



वार्षिक प्रतिवेदन
Annual Report
2013-14



भारत
ICAR

राष्ट्रीय मिथुन अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद)

झरनापानी, मेड्जीफेमा, नागालैन्ड - 797 106 भारत



NATIONAL RESEARCH CENTRE ON MITHUN

(Indian Council of Agricultural Research)

Jharnapani, Medziphema, Nagaland - 797106, India

www.nrcmithun.res.in

Glimpses of our previous Annual Reports



This Annual Report contains unprocessed or partially processed data/scientific information which would form the basis of research articles in due course. Hence, the data/information contained in this report, should not be used without written permission of this Institute, other than for quoting in any scientific reference.

1.	भाक्कथन - Preface	i-iii
2.	कार्यकारी सारांश	iv-viii
3.	Executive Summary	ix-xv
4.	Introduction	xvi
5.	जनादेश / Mandate	xvi
6.	Financial statement	xvii
7.	Resource generation	xvii
8.	Staff Position	xviii
9.	Organogram	xviii
10.	Research Achievements	
	Animal Genetics and Breeding	3-15
	Animal Nutrition	15-16
	Animal Physiology	17-24
	Animal Reproduction	25-27
	Animal Health	28-30
11.	Miscellany	
	राज ाषा अनु ाग	33-35
	Library Profile	35-36
	Ongoing Research Projects	36-38
	Publication	38-44
	Training/Seminars/Conference/Symposia/Workshops Attended and Abstracts/Posters presented	44-52
	Honours/Awards/International Assignment	53-54
	Linkage and Collaboration	55
	Activities for Socio-economic development	55-58
	Activities of KVK	59-75
	Mega Events	76-80
	Institute Personnel Profile	81
	In-charges and Members of Different Celles	82
	Vigilance Awareness Week	83-84

Guidance and Publisher

Dr. Chandan Rajkhowa
Director

Editorial Board

Chief Editor

Dr. Sabyasachi Mukherjee

Members

Dr. (Mrs.) Anupama Mukherjee

Dr. Jayanta Kumar Chamuah

Dr. Nazrul Haque

Dr. K. K. Baruah

Hindi Translation

Dr. (Mrs.) Anupama Mukherjee

Correct Citation

Annual Report 2013-14

National Research Centre on Mithun (NRCM)

Indian Council of Agricultural Research (ICAR)





प्राक्कथन

मुझे संस्थान के 2013-14 के मूल्यवान दस्तावेज वार्षिक प्रतिवेदन जिसमें राष्ट्रीय मिथुन अनुसंधान केंद्र की गतिविधियों को दर्शाया गया है, को प्रस्तुत करते हुए अत्यंत गर्व महसूस हो रहा है।

इस वर्ष संस्थान में पशु आनुवांशिकी एवं प्रजनन अनुभाग में FISH के माध्यम से गुणसूत्र आर्टिटेक्चर के संदर्भ में मिथुन एवं गौर की आनुवांशिक समानता स्थापित कर सके इस पशुओं की उत्पत्ति की जांच करने के लिए एक बहुत महत्वपूर्ण उपलब्धि है। इसके अलावा पशु माइक्रोसेटेलाइट मार्करों की पहचान करने में मदद मिली है। मिथुन में उच्च एलील की आवृत्ति के साथ कुछ अनुठा एलील तैयार करने के लिए मदद मिली है। अन्य संबंधित गोजातीय प्रजातियों के साथ मिथुन की आनुवांशिक स्थिति जानने के लिए एफाइलोजेनेटिक पेड़ तैयार करने की सहायता की है। मिथुन की वृद्धि दर के साथ एसएनपीएस के सहयोग से अध्ययन के बेहतर विकास दर मिथुन के चयन के लिए उपयोगी होगा जो महत्वपूर्ण पाया गया है। मैं इन बहुमूल्य जानकारी सृजन के लिए वैज्ञानिकों को बधाई देता हूँ।

पशु पोषण अनुभाग में कम समय में हरी घास एवं मिश्रण को कम करने के लिए एक अनुठा विधि विकसित किया है। इन विधियों का प्रयोग हरा चारा सूखाया जा सकता है। जिसमें बरसात के मौसम में

PREFACE

It is my proud privilege to place this valuable document of Annual Report showcasing the activities of NRC on Mithun for the year 2013-14.

During the year, the Animal Genetics and Breeding section could establish the genetic similarity of gaur and mithun in terms of chromosome architecture through FISH. This is a very significant achievement as because the finding will lead us to investigate in detail the origin of this animal. Moreover Cattle microsatellite markers helped us to identify some unique alleles with high allele frequency in mithun. This has also helped us to prepare the phylogenetic tree for knowing the genetic status of mithun with other related bovine species. The study of association of SNPs with growth rate of mithun has been found to be significant, which will be useful for selection of mithun with better growth rate. I congratulate the scientists for generating these valuable information.

The department of Animal Nutrition could develop a unique method to reduce the mixture of green grasses and thereby, reducing the duration of drying period. This method will facilitate efficient drying even in rainy season and minimize the use of

बिजली की कम से कम उपयोग किया गया । 49 शुद्ध कल्चर (VTCC) अलग एकत्र किया गया ये वैज्ञानिकों द्वारा पूरा किया गया कार्य सराहनीय है ।

पशु शरीर क्रिया विज्ञान अनुभाग में पशुओं का तुलना में स्तनपान के विभिन्न चरणों में मिथुन दूध में लैक्टोफेरिन के उच्च एकाग्रता एवं मिथुन लैक्टोफेरिन में जीवाणु प्रतिरोधी क्षमता पाए गए है जो एम्पीसिलिन और केनामाइसिन जैसा है। यह बहुत ही महत्वपूर्ण खोज है और हमें जैव सक्रिया गुणों के साथ मिथुन दूध को बढ़ावा देने में सहायता मिलेगा ।

पशु प्रजनन के क्षेत्र में, मिथुन वीर्य के संरक्षण में ग्लूटाथैऑन के अलावा शुक्राणु पैरामीटर, जैव रासायनिक और तरल स्टोर में एंटी ऑक्सीडेंट प्रोफाइल को बनाए रखने के लिए लाभदायक पाया गया। इस परिणाम से हमें मिथुन वीर्य संरक्षण के लिए एक नई दिशा मिली है।

पशु स्वास्थ्य अनुभाग में विभिन्न गैस्ट्रोआंत्र परजीवी, ऊतक प्रोटोजोआ मल परीक्षण एवं सीरो-प्रसार अध्ययन के माध्यम से सामान्य स्क्रिनिंग के माध्यम से पता चला है कि इन अध्ययनों के आधार पर उत्पन्न जानकारी निश्चित रूप से मिथुन में परजीवी बीमारी की सही स्थिति का पता करने के लिए हमें सहायता मिलेगी।

विभिन्न प्रौद्योगिकी टीकाकरण कार्यक्रम स्वास्थ्य शिविरों की सूचना अवधि के दौरान नागालैंड, मणिपुर एवं अरुणाचल प्रदेश के विभिन्न स्थानों में टीएसपी के तहत आयोजित किए गए। इन कार्यक्रमों से वैज्ञानिक तरीके से मिथुन मालिकों के बीच जगरूकता लाने में मदद होगी।

संस्थान का 25 वर्ष पूरे होने के उपलक्ष्य में रजत जयंती समारोह आयोजन किया गया । इस अवसर पर कुछ महत्वपूर्ण कार्य का आयोजित किया गया था। इसमें इंटरफेस मीटिंग एवं मिथुन महोत्सव 2014 था। इस समारोह में गणमान्य व्यक्तियों के साथ बड़े टेक्नोक्रेट की नीति निर्णयकगण एवं हजारों किसानों यह समारोह कार्यक्रम संस्थान के लिए बहुत

electricity. 49 pure cultures of bacteria from mithun rumen have been isolated and deposited in VTCC, These are commendable job accomplished by the scientist and they deserve appreciation for the same.

Animal Physiology section identified higher concentration of lactoferrin in mithun milk in various stages of lactation than that of cattle. Anti-microbial effect of mithun lactoferin could be documented as a inhibitor of microbial growth, which is comparable to ampicillin and kanamycin. This is a very significant finding and will help us to promote mithun milk with bioactive properties.

In the field of Animal Reproduction, the glutathione addition in the preservation of mithun semen was found to be beneficial for maintaining sperm parameters, biochemical and anti-oxidant profiles in liquid storage. This result has given us a new direction for mithun semen preservation.

In the field of Animal Health, various gastro-intestinal parasites, tissue protozoa were detected through normal screening through faecal examination and sero-prevalence study. The information generated based on these studies will definitely help us to know the exact position of parasitic disease in mithun.

Various technology injection programme, health camps were organized under TSP in different places of Nagaland, Manipur, Arunachal Pradesh during the reported period. These programmes have helped to bring in enthusiasm among the mithun owners for scientific rearing as well as awareness among them.

It's a rare honour for us to host the Silver Jubilee Celebration of this Institute this year with the completion of eventful 25 years of existence. We have celebrated mega events

ही महत्वपूर्ण है। जिसमें से इस संस्थान का 25 वर्ष राष्ट्रीय मिथुन अनुसंधान केंद्र की एक गौरव गाथा बना है। जिससे निश्चित रूप से एक शानदार मार्ग विकसित किया है।

इस संस्थान की प्रगति एवं विकास के लिए डॉ.एस. अय्यप्पन, सचिव डेयर और महानिदेशक, भारतीय कृषि अनुसंधान परिषद एवं डॉ. के. एम. एल. पाठक, उप महानिदेशक (पशु विज्ञान), डॉ. बी एस. प्रकाश, सहायक महानिदेशक (पशु पोषण एवं कार्यिकी) एवं डॉ. आर एस. गांधी, सहायक महानिदेशक (पशु कार्यिकी एवं प्रजनन) का आशीवाद, सहायता, मार्ग दर्शन 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) एवं डॉ. विनीत भसीन, प्रधान वैज्ञानिक (पशु आनुवांशिकी प्रजनन) एवं डॉ. (श्रीमती) नीलम गुप्ता प्रधान वैज्ञानिक (पशु जैव तकनीकी) 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. सब्यासाची मुखर्जी वरिष्ठ वैज्ञानिक, को विशेष धन्यवाद देना चाहता हूँ, जिन्होंने इस प्रतिवेदन को सही समय पर प्रकाशित करने के लिए अत्यंत मेहनत की है। मैं, डॉ. (श्रीमती) अनुपमा मुखर्जी एवं श्रीमती कामिनी वर्मा को कार्यकारी सारांश एवं प्राक्कथन 2013-14 का हिन्दी में अनुवाद एवं टंकण करने के लिए विशेष धन्यवाद देता हूँ।

अंत में, मैं, भगवान सर्वशक्तिमान के कमल चरणों में आशीवाद के लिए प्रार्थना करता हूँ कि, वे सभी वैज्ञानिकों एवं स्टाफ को प्रेम एवं आशीवाद प्रदान करें जिससे वे सभी अपने अथक प्रयास द्वारा इस संस्थान के भविष्य के कार्यक्रमों को सफलतापूर्वक पूर्ण कर सकें।

“जय हिन्द”

चन्दन राजखोआ
(चन्दन राजखोआ)

like Interface Meeting and Mithun Festival, 2014 in a jubilant way, where thousands of farmers participated along with large number of technocrats, policy makers and other dignitaries. These are significant achievements of the Institute, showcasing various technologies developed in course of a spectacular journey and thereby, creating a saga of 'NRCM'.

The progress and development of the Institute wouldn't have been possible without constant support, guidance and blessing of Dr. S. Ayyappan, Hon'ble Secretary DARE and DG, ICAR; Dr. K.M.L. Pathak, Hon'ble DDG (Animal Science); Dr. B.S. Prakash ADG (AN&P) and Dr. R. S. Gandhi, ADG (AP&B). 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 and Breeding) and Dr. Neelam Gupta, PS (Animal Biotechnology) is also acknowledged with gratitude.

Special thanks to Dr. Sabyasachi Mukherjee, PS, and Chief Editor of this report, with other members of the Editorial Board for their painstaking effort to bring this document in the present shape. I must express thanks to Dr. (Mrs.) Anupama Mukherjee and Mrs. Kamini Verma for the preparation of the Hindi portion of the report.

Lastly, I pray to the Lotus feet of Lord Almighty for blessings and love to all the scientists and other staff members of the Institute so that they can put their tireless effort for successful implementation of the programmes of the Institute in future.

"Jai Hind"


(Chandan Rajkhowa)

कार्यकारी सारांश

इस अनुभाग में, इस संस्थान में पूर्ववर्ती वर्षों के दौरान विभिन्न वर्गों में वैज्ञानिक द्वारा विभिन्न विभागों में जैसे पशु आनुवांशिकी एवं प्रजनन, पशु शरीर क्रिया विज्ञान, पशु पोषण, पशु स्वास्थ्य, पशु प्रबंधन कुछ नवीनतम अनुसंधान कार्य का संक्षिप्त रूप से विवरण इस प्रकार है। भारतीय कृषि अनुसंधान परिषद के तत्वावधान में राष्ट्रीय मिथुन अनुसंधान केन्द्र के साथ उत्तर पूर्वी पर्वतीय क्षेत्र में आवश्यक वैज्ञानिक जानकारी में मिथुन पालन के सर्वांगीण विकास के लिए विभिन्न कार्यक्रम किए गए। इसके अलावा विभिन्न विकासात्मक गतिविधियों को भी सीधे टीएसपी कार्य के तहत उनकी बेशकीमती पशु पालन के माध्यम से जनजातीय मिथुन पालकों के लिए आर्थिक लाभ हेतु यह संस्थान प्रयासरत है।

पशु आनुवांशिकी एवं प्रजनन के तहत कुछ संशोधन के साथ रक्त श्वेत रक्त कणिका द्वारा कल्चर तकनीक भारतीय गौर की मेटाफेस गुणसूत्रों का उपयोग किया गया। मैसूर जू में रखे गए गौर के रक्त नमूनों को पशुओं से एकत्र किए गुणसूत्रीय प्रोफाइल 2n गुणसूत्र संख्या 58 है। लिंग क्रोमोसोम इन पशुओं में X उपमेटासेंट्रिक है, जबकि Y गुणसूत्र मेटासेंट्रिक है। मिथुन के लिए प्रयुक्त प्रोटोकॉल का उपयोग सी. आर. बैंडिंग का अध्ययन मेटाफेस प्रसार किया गया। बैंड नमूने मिथुन की तरह के X गुणसूत्र द्वितीय सबसे बड़ी उपमेटासेंट्रिक गुणसूत्र में है कि 50 प्रतिशत सेंट्रोमेरिक सूचकांक इस बात कि पुष्टि की करता है Y गुणसूत्र आदर्श मेटासेंट्रिक है C बैंडिंग द्वारा हेट्रोक्रोमैटिन का पता चलाता है, सभी अग्रकेंद्रिक गुणसूत्रों में गुणसूत्र बिंदू अनुलग्न होते हैं।

आणविक सेंटोजेनिक स्थलों के अध्ययन के लिए सेंट्रोमेरिक क्षेत्र का गौजातीय द्वारा रिपोर्ट की गई प्राइमरों का सफलतापूर्वक दोनो प्रजातियों के बीच आनुवांशिक समानता का संकेत देता है गौर से

डीएनए प्रवर्धित किया गया। संकेत फ्लोरोसेंस सूक्ष्मदर्शी के तहत संस्करण का उपयोग किया गया रोडीमीन द्वारा फ्लोरोसेंस सेंट्रोमेरिक क्षेत्रों में स्पष्ट संकेत दिखाई दिया।

व्यापक जीनोम सहसंबंध अध्ययन के लिए संसाधन राष्ट्रीय मिथुन अनुसंधान केंद्र संस्थान फार्म पर स्थित जनसंख्या से चयन किया गया था आबादी एवं गैर बढ़िया नस्ल का आबादी को किसानों और समुदाय क्षेत्र से एकत्रित किया गया परिमाणत्मक लक्षण जन्म के समय वजन शरीर भिन्न अंतराल विकास दर दूध का सेवन एर शव लक्षण पर वजन मेन्डेलियन कोट रंग और सींग विवरण के रूप में भी रिकार्ड किया गया था। जीनोम डीएनए एन पशुओं के रक्त नमूनों से निकाली गई कुल 24 पशुओं की Illumina® गौजातीय एच डी मनका चीप के साथ प्रथम चरण में निर्माता निर्धारित प्रोटोकॉल द्वारा जीनोमटाइपिंग किया गया।।

माइक्रोसेटेलाइट मार्करों भारतीय मिथुन पशु एवं जंगली गौर पर परीक्षण किया गया और इन प्रजातियों की आनुवांशिक विविधता 30 पशुओं के विशेषमाइक्रोसेटेलाइट का उपयोग करके जांच की गई विश्लेषण उच्च अद्वितीय एलील का पता चला एलील आवृत्तियों 19 (63%) माइक्रोसेटेलाइट मार्करों सफलतापूर्वक प्रवर्धित मिथुन एवं जंगली गौर के जीनोमिक डीएनए, स्थलों में से 15 (79%) अधिक थे जानकारी सामग्री के साथ क्रमशः मिथुन और गैर में भिन्न इकाइयों वाला (PIC) 0.50 अधिक एलील मिथुन की संख्या 8 से 25 एवं दो गौर में सात के पाये गए हिट्रोजाइगोसिटी एवं (H_o) and Nei's हिट्रोजाइगोसिटी (H_e) अधिक एलील मिथुन की संख्या 8 से 25 एवं दो गौर में सात के पाये गए हिट्रोजाइगोसिटी एवं मूल्यों 0.15 से 0.94 एवं 0.31 से 0.89 मिथुन एवं 0.01 -0.99 एवं 0.36

गौर में से 0.83 में से मिथुन एवं गौर यह औसत अनुमानों 19 माइक्रोसेटेलाइट loci भार में PIC में 0.48, 0.66 एवं 0.63 मिथुन में एवं 0.62, 0.71 थे और गौर में 0.61 क्रमशः इंद्रा जनसंख्या जनन स्तर (F_{is}) 0.30 में था मिथुन एवं गौर में 0.065 माइक्रोसेटेलाइट अध्ययन के आधार पर चार मिथुन स्ट्रेनों के आनुवांशिक स्थिति दिखाने जंगली गौर पशुओं एवं थो- थो-गाय के बीच पशु कार्यिकी आनुवांशिक पेड़ तैयार किया गया।

22 मिथुन की साइटोक्रोम बी जीन अनुक्रम था। अनेय की दृश्यों जैसे संबंधित प्रजातियों बॉस टॉरस, बॉस इंडिकस, बुबेलिस बुबेलिस आदि डाउनलोड किया गया जीन बैंक आंकड़ा आधार पर वंशावली पेड़ से निर्माण किया गया था इसके अलावा कार्य प्रगति पर है।

132 मिथुन के विकास शरीर के वजन भार नियमित रूप से दर्ज की गई और अनुक्रमण लेप्टीन जीन एम्पीलिकोन के नमूने मिथुन की (422 bp and 588 bp) से बाहर किए गए 17 SNPs अनुक्रम कुल 422 बीपी एम्पीलिकोन की पहचान की गई 132 पशुओं 588 बीपी का एक और पीसीआर लेप्टीन एम्पीलिकोन में, 9 SNPs कुल 122 अनुक्रम पहचान की गई।

SAS Loc314 संख्यिकीय पैकेज एसोसिएशन अध्ययन के लिए कुल 132 मिथुन का निर्भार चार जन्म के समय वजन भार एवं वयस्क वजन एसोसिएशन था। गौर महत्वपूर्ण हालांकि, आश्रित चार औसत दैनिक एसोसिएशन Loc314 साथ वजन (ADG) महत्वपूर्ण हो पाया था। इसी तरह संघ आश्रित चार जन्म के समय वजन वयस्क की भार गौर महत्वपूर्ण पाए गए। SAS Loc322 तथा में ADG SAS Loc322 साथ में महत्वपूर्ण हो पाया था। उच्च विकास लक्षण के लिए मिथुन का चयन के लिए एसएस के PROC GLM साथ विश्लेषण इसके लिए उपयोग किया जा सकता है जो एक बहुत ही

महत्वपूर्ण कार्य है।

एक अन्य महत्वपूर्ण शोध कार्य मिथुन में वृद्धि लक्षण के ट्रांसक्रिपटन विश्लेषण आरएएन दृष्टिकोण एवं मिथुन के पूरे जीनोम अनुक्रमण (बॉस फ्रॉंटेलिस) के माध्यम से प्रगति में के डी नोवो ट्रांसक्रिपटन विश्लेषण के लिए जैव सूचना विज्ञान विश्लेषण मिथुन के विभिन्न कार्य किया गया 418 बिलियन उच्च गुणवत्ता का नमूना कुल 143090 की असंबली के परिणाम के रूप में टेप मतलब जीसी सामग्री 47.63% के साथ, लंबाई ≥ 150 बीपी की पहचान की गई तुलनात्मक विश्लेषण, विभिन्न व्यक्त कुल 148 टेप से पता चला है कि जो की 70 नीचे विनियमित और 78 उच्च विकास दर वाले मिथुन में विनियमित शीर्ष पांच अप विनियमित जीन की अभिव्यक्त प्रोफाइल (DUSP1, RCAN1, Eif2s3y, अंतर MUSTN1, MYH2) और नीचे विनियमित जीन (MTR_5g051190, PFKFB3, RAD52, CYP4F2 और SNAI3) परिमाणात्मक वास्तविक समय पीसीआर विधि द्वारा मान्य किया गया। जीन ओन्टोलोजी (GO) विश्लेषण का भी किया गया। पहचाने जाने की दृष्टि की कुल संख्या आणविक समारोह, जैविक प्रक्रिया और सेलुलर घटक 3910, 1311 और 668, श्रेणी क्रमशः GO एनोटेशन से टॉप पांच आणविक कार्यों जिन आयन थे बैंडिंग एटीपी बैंडिंग, न्यूक्लिक एसिड डीएनए बैंडिंग एवं धातु आयन बैंडिंग है।

पशु पोषण अध्ययन, के बीच संबंध के तहत नमी की मात्रा और जीवाणु भार विभिन्न से तैयार फीड ब्लॉक में सामग्री के संयोजन निर्धारित किया गया था आर्थिक रूप से विकास दिशा में व्यवहार्य खिला नीति प्रयोग करने के लिए हरी चारा से नमी के वाष्पीकरण की दर में वृद्धि करने के लिए आयोजित सुखाने अवधि के दौरान को कम करने के लिए चारा विकसित हो तरीके एवं साधन तैयार करते हैं। दो नए तरीकों को विकसित किए गए इन विधियों का प्रयोग

हरा चारा सूखाया जा सकता है बरसात के मौसम में बिजली की कम से कम उपयोग के साथ हेस आगे के लिए उपयोग किया गया तैयार फीड ब्लॉक बनाया गया।

मिथुन में कुल गैस उत्पादन नमूने के निर्धारण के लिए स्थानीय स्तर पर उपलब्ध पौधे फीड चारा थीबोनहा गाथेरू (होत्येनुया क्राडेरा)सिलेरोडेन्ड्रस कोलोब्रोकिनम मोली मोमोचुंग वाईड एप्पल लिवेनो थीरूकोलू बिटर पत्तियों से निर्धारित पोरबा से मिश्रित प्लांट के नमूने,अनाज व्यय और मक्का भिन्न करने के लिए मिली ग्राम 16.40 से 91.73 के बीच पाया गया।

पशु चिकित्सा प्रकार कल्चर कार्य में, जीवाणु 49 शुद्ध कल्चर रोल ट्यूब विधि उपयोग करके पृथक किया गया। इन जीवाणु की पहचान का कार्य प्रगति पर है।

गौजातीय के उच्च फीड कार्यकुशलता शामिल मैटोकंड्रियल प्रोटॉन रिसाव कैनेटीक्स के विनियम के जीन की अभिव्यक्त द्वारा प्रजातियों में प्रगति 15 पशुओं की मांसपेशी नमूना की बायोप्सी दृढ़ संकल्प के लिए ले जाया गया मैटोकंड्रियल ऊर्जा उपयोग 80 डिग्री से. पर संरक्षित चारा अनुपात 8 वीं में 17.82 मूल्य की 11.02 to 33.70 के बीच भिन्न पाया गया 12वें fortnight, पखवाड़े में 12.47 मुख्य मूल्य 9.23 to 20.72 और 8.72 to 21.47 16वीं पखवाड़े में मध्य मूल्य 12.25 है।

पशु शरीर क्रिया विज्ञान के तहत विभिन्न स्तर के दौरान मिथुन दूध में लैक्टोफेरिन की मात्रा का मिथुन कोलेस्ट्रॉल में लैक्टोफेरिन सांद्रता पशु गाय की तुलना में दो गुना अधिक पाया गया मिथुन दूध एवं गाय दूध सीगनीफिकेंटली की ($P<0.01$) काफी अधिक सांद्रता शामिल है। पशु गाय एवं मिथुन दूध के बीच लैक्टोफेरिन सांद्रता की तुलना में प्रति स्तर के दौरान की कीफी उच्च एकाग्रता है। लैक्टोफेरिनकी शुद्ध मिथुन दूध से पहचान की और

वेस्टर्न ब्लॉट तकनीक द्वारा पुष्टि की गयी।

विभिन्न प्रतिरोधी जीवाणु पर मिथुन सीगनीफिकेंटली लैक्टोफेरिन (mLF) के प्रतिरोधी प्रभाव का अध्ययन किया गया मिथुन में सीगनीफिकेंटली लैक्टोफेरिन क्रमशः 53% और 28% द्वारा *S. aureus* ई.कोलाई के विकास को रोकना एवं एम्पीसिलीव और कानामेसिन के बराबर पाए गए।

जीन अभिव्यक्त गर्मी की आघात प्रोटीन का भी अध्ययन किया गया और पाया गया कि दो जीन (HSP 70 & HSP 90) उच्च है जुताई से पहले की तुलना मिथुन बैल को तीन घंटे के जुताई के HSP 70 सापेक्ष जीन अभिव्यक्त के बाद उच्च महत्वपूर्ण था।।

विकास के विभिन्न स्तर के दौरान मिथुन की मांसपेशी में वैशिवक जीन के विभिन्न स्तर की 28 मिथुन पर अध्ययन विकास और पशु बछड़े से वयस्क एजलेंट प्लेटफॉर्म पर डीएनए गौजातीय माइक्रोएरे का उपयोग 3-6 के बीच दो महीनों वीर्य नमूनें ताजा मिथुन वीर्य जांच की गई जीन विभिन्न विकास स्तर पर जीन की अभिव्यक्त अंतर दिखाई दिया 1,282 (5.6%) जांच विभिन्न चरणों में महत्वपूर्ण अंतर दिखाई दिया एवं मांस गुणवत्ता के उच्च थे। 126 जीनों के द्वारा प्राप्त किया गया विश्लेषण GO KEGG विश्लेषण के साथ 63 मार्ग है गुण से संबंधित पाए गए 73 जीन शामिल है जो कि 28 जीन एक ही मार्ग में पाए गए 35 जीन क्रमशः 2-16 मार्ग में पाए गए है।

एक अन्य कार्य में ट्रांसक्रिपटोम आस पास पशु बछड़े की तुलना की गई मिथुन की मांसपेशी के ऊतकों का विश्लेषण ट्रांसक्रिपटोम प्रोफाइल के तुलना मिथुन एवं पशु बछड़ों के बीच 393 जीनों की अभिव्यक्त में काफी महत्वपूर्ण अंतर है 117 जीनों की जैविक कार्यों की जांच की प्रजातियों के बीच 2 गुना से अधिक है। वर्गीकृत किया गया था। विनियमित ऊपर एवं 45 जीन पशु बछड़ों मिथुन में नीचे विनियमित किया गया

इनमें से 72 जीन थे। जीन प्रोटीन उपापचय एवं संशोधन (22जीन) में संकेत पारगमन (15), न्यूक्लियोसाइड, न्यूक्लियोटाइड और न्यूक्लिक एसिड उपापचय (13), सेल चक्र (9), सेल संरचना और गतिशीलता (9), विकास की प्रक्रिया (9) इंट्रोक्लियर प्रोटीन यातायात (7) सेल प्रसार ऐर अंतर (6) सेल आसंजन (6), लिपिड, फैटी एसिड और स्टेरॉयड उपापचय (5) ट्रांसपोर्ट (5), और अन्य प्रक्रियाएँ शामिल थी।

पशु प्रजनन के तहत ऐसे ग्लूटाथैऑन (GSH), के रूप में एडीटीभ के प्रभाव सुपर ऑक्साइड (SOD), कैटलेसस (CAT) पशु प्रजनन के तहत ऐसे ग्लूटाथैऑन (के रूप में एडीटीभ के प्रभाव सुपर ऑक्साइड कैटलेसस और शुक्राणु पर मेलाटोनिन (MT) पैरामीटर 0, 6, 24 के लिए तरल भंडारण (5°C) में जैव रासायनिक एवं एंटीऑक्सीडेंट प्रोफाइल एवं ऊष्मायन के 30 घंटे अध्ययन किया गया परिणाम 10 मिमि 100 यू /मिलीलीटर में SOD पर GSH, 100 यू / एमएल और 3 मिमि मीट्रिक टन पर कैट महत्वपूर्ण ($p < 0.05$) प्रभाव नहीं हुआ।

शुक्राणु पैरामीटर, तरल वीर्य भंडारण में जैव रासायनिक एवं एंटीऑक्सीडेंट प्रोफाइल परिणाम मिथुन से शुक्राणु के संरक्षण के लिए एक नया दृष्टिकोण प्रदान की है और इसलिए मांस उद्योग के लिए इस प्रजाति के सुधार में योगदान शामिल है।

मिथुन का शरीर वजन का अध्ययन किया गया पैरामीटर 72 महीने में अन्य युवा पशुओं से आयु समूह के ऊपर अधिक पाया गया इन मानकों पशुओं की आयु रूप में प्रति बढ़ रहे थे। पैरामीटर अधिक आयु समूहों के बीच भिन्न है।

शरीर वजन एवं पेल्विक पैरामीटर के बीच सहसंबंध समूह द्वितीय में सकारात्मक और अन्य समूहों में अधिक नहीं था। इस अध्ययन के परिणाम प्रजनन उद्देश्य के लिए मिथुन गायों के चयन के लिए उपयोग किया जाएगा।

एक अध्ययन में मिथुन वीर्य में ट्रिस आधारित वीर्य बढ़ाने में वीर्य संरक्षण के अलावा अंडे की जर्दी पर एलडीएल के प्रभावों का निर्धारण करने के लिए आयोजित किया गया एलडीएल के बदले अंडे की जर्दी का बढ़ाने वालें में 8% और 10% (शुष्क पदार्थ के आधार पर जोड़ा गया परिणाम 8% से कम एलडीएल वीर्य संरक्षण के पूर्व फ्रीज एवं पिघलने चरण में शुक्राणु जैव रासायनिक पैरामीटर और एंटीऑक्सीडेंट प्रोफाइल को बनाए रखने ($p < 0.05$) में एक महत्वपूर्ण प्रभाव था।

पशु स्वास्थ्य मिथुन में फैक्सओला जायजेंटिका (बॉस फ्रॉंटेलिस) के सीरम वैज्ञानिक प्रसार का अध्ययन का परीक्षण किया गया। 154 पशुओं में से 30 पशुओं की सीरा 19.23% के प्रतिशत जो एलिसा में प्रतिक्रियाशील पाए जाते हैं। 25.84% मुक्त सीमा हालत में रिकार्ड कि गई 10.44% अर्द्ध गहन प्रणाली में कम प्रसार नि.मित स्वच्छ एवं प्रबंधन की बेहतर प्रणाली के व्यवहार की वजह था। हालांकि जंगल के प्राकृतिक चरागाह क्षेत्र में मेटासरकेरियल संक्रमण मुक्त रेंज के रूप में उत्तर पूर्वी पर्वतीय क्षेत्र एवं जलवायु परिस्थितियों का एक अदभूत जियोग्राफी मुख्य रूप से इस क्षेत्र में संक्रमण के प्रसार के लिए उत्तरदायी है।

भारत के उत्तर पूर्वी पर्वतीय क्षेत्र से मिथुन में टोक्सोप्लासमा जोडी (बॉस फ्रॉंटेलिस) के सीक्रोप्रवयलेंस एलिसा किट (CHEKIT* TOXOTEST, IDEXX प्रयोगशाला, संयुक्त राज्य अमेरिका) के रूप में अध्ययन किया गया जांच की 195 पशुओं में से 8 (4.10%) पशुओं संदिग्ध पाया गया (0.51%) उत्तर पूर्वी पर्वतीय क्षेत्र की इस बहुमूल्य पशु में सकारात्मक पाए गए।

पोरबा में मिथुन (बॉस फ्रॉंटेलिस) के गैस्ट्रोइंटेस्टाइनल पेट के जीवाणु परजीवियों का मौसमी प्रसार का अध्ययन किया गया और ट्राइकोस्ट्रोजिलस के संबंध में मौसम के बीच इसके

प्रसार में कोई महत्वपूर्ण अंतर नहीं पाया गया। हीमॉकसस में उच्च प्रतिशतसमुख्य रूप से मानसून के बाद देखा गया जबकि इसोफा जोस्टोमेसिस के मामले में रिकार्ड की प्रतिशतता, पूर्व मानसून में सबसे अधिक था। वर्ष के दौरान सर्दियों के मौसम में कुपेरिया प्रभाव सामान्य थी टोक्सोकैरा विटुलोरम प्राफीसटोमम वर्म संक्रमण का मानसून के पूर्व मौसमों का रिकार्ड प्रबंधन की अर्द्ध 110 गहन प्रणाली अंतर्गत पेट के जीवाणु परजीवियों का मौसमी प्रसार का अध्ययन किया गया। ट्राइकोस्ट्रोजिलस एसपीपी द्वारा संक्रमण का अधिक प्रभाव सर्दियों के दौरान एवं पूर्व मानसून के मौसम में पाया गया जबकि हीमॉकस का प्रभाव मानसून के मौसम में रिकार्ड किया गया सभी मौसमों में कुपेरिया का प्रभाव सामान्य था। एस की प्रभाव पपिलोसस एवं टी विटुलोरम मानसून के बाद मौसम में संख्यिकीय महत्वपूर्ण था। ट्राइकोरिस एसपीपी मानसून की मौसम के बाद तीन मौसमों में पाया गया। निमाटोडीरस सभी मौसमों में रिकार्ड किए गए एक पशुओं में वजन कम था। सभी मौसमों में जांच कि 110 बाहर सकारात्मक थे एम बैंडिंग मानसून के पूर्व समय में अधिक था। जबकि एम एक्सपनसा की प्रकोप मानसून के मौसम में अधिक था। परफीसटोमस के अलावा सर्दियों में बहुत कम पाया गया।

मिथुन में पपिलोमाटोसिस अर्द्ध गहन प्रणाली के अंतर्गत 565 मिथुन की विभिन्न रोगों के लिए स्क्रीनिंग (मौसा) किया गया।

नागालैंड एवं मणिपुर के 12 गांव में 350 मिथुन पशुओं का सर्वेक्षण किया गया तथा विभिन्न रोगों के सीरो के जांच के लिए मिथुन फार्म एवं अन्य पशुओं से सीरो रक्त के नमूने एकत्र आईवीआर के सीरो अध्ययनों से पता लगा कि इसका प्रकोप (350 में से 33) 9.33 % पाया गया। जबकि मुक्त चरण में ब्रूसीसिस की व्यापकता (350 में से 56) 16 % पाया गया। BVD एंटीबॉडी की सीरो-प्रसार BVD Ag

एलिसा द्वारा 2.66% (300 में से 9) पाया गया। जबकि (350 में से 66 पशुओं) 19 % में पाया गया। लगभग 200 बीपी की पीसी आर उत्पाद, प्रवर्धित अनुक्रम एवं टाइपिंग के लिए विश्लेषण किया गया था। BPV1 एवं 2 में मौसा की पहचान की गई मिथुन पीसीआर मिथुन पशु एवं भैंस फेब्रोपपिलोमा एवं पपिलोमा की विकृति से पहचान की गई। इंडोपीटीक पशुओं में सामान्य नहीं है। नोट किया गया 2 से अधिक प्रजातियों प्रसारण मिथुन एवं पशु में पाया गया एफएमडी प्रकोप नागालैंड के, फेक, दीमापुर, कोहिमा जिलों में पांच अलग क्षेत्रों में रिकार्ड किया गया एफएमडी सभी मामलो 300बीपी एम्पलिफेनिंग प्रइमारों का उपयोग आर टी पीसीआर द्वारा पुष्टि की गई।

तुलनात्मक मूल्यांकन एवं मिथुन (बॉस क्रॉटिलिस) पशुओं एवं थो-थो सेल की मध्यस्थता प्रतिरोधी की स्थिति का अध्ययन किया गया। 40 प्लाज्मा नमूने (प्रत्येक शारीरिक स्तरों के लिए (n=10) की विभिन्न मिथुम से एकत्र किए गए आयु के 1 वर्ष से कम) बछड़ा स्तनपान कराने वाली मादा, वयस्क ड्राई मादा एवं नर सभी 40 नमूनों में से प्लाज्मा इम्यूनोग्लोबिन (Ig G, IgE, IgM एवं IgA) सांद्रता एलिसा किट का उपयोग अनुमान लगाया गया आईजी ए एवं आईजी एम सांद्रता आईजी ई काफी भिन्न था। जबकि विभिन्न शारीरिक स्तरों के मध्य काफी अलग पाए गए। थो-थो पशुओं के स्थिति का मूल्यांकन कार्य प्रगति की है।

पूर्व वर्ष के दौरान सामाजिक-आर्थिक विकास के लिए किए गए क्रिया कलाप विभिन्न प्रौद्योगिक टीकाकरण टीएसपी के तहत इनपुट वितरण कार्यक्रम शामिल थे। पूर्वोत्तर पर्वतीय क्षेत्र के स्थानीय मिथुन मालिकों के लाभ स्वच्छ मिथुन एवं अन्य पशुधन प्रजातियों के स्वास्थ्य के लिए टीकाकरण शिविरों का आयोजन किया गया।

EXECUTIVE SUMMARY

This section contains major research work carried out during the preceding year in the different scientific sections viz. Animal Genetics and Breeding, Animal Nutrition, Animal Physiology, Animal Reproduction and Animal Health in a summarized form. National Research Centre on Mithun under the aegis of Indian Council of Agricultural Research has taken up various programmes for all round development of Mithun rearing in the North Eastern Hilly region with necessary scientific inputs. Apart from this, various developmental activities were also carried out for socio-economic benefits for the tribal Mithun owners through rearing of their prized animals directly under TSP programmes.

Under Animal Genetics and Breeding, the whole blood lymphocyte culture technique with slight modification was used for preparation of metaphase chromosomes of Indian Gaur. The blood samples were collected from the animals kept at the Mysore zoo after tranquilizing the animals. The chromosome profile of Gaur indicated that the $2n$ chromosome number is 58 and among sex chromosomes, X chromosome is sub metacentric whereas, Y chromosome is metacentric. The metaphase spread was studied for C- and R-banding using the same protocol for mithun. The band pattern were studied and it was confirmed that similar to

mithun, the X chromosome is second largest sub metacentric, however the Y chromosome is ideal metacentric with a perfect centromeric index of 50%. The C-banding showed darkly stained heterochromatin region at the point of attachment, i.e. centromere in all the acrocentric chromosomes.

For studying the molecular cytogenetic landmarks, bovine-reported primers for centromeric region were successfully amplified the DNA of the Gaur, indicating genetic similarity between two species. The FISH signals were captured using Cytovision (version 7.2) under epifluorescence microscope (Nikon-90i). The centromeric regions showing fluorescence signals with Rhodamine indicated clear signals at the centromeric region.

For genome wide association study, the animals were selected from a resource population maintained at NRCM institute farm (F_1 , F_3 and F_4 populations) and non-pedigreed populations from farmers and community field. The Quantitative traits considered were birth weight, body weight at different interval, growth rate, feed intake and carcass traits. Mendelian traits such as coat colour and horn description was also recorded. Genomic DNA was extracted from the blood samples of these animals. A



total of 24 animals were sent for genotyping in the first phase with the Illumina® Bovine HD Genotyping Bead Chip assay, according to the manufacturer's protocol.

Cattle microsatellite markers were tested on Indian mithun and wild gaur and subsequently, genetic diversity of these species was investigated using 30 cattle-specific microsatellites. The analysis revealed some unique alleles with high allelic frequencies. Nineteen (63%) microsatellite markers successfully amplified the genomic DNA of mithun and wild gaur; where 15 (79%) of these loci were highly polymorphic in mithun and gaur, respectively with Polymorphic Information Content (PIC) greater than 0.50. The number of allele ranged from eight to 25 in mithuns and two to seven in gaur. Observed heterozygosity (H_o) and Nei's expected heterozygosity values (H_e) ranged from 0.15 to 0.94 and 0.31 to 0.89 in mithun and 0.01 to 0.99 and 0.36 to 0.83 in gaur. The average estimates of H_o , H_e and PIC across 19 microsatellite loci were 0.48, 0.66 and 0.63 in mithun, and 0.62, 0.71 and 0.61 in gaur, respectively. Intra-population inbreeding level (F_{IS}) was 0.30 in mithun and 0.065 in gaur. Based on the microsatellite study, phylogenetic tree was prepared to show the genetic status of four mithun strains with wild gaur and Tho tho cattle:

Cytochrome b gene of 22 mithuns was sequenced. The Cytb sequences of other related species like *Bos taurus*, *Bos indicus*, *Bubalus bubalis* etc were downloaded from Genbank data base and phylogenetic tree was constructed. Further work is in progress.

Growth and body weight of 132 mithuns were recorded regularly and sequencing of samples of leptin gene amplicons (422 bp and 588 bp) of mithuns were carried out. A total of 17 SNPs have been identified in the 422 bp amplicons sequenced from a total 132 animals. In another PCR leptin amplicon of 588 bp, nine SNPs have been identified sequenced from a total of 122.

SAS statistical package was used taking total 132 mithuns for the association study. Association of dependent variable birth weight and adult weight with SNP Loc314 was found to be non-significant. However, association of Dependent variable average daily weight gain (ADG) with SNP Loc314 was found to be significant. Similarly, association of dependent variables Birth weight, Adult Body Weight were found to be non significant with SNP Loc322, however, ADG was found to be significant with SNP Loc322 in the analysis with PROC GLM of SAS. This is a very significant work which may be used for selection of mtihuns for higher growth traits.

In another important research work,

transcriptome Analysis of growth traits in mithun through RNA-seq approach and Whole Genome Sequencing of Mithun (*Bos frontalis*) was in progress. The bioinformatics analysis for the de novo transcriptome analysis of mithun taking the various steps was carried out. A total of ~4.18 billion high quality paired-end reads were generated per sample. As a result of assembly total of 143090 transcripts were identified having length ≥ 150 bp, with mean GC content 47.63%. Comparative analysis revealed total 148 transcripts differentially expressed, of which 70 down regulated and 78 up-regulated in mithuns having high growth rate. The differential expression profile of top five up-regulated genes (DUSP1, RCAN1, Eif2s3y, MUSTN1, MYH2) and down-regulated genes (MTR_5g051190, PFKFB3, RAD52, CYP4F2 and SNAI3) were validated by quantitative real-time PCR method. The analysis of gene ontology (GO) was also carried out. The total number of GO terms identified in molecular function, biological process and cellular component category are 3910, 1311 and 668, respectively. Top five molecular functions from GO annotation were zinc ion binding, ATP binding, nucleic acid binding, DNA binding and metal ion binding.

Under Animal Nutrition study, relationship between moisture content and bacterial

load in feed blocks prepared with different combinations of ingredients was determined towards the development of economically viable feeding strategy. Experiments were also conducted to increase the rate of evaporation of moisture from green grasses to prepare hay evolving ways and means to reduce the duration of drying period. Two innovative ways were developed. Using these methods, green fodders can be dried even in rainy season, with minimum use of electricity. Further the hays were used for preparation of feed blocks.

For determination of total gas production pattern in mithun, total gas production was determined from locally available plants / feeds / fodders (Thebonha, Gatheru (*Houttuynia chordata*), Gatha (*Clerodendrum colebrookianum*), Moli, Momochung, Wild apple, Livino, Therukhlu, Bitter leaves, mixed plant samples from Porba, Spent grain and Maize cobs) were observed to vary between 16.40 to 91.73 ml/g.

In the Veterinary type culture work, 49 pure cultures of bacteria have been isolated using roll tube method. Characterization and identification of those bacteria is under progress.

The work on elucidating the mechanisms involved in higher feed efficiency of bovine

species by expression of the genes regulating mitochondrial proton leak kinetics is in progress. Biopsy of muscle sample of 15 animals was taken for determination of mitochondrial energy utilization efficiency and preserved at -80°C. The feed : gain ratio was observed to vary between 11.02 to 33.70 with a mean value of 17.82 in 8th fortnight, 9.23 to 20.72 with a mean value of 12.47 in 12th fortnight and 8.72 to 21.47 with a mean value of 12.25 in 16th fortnight.

Under the Animal Physiology, quantification of lactoferrin in mithun milk during different stages of lactation was carried out. The lactoferrin concentrations in mithun colostrums were found to be more than two times higher than cattle cow. Similarly, mithun milk contains significantly higher ($P < 0.01$) concentrations of lactoferrin than cattle milk. When compared the milk lactoferrin concentrations between cattle and mithun milk, mithun milk contains significantly higher concentration of lactoferrin during each stages of lactation. Lactoferrin was also purified and identified from mithun milk and confirmed by western blot technique.

Antimicrobial effect of Mithun Lactoferrin (mLF) on different pathogenic bacteria was also studied. Mithun lactoferrin could

inhibit the growth of *S. aureus* and *E. coli* by 53% and 28% respectively and was observed to be comparable to Ampicillin and Kanamycin.

Gene expression of heat shock proteins was also studied and it was found that two genes (HSP 70 & HSP 90) are highly expressed in mithun bulls after three hours of ploughing and the relative gene expression of HSP 70 was highly significant after ploughing in comparison to before ploughing.

Global gene expression in muscle of mithun during different stages of growth was also studied on 28 mithuns of different stages of growth and also from cattle calf aged between 3-6 months using cDNA bovine microarray on Agilent platform. Two semen samples i.e. fresh and cryopreserved mithun semen were also examined for differential gene expression. Gene expression in different growth stages showed differences. About 1,282 (5.6%) probes showed significant differences at different growth stages and 126 genes showing strong correlation with meat traits formation were gained by the GO analysis. With the KEGG analysis, 63 pathways were found to be related to traits formation which involved 73 genes. About 28 genes were found in a single pathway while 35 genes were found in 2-16 pathways, respectively.

In another work, transcriptome analyses of

muscle tissues of mithun vis-à-vis cattle calves were done and compared. A comparison of muscle transcriptional profiles revealed significant differences in expression of 393 genes between mithun and cattle calves. Biological functions of 117 genes was classified with over 2-fold differences in expression between the examined species. Among them, 72 genes were up-regulated and 45 genes were down-regulated in mithun vs. cattle calves. The genes were involved in protein metabolism and modifications (22 genes), signal transduction (15), nucleoside, nucleotide and nucleic acid metabolism (13), cell cycle (9), cell structure and motility (9), developmental processes (9), intracellular protein traffic (7), cell proliferation and differentiation (6), cell adhesion (6), lipid, fatty acid and steroid metabolism (5), transport (5), and other processes.

Under Animal Reproduction, the effects of the additives such as glutathione (GSH), super oxide dismutase (SOD), catalase (CAT) and melatonin (MT) on sperm parameters, biochemical and antioxidant profiles in liquid storage (5°C) for 0, 6, 24 and 30 h of incubation studied. The result revealed that GSH at 10mM, SOD at 100 U/ml, CAT at 100 U/ml and MT at 3 mM had a significant ($p < 0.05$) effect in maintaining sperm parameters,

biochemical and antioxidant profiles in liquid semen storage. The results provided a new approach to the preservation of sperm from mithun and so contribute to the improvement of this species for the beef industry.

Pelvimetry of mithun and its correlation with body weight was also studied and found that the pelvic parameters were higher in 72 month and above age group than other young animals. These parameters were increased as per the age of the animal and the parameters were significantly differed between the age groups. The correlation between the body weight and pelvic parameters was positive in group II and not significant in other groups. The result of this study will be utilized for selection of mithun cows for breeding purpose.

A study was also conducted to determine the effects of the LDL on semen preservation instead of egg yolk in Tris based semen extender in mithun semen. LDL was added at 8% and 10% (dry matter basis) in extender instead of egg yolk. The result revealed that LDL at 8% had a significant ($p < 0.05$) effect in maintaining sperm parameters, biochemical and antioxidant profiles in pre freeze and post thaw stage of semen preservation.

Under Animal Health, serological



prevalence of *Fasciola gigantica* in Mithun (*Bos frontalis*) was studied. Out of 156 animals tested, sera of 30 animals are found to be reactive in ELISA which yielded a percentage of 19.23%. Out of this 25.84% was recorded in free range condition and 10.44% was recorded in semi intensive condition. The lower prevalence in semi-intensive system was due to practice of regular deworming and better system of management. However, in free range condition access to metacercarial infestation in natural grazing area of forest is there. As a whole, a peculiar geography of north eastern hilly region and climatic conditions are mainly responsible for low prevalence of this infection in this region.

Seroprevalence of *Toxoplasma gondii* in mithun (*Bos frontalis*) from north eastern hilly region of India was also studied as per ELISA kit (CHEKIT* TOXOTEST, IDEXX Laboratory, USA). As a whole, out of 195 animals examined, only 8 (4.10%) animals were found to be suspected and one (0.51%) animal found to be positive in this precious animal of north eastern region.

Seasonal prevalence of gastrointestinal helminth parasites of Mithun (*Bos frontalis*) in Porba was also studied and found that with respect to *Trichostrongylus*, there was no significant difference in its prevalence between the seasons. In case of

oesophagostomiasis, the recorded percentage was highest in pre-monsoon, followed by winter, whereas in haemonchosis, higher percentage was mainly noticed in post-monsoon. There was no significant occurrence of *Cooperia* in any season of the whole year. *Toxocara vitulorum* was recorded in all other seasons except in winter. The prevalence of *Paramphistomum* was noticed in winter only whereas tapeworm infection was recorded in all the seasons except pre-monsoon season. The seasonal prevalence of helminth parasites in the semi-intensive system of management was also studied taking 110 animals. With regard to *Trichostrongylus* spp. infection, highest incidence was observed during winter and in pre-monsoon season. *Haemonchus* infection was recorded highest in monsoon, followed by pre-monsoon, winter and post-monsoon seasons. There was very low occurrence of *Cooperia* in all the seasons. Occurrence of *S. papillosus* and *T. vitulorum* was statistically significant ($P < 0.05$) in post-monsoon season. *Trichuris* spp. was observed in three seasons except in the monsoon period. *Nematodirus* spp. was recorded only in monsoon season, that too with low incidence; only one animal being positive out of 110 examined in all seasons. The occurrence of *M. expansa* was recorded to be higher in monsoon season,

whereas *M. benedeni* was higher in pre-monsoon period. Among paramphistomes, very low incidence was noticed, that too in winter only.

Screening of Mithuns under semi intensive condition for various diseases with special reference to papillomatosis (warts) was carried out and a total of 565 animals were surveyed in 12 villages of Nagaland and Manipur and about 350 serum/blood samples were collected from mithun and other livestock for sero-monitoring of different diseases. In free range, prevalence of brucellosis was observed to be 16 % (56 of 350) while that of IBR was observed to be 9.33 % (33 of 350 animals). Sero-prevalence of BVD antibody was found to be 19 % (66 out of 350 animals) while that for BVD Ag was observed to be 2.66% (9 out of 350 animals) by ELISA. PCR product of about 200 bp was amplified, sequenced and analysed for its typing. BPV-1 & 2 have been identified from cases of warts in mithun, cattle and buffalo by PCR. Fibropapilloma and papilloma have been identified by histo-pathology of warts. Endophytic papilloma has been observed in mithun which is not common in cattle. Cross species transmission of BPV-2 was observed in mithun and cattle. FMD outbreaks were been recorded in five different areas in Phek, Dimapur and Kohima districts of Nagaland. All cases of

FMD were confirmed by RT-PCR using OIE recommended primers amplifying about 300bp.

Comparative evaluation of Humoral and Cell-mediated Immune status of Mithun (*Bos frontalis*) and Tho-Tho Cattle was also studied. A total of 40 plasma samples (n=10 for each physiological stages) were collected from Mithun under various physiological stages viz. Calf (below 1 years of age), Lactating females, adult dry females and adult males. The plasma Immunoglobulin (Ig G, IgE, IgM and IgA) concentrations of all 40 samples were estimated using ELISA kits. The Ig A and Ig M concentrations were found to differ significantly among under different physiological stages while the Ig G and Ig E did not vary significantly. The assessment of humoral immune status of Tho-Tho cattle was under progress.

Activities undertaken for socio-economic development during the preceding year included various technology Injection as well as input distribution programmes under TSP. This was for direct benefit of the mithuns and their owners in the mithun native tracts of North East Hill region. This also included organisation of health camps for deworming and vaccination of mtihuns and other livestock species.



INTRODUCTION

The Institute

The National Research Centre on Mithun was established in June 1988 in the state of Nagaland under the aegis of Indian Council of Agricultural Research to provide impetus on the research work on mithuns (*Bos frontalis*). Mithun, a ruminant species belonging to family *bovidae* and assumed to be the domesticated form of wild gaur (*Bos gaurus*) is indigenous to the eastern Himalayas and has been referred to as 'sacrificial ox' of the North Eastern region of India. It played an important role in the traditions and rituals of the vast tribal population of this region. Mithuns live at elevations between 300 to 3000 m in the hilly terrains of North East India.

NRC on Mithun is playing key role in conservation, breeding and health management of Mithun. The scientists of NRC on Mithun in the past 25 years has generated information in all aspects of Mithun production and developed many farmers' friendly technologies which have greatly helped the Mithun owners to make the Mithun husbandry a successful and economic venture.

Geographical Distribution and Population Status of mithun

Mithun is distributed within a limited geographical boundary. It is mainly found in the North- Eastern region of India (Arunachal Pradesh, Nagaland, Manipur and Mizoram), Myanmar, China, Bangladesh and Bhutan. It is difficult to ascertain the total population of Mithun, as no systematic population record of mithun is available in the mithun inhabited areas except India. According to the Livestock census (2007), out of the total mithun population in India (264,138), 218,931 animals are available in Arunachal Pradesh followed by 33,244 in Nagaland, 10,024 in Manipur and 1939 in Mizoram.

Mithun is traditionally reared under forest ecosystem.. As the population growth of this animal is not very high due to problem of inbreeding, indiscriminate slaughter, cross breeding with cattle and habitat destruction due to local agricultural practices ('Jhum' cultivation), therefore, this animal deserves special attention for the conservation, breeding and propagation.

जनादेश

- ❑ देश में उपलब्ध मिथुन के जननद्रव्य की पहचान, मूल्यांकन एवम गुणवर्धन 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 (2013-14)****Plan****(₹ in lakh)**

Sl.no	Head of Account	Revised Estimate	Expenditure Incurred
1	Esstt. Charges	-	-
2	OTA	-	-
3	TA	10.00	9.98
4	Contingency	247.00	246.98
5	Equipments	0.00	0.00
6	Works	0.00	0.00
7	Library	15.00	14.98
8	Vehicle	-	-
9	HRD	5.00	4.95
10	Furniture and fixtures	5.00	4.97
11	Livestock	3.00	2.89
12	Maintenance	15.00	14.85
	TOTAL	300.00	299.60

Non Plan**(₹ in lakh)**

Sl.no	Head of Account	Revised Estimates	Expenditure Incurred
1	Esstt. Charges	259.00	258.94
2	Wages	28.15	28.15
3	OTA	0.00	0.00
4	TA	5.00	4.99
5	Other charges	14.36	14.30
	Works – annual repair & maintenance		
	i. Office building	4.00	3.96
	ii. Residential building	4.00	4.00
	iii. Minors works	5.00	4.93
	TOTAL	319.51	319.27

RESOURCE GENERATION (2013-14)**(₹ in lakh)**

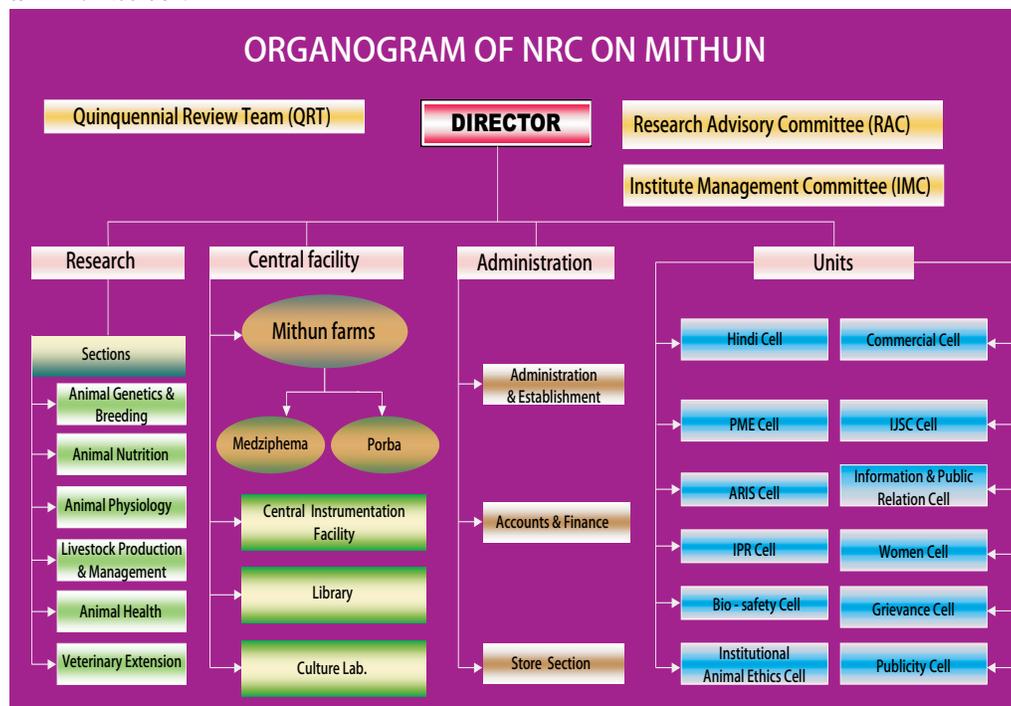
Sl. no.	Items	Resource Generation	
		Target	Actual
1.	Sale of farm produce, others sales	12.70	12.96

STAFF POSITION

Category	VIIth	IXth	Xth	XIth	Redeployment/ Revision of cadre strength	Present Strength after redeployment/ Revision	Present Position	Vacant
RMP	1	-	-			1	1	0
P.S	1	-	-			1+1***	2	1
Sr.Scientist	3	-	-		1	5	2	3
Scientist	7	-	-		3	11	6	5
T6	3	-	-			3	3	0
AO	-	-	-		-	1	-	1
AAO	1	-	-		-	2	1	1
AFAO	-	1	-		-	1	1	0
Assistant	1	-	-		-	4	4	0
P.A	-	-	-		1	1	-	1
UDC	1	1*	-		-	1	-	1
LDC	1	1*	-		1	4	3	1
Jr.Steno	1	-	-		-	1	1	0
T2	-	5*	-		-	-	-	0
T1	2	5*	-		-	2	2	0
Supporting	8	7*	3**		-	8	8	0
Total	30	20(19*+1)	3**		6	47	34	14

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

*** In the redeployment stage, the sanctioned post of Principal Scientist in Animal Physiology has been redeployed to Animal Nutrition.



Research Achievements





The empiricists are like the ant; they only collect and use. The rationalists resemble the spiders, who make cobwebs out of their own substance. The scientist is like the bee; it takes a middle course; it gathers material from the flowers, but adapts it by a power of its own. [Novum Organum, XCV, 1620]

...Francis Bacon



ANIMAL GENETICS AND BREEDING

Application of fluorescent *in-situ* hybridization (FISH) to find out the unique feature of mithun chromosomes

The whole blood lymphocyte culture technique with slight modification was used for preparation of metaphase chromosomes of Indian Gaur. For generating the cytogenetic profile of gaur the blood samples were collected from the animals kept at the Mysore zoo after tranquilizing the animals. The blood samples were collected aseptically from the caudal vein in the vacuotainer tubes and brought with minimum jerk and maintaining the cool chain to the laboratory. The chromosome profile of Gaur indicated that the 2n

chromosome number is 58 and among sex chromosomes, X chromosome is sub metacentric (Figure.1) whereas, Y chromosome is metacentric. (Figure.2)

The metaphase spread was studied for C- and R-banding using the same protocol for mithun. The band pattern were studied and it was confirmed that similar to mithun, the X chromosome is second largest sub metacentric, however the Y chromosome is ideal metacentric with a perfect centromeric index of 50%. The C-banding showed darkly stained heterochromatin region at the point of attachment, i.e. centromere in all the acrocentric chromosomes.

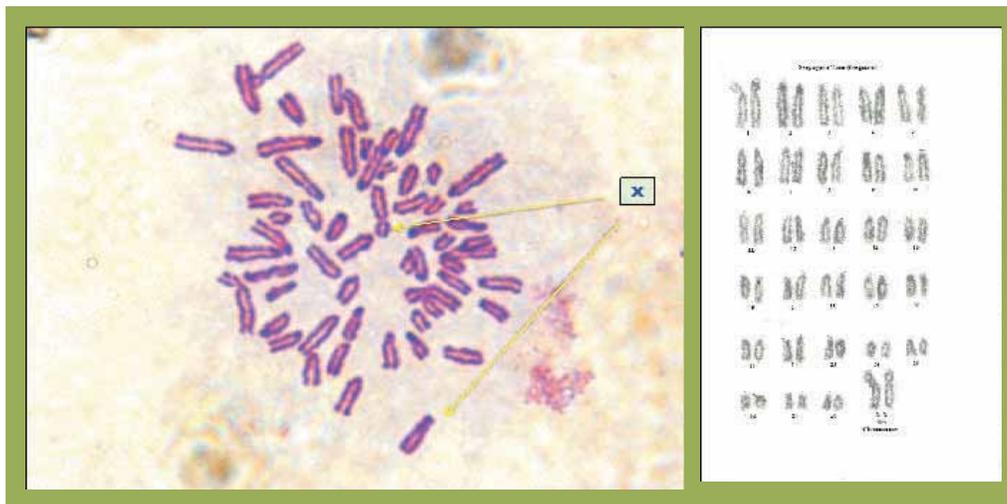


Figure.1 : Metaphase spread and karyotype of female Gaur (*Bos gaurus*)

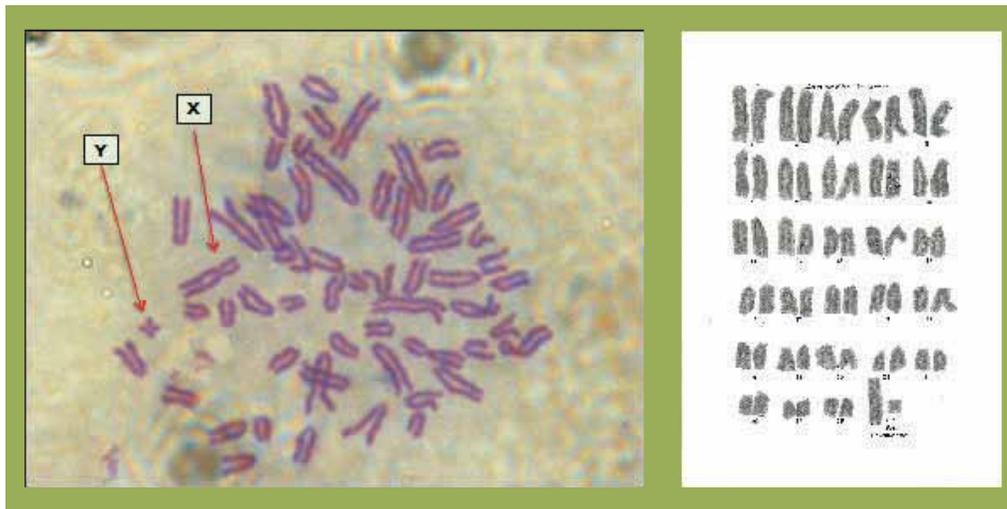


Figure.2 : Metaphase spread and karyotype of male Gaur (*Bos gaurus*)

Species	2n	Autosome		Sex chromosome	
		SM	A	X	Y
Cattle	60	-	29	SM	A
Mithun	58	1	27	SM	M
Mithun cattle crossbred	58	1	27	SM	M
Indian Gaur	58	1	27	SM	M

The highly repetitive sequences were concentrated in the two regions mainly and are the one having heterochromatin; one such region is at the centromere and the other towards the end at the telomeric region. For studying the molecular cytogenetic landmarks of this region, reported bovine primers for centromeric region were successfully amplified the DNA of the Gaur, indicating genetic similarity between two species. The amplified PCR product was hybridized using the standard protocol of FISH after purification with the

metaphase spreads and the slides were hybridized overnight and were screened next day after following the FISH washing protocol as per the manufacturer's instruction.. The signals were captured using Cytovision (version 7.2) under epifluorescence microscope (Nikon-90i). The centromeric regions were showing fluorescent signals in the trials where Rhodamine was used, indicating clear signals at the centromeric region. (Figure.3)

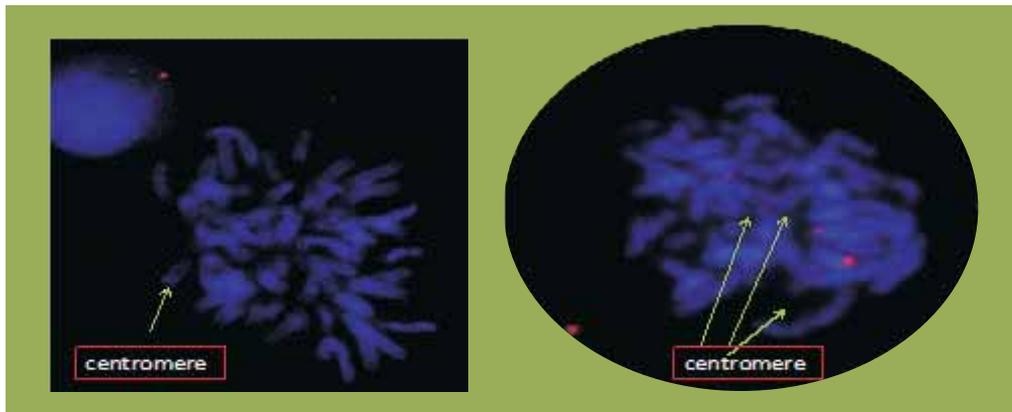


Figure.3 : Mithun female metaphase spread showing centromeric signals

Genome Wide Association Studies for Growth and Feed efficiency traits in Mithun (*Bos frontalis*)

The animals were selected from a resource population maintained at NRCM institute farm (F₁, F₃ and F₄ populations) and non-pedigreed populations from farmers and community field. The Quantitative traits considered were birth weight, body weight at different interval, growth rate, feed intake and carcass traits. Mendelian traits such as coat colour and horn description was also recorded using good digital pictures on each animal. selection of diverse Mithun population was made on the two criteria; one 'reference population' and second the 'training population'

Selected diverse Animals maintained at the farm

Source	Unrelated individuals	Parents	F1	F2	F3	F4
Arunachal	3	1	7	13	6	
Manipur	4		4	12	4	
Mizoram	2	2	13	12		
Nagaland	15	5	16	19	12	5
Total	24	8	40	56	22	5
Grand Total		16	80	112	44	10

Source	Number related individuals	Number of Families
Arunachal	23	3
Manipur	25	2
Mizoram	28	3
Nagaland	62	10
Total	138	

Source	Number of unrelated individuals from field	Total
Dam-great grand offsprings	29	52
Dam-great grand offsprings		30
Dam-great grand offsprings	61	89
Dam-great grand offsprings	36	98
		269

Blood samples from all the animals from reference as well as training set of populations were collected aseptically in a vacuutainer tube from jugular vein and was immediately transported to the laboratory with minimum jerks and maintaining cool chain. Genomic DNA has extracted from the blood as per the manufacturers' instruction and quality and quantity was assessed in the isolated DNA (Figure. 4) The genomic DNA is quantified so as to

have right concentration to fulfil the requirements for the Illumina® Infinium® SNP genotyping platform. A total of 24 animals were sent for genotyping in the first phase with the Illumina® Bovine HD Genotyping Bead Chip assay, according to the manufacturer's protocol.

The genotypic data was passed by quality control check before actual analysis was started. The various attributes for QC like genotype call rate was defined based on

validated standard cluster file provided by the manufacturer. Genotyping data was pruned with the GenABEL package for 'R', using the *check.marker* function (attributes: maf = 0.05, call = 0.95, period call = 0.95, p.lev = 0, ibs.mrk="ALL", ibs.threshold = 0.95). Pruning was performed on the collective dataset prior to generation of Wright's fixation indices (based on fixation index (F) and weighted F_{ST}), STRUCTURE analysis and genetic distance.

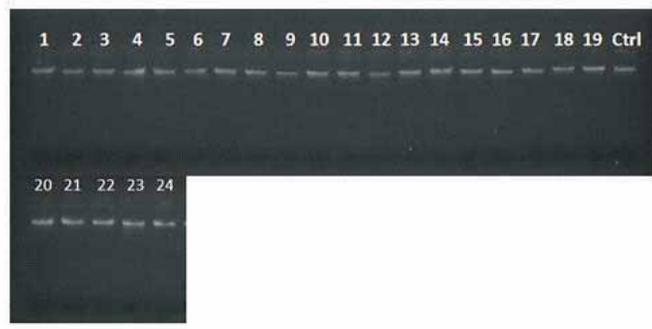


Figure.4 : Gel photo of DNA samples for Infinium Genotyping

Quality Control Report of Infinium Genotyping

Index	Sample ID	Call Rate	Sentrix ID	Sentrix Position
1	S1	0.9688764	7524472021	R01C01
2	S2	0.9721169	7524472021	R02C01
3	S3	0.9731516	7524472021	R03C01
4	S4	0.9730398	7524472021	R04C01
5	S5	0.9715063	7524472021	R05C01
6	S6	0.9668428	7524472021	R06C01
7	S7	0.9698173	7524472021	R07C01
8	S8	0.969541	7524472021	R08C01
9	S9	0.966069	7524632018	R01C01
10	S10	0.9686617	7524632018	R02C01
11	S11	0.9680087	7524632018	R03C01
12	S12	0.9699214	7524632018	R04C01

13	S13	0.9714074	7524632018	R05C01
14	S14	0.9718071	7524632018	R06C01
15	S15	0.9694149	7524632018	R07C01
16	S16	0.9486517	7524632018	R08C01
17	S17	0.9584016	7524632012	R01C01
18	S18	0.9628774	7524632012	R02C01
19	S19	0.9648274	7524632012	R03C01
20	S20	0.9632797	7524632012	R04C01
21	S21	0.9632681	7524632012	R05C01
22	S22	0.9641988	7524632012	R06C01
23	S23	0.9463406	7524632012	R07C01
24	S24	0.9386628	7524632012	R08C01

Microsatellite characterization

Cattle microsatellite markers were tested on Indian mithun and wild gaur and subsequently, genetic diversity of these species was investigated using 30 cattle-specific microsatellites. The analysis revealed some unique alleles with high allelic frequencies. Nineteen (63%) microsatellite markers successfully amplified the genomic DNA of mithun and wild gaur; where 15 (79%) of these loci were highly polymorphic in mithun and gaur, respectively with Polymorphic Information Content (PIC) greater than 0.50. The number of allele ranged from eight to 25 in mithuns and two to seven in gaur. Observed heterozygosity (H_o) and Nei's expected heterozygosity values (H_e) ranged from 0.15 to 0.94 and 0.31 to 0.89 in mithun and 0.01 to 0.99 and 0.36 to 0.83 in gaur. The average estimates of H_o , H_e and PIC across 19 microsatellite loci were 0.48, 0.66 and 0.63 in mithun, and 0.62, 0.71 and 0.61 in gaur, respectively. Intra-population inbreeding level (F_{IS}) was 0.30 in mithun and

0.065 in gaur. The study provided valuable information on the present genetic status of mithun and gaur populations and also demonstrated that cattle microsatellite markers can be applied effectively on mithuns and wild gaur for studying their genetic diversity. Based on the microsatellite study, phylogenetic tree was prepared to show the genetic status of four mithun strains with wild gaur and Tho tho cattle. (Figure. 5)

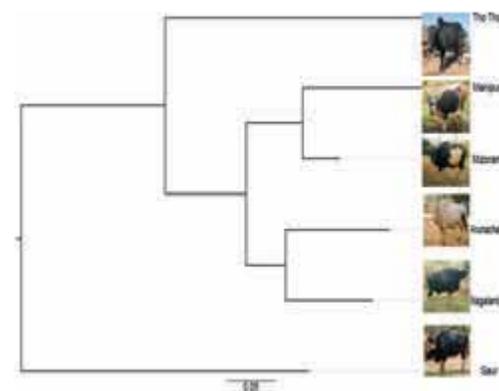


Figure.5 : Phylogenetic tree showing genetic similarity between species.

Bottleneck effect

A normal L-shaped distribution of allelic frequencies was found in the bottleneck analysis in Indian mithun population by the qualitative graphical test (Figure). There was no mode-shift found in the distribution of allelic frequencies showing the absence of any genetic bottleneck in the Indian mithun population, similar to Yunnan mithun (Qu et al., 2012). However, gaur population was found to have shifted mode indicating presence of bottleneck in recent history as the distribution of allelic frequency didn't form exactly L-shaped distribution (Figure).

The normal L-shaped distribution of allelic frequencies in the bottleneck analysis without any mode-shift by the qualitative graphical test showed absence of genetic

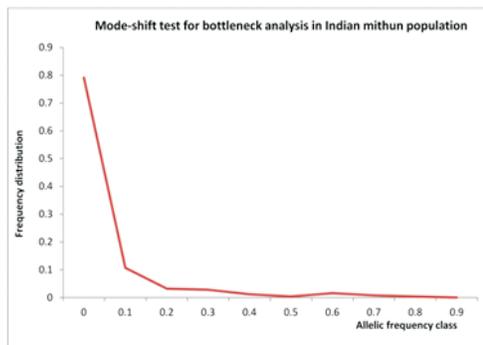


Figure. 6 : Mode-shift test for bottleneck analysis in Indian mithun population - normal L-shaped distribution

Genetic and Biodiversity Studies on Mithun (*Bos frontalis*)

Cytochrome b gene (*Cyt b*) of a number of mithuns was sequenced. The *Cyt b* sequences of other related species like *Bos taurus*, *Bos indicus*, *Bubalus bubalis* etc

bottleneck in Indian mithun population. Bottleneck analysis indicated that in spite of lower heterozygosity and small population size, there is not such evidence of genetic bottleneck in the Indian mithun population so far, which is an encouraging fact. However, genetic bottleneck was observed in wild gaur population, which was expected and may be attributed to small population size of wild gaur under zoo condition. This type of genetic bottleneck was also reported in other wild species viz. European bison (Luense et al., 2005) and giant panda (Zhang et al., 2002). However, this genetic bottleneck may not be indicative of any low reproductive capacity of wild gaurs as no such evidence was present. This is the first study of genetic bottleneck in Indian mithun and wild gaur population.

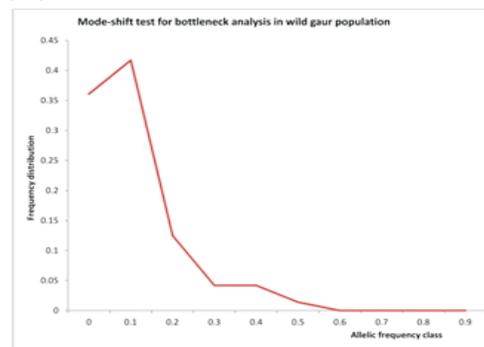


Figure. 7 : Mode-shift test for bottleneck analysis in wild gaur population - mode shifted.

were downloaded from Genbank data base and phylogenetic tree was constructed.

The evolutionary history was inferred using the Neighbor-Joining method. The optimal tree with the sum of branch length = 0.29170566 was shown (Figure. 8). The

percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) are shown next to the branches. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree. The evolutionary distances were computed using the Tamura 3-parameter method and

are in the units of the number of base substitutions per site. The analysis involved 41 nucleotide sequences. Codon positions included were 1st+2nd+3rd+Noncoding. All positions containing gaps and missing data were eliminated. There were a total of 874 positions in the final dataset. Evolutionary analyses were conducted in MEGA5. Further work was in progress.

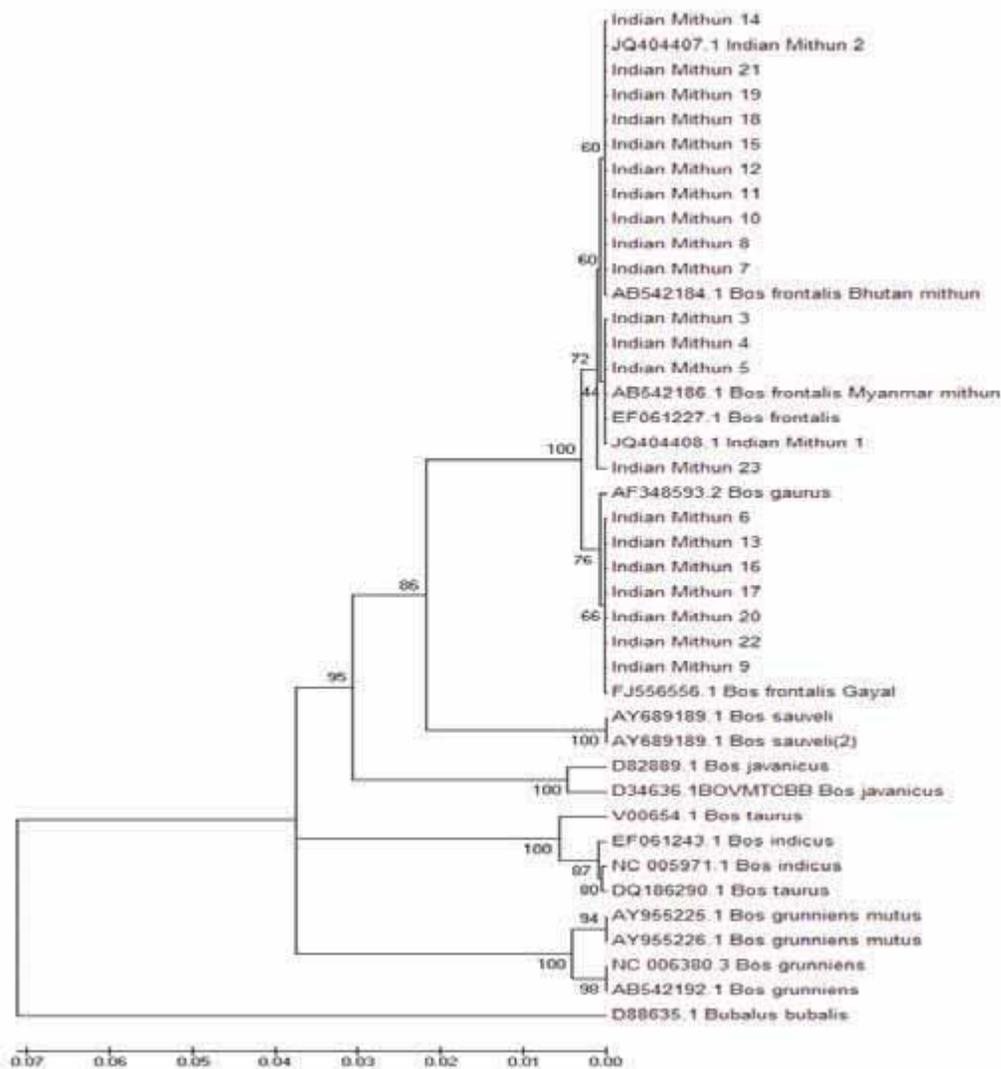


Figure. 8 : Evolutionary relationships of taxa between mithun with other livestock species.

Identification of SNPs in leptin gene for selection of mithun (*Bos frontalis*) for higher growth traits and characterization of leptin protein

Growth and body weight of around 23 experimental mithuns were recorded regularly. Apart from these, around 90 adult mithuns body measurements were recorded in terms of their birth weight, maturity weight, average daily weight gain (ADG), heart girth, body length, and height at wither. Sequencing of 168 samples of leptin gene amplicons (422 bp and 588 bp) of mithuns were carried out. Consensus sequences were constructed from these raw sequences. These sequences were aligned and SNPs were identified using different bioinformatics software (MEGA4, Muscle, Bioedit, Megalign etc). A total of 17 SNPs have been identified in the 422 bp amplicons sequenced from a total 132 animals.

SI No.	SNP	Location	Frequency
1	A>G	26	32/132
2	C>T	52	30/132
3	G>A	54	2/132
4	C>T	59	32/132
5	T>C	131	32/132
6	A>T	191	2/132
7	A>C	191	30/132
8	G>A	229	32/132
9	G>A	310	23/132
10	T>C	314	115/132
11	C>T	322	115/132
12	C>T	361	32/132
13	C>T	371	85/132
14	C>T	382	30/132
15	T>A	383	2/132
16	T>G	383	30/132
17	G>A	387	32/132

In another leptin amplicon of 588 bp, nine SNPs have been identified sequenced from a total of 122 animals. Out of these nine SNPs, four are detected in coding region (exon 3 - 87-446 bp). These are as below -

SI No.	SNP	Location	Frequency
1	G>A	34	5/122
2	G>T	63	120/122
3	G>C	64	120/122
4	G>T	66	120/122
5	A>C	85	120/122
6	G>A	305	65/122
7	T>C	357	85/122
8	T>C	373	108/122
9	T>C	480	110/122

Association study of SNPs with growth parameters of mithun

For the association study, three growth parameters were taken (birth weight, maturity weight, average daily weight gain - ADG). While the genetic and non-genetic factors included sex (male and female), strain of the animals (four - Nagaland, Arunachal, Manipur and Mizoram), period of birth (clubbing various year of birth into three period) and SNP position (SNP26, 314, 322, 371).

SAS statistical package was used taking PROC GLM (generalized least squares method) procedure taking total 132 mithuns in the analysis.

Class Level Information		
Class	Levels	Values
Sex	2	Female Male
Strain	4	1 2 3 4
Year_code	3	1 2 3
Loc314	2	1 2

PROC GLM procedure - Association of dependent variable Birth_Wt with SNP Loc314 was found to be non-significant (Figure. 9) Similarly, association of dependent variable Adult Body_Wt with

SNP Loc314 was found to be non-significant (Figure. 10). However, Association of Dependent variable Average daily weight gain (ADG) with SNP Loc314 was found to be significant (Figure. 11)

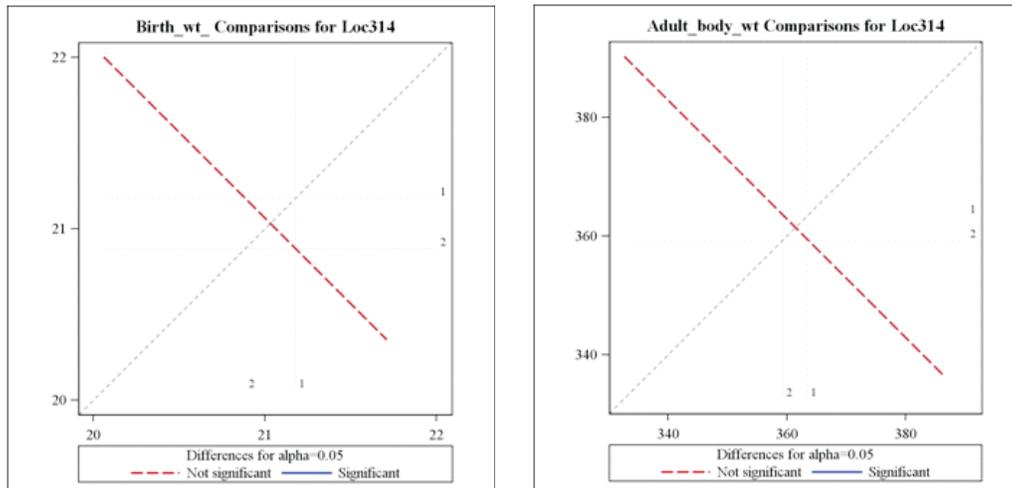


Figure. 9 & 10 : Graph showing non-significant correlation

Analysis of Variance

Source	DF	Sum o Squares	Mean Square	F Value	Pr > F
Model	7	0.44939990	0.06419999	5.62	<.0001
Error	122	1.39287606	0.01141702		
Corrected Total	129	1.84227596			

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Sex	1	0.15192709	0.15192709	13.31	0.0004
Strain	3	0.01379993	0.00459998	0.40	0.7512
Year_code	2	0.21301733	0.10650866	9.33	0.0002
Loc314	1	0.07065556	0.07065556	6.19	0.0142

Loc314	ADG LSMEAN	Standard Error	H0:LSMEAN=0	H0:LSMean1=LSMean2	
			Pr > t	t Value	Pr > t
1	0.21483678	0.01101757	<.0001	-2.49	0.0142
2	0.31318421	0.03884829	<.0001		

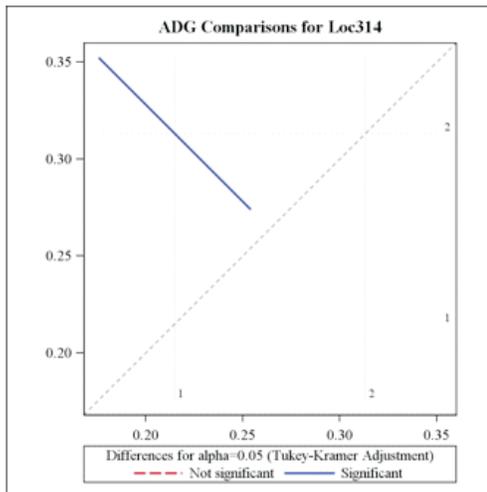


Figure. 11 : Graph showing significant correlation

For SNP location at 322 codon position, association of dependent variables Birth weight (Figure. 12), Adult Body Wt (Figure. 13) were found to be non significant with SNP Loc322, however, ADG was found to be significantly associated with SNP Loc322 in the analysis with PROC GLM of SAS (Figure. 14).

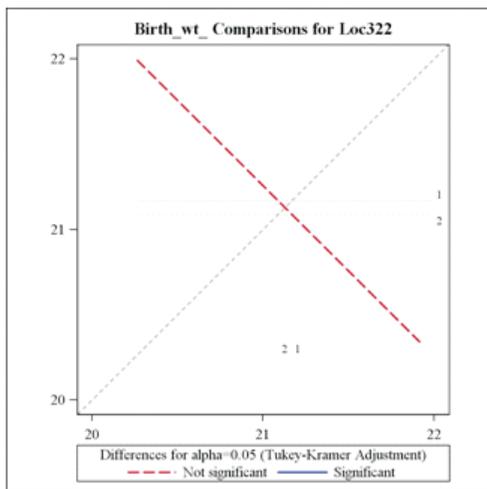


Figure. 12 : Graph showing significant correlation

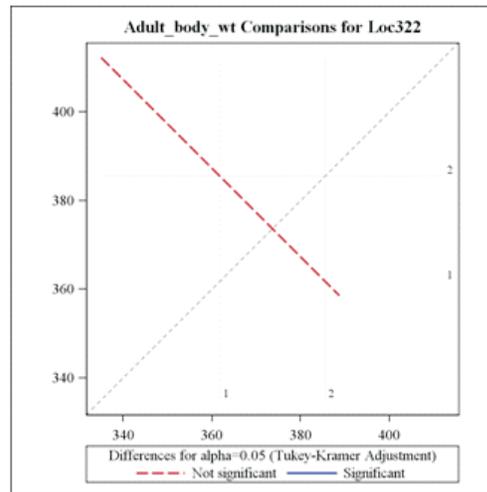


Figure. 13 : Graph showing non-significant correlation

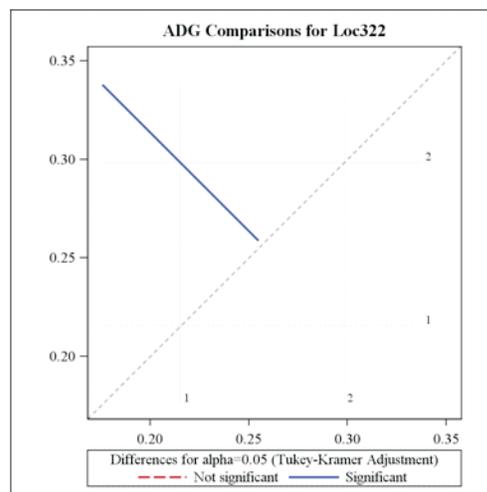


Figure. 14 : Graph showing significant correlation

Transcriptome Analysis of growth traits in mithun through RNA-seq approach and Genome Analysis of Mithun (*Bos frontalis*)

In the first study, RNA was isolated from muscle tissue samples and transcriptome sequencing was performed in Illumina HiSeq platform through outsourcing. Bioinformatics analysis of transcriptome data was carried out. For the genome

analysis of mithun, DNA was isolated from one female mithun, quality was checked to be very high quality and whole genome sequencing was performed on Illumina HiSeq 2000 platform. Total 150 GB paired end data (2x 100 bp) was generated followed by bioinformatics analysis.

Bioinformatics analysis

The bioinformatics analysis pipeline for the *de novo* transcriptome analysis of mithun taking the following steps was carried out - fastq quality checking and filtering, *de novo* transcriptome assembly, expression estimation and Transcriptome annotation.

Table 1 - Samples summary

Species	<i>Bos frontalis</i>
Condition types	Muscle tissues
Sequencing Platform	Illumina HiSeq 2000
Library type	Paired End
GC %	~ 47
Mean number of paired-end reads	83.6 million
Read length (bp)	101*2

Fastq quality check

This step involves checking of quality parameters for the sequences obtained from sequencer. The following checks are performed for an input fastq file - base quality score distributions, average base content per read and GC distribution in the reads

Base quality score distribution

The x-axis represents sequencing cycle and y-axis represents the Phred quality score of bases. The quality of left (also called R1) and right (also called R2) end of the paired-

end read sequence was shown in (Figure. 15 & 16) respectively. It can be clearly seen that the average base quality was above Q20 (error-probability ≥ 0.01) for majority of read cycle in R1.

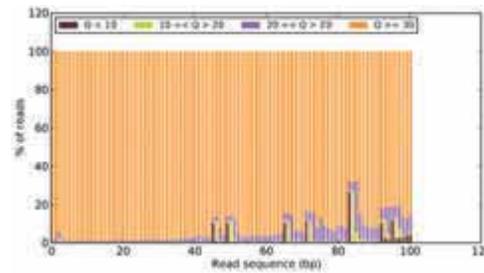


Figure. 15 : Base quality distribution of 'Sample high 1' left end of paired-end read

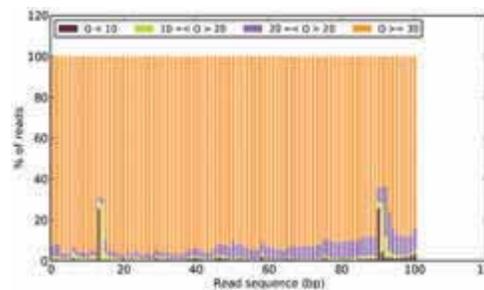


Figure 16 : Base quality distribution of 'Sample high 1' right end of paired-end read

Base composition distribution

The composition of nucleotides in the sequence read is shown in Figure. 2a - 2b.. The x-axis represents sequencing cycle and y-axis represents nucleotide percentage. The base composition of left and right end of the paired-end read sequence is shown in Figure. 17 and Figure. 18, respectively. A bias in first 18 cycles and last 19 cycles of R1 and first 18 cycles and last 11 cycles of R2 is observed in the across the samples. Biasing in sequence composition is in general observed in transcriptome experiments.

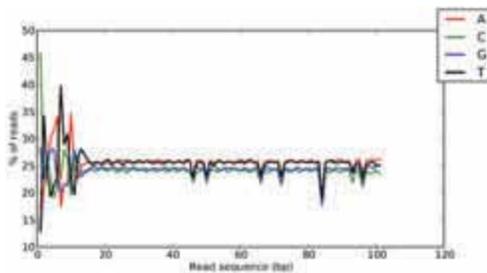


Figure. 17: Base composition in the left end of muscle sample paired-end read

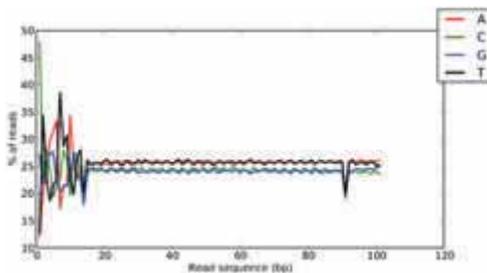


Figure. 18: Base composition in the right end of muscle sample paired-end read

GC distribution

The average GC content distribution in the sequenced read of the sample is shown in Figure. 19 & 20. The x-axis represents average GC content in the sequence and y-axis represents total percentage of reads. The average GC content of the reads in the sample follows a normal distribution.

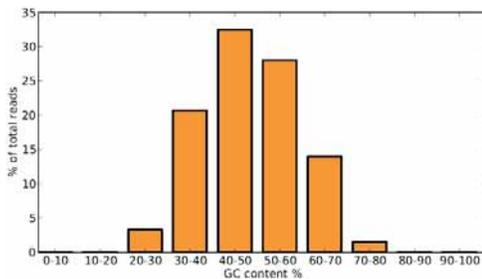


Figure. 19 : GC distribution over left end read of sequence

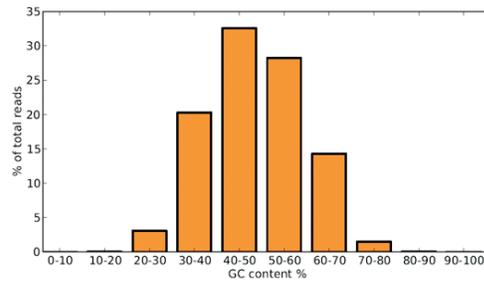


Figure. 20: GC distribution over right end read of sequence

De novo transcriptome assembly

The fastq files were trimmed before performing assembly. First 18 bases and last 19 bases were removed from all R1 reads and first 18 bases and last 11 bases were trimmed from all R2 reads to avoid specific sequence bias and low quality bases. Such reads were also filtered out whose average quality score was <20 in any of the paired end and reads contaminated with Illumina adapter.

The trimmed reads were then assembled using SOAPdenovo31mer algorithm with default options. The transcriptome assembly result was summarized below (Table 2). The transcript length distribution for all assembled was shown (Figure. 21). Only 35% of total assembled transcripts were of length ≥ 150 bp. The GC content distribution of the all assembled transcripts was shown (Figure. 22). Main focus was on transcript of length ≥ 150 bp for transcript expression estimation and downstream annotations.

Table 2: Assembled transcript summary

	All assembled transcripts	Transcripts of length >= 150 bp
Number of assembled transcript	408,911	143,090
Longest transcript length (bp)	29,564	29,564
Mean GC % of transcripts	47.31	47.63

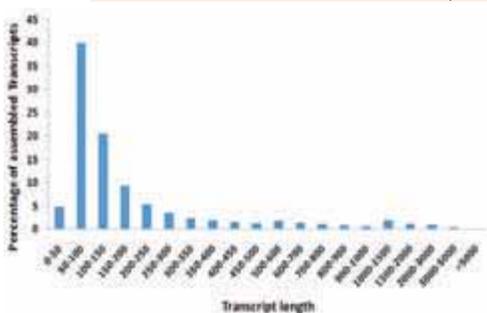


Figure. 21 : Assembled transcript length distribution

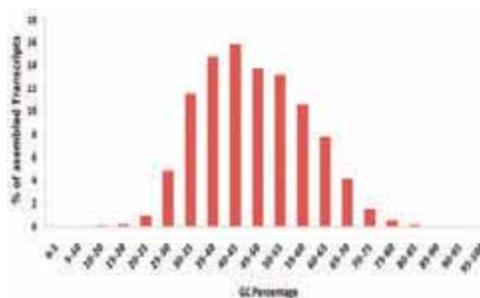


Figure. 22 : GC content distribution of all assembled transcripts

ANIMAL NUTRITION

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

Determination of relationship between moisture content and bacterial load in feed blocks prepared with different combinations of ingredients

The bacterial load in paddy straw and spent grain based feed block varied between 7×10^5 to 3×10^6 CFU/g with moisture content 9.53 to 14.64%; in green fodder, paddy straw and spent grain based feed block 2.5×10^5 to 7×10^7 CFU/g with moisture content 11.09 to 12.50% and in tree leaves, paddy straw and spent grain based feed

block 5×10^6 to 2×10^7 CFU/g with moisture content 12.22 to 14.29% after storage for a duration of two years.

Increasing evaporation rate of moisture from green grasses for preparation of hay

Experiments were conducted to increase the rate of evaporation of moisture from green grasses to prepare hay evolving ways and means to reduce the duration of drying period. Two innovative ways were developed. Using these methods, green fodders can be dried even in rainy season, with minimum use of electricity. Further the hays were used for preparation of feed blocks (Figure. 23 & 24).



Figure. 23 : Maize stover – paddy straw – spent grain based feed block



Figure. 24 : Congo Signal – paddy straw – spent grain based feed block

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

Determination of total gas production pattern in mithun

Total gas production determined from locally available plants / feeds / fodders (Thebonha, Gatheru (*Houttuynia chordata*), Gatha (*Clerodendrum colebrookianum*), Moli, Momochung, Wild apple, Livino, Therukhlu, Bitter leaves, mixed plant samples from Porba, Spent grain and Maize cobs) were observed to vary between 16.40 to 91.73 ml/g.

Veterinary type culture

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

Elucidating the mechanisms involved in higher feed efficiency of bovine species by expression of the genes regulating mitochondrial proton leak kinetics

Fifteen mithun (*Bos frontalis*) weighing 116.3 ± 7.65 kg were fed *ad lib* concentrate mixture (crushed maize 50%, deoiled mustard cake 30%, wheat bran 17%, mineral mixture 2% and salt 1%) and available roughages (paddy straw / tree leaves / napier) in a growth trial for determination of variation in feed efficiency and its relation with mitochondrial energy utilization efficiency. The animals were maintained in a shed with facilities for individual feeding. Before starting the experiment the animals were dewormed. The animals were weighed at fortnightly interval and feeding records were maintained on daily basis. At the beginning of the experiment, a biopsy of muscle sample of about 2 g were collected from all the animals for determination of mitochondrial energy utilization efficiency and preserved at -80°C . The feed : gain ratio was observed to vary between 11.02 to 33.70 with a mean value of 17.82 in 8th fortnight, 9.23 to 20.72 with a mean value of 12.47 in 12th fortnight and 8.72 to 21.47 with a mean value of 12.25 in 16th fortnight.

ANIMAL PHYSIOLOGY

Quantification of lactoferrin in mithun milk during different stages of lactation

Milk samples were collected from mithun cows (n=347) of different stages of lactation viz., early, mid and late lactation. Milk samples were also collected from cattle cows (281) reared at NRC on Mithun farm located at Medziphema Mithun Farm, Nagaland during different stages of lactation. In addition, colostrums were collected from both mithun (n=81) and cattle cows (n=53). Lactoferrin was quantified in colostrums and milk collected from mithun and cattle cows using ELISA techniques.

The lactoferrin concentrations in mithun colostrums were found to be more than two times higher than cattle cow. Similarly, mithun milk contains significantly higher (P<0.01) concentrations of lactoferrin than cattle milk (Figure. 25)

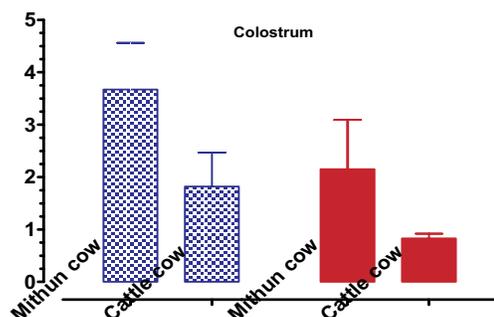


Figure. 25 : Comparison of lactoferrin concentrations (mg/ml; \pm SD) in colostrums and milk of mithun vs. cattle cow

Lactoferrin concentrations as estimated in milk of both mithun and cattle cows during different stages of lactation has been depicted in Figure. 26. Mithun milk lactoferrin concentrations was found to be

significantly higher (P<0.01) during early lactation than that of mid or late lactation. Similar trend was followed for the cattle milk during different stages of lactation. When compared the milk lactoferrin concentrations between cattle and mithun milk, mithun milk contains significantly higher concentration of lactoferrin during each stages of lactation.

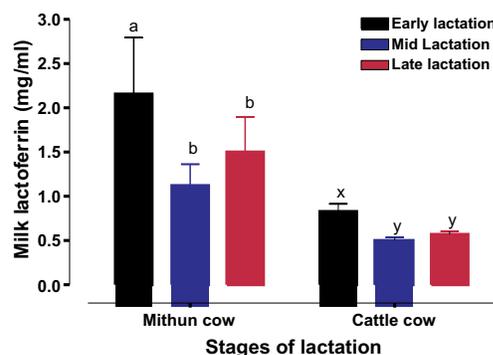


Figure. 26 : Comparison of lactoferrin concentrations (mg/ml; \pm SD) in milk of mithun vs. cattle cow during different stages of lactation

Purification of Lactoferrin from Mithun milk

For the purpose of purification of lactoferrin from Mithun milk, first milk was pooled from a healthy Mithun mother and frozen at -20°C until used. The milk was thawed and cream was removed by centrifugation at 4°C, 15000 rpm for 1 hr, after that skim milk was adjusted to pH 4.7 with 5 N HCl and the caseins precipitated was removed by

another centrifugation at 4°C, 15000 rpm for 45 min. supernatant was adjusted to pH 6 with 1 N NaOH. Immunoglobulin was removed from the liquid part by ammonium sulphate (48%) precipitation technique. Supernatant was dialyzed against 5 mM Sodium Phosphate buffer pH6 for overnight then applied to the Heparin-CL-Agarose column and washed with same buffer. Finally lactoferrin was eluted with 5 mM Phosphate buffer containing 100, 200 and 500 mM NaCl respectively.

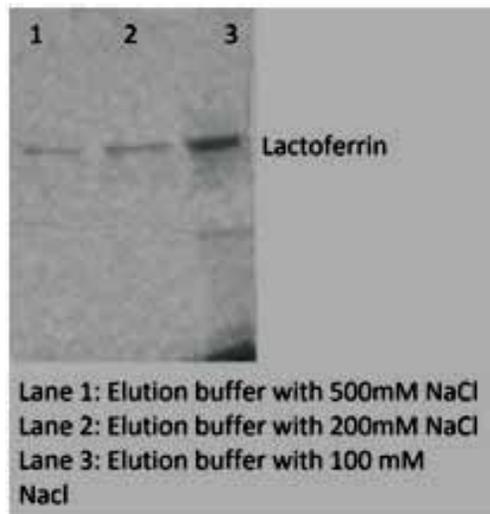


Figure. 27 : Purified Mithun lactoferrin as separated by SDS PAGE

Identification of Lactoferrin

Elution fractions was separated by 12% SDS PAGE and a single band was identified between ~70-80Kd (Figure. 27) with respect to protein marker and confirmed by Western blot with mouse anti bovine lactoferrin (Figure 28).



Figure. 28 : Confirmation of mithun lactoferrin through Western Blot

Expression patterns of lactoferrin gene

Total RNA was isolated from milk samples of Mithun cows using commercially available RNA isolation kit (Qiagen). RNA was reverse transcribed into cDNA with suitable primers following the manufacturer's instructions. PCR was optimized for studying the expression patterns of lactoferrin gene in mithun (Figure. 29)

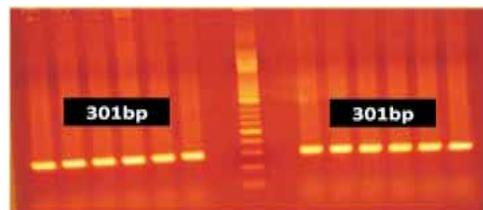


Figure. 29 : Expression of mithun lactoferrin gene

Primers used:

Forward Primer CAGCTGTGTTCCCTGCATTG

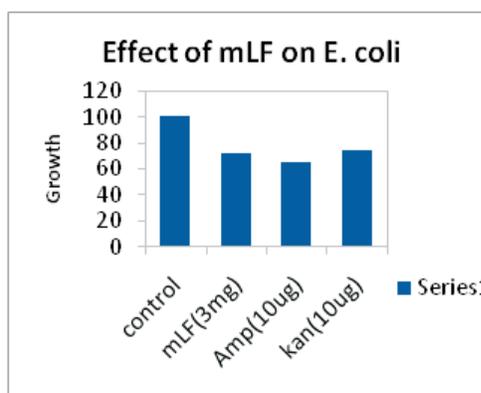
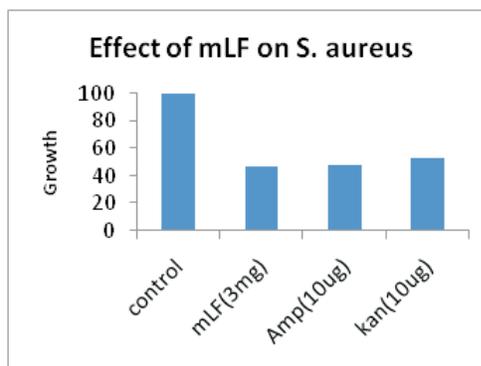
Reverse Primer CCCCTTGCACAGTTGACA

Antimicrobial effect of Mithun Lactoferrin (mLF) on different pathogenic bacteria

Pure cultures of *E. coli* BI21DE3 were swabbed over Luria Agar plates containing 0.6% Luria Agar and paper disks with different concentrations of Kanamycin, Ampicillin and mLF were placed followed by overnight incubation at 37°C for carrying out disc diffusion test. A smaller zone of inhibition was observed with mLF while a larger clear zone of inhibition was observed for Ampicillin and Kanamycin indicating. MIC was measure for mLF by broth dilution method against *E. coli* and *S. aureus*. MIC of mLF for *E. coli* and *S aureus* was observed to be 3 and 3±0.5 mg/ml respectively. It was observed that mLF could reduce growth of *E. coli* by 30% and for *S. aureus* by 50% with respect to control. Mithun lactoferrin could inhibit the growth of *S. aureus* and *E. coli* by 53% and 28% respectively and was observed to be comparable to Ampicillin and Kanamycin.

Effect of mithun Lactoferrin and antibiotics on growth of *S. aureus* and *E. coli*

	<i>S. aureus</i>		<i>E. coli</i>	
	Growth (%)	Inhibition (%)	Growth (%)	Inhibition (%)
Control	100	Nil	100	Nil
mLF(3mg)	46.9	53.1	72	28
Amp(10ug)	47.9	52.1	65	35
Kan(10ug)	53	47	74	26



Gene expression studies of heat shock proteins

Whole blood was collected in the heparinized test tubes from mithun bulls before and after ploughing. Total DNA was isolated from whole blood by using DNeasy mini kit (Qiagen). Blood was first lysed with Proteinase-K and the lysate is loaded on to the DNeasy mini spin column followed by centrifugation. During centrifugation DNA was selectively bound to the DNeasy membrane as contaminants pass through. Then the bound DNA was eluted with elution buffer. This final extracted DNA was utilized to study the

expression of heat shock proteins 70 and 90 by PCR.

Heat shock proteins (HSPs) being abundantly expressed in cytosol, EPR and nucleus have been incriminated to serve vital role as cellular protectant from diverse kinds of stressors. Heat shock protein belongs to a family that consists of a variety of proteins and therefore has been classified as per their molecular weight (kDa) as HSP 110, HSP 100, HSP 90, HSP 70, HSP 60, HSP 40, HSP 32 and HSP 10. When the cells are subjected to stress, heat shock genes are expressed and heat shock proteins are formed. This increase in expression is [transcriptionally](#) regulated resulting dramatic [upregulation](#) of the heat shock proteins and is induced primarily by [heat shock factor](#) (HSF). Stressors results in denaturation of proteins that leads to activation of HSF. The activated HSF monomers translocated into the nucleus forming HSF trimer complexes with heat shock elements (HSE) in the promoter region of the HSP gene. HSP mRNA is transcribed and enters cytosol for translating into heat shock proteins (HSP). This newly formed HSPs functions as molecular chaperones, assisting in the assembly and translocation of newly synthesized proteins within the cell and repair and refolding of denatured proteins.

Out of these HSPs, HSP 90 helps in protein translocation and regulation of steroid hormone receptors and HSP 70 serves as a primary molecular chaperone in cellular, tissues and organs level protection against stress by promoting the folding of nascent polypeptides and correcting the misfolding of denatured proteins. HSP70 interacts with key regulators of many signal transduction pathways controlling cell homeostasis, proliferation, differentiation and cell death. The interaction of Hsp70 with these regulatory proteins continues in activation cycles that also involve Hsp90 and a number of co-chaperones. HSP 70 also plays a role as anti-apoptosis. The levels of Hsp70 in cells have been correlated with tolerance to a wide variety of stresses. The level of HSP70 at high altitude was found to abruptly elevated under stress.

More information is available on the effect of different stressors and the role of heat shock proteins in most of the livestock and different breeds of bovines except in mithun. In this present study, it was found that, both genes (HSP 70 & HSP 90) are highly expressed in mithun bulls after three hours of ploughing (Figure. 30) and also the relative gene expression studies for HSP 70 was highly significant (Figure. 31) after ploughing in comparison to before ploughing.

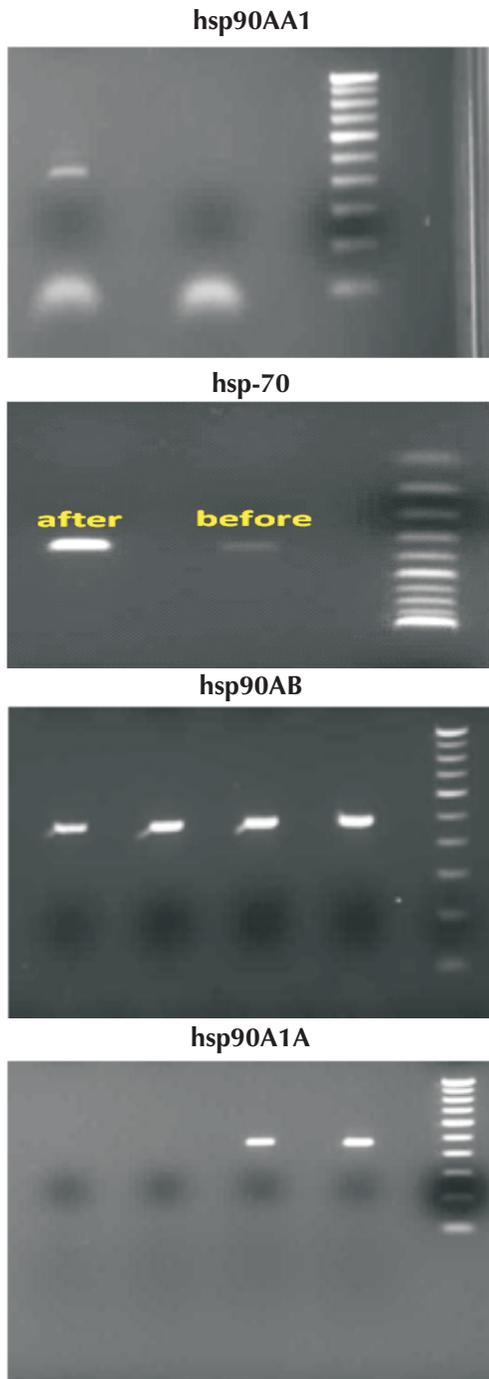


Figure. 30 : Expression of heat shock protein genes (hsp-70& 90) before and after ploughing

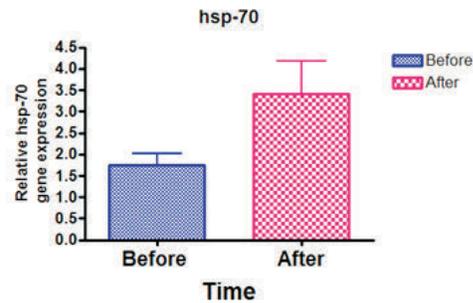


Figure. 31: Relative gene expression for hsp-70 before and after ploughing

Global gene expression in muscle of mithun during different stages of growth

A total of 28 muscle samples collected through biopsy from mithuns of different stages of growth and also from cattle calf aged between 3-6 months were run for cDNA bovine microarray using Agilent platform. Two semen samples i.e. fresh and cryopreserved mithun semen were also examined for differential gene expression through bovine cDNA microarray. A total of seven groups were made based on the age and growth rate of the animals:

- G1 (ETT) : mithun calves aged between 1-2 months
- G2 (MCM): mithun calves aged between 3-6 months
- G3 (PM): mithuns aged between 6 months and 1 year
- G4 (RAM): mithuns aged between >1 year to 2 years
- G5 (HAQ) : Mithuns aged between >2 years and 3 years
- G6 (L2): Adult mithuns with absolutely no body growth and hence treated as control

- G7 (DCM) : Consists *cattle calves* aged between 3-6 months

In addition, differential global gene expressions were compared between two mithun semen samples (fresh and cryopreserved).

Normalization

The normalization was done using GeneSpring GX 11.0 software.

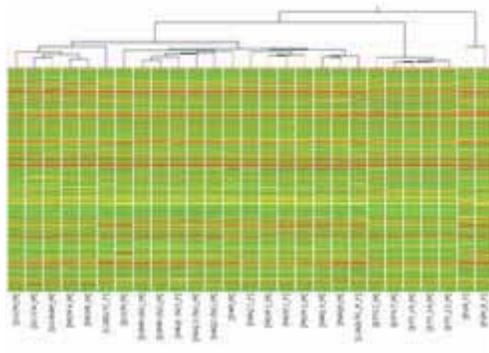
Normalization Method Used

Percentile Shift Normalization

Percentile shift normalization is a global normalization, where the locations of all the spot intensities in an array are adjusted. This normalization takes each column in an experiment independently, and computes the n^{th} percentile of the expression values for this array, across all spots (where n has a range from 0-100 and $n=75$ is the median). It subtracts this value from the expression value of each entity. Analysis was done with respect to control samples.

Intra array QC

Intra-array normalization deals with variability within a single array and should be carried out using accepted methods before inter-array normalization is applied.



In intra array normalization, processed signal (dye normalized background subtracted signal intensity) is log transformed and then for each of the array the 75th percentile value is calculated separately. In each sample the log transformed intensity values for each probe is subtracted by the calculated 75th percentile value of the respective array and expression values are obtained.

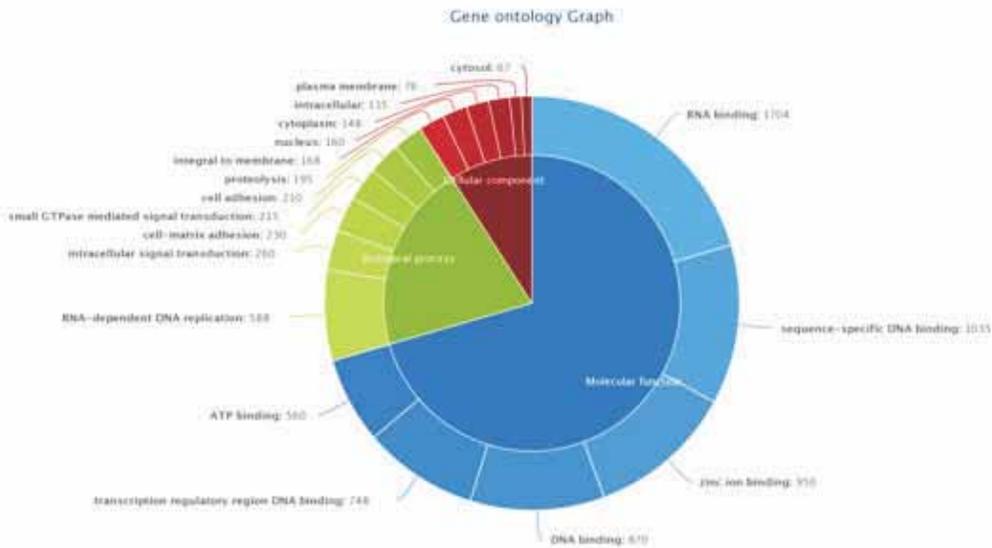
Gene expression in different growth stages showed differences. In order to establish the correlation between gene expression mechanisms and meat traits formation which controlled by polygenes, microarray analysis was performed in Longissimus dorsi muscle tissue of different growth stages of mithun and cattle. About 1,282 (5.6%) probes showed significant differences at different growth stages and 126 genes showing strong correlation with meat traits formation were gained by the GO analysis. With the KEGG analysis, 63 pathways were found to be related to traits formation which involved 73 genes. About 28 genes were found in a single pathway while 35 genes were found in 2-16 pathways, respectively. The panel of transcripts and gene pathway analysis in different growth stages may be helpful for the study on beef traits formation and the gene expression profile construction in *Longissimus dorsi* muscle tissues would also make a model for screening candidate genes which have genetic effect on meat quality in bovine species.

Mithun muscle transcriptome profiling

Transcriptome analyses of muscle tissues of

mithun vis-à-vis cattle calves were done and compared. We aimed to identify the genes whose expression may reflect the muscle phenotype of each species. A comparison of muscle transcriptional profiles revealed significant differences in expression of 393 genes between mithun and cattle calves. We classified biological functions of 117 genes with over 2-fold differences in expression between the examined species. Among them, 72 genes were up-regulated and 45 genes were down-regulated in mithun vs. cattle calves. The genes were involved in protein metabolism and modifications (22 genes), signal transduction (15), nucleoside, nucleotide and nucleic acid metabolism (13), cell cycle (9), cell structure and

motility (9), developmental processes (9), intracellular protein traffic (7), cell proliferation and differentiation (6), cell adhesion (6), lipid, fatty acid and steroid metabolism (5), transport (5), and other processes. For the purpose of transcriptome data validation, we randomly selected 4 genes: trip12, mrps30, pycrl, and c-erbb3. RT-PCR results showed similar trends in gene expression changes as those observed in transcriptome studies. Basing on results of the present study, we proposed a model of the regulation of skeletal muscle growth and differentiation, with a principal role of the somatotropic pathway. It may explain at least in part the development of muscle phenotype in mithuns. We assumed that the growth hormone directly or indirectly



Gene Ontology graph represents Q-significant & uniquely expressed transcripts.

(through IGF-1) activates the calcium-signaling pathway with calcineurin, which stimulates myogenic regulatory factors (MRFs) and inhibits early growth response gene. The inhibition results in indirect activation of MRFs and impaired activation of TGF-beta1 and myostatin, which finally facilitates terminal muscle differentiation.

Designing of Mithun specific probes for cDNA microarray

A 400K gene expression microarray probes were designed with 60-mer oligonucleotides for mithun. The 400K array comprised of a total number of 420288 features including 416505 probes, 3783 Agilent controls. Around 60030 unique transcripts of mithun were collected from NGS data. Retrieved sequences were used for probe design. Probes were

categorized as specific and cross hybridizing on the basis of BLAST result. Total numbers of specific probes designed are 200768 and cross hybridizing probes designed are 134808. We have also pooled 11865 numbers of probes from catalog. (Table 3). Finally 347411 probes are included in the microarray design specifically made for mithun (*Bos frontalis*).

Table 3. Probes design summary

Total No. Of Clustered Transcripts	60030
No. of catalog probes	11865
No. of NGS transcripts probes	335576
Total No. Of probes designed:	347441
Length of probe	60 bp
Avg. Probes/Transcript	2 to 6 probes
Probe Orientation	Sense/Antisense
2x400K Array Specification	
Total number of features:	420288
Total no. of available features:	416505
Agilent control:	3783



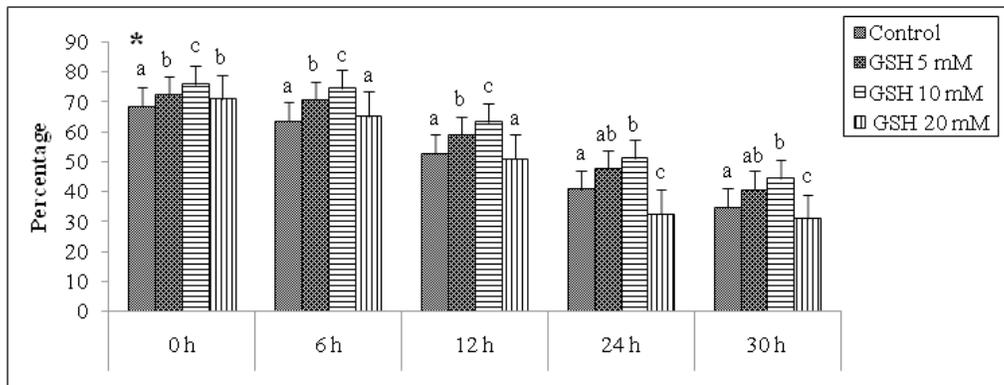
Scientist farmers interaction Viswema village

ANIMAL REPRODUCTION

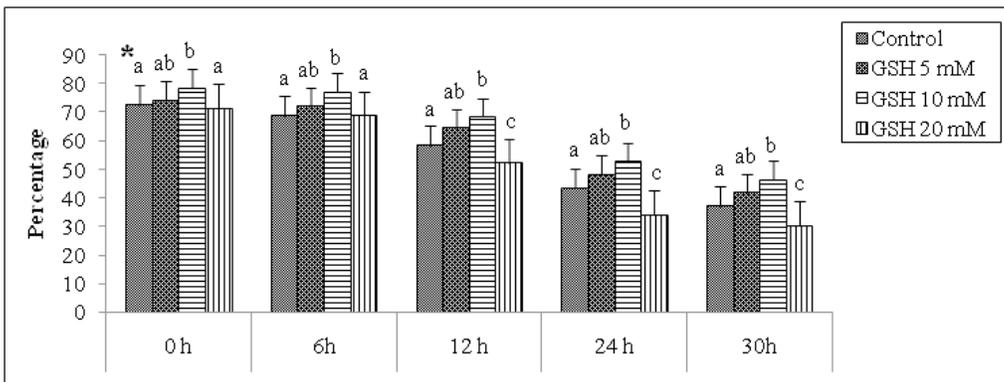
Study on effects of additives on seminal parameters of mithun

Study was conducted to determine the effects of the additives such as glutathione (GSH), super oxide dismutase (SOD), catalase (CAT) and melatonin (MT) on sperm parameters, biochemical and antioxidant profiles in liquid storage (5°C) for 0, 6, 24 and 30 h of incubation. The concentration of GSH at 5, 10 & 20 mM, SOD at 50 U/ml, 100 U/ml & 150 U/ml, CAT at 50 U/ml, 100 U/ml & 150 U/ml and

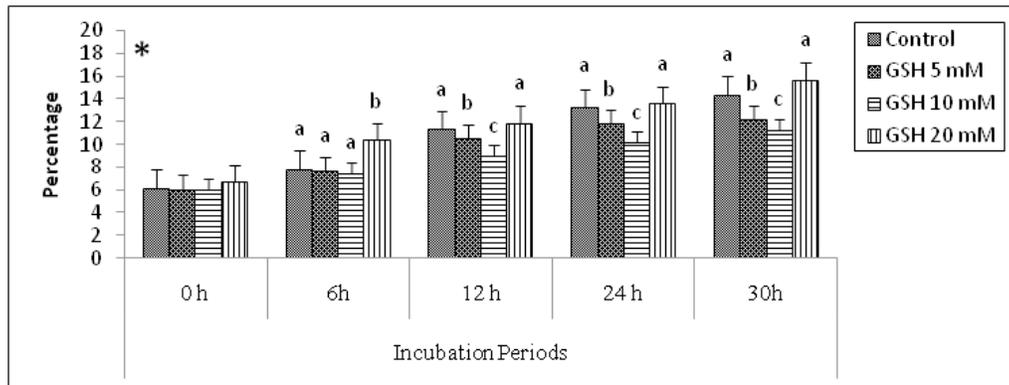
MT at 1 mM, 2 mM, 3 mM & 4 mM were used in the diluents of Tris-based extender. The result revealed that GSH at 10mM, SOD at 100 U/ml, CAT at 100 U/ml and MT at 3 mM had a significant ($p < 0.05$) effect in maintaining sperm parameters, biochemical and antioxidant profiles in liquid semen storage. The results of this study therefore provide a new approach to the preservation of sperm from mithun and so contribute to the improvement of this species for the beef industry.



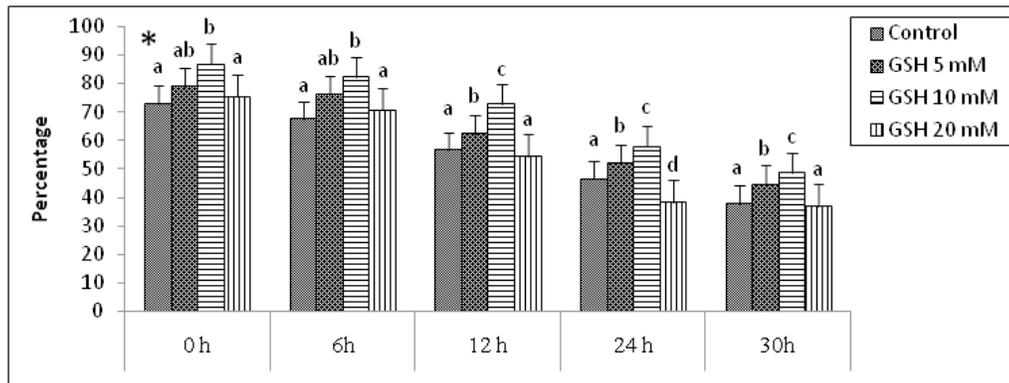
Effect of diluents supplementation with reduced glutathione (GSH) on motility of spermatozoa of mithun semen (* indicates $p < 0.05$)



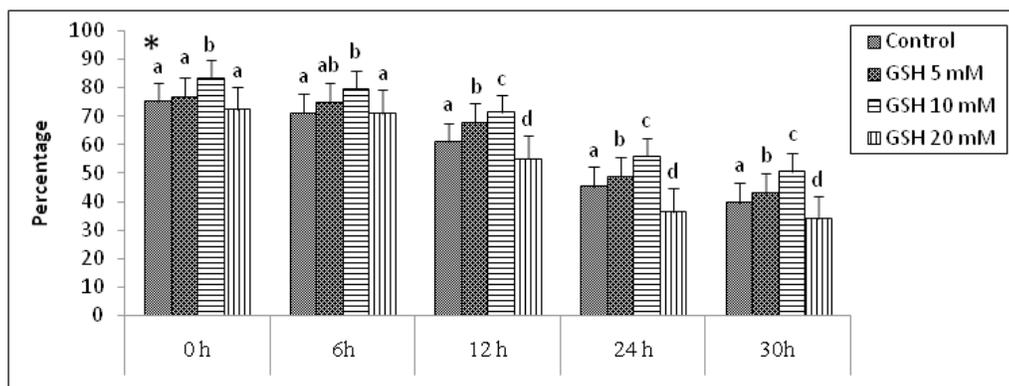
Effect of diluents supplementation with reduced glutathione (GSH) on viability of spermatozoa of mithun semen (* indicates $p < 0.05$)



Effect of diluents supplementation with reduced glutathione (GSH) on total sperm abnormality of spermatozoa of mithun semen (indicates $p < 0.05$)*



Effect of diluents supplementation with reduced glutathione (GSH) on acrosomal integrity of spermatozoa of mithun semen (indicates $p < 0.05$)*



Effect of diluents supplementation with reduced glutathione (GSH) on plasma membrane integrity (HOST) of spermatozoa of mithun semen (indicates $p < 0.05$)*

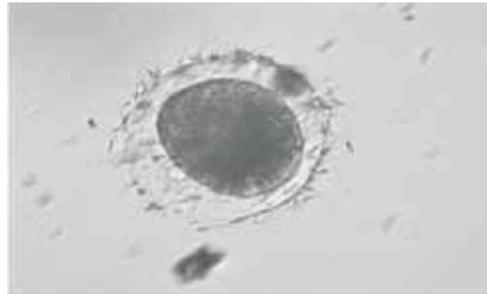
Pelvimetry of mithun

The study was conducted on mithun cows consisting of four groups based on age at mithun farm, NRC on Mithun, Nagaland to study the external pelvimetry and its correlation with body weight. Distance between angle of haunch, ischial tuberosity and between grop and hip joint were measured. Based on these, inlet and outlet of transverse, vertical pelvic diameter and pelvic area were measured of different age group such as group I: 24 – 36 months, group II: 37-48 months, group III: 49 – 72 months and group IV: 72 months and above, respectively. This study was concluded that the pelvic parameters were higher in 72 month and above age group than other young animals. These parameters were increased as per the age of the animal and the parameters were significantly differed between the age groups. The correlation between the body weight and pelvic parameters was positive in group II and not significant in other groups. The result of this study will be utilized for selection of mithun cows for breeding purpose.

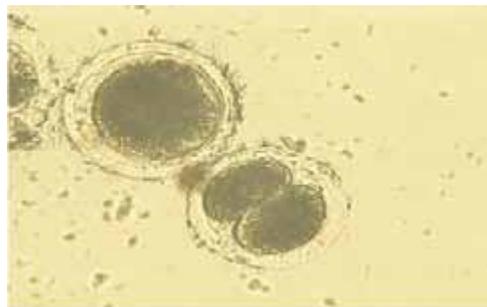
Effect of low density lipo protein (LDL) in mithun semen preservation

A study was conducted to determine the effects of the LDL on semen preservation instead of egg yolk in Tris based semen

extender in mithun semen. LDL was added at 8% and 10% (dry matter basis) in extender instead of egg yolk. The result revealed that LDL at 8% had a significant ($p < 0.05$) effect in maintaining sperm parameters, biochemical and antioxidant profiles in pre freeze and post thaw stage of semen preservation. The results of this study provide a new approach to the preservation of sperm from mithun and so contribute to the improvement of this species for the beef industry.



Effect of 8% LDL on mithun semen on zona binding assay



Effect of 8% LDL on mithun semen on in vitro fertility test



ANIMAL HEALTH

Serological prevalence of *Fasciola gigantica* in Mithun (*Bos frontalis*) hilly region of India

The serum samples were collected from different geographical locations of Nagaland and Mizoram in free range condition of rearing. However, in institute farm, serum samples were collected from semi intensive condition. In the present study, no eggs of the flukes were recovered on faecal examination but attempt was made for studying the sero-prevalence of this parasite in mithun. Seroprevalence of fasciolosis in mithun was recorded in free range condition as well as in semi intensive condition. Out of 156 animals tested, sera of 30 animals are found to be reactive in ELISA which yielded a percentage of 19.23%. Out of this 25.84% was recorded in free range condition and 10.44% was recorded in semi intensive condition. The lower prevalence in semi-intensive system was due to practice of regular deworming and better system of management. However, in free range condition access to metacercarial infestation in natural grazing area of forest is very common. As a whole, a peculiar geography of north eastern hilly region and climatic conditions are mainly responsible for low prevalence of this infection in this region.

Seroprevalence of *Toxoplasma gondii* in Mithun (*Bos frontalis*) from north eastern

Mithun (*Bos frontalis*) is mostly utilized for meat purpose by the local tribal peoples of north eastern hilly region of India. Meat born diseases is very important issues for the people of this areas from the public health point of view. In order to realize the issues, the serological prevalence of Toxoplasmosis was carried out as per ELISA kit (CHEKIT* TOXOTEST, IDEXX Laboratory, USA) to find out *Toxoplasma gondii* antibody. As a whole, out of 195 animals examined, only 8 (4.10%) animals were found to be suspected and one (0.51%) animal found to be positive in this precious animal of north eastern region.

Seasonal prevalence of gastrointestinal helminth parasites of Mithun (*Bos frontalis*) in Porba

To study the seasonal prevalence of helminth parasites in the Porba farm, 22 animals, irrespective of age and sex, were screened during the period from 2012-13. With respect to *Trichostrongylus*, there was no significant difference in its prevalence between the seasons. In case of oesophagostomiasis, the recorded percentage was highest in pre-monsoon, followed by winter, whereas in haemonchosis, higher percentage was mainly noticed in post-monsoon. There was no significant occurrence of *Cooperia* in

any season of the whole year. *Toxocara vitulorum* was recorded in all other seasons except in winter. The prevalence of *Paramphistomum* was noticed in winter only whereas tapeworm infection was recorded in all the seasons except pre-monsoon season.

Seasonal prevalence of GI helminths in adult Mithun in Jharnapani (Nagaland) farm

For studying the seasonal prevalence of helminth parasites in the semi-intensive system of management, 110 animals were examined in different seasons of the year like pre-monsoon, monsoon, post-monsoon and winter. With regard to *Trichostrongylus* spp. infection, highest incidence was observed during winter and in pre-monsoon season. *Haemonchus* infection was recorded highest in monsoon, followed by pre-monsoon, winter and post-monsoon seasons. There was very low occurrence of *Cooperia* in all the seasons. Occurrence of *S. papillosus* and *T. vitulorum* was statistically significant ($P < 0.05$) in post-monsoon season. *Trichuris* spp. was observed in three seasons except in the monsoon period. *Nematodirus* spp. was recorded only in monsoon season, that too with low incidence; only one animal being positive out of 110 examined in all seasons. The occurrence of *M. expansa* was recorded to be higher in monsoon season, whereas *M. benedeni* was higher in pre-

monsoon period. Among amphistomes, very low incidence was noticed, that too in winter only.

Screening of Mithuns under semi intensive condition for various diseases with special reference to papillomatosis (warts)

A total of 565 animals were surveyed in 12 villages of Nagaland and Manipur and about 350 serum/blood samples were collected from mithun and other livestock for sero-monitoring of different diseases. In free range mithun, the prevalence of brucellosis was observed to be 16 % (56 of 350) while that of IBR was observed to be 9.33 % (33 of 350 animals). Sero-prevalence of BVD antibody was found to be 19 % (66 out of 350 animals) while that for BVD Ag was observed to be 2.66% (9 out of 350 animals) by ELISA. PCR product of about 200 bp was amplified, sequenced and analysed for its typing. BPV-1 & 2 have been identified from cases of warts in mithun, cattle and buffalo by PCR. Fibropapilloma and papilloma have been identified by HP of warts. Endophytic papilloma has been observed in mithun which is not common in cattle. Cross species transmission of BPV-2 was observed in mithun and cattle. FMD outbreaks were been recorded in five different areas in Phek, Dimapur and Kohima districts of Nagaland. All cases of FMD were confirmed by RT-PCR using OIE recommended primers amplifying about 300bp.

Pulmonary tuberculosis was diagnosed in a mithun by necropsy examination and acid fast mycobacterium tuberculosis bacteria were observed, identified and DNA extracted from the caseated lung tissues were amplified by PCR. Naval ill was diagnosed in three numbers of mithun calves and *E. coli* were cultured, isolated and identified from all the three cases.

Multiple drug resistant strains of *Enterobacter agglomerans* and *Pseudomonas aeruginosa* were isolated and identified from the eyes of swamp bufflaoes suffering with conjunctivitis. They were found to be sensitive to tetracycline, ciprofloxacin and amoxicillin but were resistant to ampicillin, gentamicin, nitrofurantoin and cephalixin.

Comparative evaluation of Humoral and Cell-mediated Immune status of Mithun (*Bos frontalis*) and Tho-Tho Cattle

A total of 40 plasma samples (n=10 for each physiological stages) were collected from Mithun under various physiological stages viz. Calf (below 1 years of age), Lactating females, adult dry females and adult males. The plasma Immunoglobulin (Ig G, IgE, IgM and IgA) concentrations of all 40 samples were estimated using ELISA kits. The Ig A (Figure. 32) and Ig M (Figure. 33) concentrations were found to differ significantly under different physiological stages while the Ig G (Figure. 34) and Ig E (Figure. 35) did not vary significantly. The assessment of humoral immune status of Tho-Tho cattle is under progress.

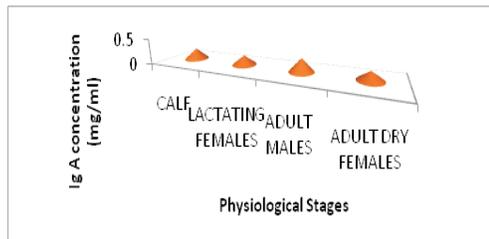


Figure. 32: IgA concentraion in mithuns

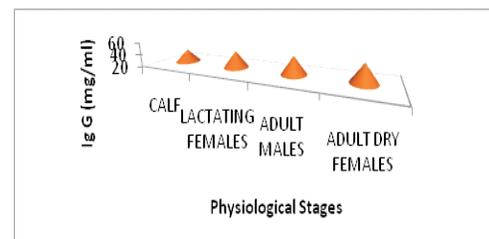


Figure. 34: IgG concentraion in mithuns

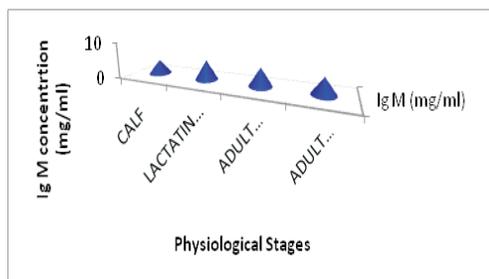


Figure. 33: IgM concentraion in mithuns

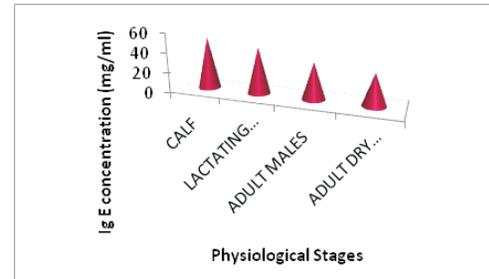


Figure. 35: IgE concentraion in mithuns

Miscellany





Indian democracy in safe and young hands

राजभाषा अनुभाग

राष्ट्रीय मिथुन अनुसंधान केन्द्र झरनापानी, मेड्जीफेमा, नागालैंड में दिनांक १० सितम्बर से १६ सितम्बर २०१३ तक किया गया। इस शुभ अवसर पर हिंदी सप्ताह का उद्घाटन समारोह डॉ. चंदन राजखोवा द्वारा दीप प्रज्वलित करके हिन्दी सप्ताह का शुभारम्भ १० सितम्बर २०१३ को सुबह ११ (ग्यारह) बजे संस्थान के सभा कक्ष में किया गया। इस समारोह में संस्थानो के सभी अधिकारी एवं

कर्मचारीगण उपस्थित थे। इस सप्ताह के दौरान संस्थान में हिंदी भाषा के प्रचार एवं प्रसार के लिए विभिन्न प्रतियोगिताओं का आयोजन किया गया। जिसमें परिसर के बालक एवं बालिकाओं के लिए भी प्रतियोगिता का आयोजन किया गया। इन सभी प्रतियोगिताओं में न सिर्फ कर्मचारी अपितु अधिकारियों ने भी उत्साह पूर्वक हिस्सा लिया।

संस्थान में हिन्दी सप्ताह के दौरान आयोजित प्रतियोगितायें

क्रम संख्या	प्रतियोगिता का नाम	आयोजन की तिथि
1.	तात्कालिक भाषण	10. 9. 2013 11. बजे सुबह
2.	पत्रलेखन, अंताक्षरी	13. 9. 2013 3 बजे शाम सुबह
3.	निबंध लेखन	16.9.2013 11 बजे सुबह
4.	पुरस्कार वितरण एवं समापन समारोह	16. 9. 2012 3 बजे शाम

इस सप्ताह का समापन समारोह दिनांक १६ सितम्बर २०१३ संस्थान के सम्मेलन कक्ष में निदेशक डॉ.चंदन राजखोवा ने उपस्थित सभी अधिकारियों एवं कर्मचारियों को राजभाषा प्रयोग की ओर विशेष रूप से प्रोत्साहित करते हुए कहा कि, हिन्दी सप्ताह के सभी कार्यक्रम हिन्दी को बढ़ावा देने के लिए आयोजित किये जाते हैं। इनसे हमें हिन्दी में अधिकाधिक कार्य करने की प्रेरणा मिलती है। हिन्दी

हमारी राष्ट्रभाषा है, अतः हम सभी को राष्ट्रभाषा का सम्मान करना चाहिए और कार्यालय एवं दैनिक कार्यों में प्रयोग करना चाहिए। इस सप्ताह के समापन समारोह में विभिन्न प्रतियोगिताओं के विजेताओं को निदेशक द्वारा पुरस्कार प्रदान किया गया। अंत में हिन्दी सप्ताह के सफल आयोजन पर सभी को बधाई दी।





गणतंत्र दिवस समारोह

राष्ट्रीय मिथुन अनुसंधान केन्द्र झरनापानी मेड्जीफेमा नागालैन्ड में दिनांक 26 जनवरी 2014 को 65वाँ गणतंत्र दिवस मनाया गया। गणतंत्र दिवस के शुभ अवसर पर संस्थान के निदेशक डॉ. चन्दन राजखोवा महोदय ने ध्वजारोहण किया एवं संस्थान के उपस्थित सभी अधिकारी एवं कर्मचारी गण को संबोधित किया। इस समारोह के दौरान संस्थान के सभी अधिकारी एवं कर्मचारी गण उपस्थित थे तथा

संस्थान परिसर के बालक बालिकाओं के लिए विभिन्न प्रतियोगिता का आयोजन किया गया, इन प्रतियोगिताओं के विजेताओं को पुरस्कार प्रदान किया गया। संस्थान के निदेशक डॉ. चन्दन राजखोवा ने देश के प्रति निष्ठापूर्ण सेवाओं द्वारा निर्धारित लक्ष्य प्राप्त करने एवं अपने देश के प्रति गौरव को बनाये रखने के लिए कार्य करने हेतु सभी अधिकारियों एवं कर्मचारियों को बधाई दी।

स्वतंत्रता दिवस समारोह

राष्ट्रीय मिथुन अनुसंधान केन्द्र झरनापानी मेड्जीफेमा नागालैन्ड में दिनांक 15 अगस्त 2013 को स्वतंत्रता दिवस मनाया गया। स्वतंत्रता दिवस के शुभ अवसर पर संस्थान के निदेशक डॉ. चन्दन राजखोवा महोदय ने ध्वजारोहण किया एवं संस्थान के उपस्थित सभी अधिकारी एवं कर्मचारी गण को संबोधित किया। इस समारोह के दौरान संस्थान के सभी अधिकारी एवं कर्मचारी गण उपस्थित थे तथा

संस्थान परिसर के बालक बालिकाओं के लिए विभिन्न प्रतियोगिता का आयोजन किया गया, इन प्रतियोगितों के विजेताओं को पुरस्कार प्रदान किया गया। संस्थान के निदेशक डॉ. चन्दन राजखोवा ने देश के प्रति निष्ठापूर्ण सेवाओं द्वारा निर्धारित लक्ष्य प्राप्त करने एवं अपने देश के प्रति गौरव को बनाये रखने के लिए कार्य करने हेतु सभी अधिकारियों एवं कर्मचारियों को बधाई दी।

LIBRARY PROFILE

Sl. No.	Particulars	Period (2013-2014)	Total
1	Books	68	1730
2	Journals		
	a) Indian	7	7
	b) International	8	8
3	Abstract CD		
	a) Agris CD	-	-
	b) Vet CD	-	-
	c) Beast CD	-	-
	d) Resource CD	-	-
	e) Medline	-	-
	f) Miscellaneous	-	-
4	Annual Report	108	1075
5	Research		
	Highlights/Compendium/Technical Bulletin	2	29
	Others Publication	95	1192
6	Thesis	00	04

The library is not a shrine for the worship of books. It is not a temple where literary incense must be burned or where one's devotion to the bound book is expressed in ritual. A library, to modify the famous metaphor of Socrates, should be the delivery room for the birth of ideas - a place where history comes to life. (Cited in *ALA Bulletin*, Oct. 1954, p.475 by Norman COUSINS).

No wonder, our Institute library in spite of

its limited scope, catering the needs of the scientists and staff alike even for visitors who coming to this Institute for various purposes by providing information of their choices to fire their ideas.

Libraries are an essential element in a process of giving users access to digital knowledge. For many people they are the only place with an access to free internet.

Most importantly, however, libraries are the places where smart and clear answers to

even most difficult questions may be expected from sheer volumes of information available.

We could procure 68 printed books in the field of Animal Genetics, Physiology, Production, Nutrition, Animal Health, Biotechnology, Bioinformatics, Intellectual Property apart from subscription of seven

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-Resource in Agriculture) - thanks to NAIP-IARI for granting this facility to this Institute.



ONGOING RESEARCH PROJECTS - INSTITUTIONAL (As on 31st March 2014)

- Application of Fluorescent In-Situ Hybridization (FISH) To Find Out The Unique Features Of Mithun Chromosomes : Dr. Anupama Mukherjee
- Development Of Economically Viable Feeding Strategy For Rearing Mithun In Intensive System Using Spent Grains From Breweries Industries: Dr. Nazrul Haque
- Comparative evaluation of humoral and cell-mediated immune response of mithun (*Bos frontalis*) and Tho tho cattle: Dr Akhilesh Kumar
- Development of Mithun based Integrated Farming System Model for Sustainability and Livelihood Security of small and marginal farmers : Dr. Meraj

- Haider Khan
- Etiopathological Study of Papillomatosis of Mithun (*Bos frontalis*) : Dr. Vidya Singh
 - Evaluation of the Draught Capability of Mithun : Dr. Kishore Kumar Baruah
 - Genome Wide Association Mapping for identification of Quantitative trait loci in mithun : Dr. Anupama Mukherjee
 - Impact of Heat Stress on Mithun Production and it's Amelioration Strategies
 - Isolation and Characterization of Botanicals from NEH region for their Anti-bacterial or Anti-methanogenic Activities : Dr. Nazrul Haque
- Studies on Ectoparasites of Mithun (*Bos frontalis*) : Dr. Jayanta Kumar Chamuah
- Mithun milk lipid: Characteristics and bioactive Properties : Dr. Vidya Singh
 - Mithun milk protein: it's characterization and bioactive properties : Dr. Vidya Singh
 - Studies on Endocrinological Profile of Mithun (*Bos frontalis*) Bulls for Enhancing Fertility : Dr. Perumal P
 - Study on the Epidemiology of Important Disease (FMD, Brucella etc.) of Mithun and their Association with Disease Resistance/Susceptibility : Dr. Vidya Singh
 - Therapeutic and Preventive Management of Gastrointestinal Helminth Parasites of Mithun (*Bos frontalis*) : Dr. Jayanta Kumar Chamuah

ONGOING RESEARCH PROJECTS - EXTERNALLY FUNDED (As on 31st March, 2014)

- Characterization and Purification of Lactoferrin from Mithun (*Bos frontalis*) milk and its antimicrobial potency on different pathogenic bacteria of mithun : Dr. K.K. Baruah
- Elucidating the Mechanism involved in higher feed efficiency of bovine species by expression of the genes regulating mitochondrial proton leak kinetics : Dr. Nazrul Haque
- Epidemiology and genetic characterization of important helminth parasites of mithun (*Bos frontalis*) in north-eastern hilly region of India : Dr. Jayanta Kumar Chamuah
- Establishment of Bioinformatics Infrastructure facility for Biology Teaching Through Bioinformatics (BIF-BTBI) under the BTISnet : Dr. K.K. Baruah
- Establishment of Institutional level Biotech Hub (IBThubs) by DBT Under Special Programme for North Eastern States of India : Dr. K.K. Baruah



- Genetic and Biodiversity Studies on Mithun: Dr Sabyasachi Mukherjee
- Identification of SNPs in Leptin Gene for Selection of Mithun (*Bos frontalis*) for Higher Growth Traits and Characterization of Leptin Protein : Dr. Sabyasachi Mukherjee
- Onset of Puberty and Induction of Estrus: Role of Kisspeptin (KiSS1) in bovine species (Mithun and Cattle) : Dr. Kishore Baruah
- Prevalence and Molecular Epidemiology of Bovine Viral Diarrhoea (BVD) in Ruminants with Reference to Mithun (*Bos frontalis*) in North East States of India : Dr. Vidya Singh

ONGOING RESEARCH PROJECTS - INTER - INSTITUTIONAL

- Transcriptome analysis through RNA-seq approach and Whole Genome Sequencing of Mithun (*Bos frontalis*) (Inter-Institutional collaborative project) : Dr Sabyasachi Mukherjee
- Veterinary Type Culture : Dr. N. Haque

PUBLICATION

Research Articles

Dr. Anupama Mukherjee

- Mukherjee Anupama, Mukherjee Sabyasachi, Sahoo Nihar Ranjan, Longkumer S, Mech Moonmoon and Rajkhowa Chandan. 2013. Characterization of leptin gene and analysis of genetic polymorphism in mithun. *Indian Journal of Animal Sciences* 83(8): 851-853.
- Mukherjee Anupama, Mukherjee Sabyasachi, Longkumer S, and Rajkhowa Chandan. 2013. Genetic parameters of growth and reproductive traits in mithun (*Bos frontalis*). *Indian Veterinary Journal* 90(8): 34-36.
- Sahoo N R, Naskar Soumen, Tamuli

MK, Mukherjee Anupama, Mukherjee Sabyasachi, and Longkumer I. 2013. Chromosomal profile of ghungroo breed of pig. *Indian Veterinary Journal* 90 (9): 77-79

Dr. K. K. Baruah

- J.K.Chamuah, P.Perumal, K.K.Baruah and D.Borkakoty (2013) Trichobezoars in Mithun Calves. *Indian Vet. J.* 90(4): 98.
- Champak Barman, Anubha Baruah, B. K. Sarmah, K. K. Baruah, B. C. Sarmah, P. Chakravorty, A. Dutta B. C. Deka, and P.Thakuria (2013) Serum Mineral Concentrations in Superovulated Mithun Cows. *Indian Vet. J.* 90(5).80-82.

- Champak Barman, Anubha Baruah, B. K. Sarmah, K. K. Baruah, B. C. Sarmah, P. Chakravorty, A. Dutta B. C. Deka, M. Mondal, C. Rajkhowa and P.Thakuria (2013) Serum Protein, Glucose and Cholesterol Concentrations in Superovulated Mithun Cows. *Indian Vet. J.* 90(6):140-141.
- Mohan Mondal, K. K. Baruah and C. Rajkhowa (2014) Mithun : An Animal of Indian Pride. *Livestock Research for Rural Development* 26 (1): 1-9 <http://www.lrrd.org/lrrd26/1/mond26006.html>.
- K. C. Das, S. S. Paul, L. Sahoo, K. K. Baruah, P. K. Subudhi, K. Ltu and C. Rajkhowa (2014) Bacterial diversity in the rumen of mithun (*Bos frontalis*) fed on mixed tree leaves and rice straw based diet. *AFRICAN Journal of Microbiology Research* DOI: 10.5897/AJMR2013.6507. Article no.: 78BFODE46929 <http://www.academicjournals.org/AJMR>.
- R. Laha, C. Rajkhowa, J.K.Chamuah and A. Goswami (2013) Gastrointestinal Parasitic Infections in Mithun in organised Farm. *Indian Journal of Hill Farming* 26(1):45-46
- J.K Chamuah, A. Sakhrie, K. Khate, K. Vupru and C.Rajkhowa (2013) "Seroprevalence of *Toxoplasma gondii* in mithun (*Bos frontalis*) from north eastern hilly region of India". *J Parasit Dis* (DOI: 10.1007/s12639-013-0396-0)
- J. K. Chamuah, P. Perumal, K. K. Baruah and D. Borkotoky (2013). Trichobezoars in Mithun calves. *Indian Vet. J.* 90(4): 98.
- J. K. Chamuah, P. Perumal and A. Mech (2013). Epidemiology and control measures of Helminth Parasites in small ruminants.. *Journal of Bioresources and Stress Management* 4(2): 278-287.

Dr. Jayanta Chamuah

- O. K. Raina, Siju Susan Jacob, M. Sankar, D. Bhattacharya, S. Bandyopadhyay, Anju Varghese, Jayanta Kumar Chamuah & H. Lalrinkima (2013). *Genetic characterization of Fasciola gigantica from different geographical regions of India by ribosomal DNA markers*. *J Parasit Dis* DOI 10.1007/s12639-013-0276-7
- Dr. Vidya Singh
- Kumar, S., Singh, B.R., Bhardwaj, M and Singh, V. (2014). Occurrence of *Bordetella* Infection in Pigs in Northern India. *International Journal of Microbiology*, Article ID 238575, 6 pages <http://dx.doi.org/10.1155/2014/238575>.
- Singh, B.R., Singh, V., Ebibeni, N and Singh, R.K. (2013). Antimicrobial and Herbal Drug Resistance in Enteric Bacteria Isolated from Faecal

Droppings of Common House Lizard/Gecko (*Hemidactylus frenatus*). *International Journal of Microbiology* Volume 2013, Article ID 340848, 8 pages <http://dx.doi.org/10.1155/2013/340848>

- Singh, B.R., Singh, R.K. and Singh, V. (2014). Microbial Quality and Safety of Axone - Akhuni, a Fermented Soybean Food of Nagaland. *Noto-are* 15185525: *Medicine*.

Dr. Perumal P

- Jayaganthan, P., Perumal, P., Balamurugan, T.C., Verma, R.P., Singh, L.P., Pattanaik, A.K., Meena Kataria. 2013. Effects of *Tinospora cordifolia* supplementation on semen quality and hormonal profile of ram. *Animal Reproduction Science* 140 (1): 47-53.
- P. Perumal, S. Das, D.N. Mohanty, A.K. Barik and P.C. Mishra. 2013. Study of certain haematological parameter in repeat breeding cows. *International Journal of Bio – Resource and Stress Management* 4(2): 242-245.
- M. Veeraselvam, R. Sridhar, M. G. Jayathangaraj, P. Perumal and N. V. Rajesh. 2013. Prevalence of endoparasitic infection in captive sloth bears. *Indian Veterinary Journal* 90 (8): 09-11.
- P. Perumal, Kezhavituo Vupru, K. Khate and J.K. Chamuah. 2013. Dystocia due to bilateral shoulder flexion in a swamp buffalo – case report. *International Journal of Livestock Research*. 3(2): 191-192.
- T.C. Balamurugan, P. Perumal, S.M.K. Thirumaran, P. Jayaganthan, S. Namagirilakshmi, P. Selvaraj, S. Jayachandran and P. Krupakaran. 2013. Embryonic stem cells and their application in buffalo production and reproduction. *Advanced Biotech*. 12 (07): 46 -48
- P. Perumal, Kezhavituo Vupru and C. Rajkhowa. 2013. Effect of addition of reduced glutathione on the liquid storage (5°C) of mithun (*Bos frontalis*) semen. *Indian Journal of Animal Science*. 83 (10): 1024 – 1028.
- P. Perumal, Kezhavituo Vupru and C. Rajkhowa. 2013. Effect of addition of taurine on the liquid storage (5°C) of mithun (*Bos frontalis*) semen. *Veterinary Medicine International*. Volume 2013, Article ID 165348, 7 pages, <http://dx.doi.org/10.1155/2013/165348>
- J. K. Chamuah, P. Perumal and A. Mech. 2013. Epidemiology and Control measures of Helminth Parasites in Small ruminants. *International Journal of Bio – Resource and Stress Management* 4(2): 278 - 287.
- Srivastava, N., Srivastava, S.K., Ghosh, S.K., Amit Kumar, Perumal, P. and

- Jerome, A. 2013. Acrosome membrane integrity and cryocapacitation are related to cholesterol content of bull spermatozoa. *Asian Pacific Journal of Animal Reproduction*. 2(2): 126-13.
- M. Veeraselvam, R. Sridhar, T. M. A. Senthilkumar, P. Perumal and M. G. Jayathangaraj. 2013. Detection of *Mycobacterium bovis* in captive sloth bears (*Melursus ursinus*) by polymerase chain reaction. *International Journal of Zoology and Research*. 3 (5): 17–20.
 - M. Veeraselvam, R. Sridhar, M. G. Jayathangaraj and P. Perumal. 2013. Behavioural study of captive sloth bears using environmental enrichment tools. *International Journal of Zoology*. Volume 2013, Article ID 526905, 6 pages, <http://dx.doi.org/10.1155/2013/526905>
 - J. S. Rajoriya, J. K. Prasad, S. K. Ghosh, P. Perumal, Anuj Kumar, Shobhana Kaushal and Mahak Singh 2013. Effects of seasons on enzymatic changes and cholesterol efflux in relation to freezability in Tharparkar bull semen. *Asian pacific journal of Reproduction*. 2 (4): 280-288.
 - M. Veeraselvam, R. Sridhar, T. M. A. Senthilkumar, P. Perumal and M. G. Jayathangaraj. 2014. Diagnosis of *Mycobacterium bovis* in captive sloth bears (*Melursus ursinus*) by polymerase chain reaction. *Proceedings of the Zoological Society*. DOI 10.1007/s12595-014-0102-y.
- Dr. Akhilesh Kumar**
- A.Kumar, S.Dey, K.Mahendran, M.Sarvanan, K.Sarma, Rajat Garg and P.S.Banerjee (2013). Concurrent Babesiosis, Monocytic and Granulocytic Ehrlichiosis in a dog. *Indian Vet.J.*, 90(7):66-68.
 - Akhilesh Kumar, S.dey and Sumit Mahajan (2013).Diagnostic potential of vertebral heart scale in dilated cardiomyopathy in dogs. *Indian J. Vet. Med.*, 33(2): 131-132.
 - Sumit Mahajan, Rajesh Agrawal, Mahesh Kumar, Anand Mohan, Akhilesh Kumar, Nishi Pande and Raj Narayan Trivedi (2013). Electron microscopy based detection of PPR virus in goat and its confirmation by sandwich ELISA and RT-PCR. (2013). *Indian J. Vet. Med.*, 33(2): 92-95.
 - S.Mahajan, A.Kumar and P.S.Maurya (2013). Therapeutic Management of *Psoroptes natalensis* infestation in a buffalo. *Intas Polivet.*, 14(II):317-318
 - S.Mahajan, K.Mahendran and A.Kumar (2013). Clinical Management of Most Eczema in a dog. *Intas Polivet.*, 14(II):403-404.
 - Sumit Mahajan, K.Mahendran, S.Dey and Akhilesh Kumar (2013). Polioencephalomalacia in a goat. *Indian J. Vet. Med.*, 33 (2) 148-149.

Book/Book Chapter published

- M.Mondal, K K Baruah and C. Rajkhowa. Editors: Hormone Immunoassays for Mithun and their Applications to Endocrinology of Growth and Reproduction (2013). NRC on Mithun (ICAR), Nagaland.
- Perumal, P. 2013. Antioxidants on mithun (*Bos frontalis*) semen preservation. *LAP Lambert Academic Publication, ISBN 978-3-659-33216-6*.
- K. J. Kantharaja and P. Perumal. 2013. Buffalo calf management on reproductive and performance of cow. Benefit effect of buffalo (*Bubalus bubalis*) calf management. *LAP Lambert Academic Publication, ISBN 978-3-659-36090-9*.
- Bhaskar Bora, Perumal, P. 2013. Therapeutic management of infertility in cattle. Combination therapy to postpartum anoestrus in dairy cows. *LAP Lambert Academic Publication, ISBN 978-3-659-41363-6*.
- M. Veeraselvam, R. Sridhar and P. Perumal 2013. Health, diseases and environmental enrichments in captive sloth bears. Enrichments in captive sloth bear (*Melursus ursinus*). *LAP Lambert Academic Publication, ISBN 978-3-659-47519-1*.
- J. S. Rajoriya, J.K. Prasad and P. Perumal. 2014. Cryopreservation of Tharparkar (*Bos indicus*) bull semen. Effect of seasons on semen production, quality and heat shock proteins of Tharparkar (*Bos indicus*) bull. *LAP Lambert Academic Publication, ISBN 978-3-659-51923-9*
- P. Perumal, T.C. Balamurugan, P. Jayaganthan, K. Karupanasamy and Gopal Krishnan. 2013. Probiotics in Animal Production. In: Probiotics in Sustainable Food Production: Current Status and Future Prospects, volume 2: Probiotics in Food Production. Editors: Dr. A. Ramanathan and Dr. T. Senthivel. Published by Bonfring, Coimbatore, Tamilnadu, India. PP: 249–258.
- K. Karupanasamy, P. Perumal, A. Gopala Krishnan and M. Saminathan. 2013. Alternatives to antibiotic growth promoters in livestock and poultry production. In: Probiotics in Sustainable Food Production: Current Status and Future Prospects, volume 2: Probiotics in Food Production. Editors: Dr. A. Ramanathan and Dr. T. Senthivel. Published by Bonfring, Coimbatore, Tamilnadu, India. PP: 269–276.
- T. C. Balamurugan, P. Jayaganthan, P. Perumal, S. Namagirilakshmi, R. Anitha, P. Selvaraj, Prakash Krupakaran and S. Jayachandran. 2013. Application of probiotics, prebiotics and synbiotics in livestock. In: Probiotics in Sustainable Food Production: Current Status and Future Prospects, volume 2: Probiotics in Food Production. Editors: Dr. A.

Ramanathan and Dr. T. Senthivel.
Published by Bonfring, Coimbatore,
Tamilnadu, India. PP: 284 – 289.

Training Manual / Bulletin / Folder / Technical Article published

- M Mondal,, KK Baruah, C Rajkhowa and BS Prakash. 2013. Development of Hormone Immunoassays and their Applications in Reproductive Endocrinology of Mithun).
- V.Singh, A.Kumar and J.K.Chamuah, K.K.Baruah, N.Haque, Aupama Mukherjee, S. Mukherjee, M.H.Khan and P.Perumal (2013). Manual of Basic Principles of PCR and Its Application in Research; National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- V.Singh, A.Kumar, J.K.Chamuah, K.K.Baruah, N.Haque, Aupama Mukherjee, S.Mukherjee, M.H.Khan and P.Perumal (2014). Recent Advances in Mithun Management with special Reference to Disease Diagnosis. National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- A.Kumar, R.K.Singh, Vidya Singh and M.H.Khan, 2013. Manual of Basic Aspects of First Aid, Treatment and Vaccination; National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- A.Kumar,V.Singh, R.K.Singh,N.Haque and K.K.Baruah, 2013. Manual of Therapeutic Interventions and Scientific Mithun Rearing Practices; National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- Sabyasachi Mukherjee, Anupama Mukhere, Nazrul Haque, Kishore Baruah, Jayanta Chamuah, Perumal P, Akhilesh Kumar and Chandan Rajkhowa (2014). The saga of my 25 years of journey-an Autobiography. Souvenir on Interface & Mithun festival, 2014. Published by the Director, National Research Centre Mithun, Jharnapani, Medziphema, Nagaland, 1p.
- A.Kumar, V.Singh, K.K. Baruah, N.Haque, R.K.Singh and K.Khate, 2014. Common Zootic Diseases of Mithun. National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- Kumar, A., Haque, N., Baruah, K. K., Khate, K. and Changkire Imyarila (2013). Colostrum feeding to newborn calf: Myths, Ignorance and Advantages In: Basic Aspects of First Aid, Treatment and Vaccination. National Research Centre on Mithun, Jharnapani, Medziphema, Nagaland, p.49-50.
- Kumar, A., Khate, K., Haque, N.,



Baruah, K. K. and Singh R. K. (2013). Method of identification for mithun. In: Basic Aspects of First Aid, Treatment and Vaccination. National Research Centre on Mithun, Jharnapani, Medziphema, Nagaland, p 51-53.

- Singh, V., Kumar, A. and Chamuah, J. K., Baruah, K. K., Haque, N., Mukherjee, Aupama, Mukherjee, S., Khan, M. H. and Perumal P. (2013). Manual of Basic Principles of PCR and Its Application in Research; National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- Kumar, A., Singh, V., Singh, R. K., Haque, N. and Baruah, K. K. (2013). Manual of Therapeutic Interventions and Scientific Mithun Rearing Practices; National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.
- Singh, V., Kumar, A., Chamuah, J. K., Baruah, K. K., Haque, N., Mukherjee, Aupama, Mukherjee, S., Khan, M. H. and Perumal, P. (2014). Recent Advances in Mithun Management with Special Reference to Disease Diagnosis. National Research Centre on Mithun, Indian Council of Agricultural Research, Jharnapani, Medziphema – 797 106, Nagaland.

Training/ Refresher Course/ summer / Winter Institutes/ Seminars/ Conferences/

Symposia/ Workshop attended, Poster/Abstract presented, Life Membership obtained

Dr. K. K. Baruah

- Participated 3rd Review meeting of Biotech Hub held on 24th and 25th June, 2013 at Agartala.
- Participated and presented paper at First International and Third National Conference on Biotechnology, Bioinformatics and Bioengineering held on June 28-29, 2013, at Tirupati.
- Participated in the Annual Review Meeting of ITMU and Agri Business meeting held at NIRZAFT, Kolkata on 26th and 27th September, 2013.
- Attended 6th Interactive meeting for North East Bioinformatics Centre held on 11th and 12th October, 2013 at Silchar.
- Participated in the SAPI Conference held at Mathura from 19th to 22nd November, 2013.
- Attended the National Seminar cum NAVS Convention held at Hisar from 28th to 29th Jan-2014.
- Participated in the 25th Annual BITSet coordinators meeting held at Goa from 27th to 28th February, 2014.

Dr. Nazrul Haque

- Haque, N., Das, K. C., Toppo Saroj, Mondal, M., Prasad, N. and Baruah, K. K. (2014). Energy utilization pattern in

- mithun fed on Congo Signal grass based diet supplemented with spent grain with wheat bran or rice bran. Proceedings National Seminar on “Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050”, held on January 23-25, 2014, held at Medziphema, Nagaland, organized by Indian Association of Hill Farming in collaboration with ICAR Research Complex for NEH Region, Nagaland Centre, Nagaland, Abstract No. TSO17, Pp. 195.
- N. Haque, K. C. Das, Saroj Toppo, M. Mondal, N. Prasad and K. K. Baruah (2014). Energy utilization in mithun fed on spent grain based feed block. Proceedings National Seminar on “Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050”, held on January 23-25, 2014, held at Medziphema, Nagaland, organized by Indian Association of Hill Farming in collaboration with ICAR Research Complex for NEH Region, Nagaland Centre, Nagaland, Abstract No. TSP11, Pp. 200.
 - Lassiter, K., Kong, B.-W., Piekarski, A., Dridi, S., Haque, N. And Bottje, W. (2013). Overexpression of AMPKa1 and HSP70 and effects on cell bioenergetics in response to 4-hydroxy 2-nonenal (4-HNE) in quail muscle (QM7) cells. Presented in the 20th Annual Meeting of the Society for Free Radical Biology and Medicine, held in November 20-24, 2013 in San Antonio, Texas.
- ### Dr. Anupama Mukherjee
- Anupama Mukherjee, S. Mukherjee, , Imsosoang Longkumer, Moonmoon Mech, A. O. Adebambo and David Kiwi. 2014. Molecular cytogenetic tools in conservation and improvement of mithun (*Bos frontalis*). In: National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050. ICAR Res. Complex for NEH Region, Nagaland, January 23-25, 2014, pp.196.
 - Anupama Mukherjee, Sabyasachi Mukherjee, I. Longkumer and Moonmoon Mech, 2014. Cytogenetic Profile of Indian Gaur (*Bos gaurus*). International Conference on “Frontier Discoveries and Emerging Opportunities in Life Sciences organized by School of Biological Sciences, Dr. Hari Singh Gour University Sagar, M.P. from 13-15th Feb. 2014.
 - Anupama Mukherjee and Sabyasachi Mukherjee 2013. Veterinary Cytogenetics: Perspective and Commerce with special reference to Mithun. Invited Lecture. In: Agri Business & Market Intelligence. Summer School, Nagaland University, SASRD, Medziphema, Nagaland, 6-26 September 2013.
 - Anupama Mukherjee and Sabyasachi Mukherjee 2014. Cytogenetic Architecture of Mithun and its related ancestral species. Invited lecture in:

Brain Storming Session on "Chromosomal Aberration and Infertility", NDRI, Karnal, 15 January, 2014.

Dr. Sabyasachi Mukherjee

- Sabyasachi Mukherjee and Anupama Mukherjee. 2013. Animal Production System for feeding billions in the back drop of climate change with special reference to mithun. Invited Lecture. In: Agri Business & Market Intelligence. Summer School, Nagaland Univeristy, SASRD, Medziphema, Nagaland, 6-26 September 2013.
- Sabyasachi Mukherjee, Anupama Mukherjee and Rajkhowa C.2013. Whole genome sequencing and *de novo* assembly of Mithun. Invited lecture. In: SciGenom Conferences 2013 NextGen Genomics & Bioinformatics Technologies (NGBT) Conference, IGIB (CSIR), New Delhi, 14-16 Nov 2013, pp. 43.
- Sabyasachi Mukherjee, Anupama Mukherjee, Imsosoang Longkumer, Moonmoon Mech, Sanjeev Kumar and Rajkhowa C. 2014. Genetic diversity analysis of Indian mithun (*Bos frontalis*) and wild gaur (*Bos gaurus*) using cattle microsatellite markers. Oral presentation. In: The International Conference on Biodiversity, Bio-resources and Biotechnology. The Association for the Advancement of Biodiversity Science

and Society for Applied Biotechnology, Mysore, 30-31 January, 2014,.pp.26.

Dr. Jayanta Chamuah

- National Symposium on "One Health: Harnessing Biotechnology for Addressing Veterinary and Biomedical Concerns on Food Safety, Zoonoses and Environmental Sustainability" on 4th & 5th February, 2014 organised by Department of Veterinary Public Health, College of Veterinary Science, Assam Agricultural University.
- Seasonal prevalence of gastrointestinal helminth parasites of Mithun (*Bos frontalis*) in Porba. J.K.Chamuah, A. Sakhrie, D. Borkotoky, P. Perumal and C. Rajkhowa : In the proceedings national seminar on; " Emerging challenges and Prospective strategies for hill agriculture in 2050" organized by ICAR Research complex for NEH region, Nagaland Centre, Jharnapani from January 23-15, 2014.
- Immature amphistomosis of mithun-A case report. J.K Chamuah, A. Sakhrie, K.Khate, D. Borkotoky, V.Singh and A. Kumar. In the proceedings national seminar on; "Advances and Applications of Diagnostic Pathology for Disease Management in Livestock, Poultry, Pet, fish Laboratory Animal and Wildlife" from 21st to 23rd Nov 2013 organised by Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry,

OUAT, Bhubaneswar-751003.

- Comparative study of occurrence of gastrointestinal parasites in Tho-Tho and Cross bred cattle's of Nagaland. J.K. Chamuah, A. Sakhrie, D. Borkotoky, and N. Ebibeni. In the proceedings national seminar on; "Advances and Applications of Diagnostic Pathology for Disease Management in Livestock, Poultry, Pet, fish Laboratory Animal and Wildlife" from 21st to 23rd Nov 2013 organised by Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar-751003.
- Prevalence of gastrointestinal helminth parasites of Naga indigenous pigs in Phek district of Nagaland. D. Borkotoky, J.K Chamuah, A. Sakhrie, N.Ebibeni and K.Khate. In the proceedings national seminar on; "Advances and Applications of Diagnostic Pathology for Disease Management in Livestock, Poultry, Pet, fish Laboratory Animal and Wildlife" from 21st to 23rd Nov 2013 organised by Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar-751003.

Dr. Vidya Singh

- Attended National Seminar on "Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050" organized by Indian Association of Hill

Farming and ICAR RC NEHR, Nagaland Centre, from 23-25th Jan 2014.

- Participated in 1st International Horti Expo held at C.V.Sc. Khanapara, Guwahati, Assam from 8-11 Jan 2014.
- Attended a three day training programme on 'Application of Bioinformatics Tools in Biological Sciences' organized by the BIF, C.V.Sc, Khanapara, Guwahati-22 from January 8-10, 2014.

Dr. Perumal P.

- P. Perumal, K. Vupru, K. Khate, and C. Rajkhowa. 2013. Effect of addition of taurine on the liquid storage (5°C) of mithun (*Bos frontalis*) semen. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
- P. Perumal, K. Vupru, K. Khate, and C. Rajkhowa. 2013. Effect of addition of Pomegranate (*Punica granatum*) juice on the liquid storage (5°C) of mithun (*Bos frontalis*) semen. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to



- Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
- P. Jayaganthan, P.Perumal, T.C. Balamurugan, R.P. Verma, L.P. Singh, A.K. Pattanaik, Meena Kataria. 2013. Effects of *Tinospora cordifolia* supplementation on semen quality and hormonal profile in rams. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
 - Bhaskar Bora, K. K. Baruah, N. Savino, A. Dhali, M. Mondal, A. Mukherjee, C. Rajkhowa and P. Perumal. 2013. Effects of different concentration of glycerol and method of addition on apoptosis in fresh and cryopreserved mithun (*Bos frontalis*) semen. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
 - Bhaskar Bora, P. Perumal, K. K. Bonia, M. H. Khan and R. K. Biswas. 2013. Effect of non-hormonal treatments on postpartum true anoestrus crossbred dairy cows. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
 - T. C. Balamurugan, Gopal Puri, Ravi Ranjan, P. Perumal, Sadhan Bag, B.C. Das and A. C. Majumdar. 2013. Immunological and molecular characterization of buffalo embryonic stem cells. 22nd Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
 - T. C. Balamurugan, Gopal Puri, Ravi Ranjan, P. Perumal, Sadhan Bag, B.C. Das and A. C. Majumdar. 2013. Evolving a totipotent stem cell marker. 22nd Annual Conference of Society of Animal Physiologists of India and

- National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19- 21, 2013, UP Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansathan, Mathura.
- N. Srivastava, S. K. Srivastava, S. K. Ghosh, A. Kumar, A. Jerome and P. Perumal. 2013. Sequestration of PDC-109 by specific antibodies improves freezability of bull spermatozoa. Bovine Medicine ID: 107, Poster No - 083, PP. 107, World Veterinary Congress -2013, Prague, Checkslovakia from November 17-20, 2013.
 - P. Perumal, K. Vupru, K. Khate and C. Rajkhowa. 2014. Effect of superoxide dismutase on the liquid storage (5°C) of mithun (*Bos frontalis*) semen. 29th Annual Convention of the Indian Society for Study of Animal Reproduction and National Symposium on Frontier Reproductive Biotechnologies for Enhanced Animal Fertility and Fecundity: Global Perspective from January 08 -10, 2014, Nagpur Veterinary College, Maharashtra Animal & Fishery Sciences University, Nagpur, (M.S.).
 - P. Perumal, K. Vupru, K. Khate, and C. Rajkhowa. 2014. Pelvimetry in swamp buffalo cows of Nagaland. 29th Annual Convention of the Indian Society for Study of Animal Reproduction and National Symposium on Frontier Reproductive Biotechnologies for Enhanced Animal Fertility and Fecundity: Global Perspective from January 08 -10, 2014, Nagpur Veterinary College, Maharashtra Animal & Fishery Sciences University, Nagpur, (M.S.).
 - Bhaskar Bora, P. Perumal, K. K. Bonia and R. K. Biswas. 2014. Effect of Stenot on postpartum true anoestrus crossbred dairy cows. 29th Annual Convention of the Indian Society for Study of Animal Reproduction and National Symposium on Frontier Reproductive Biotechnologies for Enhanced Animal Fertility and Fecundity: Global Perspective from January 08 -10, 2014, Nagpur Veterinary College, Maharashtra Animal & Fishery Sciences University, Nagpur, (M.S.).
 - P. Perumal, J. K. Chamuah, K. Vupru and C. Rajkhowa. 2014. Scrotal circumference and its relationship with testicular growth, age and body weight in Tho Tho (*Bos indicus*) bulls. National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 January 20 -22, 2014, ICAR Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland.
 - P. Perumal, K. Vupru, K. Khate and C. Rajkhowa. 2014. Effect of addition of melatonin on the liquid storage (5°C) of mithun (*Bos frontalis*) semen.

- International conference on Reproductive Health: Issues and Strategies under Changing Climate Scenario and 24th Annual meeting of ISSRF from February 6-8, 2014, at Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India.
- Bhaskar Bora, K. K. Baruah, N. Savino, A. Mukharjee, C. Rajkhowa and P. Perumal. 2014. A study on the effect of cryopreservation on apoptosis of mithun (*Bos frontalis*) bull spermatozoa. National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 January 20 -22, 2014, ICAR Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland.
 - D. Borkotoky, P. Perumal, R.K. Singh and C. Rajkhowa. 2014. Morphometric attributes of Naga local pigs. National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 January 20 -22, 2014, ICAR Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland.
 - J.K. Chamuah, A. Sakhire, D. Borkotoky, P. Perumal and C. Rajkhowa. 2014. Seasonal prevalence of gastrointestinal helminth parasites of mithun (*Bos frontalis*) in Porba. National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 January 20 -22, 2014, ICAR Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland.
 - V. Ramakrishnan, Suresh Kumar, C. Manivannan C. Suresh, M. Veeraselvam, S. Rajathi, M. Sundaravinayaki, P. Perumal, and Gajanan M Chigure. 2014. Ethno veterinary practices of small ruminant livestock farmers in Melur taluk of Madurai district, Tamil Nadu. National Seminar & Annual Conference on Sheep and goat biodiversity and breeding policies - issues and perspective in Krantisinh Nana Patil College of Veterinary Science, Shirwal (Satara), Maharashtra Animal & Fishery Sciences University, Nagpur, Maharashtra from February 21 to 22, 2014.
 - M. Veeraselvam, V. Ramakrishnan and P. Perumal. 2014. Effect of oestrus synchronization of goats with progesterone vaginal sponges and prostaglandin. National Seminar & Annual Conference on Sheep and goat biodiversity and breeding policies - issues and perspective in Krantisinh Nana Patil College of Veterinary Science, Shirwal (Satara), Maharashtra Animal & Fishery Sciences University, Nagpur, Maharashtra from February 21 to 22, 2014.
 - V. Ramakrishnan, Gajanan M Chigure, C. Suresh, M. Prabhu, P. Perumal, M. Veeraselvam and V. Sujatha. 2014. Effects of indigenous papaya-plant against gastrointestinal nematodes in sheep. National Seminar & Annual

- Conference on Sheep and goat biodiversity and breeding policies - issues and perspective in Krantisinh Nana Patil College of Veterinary Science, Shirwal (Satara), Maharashtra Animal & Fishery Sciences University, Nagpur, Maharashtra from February 21 to 22, 2014.
- National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 from January 23 – 25, 2014 in ICAR Complex for NEH Region, Nagaland Centre, Jharnapani.
 - 24th Annual Meeting of Indian Society for Study of Reproduction and Fertility (ISSRF) and International Conference on Reproductive Health: Issues and Strategies under Changing Climate Scenario from February 6-8, 2014 in Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh.
 - 1st Mithun (*Bos frontalis*) festival, Lairam Phungka Village, Manipur from 27th – 28th February, 2014 organised by North Eastern Border Area Development Organization (NEBADO), Manipur and Lairam Phungka Village Mithun Farmers.
 - Life member of International Society of Biometeorology (ISB/2013), USA.
 - Life member of Livestock Emission and Abatement Research Network (LEARN/2013).
 - Short course training on from 17/07/13 to 24/07/13 (8 days) at Department of Animal Reproduction, Gynaecology and Obstetrics, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa.
 - ICAR sponsored winter school on Climate change and Abiotic stress management in livestock: Basic concepts and amelioration measures from 05/11/13 to 25/11/13 (21 days) at National Institute of Animal Nutrition and Physiology (NIANP), Bangalore.

Dr. Akhilesh Kumar

- Attended 3 days training on "Application of Bioinformatics Tools in Biological Sciences" conducted at Bioinformatics Infrastructure Facility, College of Veterinary Science, Khanapara, Guwahati 22 from 8th to 10th January 2014.
- Attended 3 days National Seminar on "Emerging challenges and Prospective Strategies for Hill Agriculture in 2050" organized by Indian Association of Hill Farming and ICAR Research Complex for NEH Region, Nagaland Center, Jharnapani, Medziphema, from 23rd to 25th January, 2014.
- Attended a 3 days XXXII Annual Convention of ISVM & International Symposium on "The 21st Century Road Map for Veterinary Practices, Education & Research in India & Developing Countries" organized by SKAUST (J) at R. S. Pura, Jammu from 14 to 16th Feb, 2013.



- J.K Chamuah, A. Sakhrie, K.Khate, D. Borkotoky, V.Singh and A. Kumar (2013). Immature amphistomosis of mithun-A case report. In the proceedings national seminar on; "Advances and Applications of Diagnostic Pathology for Disease Management in Livestock, Poultry, Pet, fish Laboratory Animal and Wildlife" from 21st to 23rd Nov 2013 organised by Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar-751003.
- Akhilesh Kumar, S.Dey, Sumit Mahajan, K.Mahendran, Brijesh kumar and Abhishek Chandra Saxena (2014). Clinico-epidemiological and electrocardiographic study of canine cardiac diseases. In: "XXXII Annual Convention of Indian Society For Veterinary Medicine & International Symposium on 2st Century Road Map for Veterinary Practice, Education and Research in Indian and Developing countries" held at Sher-e-Kashmir University of Agricultural Sciences& Technology of Jammu, R.S.Pura, Jammu (J&K), Indian on 14-16 February, 2014.
- A.Kumar, S.Dey, K.Mahendran, A.Dan, S.Mahajan and A.C.Saxena (2014). Evaluation of different cardiac biomarkers in diagnosis of dilated cardiomyopathy in canine (Poster). In: "XXXII Annual Convention of Indian Society For Veterinary Medicine & International Symposium on 2st Century Road Map for Veterinary Practice, Education and Research in Indian and Developing countries" held at Sher-e-Kashmir University of Agricultural Sciences& Technology of Jammu, R.S.Pura, Jammu (J&K), Indian on 14-16 February, 2014.
- International Symposium on 2st Century Road Map for Veterinary Practice, Education and Research in Indian and Developing countries" held at Sher-e-Kashmir University of Agricultural Sciences& Technology of Jammu, R.S.Pura, Jammu (J&K), Indian on 14-16 February, 2014.
- A.Kumar, S.Dey, S.Mahajan, K.Mahendran and A.Dan, (2014). Clinical propaedeutics of cardiovascular disorders in canine (Poster). In: "XXXII Annual Convention of Indian Society For Veterinary Medicine & International Symposium on 2st Century Road Map for Veterinary Practice, Education and Research in Indian and Developing countries" held at Sher-e-Kashmir University of Agricultural Sciences& Technology of Jammu, R.S.Pura, Jammu (J&K), Indian on 14-16 February, 2014.
- S.Mahajan, K.Mahendran, A.Kumar and S.Dey (2014). Staphylococcal associated infection in dog and its management. In: "XXXII Annual Convention of Indian Society For Veterinary Medicine & International Symposium on 2st Century Road Map for Veterinary Practice, Education and Research in Indian and Developing countries" held at Sher-e-Kashmir University of Agricultural Sciences& Technology of Jammu, R.S.Pura, Jammu (J&K), Indian on 14-16 February, 2014.

HONOURS/AWARDS/INTERNATIONAL ASSIGNMENT



Dr. C. Rajkhowa, Director received Fellow of Society of National Academy of Veterinary Science from Shri Bhupinder Singh Hooda, Chief Minister of Haryana at National Seminar cum NAVS Convention held at Hisar from 28 - 29 January, 2014

- Dr. K. K. Baruah : Received Award in Excellence in Animal Biotechnology from Dr. Devarajan Thangadurai, President of Society of Applied Biotechnology at First International and Third National Conference on Biotechnology, Bioinformatics and Bioengineering held on June 28-29, 2013, at Tirupati.
- Dr. K. K. Baruah : Received Fellow of Society of National Academy of Veterinary Science from Shri Bhupinder Singh Hooda, Chief Minister of Haryana at National Seminar cum NAVS Convention held at Hisar from 28 to 29 January, 2014
- Dr Nazrul Haque: Best Oral Presentation Award from Indian



Association of Hill Farming on presentation of the paper “Haque, N., Das, K. C., Toppo Saroj, Mondal, M., Prasad, N. and Baruah, K. K. (2014). Energy utilization pattern in mithun fed on Congo Signal grass based diet supplemented with spent grain with wheat bran or rice bran.” In National Seminar on “Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050”, held on January 23-25, 2014 at ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland.

- Dr Nazrul Haque: Visited University of Arkansas, Fayetteville, USA availing DBT's Overseas Associateship for Northeastern Region from 1st May to 27 October, 2013. He worked with Prof. Walter Bottje of the Center of Excellence for Poultry Science on assessment of bioenergetics in hsp70 and ampktransfected as well as heat stressed quail myocytes



- Dr. Perumal P: Received Certificate of Excellence in Reviewing by International Journal of Livestock Research (ISSN 2230-7613) for the year 2013.

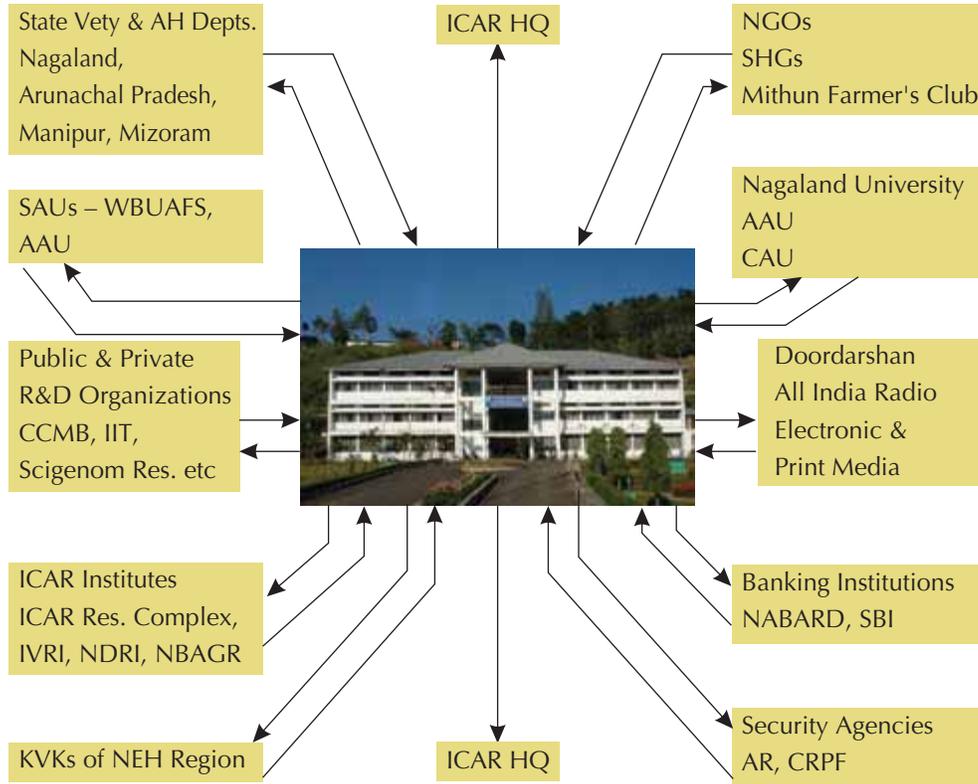


- Sh. TH. Dipal Meitei Appointed as the Nodal Officer as well as the department user for NRC on Mithun under the Implementation of e-publishing of tender through Central Public Procurement Portal (CPPP).



- As per the instruction of council vide letter No.12(01)/2012-CDN(A&A) dated. 24.01.2014 NRC on MITHUN has registered for the first time with the Central Public Procurement Portal(CPPP) and adopted the Mandatory e-publications of tender enquiries for the procurement of various instruments/goods etc of the main scheme and external funded projects through the Central Public Procurement Portal(CPPP) <http://eprocure.gov.in> . As per the instructions laid down by the Ministry of Finance, Govt of India this institute has already created the nodal officer to oversee the process of the E-publishing on 03.02.2014. The departmental user for the execution of the entire e-publication system through the Central Public Procurement Portal has also been created. So far this institute has successfully e-published four numbers of tender enquiries in the portal.

LINKAGES AND COLLABORATION



ACTIVITIES UNDERTAKEN FOR SOCIO-ECONOMIC DEVELOPMENT OF MITHUN REARERS AND FARMERS OF NORTH EAST HILL REGION

Trainings/Technology Injection Programmes/Extension Activities organized under TSP

Sl. No.	Place of Activity/Training	Date	Activities	Name of Scientists involved
1	NRC on Mithun, Jharnapani	2-4 April, 2013	Training on Basic principles of Bioinformatics and its Application in Biological Sciences	Dr. K.K. Baruah, Dr. N. Haque, Dr. Vidya Singh, Dr. Anupama Mukherjee, Dr. Sabyasachi Mukherjee, Dr. J.K. Chamuah, Dr. P. Perumal.
2	NRC on Mithun, Jharnapani	5.04.13	Hands on Training on Diagnosis of Brucellosis in Mithun and other livestock	-Do-

3	Mani village, Papumpare, Arunachal Pradesh	23.09.13	TSP	Dr. C. Rajkhowa Dr. Sabyasachi Mukherjee Dr. M.H. Khan Dr. J.K. Chamuah
4	NRC on Mithun, Jharnapani	23.09.13	Farmers training programme under TSP	Dr. Anupama Mukherjee, Dr. Kobu Khate, Dr. Akhilesh Kumar.
5	Mezoma, Kohima	30.09.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. Vidya Singh Dr. Kobu Khate
6	Enhulumi, Phek	19.10.13	Farmers Training and Input Distribution under TSP programme	Dr. Vidya Singh Dr. D. Borkotoky
7	Maova, Dimapur	23.10.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. Vidya Singh
8	Pholami, Phek	26.10.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. Vidya Singh Dr. D. Borkotoky
9	Visema , Kohima	18.11.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. Sabyasachi Mukherjee Dr. M.H. Khan Dr. J.K. Chamuah Dr. Kobu Khate
10	Jotsoma, Kohima	20.11.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. M.H. Khan Dr. Kobu Khate
11	Kidima, Kohima	22.11.13	Farmers Training and Input Distribution under TSP programme	Dr. Vidya Singh Dr. Sabyasachi Mukherjee
12	Dzulekema, Kohima	23.11.13	Farmers Training and Input Distribution under TSP programme	Dr. Akhilesh Kumar Dr. J.K. Chamuah Dr. Kobu Khate
13	NRC on Mithun, Jharnapani	15-17 November, 2013	Training Programme on Basic Principles of PCR and its Application in Research for Educated Youth (under Tribal Sub Plan)	Dr. Akhilesh Kumar Dr. Vidya Singh Dr. K.K. Baruah Dr. N. Haque Dr.Sabyasachi Mukherjee Miss. M. Mech
14	NRC on Mithun, Jharnapani	27-29 November, 2013	Training on Basic Aspects of First Aid, Treatment and Vaccination for rural youth and veterinary field assistants	Dr. Vidya Singh Dr. Akhilesh Kumar Dr. K.K. Baruah Dr. N. Haque Dr. S. Mukherjee Dr. Anupama Mukherjee Dr. J.K. Chamuah Dr. P. Perumal Dr. M.H. Khan Dr. R.K. Singh

15	NRC on Mithun, Jharnapani	3-6 December, 2013	Therapeutic Interventions and Scientific Mithun Rearing Practices for paraveterin arian of different District of Nagaland	Dr. Akhilesh Kumar Dr. Vidya Singh Dr. K.K. Baruah Dr. N. Haque Dr. R.K. Singh
16	Porba, Phek	17.12.13	TSP	Dr. P. Perumal Dr. J.K. Chamuah Dr. D. Borkotoky
17	Losami, Phek	18.12.13	TSP	Dr. Perumal Dr. J.K. Chamuah Dr. D. Borkotoky
18	Meluri, Phek	21.12.13	105 Farmers	Dr. Vidya Singh Dr. Akhilesh Kumar Dr. D. Borkotoky Dr. R.K. Singh
19	Lairam Phungka Village, Manipur	28.02.14	TSP during 1st Mithun Festival of Manipur	Dr. Sabyasachi Mukherjee Dr, P. Perumal
20	NRC on Mithun, Jharnapani	14-17 February, 2014	Hands on training for Basic Principles of PCR and its Application in Biological Research	Dr. Vidya Singh Dr. Akhilesh Kumar
21	NRC on Mithun, Jharnapani	18-20 February, 2014	Hands on Training for state veterinary officials on	Dr. Vidya Singh Dr. Akhilesh Kumar



Mithun health camp, Mani village, Arunachal Pradesh



Medicine and other inputs distribution in Porba village, Nagaland



Mithun farmers from Manipur getting training in Mithun Husbandry under TSP



TSP programme at Lossami village, Nagaland



1st Mithun Festival and Mithun Health Camp, Lairam Phungka Village, Ukhrul, Manipur



Training Programme on 'Basic Principles of PCR and Its Application in Research for Educated Rural Youth under TSP

ACTIVITIES OF KVK

1. Training organized from 1 st April 2013 -31st March 2014.

Subject	Practicing farmers		Extension Personal		Rural Youth		Sponsored		Total	
	Cours- es	Particip- ants	Cours- es	Participa- nts	Cours- es	Participa- nts	Cour- ses	Partici- pants	Cou- rses	Partici- pants
Agronomy	11	239	2	39	5	99	2	141	20	518
Soil Science	12	251	1	8	2	28	3	55	18	342
Plant Protection	12	283	1	13	1	15	0	0	13	311
Horticulture	6	104	1	15	4	117	0	0	12	226
Animal sc	5	126	0	0	4	94	0	0	9	220
Total	46	1003	5	75	16	353	5	196	72	1617

2. On farm Trails from 1st April 2013-31st March 2014.

S. No.	Area	Title of the OFT	No. of Trials	Farmers covered
1.	Agronomy	Comparison of SRI var., SARS6 with conventional practice of paddy cultivation	5	5
2.		Performance of upland jhum paddy var., SARS 1 and SARS	15	15
3.		Trial on different dates of sowing in lentil var., DPL 62	5	5
4.	Soil Science	Effect of liming in maize	4	4
5.		Effect of biofertilizer in French bean	4	4
6.	Plant Protection	Evaluation of Fungicides Carbendazim and Copper Oxychloride against Anthracnose disease management in beans.	3	3
7.		Effect of <i>Bacillus thuringensis</i> @ 1g/ltr water and neem oil@5ml/ltr water against cabbage butterfly	3	3
8.	Horticulture	Performance of French bean var. Sel-9 and Pant Anupama at different dates of sowing. Date of sowing 1 week of April (10 days interval)	3	3
9.		Performance of Radish var. Japanese White and Pusa Chetki under Pfitsero condition.	3	3
10.	Animal Science	Creep feeding of preweaned piglets to boost weight gain and reduce preweaning mortality	4	4
11.		Chemical castration of pigs	4	6
Total			53	55

3. Frontline demonstration Activities from 1st April 2013-31st March 2014.

Subject	Title of demonstration	No. of Demonstration	Farmers covered	No. of activities	Participants
Agronomy	Performance of Maize var., Ayush 1011	15	15	Field days	10
	Performance of Maize var., HQPM 1	15	15	Farmers Training	62
Soil Science	Effect of Vermicompost in groundnut	4	4	Training, Method demonstration, Field day	51
	Biofertilizer application in potato	4	65	Training, method demonstration, Field day	151
	Biofertilizer application in potato (On going)	4	25	Training cum demonstration	15
	Land degradation management (On going)	3	3	Training cum demonstration	11

Plant Protection	Popularisation of Trichocards (<i>Trichogramma japonicum</i>) for stem borer management in paddy@50000 egg parasitoids/ha.	2	20	Training ,Method demonstration,Field day.	22
	Biofor-PF-2 against soft rot management in ginger @1kg/10kg rhizome	1	2	Training ,Method demonstration,Field day.	25
Horticulture	Performance of Cabbage var. Rareball under Pftusero condition	5	5	Field days	15
	Performance of King Chilli under low cost polyhouse under Pftusero condition	3	3	Farmers Training	15
	Popularisation of Oyster Mushroom	3	3	Demonstration	41
Animal Science	Iron supplementation to prevent piglet anaemia (indc: piglet survivality, growth rate and coat condition)	4	4	Demonstration	21
	Management of coccidiosis in 6 rabbits by following preventive anti coccidial medication (indc: Incidence of diarrhoea, mortality rate)		6	Demonstration	30
Total		69	170		469

4. Other extension Activities.

Sl. No	Activities	No.	Participants		Total
			Male	Female	
1.	Field Days	10	253	281	534
2.	Kisan Mela/Mithun Festival	1	2200	1800	4000
3.	Diagnostic visit	51	83	67	150
4.	Scientist visit to farmer's field	63	85	111	196
5.	Farmers visit to KVK	63	-	-	63
6.	Method demonstration	13	106	151	257
7.	News paper coverage	23	-	-	-
8.	Folder	3	-	-	-
9.	Mobile advisory service	48	-	-	550
10.	Celebration of important day	2	36	75	111
11.	Exhibition	2	2281	1825	4106
12.	Advisory /helpline service	10	43	44	87
13.	Radio Talk	6	-	-	-
14.	Lecture delivered	19	258	363	621
15.	Publication	12	-	-	-
16.	Animal Health Camp	4	142	3	145
	Total	330	5487	4720	6820

5. Workshop /Seminar Organised

Title	Male	Female	Total	Sponsoring agency
Awareness cum training on protection of plant varieties and farmers rights	81	25	106	Protection of plant varieties and farmers rights, New Delhi Govt. of India
Outreach extension programme for improved management of domesticated Mithun	8	27	35	CAUPHT, Ranipool, Gangtok
Farmers Scientist Interaction	0	62	62	ATMA Phek
Farmers Scientist Interaction	21	35	56	ATMA Phek

6. SAC: One on 5th September 2013

7. Results of On Farm Trails

A. Comparison of SRI var., SARS - 6 with conventional practice of paddy cultivation

OFT on comparison of SRI with conventional practice of paddy cultivation using variety SARS 6 was conducted under 5 different pockets of Phek district. As there is low yield under conventional practice and SRI technology promises better yield so this technology was tested. SRI has the potential to filling up the gap of low yield and also under this technology seed requirement is less and provides better water use efficiency under water stress conditions. The average plant height (cm), no. of leaves, no. of effective tillers, grains/panicle, yield (kg/ha) and test weight (gm) was found to be 69.18, 39.17, 27.80, 107.80, 4260 and 34.66 respectively. However in check the average plant height (cm), no. of leaves, no. of effective tillers, grains/panicle, yield (kg/ha), test weight (gm) was 73.00, 37.20, 17.80, 96.80, 3593 and 30.00. Cost benefit ratio was 4.1 in SRI while in conventional practice it was 3.5. Result clearly demonstrates the superiority

of the SRI technology of conventional practices.

Farmers Feedback: The seed rate is less under SRI technology so the cost of seed is reduced. The crop was transplanted in line using row marker and rope with indicated distance markings of 25 X 25 cm is cumbersome, time consuming and tedious; however use of cono weeder for weeding operation reduced the drudgery as the crop was transplanted in line.

Recommendation to Scientific Institute: Small equipment for line transplanting suitable for hilly terrain is required to harvest the potentials of SRI technology.

B. Performance of upland jhum paddy var., SARS 1 and SARS 2

OFT on performance of upland jhum using paddy variety SARS 1 and SARS 2 at 15 locations was conducted. The problem diagnosed is poor yield of local cultivar and to achieve higher yield improved varieties viz., SARS 1 and SARS 2 were tested. Jhum field was cleaned manually and paddy seeds were broadcasted and growth and yield parameters were recorded regularly at 30 days interval. From the data recorded in

SARS 1, the average plant height (cm) was 60.71, no. of effective tillers 9.38, grains/panicle 64.44, yield (kg/ha) 4199 and test weight (gm) was 34.66. While in SARS 2 the average plant height (cm) was 63.50, no. of effective tillers 11.30, grains/panicle 62.20, yield (kg/ha) 2598 and test weight (gm) was 26.33. In local check the average plant height (cm) was 71.00, no. of effective tillers 8.60, grains/panicle 61.20, yield (kg/ha) 3191 and test weight (gm) was 29.00. The BC ratio of SARS1, SARS2 and local check were 3.9, 2.4 and 3.0 respectively.

Farmers Feedback: Paddy variety SARS1 is better in yield over SARS2 and local cultivar, however, as seed is broadcasted so seed requirement is higher than TRC.

Recommendation to Scientific Institute: As the seeds are broadcasted so due to bird attack lots of seeds get damaged, hence, any improved technology against bird attack may reduce the seed loss. Small tools and implements for line sowing like dibbler, wheel hoe with calibration system for sowing in line may also enhance efficiency in intercultural operations as well as reduce drudgery under jhum paddy.

C. Trial on different dates of sowing in lentil var., DPL 62

OFT on different dates of sowing in lentil was undertaken with 5 trials using lentil variety DPL 62. This trial was taken to find suitable date of sowing as lentil is uncommon crop for the district and it may have potential under rainfed conditions. In

the trial three different dates with an interval of 30 days were recorded as early sowing, optimum sowing and late sowing. From the data recorded for the average plant height (cm) pods/plant, yield (kg/ha) and test weight (gm), found to be 52.60, 18.00, 1967 and 2.7 in early sown conditions, while 50.20, 15.80, 1761 and 2.4 in optimum sowing conditions and 45.80, 11.20, 1498 and 2.5 in late sowing conditions respectively. Data reveals that early sown lentil has performed better than optimum and late sown conditions.

Farmers Feedback: Performance of early sown lentil was good and they observed that the incidents of pests and diseases were negligible in early sown crop. But found that line sowing was strenuous and labour intensive.

Recommendation to Scientific Institute: Small and light tools for land preparation and intercultural operation for moderate and higher sloppy areas will help in reducing the drudgery.

D. Effect of liming in maize Var. 9455

An OFT on effect of liming in maize Var. 9455 was taken up at Lekromi and Porba villages. Data for parameters like average plant height (cm), number of leaves/plant, number of cob/plant, grain yield (kg/ha), soil pH before sowing, soil pH after sowing and B:C ratio was recorded and average for lime treated plots found to be 87.73, 8.33, 2.66, 27.06 q/ha, 4.56, 6.5, and 1.53 and control plots found to be 76, 7.4, 2.2, 21.00, 4.56, 4.67, and 1.35. Result indicates that

liming has not only resulted in better yield but also enhanced the pH and this may help the subsequent crop.

Farmers Feedback: Liming application resulted in vigorous plant growth and better yield.



E. Effect of biofertilizer in French bean Var. Anupam

On Farm Trial on Effect of biofertilizer in French bean Var. Anupama was conducted at Porba village in an area of 0.5 acre where Rhizobium and Phosphotika biofertilizer were used as seed treatment. Result showed that biofertilizer treated crop recorded as average plant height (cm), number of leaves/plant, number of branches/plant, number of pods/plant, average yield (kg/ha) and B:C ratio as 14.56, 15.2, 3.13, 14.53,

8953.2 and 3.71, whereas in control parameter were recorded as 13.00, 12.40, 2.60, 10.80, 8520.0 and 3.53 respectively.

Farmers Feedback: French bean var. Anupama is soft compared to local beans and use of biofertilizer has enhanced the yield.



F. OFT on Performance of French bean var. Sel-9 and Pant Anupama at different dates of sowing

OFT was conducted on French bean in three villages in order to evaluate the performance of two varieties namely; Sel-9 (Arka Komal) and Pant Anupama and to

determine the suitable time for sowing. French bean is susceptible to fungal attack and planting at suitable time may help in avoiding the attack. Sowing of Sel-9 (Arka Komal) and Pant Anupama was done on two intervals of 10 days, so the dates of sowing were 1st April, 11th April and 21st April. Yield recorded for 1st April and 11th April of sowing for Sel-9 (Arka Komal) was 7.5t/ha and 5.82t/ha and for Pant Anupama was 6.33t/ha and 3.43t/ha. The crop sown on 21st April could produce as both the varieties suffered severely from anthracnose and rotting disease. Among the two varieties, Sel-9 yield was higher as the pods are harder than Pant Anupama. As dates of sowing concerns, the crop sown on 1st April showed better yield and plant growth in both the varieties than crop sown on 11th April, whereas the crop sown on 21st April failed completely.

Farmers feedback: Local cultivars are fibrous and late maturity type, whereas the improved variety fetches high price in the market being tender and palatable.



G. Performance of Radish var. Japanese White and Pusa Chetki under Pfitsero condition

An On Farm Trial was conducted in three villages to evaluate the performance of two varieties of Radish viz. Japanese white and Pusa chetki. The average root length (cm), root weight (g) and yield (q/ha) found to be 24.42, 175.96 and 286.66 in Japanese white and 16.47, 150.4, and 218.33 in Pusa chetki. Japanese white has performed better in comparison to Pusa chetki.

Farmers feedback: Farmers are interested to cultivate radish variety Japanese white commercially owing to its good marketability outside the district.

Recommendation to Scientific Institute: As Phek district receives high rainfall during the kharif season, so variety tolerant to high rainfall is much needed.

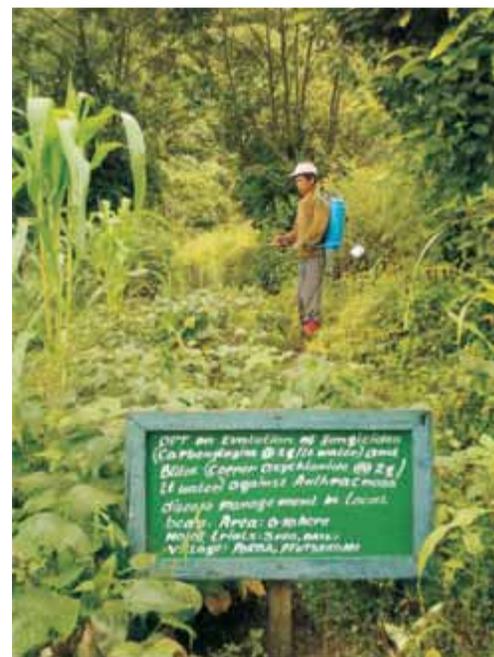


H. Evaluation of Fungicides, Carbendazim and Copper Oxychloride against Anthracnose disease management in beans

An On farm trial to evaluate two fungicides Carbendazim @ 2 gm/ltr water and Copper Oxychloride @2gm/ltr water against Anthracnose disease in French bean local

cultivar. The trial was conducted in an area of 0.40 ha in the fields of three farmers in porba and Pfuteromi villages. Three spraying were done at weekly interval. As performance parameters; average plant height (cm), average plant spread (cm), numbers of pods/plant, average yield (t/ha) and B:C ratio was recorded and it was found to be 39.6, 37.2, 27.1, 4.7, and 1.68 in Carbendazim treated plots and 41.3, 38.2, 29.4, 5.25, and 1.86 in Copper Oxychloride treated plots, however in control plot performance found to be 22.8cm, 26.1, 18.7, 2.91, and 1.03 respectively.

Farmers feedback: Copper Oxychloride found to be more effective in controlling the Anthracnose in French bean.





I. Effect of *Bacillus thuringiensis* @ 1g/lit water and neem oil @ 5ml/lit water against cabbage butterfly

An on farm trial was conducted to reduced high infestation of cabbage butterfly larvae by using *Bacillus thuringiensis* @ 1g/lit water and neem oil @ 5ml/lit water. Variety of the cabbage was taken as rare ball and trial was conducted in three farmers field of Porba and Thipuzumi villages in an area of 0.40 ha. 1st spraying was done one month after transplanting followed by 2nd spraying at 2 weeks of interval from 1st spraying. Emergence of larvae were recorded 20-25 days after transplanting. Larva count was done a day before each spray. *Bacillus thuringiensis* treated plot recorded average larvae count/plant at harvesting as 1.2 and

infestation as 30%. Yield was recorded as 32.01t/ha, whereas B:C ratio found to be 2.86. Neem oil treated plots recorded average larvae count/plant at harvesting as 1.6 and infestation as 40%. Yield was recorded as 23.34 t/ha, whereas B:C ratio found to be 2.08. In control plot average larvae count/plant at harvesting was found to be 17.5 and infestation was recorded as 90%. Yield was recorded as 15.41 t/ha, whereas B:C ratio found to be 1.40.

Farmers feedback: Farmers were excited to see the performance of *Bacillus thuringiensis* and neem oil against cabbage butterfly larvae management as both are organic pesticides and reduces pest population.



A. Creep feeding of pre-weaned piglets to boost weight gain and reduce preweaning mortality

An on farm trial on feeding of young litter with a special diet to improve the body weight gain and boost the immunity to reduce the post weaning mortality was conducted. The creep feed (Protein 20%, Digestible energy (K.cal/Kg) 3400) was introduced from the piglet age of 7 days and it was continued to 45 days of age. This has reduced post weaning mortality and resulted in higher body weight gain in the test group compared to control.

Farmers feedback: Creep feeding results in higher weight gain at latter stage also.

B. Chemical castration of pigs:

Traditional method of castration leads to infection and death of piglets so, as an alternative method chemical castration was tried. In this method mixture of 0.25 g $KMnO_4$ + Sol. Glacial acetic acid 17 ml + distilled water 83 ml was injected inter testicular. The trial was conducted with 10 piglets and all the piglets survived. No incidence of mortality due to infection was recorded, whereas success rate was noted as high as 100%.

Farmers feedback: This is a simple procedure can be practiced by the farmer himself.

Results of Front Line Demonstrations

A. Performance of Maize var., Ayush 1011

FLD on hybrid maize variety Ayush 1011 was conducted in 1 acre area in two

different villages of Phek district. As maize is the major crop in Phek district but cultivation of hybrid variety are uncommon. Ayush 1011 is a short duration type, while the local cultivars are of long duration and also some yield is reduced due to lodging. The growth and yield parameters of hybrid maize was recorded as the average plant height (cm) 50.20, pods/plant 15.80, yield (kg/ha) 1761 and test weight (gm) 2.4. The B:C ratio recorded were 2.7 for hybrid variety whereas B:C of local cultivar found to be 2.3.

B. Performance of Maize var., HQPM 1

FLD on performance of Quality Protein Maize var., HQPM 1 was conducted on farmers field in 1 acre area. From the data collected the average plant height was recorded as 140.20 cm in HQPM 1 while in local cultivar it recorded 180 cm, however the number of cobs per plant and grain yield did not vary much in both. The B:C ratio was found to be 2.8 and 2.1 respectively.

C. Effect of vermicompost on groundnut var. JL-24

A front line demonstration on Effect of vermicompost on groundnut var. JL-24 was conducted in Phek and Gidemi village in an area of 1 acre. Growth performance and yield parameters like; average plant height (cm), average numbers of leaves/plant, average number of branches/plant, average number pods/plant, average number of seeds/pod, average yield (q/ha) and B:C ratio was recorded under vermicompost application as 37.88, 52.6, 7.93, 28.8, 4.6, 18.13 and 1.53 respectively. In control

these parameters were recorded as 37.88, 52.6, 7.93, 28.8, 3.8, 14.75 and 1.35 respectively. Groundnut var. JL - 24 performed well in this region and also use of vermicompost increased the yield compared to control.



Effect of Biofertilizer application in potato (2012-13)

FLD on Biofertilizer application in potato has been taken up in Phek, Lekromi, Porba, and Pholami villages in an area of 0.55 ha where biofertilizer (Azotobacter and Phosphotika) was used as tuber treatment and the varieties were taken as Kufri Kanchan, Kufri Girdhari and Kufri Jyoti.

Data recorded for various parameters like; average plant height (cm), average number of leaves/plant, average number of shoots/plant, average number of tubers/plant, yield (kg/ha) and B:C ratio for Kufri Kanchan treated with biofertilizer as 45.90, 107.5, 6.4, 12.73, 26000.00 and 2.24, whereas in control 35.8, 104.6, 6.0, 10.8, 19000.00 and 2.01 respectively. Kufri Girdhari treated with biofertilizers recorded as 73.92, 171.2, 6.6, 12.93, 28000.00 and 4.57, whereas in control 63.7, 137, 5.2, 10.2, 21300.00 and 3.39. Kufri Jyoti treated with biofertilizers recorded as 63.16, 220.4, 6.66, 11.86, 24700.00 and 4.70 whereas in control the data recorded was 54.96, 167.8, 5.8, 9.4, 18200.00 and 3.63 respectively. All the three varieties viz. Kufri Kanchan, Kufri Girdhari and Kufri Jyoti treated with biofertilizer have performed better than untreated groups and among varieties performance of Kufri Girdhari was found to be better followed by Kufri Kanchan and Kufri Jyoti.





Popularization of King chilli production under low cost polyhouse under Pftusero condition

A front line demonstration was conducted in three villages to popularize King chilli production under low cost polyhouse. Trainings were conducted before the demonstration in these villages and seedlings, polythene sheet and other materials were provided to the farmers for the demonstration. Data recorded revealed that growth and performance under polyhouse was better than open condition. Parameters like plant height (cm), primary branches, fruits/plant, fruit length (cm), fruit weight (g), yield (q/ha), and B:C ratio was recorded and average value for each parameter under polyhouse conditions found to be; 111.3, 12.6, 73.7, 5.7, 7.2, 55.83 and 2.53 and under open condition found to be 90.2, 13.6, 48.0, 3.72, 4.74, 45.0 and 2.0 respectively. It was also recorded that the incidence of fruit rot was low under poly house compared to open condition during growing season.



Popularization of cabbage var. Rare Ball under Pftusero condition

A front line demonstration was conducted to popularize cabbage variety Rare Ball in Pftusero area. Local growing varieties such as pride of India, Golden acre etc. are susceptible to diseases like rotting and suffers a heavy yield losses during growing season i.e May to August. Hence, a demonstration was planned to popularize

high rainfall tolerant variety in 5 different villages. 50 farmers were trained and were selected for growing and seeds were provided to them. Data against parameters like; plant height (cm), plant spread (cm), numbers of leaves, head diameter (cm), head weight (g), yield (q/ha) and B:C ratio was recorded. Average value for each parameters found to be; 31.37, 37.56, 11.66, 13.34, 959.33, 241.75 and 2.55 in the cabbage variety Rare Ball and 31.0, 31.5, 12.0, 12.30, 676.00, 185.90 and 2.06 in local check (cabbage variety Pride of India). Cabbage var. Rare Ball had performed better in yield and incidences of fungal rot disease were found to be low compared to the variety Pride of India.



Popularization of Oyster Mushroom in Phek district

A Front line demonstration to popularize oyster mushroom was conducted in three villages of phek district viz. Inhulumi, Rihuba, Porba. Three training cum demonstration were conducted for 56 participants. Data recorded revealed that it took 10-12 days from spawning to pin head formation, 6-8 days from pin head to harvest, 20-25 days from spawning to harvesting. Average yield recorded to be 870g/bag and B:C ratio found to be 3.09. Youth as well as women folks were very much interested to take up mushroom production as a source of income.





Popularisation of Trichocards (*Trichogramma japonicum*) against stem borer management in paddy

A Front line demonstration to popularize of Trichocards (*Trichogramma japonicum*) against stem borer management in paddy was carried out in three villages in an area of 3.5 ha. *Trichogramma* egg parasitoids were released @ 50,000 egg parasitoids/ha, after 30 days after transplanting (DAT). Data were recorded at monthly interval after application of Trichocards in quadrat method of 1sqm area. Data on various parameters like; number of hill/m², number of effective tillers/hill, number of white earheads/hill, yield (t/ha) and B:C ratio was recorded. Average performance against each parameter found to be 62.66, 7.23, 0.6, 3.4, and 2.08 in treated plot and 63.66, 5.26, 1.6, 2.9 and 1.93 in control plots. Application of *Trichogramma japonicum*, had not only controlled the stem borer but also found effective against leaf folder and thereby increases the yield.

Farmers are interested to use trichocards against rice stem borer management as it is safe and organic.



Application of Biofor (PF-2) against soft rot management in ginger

A Front line demonstration on application of Biofor PF-2 against management of soft rot disease in ginger was conducted in Gidemi village. Biofor PF-2 is an organic biopesticide containing beneficial microbes was applied @ 1kg/10 kg of rhizomes. It has the ability to biologically control ginger rot and wilt. Local cultivar of ginger were treated with Biofor PF-2 containing *Pseudomonas fluorescens* and *Trichoderma harzianum* before planting. Rhizomes were planted at a spacing 30x45 cm (plant to plant x row to row) in the month of April. Average plant height (cm), average numbers of shoots/plant, average numbers of leaves/shoot, average rotting percentage, average yield and B:C ratio and the same found to be 59.1, 12.3, 10.0, 29.1, 7.1 and

2.20 under Biofor PF-2 treated plot and 58.7, 7.5, 6.6, 43.7, 5.4, and 1.87 for control plots.

Rotting percentage of ginger rhizomes treated with Biofor PF-2 reduced compared to untreated group and this has resulted in higher yields.



Supplementation of Iron to prevent piglet anaemia

A demonstration on supplementation of

Iron to prevent piglet anaemia was conducted to demonstrate its effect on piglet survival, growth rate and coat condition. Sow's udder was painted with a saturated solution of ferrous sulphate @ 0.5 kg of ferrous sulphate in 10 litres of hot water to supply Iron to piglets. Intensive rearing and low iron content in milk cause anaemia in piglets leading to poor growth and piglets becomes prone to other disease. Solution was applied to udder of lactating sow from the day of farrowing to weaning (45days). Good coat condition, higher body weight and reduce mortality was noted in the test group.

Management of coccidiosis in rabbits through preventive anti coccidial medication

Coccidiosis is a major cause of mortality in rabbits. The infection is seen more during the rainy season from May-September when the humidity is high leading to sporulation of coccidial cyst. Common symptoms are rough hair coat, retarded growth and dysentery. FLD was performed to demonstrate the prevention of coccidiosis by protective/preventive dose of Amprolium, Ethopabate, Sulphaquinoxaline and Pyrimethamine combination was given orally @ 60 ml/4 ltr of water on the 1st day followed by 30 ml/4 ltr of water on the 2nd, 3rd, and 4th day of every month from April to September. Mortality and incidence of diarrhoea reduced in the test groups compared to the control.

Trainings/summer school/winter school attended

Dr. Debojyoti Borkotoky had attended

- Participated in the training programme on 'Artificial insemination techniques in livestock management' organized by Extension Education Institute, GOI, Ministry of Agriculture, AAU, Khanapara from 21th to 25th October'2013.
- Participated in the ICAR sponsored short course on 'Avenues for Farmers' Empowerment and Agro-based Entrepreneurship Development' organized by ICAR Research Complex for NEH Region, Nagaland centre, Jharnapani from 20th -29th August'2013.

Mrs. T, Esther Longkumer attended

- Summer school ' Agribusiness and market intelligence ' during 06 November 2013 to 26 november 2013 at NU SASARD, Medziphema

Mrs. Liza Baruah Bharali Attended

- Training attended on 'Mushroom production' from 26th February 2013 to 29th February 2013 at CIFRI, Guwahati

Mrs. Hanna K. Asangla attended

- Training attended on 'Direct seeded rice' at CRURRS Jharkhand from 27th -28th September 2013
- Training attended on "Rice Knowledge management for food and nutritional security" under NAIP project at ICAR(RC) Tadong Gangtok w.e.f 28th Nov to 4th December 2013.

Conferences:

Dr. R K Singh had attended

- Training on Application of Bioinformatic tools in Biological Sciences from 8th to 10th January Organized by Bioinformatics Infrastructural Facility, College of Veterinary Sciences, AAU, Khanapara, Guwahati -Assam
- Annual Zonal Workshop of KVKs of Zone III organized by Zonal Project Directorate, Zone III, Umiam, Meghalaya, held at College of Veterinary Science, AAU, Khanapara, Guwahati from 28th to 30th May 2013
- National Seminar on "Extension Approaches for Inclusive Agricultural Development in Hilly, Tribal and Backward Areas" held at College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam from 20-22 August, 2013.
- 8th National Workshop of Krishi Vigyan Kendras, organized by ICAR at University of Agricultural Sciences, Bengluru, Karnataka, from 23-25th October 2013.
- National Seminar on Protected Cultivation of Horticultural Crops and Value Addition organized by Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed to be University) Formerly Allahabad Agricultural Institute, Allahabad, from 29-30th November 2013.



Presented Papers

Dr. R K Singh

1. Borkotoky, D. Singh, R. K., and Rajkhowa, C. 2013. Indigenous backyard chicken production system followed by Chakhesang Tribe of Nagaland; In: National Seminar on "Extension Approaches for Inclusive Agricultural Development in Hilly, Tribal and Backward Areas" held at College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam from 20-22 August, 2013.

2. Singh, R. K. and Bharali, R. 2013. Cultivation of Tomato under Protected Condition in Phek District of Nagaland; In: National Seminar on "Protected Cultivation of Horticultural Crops and Value Addition" held at Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed to be University) Formerly Allahabad Agricultural Institute, Allahabad, from 29-30th November 2013.

Dr. Debojyoti Borkotoky

- Participated and Presented a poster entitled "Morphometric Attributes of Naga Local Pig" in the National Seminar on Emerging Challenges and Prospective Strategies for Hill Agriculture in 2050 held during 23rd to 25th January' 2014 at ICAR(RC) NEHR, Nagaland centre, Jharnapani

- Participated and Presented a paper entitled "Sero-incidence of Reproductive Viral Diseases of Pigs in Hill States of North

East India" and a poster entitled "Comparative study of occurrence of gastrointestinal parasites in tho-tho and cross bred cattle's of Nagaland" in the 30th Annual Conference and National Symposium of Indian Association of Veterinary Pathologist held during 21-23 November, 2013 at C.V.Sc and AH, OUAT, Bhubaneswar, Odisha.

- Participated as an expert at State Specific Farmer Scientist Interactions during Krishi Vasant 2014, the National Agriculture fair cum Exhibition at Nagpur during 9-13 February, 2014.

Programme organized at KVK Phek - Porba

- Organized Farmers Scientist Interaction on 24th March 2014 sponsored by ATMA Phek.

- Organized Farmers Scientist Interaction on 31st March 2014 sponsored by ATMA Phek.

- Organized Awareness cum Training on Protection of Plant Varieties and Farmers Rights at Pfutsero sponsored by Protection of Plant Varieties and Farmers Rights Authority, Govt. of India, New Delhi.

Publications

- Reports of hairballs (trichobezoars) in unweaned mithun calves- J.K Chamuah, P. Perumal, K.K Baruah and D. Borkotoky. Indian veterinary Journal 90 (4): 98, April 2013

- Genotoxicity of nimesulide in Wistar rats - Debojyoti Borkotoky, Sushen K. Panda, Gyana R. Sahoo, Subas C. Parija

Drug and chemical toxicology pg 1-6, Oct. 2013

- Spina bifida in a piglet-A case report - M.K. Patra, Ebibeni Ngullie and Debojyoti Borkotoky. International journal of Livestock Research Vol 4 (1), 143-145, January 2014
- Singh, B. R., Singh, V., Ebibeni, N., and Singh R. K.. 2013. Antimicrobial and Herbal Drug Resistance in Enteric Bacteria isolated from Faecal Droppings of Common House Lizard/Gecko (Hemidactylus frenatus). International Journal of Microbiology. Volume 2013, Article ID 3 4 0 8 4 8 , 8 p a g e s

<http://dx.doi.org/10.1155/2013/340848>
Award:

Best Oral Paper Presentation Award to Dr. R. K. Singh, On the paper entitled "Cultivation of Tomato under Protected Condition in Phek District of Nagaland" In: National Seminar on "Protected Cultivation of Horticultural Crops and Value Addition" held at Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed to be University) Formerly Allahabad Agricultural Institute, Allahabad, from 29-30th November 2013



Technology Injection cum Input Distribution Programme" including Farmer's Training and Mithun Health Camp Under TSP in Maova Village, Nagaland

MEGA EVENT - SILVER JUBILEE CELEBRATION AND INTERFACE MEETING

The Institute celebrated the Silver Jubilee this year on 27 March 2014 in a glittering function with the presence of a galaxy of dignitaries including Sri Yitachu, Parliamentary Secretary, Vety & A.H., Govt of Nagaland; Dr. Benjongliba Aier, Parliamentary Secretary, Dept of Agriculture, Govt of Nagaland; Dr. S. Ayyappan, Hon'ble Secretary, DARE & DG, ICAR; Prof. K. M. L. Pathak, DDG (AS); Dr. B. S. Prakash, ADG (AN & P). A Technology

Exhibition showcasing various technologies developed by the Institute and mithun value added products was also organized on this occasion participated by many self-help groups and NGOs. An interface meeting was held with the scientists and various stake-holders of mithun husbandry and attended by Directors, and Joint Directors of ICAR Institutes of NEH States, Nagaland University etc.



Top Left : Dr. S. Ayyappan, Hon'ble Secretary, DARE & DG, ICAR delivering his presidential speech.

Top Right : Prof. K. M. L. Pathak, DDG (AS), ICAR giving his guiding oration.

Sri Yitachu, Hon'ble Parliamentary Secretary, Vety & A.H.; Dr. Benjongliba, Parliamentary Secretary, Agriculture, Govt. of Nagaland; Dr. S. Ayyappan, Secretary, DARE & DG, ICAR; Prof. K.M.L. Pathak, DDG (AS); Dr. S. N. Puri, VC, CAU and Dr. C. Rajkhowa, Director, NRCM sitting on stage on the occasion of Silver Jubilee Celebration and Interface Meeting.



Top : Sri Yitachu, Hon'ble Parliamentary Secretary, Vety & A.H.; Dr. Benjongliba, Parliamentary Secretary, Agriculture, Govt. of Nagaland; Dr. S. Ayyappan, Secretary, DARE & DG, ICAR; Prof. K.M.L. Pathak, DDG (AS) and Dr. C. Rajkhowa, Director, NRCM is inaugurating the Technology Exhibition in the Institute on the occasion of Silver Jubilee Celebration.

Bottom : The dignitaries are visiting the NRCM Stall during the exhibition

MITHUN FESTIVAL AND FARMERS FAIR 2014

Mithun Festival and Farmers Fair 2014 was organized on 28 March 2014 at Porba research station which was inaugurated by the Sri Ashwani Kumar, Hon'ble Governor, Nagaland in the presence of Dr. S. Ayyappan, Hon'ble Secretary, DARE & DG, ICAR; Prof. K. M. L. Pathak, DDG (AS); Dr. B. S. Prakash, ADG (AN & P) and other

dignitaries. The people of Phek showcased their traditional dances and various agricultural products during the occasion followed by inauguration of the new KVK building. A large number of mithun owners and farmers participated in this programme to make it a grand success.



Sri Ashwani Kumar, Hon'ble Governor, Nagaland and the First Lady of Nagaland; Dr. S. Ayyappan, Secretary DARE & DG, ICAR and other dignitaries taking stock of Farmers' Fair, Porba from the pavilion.

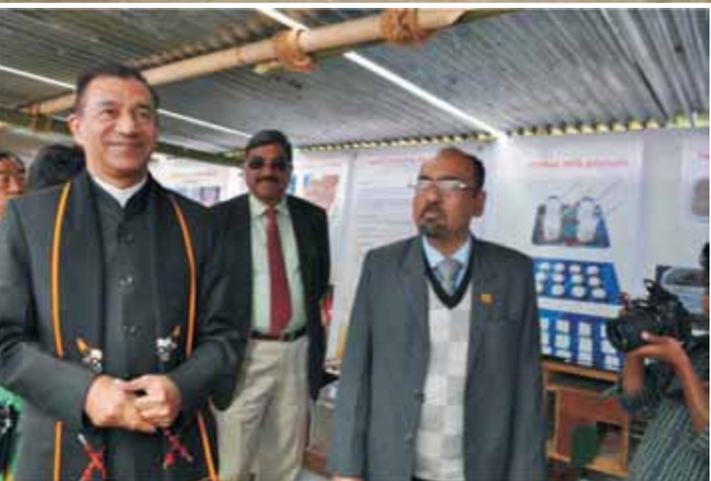


Top Left & Right : Dr. S. Ayyappan, Prof. K. M. L. Pathak, Dr. B. S. Prakash and Dr. C. Rajkhowa are interacting with Mithun Farmers Association of Papumpare, Arunachal Pradesh led by Dr. T. Heli.

Middle : Sri Ashwani Kumar, Hon'ble Governor, Nagaland and the First Lady of Nagaland are being received during the Mithun Festival, 2014 at Porba.

Bottom : Dr. C. Rajkhowa, Director NRCM and Dr. S. V. Ngachan, Director, ICAR Res. Complex for NEH Region, Barapani are welcoming Sri Ashwani Kumar, Hon'ble Governor and other dignitaries of Nagaland at Porba.





Top : Sri Ashwani Kumar, Hon'ble Governor, Nagaland and the First Lady of Nagaland inaugurating Mithun Festival & Farmers' Fair 2014 at Porba.

Middle : Dignitaries taking part in the traditional Naga Folk Dance, Porba.

Bottom : Sri Ashwani Kumar, Hon'ble Governor, Nagaland; Dr. K. M. L. Pathak, DDG (AS) and Dr. C. Rajkhowa visiting NRCM stall, Porba.

INSTITUTE PERSONNEL PROFILE (AS ON 31 MARCH 2014)

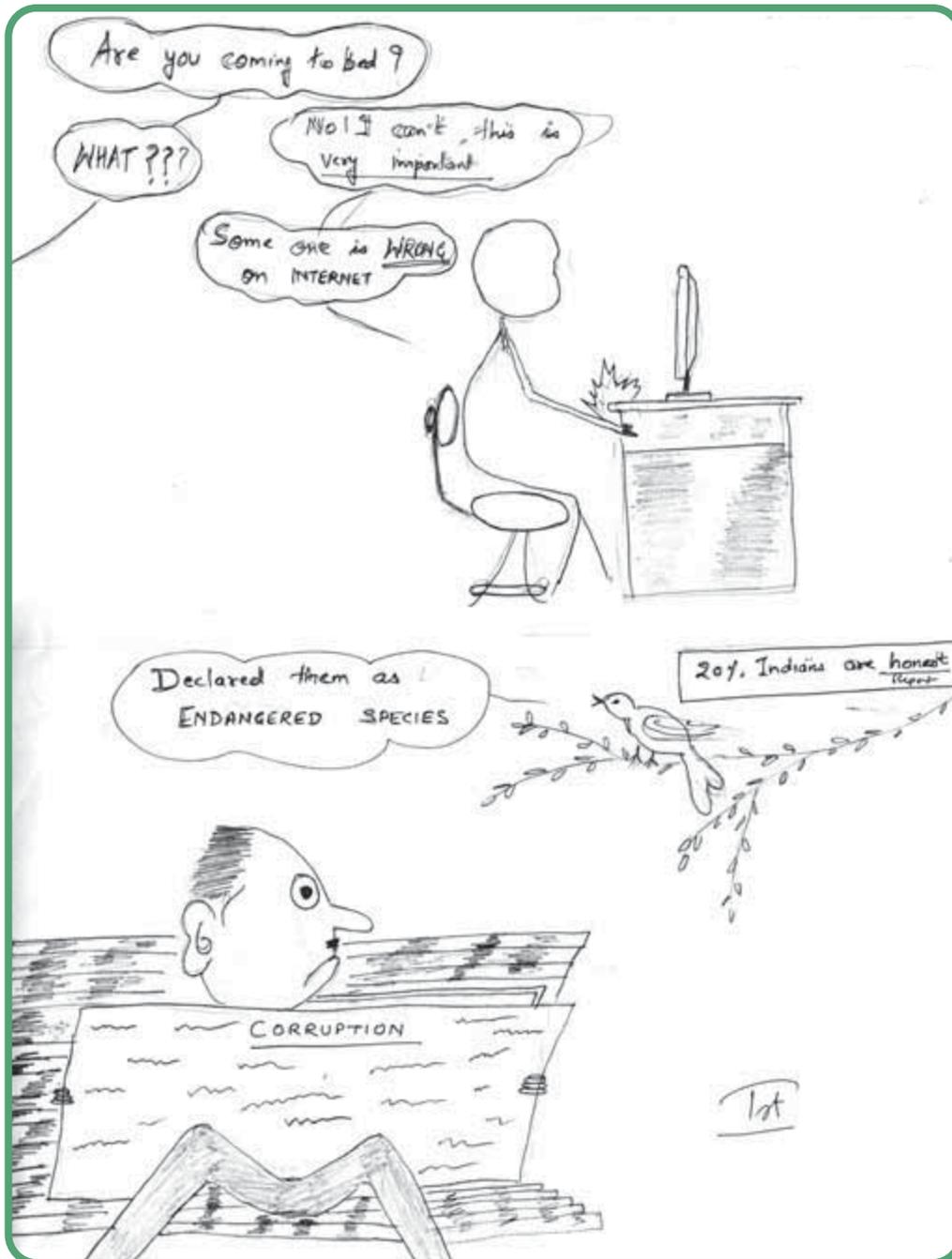
Sl.No	Cadre Name	Name	Designation
1	RMP	Dr.C.Rajkhowa	Director
2	Scientific	Dr. K. K. Baruah	Principal Scientist
		Dr. Nazrul Haque	Principal Scientist
		Dr. Anupama Mukherjee	Sr. Scientist
		Dr. Sabyasachi. Mukherjee	Principal Scientist
		Dr. M. H. Khan	Sr. Scientist
		Dr. Naresh Prasad	Scientist (on study leave)
		Dr. Jayanta Kumar Chamuah	Scientist
		Dr. Vidya Singh	Scientist
		Dr. Perumal P	Scientist
		Dr. Akhilesh Kumar	Scientist
3	Technical	Dr. Kezhavituo Vúprú	Live Stock Farm Manager
		Dr. Kobu Khate	Technical Officer
		Dr. Prakash Ranjan Dutta	Farm Manager
		Mr. Rokongulie Krose	Veterinary Field Asstt.
		Mr.Vizekrol Kikhi	Driver (T-1)
4	Administration	Mr.S.P.S. Negi	AAO
		Mr. Safal Chetri	AFAO
		Mr. Th. Dipal Meitei	Assistant
		Ms. Aloli Rengma	Assistant
		Mr. Surjit Kumar	Assistant
		Mr. Manoj Kumar Mahapatra	Assistant
		Mr. K.M. Chúsi	LDC
		Mrs. Achúno Solo	LDC
		Mr. Mahendra Kumar	LDC
		Ms. Vikhobeino Kiso	Stenographer Gr.III
Mr. Shatrughan Verma	SSS		
5	Supporting	Mr. Zakahi	SS Gr.III
		Mr. Vezato	SS Gr.III
		Mr. Zhophuhu	SS Gr.III
		Mr. Povetso	SS Gr.II
		Mr. Vecúzo	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. Borkotoky	S M S (Animal Science)
		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)
		Nukusa T.Vadeo	Programme Assistant (Computer)
		Keniseto Chucha	Farm Manager
		R. Imsennaro Longchar	Jr.Steno cum Computer Operator
		Bodan Ch. Kachari	Driver cum Mechanic
		Vevo	SSS
Shetsonyi Puro	SSS		

IN-CHARGE AND MEMBERS OF DIFFERENT CELLS

1.	Hindi Cell	- Dr. (Mrs) Anupama Mukherjee.
2.	ARIS Cell	- Dr. Nazrul Haque
3.	IPR/ITMU Cell	- Dr. K.K. Baruah
4.	PME/RFD Cell	- Dr. Sabyasachi Mukherjee
5.	Institutional Animals Ethics Cell	- Dr. Nazrul Haque Dr. Sabyasachi Mukherjee Dr. Kobu Khate Dr. Kezhavituo Vúprú Dr. Jayanta Kumar Chamuah Mr. Aru Khate
6.	Information and Public Relation Cell	- Dr.K.K. Baruah Mr. S.P.S. Negi
7.	IJSC Cell	- Dr. Nazrul Haque Dr. Kezhavituo Vupru Dr. Kobu Khate Mr. S.P.S. Negi (Member CJSC) Mr. Th..Dipal Meitei Mrs. A.Solo Mr. Mahender Kumar
8.	Women Cell	- Dr. (Mrs) Anupama Mukherjee Ms. Aloli Rengma Dr. Jayanta Kumar Chamuah Mr. S.P.S. Negi Mrs. Meisiehunuo.
9.	Grievance Redressal Cell	- Dr. K.K. Baruah Dr. N. Haque
10.	Bio-Safety Cell	- Dr. K.K. Baruah Dr. Nazrul Haque Dr. (Mrs) Anupama Mukherjee Dr. Sabyasachi Mukherjee Dr. Jayanta Chamuah
11.	Commercial Cell	- Dr. K.K. Baruah
12.	Institute Library	- Dr. Sabyasachi Mukherjee
13.	Livestock Farm	- Dr. Kezhavituo Vupru
14.	Head of Office	- Mr.S.P.S. Negi
15.	In-Charge, Vehicles	- Mr. S.P.S. Negi
16.	In-Charge Estates	- Dr. Kezhavituo Vupru
17.	Publicity Cell	- Dr.Vidya Singh
18.	Guest House	- Dr.Jayanta Kumar Chamuah
19.	Transparency Officer	- Dr, Nazrul Haque
20.	Vigilance Officer	- Dr. K. K. Baruah
21.	In-Charge Sports	- Dr. Sabyasachi Mukherjee
22.	Scientist-in-Charge, Institute Farm	- Dr. Nazrul Haque

VIGILANCE AWARENESS WEEK

Cartoons against Corruption



1st prize : Dr. (Mrs.) Anupama Mukherjee

