antibiotic sensitivity pattern of *Staphylococcus sp.* and *Clostridium sp.*

Antibiotic disc	*Staphylococcus* (%)						*Clostridium sp.* (%)					
	Meat			Milk			Meat			Milk		
	H	M	L	H	M	L	H	M	L	H	M	L
Ciprofloxacin (CF30)	100			100			100			100		
Nalidixic acid (NA30)	75	25		75	25			75	25		75	25
Chloramphenicol (C30)	100			100			50	50		50	50	
Gentamicin (G30)	58.3	41.7		58.3	41.7		41.7	58.3		41.7	58.3	
Streptomycin (S25)		41.7	58.3		41.7	58.3						
Ceftriaxone (Cl30)			100			100	66.7	33.3		66.7	33.3	
Amoxycillin (AM30)	100			100				83.3	16.7		83.3	16.7
Tetracycline (T30)	100			100			-	-	-	-	-	-
Enrofloxacin (EX30)	100			100			66.7	33.3				
Amikacin (Ak30)			100			100			100			
Furazolidone (FR 50)			100			100			100			100
Kanamycin (K30)			100			100		83.3	16.7		83.3	16.7
Nitrofurantoin (NR100)		66.7	33.3		66.7	33.3			100			100

Evaluation of the associations between blood PGFM and reproductive health in mithun

Fertility in the postpartum period determines the profitability of animal production. Disorders in the normal postpartum reproductive processes are manifested as low conception rates, increased postpartum intervals and reduced pregnancy rates. Postpartum reproductive health plays a pivotal role in influencing the resumption of ovarian activity in ruminants. Postpartum reproductive disorders like retained fetal membranes, puerperal endometritis and delayed uterine involution severely limit the reproductive potential. One useful marker for prostaglandin-F_{2a} in peripheral circulation is 13,14-dihydro-15-keto-PGF_{2a} (PGFM). Dynamic changes in the peripheral PGFM levels are known to be indicative of the initiation and progress of parturition, reproductive tract infections and resumption of ovarian activity in the postpartum period. However, there was no information regarding the level of PGFM during postpartum reproductive disorders in mithuns, and whether quantification of PGFM level could be used in the diagnosis of postpartum reproductive disorders in this species were available. Therefore, the objective of this study is to evaluate the associations between blood PGFM and reproductive health in mithun.

Mithuns with retained fetal membranes

Fourteen pregnant mithuns were observed 15 days prior to the expected day of calving. Blood samples were collected at 12 h intervals by jugular venipuncture from 10 days prior to the expected date of calving to 5 days postcalving. Of these, eight mithuns had retained fetal membranes and six mithuns had normal parturition. Retained fetal membranes were defined as the condition in which the fetal membranes were not expelled from the uterus for at least 12 h after delivery of the calf.

Mithuns with postpartum endometritis

Blood samples were collected from fifteen postpartum mithuns at 15 min intervals for 6 h on days 7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 84 and 96 postpartum through an indwelling jugular catheter. During the experimental period, eight mithuns were diagnosed with endometritis between days 45–63 postpartum, while seven mithuns were free of any detectable infections of their reproductive tract.

Mithuns with different postpartum intervals

Twenty-one multiparous mithuns free of pathological conditions were taken in this group. Blood samples were collected daily by jugular venipuncture from every mithun from days 1 to 60 postpartum. Thereafter, sampling was twice weekly until first observed postpartum estrus. The estrus was recorded by visual observations and bull parading at 12 h intervals every day, and further confirmed by plasma progesterone concentrations. The postpartum interval was defined as the number of days between calving and first postpartum estrus. The rate of uterine involution in all mithuns was monitored by palpating the uterus three times each week. Involution was considered to be complete when the uterine horns had returned to their normal intrapelvic position, had normal consistency, and were of approximately equal size.

Plasma PGFM levels in mithuns with retention of fetal membranes

The temporal changes in the mean levels of PGFM in mithuns with retained fetal membranes and having normal parturitions have been recorded. There was no significant difference ($P > 0.01$) between the plasma PGFM

levels (mean±S.E.M.) in mithuns that had retained fetal membranes and those had normal calvings from 240 h until 108 h prior to parturition. However, there were lower levels ($P < 0.01$) of plasma PGFM in these mithuns from 96 h prior to parturition until the end of sampling. In every mithun, that a had normal parturition, the plasma levels of PGFM gradually increased from 168 to 156 h prior to parturition, attained peak levels ranging from 2387 to 2712 pg/ml during parturition, and then declined gradually over the rest of the sampling period.

PGFM levels in mithuns with postpartum endometritis

Mean plasma PGFM levels (mean±S.E.M.) at weekly intervals up to 12 weeks postpartum in mithuns with postpartum endometritis or without any reproductive tract infections have also been established. There was no significant difference ($P > 0.01$) in mean plasma PGFM levels (mean±S.E.M.) in mithuns that developed endometritis and those without endometritis on day 7 postpartum (1416±41.2 pg/ml versus 1397±36.39 pg/ml). In mithuns, free of reproductive tract infections the levels of PGFM declined to basal levels (range 239–262 pg/ml) by 28 days postpartum. However, the PGFM levels were higher ($P < 0.01$) in mithuns (range 993–1067 pg/ml) with endometritis between days 39 and 45 postpartum.

Plasma PGFM levels in mithuns with different postpartum intervals

The mithuns were categorized into three subgroups, according to their postpartum intervals viz., nine had postpartum intervals between 60 and 90 days; six had intervals from 93 to 111 days and six had intervals from 113 to 125 days. The concentrations of PGFM were higher ($P < 0.01$) in the first 3 weeks postpartum in mithuns having shorter postpartum intervals (60-90 days) as compared to those having longer intervals (93–111 days and 113–125 days).

The study presented the possibility of using circulating PGFM concentrations for monitoring the postpartum reproductive health of mithuns.

To elucidate the changes in gene expression in muscle of Mithun

11 genes that regulate muscle growth and marbling in other bovines were selected and expression patterns were studied using reverse transcriptase PCR and gel electrophoresis. Primers were designed using available bovine sequences in the data base for each gene and PCR for the selected genes were optimized.

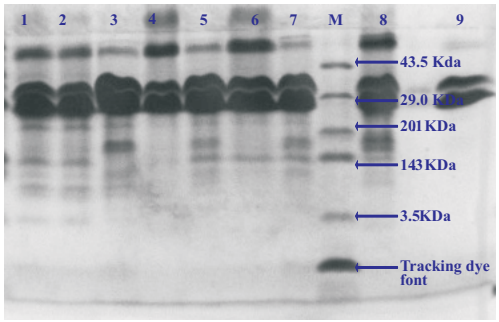
The expression patterns of 11 selected genes regulating muscle growth (GH1, GHR, IGF2, IGF1R and MSTN), marbling (FABP4 and FABP5) and muscle fibre growth (MYF5, MATR3 and TCAP) in growing mithun of different growth rates. It was found that the expression of GH1, GHR, IGF2 and IGF1R genes were higher in muscle of those animals that grow faster. On the contrary, increased expression of MSTN gene was found in the animals with slower growth rate. Higher expression of FABP4 and FABP5 were recorded in the animals that showed better marbling of the meat. Expression of the genes related to muscle fibre growth (MYF5, MATR3 and TCAP) were higher in mithuns that exhibited higher body growth. It was suggested that GH1/GHR/IGF1R/MYF5/MATR3/TCAP (which were positive regulator for muscle growth) and MSTN (negative regulator of growth) genes might be used for selection of mithun to be used for meat at an early age. FABP4/5 might be used as indicator of marbling of mithun muscle.

LIVESTOCK PRODUCTION AND MANAGEMENT

Mithun milk protein: it's characterization and bioactive properties

Comparative Tricine SDS-PAGE pattern of milk casein fractions of mithun and cow

The casein precipitate was repeatedly washed in cold distilled water and then with warm distilled water. For processing of dried casein samples the washed casein was alternately treated with 1M NaOH and 1 M HCl. The product thus obtained was treated with acetone and solvent ether and finally air dried. Whole casein sample (dried and wet) was dissolved in 100 mM trisHCI @1:100, treated in boiling water and then filtered. The cool pre-treated casein sample was then diluted in equal volume of sample buffer and heated at 100^{0}C. The sample was centrifuged and stored at -20^{0}C till further use.



Tricine SDS PAGE (16%) pattern of milk casein of cattle (dry casein-1,2 and wet casein-3), mithun cross (dry casein-4, wet casein-5), mithun (dry casein-6, wet casein-7) mithun colostrum (wet casein-8) and beta casein fraction of mithun milk (9) (M= low range protein marker, Bangalore Genei)

The electrophoresis of processed whole casein sample was performed in Tricine SDS-PAGE with 16% separating gel, 10% the spacer gel and 4% stacking gel. The elctrophoretic pattern of milk casein (dry as well as wet casein samples) of cattle, mithun cross and mithun were evaluated and compared. Irrespective of species and sample type (dry vs. wet) three common distinct bands were identified in all the lanes with molecular weight calculated as 65.62 2.65, 36.1 0.94 and 27.2 0.69 kDA. Nevertheless differences in band pattern were observed between dry and wet casein lanes. Irrespective of species in all the wet casein lanes the band with molecular weight of 13.94 0.68 kDa was present whereas another band with molecular weight of 17.24 0.76 kDa was found only in the dried casein lanes. Mithun milk lipid: Characteristics and bioactive Properties

Total phospholipids in mithun, yak and cattle ghee

The total phospholipids content of ghee was determined by extracting the fat with organic solvents. The steps involved in the process are extraction of phospholipids, digestion and colorimetric estimation. The phospholipids is extracted from filtered ghee by counter distribution technique using 87% (V/V) pre-equilibrated ethanol and petroleum ether. The extract thus obtained was subjected to digestion. The digested product was diluted to a final volume of 100ml with distilled water. Five ml of aliquot was used from the diluted samples for colorimetric evaluation. The standard used for calibration was solution of potassium dihydrogen phosphate having a concentration of 1μg/ml. However, the estimated total phospholipids content (mg/100g of fat) in mithun ghee (14.42 ± 0.80) was found significantly ($p<.05$) lesser than that of yak (17.19 ± 0.87) and cow ghee (17.55 ± 3.03) (Table 21).

Table 21. Phospholipids concentration in mithun, yak and cow ghee

Species	Total phospholipids (mg/100g of fat)
Mithun	14.42 ± 0.80^a
Yak	17.19 ± 0.87^b
Cow	17.55 ± 3.03^b

^{a,b}**Means with different superscripts differ significantly ($p<0.05$)**

ANIMAL HEALTH

Studies on tick infestation in naturally infested Mithuns *(Bos frontalis)*

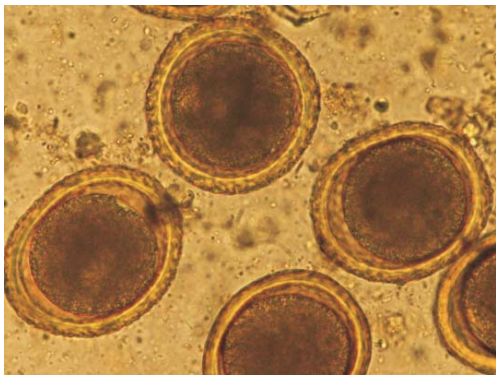
The external body parts of free range (48) mithuns from porba village under Phek district (3000 mMSL) as well as semi intensively raised mithuns (128 nos.) from institutes' mithun farm Jharnapani (250mMSL) and Porba of varied age groups and sex were examined for tick infestation.

Boophilus microplus infested mithun

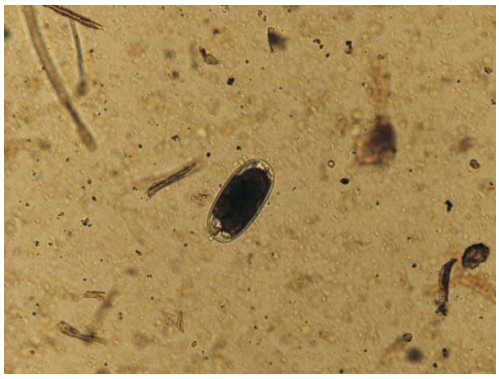
Examination of body surface of the animals revealed no ectoparasites other than Ixodid tick of the species *Boophilus microplus* . The common predilection sites of ticks were inner side of pinna, legs, belly, abdomen and neck. Out of the total 176 animals examined, 103 (58.52%) had tick infestation.In Jharnapani , out of 102 animals examined, 47 (46.07%) were positive whereas in Porba farm, it was 16 (61.53%) out of 26 animals examined. In free ranging animals of the Porba village, 40 (83.33%) out of 48 animals revealed the presence of ticks. In the present study infestation was higher in free range mithuns which might presumably due to contact with wild animals in the forest. Intensity of infestation was highest in older animals and only 4 (2.27%) in younger animals.

Prevalence of Gastrointestinal Helminthes parasites in free ranging mithun *(Bos frontalis)* from Phek district of Nagaland

A total of 93 free ranging animals were examined by standard parasitological method. The infected faecal samples positive for strongyle group of nematode parasites were subjected to coproculture for generic identification. The overall recorded incidence of gastrointestinal parasite was highest in case of *Trichostorngylus* (23.65)



Eggs of *Toxocara vitulorum*



Eggs of *Strongyle sp.*

followed by *Cooperia* (10.75%), *Haemonchus* (9.67%), *Oesophagostomum* (6.45%), *Toxocara vitulorum* (2.15%) and *Nematodirrus spp.*(1.07%). Among tape worm infection, both species of *Moniezia benedeni* (7.52%) and *M. expansa* (2.15%) was recorded. However trematode infection couldn't be noticed during

the present investigation. The total of 11.82% was noticed as a mixed infection comprising of different genus during the present investigation.

Acaricidal efficacy of crude herbal against *Boophilus microplus* infestation in mithuns from Nagaland

Tick infestation is one of the most common problems encountered in the mithuns reared both in semi-intensive as well as free range system of management. All the mithuns of the institute reared in both the farms located at Jharnapani and Porba at the altitude of 250m MSL and 2133m MSLwere examined for tick infestation and *Boophilus microplus* was found to be the most prominent tick during the present investigation. A comparative study was undertaken to test the acaricidal efficacy of Cypermethrin, Neem, Tobacco and Ivermectin against the infestation of ticks in mithuns reared under semi-intensive system of management at the institute farm. A total of 16 animals were divided into four groups with four animals in each in a completely randomized design. Each group was treated separately with Cypermethrin (1ml/l), Neem (500 g/l), Tobacco (100 g/l) as body spray where as Ivermectin (1ml/50 kg body weight) was used subcutaneously. Observation were taken to record the number of ticks in a unit area (1 inch square) before the treatment. Efficiency of various treatments was analysed at 0, 7, 14 and 21st days after treatment. Among various treatment neem was was found to be least effective even after 21 days where as Ivermectin was found to be effective on 7 and 14th day of post treatment. Tobacco and Cypermethrin were found to be effective on 14 and 21st day of post treatment. From the study, it may be concluded that Ivermectin is most effective acaricide against *B. microplus* infestation in mithun

Immature amphistomiasis – A case report

A female mithun calf reared in semi range system of management in the forest condition on examination revealed anorexia, weakness, depression, rough body coat, pale mucous membrane, persistent and foul smelling diarrhoea, and shreds of mucus and blood in faeces followed by semi solid faeces. This animal died subsequently and was examined thoroughly in necropsy. There was thickening, congestion and ulceration of the intestinal mucosa and small intestine was heavily studded with large numbers of immature amphistomes embedded in the mucosal layer and diffuse hyperemia was observed with pin point hemorrhages in the anterior part of the duodenum and jejunum. Immature worms were collected from the intestine and the gut contents for microscopic examination. Identification of immature stage of genus and species of amphistomes is rather a difficult task due to lack of several characters for specific diagnosis. Small intestine and worms were examined under the microscope for presence of suckers at both the anterior and posterior ends for confirmation of the flukes. The cause of death of animal was diagnosed as heavy infestation of immature amphistomes which lead to severe enteritis, diarrhoea and dehydration.

Etiopathological Study of Papillomatosis (warts) in Mithun *(Bos frontalis)*

All the Mithuns at the two farms of the Institute have been examined and six animals were found to be infected with cutaneous papilloma and Teat papilloma was found in one Mithuns. Besides, 200 numbers of animals were examined in field condition during animal health camps in Porba and Thupuvisu villages of the Phek district. Warts were observed in five animals in the free ranging condition in the forest. A total of 10 warts samples were collected from mithun affected with warts. The samples were collected for histopathology, Ultrastructural study and molecular characterization of the virus.

Disease Monitoring Surveillance of Mithun in NER of India

Three animal health cum vaccination camps have been organized in field condition to examine the health status of the animals and collect samples for screening of various diseases of Mithuns. A total of 340 Mithuns were surveyed (140 from the institute farm and 200 from field condition) for the prevalence of papillomatosis (warts) in Medziphema and

Phek districts. Blood and Serum samples have been collected from a total of 236 Mithuns (140 from the Institute Farm and 86 from field conditions) for carrying out disease surveillance in Mithuns.

Besides, complete necropsy was done for 10 Mithuns at the Medziphema farm of the Institute and the cause of their death were attributed to haemorrhagic gastroenteritis (6), Trauma (2), Jaundice (1) and Haemonchosis (1).

Screening for Tuberculosis (Single Intradermal Test)

38 Mithuns at the Medziphema farm were screened for Tuberculosis by single intradermal test. Of all the animals tested four were found to be positive and three were found to be doubtful and will be examined again after period of six weeks.

Screening of Vaginal Swabs for aerobic bacteria in the lower reproductive tract

A total of 40 deep vaginal swabs were collected from 14 heifer and 26 parous mithun cows and were analysed for various aerobic bacteria present therein using standard protocol. Analysis of samples revealed presence of *Pseudomonas sps. Enterococcus sps. Klebsiella pneumonia, Budbicia acquatics, Escherchia coli, Enterobacter hormaechei, Aeromonas hydrophilla, Aeromonas schubertii, Aeromonas eucranophila, Aeromonas salmonicida, Citrobacter freundii, Kluyvera cryoscens, Proteus mirabilis, Proteus penneri, Proteus vulgaris, Citrobacter amalonaticus, Hafnia albei,* etc. Bacterial isolates were examined for antimicrobial sensitivity. Most of the isolates were sensitive to majority of the antibiotics tested. However, more than 50% were resistant to ampicillin and a few to cotrimoxazole.

VETERINARY EXTENSION

A Study to Find out Status and Economics of Mithun Husbandry in Nagaland

Mithun *(Bos frontalis)* is an important role in the economic, social and cultural life of the tribal people inhabiting the region. There is an urgent need for scientific intervention for proper management as well as conservation of this animal. Technologies and techniques for the scientific management of Mithun developed by NRCM are helping in maximizing the economic contribution of this animal.

Interview schedules were developed and pre-tested on similar respondents in non-sample area and suitable modification were made in the schedules accordingly. Data were collected with the help of interview schedule from selected villages (Table 22).

Analysis and interpretation of data was done after collection of information (Table 23). The suitable statistical analysis of data such as mean, standard deviation, percentages, correlation analysis were applied (Table 24).

Multistage random sampling method

Table 22. Randomly selected district, blocks, villages and farmers

State	Nagaland			
Districts (Rank)	Kohima (III)	Phek (IV)	Tuensang (I)	Zunheboto (II)
Blocks	Zubza Tseminyu	Pfutsero Phek	Noklok Chare	Aghunato Satakha
Villages	Khonoma Tseminyu	Sakraba Losami	Chingmai Yokao	Ngozubom Satoi
Farmers	50	50	50	50
Total respondents	200			

Table 23: Profile of the Respondents

Sl. No.	Variables	Categories	Percentage (%)
1	Age	Young (upto 35)	00.0
		Middle (36 -50)	42.9
		Old (Above 50)	57.1
2	Socio -economic status (SES)	Low (Upto 20)	14.2
		Medium (21 to 30)	42.9
		High (Above 30)	42.9
2	Tribes	Angami	100.0
3	Occupation	Agriculture	100.0
4	Education level of the respondent	Illiterate	42.9
		Upto high school	57.1
		Graduate & Above	00.0
5	Social Participation	No participation	43.0
		One organization	43.0
		More than one Organization	14.0
6	Family type	Nuclear	100.0
7	Family size	Upto 4 members	14.3
		5 -8 members	71.4
		Above 8 members	14.3
8	Farm size	Small (up to 2 acre)	42.8
		Medium (2 -4 acre)	28.6
		Large (Above 4 acre)	28.6
9	House type	Kutcha	57.1
		Mixed	28.6
		Pucca	14.3
10	Family education level	Illiterate	14.2
		Upto high school	42.9
		Graduate & Above	42.9
11	Herd size	Small (upto 3)	14.3
		Medium (4 -6)	71.6
		Large (Above 6)	14.3
12	Annual Income from A.H.	Low (Upto 45,000)	42.8
		Medium (45,001-90,000)	28.6
		High (Above 90,000)	28.6
13	Total Annual Income	Low (Upto 1,50,000)	28.6
		Medium (1,50,001-2,50,000)	57.1
		High(Above 2,50,000)	14.3

Table 24. Correlation with different variables

Sl. No.	Variables	Mean	Std. Deviation	Correlations with no. of Mithun
1	Materials possession	5.57	3.10	0.176
2	Family education level	3.68	1.70	0.418
3	Annual income from AH	6.44	2.88	0.919**
4	Total annual income	2.00	0.63	0.660

**. Correlation significant at the 0.01 level
*. Correlation significant at the 0.05 level

Table 25. Role of Mithun in different forest based farming system

Sl. No.	Farming system	Role of Mithun	Percentage (%)
1	Livestock	Mithun fencing helps other livestock in the area	57.1
		Can't say	42.9
2	Forestry	Support the biomass Manured the forest, spread the seeds of many plants and trees and also helps in plant growth	14.2 42.9
		Can't say	42.9
3	Irrigation and water harvesting system	Can't say	100.0
4	Agro forestry	Manured the forest, spread the seeds of many plants and trees and also helps in plant growth	57.1
		Can't say	42.9
5	Grassland and fodder production	Gives manure, helps in growth and spread the seeds of grass and fodders trees	57.1
		Can't say	42.9
6	Integrated farming system	Manured the pond and forest with faeces that helps in fishery, horticulture and others farming system	14.3
		Can't say	85.7
7	Fishery	Manured the pond and gives food for fishes	28.6
		Can't say	72.4
8	Piggery	Can't say	100.0
9	Poultry	Can't say	100.0
10	Medicinal plant	Spread the seeds of medicinal plants in the forest	42.9
		Can't say	57.1

Table 26. Role of Mithun in forest ecosystem

Sl. No.	Forest Ecosystem	Role of Mithun	Percentage (%) of role
1	Where Mithun are raised, plant population (including medicinal plant, orchid etc)	Increase	57.1
		decrease	00.0
		Can't say	42.9
2	Mithun raising in forest is increasing soil run off	Yes	28.6
		No	28.6
		Can,t say	42.8
3	Manure of Mithun helps in better plant growth	Yes	72.4
		No	0.00
		Can,t say	28.6

- Survey work on Mithun farmers revealed that they were of the age group of above 50 years with medium to high socio-economic status, education status up to high school, agriculture as their main occupation and medium level of income from Animal Husbandry.
- It was also observed that the Mithun farmers raising more Mithun had more income from Animal Husbandry, had more total income (1,50,001-2,50,000) and had high socio-economic status.
- Correlation analysis between Annual income from Animal Husbandry and number of Mithun raised were highly significant and positively correlated and total annual income of Mithun rearers from this region was also positively correlated with number of Mithun raised. This indicates that Mithun farmers having more Mithun have more income from Animal Husbandry and total annual income
- Analysis of survey data regarding role of Mithun in different forest based farming system showed that (Table 25)-

- In Livestock: Mithun fencing helped other livestock in the area (57.10%).
- In Forestry: Manured the forest spread the seeds of many plants and trees and also helps in plant growth (42.90%).
- In Agro forestry: Manured the forest, spread the seeds of many plants and trees and also helps in plant growth (57.10%).
- In Grassland and fodder production: Gives manure helps in growth and spread the seeds of grass and fodders trees (57.10%).
- Regarding Integrated farming system they told that manured the pond and forest with faeces that helps in fishery, horticulture and others farming system (14.30%).

- Analysis of surveyed data regarding role of Mithun in forest ecosystem showed that, where Mithun were raised, plant population (including medicinal plant, orchid etc) increased and manure of Mithun helped in better plant growth (Table 26).
- In this region with high meat consumption, meat were preserved and stored by their traditional system i.e. smoking and the people of this region also prepared Mithun meat pickle and others items from meat. Although in this region skin was consumed along with meat and sometimes preserved with meat to eat.

Miscellany

"सारे जहाँ से अच्छा हिन्दुस्ताँ हमारा,
हम बुलबुले है इसकी, ये गुलिस्ताँ हमारा"

राज ाषा आयोग

संस्थान में ारत सरकार की राज ाषा नीति का अनुपालन के रूप में हिन्दी के प्रति जागरूकता पैदा करने तथा प्र ावों में गति लाने के लिए संस्थान में एक राज ाषा प्रकोष्ठ है, इसमें एक वरिष्ठ वैज्ञानिक हिन्दी प्र ारी के रूप में तथा एक लिपिक एवं अनुवादक कार्यरत है। इस संस्थान के वैज्ञानिक द्वारा कृषकों के जीवन में पशुपालन में गुणात्मक सुधार हेतु महत्वपूर्ण तथ्यों को अवगत कराया जाता है। पशुपालन के क्षेत्र में इस संस्थान की ूमिका रही है। इस गतिविधियों एवं जानकारियों को अन्य ाषाओं के साथ- साथ हिन्दी में ी किसानों तक पहुँचाने में यह संस्थान प्रयासरत है। रा.मि.अनु. केन्द्र एक वैज्ञानिक संस्थान है। इस कार्यालय में राज ाषा हिन्दी को काफी बढ़ावा दिया जाता है तथा कार्यालय में हम स ी का कर्तव्य है कि राज ाषा हिन्दी की पहचान एवं गौरव को बनाए रखे और इसकी प्रचार-प्रसार को बढ़ाने के लिए हिन्दी का प्रयोग करना चाहिए। संस्थान के हिन्दी अनु ाग में वैज्ञानिक/ अधिकारियों ने राज ाषा के प्रचार-प्रसार हेतु अनेक उल्लेखनीय कार्य किए है। इस संस्थान में हुई उपलब्धियों का संक्षिप्त विवरण निम्नलिखित है :-

- इस कार्यालय में गैर हिन्दी ाषी लोगों के शब्द ज्ञान हेतु प्रतिदिन हिन्दी में एवं अंग्रेजी समानार्थ के साथ हिन्दी का एक शब्द लिखा जाता है।
- हिन्दी प्रकोष्ठ में टिप्पणी एवं मसौदा लेखन इत्यादि कार्य हिन्दी में होते हैं।
- संस्थान के हिन्दी प्रकोष्ठ एवं अन्य प्रकोष्ठ के कंप्यूटर में हिन्दी सॉफ्टवेयर लगाकर द्वि ाषी रूप में काम करने की सुविधा की गई है।
- कार्यालय में हिन्दी में प्राप्त पत्रों के शत-प्रतिशत उत्तर हिन्दी में ही दिए जाते हैं।
- कार्यालय में अधिकांश नामपट्ट,शीर्षक-पत्र इत्यादि द्वि ाषी हैं तथा समय-समय पर आवश्यकतानुसार नामपट्ट द्वि ाषी रूप में बनवाये जाते हैं।
- कार्यालय में राज ाषा कार्यान्वयन समिति की बैठकें हिन्दी में होती हैं।
- कार्यालय में तिमाही रिपोर्ट, वार्षिक रिपोर्ट इत्यादि हिन्दी में ेजे जाते हैं।
- कार्यालय में धारा 3 (3) के अन्तर्गत आने वाले प्रपत्र एवं सुचानायें इत्यादि द्वि ाषी रूप में प्रयोग किए जाते है।
- कार्यालय में राज ाषा वि ाग के आदेशों के अनुसार संस्थान के स्वीकृत बजट में पुस्तकालयों के लिए निर्धारित राशि में से हिन्दी पुस्तकों की खरीद जिसमें संस्थान में प्रयोग किए जाने वाले विज्ञान शब्दकोश,सरकारी टिप्पणियाँ एवं कार्यालय उपयोग हेतु पुस्तकें मँगवाई जाती हैं।
- कार्यालय में सरकारी काम- काज में राज ाषा के रूप में हिन्दी के प्रति जागृति करना एवं इसके प्र ावों में गति लाने के लिए संस्थान में राज ाषा प्रकोष्ठ की स्थापना की गई, जिसमें नियमित रूप से राज ाषा को बढ़ावा देने के लिए कार्यक्रम आयोजित किये जाते है।

राजा ाषा हिंदी सप्ताह का आयोजन एवं वि िन्न कार्यक्रम

राष्ट्रीय मिथुन अनुसंधान केन्द्र झरनापानी नागालैंड संस्थान में दिनाँक 13 सितम्बर से 20 सितम्बर 2010 तक (हिंदी सप्ताह) समारोह का आयोजन ा. कृ. अ. प. (उत्तर पूर्वीय क्षेत्र) नागालैंड केन्द्र के साथ संयुक्त रूप से आयोजित किया गया। इस शु ा अवसर पर इस आयोजन के मुख्य अतिथि डॉ. अकाली सेमा निदेशक सी. आई. एच एवं रा.मि. अनु. केन्द्र संस्थान के डॉ. चंदन राजखोवा निदेशक महोदय द्वारा वृक्षारोपण एवं दीप प्रज्वलित कर तथा राष्ट्रगान के साथ हिन्दी सप्ताह का शु ारम्ा 13 सितम्बर को सुबह 11 (ग्यारह) बजे संस्थान के सम्मेलन कक्ष में किया गया। इस समारोह में रा.मि. अनु. केन्द्र एवं आई.सी. ए. आर उत्तर पूर्वीय क्षेत्र, नागालैंड केन्द्र दोनो संस्थानो के स ी अधिकारी एवं कर्मचारीगण उपस्थित थे। इस दौरान संस्थान में हिंदी ाषा के प्रचार एवं प्रसार के लिए वि िन्न प्रतियोगिताओं का आयोजन किया गया। जिसमें परिसर के बालक एवं बालिकाओं के लिए ी कई प्रतियोगिताओं का आयोजन किया गया। इन स ी प्रतियोगिताओं में न सिर्फ कर्मचारी अपितु अधिकारियों ने ी उत्साह पूर्वक हिस्सा लिया।

संस्थान में हिन्दी सप्ताह के दौरान आयोजित प्रतियोगितायें

क्रमसंख्या	प्रतियोगिता का नाम	आयोजन की तिथि
1.	तत्कालीन ाषण/ समाचार पत्र वाचक	13.9.2010 11.30 बजे सुबह
2.	निबंध लेखन / टिप्पणी एवं प्रारूप लेखन/ स्मरण शक्ति / अंताक्षरी	14.9.2010 11सुबह 3 बजे शाम
3.	पत्र लेखन / हिन्दी अनुवाद /सुन्दर हस्ताक्षर	16.9.2010 11 बजे सुबह
4.	वाद-विवाद	17.9. 2010 11बजे सुबह
5.	पुरस्कार वितरण एवं समापन समारोह	20. 9. 2010 3 बजे शाम

इस सप्ताह का समापन समारोह दिनाँक 20 सितम्बर 2010 को संस्थान के सम्मेलन कक्ष में निदेशक डॉ.चंदन राजखोवा एवं आई.सी. आर संस्थान के संयुक्त निदेशक डॉ. बी.पी. ाट्ट की उपस्थित में किया गया। इस अवसर पर संयुक्त निदेशक डॉ. बी.पी. ाट्ट ने उपस्थित स ी वैज्ञानिकों अधिकारियों एवं कर्मचारियों को राज ाषा प्रयोग की ओर विशेष रूप से प्रोत्साहित करते हुए कहा कि, हिन्दी सप्ताह के स ी कार्यक्रम हिन्दी को बढ़ावा देने के लिए आयोजित किये जाते हैं। इनसे हमें हिन्दी में अधिकाधिक कार्य करने की प्रेरणा मिलती है। इस अवसर पर डॉ. बी. आर. सिंह ने कहा की हिन्दी हमारी राष्ट्र ाषा है, अतः हम स ी को राष्ट्र ाषा का सम्मान करना चाहिए और कार्यालय एवं दैनिक कार्यों में प्रयोग करना चाहिए। इस सप्ताह के समापन समारोह में वि िन्न प्रतियोगिताओं के विजेताओं को निदेशक डॉ.चंदन राजखोवा एवं संयुक्त निदेशक डॉ. बी.पी. ाट्ट ने पुरस्कार प्रदान किया। इस दौरान संस्थान के अधिकारी एवं कर्मचारीगण ने कार्यालय में हिन्दी ाषा के उपयोग के लिए एवं राज ाषा के प्रति अपनी निष्ठा को समर्पित किया। हिन्दी सप्ताह के दौरान संस्थान के एक गैर हिन्दी ाषी कर्मचारी ने अपने दैनिक कार्य में हिन्दी ाषा का प्रयोग करके हिन्दी ाषा को बढ़ावा दिया और राज ाषा के प्रति अपनी निष्ठा को अ िव्यक्त किया। इसलिए इस व्यक्ति को समापन समारोह में स ा कक्ष में उपस्थित स ी लोंगों ने सम्मान किया। अंत में संस्थान के निदेशक ने हिन्दी सप्ताह के सफल आयोजन पर स ी को बधाई दी एवं आशा व्यक्त की कि संस्थान में राज ाषा के उपयोग में प्रगति आयेगी।

हिन्दी सप्ताह के दौरान आयोजित प्रतियोगितायें एवं विजेता प्रति ागी

क्र.सं.	प्रतियोगिता	प्रतियोगी वर्ग	विजेता	स्थान
1.	ाषण (तत्कालिक)	हिन्दी ाषी	डॉ. विद्या सिंह डॉ. नरेश प्रसाद	प्रथम द्वितीय
		गैर हिन्दी ाषी	डॉ. मोहन मंडल	तृतीय
2.	हिन्दी समाचार वाचक	हिन्दी ाषी	डॉ. आर के सिंह डॉ. विद्या सिंह	प्रथम द्वितीय
		गैर हिन्दी ाषी	डॉ. रिंकी शर्मा श्री शत्रुघन वर्मा	प्रथम प्रथम
3.	निबंध लेखन	हिन्दी ाषी	डॉ. विद्या सिंह डॉ. नरेश प्रसाद	द्वितीय तृतीय
		गैर हिन्दी ाषी	डॉ. ऋतुराज	तृतीय
4.	टिप्पणी एवं प्रारूप लेखन स्मरण शक्ति	गैर हिन्दी ाषी	श्री सीमन्तो बोरा श्री कामेश्वर	द्वितीय तृतीय
		हिन्दी ाषी	श्रीमती कामिनी वर्मा	द्वितीय
5.	हिन्दी अनुवाद	गैर हिन्दी ाषी	डॉ. रिन्की शर्मा	द्वितीय
6.	वाद-विवाद प्रतियोगि ता	हिन्दी ाषी	डॉ. अनुपमा मुखर्जी डॉ. आर. के. सिंह डॉ. विद्या सिंह	प्रथम द्वितीय तृतीय
		गैर हिन्दी ाषी	डॉ. रिन्की शर्मा	तृतीय
7.	अंताक्षरी		डॉ. बी आर. सिंह एवं श्री शत्रुघन वर्मा डॉ. आर. के सिंह एवं डॉ. रिंकी शर्मा श्री रबी एवं हारनाथ	प्रथम द्वितीय तृतीय
8.	सुन्दर हस्ताक्षर	गैर हिन्दी ाषी	अंगानो अकानी रोको	

सर्तकता एवं जागरूकता सप्ताह

संस्थान के कार्यालय में इस वर्ष के दौरान सर्तकता, जागरूकता, सप्ताह दिनाँक 25 अक्टूबर 2010 से 1 नवम्बर 2010 तक मनाया गया। इस आयोजन में कार्यालय के निदेशक डॉ. चन्दन राजखोवा एवं स ी अधिकारियों एवं कर्मचारियों ने हिस्सा लिया। इस समारोह में कई प्रतियोगिताओं का आयोजन ी किया गया। इन स ी प्रतियोगिताओं में न सिर्फ कर्मचारी अपितु अधिकारी एवं निदेशक ने ी उत्साह पूर्वक हिस्सा लिया। इस समारोह में सर्तकता जागरूकता के प्रचार एवं प्रसार के लिए ाषण भ्रष्टाचार एवं लोकतंत्र के बारे में जागरूकता, एवं सूचना का अधिकार : प्रणाली को पारदर्शी तंत्र का बनाने का साधन, चित्रकला आदि का आयोजन हिन्दी में ी किया गया। इस समापन समारोह में वि िन्न प्रतियोगिताओं के विजेताओं को कार्यालय के निदेशक महोदय द्वारा पुरस्कार वितरित किए गए।

LIBRARY PROFILE

A library is a collection of sources, resources, and services, and the structure in which it is housed; it is organized for use and maintained by a public body, an institution, or a private individual. In the more traditional sense, a library is a collection of books. It can mean the collection itself, the building or room that houses such a collection, or both (Wikipedia).

Library can be classified under different categories, and our Institute library belongs to academic category. The main purpose of an academic library is to provide support to the teaching and research of any Institution. In general, an academic library contains mostly all published and documented materials required for speicific purposes of research and academic purpose and hence, there is little scope for non-academic materials. in an academic library.

We could procure 94 printed books in the field of Animal Genetics, Physiology, Production, Nutrition, Health and Biotechnology apart from subscription of six national and eight foreign scientific journals during this period. With the advent of digital library concept, our Institute library also started online journal searching facility for the scientists and other research staff through the introduction of CeRA (Consortium of e-Resources in Agriculture) – thanks to NAIP-IARI for granting this facility to this Institute.

Sl.No.	Particulars	Period (2010-11)	Cumulative Total
1	Books	94	1380
2	Journals		
	a) National	06	06
	b) International	08	08
3	Abstract CD		
	a) Agris CD	-	13
	b) Vet CD	-	29
	c) Beast CD	-	08
	d) Resource CD	-	01
	e) Medline	-	20
	f) Miscellaneous	04	15
4	Annual Report	118	840
5	Research Highlights /Compendium /Technical bulletin	04	18
	Others Publications/Proceedings	55	862
6	Thesis	00	04

TRAINING /REFRESHERS COURSE/SUMMER SCHOOL/WINTER SCHOOL/SEMINARS/CONFERENCE/SYMPOSIA/WORKSHOPS ATTENDED

Name & Designation	Name of the Programme	Durtion
Dr.K.K. Baruah	ICAR Training-cum-Workshop on Intellectual property and Technology Management", Kolkata	28-29 January, 2011.
Dr. Sabyasachi Mukherjee	Regional training workshop on "In vivo conservation of Animal Genetic Resources", NAS complex, New Delhi.	28 -30 October, 2010.
	Sensitization cum Training workshops for the Nodal Officers of PIMS-ICAR (Project Information & Management System of ICAR), Directorate of Water Management Research (ICAR), Bhubaneswar.	30 October 2010.
Dr.Naresh Prasad	Bos frontalis festival, 2010 IG Park, Itanagar.	30 - 31 May 2010
	Agri-Fair-2010-2011 at ICAR Research Complex for NEH Region, Umiam, Barapani, Meghalaya	28 February – 2 March, 2011
Dr.Vidya Singh	ICAR Sponsored winter school on "Basic techniques in solid phase peptide synthesis and applications of synthetic peptides in animal disease diagnosis and research", Division of Animal Biotechnology, IVRI, Izatnagar, Bareilly.	22 October -12 Novem ber 2010.
	National symposium on "Recent trend in diagnosis and pathology of emerging and re-emerging diseases of livestock and poultry", Indian Association of Veterinary Pathologist, Veterinary College, Khanapara, Guwahati	25 –27 November,2010
	Data Analysis using SAS" at ICAR Research Complex, Barapani	28January to 02 March,2011
	North East Agri Fair held at ICAR Research Complex, Barapani	28 February – 2 March, 2011
	North East Agri Expo held at Dimapur, Nagaland	15 –19 March 2011.

ONGOING RESEARCH PROJECTS – INSTITUTIONAL

1. Conservation and propagation of quality Mithun germplasm in Nagaland: K.K.Baruah.
2. Standardization of Superovulation and Embryo Transfer Protocols in Mithun: K.K. Baruah.
3. Isolation and Characterization of Botanicals from NEH Region for Their Antibacterial or Antimethanogenic Activities: Nazrul Haque.
4. Development of Economically Viable Feeding Strategy for Rearing Mithun in Intensive System Using Spent Grains from Breweries Industries: Nazrul Haque.
5. Genetic Studies of Leptin Gene and Its Association with Growth and Nutritional Performance of Mithun: Anupama Mukherjee.
6. Genetic Studies on Mithun: Anupama Mukherjee.
7. Effect of Feeding Different Levels of Dietary Protein on Growth, Nutrient Utilisation, Carcass Characteristics and Leather Quality in Mithun *(Bos frontalis)*: K.C.Das.
8. Comparative Studies on Growth, Nutrient Utilization, Carcass Characteristics and Leather Quality in Mithun and Local Cattle on Tree Leaves Based Ration: K.C.Das.
9. Identification of novel genes involved in muscle growth of mithun (Bos frontalis) and its comparison with local cattle (Bos indicus) of Nagaland: Mohan mondal.
10. Genetic Characterization of Kappa Casein Gene of Mithun: Sabyasache Mukherjee.
11. Mithun milk lipid: Characteristics and bioactive Properties: Anjumoni Mech.
12. Mithun milk protein: it's characterization and bioactive properties: Anjumoni Mech.
13. A Study to Find Out Status and Economics of Mithun Husbandry in Nagaland: Naresh Prasad.
14. Therapeutic and Preventive Management of Gastrointestinal Helminth Parasites of Mithun *(Bos frontalis)*: Jayanta Kumar Chamuah.
15. Etiopathological Study of Papillomatosis of Mithun *(Bos frontalis)*: Viday Singh.

ONGOING RESEARCH PROJECTS – INTER – INSTITUTIONAL

1. Resource base, traditional knowledge andparticipation of farm women in livestock production [in collaboration with NRCWA (lead centre), IVRI and NRC on Pig: A Mech, R.K Singh and A Dhali
2. Morphometric andgenetic characterization of Mithun (in collaboration with CARI, Izatnagar): S Mukherjee, Anupama Mukherjee, Sanjeev Kumar, Kezhavituo, Kobu Khate and C Rajkhowa.
3. Veterinary type culture-Rumen microbes [in collaboration with National Institute for Animal Nutrition and Physiology, Bangaluru (Lead centre on rumen microbes) : N Haque and KC Das

ONGOING RESEARCH PROJECTS – EXTERNALLY FUNDED

1. Conservation and propagation of quality Mithun germplasm in Nagaland: KK Baruah, M Mondal, A Dhali, MK Karunakaran, BC Sarmah and BC Deka. Funded by DBT, Ministry of Science and Technology, GOI, New Delhi.
2. Isolation and characterization of fibre degrading microbes and manipulation of rumen ecosystem in Mithun *(Bos frontalis)* for improving fibre degradation: KC Das, SS Pal, B Prakash, M Mondal, KK Baruah, S Mukherjee, A Dhali, PK Subudhi, C Rajkhowa.

3. Elucidating the physiological and genomic regulation of ovarian follicular development for reproduction augmentation in Mithun *(Bos frontalis)*: Mohan Mondal.
4. Application of endrocrine biotechnology for induction of mother – neonate bonding in Mithun *(Bos frontalis)*. Dr. Mohan Mondal. DBT, GoI, New Delhi.
5. Identification of SNPs in leptin gene for selection of Mithun *(Bos frontalis)* for higher growth traits and characterization of leptin protein. Funded by DBT, Ministry of Science and Technology, GOI, New Delhi (NER Division)
6. Genetic and Biodiversity studies on Mithun *(Bos frontalis)*.Funded by DBT, Ministry of Science and Technology, GOI, New Delhi (NER Division)

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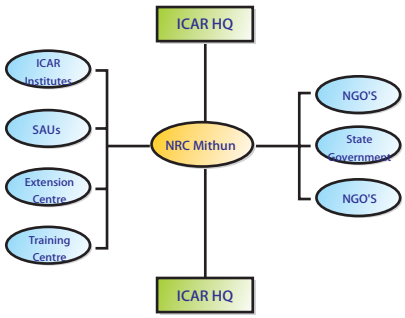
LINKAGES AND COLLABORATION



ACTIVITIES OF KRISHI VIGYAN KENDRA (KVK)

Krishi Vigyan Kendra (Porba), Phek is a district level Farm Science Center established by the Indian Council of Agricultural Research (ICAR), New Delhi under the administrative control of NRC on Mithun, Jharnapani, Nagaland, with the aim of reducing the time lag between technology generation and it's transfer to the farmer's field to increase production and sustainability. Agriculture is the mainstay of the district and is basically rain fed. A traditional farming system called 'Zabo' farming system is also practiced in the Kikruma area of the district. Paddy, maize, beans, pea, cowpea, arhar and nagadal are the common agronomical crops whereas cabbage banana, orange, passion fruit, guava, garlic, potato, ginger and cardamom are the common horticultural crops. Besides this pig, goat, backyard poultry, mithun and cattle are important livestock of the district. PRAs of the various villages have been conducted to find out the gap between technologies available and practiced by the farmers. Based on the PRA and analyzing the information available in KVK,Phek has undertaken numerous training and demonstration programme to address to the needs of the farming community.

Functions of KVK

- Conducting "On Farm Testing" (OFT) for identifying technologies in terms of location specific sustainable land use system
- Organizing training to update the extension personnel with emerging advances in agriculture research on regular basis.
- Organizing short and long term training courses in agriculture and allied vocations for farmers and rural youth with emphasis on" learning by doing" for higher production on farms and generating self employment.
- Organizing front line demonstration (FLD) on various crops/livestocks to generate production data and feedback informations.

Training Programmes organized during 2010-11

Area	Courses	Participants
Crop Production	12	286
Horticulture	15	313
Plant Protection	14	334
Home Science	11	253
Animal Science	17	443
Soil Science	15	338
Agril Engineering	9	167
Total	95	2119

Sponsored Training

S. No	Duration (Days)	Training on the topic /Place	No. of participants	Sponsor	Type of Participants
1.	1	Soil fertility management	61	NABARD	Farmer's Club Members
2.	1	Vermicomposting	61	NABARD	Farmer's Club Members
3.	1	Production and management technology on potato	61	NABARD	Farmer's Club Members
4.	1	Production and management technology on potato	61	NABARD	Farmer's Club Members
5.	1	Integrated farming system	61	NABARD	Farmer's Club Members
6.	1	Awareness of poultry diseases and production technology on paddy	30	NABARD	SHG Members
7.	4	Backyard rabbit farming	30	NABARD	SHG Members
8.	4	Backyard rabbit farming	30	NABARD	SHG Members
9.	4	Backyard rabbit farming	30	NABARD	SHG Members
10.	4	Backyard rabbit farming	30	NABARD	SHG Members
11.	2	Irrigation with rain water harvesting structure, treadle pump and micro irrigation system	30	NABARD	Practicing Farmers
12.	10	Entrepreneurship Development programme on food processing	26	ASSOCHAM	SHG Members

Workshops/ Seminars organized

- Linking of Small Time Entrepreneurs with Govt. Schemes and Market organized at NRC on Mithun, Jharnapani, Nagaland on 4th March 2011 in collaboration with ASSOCHAM, New Delhi.

On Farm Trials

S. No	Subject	Tittle of programme
1	Soil Science	1. Effect of PSB Inoculation in potato 2. Effect of composting methods on nutrient availability of mithun dung on tomato 3. Impact of Azolla (Azolla caroliniana) inoculation in paddy Var.-RCM 10
2	Agronomy	1. To evaluate the performance of wheat var. PWB 343
3	Home Science	1. Design and development of low cost high quality diet for hard working farm women in agriculture 2. Processing of local guava for jam and jelly preparation.
4	Horticulture	1. Performnace of carrot var. Early Nantes 2. Performnace of French bean var. Anupama 3. Performance of tomato var. Rohini under polyshade during rabi season. 4. Performance of cauliflower under open and Poly house during rabi season

5	Plant Protection	1. 2.	Effect of Biofor-PF-2 on soft rot of ginger Evaluation of various organic formulation for management of Aphids in Cauliflower.
6	Animal Science	1. 2. 3. 4. 5.	Brooding of rabbit Effect of quality protein maize on performance of rabbit Performance of turkey bird under agroclimatic condition of Phek district Khaboo (Ficus hookeri) bio-fencing development in natural habitation of mithun. Performance of Khaki Campbell ducks under agroclimatic condition of Phek district
7	Agri. Engineering	1. 2. 3. 4. 5. 6.	Assessment of the drip irrigation system in rabi vegetables Refining the present Cardamom drier developed by the innovator farmer to improved its efficiency Maintenance of proper crop geometry using adjustable Row maker Rain water harvesting with LDPE Poly sheet lining for seepage control Performance of Paddy weeder (Cono weeder) Performance of Cauliflower under mulch during winter

Front Line Demonstrations

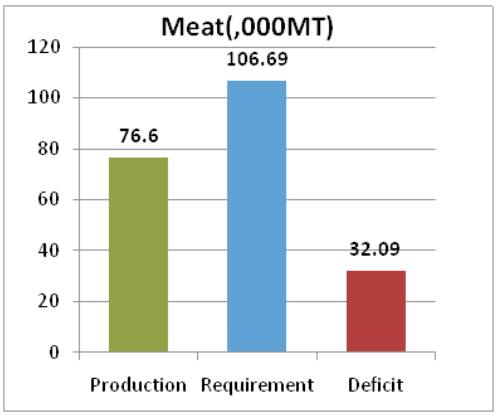
Sl. No	Subject	Title of programme	
1	Soil Science	1. 2.	Inoculation of Azolla (Azolla caroliniana) in lowland paddy PSB Inoculation in potato
2	Agronomy	1. 2. 3. 4.	Popularization of rapeseed var. M 27 Popularization of potato var. Kufri megha Popularization of field pea var. Rachna Popularization of field pea var. Aparna
3	Home Science	1. 2. 3.	Scientific technology in nutritional garden Processing of ginger products Value addition on maize
4	Horticulture	1. 2. 3. 4.	Popularization of Oyster Mushroom Popularization of off season tomato var.Rohini production under polyhouse Popularization of garden pea var. Arkel Popularization of oyster mushroom
5	Plant Protection	1. 2.	Popularization of Trichocards for stem borer management in paddy. Popularization of improved apiary boxes for local bee (Apis cerana) rearing.
6	Animal Science	1. 2. 3. 4. 5.	Performance of Hampshire crossbred pig under agro climatic condition of Phek district Performance of vanaraja birds under agro climatic condition of Phek district Performance of newzealand white breed as broiler rabbit Supplementation of mineral mixture in mithun Methods of brooding of kits
7	Agril Engg.	1. 2.	Drip irrigation in Cauliflower Drip irrigation in Tomato

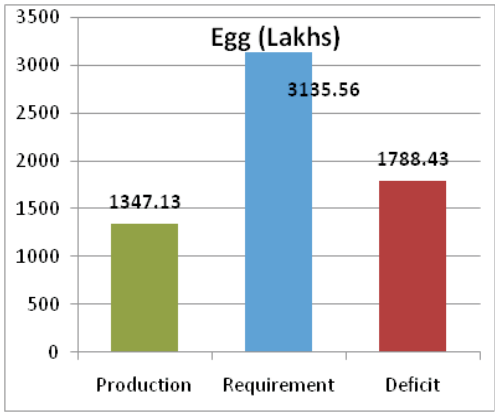
Other Extension activities organized

Nature of Extension Activity	No. of activities
Animal Health/Vaccination Camp	4
Exhibition	2
Newspaper coverage	3
Popular article (News paper)	1
News letter	2
MethodDemonstrations	4
Radio talks	2
Exposure visits	1
Folder/Leaflet	1
Lectures delivered as resource person	4
PRA	6 villages
Scientist visit to farmers field	78 Farmers
Farmers visit to KVK	33 Farmers

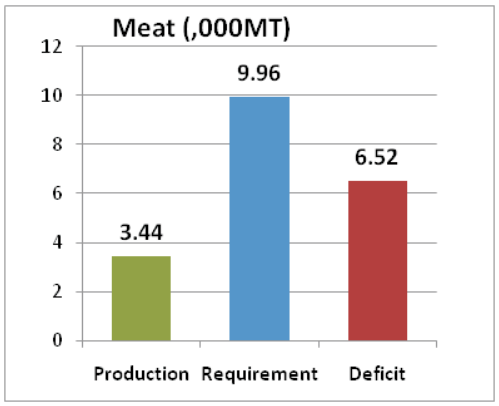
Sustainable Rabbit Farming: A Case Study

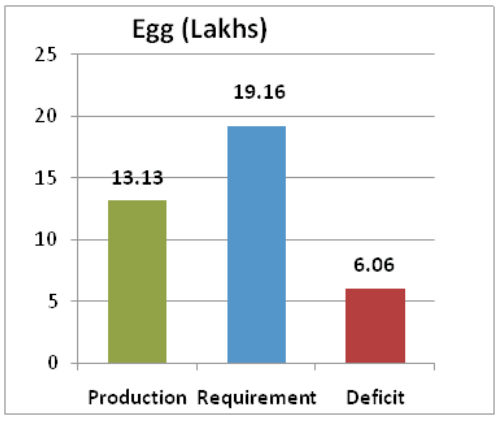
People of the Northeastern region are basically non vegetarian in their food habit, so products of livestock origin have great demand. The region produces about 53.3 percent of the total meat and 37.4 percent of its egg requirement. Production, requirement and deficit of meat and eggs in Nagaland and Phek district clearly reflected the annual deficit of about 32090 MT of meat and 1788.43 lakh eggs, while the value for Phek district of Nagaland was 6520 MT and 6.03 lakh. This showed that, there was ample scope for popularizing the better strains of pig, goat, buffalo and poultry and also introduction of unconventional meat animal like rabbit.





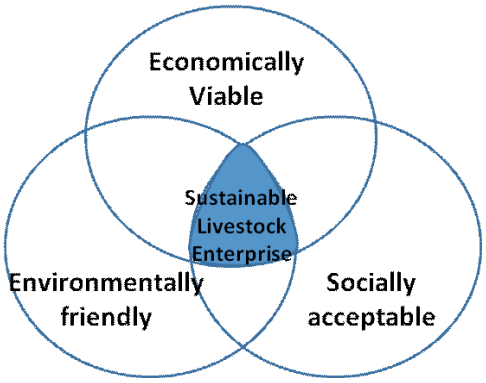
Production, Requirement and Deficit of Meat and Eggs in Nagaland





Production, Requirement and Deficit of Meat and Eggs in Phek district, Nagaland

The widening gap between the demand and supply of livestock products can be met through bringing out changes in the production structure. Sustainability is the key issue which was addressed by introducing new extension approach in disseminating the technologies. Sustainable livestock production system can best be described as a farming practice or system that is economically viable, environmentally friendly, and socially acceptable. Sustainability in reference to agriculture production system includes references to financial, environmental, ethical, social and product quality issues and in addition to these considerations, sustainable livestock production also needs to address animal welfare issues.



Essentials for Sustainable Models for Entrepreneurial Development

Adaptable Breeds, locally available feeds and housing with local resources were chosen as environmental friendly approach in co-operation with village headmen and village council. The council has played a facilitative role in disseminating the technologies. The livestock and technologies thus selected were compatible with their food habits and the way of life of the local populace. A good market for the produce has made the activity economically viable. The proposal was discussed with NABARD, Dimapur and they has provided necessary financial support to carry out the programme.

A novel extension approach for horizontal spread among farming community was taken up. The Commodity Based Groups were identified amongst the Self- Help Groups (SHGs) from the target villages. The selected members of the group were trained and provided a pair of rabbit with a pre-condition that after the first kindling they will share a pair of the rabbit with the fellow farm women. The second tire farm women will get hands on training from the tire one farm women under the supervision of the KVK's subject matter specialist. Adequate technical guidance as and when required was made available to the farmers. Well defined exit strategy has been followed so the farm women may carry on the activities on their own.

Rabbitry was introduced in the 7 villages of the Phek district. Initially it was introduced in two villages in 2008-09. Latter, the activity was promoted in four villages during 2009-10 and two villages in 2010-11 in view of positive feedback from the farmers. A total of 240 beneficiaries were trained, however only 229 farm women were given a pair of rabbit. These farm women in turn have given hands on training to another 210 farm women, so the total spread was 450 farm families (Table-1).

Table 1: Yearwise distribution and propogation of Rabbitry in adopted villages

S. No.	Year	Village	Primary Beneficiary	Secondary Beneficiary	Total
1.	2008 -09	Porba U. Khel	30	55	85
2.	2008 -09	Gidemi	30	35	65
3.	2009 -10	Sakaraba	30	30	60
4.	2009 -10	Porba L. Khel	30	36	66
5.	2009 -10	Pfutseromi	30	32	62
6.	2010 -11	Kikruma	60	22	82
7.	2010 -11	Thevopisu	30	-	30
	Total		240	210	450

Out of 450 farm families 384 were having 2-3 females, 56 were raising 4-7 females and 10 were keeping 8-10 females and considering an average gain of Rs. 5,000 for micro unit, 12,000 for small unit and 20,000 for medium unit, the total 450 farmers collectively have earned about Rs 44.92 lakh.

These efforts of the KVK Phek and NABARD, Dimapur have helped in developing rural entrepreneurs among youth and enhanced incomes of rural people. The new extension methodology for group actions through facilitative support of village councils helped in promoting the horizontal spread of technology through wider participation of the community.

Master Trainers were developed among youth as a part of Exit Strategy. Total 450 farmers collectively have earned about Rs 44.92 lakh. This example explains about how the Rural Capital Wealth Formation can take place through entrepreneurial development and motivation.

Table 2: Economic Gain due to Rabbitry Enterprise

S. No.	Particulars	Rate (Rs.)	Amount
Expenditure			
1.	Initial cost	300/pair	300
2.	Housing (localy available materials)	500/	500
3.	Feeding (Approx.)	1200/	1200
4.	Misc	100	100
Total Expenditure			**2100**
Income			
1.	Sale of 25 kits (6 kits/kindling @ 5 kindling/year and 15% mortality)	150/each	3750
2.	Value of parent stock	250/rabbit	500
Total Income			**4250**
Net return			**2150**

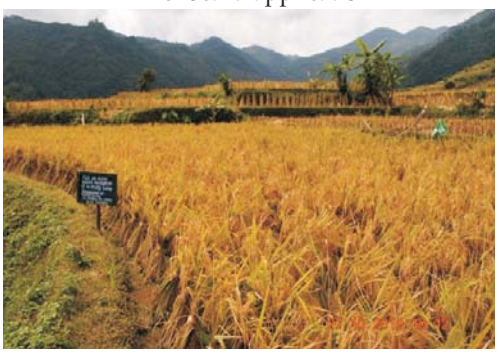
Front line demonstration on stem borer management in paddy using *Trichogramma japonicum*

Paddy is the main crop of Phek district. Most of farmers cultivate paddy in both terraces and Jhum areas .Stem borer has been reported to be the major insect pest of Paddy in the district. About 20-30% of yield is reduced due its infestation. To overcome this problem, a front line demonstration on popularization of Trichocards containing Trichogramma japonicum egg parasitoids was carried out in two villages in an area of 7 ha. Trichocards were released after 30 DAT of paddy in the main field. Data were recorded at monthly interval after *Trichocards* application in quadrate method of 1sqm area.

Stem borer infestation

Trichocard application

Paddy at 40 days after application



Paddy at harvesting stage

The result of the demonstration revealed that by using *Trichogramma japonicum* against rice stem borer, the yield of paddy could be increased by 15-20%.

Result of Front Line Demonstration on stem borer management in paddy using *Trichogramma japonicum*

SI.No	Parameters	Treated	Control
1	Number of hill/m2	70.30	63.6
2	Number of effective tillers/hill	7.33	5.26
3	Number of white ear heads/hill	0.80	1.60
4	Yield(t/ha)	3.20	2.50
5	B:C	1.74	1.36

Different faces of the KVK

A Front Line Demonstration on Popularization of Garden pea var. Arkel was conducted during rabi season in 6 villages. An average yield of Arkel was recorded to be 7.99t/ha and 6.40t/ha in local variety

A Front Line Demonstration on Popularization of Protected cultivation technology for tomato cultivation during rainy season. Result showed that the average yield of tomato var. Rohini was 17.17t/ha under polyshade and 3.0 t/ha under open condition. Low yield in open condition was due to severe blight disease resulting in 60-70% reduction in yield


An On farm Trial was conducted on performance of cauliflower varieties in polyhouse and open condition during winter under Pfutsero condition. The results revealed that under open condition highest yield was recorded in variety Snowball (18.25t/ha), followed by Madhuri (13.6t/ha) and Sumedha(8.38t/ha). Under polyhouse, snowball recorded an yield of 13.04t/ha.

Exposure visit of Phek district farmers to Sikkim

Oyster mushroom production in Pholami village

Training programme on Mushroom production

Vaccination of Mithuns at Porba

On Farm Trail on Khaki Campbell Duck

On Farm Trail on Khaki Hampshire Cross Pigs

OFT on PSB Inoculation in potato Var. Kufri Megha An OFT on PSB Inoculation in potato Var. Kufri Megha was conducted in Pfutseromi village. Average tuber yield of biofertilizer treated was recorded as 22.32t/ha and B:C ratio 1:2.30, where as in the control plot average yield was 20.65t/ha and B:C ratio as 1:2.11

FLD on Innoculation of Azolla caroliniana in lowland paddy

Training cum demonstration on PSB inoculation on potato

An On farm trial(OFT) on Soft rot management of ginger by using Biofor PF-2 was conducted in Gidemi village. Results showed that Biofor PF-2 treated area recorded higher yield (7.5t/ha) than untreated area (4.0t/ha).

An OFT was conducted in Cauliflower for Aphids management by using different organic formulations in farmers field of Porba village. The result showed that Tobacco extract reduced aphid infestation by(60%), Garlic spray(45%) and Neem oil (40%).

FLD on Drip irrigation was conducted at Porba and Thipuzu Village for popularization of efficient use of water in winter season and under protected cultivation.

Integrated approached of farming with seepage control on water harvesting structure using LPDE pond lining, duckery, fishery and irrigation under the project sponsored by NABARD conducted at 7 different village

Aparna variety of field pea performed well compared to local cultivar as the yield was 17.50 qtl/ha where as the local yield was 12.40 qtl/ha.

On campus training on processing of fruits and vegetables

Rachna variety of field pea performed well in terms of yield compared to Aparna variety and local. The yield of Rachna was 19.73 qtl/ha .

Vanraja Birds at farmer's Backyard

Demonstration on preparation of jam and pickle

Passion fruit squash

INSTITUTE PERSONNEL PROFILE (as on 31 March 2011)

Sl.No	Cadre Name	Name	Designation
1	RMP	Dr.C.Rajkhowa	Director
2	Scientific	Dr. K. K. Baruah	Principal Scientist
		Dr. Nazrul Haque	Principal Scientist
		Dr. K. C. Das	Sr. Scientist
		Dr. Anupama Mukherjee	Sr. Scientist
		Dr. Sabyasachi. Mukherjee	Sr. Scientist
		Dr. M. Mondal	Sr. Scientist
		Dr. B. Prakash	Scientist
		Dr. A. Mech	Scientist
		Dr. Naresh Kumar	Veterinary Extension
		Dr.Jayanta Kumar Chamuah	Scientist
		Dr. Vidya Singh	Scientist
3	Technical	Dr.Kezhavituo Vűprű	LFM
		Dr. Kobu Khate	Veterinary Officer
		Dr. Prakash Ranjan Dutta	Technical Officer (T6)
		Mr. Rokongulie Krose	Veterinary Field Asstt.
4	Administration	Mr.S.P.S. Negi	AAO
		Mr. Th. Dipal Meitei	Assistant
		Miss. Aloli Rengma	Assistant
		Mr. K.M. Chűsi	LDC
		Miss. Achűno Solo	LDC
		Mr. Mahendra Kumar	LDC
5	Supporting	Mr. Zakahi	SS Gr.III
		Mr. Vezato	SS Gr.III
		Mr. Zhophuhu	SS Gr.III
		Mr. Povetso	SS Gr.II
		Mr. Vecűzo	SS Gr.II
		Mr. Thupuvoyi	SS Gr.I
		Mr. Vezhocho	SS Gr.I
6	Staff of KVK	Dr.R.K.Singh	Programme Coordinator
		Dr.D.J. Borkotoky	S M S(Animal Science)
		Er. Chitrasen Lairenjam	S M S(Agril Engg.)
		Hannah K. Asangla	S M S(Agronomy)
		T.Esther Longkumer	S M S(Soil Science)
		Rinku Bharali	S M S(Horticulture)
		Liza Barua Bharali	S MS (PlantProtection)
		Virginia Thabah	Programme Assistant
		Nukusa T.Vadeo	Computer Programmer
		Keniseto Chucha	Farm Manager
		R. Imsennaro Longchar	Jr.Steno cum/Accountant
		Bodan Ch. Kachari	Driver cum Mechanic
		Vevo	Grade IV
		Shetsonyi Puro	Grade IV

IN-CHARGE AND MEMBERS OF DIFFERENT CELLS

1.	Hindi Cell	Dr. (Mrs.) Anupama Mukherjee.
2.	ARIS Cell & PERMIS NET	Dr. Nazrul Haque
3.	IPR Cell	Dr. K. K. Baruah
4.	PME Cell	Dr. Sabyasachi Mukherjee
5.	Institutional Animal Ethics Cell	Dr. K. C. Das, Chair man Dr. Sabyasachi Mukherjee Dr. Mohan Mondal Dr. Kobu Khate Dr. Kezhavituo Vűprű Dr. A. S. Dihingia Dr. A. Chakravorty Mr. Aru Khate
6.	Information and Public Relation Cell	Dr. B. Prakash Sri. S.P.S. Negi
7.	IJSC Cell	Dr. K. C. Das Dr. A. Dhali Sri S.P.S Negi Dr. K. Vupru Dr. Kobu Khate Mr. Th. Dipal Meitei Ms. A. Solo Mr. Mahender Kumar
8.	Women Cell	Dr.(Mrs)Anupama Mukherjee Dr. (Mrs)Anjumoni Mech Mrs. Dielievino, President, Women Organization. Medziphema town Nagaland AAO of the Institute
9.	Grievance Cell	Dr. K. C. Das
10.	Bio-safety Cell	Dr. K.K. Baruah Dr. K. C .Das Dr (Mrs) Anupama Mukherjee
11.	Commercial Cell	Dr. K. K. Baruah
12.	Institute Library	Dr. Sabyasachi. Mukherjee
13.	Livestock Farm	Dr.Kobu Khate
14.	Stores	Dr. Kezhavituo Vűprű
15.	Vehicle	Sri. S.P.S. Negi / Dr. Kobu Khate
16.	Estate & Guest House	Dr. Kobu Khate
17.	Scientist In-Charge, Institute Farm	Dr. Nazrul Haque
18.	Sports	Dr. Sabyasachi Mukherjee
19.	Transparency Officer	Dr. Nazrul Haque

HONOURS/AWARDS/FELLOWSHIP/SCIENTIST VISITED ABROAD

1. Dr. Sabyasachi Mukherjee, Sr. Scientist

availed ICAR-NAIP sponsored foreign training programme in the field of "Genome Resource Conservation" at Iowa State University, Ames, Iowa for three months during 26 Marach to 22 June, 2010

2. Dr. K. K. Baruah: Completed Post doctoral training programme at University of Wisconsin, Madison, USA in 2010 under Department of Biotechnology Overseas Associateship, Govt. of India.

3. Dr. K.K. Baruah: Received Dr. A. Roy memorial award from Society of Animal

Physiologists of India for contribution to the research in Animal Physiology in the SAPI Silver Jubilee and International Conference held at IVRI on 11th to 13th November, 2010.

4. Dr. K.C. Das: Awarded DBT Overseas

Fellowship and undergone training in the area of Rumen Biotechnology at Lakehead University, Thunder Bay, Canada from 1st August, 2010 to 31st October, 2010.

5. Dr. Mohan Mondal: Received Young Biotechnologist Award 2010 by the Society for Applied Biotechnology for significant contribution in the field of Animal Biotechnology

6. Dr. Mohan Mondal: Received Fellowship of the Society for Applied Biotechnology (F. S. A. B.) w.e.f. 2010

7. Dr. Mohan Mondal: Selected as Life Member of the National Academy of Science (M. N. A. Sc.) w.e.f. 2010

8. Dr. Mohan Mondal: Selected on invitation as Visiting Professor (2011-12) under Lady Davis Fellowship of Jewish University of Jerusalem, Rohovot, Israel

9. Dr. Mohan Mondal: Selected as Host Research Scientist for a Senior Professor from Animal Reproduction Research Institute, Giza, Egypt under Senior Fellow scheme of CV Raman Fellowship for the African Researchers 2010-11

10. Dr. Mohan Mondal: Selected as Mentor for Summer Training for Students by the National Academy of Science, India (NASI), Indian National Science Academy (INSA) and Indian Science Academy

Young Biotechnologist Award 2010

PERSONALIA

Joining / Appointment / Transfer / Promotion

- Dr. Jayanta Kumar Chamuah, Scientist, Vety. Parasitology - Joined on 22.04.2010
- Dr. Vidya Singh, Scientist, Vety. Pathology - Joined on 23.04.2010
- Sh. Vizekrol Kikhi, Driver -Transferred from KVK, Phek to NRCM, Jharnapani w.e.f. 01.04.2010
- Sh. Mahendra Kumar - Promoted from Skilled Support Staff to the post of Junior Clerk w.e.f.09.09.2010.
- Sh. Manish Negi - Appointed to the post of Stenographer Gr.III on 01.10.2010
- Sh. Manish Negi - Transferred to CSWCR&TI, Dehradun on. 13.01.2011
- Ms. Aloli Rengma - Promoted from UDC to Assistant w.e.f. 31.03.2011

SPORTS ACTIVITIES

The Institute sports team participated in the ICAR Zonal Sports Meet (Final) at CAZRI, Jodhpur during 9-13 November, 2010 and got one silver medal won by Ms. Virginia in the High Jump event (women). She has made the Institute proud for her achievement.

Mega Event : Interface Meeting, 4 February, 2011

- A interface Meeting was organized for "Development of Agriculture and Allied Sectors in Nagaland" in collaboration with the Agriculture and Allied Departments, Govt. of Nagaland.
- Sri T. R. Zeliang, Hon'ble Minister for Animal Husbandry, Govt. of Nagaland; Dr. Chumben Murry, Hon'ble Minister for Agriculture, Govt. of Nagaland; Dr. S. Ayyappan, Hon'ble Secretary, DARE and Director General, ICAR along with respected DDG's Dr.K.M.L.Pathak, Animal Science; Dr. A. K. Singh, NRM, Dr. Arvind Kumar, Education; Dr. K. D. Kokate, Extension; Dr. (Mrs.) Meena Kumari, Fishery visited our Institute along with others dignitaries of ICAR Headquaters as well as Vice Chancellors Dr. S.N. Puri of Central Agri. University, Imphal and Dr. K. M. Bujarbaruah of Assam Agri. University, Jorhat and Directors of various ICAR Institutes of North East Region.
- To showcase the strength of DARE/ICAR as a powerful Institution in evolving solutions for the problems faced by the Indian farmers and livestock keepers.
- To provide scientific interventions to the farmers including Mithun rearers to solve their problems in diverse field of agriculture and allied sectors.

Inauguration of the exhibition

Lamp lighting ceremony

Facilitation of Hon'ble Ministers by the Director General, ICAR

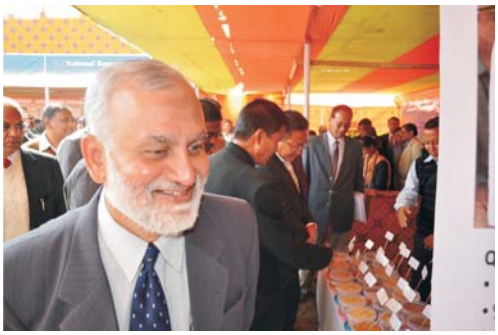
Release of Compendium of Status Papers and Mithun Newsletter

Address by Sri T. R. Zeliang, Hon'ble Minister of A.H., Govt of Nagaland

Address by Dr. S. Ayyappan, Hon'ble DG. ICAR

Address by Prof. K. M. L. Pathak, Hon'ble DDG (AS), ICAR

Address by Dr. Chandan Rajkhowa, Hon'ble Director, NRCM




Dignitaries in the exhibition ground


Dignitaries visiting Laboratories


Dignitaries visiting Mithun farm

PHOTO GALLERY

Director in the Mithun *(Bos frontalis)* Festival, Itanagar, 01 June, 2010.

Participation in the 2nd North East Agri. Expo Dimapur, 15 – 19 December, 2010 - showcasing Mithun products

Dr. N. Balaraman, Hon'ble Chairman, RAC with other members, 16 – 17 February, 2011.

Visit of RAC team to Porba farm, 17 February, 2011

Prof. Hassan Shawky Mohammad Yossef, Deputy Director, Animal Reproduction Research Institute (ARRI), Giza, Egypt and Senior Fellow 2010, CV Raman Fellowship for African Research, Govt. of India - 1 February to 1 March, 2011.



Visit of Major General N. George, Chief of Staff, HQ 3 Corps, 30 March, 2011




Visit of Brig. P. S. Narwal – CO, R.V.S., HQ Eastern Command, 23 March, 2011