NPSN: 00816-830/2020/21

Annual Report

2076/77 (2019/2020)

Government of Nepal

Nepal Agricultural Research Council

National Cattle Research Program

Rampur, Chitwan, Nepal

2020

Staffs of NCRP, Rampur, Chitwan

NCRP Farm, Rampur, Chitwan

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Rampur, Chitwan, Nepal

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FOREWORD

National Cattle Research Program (NCRP) has been mandated for research on cattle breeding, cattle health, cattle production and management, cattle nutrition and pasture/fodder so as to improve the production and productivity of cattle reared in Nepal. This report presents the overall glimpse of National Cattle Research Program (NCRP) and concise information on developed technologies by NCRP on different aspects of cattle farming to improve efficiency and make cattle farming a more profitable business.

Due to emergence of COVID-19 we were not able to complete our planned activities as expected in this FY. Despite the condition, some outputs have been acheived which can be extended in the farmer's field. This year we conducted research works related to management of mastitis and infertility, molecular detection of blood protozoan, antibiotic residue in raw milk, isolation and molecular characterization of SIGA toxin producing *E.coli* O157:H7 in cows milk, study on different timing of AI, comparision of hand milking and machine milking, package of practices for Yak/Chauri, heat stress management, study on hydroponics fodder production, year round forage based milk production, establishment of Terai cattle herd for the evaluation of productive & reproductive performance and conservation as well maintenance of Lulu and Achhami cattle.

Our cattle herd is also linked to Dairy Cattle Improvement Program (DCIP) headed by NLBO, Pokhara. Adoption of the exotic semen & sexed semen in the NCRP farm received from National Livestock Breeding Office (NLBO), Pokhara for the further multiplication was helpful to produce the high- quality female calves for the replacement in the NCRP farm.

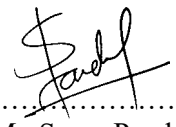
In the fiscal year 2076/77, we were successful to run biogas plant of 200m^3 capacity in full fledged. Likewise, use of sexed semen is giving promising outcomes to minimize the problem due to male calves which is one of the major constraints of cattle farming in Nepal.

Dairy sub-sector contributes 8% of GDP in Nepal. Despite a larger cattle population, the buffaloes contribute around 60% of the annual milk production and rest is contributed by cattle. Annual milk production is 2168434 MT (MoALD, 2076). Per capita availability of milk in the country is 74.21 litres per person per year, whereas FAO recommends 92 litres. We are consuming less than recommended amount. Thus, our total efforts are towards the fulfilment of milk and milk products demand in the country.

In near future we have envisaged the establishment of satellite research station in mid hill and high hill as well, center of excellence for dairy research, production of sexed semen within the country and developing NCRP farm as a model resource farm.

Finally, this report is the outcome of the untiring efforts of NCRP team. I would like to thank all the staffs of NCRP. I am very much thankful to Dr. Yagya Raj Pandeya for his efforts in editing this annual report. I am sincerely thankful to management team of NARC for their support in implementing the program smoothly. I am very much indebted to Dr. Deepak Bhanadari, Executive Director of NARC & Dr. Tek Bahadur Gurung, former acting Executive Director of NARC for their continuous support, motivation & guidance. I am very

much thankful to Dr. Swoyam Prakash Shrestha (Director of Livestock & Fisheries Research, NARC) and other directors of NARC for their guidance and support. I would like to thank Dr. Madhav Prasad Acharya (Former Coordinator of NCRP) for implementing project activities in his leadership in NCRP and supporting us. Likewise support from the NASRI, research centers under NASRI, other institutions within and outside NARC are gratefully acknowledged for their collaboration and partnership with us during the year. Especially NMRP Rampur, AFU Rampur, DoAR Parwanipur and VHLEC Chitwan are appreciated.



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Mr. Sagar Paudel
Coordinator/Senior Scientist (S3)
National Cattle Research Program
Rampur, Chitwan
Date: 9th November, 2020

ABBREVIATIONS

&	: and
@	: at the rate of
µ	: micro
*	: Significant
**	: Highly Significant
AI	: Artificial Insemination
AITC	: Agriculture Information and Training Center
AD	: Anno Domini
ADS	: Agriculture Development Strategy
AFU	: Agriculture & Forestry University
AGDP	: Agricultural Gross Domestic Product
APP	: Agriculture Perspective Plan
AST	: Antibiotic Sensitivity Test
BCS	: Body Condition Score
B.Sc.Ag.	: Bachelor of Science in Agriculture
B.Ed.	: Bachelor of Education
B.S.	: Bikram Sambat
B.V.Sc. & A.H.	: Bachelor of Veterinary Science and Animal Husbandry
BQ	: Black Quarter
BT	: Body Temperature
CBS	: Central Beuro of Statistics
CF	: Crude Fiber
cm	: centimetre
CMT	: California Mastitis Test
CP	: Crude Protein
DCIP	: Dairy Cattle Improvement Program
DCP	: Di Calcium Phosphate
DLS	: Department of Livestock Services
DLSO	: District Livestock Service Office
DM	: Dry Matter
ELISA	: Enzyme Linked Immuno Sorbent Assay
FAO	: Food and Agriculture Organization
FMD	: Foot and Mouth Disease
FY	: Fiscal Year
g	: gram
GM	: Green Matter
GDP	: Gross Domestic Product
ha	: hectare
HF	: Holstein Friesian
HMF	: Hydroponic Maize Fodder
HS	: Haemorrhagic Septicaemia
IAAS	: Institute of Agriculture and Animal Science
INGO	: International Non Governmental Organization

J.T.	: Junior Technician
J.T.A.	: Junior Technical Assistant
kg	: kilogram
L/lit.	: Litre
LPPM	: Livestock Product Production and Management
m	: meter
M.Sc.An.Sc.	: Master of Science in Animal Science
M.V.M.	: Master of Veterinary Medicine
MDR	: Multiple Drug Resistant
Min.	: Minute
ml	: mililiter
mm	: millimetre
MoAC	: Ministry of Agriculture and Cooperatives
MoALD	: Ministry of Agriculture and Livestock Development
MoF	: Ministry of Finance
MoLD	: Ministry of Livestock Development
MRL	: Maximum Residue Limit
MRSA	: Methicillin Resistant Staphylococcus Aureus
MT	: Metric Ton
MVSc	: Master of Veterinary Science
NARC	: Nepal Agricultural Research Council
NASRI	: National Animal Science Research Institute
NBRP	: National Bovine Research Program
NCRP	: National Cattle Research Program
NGO	: Non-Governmental Organization
NLBO	: National Livestock Breeding Office
NMRP	: National Maize Research Program
NPK	: Nitrogen, Phosphorus and Potash
NVA	: Nepal Veterinary Association
^{o}C	: Degree Centigrade
^{o}F	: Degree Fahrenheit
OR	: Out-reach
PCR	: Polymerase Chain Reaction
PCV	: Packed Cell Volume
PFAF	: Pasture, Forage and Agro Forestry
RCBD	: Randomized Complete Block Design
Rs.	: Rupees
SAADC	: Sustainable Animal Agriculture for Developing Countries
SCM	: Sub Clinical Mastitis
SNF	: Solid Not Fat
SPSS	: Statistical Package for Social Science
UMMB	: Urea Molasses Mineral Block
USG	: Ultrasonography
WHO	: World Health Organization

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

सङ्क्षिप्त वार्षिक प्रतिवेदन

नेपाल कृषि अनुसन्धान परिषद् अन्तर्गतका विभिन्न बाली वस्तु अनुसन्धान कार्यक्रमहरू मध्ये राष्ट्रिय गाई अनुसन्धान कार्यक्रम पनि एक हो । नेपालको सन्दर्भमा मुख्यतया दुध उत्पादन, खेतबारीमा जोत्न तथा गाडा तान्न, गोबर मल उत्पादनका साथै धार्मिक एवम् सांस्कृतिक महत्वका दृष्टिकोणले गाईपालन हुँदै आएको छ । नेपाल सरकारका विभिन्न आयोजनाहरूमा पनि गाई प्रवर्द्धनका लागि आवश्यक पर्ने प्रविधि विकासले प्राथमिकता पाएको छ । नेपाल सरकारका योजनाहरूमा दुग्ध उत्पादन, प्रसोधन तथा बजार व्यवस्थापन जस्ता कार्यहरू प्राथमिकतामा परेका छन् । नेपाल कृषि अनुसन्धान परिषद्ले आफ्नो स्थापना काल वि.सं. २०४८ साल देखिनै गाईपालन प्रवर्द्धनका लागि आवश्यक प्रविधि विकास गर्न अल्प, मध्य तथा दीर्घकालीन नीति लिएर अनुसन्धानमूलक विभिन्न कार्यक्रम सञ्चालन गर्दै आएको छ ।

लक्षित प्रतिफलका लागि आ.व. २०७६/७७ मा सञ्चालित विभिन्न अनुसन्धान परियोजनाहरूको प्रतिफल, उत्पादन र प्रचार/प्रसार कार्यहरूको उपलब्धि यो वार्षिक प्रतिवेदनमा उल्लेख गरिएको छ। कार्यक्रममा खास गरी अनुसन्धान र उत्पादन गतिविधिहरू सञ्चालनमा ल्याइएको थियो । क) अनुसन्धान कार्यहरू जसमा राष्ट्रिय गाई अनुसन्धान कार्यक्रमको फार्ममा रहेका स्थानीय गाईहरूमा उन्नत जातको विर्य प्रयोग गरी उत्पादन भएका वर्णशंकर गाईहरूको मूल्याङ्कन गर्ने, गाईहरूमा हुने मुख्य प्रजनन हर्मोनहरूको अध्ययन, स्टाफाइलोकोकस जीवाणुले हुने थुनेलोको अवस्था र उपयुक्त औषधिहरूको छनौट, नेपालमा भ्यागुते रोग विरुद्ध प्रयोग हुने खोपको मूल्याङ्कन, गाईको दुधमा सिगा टक्सिन उत्पादन गर्ने ईकोलाई ०१५७:एच७ को जैविक विशेषतीकरण, हाईड्रोपोनिक घाँस उत्पादन प्रविधि, गाईहरूको रगतमा हुने प्रोटोजोवाहरूको अवस्था पहिचान, गर्मीबाट हुने तनाव कम गर्ने उपायहरूको अध्ययन, याक-चौरी सम्बन्धी अध्ययन, वर्षभरी घाँसको प्रयोग गरी दुधको उत्पादन लागत घटाउने र बाह्य अनुसन्धान स्थलहरूमा प्रविधिहरूको प्रमाणीकरण गर्ने ।

ख) उत्पादन गतिविधि अन्तर्गत नेपाल वा अन्य देशमा उत्पादित जर्सी तथा होलस्टिनको विर्य प्रयोग गरी उन्नत नश्लका जर्सी तथा होलस्टिनका वर्णशंकर बहर तथा बाच्छीहरू उत्पादन गरी वितरण गर्ने, परिषद्बाट सिफारिस भएका विभिन्न घाँसका बिउहरू प्रयोग गरी घाँस उत्पादनमा वृद्धि ल्याउनुका साथै बिउहरू वितरण गर्ने र दुध तथा दुग्ध पदार्थ उत्पादन गर्ने गतिविधिहरू सम्पन्न गरिएका छन् ।

- स्थानीय जातका तराई गाईहरूलाई उन्नत जातको बहर वा विर्य प्रयोग गरी जन्मेका वर्णशंकरहरूको मूल्याङ्कन परियोजना अन्तर्गत यो आर्थिक वर्षमा ४ वटा ५०% तराई

र होल्स्टेन फ्रीजियन वर्णशंकर बाच्छा-बाच्छीहरू (औषत जन्म तौल २१.७६ के.जी.), ३ वटा ५०% तराई र जर्सी वर्णशंकर बाच्छा-बाच्छीहरू (औषत जन्म तौल १६.०० के.जी.) र ६ वटा १००% शुद्ध तराई नश्लका बाच्छा-बाच्छीहरू (औषत जन्म तौल १७.१७ के.जी) जन्मिए ।

- गाईको थुनेलो सम्बन्धी अनुसन्धानमा चितवनमा ३९.९२% (९७/२४३) र नवलपरासीमा १८% (१५/७९) स्टाफाईलोकोकस जीवाणुले हुने लक्षण नदेखाउने प्रकारको थुनेलोको सङ्क्रमण देखियो । उपचारका लागि सेफ्ट्रीएक्जोन, जेन्टामाईसीन र सिप्रोफ्लोक्सासीन क्रमस प्रभावकारी देखिए भने टेट्रासाईकिलीन र एन्रोफ्लोक्सासीन प्रभावकारी नरहेको पाइयो ।

- कम लागतमा दुध उत्पादनका लागि दानासहित ५०% अकोसे हरियो घाँस, ३०% कोसे हरियो घाँस र २०% सुख्खा रेसदार खाने कुरा खुवाउँदा प्रति लिटर दुध उत्पादनको मुल्य रु. २५.६३ पाइयो ।

- हाईड्रोपोनिक घाँस उत्पादनका लागि ७ केजी प्रति वर्ग मिटरका दरले मकैको बिऊ राख्दा बढी घाँस उत्पादन भएको पाइयो । ७ केजी प्रति वर्ग मिटर बिऊ दरमा २८.० ९+०.५५ केजी र ४ केजी प्रति बर्ग मिटर बिऊ दरमा १६.४६+०.२५ केजी हरियो घाँस उत्पादन भयो ।

- गाईहरूमा दिउसो दुई पटक नुहाउने (१२ र ३ बजे) र दिउँसो १२ देखि ४ बजेसम्म पङ्खा लगाउँदा गर्मीले हुने तनाव कम गर्न सकिन्छ ।

- बाच्छा-बाच्छीहरूलाई मिल्क रिप्लेसर खुवाउने परीक्षण गर्दा बाच्छा-बाच्छीको औसत दैनिक तौल बृद्धि टि-० मा ३४४.०० ग्राम, टि-१ मा २२९.११ ग्राम र टि-२ मा ३१३.१० ग्राम रहेको छ । टि-० समूहको एउटा बाच्छा-बाच्छीलाई खुवाउन रू. १२६२५.८० देखि रु. १६८३४.४० खर्च लाग्ने देखियो भने त्यसै गरी टि-१ र टि-२ समूहको एउटा बाच्छा-बाच्छीलाई खुवाउन क्रमशः रु. ६८१५.६४ देखि रु. ७४९३.४४ र रु. ७७९८.४० देखि रु. ८५५४.४० लाग्ने देखियो । खुवाउनका लागि मिल्क रेप्लेसर सस्तो देखिए तापनि तौल वृद्धिमा चाहिँ राम्रो देखिएन ।

- उत्पादन कार्यक्रम अनुरूप यस वर्षमा ४९ वटा बाच्छा-बाच्छी, ११६० मे. टन हरियो घाँस, १२३४७५.७० लिटर दुध, ४५४.०६ के.जी. पनिर, १३१ के.जी. खुवा, २१.५ के.जी. घ्यू, ५४.५० लिटर दही, ५०० गोटा रसबरी, २५० के.जी. मकैचरी र ११०

के.जी. जै घाँसको बिऊ उत्पादन गरियो । यस वर्ष उत्पादित दुधमा औसत घृतांश ५.११%, एस.एन.एफ., ८.८७%, प्रोटिन ३.२५% र ल्याक्टोज ४.९३% रहेको थियो ।

- १२ वटा बहरहरू चितवन र मकवानपुर जिल्लाका किसानहरूलाई नस्ल सुधारका लागि बिक्री वितरण गरियो । त्यस्तै: २० के.जी. कमन भेच, ४० के.जी. जै र ५०० सेट सुपर नेपियर घाँसका बिउहरू बाह्य अनुसन्धान स्थलमा वितरण गरियो । यस कार्यक्रम भित्रका जग्गाहरूमा विभिन्न बहुवर्षीय घाँसहरू: स्टाइलो, सेटारिया, सिग्नल, नेपियर, सोर्घम, भेच, मुलाटो घाँसको क्षेत्र विकास गरिनुका साथै विभिन्न डाले घाँसका बिरुवाहरू लगाउने कार्य गरियो ।

- त्यसै गरी यस आर्थिक वर्षमा ४९९२ भन्दा बढी किसान, विद्यार्थी तथा सम्बन्धित सरोकारवालाहरूलाई फार्म भ्रमण/अवलोकन तथा गाईपालन सम्बन्धी जानकारी प्रदान गरिनुका साथै माडी चितवनमा पशु-स्वास्थ्य तथा बाँझोपन निवारण शिविर सञ्चालन गरियो जसमा गाईहरूका साथै अन्य पशु वस्तुहरूको उपचार र परामर्श सेवा प्रदान गरिएको थियो ।

- यो आर्थिक वर्षको राजस्व सङ्कलन रु. ७५२११०९.९२ रहेको छ । गाईको दुध र दुग्ध पदार्थ बिक्रीबाट जम्मा रु. ७११०६३५.०० राजस्व सङ्कलन भयो । बाच्छा-बाच्छी र मल बिक्रीबाट जम्मा रु. १३०९०.००, घाँसको बिउबाट रु. ५४१३३.००, प्रशासनिक कार्यक्रमबाट रु. ३१७२५१.९२ र हल भाडाबाट रु. २६०००.०० राजस्व सङ्कलन भयो ।

- राष्ट्रिय गाई अनुसन्धान कार्यक्रममा अझै पनि पूर्वाधार तथा भवनहरू निर्माणाधीन अवस्थामा रहेका छन् । हालसम्म पाँच वटा गाईगोठ, १ वटा बाच्छा-बाच्छी गोठ, १ वटा बहर गोठ, १ वटा आइसोलेसन गोठ, १ वटा मेटाबोलिक क्रेटसहितको गोठ, १ वटा हे बार्न, २ वटा साइलो पिट, १ वटा दुध तथा दुग्ध पदार्थ बिक्री कक्ष निर्माण भएका छन । १ वटा प्रयोगशाला भवन निर्माण भए पनि पूर्ण रूपमा सञ्चालन हुन बाँकी रहेको छ । त्यसै गरी २०० घन मिटर क्षमताको बायो ग्यास निर्माण भै सञ्चालनमा रहेको छ ।

EXECUTIVE SUMMARY

National Cattle Research Program (NCRP) is one among the various commodity programs under the Nepal Agricultural Research Council (NARC). Cattle are the source of milk, manure and draught with high religious and cultural value in Nepal. The commodity is prioritized by Agriculture Development Strategies (ADS) and other national periodic plans. Further these government plans have spell out the need of technology generation to promote the milk and milk products, processing and marketing. NARC has prepared short, medium and long term research strategies to generate the improved technology to promote the commodity since its establishment in 2048 B.S.

To implement approved plan of NCRP during FY 2076/77 it has conducted the different research and production & extension activities which has been mentioned in this report.

In the research activities, different projects were conducted like: **Cattle Breeding**- "Evaluation of the local dairy cows through crossbreeding with exotic breed semen at NCRP Farm, Rampur, Chitwan", and "Assessment of major reproductive hormones in cyclic and non- cyclic crossbred dairy cows". **Cattle Health**- "Screening of antibiotic residues in raw milk in dairy pocket area of Nepal", "Status of haemoprotozoans in dairy cattle of Nepal", "Epidemiological studies on cattle mastitis", "Evaluation of protective immunity and longevity of Haemorrhagic Septicemia (HS) vaccine commonly used in Nepal". "Isolation and molecular characterization of SIGA toxin producing *E.coli* O157:H7 in milk of cow". **Fodder and Nutrition**-"Development of year round cost effective forage based milk production technology for cross bred cattle" and "Study on hydroponic fodder production and use in dairy animal".**Cattle Production and Management**-"Study on existing situation of heat stress management of crossbred cattle in the dairy pocket area of the terai region during the summer months". "The effects of feeding milk replacer on body growth and its economic feasibility in dairy calves", "Development of package of practices for Yak/Chauri" and "Cattle herd management and production project". **Outreach**- "Participatory technology development and verification at outreach sites".

In evaluation of the local dairy cows (Terai) through crossbreeding with exotic breed semen at NCRP Farm, Rampur, Chitwan: Four 50 % Terai HF crossbred calves, three 50% Terai Jersey calves and 6 Pure Terai calves were born in this FY. Average birth weight of 50 % Terai HF crossbred calves was 21.76 kg, average birth weight of 50% Terai Jersey crossbred calves was 16.00 kg whereas that of Pure Terai was 17.17 kg.

In epidemiological studies on cattle mastitis: The prevalence of Staphylococcal subclinical mastitis was found to be 39.92% (97/243) and 18% (15/79) in Chitwan and Nawalparasi district respectively. In antibiotic sensitivity test of *Staphlococcus aureus* infected milk sample, ceftriaxone was the most sensitive followed by gentamicin and

ciprofloxacin. *S. aureus* was resistant to tetracycline and enrofloxacin (most resistant).

In development of year round cost effective forage based milk production technology for cross bred cattle: Feeding 50% non legume green forage + 30 % legume green forage + 20 % dry roughage over mentioned feeding regime had lowest production cost of Rs. 25.63/liter of milk production.

In study on hydroponic fodder production and use in dairy animal: The result suggests that forage production at the seed rate 7 kg/m^2 is suitable for optimum hydroponic maize fodder production per unit area. Green matter yield per m^2 was highest in 7 kg/m^2 seed rate (28.09±0.55 kg) and lowest in 4 kg/m^2 seed rate (16.46±0.25 kg).

Study on existing situation of heat stress management of crossbred cattle in the dairy pocket area of the terai region during the summer months: In the heat stress management trial during the experimental period, the result of T3 group (sprinkle at 12 noon and 3 PM and fan cooling from 12 noon to 4 PM) had better result compared to other treatment groups.

Milk replacer feeding trial was conducted in 48 calves and average daily weight gain in T0 (whole milk), T1 (normal milk replacer) and T2 (medicated milk replacer) group was found to be 344.00 gm, 229.11 gm and 313.10 gm respectively. Cost for feeding a calf in T0 group was from Rs. 12625.80 to Rs. 16834.40, in T1 group cost was from Rs. 6815.64 to Rs. 7493.44 and in T2 group cost was from Rs. 7798.40 to Rs. 8554.40. Although cost of feeding was less in milk replacer fed group than control group but growth rate was lower in milk replacer fed calves than control group.

Similarly, in production and extension activities use of high quality semen produced in the country and other countries to produce improved cross breeds of Jersey and Holstein, forage cultivation and seed production, milk and dairy products production and extension of verified technology via training, workshop & health camp were conducted.

In production program 49 calves were produced during this year. Similarly, approximately 1160 metric ton green fodders, 123475.70 liters milk, 454.06 kg paneer, 131.00 kg khuwa, 54.50 liters dahi, 21.50 kg ghee and 500 pieces of rasbari were produced. 250 kg teosinte and 110 kg oat seed were produced.

The average composition of whole milk produced in NCRP farm was as 5.11%, 8.87%, 3.25% and 4.93% respectively for fat, SNF, protein and lactose. Average electrical conductivity was 4.73.

Twelve crossbred male calves were distributed to farmers of Chitwan and Makwanpur district for upgrading of local cattle in the area. Similarly, 20 kg common vetch and

40 kg oat was distributed to the farmers of Chitwan & Rupandehi. 500 sets of super napier were distributed to farmers of outreach site Devdaha, Rupandehi. Perennial grasses like stylo, setaria, signal grass, napier, sorghum, vetch, mulato, para grass were cultivated in fodder cultivating area of the program. Thus, cultivated grasses were harvested and fed to cattle of NCRP farm.

Total revenue of this fiscal year was Rs. 7521109.92. Revenue from sale of milk and milk products was Rs. 7110635.00. Revenue from sale of calves and manure was Rs. 13090.00. Revenue from sale of forage seeds was Rs. 54133.00. Revenue from administrative program was Rs. 317251.92 and from hall rent was Rs. 26000.00

In this FY more than 4992 farmers, students, extension staffs, NGO/INGO staffs, local government authorities of different places and other stake holders visited the NCRP farm and consultancy services was provided to them on cattle farming. One animal health & infertility management camp was organized at Madi, Chitwan.

National Cattle Research Program is still in constructive phase in Rampur, Chitwan. Till date, there are five cattle sheds, one calf shed, one bull shed, one isolation shed, one shed with metabolic crates, two silo pits, one hay barn and one dairy unit constructed. Other structure like laboratory building is constructed and still in need of partition & decoration. Biogas plant of 200 cubic meters has been constructed and is regularly supplying biogas for 60 families in their kitchens.

1. WORKING CONTEXT

National Cattle Research Program (NCRP) is a commodity program among the various commodity programs of Nepal Agricultural Research Council (NARC) comprising cattle. Cattle are the main source of milk production, animal traction and manure in Nepal. This commodity is prioritized by the government in different long-term plan such as Agriculture Prospective Plan (APP) and Agriculture Development Strategy (ADS). Contribution of agriculture is 28.1% in GDP (MoF, 2019). Livestock contributes 25.68 % in AGDP and about 11% in GDP. Cattle stand second after buffalo which contributes 40.0% in milk production of Nepal (Livestock Diary, 2076). Contribution of dairy sub-sector is 8% in national GDP and it shares 63% of total livestock contribution (MoALD, 2018). In Nepal, the total annual milk production is 2169714 MT (Livestock Diary, 2076). As concept developed by WHO and FAO availability of milk should be 250 ml/head/day. In present situation actual availability of milk is 202.90 ml/head/day considering population of Nepal as 29.3 million. There is gap between recommended and actual available amount i.e. 47.1ml/head/day. So overall 515745 MT milk is still deficient for approx 30 millions of Nepalese people.

The growth trend of cattle population in the country is described in the table 1 below.

Table 1. Cattle population and milk production trend in Nepal

Year	Total population	Milking cattle	Milk yield from cattle (MT)	Total milk yield (MT)
2007/08	7090714	915411	400950	1388730
2008/09	7175198	932876	413919	1445419
2009/10	7199260	954680	429030	1495897
2010/11	7226050	974122	447185	1556510
2011/12	7244944	998963	468913	1622751
2012/13	7274022	1025591	492379	1680812
2013/14	7243916	1024513	532300	1700073
2014/15	7241743	1025947	587719	1755725
2015/16	7302808	1026135	643806	1854247
2016/17	7347487	1029529	665285	1911239
2017/18	7376306	1039538	856675	2141697
2018/19	7385035	1560584	795530	2168434

Source: Statistical Information on Nepalese Agriculture, 2075/76 (2018/19)

National Cattle Research Program is located in Rampur Chitwan of Bagmati Province Nepal with sub- tropical climate. Land occupancy of the program in Rampur is chiefly rain-fed while a portion of the total occupancy being irrigated through deep tube wells. Chitwan in particular is marked as one of the leading districts in dairy sector in the country and was recognized as self sufficicient district in milk production in 2076 BS. The volume of the milk being collected and its contribution in terms of the supply of the fluid milk to the national milk grid is outstanding.

However, there are some challenges in terms of the diseases outbreak and productivity constraints. Infertility in cattle regardless the breed is perhaps the most limiting factors towards the dairy sector improvement. Likewise, the frequent occurrence of the mastitis contributes to low quality & quantity of milk production. Regarding its command area, it is a national program so research should focus on overall management of cattle in all agro-ecological zones of the country.

2. INTRODUCTION

2.1 Background

National Cattle Research Program (NCRP) is one among the various commodity programs under the Nepal Agricultural Research Council (NARC), administered directly by the director for livestock and fisheries research. It has evolved from the Livestock Development Farm of the Department of Livestock Development and Animal Health after the establishment of Nepal Agricultural Research Council in 2048 B.S. (1991AD) and named as National Bovine Research Program (NBRP) at Khumaltar, Lalitpur to conduct research works on cattle and buffaloes. Realizing the importance of the commodity specific research in the country, NARC management decided to separate the cattle from NBRP. In 2069 B.S. (2013 AD) NBRP was re-structured to form National Cattle Research Program and National Buffalo Research Program as two separate commodity programs. National Buffalo Research Program was established in Tarahara, Sunsari and NCRP was shifted from Khumaltar to Rampur, Chitwan in 2071 B.S. (2014 AD). It is situated in the central region of Nepal (27^0 65′ N latitude; 84^0 35′ E longitude and 187 masl.) at Rampur, Chitwan. It has humid and subtropical climate with cool winter (2-3 ^oC) and hot summer (43 ^0C). The annual rainfall is over 1500 mm with a distinct monsoon period (>75% of annual rainfall) from mid-June to mid-September. This is situated 10 km west from the Bharatpur (district headquarters of Chitwan). NCRP complex extends in an area of 25 hectare of land.

As a component of NARC, it aims to contribute towards increasing the production and productivity of livestock sectors in general and research and development of cattle in particular. Therefore, generation of appropriate technologies for various agro-ecological zones of the country, client oriented, problem based, participatory, holistic and systematic research on cattle is the approach undertaken by this program to maintain the dynamism in livestock production system and uplift the living standard of Nepalese people.

2.2 Goal

Livelihood of farming communities improved through increased livestock productivity.

2.3 Vision

To enhance the production and productivity of cattle for nutritional security and livelihood improvement of Nepalese people and be a leading research institute in the country.

2.4 Mission

Improving cattle production and productivity by conducting problem based, farmer oriented, participatory and systematic research, and recommend innovative and adaptable technologies to farmers.

2.5 Mandate

- Conducting research in areas of cattle feeding/nutrition, fodder/pasture, breeding, health, production & management and socio-economic aspects, suitable for various agro-ecological zones of country.
- Documentation, maintenance and update information on cattle research in Nepal.
- Verify and recommend adaptable technologies for dairy (cattle) sector transformation in the country.
- Develop and recommend suitable technologies related to milk production, collection, processing, milk product diversification and marketing.
- Publication of developed technologies on cattle and collaborations with extension agencies for their disseminations and easy adaptation by farmer.
- Collaboration with national and international research organizations, institutions and centers for research support and specialization development.
- Evaluation, characterization, exploration, utilization and conservation of cattle germplasm.
- Assist in cattle breed registration and release.
- Determine, formulate and prioritize issues and strategies in short, medium and long term in national cattle research in the country.
- Assist in formulating and implementing the government policies for cattle sector development.

2.6 Objectives

- To generate, verify and recommend suitable adaptable technologies in feeding, breeding, production and health management of cattle for various agro-ecological zones of the country.
- To document, maintain and update information on cattle research in Nepal.
- To determine, formulate and prioritize issues and strategies in short, medium and long term in national cattle research in the country.
- To establish, maintain and strengthen linkage with other national and international organization for collaborative and participatory research.
- Evaluation, characterization, exploration, utilization and conservation of cattle germplasm.
- To assist in cattle breed registration and release.
- To assist in formulating and implementing the government policies regarding all aspects of cattle.

2.7 Achievements

- Fifty percent gene level of crossbred Jersey or Holstein-Friesian (HF) is suitable for the on-farm condition of mid hills. Age at calving, calving interval and milk yield of 50 % Jersey and HF was recorded (32.4 & 27.9 months), (13.8 & 17.7 months) and (1471 & 1836 liters/ lactation) respectively.
- Early weaned crossbred cattle calves at 4 months of age performed better than the calves weaned at 2 and 6 months of age. The age and body weight at puberty of the cross-bred calves weaned at 4 months of age was 12.33 months and 195.3 kg. Whereas the calves weaned at 2 and 6 months of age had puberty at 12.7 & 14.4 months of age and body weight at puberty were 169.5 and 148.02 kg respectively.
- Increased milk production in cows and better growth rate of forthcoming calves can be expected by steaming up diet during last two months of gestation.
- Calves can be raised successfully by replacing whole milk feeding with unconventional milk replacer after the age of 21 days. Feeding milk replacer based on butter milk and whole milk saved Rs. 2284 and Rs. 2141 per calf respectively during four months rearing period.
- Induced lactation is possible in dry and infertile animal with the use of sex steroids. Estrogen (Estradiol 17 ß and) progesterone (4-pregnene-3, 20 di-one) in the ratio of 1:2.5. It was more effective in terms of induction and average milk yield as compared to the hormone ratio of 1:1.
- Milk yield is affected significantly by the increased feeding frequency of lactating animals. Dividing the daily concentrate requirement of high yielding cattle (> 10 liters/day) into three parts and feeding them three times a day (7 a.m., 12 noon & 4 p.m.) produced an additional 495 liters of milk per lactation as compared with two times feeding (7 a.m. & 4 p.m.) 2268 liter/ lactation.
- Urea molasses mineral block (UMMB) feeding was economical for increased milk production in crossbred dairy cattle. Dairy cows supplemented with UMMB produced 1282.6 liters of milk as compared to the cows without supplementation (855.9 liters) in 140 days of study period.
- Early pregnancy diagnosis in bovine (30 days onward) from milk and blood serum has been established by ELISA technique.
- Use of post milking teat dipping solution (povidone iodine: glycerol=9:1) for prevention of mastitis.
- Use of mastitis detector for detection of sub-clinical mastitis.
- The quality forage-based production system reduced the cost of milk production by reducing concentrate feed by 35% to 45%. Animals fed in certain feed regime (2 kg feed for maintenance and extra for milk production) and rest dry matter supplied by combination of 50% non legume forage + 30 % legume forage + 20 % dry roughage per liter milk production cost as Rs. 19.46 in farm condition.

2.8 Strategies

The strategy of NCRP is to generate the technology on cattle promotion suitable for different agro ecological zone of the country. The strategies are short term, medium term and long-term research. The research strategies are based on the cattle breeding, feeds and feeding, health, product processing and socioeconomic of the farming.

2.9 Current thrust area for research

National Cattle Research Program (NCRP) is focused to generate the dairy cattle related technology as per the national demand.
The current thrusts are:

i. Genetic improvement of cattle using the genetic material (semen) generated by DCIP and other programs
ii. Evaluation of the local dairy cows through crossbreeding with exotic breed semen at NCRP Farm, Rampur, Chitwan
iii. Adaptation of Lulu cattle in tropical region
iv. Improve the fertility status of cattle by focusing on the problems related to infertility and its management
v. Development of package of practices for Yak/Chauri
vi. The effects of feeding milk replacer on body growth and its economic feasibility in dairy calves
vii. Status of haemoprotozoans in dairy cattle of Nepal
viii. Status of antibiotic residue in cow milk
ix. Prevalence of Siga toxin producing *E. coli* in raw cow milk
x. Year roung fodder production and low-cost milk production

2.10 Infrastructure and facilities

The program has undergone significant administrative and technical changes significantly as decision made earlier by the NARC management so as to give full fledge structure that can perform nation wide research and development in cattle. The program is located in Bharatpur Metropolitan City of Chitwan district at Rampur. It is 10 km far from the main city of Chitwan district in south west region and 157 km far from the headquarter of the country Kathmandu.

Currently, the program has access to 25 ha land, out of which about 5 ha is allocated for the farm structures, laboratory buildings, office buildings, residential quarters and rest for other use such as for pasture and fodder production as a feed stuffs required for daily consumption throughout the year, research/trial plot, pastureland, fodder trees cultivation area as demonstrated in the table 2.

Table 2. Land utilization patterns at NCRP, Rampur, Chitwan

S.N.	Utilization	Area, ha	%
1	Forage cultivation	12	48.00
2	Infrastructure (farm structure, roads, office building, laboratory, residential buildings and others)	5	20.00
3	Research/trial plot	2	8.00
4	Fodder tree cultivated area	1	4.00
5	Pasture land	5	20.00
	Total	**25**	**100.00**

The program has maintained around 182 cattle heads of Jersey and Holstein Friesian crosses, Terai, Lulu and Achhami cattle breed in its farm with average daily milk production of around 350 liters. Milk is either sold as whole milk or as products like paneer, khuwa, dahi, ghee, ice cream etc. Fodder trees are cultivated in around 1 ha of land and other seasonal/perennial forages are produced as necessary in the farm with in 10-12 ha of land. Till now there is one office building, five cattle sheds (3 with 40 heads adjustment and 2 with 20 heads adjustment), two yards, one calf shed, tractor garage, four manure pits, 2 silage pits, chain link fence around farm area, one bull shed with yard, one isolation shed, one shed with metabolic crates and one laboratory building. To make the daily work efficient in the farm there are eight staff quarter buildings with the capacity of 14 family adjustments. Biogas plant having capacity of 200 cubic meters is constructed. This is providing regular gas supply for 60 households by pipeline system. Primarily for staff quarter buildings and office/labs of NCRP and NMRP, Rampur.

Similarly, there is a dairy processing unit with the facility of fluid milk storage and product processing like dahi, ghee, paneer, ice cream and khuwa. Likewise, mini veterinary laboratory to support the study of animal health parameters having the facilities of autoclave, incubator, laminar flow, hot-air oven, water bath, mastitis detector, microscopes, ELISA reader, semi-automatic biochemical analyzer, haematology analyzer etc. and there is facility of artificial insemination under artificial insemination unit where frozen semen straw can be stored, and inseminated with appropriate handling and processing. At the moment there is the facility of ultrasound machine (USG) for assessing ovarian dynamics of cow and early pregnancy diagnosis. Estrus detector is available to help in getting appropriate timing for artificial insemination.

For the farm operation there are facilities of milking machines for milking the cows, weighing balances to record the daily milk production and to measure the birth weight of the new born calves, lacto scan machine for routine milk analysis and chaff cutter for cutting the forages and straw in desired size. Animal nutrition laboratory was established in this fiscal year 2073/74 with the facility of estimation of crude protein, crude fiber, ether extract, ash and dry matter. The instruments available in nutrition laboratory are sox-holet apparatus, muffle furnace, k-jeldhal apparatus, fiber digester, hot air oven etc. The program lacks many other types of equipments needed in different unit to sophisticate the laboratories. Facility of irrigation is quite good in the area. Also, there is one four-wheeler jeep, three motorbikes, one electric auto rickshaw & nine bicycles.

2.11 Organizational Structure and human resources

The organizational structure of National Cattle Research Program, Rampur, Chitwan is presented in figure 1.

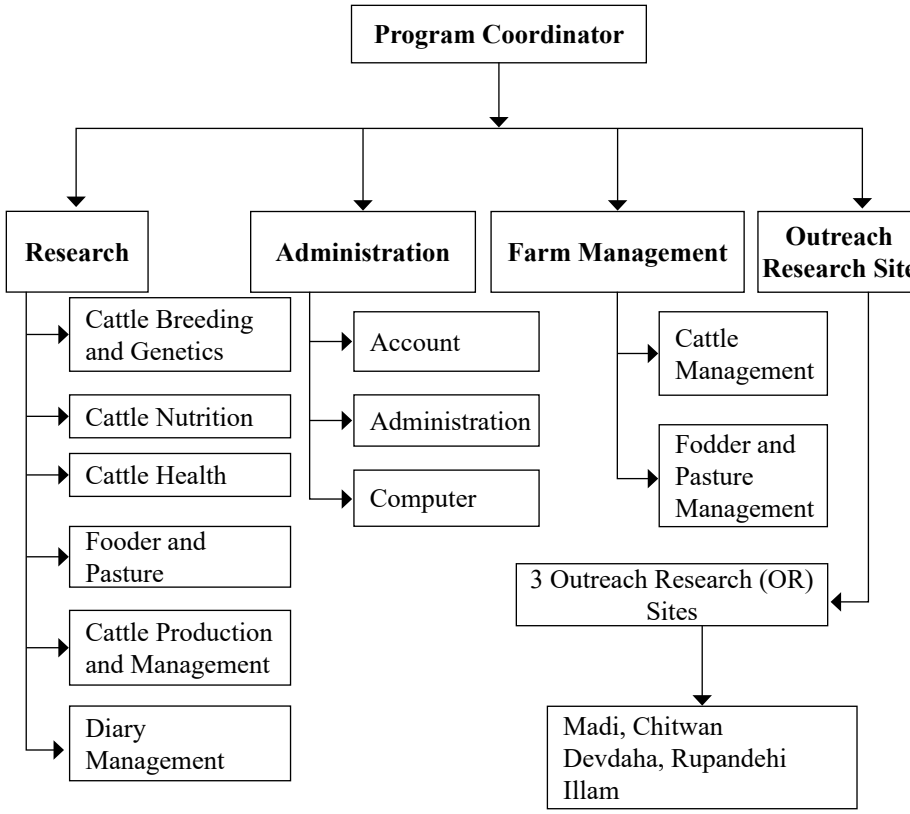

Fig 1: Organizational structure of NCRP, Rampur, Chitwan

The program is basically coordinated by Principal Scientist (S5) but in this FY it was coordinated by the Senior Scientist (S3) and supported by other scientists, technical officers, technicians and admin/finance staffs as shown in annex 2.2.

3. RESEARCH HIGHLIGHTS

In this FY NCRP carried out 12 projects out of them 9 were research projects, 1 was outreach project, 1 was farm management project and 1 was production project. Total activities were 72. Operational budget for this FY was Rs. 46870000 and capital budget was Rs. 8156000. The highlights of the research projects carried out by the scientists and technical officers of the NCRP in this FY are mentioned below. Summary of projects implemented in FY 2076/77 are given in annex 3.1.

3.1 Cattle Health

3.1.1 Screening of Antibiotic Residues in Raw Milk in Dairy Pocket Area of Nepal

Antibiotics are chemical substance derivable from microorganism that kills or inhibits microorganism and cures infection. Antibiotics are frequently used in veterinary practices to treat and prevent animal disease. They are also used at sub-therapeutic levels to increase feed efficiency, promote growth and prevent diseases (Mosalagae *et al*., 2011). In dairy animal commonly used antimicrobials are Sulphonamides, Aminoglycosides, Tetracyclines, Macrolids, Quinolones, β- lactams etc. Nowadays, approximately 80% of all food-producing animals receive medication for part or most their lives (Lee *et al*., 2001).

Residues of drugs in milk is a potential health risks because of failure to observe the mandatory withdrawal time, illegal or extra-label use of veterinary drugs and incorrect dosage levels application (Kurwijila *et al.,* 2006). Antibiotic residues above the MRL have different harmful effects on consumers like allergic reactions, disturbance of intestinal microflora (Dewdney *et al.,* 1991; Stoker *et al.,* 2007). Antibiotic contamination in milk can also cause significant economic losses for producers and manufacturers of milk and milk products. Although antimicrobial drugs are useful for treatment of human infections, their occurrence in milk causes adverse public health effects such as drug resistance and hypersensitivity that could be life threatening. Because of the public health significance, milk and milk products contaminated with antibiotics beyond a given residue levels, are considered unfit for human consumption (Plumb, 2005). The good quality of milk must be free from harmful or toxic residues, such as antimicrobial drugs. The extra-label use of these antimicrobial treatments, insufficient withdrawal period and lack of records are the most common causes of theses residue in milk, which lead to the increase of these residues in milk above the acceptable maximum residue limits (MRLs).

The (MRL) is defined as the maximum concentration of a residue, resulting from the registered use of an agricultural or veterinary chemical that is recommended to be legally permitted or recognized as acceptable in or on a food, agricultural commodity, or animal feed. The concentration is expressed in mg/kg of the commodity or mg/L in the case of a liquid commodity or ppm/ppb. To protect the public against possible health risks caused by drug residues hazards, regulations regarding veterinary use of drugs including withholding periods after antibiotics therapy and tolerance levels have been formulated (WHO/FAO-CAC, 2012) and are strictly adhered in developed countries (Lee *et al*., 2001; Donoghue, 2003).

In Nepal, most of the drugs are used without any restriction in such a huge amount and care of withdrawal period and assessment of antibiotic residue in meat and milk are not monitored properly by government and privet sectors (Sedai, 2007). Many standard methods have been

developed worldwide for antibiotic residue analysis. But use of very high-tech method to evaluate the residue in milk may be impractical in our context. The present study was designed to assess the presence of commonly used antibiotic residue in raw milk marketed at different place of Chitwan, Nawalparasi & Pokhara.

In Nepal only a few studies have been done regarding quantitative analysis of antibiotic residue in raw milk. Only limited numbers of research reports are available for qualitative and semi-quantitative analyses. Due to lack of the proper government policies and guidelines to prevent the risk of antibiotic residues in milk & milk product, still haphazard use of antibiotics in livestock and dairy sector prevail. It has become very much important to aware all the stakeholders about withdrawal period of antibiotics in milk and possible hazards due to the consumption of residue bearing milk. Due to the emergence of COVID-19 in the country we couldnot perform the planned activity in this FY. Specifically, we couldnot purchase the ELISA test kits. This project is in ongoing status and remaining activities will be performed in upcoming FY.

3.1.2 Status of Haemoprotozoans in Dairy Cattle of Nepal

Anaplasma sp., *Babesia* sp., *Theileria* sp. and *Trypanosome* sp. are major blood parasites of cattle leading to haemoprotozoan diseases in dairy cattle. These all have economic significance in dairy cattle industry. The existence of haemoprotozoan infections among farm animals causes serious losses because they are related to degradation of health status and ultimately production loss. There are many protozoa and blood parasites that affect the animal performance. *Anaplasma, Babesia, Theileria* and *Trypanosoma* are responsible for the causing anaplasmosis, babesiosis, theileriosis and trypanosomiasis respectively in cattle and other farm animals (Uilenberg, 1995). Haemoprotozoan diseases are considered some of the major impediments in the health and productive performance of cattle (Rajput *et al.,* 2005). Past effort for the study on prevalence of blood protozoa in dairy cattle are insufficient due to lack of adoption of new diagnostic techniques and expertise.

The disease causing organisms are transmitted mainly by the bites of infected vectors; however, the possibilities of mechanical transmissions can't be neglected. These diseases are prevalent in the wide range of host viz. domesticated animal, wild animal and human as well and geographical regions; including tropics to sub-tropic area of world. Haemoprotozoan diseases cause deleterious impact on the health of animal and heavy losses to the livestock sector. As a result of lowered growth rate, production, reproduction and productivity of animal eventually become problem for development of dairy industry.

Bovine anaplasmosis is also known as gall sickness and caused *Anaplasma marginale, Anaplasma centrale, Anaplasma phagocytophilum, Anaplasma bovis, Anaplasma platy.* Out of which *Anaplasma marginale* is responsible for clinical bovine anaplasmosis. Upto 17 tick species are found to be vector of these parasite including *Hyaloma, Dermacenter, Ixodes, Argas, Rhipicephalus*. Incase of tick, infection may occur intra-stadial, trans-stadial or rarely via trans-ovarian. Sometime the bites of dipterous flies act as mechanical transmitter. Trans-placental infection occurs during the acute phase of infection in dam about second and third trimester. During diagnosis of *Anaplasma* sp. they appear as dense, homogeneously staining blue purple inclusions of 0.3-1 μm in diameter. Inclusion bodies contains 1-8 initial bodies (0.3-0.4 μm) known as individual rickettiale.

Bovine babesiosis is mainly caused by *Babesia bovis and Babesia bigemina.* In one host tick, trans-ovarian transmission occurs and due to larval (*Babesia bovis*) and nymph or adult (*Babesia bigemina*), the parasitic stages are transmitted in final host. *Babesia bovis* is small, paired form at an obtuse angle to each other (1-1.5 x 0.5-1µm). *Babesia bigemina* is large paired at and acute angle to each other. *Babesia bovis* is more virulent species leading to hypotensive shock syndrome, generalized non specific inflammation, coagulation disturbances, erythrocytic stasis in capillaries and *Babesia bigemina* responsible for direct destruction of erythrocytes. Clinically in first week signs are manifested by acute phase of fever (41^0C), anaemia, increased respiration, jaundice and haemoglobinemia, haemoglobinuria and CNS involvement in late stages.

Theileriosis in bovine species is tick borne disease caused by *Theileria parva* (most pathogenic) and *Theileria annulata.* Infective stage (sporozoite) of parasite found in saliva of tick which is injected during feeding to animal host; invade leukocytes and developed into schizont. Concurrent division of parasitized WBCs increases the number of schizont in host. Some schizont give rise to merozoites and invade the RBCs. Infected RBCs are up taken by tick to complete the cycle. Clinically, the disease is manifested with high fever, swollen lymph nodes, dyspnea, lymphocytolysis, lymphoid depletion and leucopenia. *Theileria parva* causes the East Coast Fever (ECF) in cattle and *Rhipicephalus appendiculatus* is a potential vector tick. In RBCs small and rod or oval shaped merozoites are visible under microscope.

Trypanosomiasis caused by various species of *Trypanosome*; out of which *Trypanosome evansi* is responsible for surra in cattle. Surra is also vector borne disease mostly to due Tsetse fly (*Glossina* spp.) and other biting flies (*Tabanus*). Metacyclic form of parasite is infective stage present in the vector.

Treatment trials in positive cases provide the effectiveness of drugs commonly used in context of our country. For instances, the positive cases of bovine anaplasmosis are treated with tetracycline group of antibiotics and imidocarb. Similarly, diaminazene acetaurate and imidocarb are used in case of babesiosis, buparvaquinones/ butalax in theileriosis and diaminazene acetaurate in trypanosomiasis.

The differential clinical signs during various haemoprotozoan infections and symptoms are useful in the diagnosis of disease. However, difficulties are aroused when there are presences of subclinical cases, low level of parasitemia; the microscopic detection is also impossible. The carrier state of previously infected animal may show false negative during microscopic evaluation. Based on such conventional technique there are also problems in differentiation of species parasite on the basis of morphology mainly during the mixed blood parasitic infections. Serology based diagnostic tests like; IFT, ELISA are frequently used for determining subclinical infection. However, intra-species cross-reactivity of antibodies and insufficient sensitivity are shortcomings of test. For this reason, the use of specific and sensitive molecular alternative techniques has become necessary for confirmatory detection of determinants of haemoprotozoan diseases. In this research molecular diagnosis of haemoprotozoan by use of PCR was planned. Due to the emergence of COVID-19 in the country we couldnot perform the planned activity in this FY. This project is terminated.

Methodology

Hundred blood samples were collected from peripheral blood vessels of cattle from different dairy farms of Morang (40), Rupandehi (30) and Surkhet (30) districts in FY 2075/76. Serum was separated and kept in serum vials and whole blood in EDTA vials maintaining cold chain in cool box. Blood smears were prepared at field level and fixed with 10% methanol. After staining with Giemsa-Stain the slides were microscopically observed under oil immersion (100X).

DNA extraction

DNA extraction was carried out by using protocol provided in QIAGEN tissue and blood test kits, in Center for Biotechnology Laboratory of Agriculture and Forestry University (AFU), Rampur.

- Cleaning and decontamination was done by spraying bench, pipette and equipment with freshly made 10% bleach solution, after 15-30 min. then wiped away any residual bleach and rinsed with clean water and finally sprayed with 70% ethanol.
- Gloves were worn at all times, all equipments were checked for proper placement and buffers were prepared (alcohol+AE). Heating equipment set at 56^0C.

The quality and quantity of DNA was detected in nano-spectrophotometer. About 1 µl of extracted sample was allowed to nano-spectrophotometer.
The extracted DNA sample having the value 1.8 (260nm /280nm ratio) were subjected to PCR in *BIORAD T100* thermal cycler.

Dilution of primer

During this process all the works were performed in ice. The primers (Oligos) were manufactured by Sigma-Aldrich in dry forms. For dilution, we had used TE buffer in calculated amount as given in the technical data sheet. Babesia F with 466 µl, Babesia R with 463 µl, Anaplasma F with 468 µl, Anaplasma R with 491 µl, Trypanosoma F with 526 µl, Trypanosoma R with 465 µl, Theileria F and Theileria R with 435 µl of TE buffer.

To prepare aliquots from diluted primer which was used in PCR mixture; we had prepared total of 40 µl of solution containing 32 µl of TE buffer while 8 µl of diluted primer so that the ratio of diluted primer: TE buffer at 1: 5.

Mixture for PCR

- Nuclease Free Water (NFW) = 7 µl, Master Mix (MM) = 10 µl
- Forward primer (F) =1 µl, Reverse primer (R) =1 µl
- Extracted DNA (60ng/ µl) = 1 µl.

Fwd: 5`AGAGTTTGATCCTGGCTCAG 3` Rev:5`GTTAAGCCCTGGTATTTCAC 3` primer were used for *Anaplasma* sp. Initial denaturation at 95^0C for 5 min. Denaturation (40 cycles) at 94^0C for 30 sec. Annealing at 55^0C for 30 sec, Elongation at 72^0C for 90 sec. Final extension at 72^0C for 5 min.
Fwd: 5`CAGGATTGCTTTCGCAACAAG 3` Rev: 5`CCTTGACATAACCGGCGAGG 3` and Fwd:5`GCGCGGATTCTTTGCAGACGA3`Rev:5`TGCAGACACTGGAATGT-TACT3`primers are used for *Babesia* sp. and *Trypanosome* sp. respectively with initial

denaturation at 95^{0}C for 5 mi., Denaturation (30cycles) at 94^{0}C for 30 sec. annealing at 57^{0}C for 60sec, elongation at72^{0}C for 90sec. and final extension at 72^{0}C for 10 min. Fwd:5'CCTGAGAAACGGCTACCACATCT3'Rev:5'GGACTACGACGGTATCTGATCG3' primer is used for *Theileria* sp. with initial denaturation at 94^{0}C for 5 min., denaturation (25cycles) at 94^{0}C for 30 sec. annealing at 51^{0}C for 30sec, elongation at72^{0}C for 30sec. and final extension at 72^{0}C for 5 min.

Gel-electrophoresis

It was performed using 1.5% agarose 1X TBE in gel electrophoresis tank (CLEAVER Scientific Ltd.).

- 1.5% agarose gel was prepared by dissolving 1.05 gm (Calculation; 1.5 x 70/100) of agarose powder in 70 ml of 1X TBE (same concentration was also used in tank).
- Ingredients for Gel-E-Run: for each well, the well mixed solution of Loading Dye = 1 µl (6X) and PCR sample = 5 µl was dropped genteelly in the well of gel where ladder of (100bp) = 6 µl was dropped into single well (generally into first and last well).
- The setting of current in gel-electrophoresis was 400 Amp, 80Volt for 1.5 hr.

Then subjected to L.E.D. ORBIT SHAKER in the solution of $EtBr_2$ (15min.) and distilled water (DW) (5min.) and the gel was observed under the clear view UV-Transilluminator.

Results

While examining 100 blood smears under under microscope prevalence of anaplamosis, babesiosis, theileriosis and trypanosomiasis was found to be 5%, 4%, 7% and 11% respectively. In PCR 9% samples were found positive for anaplasmosis (band of 577 bp).

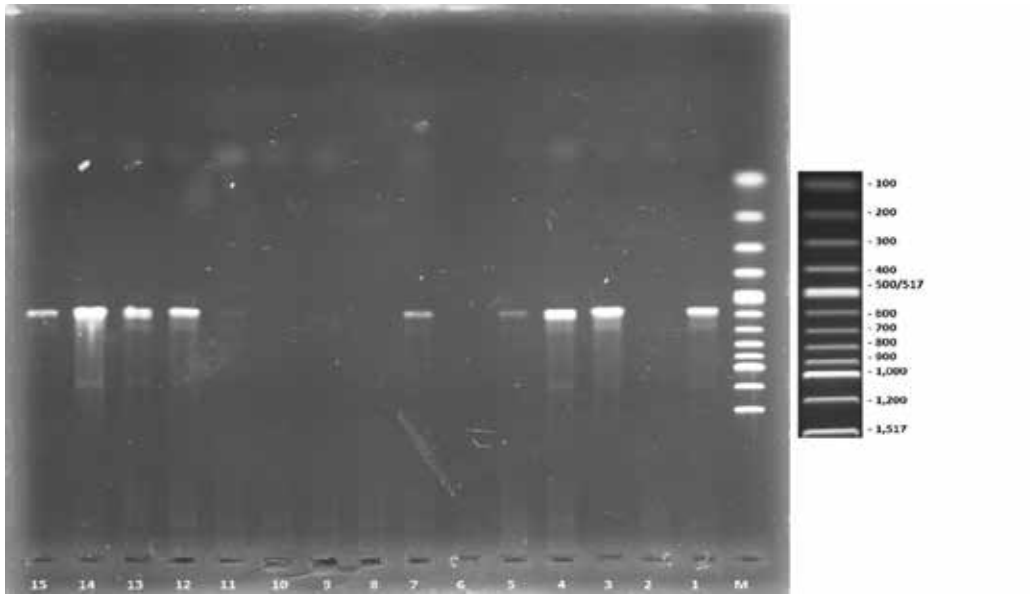

Fig 2: Identification of *Anaplasma* sp. from blood sample of cattle by Polymerase Chain Reaction (PCR). Lane, M: DNA Marker 100bp. Lane,1,3,4,5,7,12,13,14,15 positive samples with base pair 577.

3.1.3 Isolation and Molecular Characterization of SIGA Toxin Producing *E. coli* O157:H7 in Milk of Cow

Introduction

Milk being the solitary remnant of human food used among all ages of life and plays an important role in the Nepalese diet. The products are prepared through conventional methods without hygienic quality; allow growth and multiplication of different microorganism (Sethulekshm, 2018; Soomro 2002). So, it is necessary to produce quality milk having devoid of any contamination. Raw milk is consumed among farm families as they believe raw milk and their products are healthier over pasteurized one (Ali, 2011), which is totally wrong perception. Microorganisms may enter raw milk through damaged udder, milkier (human as well as automated), external dirt or unhygienic processing of milk and water.

Among number different microorganisms *E. coli* is most frequently contaminating organism on normal flora of intestinal tract of warm-blooded animals and is considered a major concern of dairy and food industries. It has capability of causing serious illnesss by producing siga toxins (Vallance, 2011). In recent years, it is reported that *E. coli* has become an organism of public health significance due to its association with life-threatening diseases in human beings. Among *E. coli*, Shiga toxigenic *E. coli* (STEC), especially the serotype O157:H7 is an emerging foodborne pathogen capable of causing potentially fatal illnesses such as hemorrhagic colitis, hemolytic uremic syndrome, and thrombocytopenic purpura in man.

Knowledge regarding milk quality and safety, awareness on milk microbial and chemical composition are of serious importance for public health as well as health of animal (calf scour), to reduce illness and mortality. In context of Nepal, due to lack of research on milk borne health hazard, we are unable to find out status of siga toxin in raw milk of cow.

Specific objectives

-To investigate the prevalence of pathogenic bacteria *E. coli* O157:H7 in raw milk of cow.

- Molecular characterization of *E. coli* O157:H7 using pair of specific, stx1 and stx2 primers.

Methodology

Collection and Preparation of Samples

Total of 322 raw milk samples were collected from Shrawan to Chaitra 2076 in sterile glass bottles aseptically from different areas of Chitwan (n= 243) and Nawalparasi (n= 79) districts of Nepal.

All the collected samples were processed within 24 hr in the laboratory adopting all possible hygienic measures during collection, transportation and processing of samples.

Bacterial isolation

For *E. coli* O157:H7 detection, 25 ml of milk from each sample was homogenized in 225 ml of modified tryptone soy broth supplemented with 0.5 mg/ml novobiocin and incubated at 37 °C for 24 hr.

After 24 hr, the broth was observed for turbidity and growth.

A loopful from mTSB broth was streaked on sorbitol Mac Conkey agar supplemented with 0.05 mg/liter cefixime and 1.25 mg/liter Potassium tellurite (CTSMAC) and incubated at 37 °C for 24 hr.

Characterization for *E. coli* O157:H7

Two to three typical sorbitol negative colorless colonies were sub-cultured on CT-SMAC agar plates for purification of serotype O157:H7 isolates.

Finally, colorless colonies were streaked on EMB (Eosin Methylene Blue) agar plates and incubated for 24 hr at 37 °C.

The typical metallic shine *E. coli* on EMB agar plates were stained with Gram's stain and confirmed by several biochemical tests {Citrate Utilization test, O-nitrophenyl-D galactopyranoside (ONPG), Indole Production, Voges-Proskauer (VP), Methyl Red (MR), Nitrate reduction, Urease, Ornithine decarboxylase, Lysine decarboxylase, Arginine, Dulcitol, Catalase, Oxydase, Sorbitol, Rhamnose, Manitol, Glucose, Arabinose, Gelatin, TSI}.

DNA Extraction

DNA will be extracted using standardized cetyltrimethyl ammonium bromide (CTAB) method as described by Ausubel *et al.,* (2003).

Polymerase Chain Reaction (PCR)

The extracted DNA form *E. coli* O157:H7 will be used for amplification of stx producing stx1 and stx2 genes using two specific pairs of oligonucleotide primers (Olsvik, 1993).

Results

During the isolation of *E. coli* bacteria in the raw milk of cow, the overall prevalence rate was 15.21% (49/322) and district-wise prevalence rates were; 16.46% (40/243) and 11.39% (9/79) in Chitwan and Nawalparasi districts respectively.

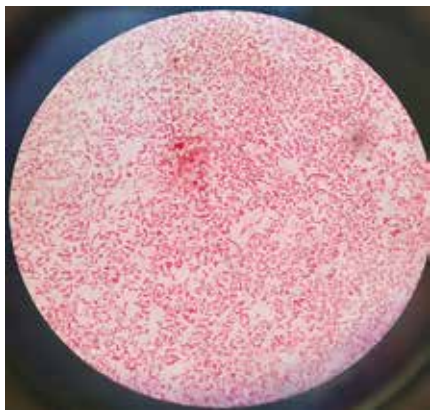

Fig 3: *E. coli* (Grams' stained, 100X)

Fig 4: Green metallic sheen in EMB media

3.1.4 Evaluation of Protective Immunity and Longevity of Haemorrhagic Septicemia (HS) Vaccine Commonly Used in Nepal

Hemorrhagic Septicemia (HS) is a major disease of cattle and buffaloes characterized by an acute, highly fatal septicemia with high morbidity and mortality. It is caused by certain serotypes of *Pasteurella multocida* that are geographically restricted to some areas of Asia, Africa, Middle East and Southern Europe (OIE, 2012). In animals, it is not always possible to treat animals in acute cases. Therefore, prevention is the only effective measure by immunization of animal.

In Nepal, combined form of vaccine for Hemorrhagic Septicemia and Black Quarter (HS+BQ) has been produced since 1967 and vaccines produced in India are also in use. However, till date there is no any work have been done on performance, efficacy and longevity of such vaccines. It is very crucial to know the protective immunity and longevity of these commonly used vaccine to know the time for booster dose and level of protective immunity as well. It is in high demand from Department of Livestock Services (DLS) to conduct research works for the evaluation of these commonly used vaccines.

Hemorrhagic Septicemia is characterized by a rapid course, fever, edematous swelling in the head-throat-brisket region, swollen and hemorrhagic lymph nodes and presence of numerous sub-serous petechial hemorrhages (Nas *et al.*, 2012). The disease has a major impact on the livestock industry in countries of South and Southeast Asia, where HS associated with serotype B: 2 is distributed widely (Dagleish *et al.,* 2007; Hajikolaei *et al.,* 2008; Ataei *et al.,* 2009). It results in severe economic losses and is ranked as the most important contagious disease of cattle and buffaloes (Benkirane and De ALwis, 2002).

Humoral immunity plays an important role in protection against the disease. Vaccination is the effective measure in controlling mortality in HS (Plotkin, 2009). The vaccines used against HS include broth bacterins, alum precipitated, aluminium hydro oxide gel and oil adjuvated (Confer, 1993). The alum precipitated and aluminium hydro oxide gel vaccines are reported to confer immunity for 4-6 months. Oil adjuvant vaccines that impart higher level of immunity up to one year. However, due to viscous it experienced a bit difficulty while injecting and cause inflammation on the site of vaccination. Although, there is no other alternative of vaccination in this disease. Crucial part is protective immunity and longevity of the vaccine.

In Nepal, no studies have been carried out so far to know the protective immunity and longevity of HS vaccines which are being used currently.

Hemorrhagic Septicemia was traditionally regarded as being caused only by serotype B or E, but other serotypes are recognized as causing the disease, particularly serotypes B:1 and B:3,4 (Bastianello & Henton, 2004). The two common serotypes of *Pasturella multocida* associated with the disease are types B: 2 (in Asia) and E: 2 (in Africa). The Asian B: 2 serotype has also been associated with sporadic septicemia disease in pigs. In Egypt and Sudan, the presence of both B and E serotypes has been reported.
However, in our context the evaluation particularly on protective immunity and duration of immunity (longevity) have not been studied. Therefore, it is very crucial to know the time of vaccination for which we should know the longevity of protective immunity. Commonly, combined vaccines of HS+BQ are being used in our country. Once evaluation we can recommend the time interval or booster dose of these vaccines.

Methodology
Study design

Three treatment groups of cattle with 20 heads in each group were made. Treatment 1 (T1) for Nepali vaccine, Treatment 2 (T2) for Indian vaccine and other is control group (without vaccination). Sample were collected in such a way that 10 adult cattle each from NCRP farm and 10 cattle from Madi, Chitwan were allocated in each trial group.

Pre-vaccination sampling

Serum sample from ten cattle of each group was taken for pre vaccination immunity status estimation.

Vaccination

We did regular vaccination in cattle of NCRP farm and Madi-OR site. For this same breed of cattle were selected. In control group cattle were kept without vaccination for antibody monitoring. H.S. & B.Q. COMBINED ALUM ADJUVANT VACCINE @ 5ml/animal by subcutaneous route manufactured by National Vaccine Production Laboratory, Tripureshwor; Kathmandu, Nepal was used in treatment 1(T1) group. Similarly, HAEMORRHAGIC SEPTICEMIA AND BLACK QUARTER VACCINE (Raksha-H.S. + B.Q.) @ 3ml/animal by subcutaneous route manufactured by INDIAN IMMUNOLOGICALS LTD, Hyderabad, India was used in treatment 2 (T2) group.

Post vaccination sampling

For estimation of immunity and longevity first sampling was done at 21st days of post vaccination then after, in every one month regularly for 6 months to know the longevity of immunity. Blood was collected and serum was separated in aseptic ways. Sera were kept in -40^{0}C until analysis.

ELISA test

For the analysis of serum sample ELISA test will be carried out. It will determine the antibody titer in vaccinated and non-vaccinated individuals. Due to emergence of COVID-19 in the country we were unable to purchase ELISA test kit and test could not be performed in this FY.

3.1.5 Epidemiological Studies on Cattle Mastitis

Mastitis is major economic disease-causing huge loss due to impairement in milk production and permanent mammary gland damage. Rather than the sporadic it is herd disease due to poor managemental practices in country like Nepal. The mastitis-associated losses include loss of milk production, cost of treatment and control of disease, cost of extra labor, discarded milk due to mastitis and drug residues and replacement cost of culled cows, loss of milk quality and increased risk of other diseases.

Subclinical mastitis is difficult to detect due to the absence of any visible clinical sign and has major cost implications associated with decreased milk production (Viguier *et al.,* 2009). Due to unjudicial use of the antibiotics and treatment protocols, development of drug resistance bacteria which also impacts on the public health aspect like MRSA (11.25 % according to Joshi, 2012), ESBL producing *E. coli* (43% according to Sascha, 2012).

The most growing concern about unsuccessful treatment of this disease is due to the evolution of antibiotic resistivity. Haphazard use of antibiotic and incomplete treatment course leads to the resistant bacteria like ESBL *E. coli*, MRSA. Development of antibiotic resistant bacterial species possesses great threat to the treatment protocol as well as in public health concerns. Local farmers are unaware about the udder and teat hygiene and also proper biosecurity measures.

Due to the risk of quick and permanent damage to the alveolar cells of the mammary gland, we need to have knowledge about prevalence of predominant cause of mastitis and their antibiogram so that therapeutic as well as preventive protocols can be established. In this study we have planned to compare the efficacy and adaptability of different available diagonostic test for subclinical mastitis. Use of these tests will help to know the risk of mastitis by early diagnosis and warn farmer to prevent the clinical mastitis in their dairy animal.

Also serotyping of the *Staphylococcus aureus* will be carried out by 6 pairs of primers including genes encoding coagulase (coa), clumping factor (clfA), the IgG-binding region and the X-region of protein A (spa), enterotoxin A (entA), and thermonuclease (nuc). Result with different bp helps to determine the strain of bacteria responsible for the clinical and subclinical mastitis.

Methodology

Milk samples were collected from individual farms and milk collection centers of Chitwan & Nawalparasi district. Samples were collected at the early morning and random sampling method was followed. The milk samples were collected in sterile bottles followed by coding. After collection milk samples were brought to the NCRP laboratory by placing in a cool box. These samples were tested immediately after arrival at the laboratory. All the samples were subjected to cultural examination on Nutrient agar, Mac-Conkey agar plate & Mannitol agar plate. They were incubated at 37°C for 24 hours. Cultural isolates were identified on the basis of colony characteristics, Gram's staining and biochemical tests. Identification of *Staphylococcus* was done by gram staining (purple grape like cluster) and various biochemical tests like catalase test and oxidase test. Slide coagulase test was done to identify *S. aureus* and CNS. All the bacteria isolated through microbiological procedures were subjected to antimicrobial susceptibility test by disc diffusion method to a large number of antibiotics. Isolated *Staphylococcus* colony preserved in 20% glycerol & stored at -40^{0}C for further molecular analysis.

Result

Prevalence of subclinical mastitis

A total of 322 samples were collected from western Chitwan & Nawalparasi district of Nepal. Overall prevalence of subclinical mastitis in western Chitwan and Nawalparasi was found to be 42.8% (104/243) & 32.9% (26/79) respectively.

Prevalence of Staphylococcal SCM at animal level

The overall prevalence of Staphylococcal SCM was found to be 39.92% (97/243) and 18% (15/79)) in Chitwan and Nawalparasi respectively.

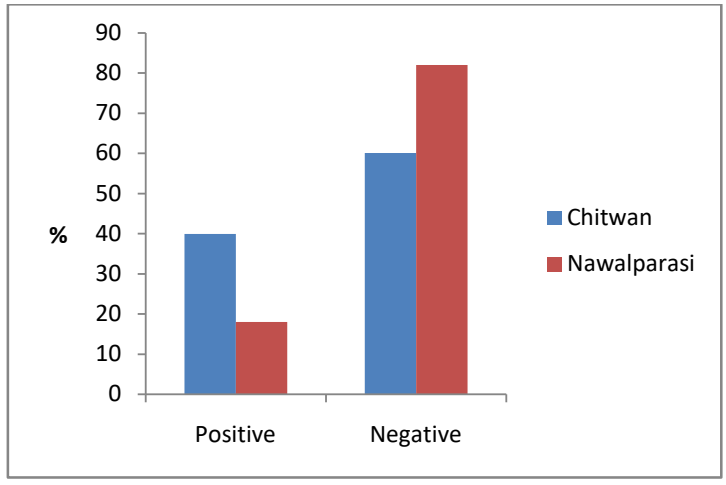

Fig 5: Prevalence of Staphylococcal SCM at animal level

AST of *S. aureus* isolates in western Chitwan

AST of 95 *S. aureus* isolates was performed. Ceftriaxone 80.0% was the most sensitive antibiotic followed by Gentamicin (76.8%). Ciprofloxacin showed highest intermediate sensitivity i.e., 56.8% sensitivity. *S. aureus* was resistant to Enrofloxacin (41.1%) and Tetracycline (36.8%). Table 3 shows the AST result for *S. aureus* isolated in western Chitwan, Nepal.

Table 3: AST of *S. aureus* isolates

	Sensitive		Intermediate		Resistant	
Antibiotics ↓	**n**	**%**	**n**	**%**	**n**	**%**
Tetracycline	8	8.4%	52	54.7%	35	36.8%
Gentamicin	73	76.8%	-	-	22	23.2%
Enrofloxacin	4	4.2%	52	54.7%	39	41.1%
Ceftriaxone	76	80.0%	15	15.8%	4	4.2%
Ciprofloxacin	15	15.8%	54	56.8%	26	27.4%

3.2 Cattle Breeding

3.2.1 Evaluation of the Local Dairy Cows through Crossbreeding with Exotic Breed Semen at NCRP Farm, Rampur, Chitwan

Twenty local terai heifers (phenotypically) were brought from the Rautahat district of Nepal and introduced at NCRP farm in the first trimester of FY 2074/75 BS. For pure breeding, we also introduced two bulls of Terai breed from Tribeni area of Nawalparasi in the same FY. Routine work like feeding, breeding, deworming, vaccination against HS, BQ and FMD, recording of breeding and production performances were carried out. In this core project, productive and reproductive performances of pure and crossbreds are being evaluated. For the production of crossbreds, artificial insemination by Jersey and Holstein Freisian bull's semen with Pure Terai cow is undergoing (In this FY we used sexed semen). Pure Terai breed was also maintained by breeding Pure Terai bulls and Pure Terai cows.

In this FY 5 Terai & HF crossbreds, 3 Terai & Jersey crossbreds and 6 pure Terai calves were born. Daily milk production of pure terai cattle is being recorded. Similarly, growth and reproductive parameter of new born calves were also recorded routinely.

Average daily milk yield of Terai cattle was 1.33 liter (0.5-3 liter). Average milk quality parameters of Terai cows are mentioned in table 29.

Fig 6: Different activities with Terai cattle in NCRP Farm, Rampur

3.2.2 Assessment of Major Reproductive Hormones in Cyclic and Non- Cyclic Crossbred Dairy Cows

Most of the cattle dairy farms are facing problem of infertility despite of their good managemental practices, which ultimately retards the farm economy. Currently practice of using hormones as treatment for infertility is becoming popular. Veterinarians and technicians are making use of exogenous reproductive hormones to overcome infertility in cows, but without assessing the hormonal profile. In this context, success results are not observed as expected and widespread misuse of hormone prevails in this sector.

Hormones basically progesterone, estrogen, luteinizing and $PGF_{2\alpha}$ imbalance is major cause of functional infertility in dairy cows (Abraham, 2017). Hormonal response to infertility happens only if the animal hormonal profile is in disorder as per normal cyclicity.

Hormonal assessment will help to know whether non-cyclic animals under good managemental practices are due to deficit of required hormonal concentration. Eventually, this will also lead to wise use of hormones in farms. This will also help to analyze the deviation of reproductive hormonal physiology in infertile cows with respect to normal cyclic cows.

Methods and Methodology

In this FY, three cyclic and three non-cyclic cows were selected in NCRP Farm, Rampur. Non-cyclic cows in anestrous condition for at least six months and below fourth parity were selected in this FY. For cyclic cows, cows in 2 months of post calving stage and showing proper estrus signs in regular cycle were selected.

In cyclic cows, blood sample collection was made 16 times each (0 hr of estrus detection, 12 hr, 24 hr, 36 hr, 48 hr, 4^{th} d, 6^{th} d, 8^{th} d, 10^{th} d, 12^{th} d, 14^{th} d, 16^{th} d, 18^{th} d, 20^{th} d, 22^{th} d and 24^{th} d)

or same way upto next regular heat detection with vacutainer tube. In case of non cyclic cows, blood sample collection was done 13 times each (0 day, 2nd day, 4th d, 6th d, 8th d, 10th d, 12th d, 14th d, 16th d, 18th d, 20th, 22th d and 24th d). Serum was separated by centrifuging @ 2000 rpm for 10 minutes and kept in deep freeze (-40^0 C). In this FY due to emergence of COVID-19 in the country we were unable to perform the planned activity of quantitative analysis of hormones by using ELISA.

In FY 2075/76, five cyclic and five non-cyclic cows of NCRP farm were selected for research. Hormone assessment was done by using ELISA test kit. For determination of estrogen and progesterone ELISA kit manufactured by CUSABIO, USA was used and for determination of LH and FSH, ELISA kit manufactured by Life Technologies, India was used.

Table 4. Hormonal values in cyclic and non cyclic cows

Parameters	Cyclic (mean±SE)	Non-cyclic (mean±SE)	Level of significance
Estrogen (pg/ml)	385.83±156.29	950.52±472.25	Non significant
Progesterone (ng/ml)	7.27±1.959	5.61±0.86	Non significant
LH (pg/ml)	0.52±0.03	0.52±0.00	Non significant
FSH (ng/L)	0.32±0.02	1.78±0.86	Non significant

Mean±SE values of estrogen and FSH are less in cyclic cows than non cyclic cows but mean±SE values of progesterone and LH are higher in cyclic cows than non cyclic cows. These values do not show statistically significant difference between cyclic and non cyclic cows ($p>0.05$).

LH value obtained by Mori *et al.,* 1974 (22720 ± 5680 pg/ml) is higher than our finding (0.52±0.03 pg/ml). FSH value obtained by Mondal *et al.,* 2004 (0.0017 ± 0.00031 ng/L) is lower than our finding (1.78±0.86 ng/L). Similarly estrogen and progesterone values obtained in our study are higher than Ahammed *et al.,* 2018. Where estrogen and progesterone values were 107.30 ± 6.97 pg/ml and 5.93 ± 0.42 ng/ml respectively.

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3.3 Cattle Fodder/Pasture and Nutrition

3.3.1 Development of Year Round Cost Effective Forage Based Milk Production Technology for Crossbred Cattle

Nepal is regarded as agricultural country where more than 65% of its population depends on agriculture for sustaining their livelihood. Livestock sector is an integral part of Nepalese agriculture system. Livestock provides nutritious food for human consumption, draft power for agricultural operations, transportation, manure for maintaining and increasing soil fertility. Livestock sector contributes about 25.68% to agricultural GDP of the country and dairy sector contributes about 2/3 rd of livestock GDP (MoF, 2019).

The breeding as well as feeding problem are perceived more serious in cattle than in buffaloes. Average production from a cow lies between 3-4 liters per day with broad range from 2-32 liters per day. This wide variation provides ample opportunity for improvement milk production in a herd.
The small holder farmers of developing countries have limited resources available for feeding their ruminant livestock. They do not have the luxury of being able to select the basal diet but use whatever is available at no or low cost. Many of the available feed resources are with low digestibility such as tropical pastures (both green and dry), crop residues and agricultural by-products which are also with low protein.

The livestock raising system in country is traditional one. Most of the farmers rear local breeds which have better adoptability and need less feed and other managements but they have lower productivity. Also, the production from these local breeds is not sufficient to accomodate the gap between demand and supply of livestock products in the country.

Population of local breeds of cattle in the country is very high compared to exotic cattle breeds. Most of the farmers are rearing their animals by feeding low quality concentrate feed and low grade roughage like straw and stover. Green grasses which are available seasonally are also with poor quality. This has resulted into high production cost of livestock products causing less return to farmers. Nowadays population of exotic dairy cattle breeds is increasing but unable to get expected production, it may be due to lack of proper feeding regime. This study will help to make proper feeding regime to improve milk production in cow.

Collection and cultivation of winter legume and non-legume forages germplasm
The different germplasm of winter legume (common vetch 100 kg and pea 50 kg) and non-legume (oat 200 kg) were collected from Fodder and Pasture Research Division, Khumaltar; Forage Seed Production Farm, Ranjitpur, Sarlahi and National Livestock Breeding Office, Gaughat, Banke. The collected seeds were cultivated at pasture/fodder cultivation plot of National Cattle Research Program, Rampur.

Yield assessment of winter forage
Both dry matter and green matter yield of winter forages cultivated in NCRP farm was assessed. In this FY oat, common vetch and pea were cultivated.

Table 5: Bio-mass and dry matter yield of winter forages cultivated in NCRP, Rampur

SN	Crop	Bio-mass yield (ton/ha)	Dry matter (ton/ha)
1	Oat	37.48	9.32
2	Common Vetch	19.65	4.65
3	Pea	22.77	5.10

Economic analysis of winter forage

The economic analysis of winter forage production (legume and non-legume) was done as presented in table 6, 7 & 8.

Production requirement

Table 6: Input requirements for production of winter forage

SN	Crop	Area (ha)	Seed (kg)	DAP (kg)	MOP(kg)	Urea(kg)	No. of labor for sowing	Tractor use time for cultivation (Min)	No. of labor for harvesting
1	Vetch	0.5	25	100	50	0	2	75	30
2	Pea	1	50	200	100	0	4	150	40
3	Oat	2	200	400	200	200	8	300	120

Production cost

Table 7: Production cost for winter forages

SN	Crop	Rent of land (Rs.)	Seed cost (Rs.)	DAP (Rs.)	MOP (Rs.)	Urea (Rs.)	Labour cost (Rs.)	Tractor cost (Rs.)	Harvesting labour cost (Rs.)	Total cost (Rs.)
1	Vetch	5000	2500	4430	1615	0	1034	1650	15510	31739
2	Pea	10000	22500	8860	3230	0	2068	3300	20680	70638
3	Oat	20000	8000	17720	6460	3860	4136	6600	62040	128816

Per kg biomass production cost

Table 8: Per kg production cost of winter forage

SN	Crop	Average bio-mass production (kg/m^2)	Total production (kg)	Per kg cost (Rs.)	20% margin (Rs.)	Per kg final price (Rs.)	Per kg average cost of legume (Rs.)
1	Vetch	1.97	9825	3.23	0.65	3.88	3.80
2	Pea	2.28	22770	3.10	0.62	3.72	
3	Oat	3.78	75680	1.70	0.34	2.04	

Collection and cultivation of summer/rainy season legume and non-legume forage

The summer/rainy season legume (rice bean) and non-legume (teosinte, sorghum, bajra, maize) forages were collected from different sources. These seed were cultivated at NCRP, Rampur fodder cultivation plot.

Yield assessment of summer/rainy season legume and non-legume forage

The different parameter (biomass yield and dry matter) of summer/rainy forage crops were recorded as presented in table 9:

Table 9: Bio mass and dry matter yield of summer forages cultivated at NCRP, Rampur

SN	Crop	Bio-mass yield (ton/ha)		Dry matter (ton/ha)	
		First cut	Second cut	First cut	Second cut
1	Teosinte	30.0	51.7	6.81	15.69
2	Maize	38.8	-	9.49	-
3	Sorghum	34.2	-	7.66	-
4	Bajra	30.0	-	6.06	-
5	Rice bean	21.6	-	6.73	-
6	Teosinte + Rice bean	54.75	-	14.21	-

Economic analysis of summer/rainy season legume and non-legume forage

The cost benefit analysis was estimated by considering different parameters like seed to bio-mass yield, rent of land, labour charge, seed cost, fertilizer cost, ploughing cost etc. Detail is provided in the table below:

Production requirement

Table 10: Input requirements for production of summer forage

SN	Crop	Area (ha)	Seed (kg)	DAP (kg)	MOP (kg)	Urea (kg)	Cow dung (Trolley)	No. of labor for sowing	Tractor use time for cultivation (min)	No. of labor for harvesting
1	Teosinte	1	35	200	100	100	8	4	150	40
2	Rice bean	0.5	12	100	50	0	5	2	75	17
3	Teosinte + Rice bean	0.5	12+8	100	50	50	5	2	75	25
4	Bajra	0.5	5	100	50	50	5	2	75	20
5	Sorghum	0.5	8	100	50	50	5	2	75	24
6	Maize	0.5	15	100	50	50	5	2	75	24

Production cost

Table 11: Production cost for summer forages

SN	Crop	Rent of land (Rs.)	Seed cost (Rs.)	DAP (Rs.)	MOP (Rs.)	Urea (Rs.)	Cow dung cost (Rs.)	Labour cost (Rs.)	Tractor cost (Rs.)	Harvesting labour cost (Rs.)	Total cost (Rs.)
1	Teosinte	10000	3500	8860	3230	1930	32000	2068	3300	20680	85568
2	Rice bean	5000	2400	4430	1615	0	20000	1034	1650	8789	44918
3	Teosinte + Rice bean	5000	2800	4430	1615	965	20000	1034	1650	12925	50419
4	Bajra	5000	600	4430	1615	965	20000	1034	1650	10340	45634
5	Sorghum	5000	960	4430	1615	965	20000	1034	1650	12408	48062
6	Maize	5000	750	4430	1615	965	20000	1034	1650	12408	47852

Per kg biomass production cost

Table 12: Per kg production cost of summer forage

SN	Crop	Average bio-mass production (kg/m^2)	Total production (kg)	Per kg cost (Rs.)	20% margin (Rs.)	Per kg final price (Rs.)
1	Teosinte	8.17	81700	1.05	0.21	1.26
2	Rice bean	2.16	10800	4.16	0.83	4.99
3	Teosinte + Rice bean	5.47	27350	1.84	0.37	2.21
4	Bajra	3.00	15000	3.04	0.61	3.65
5	Sorghum	3.42	17100	2.81	0.56	3.37
6	Maize	3.88	19400	2.47	0.49	2.96

Collection and cultivation of perennial legume and non-legume forage germplasm

The different perennial forages (Legume: stylo and Non-legume: super napier, signal grass, setaria and perennial sorghum) were collected and cultivated at NCRP Rampur.

Prepare different feeding regime and conduct feeding trial in different season

Complete feeding regime for dairy cattle was prepared by making review of different literatures, advice of nutritionist, experienced farmers and our own research experience.

The feeding regime used was

2 kg concentrate was supplied to all groups as a maintenance ration. Extra concentrate was supplied on milk production basis as following way:

Milk yield (kg)	Ratio of milk yield to concentrate fed
Under 5 kg	5:0
5-10 kg	10:1
10-15 kg	7.5:1
15-20 kg	5:1
20-25 kg and more	3:1

Other remaining dry matter (DM) was provided to different treatment groups as mentioned below:

T_1 70% non legume + 10 % legume green forage + 20 % Dry roughage
T_2 60% non legume + 20 % legume green forage + 20 % Dry roughage
T_3 50% non legume + 30 % legume green forage + 20 % Dry roughage
T_4 40% non legume + 40 % legume green forage + 20 % Dry roughage
T_5 Control (as usual practices)

Number of Replication is 4

The experimental design was RCBD

Feeding trial was conducted on lactating animal in two different seasons (winter & summer).

Performance recording (milk production)

The milk production performance was recorded during the experimental periods as shown in table 13 & 14.

Table 13: Milk production performance in winter (First experiment)

Group	Average total milk production during the experimental period (32 days)
T1	373.61
T2	385.89
T3	412.24
T4	321.60
T5	348.91

Table 14: Milk production performance in summer (Second experiment)

Group	Average total milk production during the experiment period (30 days)
T1	209.90
T2	204.26
T3	251.85
T4	206.40
T5	255.27

Cost benefit analysis of feeding trial at different season

A comparative study of cost benefit analysis was performed for the intervention of effective milk production technology for cross bred cattle farming system. The expenditure and income analysis of milk production was calculated at the end of the experiments. The feeding expenditure were calculated by the adding up the cost of feed, grasses, field preparation, sowing, harvesting labours, rent of land and miscellaneous. The gross income was obtained by selling the milk. The experiment showed that in both winter and summer season, the feeding cost per liter of milk in T3 group was lowest than other groups. Cost benefit ratio was determined, which is given in the table 15 and 16.

Table 15: Milk production cost during the winter (Experiment conducted from Magh to Chaitra-1st experiment)

Group	Average daily required amount (kg)				Cost of daily requirement (Rs.)				Consumption/day (Rs.)	Total cost of 32 days (Rs.)	Total milk yield of 32 days (Lit.)	Feeding cost of per lit. milk
	Concentrate	Oat	Legume	Dry roughage	Concentrate @ Rs. 45.75	Oat @ Rs. 2.04	Legume forage @Rs. 3.80	Dry straw @ Rs.12				
T1	4.47	26.95	3.85	2.12	204.65	54.97	14.63	25.41	299.66	9589.00	373.61	25.67
T2	4.60	26.21	8.74	2.40	210.65	53.48	33.20	28.84	326.17	10437.41	385.89	27.05
T3	4.62	19.14	11.49	2.11	211.30	39.05	43.64	25.27	319.26	10216.32	412.24	24.78
T4	4.34	15.10	15.10	2.08	198.70	30.80	57.37	24.91	311.78	9977.01	321.60	31.02
T5	5.62	15.00	0	3.00	256.97	30.60	0.00	36.00	323.57	10354.33	348.91	29.68

Table 16: Milk production cost during the summer (Experiment conducted from Baisakh to Asar- 2nd Experiment)

Group	Average daily required amount (kg)			Cost of daily requirement (Rs.)			Consumption/day (Rs.)	Total cost of 30 days (Rs.)	Total milk yield of 30 days (lit.)	Feeding cost per lit. milk
	Concentrate	Oat	Legume (Stylo)	Concentrate @ Rs. 45.75	Oat @ Rs. 2.11	Legume forage @ Rs. 3.72				
T1	3.25	35.46	9.31	148.48	44.68	20.30	213.46	6403.67	209.90	30.51
T2	3.22	30.81	13.33	147.37	38.82	29.07	215.26	6457.67	204.26	31.62
T3	3.25	28.36	17.34	148.77	35.73	37.80	222.30	6668.86	251.85	26.48
T4	3.30	18.67	18.33	151.04	23.52	39.97	214.53	6435.78	206.40	31.18
T5	5.33	30.00	0.00	243.62	37.80	0.00	281.42	8442.56	255.27	33.07

3.3.2 Study on Hydroponic Fodder Production and its use in Dairy Animal

Hydroponics fodder production is the method of producing 7-8 days fodder seedlings without soil. In this system only moisture and nutrients are provided to the growing plants. Green fodder is an essential component of dairy ration for optimum productive and reproductive performances. However, the scarcity of adequate land, fertilizer, irrigation and labor along with unavailability of green fodder round the year are major constraints for fodder production and sustainable dairy farming. Due to these constraints in conventional fodder production system, hydroponics is coming as one of the progressive technologies in agriculture which satisfies the nutrient demand of livestock (Girma and Gebremariam, 2014).

In the previous fiscal year (075/76) a small hydroponic fodder production unit (green house) was established at NCRP having 140 metallic trays with small holes for water drainage (tray size 45 cm x 102 cm). The side wall and roof of hydroponic unit is made up of transparent fiber sheet and facilitated with motor regulated water sprayers and exhaust fans. With a daily arrangement of 20 trays replacement, this unit has daily production capacity of 260 kg fresh hydroponic maize fodder at 7 kg/m^2 seed rate.

Materials and methods

A study was carried out at NCRP to assess the effect of seed rate on green matter and dry matter yield of hydroponic maize fodder (HMF) in February, 2020. Accordingly, an experimental trial was conducted using Arun-4 variety of maize with four different seed rates (4 kg, 5 kg, 6 kg and 7 kg/m^2) replicated six times. The required amount of seed per tray (according to different seed rates) was soaked overnight on separate plastic pots. On the next morning the water from soaked seeds was drained and uniformly placed on the trays. After that water was sprayed to the seed regularly (4-5 times per day). No any nutrients and chemicals were supplied to the seeds. On the 11^{th} day hydroponic maize fodder was harvested from each tray and weighed. 500 gm sample of whole hydroponic maize fodder was taken for dry matter estimation. After harvesting the leaves along with stem and roots and germinated seeds were separated manually and weighed. Data were recorded in MS-Excel 2007 and analysis of variance was done by using SPSS version16. One-way ANOVA was applied and comparison between means was done by LSD at 0.05 level of significance.

Fig 7: Hydroponic maize production in NCRP, Rampur

Results

The production parameters of hydroponic maize fodder with different seed rates are presented below in table 17. The green matter yield (total fresh yield) per m^2 of hydroponic maize fodder was found significantly increased ($p<0.001$) with increasing seed rates. The other parameters; root & seed weight (as % of total yield), leaf & stem weight (as % of total yield), plant height, GM yield per kg seed and DM yield per kg seed were statistically non-significant ($p>0.05$). The root and germinated seed yield (as % of total yield) ranged from 68.22 to 69.00. This result is similar to the findings by (Naik *et al.,* 2017) who reported the root yield 68.52%, 67.51%, 68.41%, 68.32% with seed rates 3.8, 5.1, 6.2, 7.6 kg/m^2 respectively. Similarly, the

leaf and stem weight (as % of total yield) of present findings were also supported by those authors. The green matter yield per kg seed in this study was (4.11, 4.13, 3.99 and 4.01 kg) and dry matter yield per kg seed (0.83, 0.84, 0.86 and 0.90 kg) with seed rates 4, 5, 6, 7 kg m^2 respectively. Naik *et al.,* 2017 also got non-significant result on green matter and dry matter yield per kg seed. The authors obtained dry matter yield per kg seed in a range from 0.64 to 0.68 kg with above mentioned seed rates. However, the dry matter yield per kg seed in present findings was higher (0.83 - 0.90 kg) than that reported by Naik *et al.,* 2017 which might be due to delay in harvesting the HMF (on 11th day) in this study.

Table 17: Production performance of hydroponic maize fodder with different seed rates at NCRP, Rampur

Parameters	Seed rate, kg/m^2*				P value
	4	5	6	7	
Green matter yield per m^2 (kg)	16.46±0.25	20.68±0.27	23.97±0.13	28.09±0.55	0.000
Root and seed weight (% of total yield)	68.45±0.76	68.22±0.45	68.56±0.57	69.00±0.38	0.794
Leaf and stem weight (% of total yield)	31.55±0.80	31.64±0.46	31.45±0.57	30.98±0.38	0.856
Plant height (cm)	17.73±0.49	17.9±0.38	19.11±0.52	17.88±0.39	0.145
Green matter yield per kg seed (kg)	4.12±0.06	4.13±0.05	3.99±0.02	4.01±0.06	0.256
Dry matter yield per kg seed (kg)	0.83±0.03	0.84±0.04	0.86±0.03	0.90±0.02	0.421

*Values are (Mean±SE)

The green biomass yield of hydroponic maize fodder per square meter is presented below in table 18. The green biomass yield (fresh yield) per m^2 was statistically significant for different seed rates ($p<0.001$). Green matter yield per m^2 was highest in 7 kg/m^2 seed rate (28.09±0.55 kg) and lowest in 4 kg/m^2 seed rate (16.46±0.25). On one study on Rampur Composite variety of maize, 11.10 kg green matter per m^2 was produced with seed rate of 3 kg/m^2 on 8th day harvesting (NCRP, 2019).

Table 18: Green matter yield of hydroponic maize fodder per m^2 with different seed rates at NCRP, Rampur

Seed rate, kg/m^2	Green matter yield per square meter (kg)*
4	16.46±0.25^{a**}
5	20.68±0.27^{b}
6	23.97±0.13^{c}
7	28.09±0.55^{d}

*Values are (Mean±SE). ** Values with different superscripts differ significantly ($p<0.001$)

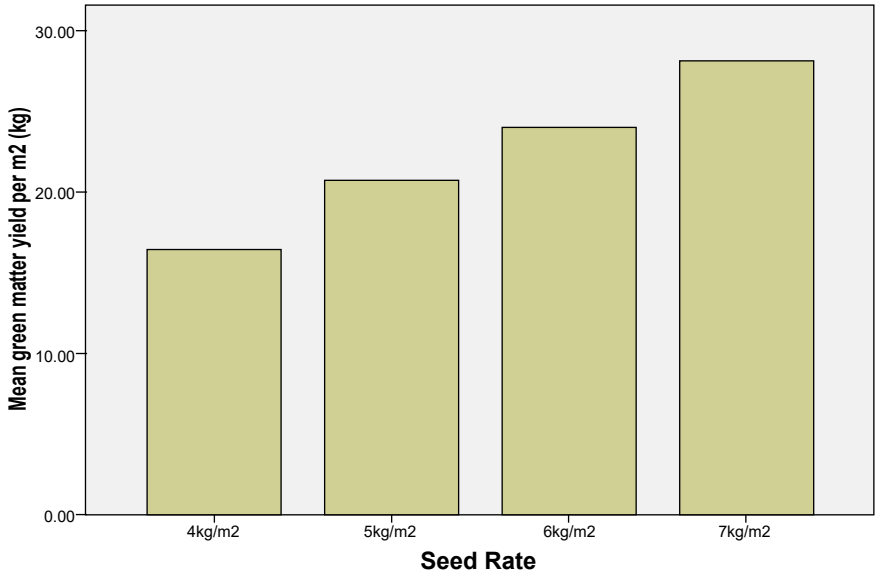

Fig 8: Mean green matter yield per m^2 in different seed rate

This result suggests that under the constraints of land availability with objectives of increasing forage production the seed rate 7 kg/m^2 is suitable for higher hydroponic maize fodder production per unit area. However, further study will be needed experimenting higher seed rates (8, 9, 10 kg/m^2) with nutrient analysis of fodder to have precise conclusion and recommendations.

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3.4 Cattle Production and Management

3.4.1 Study on Existing Situation of Heat Stress Management of Crossbred Cattle in the Dairy Pocket Area of the Terai Region During the Summer Months

Introduction

Cattle are an important livestock commodity in Nepal. Dairy sector contributes 8% in GDP. Cattle contribute 40% of total milk produced in the country. The cattle are most important in maintaining soil fertility, nutritional security and employment generation.

Hot environment affects the performance of dairy cattle directly as well as indirectly. Environmental factors consist of air temperature, humidity, air movement and radiation rate. In lactating Holstein cows, the comfortable temperature is within the range 4-24^{o}C. The effects of heat stress on the cows begin to be observed above 24^{o}C, and milk yield decreases markedly above 27^{o}C. A decline in milk yield, fertility and growth rate in hot environments is directly related to an increase in body temperature (BT). BT results from the balance between heat production (HP) and heat loss (HL). Since humidity affects the HL from an animal under high temperature conditions, dairy cattle performance falls markedly in hot, humid summers. Moreover, HP is associated with feed intake level, which in turn affects the production level. In high-producing cows, the HP is higher and the effect of a hot environment is more pronounced. Preventing an increase in body temperature in hot environments can be approached in three ways:

- Lowering the environmental temperature by modifying the structure of the shed where the cattle are kept, or by introducing cooling facilities.
- Increasing heat loss from animals by sprinkling them with water, using fans and so on.
- Increasing the efficiency of feed energy utilization, and reducing the heat increment of animals from feeding.

There are lacks of specific guidelines to combat the problem of the heat stress in cross bred cattle. Providing shade of tree, use of thatch roof etc. are common practice for heat stress management. By properly managing heat stress condition, production and productivity of cattle can be enhanced.

Due to climate change temperature of inner terai and terai region is increasing at the rate of 0.04^{0}C annually. There are many animals reared by supplying poor plane of nutrition and without use any technique to combat heat stress. Animals are mostly dependent on straw feeding only. Management of heat stress for improving productivity of dairy animals during the summer months is of prime importance.

Selection of animal and preparation of research protocol and materials

Lactating dairy crossbred cattle of similar parity, calving months, production level and stage of lactation were selected for heat stress management trial in the National Cattle Research Program, Rampur. The research protocol and material (fan, sprinkle and place) were managed before the trial setting.

Heat stress management trial conduct

Twenty crossbred lactating animals were selected and arranged in following ways for the trial conduction.

Replication: 4 (one animal was kept in one replication)
Treatment: 5 (4 animals were kept in one treatment)
Design: Randomized Complete Block Design (RCBD)
T_1: Kept in cattle shed under gypsum board during the experiment period
T_2: Under metal roof and sprinkle at 12 noon and 3 pm
T_3: Under metal roof and sprinkle at 12 noon, 3 pm and fan cooling from 12 noon to 4 pm
T_4: Under metal roof and fan cooling from 11am to 4 pm
T_5: Control

Experimental period: 2076/02/10 to 2076/05/25

Temperature condition inside the cattle shed

The maximum and minimum temperatures were recorded during the experimental period (approx four months) which is shown in the table 19. The average maximum and minimum temperature inside different cattle shed was similar.

Table 19: Average temperature (^{0}C) inside different cattle shed in different months

SN	Month	Under tree shed		Shed 1 (North -south direction)		Shed 2 (East-west direction)	
		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	Jestha	35.42±0.32	25.79±0.28	35.04±0.42	27.25±0.41	35.96±0.22	26.92±0.45
2	Asar	35.16±0.39	26.81±0.29	35.42±0.4	27.74±0.31	35.90±0.39	27.90±0.4
3	Shrawan	35.31±0.17	25.97±0.14	34.97±0.28	26.37±0.17	35.28±0.31	26.56±0.22
4	Bhadra	36.16±0.25	25.52±0.12	35.68±0.17	25.92±0.15	35.8±0.22	25.8±0.15

Pulse rate

The pulse may be defined as “the rhythmic, periodic force felt over an artery in time with the heart beat”. The pulse rate was found slightly different between treatment groups.

Table 20: Average pulse rate during the trial period in different time

Group	9: 00 AM	12:00 PM	3:00 PM
T1	62.97±2.60	64.66±2.69	64.79±0.73
T2	67.47±0.81	64.88±1.63	68.25±0.87
T3	65.72±1.13	66.44±3.04	65.13±1.50
T4	61.16±1.87	62.22±1.08	65.06±1.71
T5	63.72±2.17	65.00±0.88	67.95±1.57

Respiration rate

The respiration rates of different treatment group in different time period was recorded. No significant difference was found between the treatments at 9 AM. At 12 PM and 3 PM, the lowest rates of respiration were found in T3 groups and highest in T5 group at 12 PM.

Table 21: The average respiration rate of cattle (minute)

Group	9:00 AM	12:00 PM	3:00 PM
T1	53.57±3.05	64±3.65	61.88±6.16
T2	57.52±4.50	63.47±3.74	50.19±1.82
T3	53.44±4.08	59.44±3.83	45.22±1.96
T4	49.86±2.99	64.84±3.21	55.16±2.06
T5	54.42±2.52	75.56±0.18	58.53±2.05

Rectal temperature

The rectal temperature of T3 group has lower temperature at 3 PM than other groups.

Table 22: Average rectal temperature (^{0}F) of cattle

Group	9:00 AM	12:00 PM	3:00 PM
T1	101.41±0.16	101.81±0.16	102.06±0.28
T2	101.10±0.26	101.74±0.37	101.33±0.21
T3	101.18±0.28	101.56±0.33	100.39±0.13
T4	100.57±0.09	101.24±0.22	101.10±0.17
T5	100.68±0.19	101.78±0.21	101.25±0.26

Milk production record

Daily milk production was recorded during the whole experimental period. During the experimental period the T3 group has higher milk yield compared to other groups.

Table 23: Average monthly milk production record (liter)

Group	Mean	Minimum	Maximum
T1	686.5±14.4	643.8	705.3
T2	726.2±98.4	586.3	1014.8
T3	825±104	669	1112
T4	800.8±80.4	584.6	970.3
T5	622±176	129	965

Milk composition

There was no significant difference in milk composition among the different treatment groups.

Table 24: Average milk composition of cattle in different treatment group

Group	Fat %	SNF %	Protein %	Lactose %	Density
T1	4.17±0.44	8.38±0.18	3.06±0.06	4.61±0.10	28.16±0.75
T2	4.75±0.63	8.83±0.26	3.21±0.09	4.85±0.14	29.33±0.73
T3	4.53±0.52	8.74±0.26	3.18±0.09	4.79±0.14	29.17±0.63
T4	4.96±0.28	8.58±0.18	3.13±0.06	4.71±0.10	28.24±0.55
T5	4.66±0.30	8.97±0.14	3.27±0.05	4.92±0.07	29.11±1.16

While conducting experiment in two different years in NCRP farm, treatment group (T3) i.e. animal under metal roof and sprinkle at 12 noon, 3 pm and fan cooling from 12 noon to 4 pm faced less heat stress than other treatment groups.

3.4.2 Development of Package of Practices for Yak/Chauri

Introduction

Yak is strong, hardy animal thriving in very cold (-50^{0}C) climate and also resistant to hypoxia (Paudel, 1994). These are only domesticated bovine of altitude more than 3000 meter above sea level. Crossbred of Yak and hill cow (Kirko) is called Urang Chauri whereas crossbred of Nak (Female Yak) and hill bull/ Tibetian bull (Lyang) is called Dimjo Chauri. Male Chauries are called Jhopkyos and they are sterile. Nak (female Yak) and female Chauries are used for milk production, whereas Yak and Jhopkyos are used as pack animal. Small body size (180-390 kg), poorly developed sweat glands, thick layer of subcutaneous fat and two types of hair (coarse and fine) which acts as effective insulator against the low temperature (Paudel, 1995). Yak/Chauries are multipurpose and semi domesticated animal in himalayas. Yak/ Chauries are source of milk, meat, hide, hair energy and trasnportation. They play a key role in agro-biodiversity conservation and maintaining the high rangeland ecosystem, also in cultural traditions, livelihood strategies, and all aspects of socioeconomic development in the high mountain areas.

The major distribution of yak lies in the Qinghai-Tibetan Plateau in China, with relatively small populations present in the Hindu Kush Himalayas (HKH) countries (ICIMOD, 2016). In Nepal, Yak and its hybrids (Chauri) are distributed in 30 northern districts. Population of Yak and its hybrids were reported to be 56488 in 1999 (DLSO Kathmandu, 1999), 95447 in 2002 (CBS, 2004), 68097 in 2010 (DLS, 2010), 65661 in 2013 (MoAC, 2013), 48865 in 2017 (MoLD, 2017) and 69,588 (MoALD, 2020). Yak development farm Syangboche, Solukhambu is only one government farm of Nepal as resource farm and recently a Yak farm in Dolpa has been under process of establishment by government of Karnali province.

Activities performed

Household survey

Survey was conducted in Taplejung (Kali khola area), Rasuwa (Gatlang), Dolpa (Sey-Phoksundo), Manang (Lamjung Base camp & Thum Kharka) and Mustang (Boksi khola) district purposively. Survey was conducted in 25 households of all project districts.

Sample collection

Ninty nine serum samples, 243 fecal samples and 34 milk samples of Yak/Chauri were collected. Serum samples were collected to know the prevalence of brucellosis, tuberculosis and foot and mouth disease. Similarly, milk samples were collected to know the prevalence of subclinical mastitis and fecal samples for determining endoparasitic prevalence in Yak/Chauri.

Meeting with collaborators for package development

A meeting with collaborators was organized in NASRI Hall, Khumaltar, Lalitpur. Findings of previous year activities were shared to collaborators and experts. Experts suggested to perform long term research on specific area rather than covering multiple places at a time. On the basis of findings of research on small area intensively, then only we can go for recommending package of practice. Personnel like Dr. Shreeram Prasad Neupane (animal breeding scientist/expert), Mr. Rameshwor Singh Pande (livestock specialist/expert), Mr. Rudra Prasad Paudel (Joint Secretory, MoALD), Dr. Megh Raj Tiwari (Principal Scientist/NASRI Director), Dr. Doj Raj Khanal (Senior Scientist-S4), Dr. Neena Amatya Gorkhali (Senior Scientist-S4), Mr. Luma Nidhi Pandey (Senior Scientist- S4), Dr. Madhav Prasad Acharya (Coordinator NCRP/Senior Scientist-S3), Mr. Tulashi Prasad Paudel (Senior Scientist-S3), Mr. Manoj Sah (Scientist-S2), Dr. Yagya Raj Pandeya (Technical Officer/ Project leader) and Dr. Chet Raj Pathak (Technical Officer) were present in the meeting.

Group meeting with stakeholders in each project district

A group meeting was conducted with Yak/Chauri farmers, veterinary practicinars, marketers, political leaders of Kalikhola area (Sidhangwa RM) Taplejung and Chayangthapu (Yangwarak RM-1) of Panchathar district. Sharing of previous years findings were made to the participants. In sharing prevalence of endoparasite, prevalence of brucellosis, tuberculosis, sub clinical mastitis was made. Also, verification of survey findings was made at the meeting.

Application of package activities

In package we suggested farmers for at least two times deworming per year, use of ectopracidal drug, regular vaccination against FMD, HS & BQ, time to time supplementation of minerals & vitamins and cultivation & supply of nutritious forages in rangeland/pastureland. In this FY we provided antihelminthics, mineral mixture, livertonic and seed samples of white clover, rye grass & cocksfoot to the Yak/Chauri farmers of Sidhangwa Rural Municipality (Kalikhola area, Taplejung) and Yangwarak Rural Municipality (Chayangthapu, Panchathar) for application of package.

Fig 9: Meeting with collaborators in Khumaltar, Lalitpur

Fig 10: Meeting with stakeholders of Taplejung & Pachthar in Chayanthapu, Pachthar

Results

Total number of Yak/Chauries was 727 (Yak/Nak- 490 & Chauri-237) in 25 surveyed households of different district. Average number of Yak/Chauri per household was 29.08. Average number of Yak/Nak per household was 19.60 and Chauri was 9.48. According to survey, 38% of farmers use antihelimintic for their Yak/Chauries and 14% farmers vaccinate their Yak/Chauries against FMD. Problem of inbreeding seems to be increasing.

Regarding health problem of Yak/Chauries, endoparasitic prevalence, ectoparsitic prevalence, mineral deficiency, FMD and locally called AUL (Occurs when they come to lower altitude and sudden death) are common. Farmers have poor access to market to sell their dairy products.

In fecal examination major parasite were *Toxocara* sps., *Paramphistomum*sps., *Ascaris* sps., and the prevalence rate of these endoparasites was 15.29%. Quarter-wise prevalence of subclinical mastitis was found to be 10.71%. ELISA test was performed to know the prevalence of brucellosis in Yak/Chauries. ELISA test kit manufactured by ID Vet France was used. Prevalence of brucellosis was found to be 1.12% (1/89). One positive sample was from Chauri of Rasuwa district.

According to farmer; attack of wild animals like snow leopard, bear, fox, tiger; scarcity of drinking water, heavy snow fall, poor veterinary service, poor interest of youth towards farming, shifting to other business (tourism, hotel, trekking) and deficit of grazing land are problems in Yak/Chauri farming.

Conclusion

Still Yak/Chauri husbandry is traditional type in Nepal and population of Yak/Chauri is decreasing in recent years. Scarcity of drinking water, poor veterinary service, less interest of youth towards farming, less awareness of famer, predation from wild animal and heavy snow fall are major problems in Yak/Chauri farming in Nepal. From very early times, yak herding, breeding and management have became an important part of traditional cultures, religions and social life in the himalayan region, with several ethnic communities and tribes highly dependent on yak for their day-to-day activities, livelihood options and tourism. Yak/Chauri production can continue to be one of the major means of supporting pastoralists in the high-altitude areas of the himalayan region. Thus, there is a need to improve Yak/Chauri production, conserve Yak genetic diversity and traditional breed selection systems and improve the livelihoods of Yak herders.

In context of Nepal improving the awareness level of farmer is essential for improving Yak/Chauri husbandry. Prevalence of zoonotic diseases like brucellosis has been prevalent. So, control of zoonotic disease to safeguard human health has become important. Availability of veterinary service, establishment of pasture bank and regular water supply is vital. Use of regular deworming, vaccination and mineral supplement to Yak/Chauri is needed for improving production and productivity. For breed improvement, introducing superior breed from other places (China/Tibet) along with start of artificial insemination program with semen of superior genetic value will be helpful. Establishment of Yak research center and Yak resource centers in the country has become crucial. Animal insurance policy should be implemented

to minimize possible risk due to loss from predators, snow fall and diseases. For improving marketing facility, establishing more factory related to Yak/Chauri products in high altitudes recommended. This project is terminated this year and we will be collaborating in next Yak/ Chauri project being lead by NASRI, Khumaltar.

3.4.3 The Effects of Feeding Milk Replacer on Body Growth and its Economic Feasibility in Dairy Calves

In this fiscal year, 48 calves (Jersey crossbred, Holstein Friesian crossbred) were allocated for trial. They were divided randomly in three different feeding groups like T0 group (whole milk), T1 group (normal milk replacer) and T2 group (medicated milk replacer). Twenty-eight calves were allocated in T0 group, 9 calves were allocated in T1 group and 12 calves were allocated in T2 group for trial.

Birth weight of each calf was recorded and calves were fed colostrums and milk for first 2 weeks of age as 10% of their body weight. After that, feeding trial was conducted for 12 more weeks regularly. Body weight, chest girth, body length and body height of each calve was recorded weekly in regular basis. Feeding was done in such a way that each calf gets $1/10^{th}$ part of its body weight in first month, $1/15^{th}$ parts of its body weight in second month and $1/20^{th}$ parts of its body weight in third month. For determining amount of feeding, weekly body weight of each calf was considered. Feeding was done twice a daily, in morning (6-7am) and evening time (4-5pm).

Milk replacer solution was made by mixing 125 gm of milk replacer powder in 1 liter of lukewarm water. Calves in trial were supplemented with few amounts of soft green grasses, straw and feed.

Table 25. Normal milk replacer (T1)

Ingredients	Parts (%)
Wheat	35.00
Soyabean meal	30.00
Skim milk	13.50
Coconut oil	8.40
Molasses	8.00
Citric acid	1.50
Butyric acid	0.30
Mineral mixture	3.00
Multivitamin	0.30
Total	**100.00**

Table 26. Medicated milk replacer (T2)

Ingredients	Parts (%)
Wheat	35.00
Soyabean meal	30.00
Skim milk	13.50
Coconut oil	8.40
Molasses	7.985
Citric acid	1.50
Butyric acid	0.30
Mineral mixture	3.00
Antibiotic mixture	0.30
Multivitamin	0.015
Total	**100.00**

One way repeated measures ANOVA was used to compare the weekly weight gain rate in different groups. Average weekly weight gain in T0 (whole milk), T1 (normal milk replacer) and T2 (medicated milk replacer) group was found to be 2.42 kg, 1.60 kg and 2.20 kg respectively. Similarly daily weight gain was 344 gm, 229 gm and 313 gm respectively for T0, T1 and T2 group. This was statistically significant ($P<0.05$). Average consumption of whole milk by a calf till weaning in control group (T0) was 210.43 liter, whereas average milk replacer powder consumption in T1 group was 19.68 kg and 33.89 liter of whole milk and in T2 it was 22.3 kg milk replacer powder and 37.8 liter of whole milk. Average cost for feeding a calf in T0 was Rs. 12625.80 (NCRP rate @ Rs. 60/Lit) and Rs. 16834.40 (DDC rate@ Rs. 80/Lit), for T1 average cost was Rs. 6815.64 (@ Rs. 60/Lit) and NRs. 7493.44 (@ Rs. 80/Lit) and T2 was Rs. 7798.40 (@ Rs. 60/Lit) and Rs. 8554.40 (@ Rs 80/Lit).

Fig 11: Milk replacer powder prepared by mixing different ingredients & feeding of calves in control group (milk)

Fig 12: Feeding of calves in treatment group T1 (normal milk replacer) & T2 (medicated milk replacer)

3.4.4 Cattle Herd Management and Production Program

Dairy cattle herd management is important factor for dairy farms to maintain long-term high production. For this, continous and successful management is required. Factors like cattle nutrition, reproduction, health, housing management, production and marketing are important. Alongside these essentials, all dairy farms must deal with the logistics of weather, transportation, and expenses. It can be a lot to balance, but proper planning and thoughtful utilization of the latest dairy farm training and technology make it possible. We have planned for proper management of dairy herd to maintain high milk production and happy cows as far as possible we can. NCRP farm is mainly established as a research farm and function as an elite herd for cattle in the country as well.

NCRP cattle herd comprises of various blood levels of Holstein Friesian and Jersey crossbreds, Terai cattle, Achhami and Lulu cattle. The review of past work reviled that 62.5% blood level of Jersey or Holstein Friesian is better in existing management system in Nepal.

Concentrate feed (pellet), seasonal green grasses (legume and non legume), perennial forages, straw, silage and tree fodder were provided as per feeding requirement of cattle in the farm. Commonly maize and teosinte were cultivated as summer forage and oat & common vetch as winter forage. Bajra, signal grass, setaria, mulato, joint-vetch, stylo, fleminzia, napier, perennial sorghum etc. were grown as perennial fodder/forage and fed to the animals in appropriate feeding regime. Animals were vaccinated against HS, BQ and FMD as per the recommended schedule. Regular drenching against flukes/worms and use of ectoparacidal drug as per need was done. Regular observation of estrus in the cows and treatment of diseased animal as per requirement was done. Milk produced from the lactating animals was either sold as whole milk or used for making dairy product like paneer, ghee, khuwa, dahi, etc. Farmyard manure produced in the farm was used for fertilizing the forage/fodder blocks of the NCRP farm and surplus amount was sold. Biogas was also produced from manure of farm and supplied to residential area of NCRP and NMRP, Rampur. Seeds of seasonal forage were produced for planting for self and distribution.

Clean milk production (udder cleaning, utensil, teat dipping)

Milk is a sterile product when secreted in the udder of a healthy cow. It is constituted with nutrients, which makes it fertile ground for microbial growth. Due to its susceptibility to microbial spoilage, there is a need to adopt clean milk production principles to reduce chances of contamination. We had taken consideration into internal factors (general health of cow esp. mastitis) and external factors which includes cow's body, milker's hygenic habit, cleaning of milking and storage utensils, methods of milking, feed/water supplies, milking environment etc. In our farm to prevent the mastitis, regular teat dipping with the dipping solution (Povidine iodine: Glycerine=9:1) instantly after completion of milking was carried out. Regular grooming with brush and bathing with clean & fresh water was done to remove dirt and dung from external body surface especially hind parts. Milking and storage utensils were cleaned by washing with detergents and maintained aseptic. Both hand and machine milking technique are in practice. To maintain cleanliness and prevent the transmission of infections, milking machines were disinfected after completion of individual milking and in case of hand milking personal hygiene was properly followed. Cleaning and disinfection of farm was done regularly to maintain clean milking environment.

Health and infertility status monitoring

General health examinations of animal were done on regular basis at NCRP farm. Fecal examination of cattle was done as per need and drenching was done routinely in every 4 months or as per the prevalence of internal parasites. Rotation of antihelmintic drug was done in consecutive drenching program. Tick infestations were found higher in early summer months. Use of ectopracidal drugs such as cypermethrine derivativatives and ivermectine was made. Animals encountered problems like mastitis, milk fever, retention of placenta, dystocia, bloat, wound, diarrhea, anestrus and repeat breeding in this FY.

Mastitis was a major problem in NCRP farm. Microbiological culture and Antibiotic Sensitivity Test (AST) was conducted before treatment. Supportive therapies as well as preventive measures were applied for prevention and control of mastitis. Routine milk examination was done to identify sub clinical mastitis in cattle.

Problems of infertility (anestrus and repeat-breeding) were observed in farm. Underlying conditions of infertility were presence of persistent corpus leutem, follicular cyst, uterine tumor, cervicities and pyometra.

Out of 18 infertile cows at NCRP farm, 7 were treated with hormones. Five were treated with single dose prostaglandin analogue (Pregmate Injection: *Cloprostenol* @ 500 mg) having problem of persistent corpus luteum. Out of 5 treated with *Cloprostenol Injection*, all 5 cows displayed estrus and 4 became pregnant. Similarly, 2 cows were treated with GnRH analogue (GYNARICH Injection: Buserelin Acetate @ 20 mcg) with follicular cyst. None of the cows responded in GnRH treatment. Four cows with cervicities and metritis were douched with 0.2% povidone iodine and Curacin-OZ (Ofloxacin & Ornidazole). All of them displayed estrus and all of them became pregnant.

Ultrasonography was used for scanning ovarian condition and early pregnancy diagnosis in cattle.

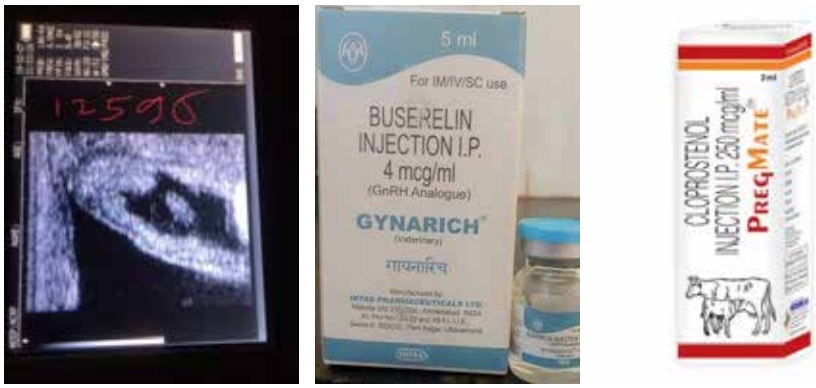

Fig 13: Early pregnancy diagnosis by using portable USG & hormones used in infertile cows

Study on different timimg of artificial insemination

A study was conducted in cows of NCRP farm to compare the conception rate on different timing of artificial insemination. Onset of estrus was detected based on the observation of estrus signs displayed by cows. For this, atleast 3 times a day regular observation was made by staffs working in farm. Ninty nine cows were selected for trial. In 12 hours after onset of estrus, 32 cows were selected. Out of 32, 29 were diagnosed for pregnancy. Of which 18 were diagnosed pregnant as conception rate of 62.06% (18/29). Similarly, in 18 hours after onset of estrus group, 24 cows were selected, of which 20 were diagnosed for pregnancy. Among them, 8 were diagnosed pregnant as conception rate of 40% (8/20). In 24 hours after onset of estrus, 17 cows were selected, of which 12 were diagnosed for pregnancy. Six were found positive for pregnancy having conception rate of 50% (6/12). In 12 and 24 hours after onset of estrus (double AI protocol), 26 cows were selected, of which 24 were diagnosed for pregnancy. Of them 14 were found positive in pregnancy test having conception rate of 58.33% (14/24).

Table 27: Conception rate at different timing of artificial insemination in cows

Time	12 hours after onset of estrus	18 hours after onset of estrus	24 hours after onset of estrus	12 and 24 hours after onset of estrus
No. of cows inseminated	32	24	17	26
No. cows diagnosed for pregnancy	29	20	12	24
Conception %	18/29=62.06	8/20=40	6/12=50	14/24=58.33

Vaccination and use of antihelmintics in prescribed time frames

Animals were vaccinated against Foot and Mouth Disease (FMD), Haemorrahagic Septicemia (HS) and Black Quarter (BQ) at appropriate time schedule. HS & BQ combined vaccine was used in every six months. Similarly, FMD vaccine was also used biannually. FMD was pregnancy safe vaccine.

Generally, antihelminthics were used once a 4 month but can be used as in need if prevalence is seen early. Use of antihelminthics was done in rotational pattern. This year oxyclozanide, ablendazole, fenbendazole, piperazine and ivermectin were used in animal as antihelmintic drug. Albendazole was not used in first trimester of pregnancy and rests of antihelmintics were pregnancy safe. In case of calves antihelmintics was used for first time in 21 days of age either with albendazole or piperazine.

Heat stress management for farm animal during summer months

During the summer months the environmental temperature of Chitwan rises above 35^0C, which leads to heat stress in cattle. To reduce heat stress condition in summer months, use of ceiling fans in the shed and regular bathing of animals twice a daily was performed. Bathing helped to reduce the heat stress and maintain cleanliness in animals.

Feeding of animals with appropriate roughage and concentrate

The farm animals of different age group were provided with appropriate ratio of roughage and concentrate according to their need for the improvement of good health as well as high

production of farm animal. Different types of legume and non-legume forages were cultivated and managed to feed cattle. Feeding to animals was done on the basis of body weight and milk production. Two kilogram of concentrate feed was provided to animal for maintenance ration and one kilogram of concentrate was provided at the rate of three kilogram of milk production above the maintenance requirement. In last two months of pregnany, extra 4-5 kg of concentrate ration was provided over the maintenance requirement.

Study on different agent to add value to silage

Maize, teosinte, sorghum, bajra & napier grasses were used for preparation of silage. To add value to silage this year chopped grass was treated by spraying 10% molasses solution. About 35 ton of silage was prepared in this fiscal year. After 2 months of fermentation, feeding of silage at the rate of 4-5 kg per animal was done. Milk production was recorded daily and milk composition was recorded monthly. In feeding experience of molasses treated silage, palatability and digestibility has increased.

Growth record of calves

In this fiscal year, total 49 calves were born, out of which 9 were Holstein Friesian cross, 20 were Jersey cross, 4 were Pure Lulu, 6 were Pure Terai, 5 were 50% Terai HF cross, 4 were 50 % Terai Jersey cross and 1 was Jersey Terai cross. Similarly, 32 were female calves and 17 were male. Average birth weight of Holstein Freisian cross bred calves was 28.48 kg. Similarly, average birth weight of Jersey crossbred calves was 23.05 kg, 50% Terai HF crossbred calves was 21.76 kg, 50% Terai Jersey crossbred calves was 16.00 kg, Pure Terai was 17.17 kg and Pure Lulu was 9.23 kg. Average daily growth rate was 295.3 gm. During this fiscal year 11 calves died. Individual birth weight of calves born in FY 2076/77 in NCRP farm is presented in table 28 below:

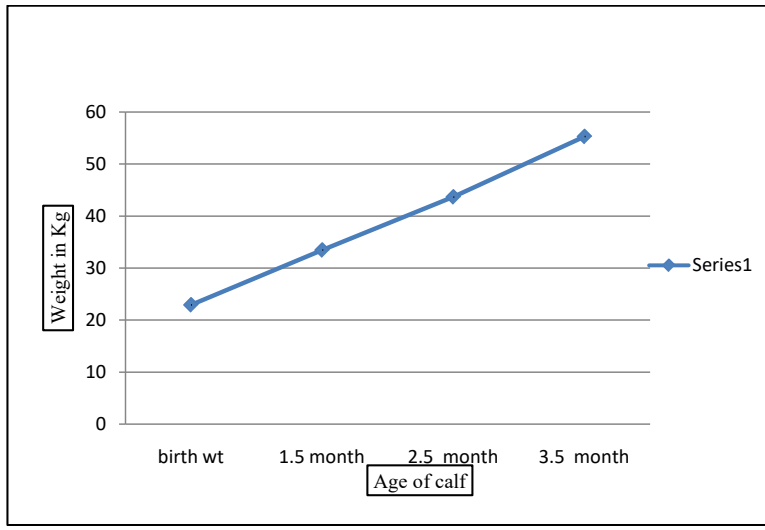

Fig 14: Graph showing age and weight gain (kg) of calves upto 3.5 months of age in NCRP farm

Table 28. Average birth weight of male and female calves in NCRP farm during FY 2076/77

SN	Date of Birth	Tag no.	Sex	Birth Weight (kg)	Breed	Remarks
1	2076-04-16	12451	Female	19	HF Cross	
2	2076-04-29	12452	Female	17	Jersey Cross	
3	2076-05-01	12453	Female	34	HF Cross	
4	2076-05-03	12454	Female	25.7	HF Cross	
5	2076-05-07	12455	Female	17.5	Jersey Cross	
6	2076-05-09	12456	Female	15	Jersey Cross	
7	2076-05-16	12458	Male	18	Jersey Cross	
8	2076-05-21	12459	Female	13	Jersey Cross	
9	2076-05-24	12460	Female	20	Terai HF Cross	
10	2076-05-30	12462	Female	23	Terai HF Cross	
11	2076-06-01	12463	Male	26	HF Cross	
12	2076-06-03	12565	Male	19	Pure Terai	Death
13	2076-06-08	12464	Female	24.3	Terai HF Cross	
14	2076-06-11	12465	Male	24.7	Jersey Cross	
15	2076-06-19	No Tag	Male	18.5	Pure Terai	Death
16	2076-06-26	No Tag	Female	13.5	HF Cross	Death
17	2076-06-29	No Tag	Female	14	Pure Terai	Death
18	2076-07-11	12467	Male	24	Jersey Cross	
19	2076-07-11	12466	Male	17	Jersey Cross	
20	2076-07-11	12476	Female	16.5	Pure Terai	
21	2076-07-22	12468	Female	16	Jersey Cross	
22	2076-07-23	12469	Male	9	Pure Lulu	
23	2076-08-05	12474	Male	18	Pure Terai	
24	2076-08-06	12470	Female	20	Jersey Cross	
25	2076-08-08	12475	Male	17	Pure Terai	
26	2076-08-11	12471	Male	20	Jersey Cross	Death
27	2076-08-20	12472	Male	16.5	Terai Jersey Cross	Death
28	2076-08-20	12473	Female	10.5	Terai Jersey Cross	Death
29	2076-09-03	12478	Female	37	HF Cross	
30	2076-09-04	No Tag	Female	21	Terai Jersey Cross	Death
31	2076-09-10	No Tag	Female	9.5	Lulu	Death
32	2076-09-12	No Tag	Female	9	Lulu	Death
33	2076-09-14	12479	Female	24	Jersey Cross	
34	2076-09-17	12480	Male	36	HF Cross	
35	2076-09-18	12481	Female	20.5	HF Terai Cross	

SN	Date of Birth	Tag no.	Sex	Birth Weight (kg)	Breed	Remarks
36	2076-09-22	12482	Male	28	Jersey Cross	
37	2076-11-21	12483	Female	19.8	HF Jersey Cross	
38	2076-12-25	12484	Female	33	HF Cross	
39	2076-01-21	12485	Female	9.4	Lulu	
40	2076-01-25	12486	Female	15	Jersey Lulu Cross	Death
41	2077-02-03	12487	Female	18	Jersey Cross	Death
42	2077-02-10	12488	Female	28	Jersey Cross	
43	2077-02-21	12489	Male	23.5	Jersey Cross	
44	2077-03-03	12490	Male	25	Jersey Cross	
45	2077-03-10	12491	Female	32.2	HF Cross	
46	2077-03-15	12492	Female	24	Jersey Cross	
47	2077-03-24	12493	Male	18.5	Jersey Cross	
48	2077-03-26	12494	Female	21	Terai HF Cross	
49	2077-03-27	12495	Female	23.8	Jersey Cross	

Comparision of machine and hand milking method

To compare the time efficiency of machine milking method over handmilking method, data recording of 24 lactating cows in each group was done for a period of a month. In machine milking, average milking rate was 0.86 liter/ minute whereas average milking rate in hand milking was 0.5 liter/minute. It showed that milking rate in machine was 72% faster than that of hand milking.

Fig 15: Milking time recording in hand and machine milking in NCRP farm, Rampur

Routine milk analysis

Milk samples from all lactating animals were collected in regular basis (monthly) and monitored for its composition. Average milk compositions of cows of NCRP farm are presented in table 29.

Table 29: Average milk composition of NCRP cows in the FY 2076/77

Breed	Fat	Density	Lactose	SNF	Protein
Jersey Cross	5.01	29.7	4.83	8.58	3.12
Holstein Freisian Cross	4.78	31.36	5.15	8.64	3.14
Pure Lulu	5.91	30.04	5.09	9.27	3.38
Pure Terai	5.99	22.69	4.03	7.34	2.66
Average	**5.11**	**29.66**	**4.93**	**8.87**	**3.25**

Routine recording of feeding and milk production

Daily recording of feeding of each animal was done in both hard and soft copies (MS-Excel). Similarly, milk production record of each lactating animal was done both in soft and hard copy.

Maintenance of pedigree record and updating of data management

Pedigree record was maintained in a herd book. But this year we were unable to update data on software due to technical error in software.

Processing & distribution of clean milk

Unfortunately, we were unable to distribute processed milk from our dairy unit in this FY also. We distributed raw milk to people of surrounding community and a commercial dairy industry near by our office regulary.

Product diversification

During this FY 454.06 kg paneer, 131 kg khuwa, 54.5 liters dahi, 21.5 kg ghee and 500 pieces of rasbari were prepared in the dairy unit and sold. Price of panner, khuwa, dahi, ghee and rasbari was Rs. 550/kg, Rs. 600/kg, Rs. 90/lit, Rs. 750/kg and Rs. 15/piece respectively.

Introduction and evaluation of different forage for permanent pasture

Different forages like super napier, setaria, signal grass, perennial sorghum, mulato, gautemala, stylo were introduced and their production performance and quality were evaluated.

Table 30: Green and dry matter estimation of fodder/pasture at NCRP farm

SN	Name of forage	GM yield (kg/m^2)	DM yield (%)
1	Super napier	6	26
2	Perennial sorghum	3.8	23
3	Stylo	1.74	22

Production of green forage

Approximately 13 ha land was used for cultivation of green forage at NCRP. Stylo, setaria, signal grass, napier hybrids (Super napier, Co3, Co4), perenial sorghum, joint vetch, mulato, desmodium were cultivated as perennial forage. Maize, teosinte, annual sorghum, bajra and rice bean were cultivated in summer. Similarly, common vetch & oat were cultivated in winter.

Seed production of major forage crops

Major forage crop for winter was oat. Oat was cultivated in 3 ropani land for seed production. Similarly, teosinte, sorghum, bajra and maize are the major summer forage crops. 250 kg teosinte and 110 kg oat seed were produced in the fiscal year 2076/77.

3.5 Outreach

3.5.1 Up-scaling and Verification of Some Proven Livestock Technologies in Outreach Sites

Several promising technologies have been generated by Nepal Agricultural Research Council (NARC) for the enhancement of livestock production and productivity from time of its establishment to date but the technology has not been adopted by the farmers as expected due to lack of proper extension and validation in farmer's field. So as to make generated technology adaptable to the farmers we are working by establishing outreach sites. In outreach sites, demonstration and verification of technologies developed in research station are made. Since outputs generated in research station may not work in the real scenario of farmer's field. It is only justice to recommend technology to farmers which are validated in farmer's field. In this FY we have worked 2 in outreach sites, one is Madi Municipality, Chitwan and other is Devdaha Municipality, Rupandehi for verification and dissemination of generated technology. These outreach sites will be developed as model village for technology demonstration and also as a resource center for livestock and fodder/forage species.

Madi, Chitwan is almost 48 km far away from Bhartapur. Some part of Madi area lies in buffer zone of Chitwan National Park. Madi is very much popular for productive agricultural land. In this place most of the farmers used to rare local cattle but nowdays farmers are shifted to crossbred cattle farming. In Madi, local government has emphasized on promotion of cattle farming & milk production. They are providing subsidy on the basis of milk production as Rs. 3 per liter of milk production. Farmers of this area are more interested on commercial cattle farming by adopting latest technology.

Devdaha of Rupandehi is almost 18 km away from Butwal city. It is a semi urban area with most of the farmers with crossbred cattle. Local government has focused on dairy sector improvement especially by breed improvement in Devdaha. Some commercial farms with large herd size of 100 cattle have been established. Farmers are involved in cattle farming through cooperatives by making groups. Different activities tested in farmer's field conditions are described below:

Evaluation of teat dipping in farmer's management condition

Demonstration of post milking teat dipping was carried out in Devdaha & Madi OR site. Different small dairy farms of Madi & Devdaha area were purposively selected. Cattle without clinical mastitis were selected for the experiment. Demonstration of post milking teat dipping was carried out and farmers were advised to use the post milking teat dip solution immediately after milking because it checks the entry of pathogen into the teat and prevent mastitis. Dipping solution was prepared by mixing povidone iodine and glycerol (9:1).

Inputs like post milking teat dip container & solution were distributed to selected dairy farmers. Milk samples were collected from lactating cattle on 0 day of teat dipping and thereafter on 60

day of teat dipping. Milk sample were collected in sterile sample collection bottle in a cool box & tested for mastitis using California Mastitis Test (CMT) as soon as possible. Post milking teat dipping helps to reduce mastitis. Teat dipping did not have any impact on the teat injury, irritation of teat or redness over teats.

Effectiveness of vaccination for major economic diseases and drenching against major internal and dipping/spraying for external parasites

Vaccination & drenching program were held in Madi, Chitwan & Devdaha Rupandehi where more than 100 cattle were vaccinated against FMD, HS and BQ & more than 200 cattle were dewormed with broad spectrum antihelmintics.

Health campaign

Animal health & infertility management camp was oraganized at OR- Site, Madi, Chitwan dated on 2076/09/22 BS. A formal program was organized at the beginning and remarks were given by senior scientist Dr. Madhav Prasad Acharya regarding activities of NCRP, objective of program and need of different approach for maximum farmers participation in the program. Our invited guest assistant professor Dr. Gokarna Gautam (AFU) put forward about objectives of animal health campaign to improve animal production and productivity. General health examinations of animals presented at camp was done and respective medicines were distributed to farmers for their animals. Pregnancy diagnosis of cattle was done using USG. Service was provided to more than 50 cattle farmers in the health camp. More than 200 animals have benefited in camp with problems of infertility, repeat breeding, anestrous, string halts, cough, diarrhoea, internal/external parasitic infestations, indigestion, emaciation, wound and so on.

Fig 16: Activites at Animal Health Camp Madi, Chitwan

Demonstration of silage making

Silage making is promising and economic option for providing nutrients through forage/fodder during the dry season. This is a way of feed conservation. Surplus green grasses at flush season are conserved to feed at dry season. In context of Nepal major problem is scarcity of nutritious feed to livestocks for limiting production. To make year-round availability of nutritious feed to animal, silage is very good alternative. This year silage making process was demonstrated in Madi, Chitwan and approximately 500 kg grass was used for making silage in plastic bags.

Fortification of UMMB using sustained release urea (SRU) and probiotic cultures

To overcome nutrient (especially mineral) deficiency in ruminant, use of urea molasses mineral block (UMMB) is recommended. An UMMB is generally composed of urea, molasses, vitamins and minerals. A composition of UMMB consists of urea (10%), molasses (30-32%), rice bran (35%), minerals (6%), salt (5%), cement (6%), di calcium phosphate (5%) etc. These ingredients are collected as per recommended ratio and mixed throughly. With the aid of pressing machine, block was pressed and sun dried for 3-4 days. The incorporation of probiotic culture at the rate of 2% in UMMB has also been done to enhance the quality. Use of UMMB in dairy cattle has improved body growth, fertility and milk production. UMMB making process was demonstrated in Madi, Chitwan.

Community forage and forage seed production

20 kg common vetch and 40 kg oat was distributed to the farmers of Chitwan and Rupandehi for seed production. 500 sets of super napier were distributed to farmers of outreach site Devdaha, Rupandehi.

Travelling seminar

During travelling seminar we visited two private commercial cattle farms, one in Sundarbazar Municipality, Paudi, Lamjung and another in Palungtar Municipality, Chayangli, Gorkha and made interaction with owner of respective farms regarding the farm management and marketing. Goat Research Center, Bandipur, Tanahu was also visited.

Visit reflected that private farms are doing better in cattle farming. They have cultivated fodder and forage which is available year round for their animals. They have made proper utilization of manure for fertilizing the soil. Farm in Lamjung makes dairy product (Paneer) and sales to Pokhara and Kathmandu while farm of Gorkha sales raw milk to Kharipati Dairy, Bhaktapur. Farm size of Paudi is 82 with 35 lactating cows (average daily milk production is 260 liter), while farm size of Chayangli is 315 with 165 lactating cows (average daily milk production is 1400 liter). Mastitis, infertility, protozoal infection and male calf management are problems in cattle farming.


Fig 17: Visit at commercial cattle farm, Chayangli, Gorkha

Village level workshop

In this FY one village level workshop was conducted in Madi, Chitwan. Twenty-five participants including ward president, government veterinary technician and cattle farmers were present in the program. Participants shared mastitis, infertility, repeat breeding, shortage of feed/fodder, management of male calf/infertile animal, pricing of milk as major issue in their area.

Fig 18: Village level workshop at Madi, Chitwan

Use of improved/latest technologies in breeding practices

Use of portable USG was made in Madi, Chitwan for early pregnancy diagnosis and to know the ovarian dynamics of cow.

Demonstration & making of milk product

Milk products like paneer, dahi, khuwa were made and procedures were demonstrated in Madi, Chitwan. Farmers were more interested in paneer making. Production of diversified dairy product helps to increase net profit and reduce the problem of milk holidays.

3.6 Multilocation Research Highlights

3.6.1 Genetic Evaluation of Lulu Cattle (Adaptation Research on Lulu Cattle in Low Altitude)

Two males and eight females of Lulu cattle were brought from National Animal Breeding and Genetics Research Center (Previously called Animal Breeding Research Division), Khumaltar, Lalitpur in falgun 2074 BS, as a collaborative research programme of NCRP, Rampur and ABRD, Khumaltar. Main purpose of this study was to look for adaptation of Lulu cattle (Hilly cattle) in terai region. Cattle were maintained in normal management condition as other cattle at NCRP farm.

This year 4 Lulu cows calved and average birth weight of a calf was 9.23 kg.
Average milk production of Lulu cattle at NCRP in this FY was 1.64 liter per day. Average lactation length was 207 days (128-309 days). Average lactation milk yield was 338 liter (120-691 liter). Milk quality parameters of Lulu cattle are presented in table 29.

Fig 19: Lactating Lulu cattle at NCRP farm, Rampur, Chitwan

3.7 Collaborative/Support Research Highlights

Such research activities are jointly conducted in collaboration with other research stations, institutes and universities (to support the students of bachelor or master degree). Here are some of the projects works carried out in the FY 2076/77.

3.7.1 Comparative Study of Seroprevalence of Brucellosis in Goat of Morang and Sunsari District using Rose Bengal Plate Test

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[2] Senior Scientist (S3), Veterinary, NCRP, Rampur, Chitwan, Nepal

ABSTRACT

Brucellosis is a priority zoonotic disease having serious economic, social and public health significance which possesses serious threat to farmers, veterinarians, and other people coming in contact with infected animals and their products like milk and meat. In human, brucellosis causes multiple systemic symptoms like fever, back pain, body aches and pain, weight loss, profuse sweating, and chills. This research was conducted in Morang and Sunsari district of Province No.1 of Nepal. A total of 204 goat blood samples from 50 farms were collected in vacutainer with clot activator and examined for brucellosis. The blood samples were stored in a refrigerator and then transported to Veterinary Laboratory, Biratnagar in ice cool box. The blood sample was subjected to centrifugation and serum was extracted and stored in serum vial. The test of brucellosis was done using Rose Bengal Plate Test manufactured by ID vet, France. Statistical analysis was done using MS Excel 2016. The seroprevalence of brucellosis in both of the districts was found to be zero. This research was performed to estimate the prevalence and threat of brucellosis in these districts but due to COVID-19 pandemic samples from the inner border which are thought to be high-risk zones couldn't be taken which might be the reason behind zero prevalence of this disease. Rose Bengal Plate Test cannot be considered as gold standard tool for brucellosis diagnosis as it can give false negative results. So, research with a good diagnostic approach should be considered from the governmental, non-governmental, and private sectors to approach this zoonotic disease and establish an effective control strategy.

***Keywords*:** Brucellosis, Goat, Morang, RBPT, Sunsari

3.7.2 Prevalence and Risk Factors of Staphylococcal Subclinical Mastitis in Dairy Animals of Western Chitwan, Bagmati Province, Nepal

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ABSTRACT

Objective: To assess the prevalence and risk factors of Staphylococcal subclinical mastitis in dairy animals of Western Chitwan, Bagmati Province, Nepal
Design: Cross-sectional study
Methodology: Milk samples from each quarter of 243 dairy animals were collected in separate universal sample bottle. CMT was performed and all positive samples were enriched in Peptone Water (PW) followed by direct plating on selective media viz. Mannitol Salt Agar. The presumptive *S. aureus* and Coagulase Negative Staphylococcus (CNS) isolates were identified by biochemical tests. Antibiogram pattern of both S. aureus and CNS to antimicrobial agents were evaluated by disk diffusion method. Risk factors were also recorded during sampling.
Results: Out of 243 dairy animals 104 representing 42.8 % were CMT positive for Subclinical Mastitis (SCM) in the study area. At the quarter level of 972 active quarters tested for subclinical mastitis, 188 (19.3%) were positive to CMT test. The prevalence of Staphylococcal SCM was 39.92% (97/243) and 18.21% (177/243) at animal level and quarter level respectively. CNS (46.33%) was the most prevalent Staphylococcus to cause SCM at quarter level. While at animal level, SCM due to occurrence of both *S. aureus* and CNS (36.08%) in an individual were more common. High Sensitivity towards Amikacin, ceftriaxone and Gentamicin was seen against both isolates. However, there was vast difference in the susceptibility of Tetracycline (70.6% vs 8.4%) and Ciprofloxacin (58.8% vs 15.8%) between *S. aureus* vs CNS isolates. Enrofloxacin showed highest intermediate susceptibility against both whereas Tetracycline (57.7% vs 14.3%) and Ciprofloxacin (56.8% vs 0%) have higher Intermediate susceptibility to *S. aureus*. Low resistance against Amikacin and Ceftriaxone was seen against both isolates. Ciprofloxacin (41.2% vs 27.4%) and Gentamicin (37.8% vs 23.2%) were more resistance towards CNS whereas Enrofloxacin (41.1% vs 25.2%) and Tetracycline (36.8% vs 15.1%) were more resistant towards *S. aureus.* Age, parity, stage of lactation, teat injuries and feeding practices had a significant influence of the prevalence of SCM. Older aged, multiparous and late lactating animals had the highest prevalence of staphylococcal SCM 58.1%, 56% and 52.6% respectively. Likewise, animals with Previous history of mastitis, teat injuries and fed prior to milking had a significantly higher prevalence of Staphylococcal SCM.
Conclusion and recommendations: The study concludes that there is a high prevalence of Staphylococcal SCM in Western Chitwan, Nepal. CNS is the most common mastitis pathogen. The indiscriminate use of antibiotic agents without AST for prophylactic as well as other therapeutic purpose could be the reasons for increased antimicrobial resistance against *S. aureus* and CNS. This study highlights the need for continuous surveillance of antibiotic, proper hygiene of farmers and animals, proper housing and feeding management.

Keywords: Antibiogram, Chitwan, *S. aureus*, Subclinical mastitis

3.7.3 Metabolic Profiling of Different Cattle Breed Present in National Cattle Research Program, Rampur, Chitwan, Nepal

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ABSTRACT

Metabolic profile test or metabolic profiling is a technique in which various constituents of blood is accessed to either differentiate clinically healthy or with problems such as low production performance, reproductive diseases or any other sub-clinical forms diseases to establish a standard profile for the herd. The method was first described by Payne in 1970 where packed cell volume (PCV), blood hemoglobin (Hb), blood glucose, serum urea nitrogen (urea N), albumin, total protein, calcium (Ca), inorganic phosphate (P), magnesium (Mg), potassium (K), sodium (Na), copper (Cu), and iron (Fe) were accessed. In this research we have accessed various biochemical parameter like serum protein, serum albumin, serum globulin, Aspartate transaminase (AST), Alanine transaminase (ALT), D-Hydroxybutyrate, Cholesterol, Glucose, Iron, Copper, Zinc, Calcium and Phosphorus of different breeds of cattle (Jersey cross, Lulu, Holstein Friesian cross) maintained at National Cattle Research Program farm located at Rampur, Chitwan. A total of 63 blood serum samples were taken from the milking cattle and dried off cattle of the farm. Data were analyzed by using R studio 1.2.5033 using independent sample t-test assuming unequal variance (Welch's t-test). The result showed statistically significant difference ($P<0.05$) in total protein, globulin, copper, SGOT, calcium, phosphorus and DHB between the breeds and also statistically highly significant difference ($P<0.01$) in cholesterol, DHB and globulin. However, no significant difference among the breeds was observed in other blood parameters like albumin, SGPT, iron, zinc and glucose. In this study, a potential approach to point out various differences in the different breeds of cattle found in Nepal was established by studying different serum biochemicals and metabolites of three breeds; Lulu, Jersey cross and Holstein Friesian cross cattle present in the cattle farm of National Cattle Research Program, Rampur.

***Keywords**:* Holstein Friesian, Jersey, Lulu, Metabolic profile, Rampur

3.7.4 Isolation, Biochemical Characterization and Antibiotics Resistance Profiling of *Escherichia coli* Subclinical Mastitis in Western Chitwan of Nepal

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ABSTRACT

Subclinical mastitis (SCM) represents a significant burden and challenge to modern diary management. Multidrug-resistant *E. coli* in milk poses a public health threat to humans especially via the consumption of unpasteurized dairy products. This study aimed to determine the occurrence of MDR *E. coli* in cows and buffaloes in the households of the western part of Chitwan district of Nepal. A total of 243 lactating cows and buffaloes were included in this study. Milk samples (n=972) were screened using the California mastitis test (CMT). *E. coli* was isolated from milk samples that were positive for the CMT using standard bacteriological protocols. A semi-structured questionnaire was administered to farmers to identify the risk factors associated with the occurrence of SCM in cows and buffaloes. Of the 243 dairy animals screened, 42.8% (n = 104/243) showed positive CMT results. However, of the 972 quarters sampled, only 19.3% (n =188/972) were positive for SCM. The prevalence of *E. coli* in these animals was found to be 16.5% in animals (n=40/243). However, *E. coli* was isolated from only 5% (n=49/972) of the quarters. Of the 49 *E. coli* isolated, the resistance to Ceftriaxone (38.8%, n=19/49) and ciprofloxacin (37.7%, n=17/49) were the most prevalent. Animals with a history of mastitis were 3.57 × (95% CI: 0.14 – 0.56; $p < 0.01$) more likely to have subclinical mastitis than other animals. Similarly, lactating animals with previous teat abrasions were 3.22× (95% CI: 0.13 – 0.77; $p = 0.011$) more likely to develop subclinical mastitis than animals without teat injuries. As expected, cleaning the barn once in 2-3 days was associated (OR: 2.2; 95% CI: 0.7, 6.5; $p = 0.14$) with an increased occurrence of SCM in lactating cows. This study reports the occurrence of MDR *E. coli* in SCM which poses a public health threat. Creating awareness of milk pasteurization, and food safety practices is necessary among the farmers.

Keywords: CMT, MDR *E. coli,* Nepal, Sub-clinical Mastitis

4. PRODUCTION

4.1 Cattle Production Program

The Program had maintained a herd of 182 heads of cattle in its farm. It includes different stages of animals of Jersey crossbreds, Holstein Friesian crossbreds, Pure Terai, Terai crossbreds, Pure Lulu and Pure Achhami. The initial and closing herd composition of fiscal year 2076/77 is given in table 31 below:

Table 31. Herd composition of cattle at the beginning and the end of fiscal year 2076/77

Opening Balance								Closing Balance						Total
Breed	Adult		H	YB	Calves		Total	Adult		H	YB	Calves		
	F	M			F	M		F	M			F	M	
HF Pure	1	0	0	0	0	0	**1**	1	0	0	0	0	0	**1**
HF Cross	20	0	2	0	7	6	**35**	23	0	14	0	2	0	**39**
Jersey Cross	51	0	11	5	14	13	**94**	57	0	13	6	12	7	**95**
Terai Pure	20	2	0	1	0	0	**23**	20	3	0	0	1	2	**26**
Terai HF Cross	0	0	0	0	0	0	**0**	0	0	0	0	3	0	**3**
Terai Jersey Cross	0	0	0	0	0	0	**0**	0	0	0	0	1	0	**1**
Lulu	8	2	0	0	2	1	**13**	8	2	2	1	1	1	**15**
Achhami	0	0	0	0	0	0	**0**	0	0	2	0	0	0	**2**
Total	**100**	**4**	**13**	**6**	**23**	**20**	**166**	**109**	**5**	**31**	**7**	**20**	**10**	**182**

M = Male, F = Female, YB = Young Bull, H = Heifer

In this FY total 49 calves were born in farm (32 female and 17 male calves).

Among them, 9 were Holstein Friesian cross, 20 were Jersey cross, 4 were Pure Lulu, 6 were Pure Terai, 5 were 50% Terai HF cross, 4 were 50 % Terai Jersey cross and 1 was Jersey Terai cross.

4.2 Forage seeds and sapling production

Table 32. Production of green grasses for livestock units maintained in the farm of NCRP during FY 2076/77

SN	Name of grass	Area cultivated (ha)	GM production (MT)	Seed production (kg)
1.	Teosinte	9	540	250
2.	Bajra	1.5	80	
3.	Annual sorghum	2	80	
4	Perennial sorghum	0.5	50	
5	Oat	9	230	110
6	Super napier	0.5	60	
7	Signal grass	0.3	0.5	
8	Setaria	0.5	1	
9	Maize	1.5	60	
10	Rice bean	0.7	0.5	
11	Hybrid Jwar	0.1	10	
	Total		**1112**	**360**

35 metric ton silage was prepared from maize, napier, teosinte, sorghum and bajra grasses produced in NCRP farm. Year round production and feeding of green grasses was followed in the farm.

In this FY, 500 sets of super napier were distributed to farmers of Chitwan.

4.3 Milk and milk products production

Table 33. Monthly milk and milk products production in the FY 2076/77

Month	Milk (ltr.)	Paneer (kg)	Khuwa (kg)	Ghee (kg)	Dahi (Liter)	Rasbari (Piece)
Shrawn 2076	8299	18.55	-	2	-	
Bhadra 2076	8593.8	30.45	-	2.5	46.5	
Aswin 2076	9658.9	45.2	21.5			
Kartik 2076	9490.9	34.05	28.5	2.5		240
Mangsir 2076	10556.9	23.6		2		
Poush 2076	10786.4	8.9	24.5			
Magh 2076	11920.8	36.55		4.5		
Falgun 2076	12281.3	23.55				
Chaitra 2076	10786.8	75.45	56.5	5.5		
Baisakh 2077	11471.6	88.9				260
Jestha 2077	11058.2	48.65		2.5	8	
Ashad 2077	8571.1	20.73				
Total	**123475.7**	**454.58**	**131**	**21.5**	**54.5**	**500**

Table 34. Calf production and distribution in the FY 2076/77

Calf Production	Sex	**Number**	**Total**
Jersey cross	M	10	25
	F	15	
Holstein Friesian cross	M	2	14
	F	12	
Lulu	M	1	4
	F	3	
Terai	M	4	6
	F	2	
Total		**No.**	49
Calf distribution	M	No.	12
	F	No.	0

5. TECHNOLOGY TRANSFER AND SERVICES

Technology generated by the research has no meaning unless it is extended to the farmers. Technology developed by NCRP and other institutes useful for different stakeholders was shared in this FY also. We hoped that it has become useful to stakeholders.

5.1 Training/workshops

In this FY 2076/77, one village level workshop on cattle production and management was organized in Madi, Chitwan. Total 30 people have participated in this program including farmers, ward president, members of dairy cooperative, government livestock officer/ technicians and scientists/officers from NCRP. During the workshop, interaction was made on health, nutrition, management and marketing issues of cattle. Problem and researchable issues on cattle were collected from the participants. Participants of workshop shared mastitis, repeat breeding, anestrus, feed and nutrition management and male calf management as major issue of cattle farming. Thus, collected problems were priotrized for conductiong research in days to come.

5.2 Service

Technical briefing useful for cattle farming was done to the farmers, students, extension officials, co-operative members, farmers group, staffs of NGOs/INGOs. More than 4992 people were benefitted through our counseling and farm visit. Beside this, program distributed the high quality bulls as a seed animal to the farmers for the further multiplication of the superior quality progeny. Moreover, program also supplied clean and fresh whole milk continuously to at least 200 household for daily consumption. Milk products like khuwa, paneer, ghee etc. were also sold to some of the households dwelling nearby vicinity of NCRP.

One Animal Health and Infertility Correction Camp was organized at Madi, Chitwan. General health examination of animals presented at the camp was done and respective medicines were distributed to farmers for their animals. Most of the animals were with problem of repeat breeding and anestrus and they were treated accordingly. Animals with poor BCS were supplied antihelmintics, minerals, vitamins and livertonics. Ectoparacidal drug was also distributed for animals. One case of upper fixation of patella (Jhayankhure) in female buffalo was corrected by surgical intervention (Medial Patellar Desmotomy). Early pregnancy diagnosis of cattle was done by using USG.

5.3 Publication

Hundred copies of Annual Report 2075/76 were published.

6. OTHER ACHIEVEMENTS

The detail of staffs' participated in different trainings/seminar/conference/ workshop is presented in the annex 6.

7. BUDGET AND EXPENDITURE

The total annual budget and expenditure of the program for this fiscal year are provided in details in annex 7.1. Program is in the need of more budgets to strengthen its research work. Program needs budget to build cattle sheds, milk parlour, laboratory and farm machineries. Details of special project budget and expenditure, revenue status and beruju status of the program are mentioned in annexes 7.2, 7.3 & 7.4 respectively.

8. KEY PROBLEMS

The major problems of the programs are:

1. Inadequate number of scientists, technicians (50% less than approved posts).
2. Inadequate farm mechanization machines/tools, laboratory facilities and cattle sheds.
3. Poor mechanism of technology dessimination.
4. Lack of carrier development opportunities and encouragement for the staffs.

9. WAY FORWARD

1. Conduct various research programmes either in sole authority or in collaboration with other institution on production & management, nutrition, feeding, breeding and health care of cattle to enhance their production & productivity.
2. Conduct farmer's field and applied research to demonstrate and disseminate the technologies for their wider adoption.
3. Upgrade the native *zebu* cattle by strengthening AI facilities and distribution of upgraded breeding bulls to the farmers.
4. Conduct research to mitigate the methane production by dairy cattle and make farming more environmentally friendly.
5. Develop low cost milk production technology.
6. Maintenance and production of improved grasses for animal feeding, silage production and forage seed distribution to the farmers.
7. Conduct research on cattle vaccines.

Annexes

Annex 1.1. Map showing site of NCRP Office

Annex 1.2. Map of showing areas of NCRP in Rampur, Chitwan

Annex 2.1. Lists of Laboratory Facilities

SN	Name of Laboratory	Major Instruments	Manpower in Laboratory	Testing Facilities
1	Dairy Laboratory	Lacto-scanner, Khuwa maker machine, Paneer vat, Sealing and filling machine, Milk pasteurizer (Batch pasteurizer), Milk analyser, Ice cream vat, Deep freeze, Refrigerator, Cream separator, Chilling vats	Senior Scientists/ Senior /Technical Officer, J.T., T1	Milk quality, Milk products quality
2	AI Laboratory	AI Gun, Refree with liquid nitrogen, Estrus detector, USG, Liquid nitrogen mother tank	Technical Officer, J.T.A.	Artificial insemination of cattle, Pregnancy test
3	Health Laboratory	Microscopes, Incubator, Laminar flow, Autoclave, Water bath, Hot-air oven, Mastitis detector, Centrifuge, ELISA reader, Hematocrit centrifuge, Refrigerator, Deep Freeze	Scientist (S1), Technical Officer, J.T.	AST, Bacterial culture, Fecal examination, Biochemical tests for mastitis, Different infectious diseases test, PCV test
4	Nutrition Laboratory	Sox-holet apparatus, Muffle furnace, K-jeldhal apparatus, Fiber digester, Hot air oven, Titration unit	Scientist (S1), J.T.	Estimation of crude protein, Crude fiber, Ether extract, Ash, Dry matter

Annex 2.2. Human Resources in 2076/77 (2019/20)

S.N.	Name	Designation	Qualification	Specialization/Working area
1.	Dr. Madhav Prasad Acharya	Coordinator/ Senior Scientist (S3)	M.V.M. (Microbiology)	Veterinary Science
2.	Mr. Devi Prasad Adhikari	Senior Scientist (S3)	M.Sc.An.Sc. (LPM)	LPPM
3.	Dr. Bodh Raj Baral	Scientist (S1)	M.Sc. An. Sc. (Animal Nutrition and Fodder Production)	Pasture Forage and Agro-forestry
4.	Dr. Gita Pandey	Scientist (S1)	M.V.Sc. (Pharmacology)	Veterinary Science
5.	Mr. Buddhi Ram Acharya	Senior Technical Officer	M.Sc., An. Sc. (LPM)	LPPM
6.	Dr. Yagya Raj Pandeya	Technical Officer	M.V.Sc. (Theriogenology)	LPPM
7.	Dr. Chet Raj Pathak	Technical Officer	M.V.Sc. (Parasitology)	Veterinary Science
8.	Mr. Hem Sharma	Administrative	B.A.	Administration
9.	Mrs. Nanda Kala Sapkota	Administrative	B.A.	Administration
10.	Mr. Binod Chandra Adhikari	Account Officer	B.Com., M.A.	Account
11.	Dr. Pratik Hamal	J.T. (T5)	B.V.Sc. & A.H.	
12.	Mr. Prabin Sapkota	J.T. (T5)	I.Sc. Ag. (Animal Science)	
13.	Mr. Kapur Bhusal	J.T. (T5)	B.Sc. Ag.	
14.	Mr. Chakra Bahadur Ghalan	J.T.A. (T4)	J.T.A. (Plant Science), B.Ed.	
15.	Mr. Khadka Bahadur Khadka	J.T.A. (T4)	J.T.A. (Plant Science), 10+2	
16.	Mr. Dipendra B. Kathayat	J.T.A. (T4)	B. Sc. Ag.	
17.	Mr. Pasupati Khanal	J.T.A. (T4)	J.T.A. (Animal Science), B.A.	
18.	Mrs. Mitra Maya Gurung	Lower Technician	I.A	
19.	Mrs. Aasha Gurung	Lower Technician	IX	
20.	Mrs. Ambika Kafle	Lower Technician	VII	
21.	Mrs. Sushma Praja	Lower Technician	S.L.C	
22.	Mr. Dipendra Ojha	Lower Technician	IX	
23.	Mrs. Manju Rai	Lower Technician	10+2	

Annex 3.1. Summary of NARC Research projects in FY 2076/77(2019/20)

S.N.	Project/Activities	Project Leader	Annual Budget in Rs. '000'	Cummulative progress upto reporting month	Project Type	Remarks
1	**Farm and Office Management Project**	**Dr. M.P. Acharya**	**1471**		**Core**	
1.1	Farm security		**354**	Farm security well maintained. 5 regular security guards hired.		
1.2	Farm Maintenance		**454**	Well maintained		
1.3	Research support (Admin. Lab services etc.)		**598**	All work done properly		
1.4	Annual report publications and audio-visual documentary production		**65**	100 copies of annual report were published.		
2	**Participatory Technology Development and Varification at Outreach Sites**	**Dr. M.P. Acharya**	**973**		**Core**	
2.1	Evaluation of teat dipping in farmers management conditions		**123**	Teat dipping was found to be effective to control mastitis in farmer's field.		
2.2	Effectiveness of vaccination for major economic diseases and drenching against major internal and dipping/ spraying for external parasites.		**115**	Drenching in 150 cattle. HS and BQ vaccination in 100 cattle of Madi Chitwan.		
2.3	Health campaign		**95**	One Health Camp was conducted in Madi, Chitwan.		
2.4	Fortification of UMMB using sustained release urea (SRU) and probiotic cultures		**90**	100 kg UMMB was made and distributed to farmers.		
2.5	Demonstration of silage making		**85**	Silage making demonstration was done in Madi by making approximately 500 kg silage.		

2.6	Community forage and forage seed production		**85**	20 kg common vetch seed and 40 kg oat seed distributed. 300 kg oat seed was produced by farmers.		
2.7	Travelling Seminar		**155**	Staffs of NCRP visited different cattle farms of Gorkha, Tanahu and Lamjung district.		
2.8	Demonstration and making of milk product		**75**	Khuwa, paneer and dahi making procedure were demonstrated at Madi, Chitwan.		
2.9	Village Level Workshop		**55**	One workshop was conducted at Madi, Chitwan.		
2.10	Use of improved/latest technologies in breeding practices		**95**	USG was used in 30 cattle at Madi for early PD.		
3	**Screening of Antibiotic Residues in Raw Milk in Dairy Pocket Area of Nepal.**	**Dr. G. Pandey**	**745**		**Time Bound**	
3.1	Milk sample collection		**65**	100 milk sample were collected		
3.2	Survey of Antibiotics used for treatment of Livestock		**30**	50 households survey was done in Chitwan.		
3.3	Detection of antibiotic residue by use of Rapid test kit		**125**	Incomplete		Due to COVID-19 unable to buy test kits
3.4	ELISA test for detection of antibiotic residue in milk		**390**	Incomplete		
3.5	Quantification of antibiotic residue in milk (HPLC)		**135**	Incomplete		
4	**Cattle Herd Management and Production Project**	**Dr. M.P. Acharya**	**17658**		**Core**	
4.1	Feeding of animals with appropriate roughage and concentrate.		**11505**	Fed animals with pellet feed (185,000 kg) and green & dry roughages.		

4.2	Health and infertility status of animal monitored bi-weekly.		**919**	Mastitis, metabolic disorder, ROP and infertility were common problems in NCRP farm.		
4.3	Vaccination and antihelmintics of animal in prescribed time frames.		**1019**	Vaccination against FMD (240), HS & BQ (148) and antihelmentics used 3 times a year in a Farm.		
4.4	Epidemiological studies on cattle mastitis.		**64**	Incomplete		Due to COVID -19
4.5	Clean milk production (udder cleaning, utensils, teat Dipping etc.)		**189**	Different managemental practices were performed.		
4.6	Processing and distribution of clean milk		**150**	Clean milk was distributed year round from a dairy unit.		
4.7	Product diversification (Paneer, Khuwa, yoghurt and Ice cream) and its study on different consumer's acceptance		**170**	Khuwa -131kg, Paneer- 417.93 kg, Yoghurt (Dahi) - 46.5 liter and Rasbary- 500 pieces were made & sold.		
4.8	Heat stress management for farm animal during summer months		**225**	Heat stress management techniques were applied in summer months.		
4.9	Routine milk analysis		**60**	Monthly milk analysis was done.		
4.10	Comparison of milking methods (Machine and hand milking)		**185**	Machine milking milked 0.86 lit./ minute while hand milking milked 0.50 lit./minute. Machine milking is 72% faster than hand milking.		
4.11	Introduction and evaluation of different forage for permanent pasture		**644**	Super napier and rice bean were introduced and evaluated.		

4.12	Seed production of major forage crops		**340**	250 Kg teosinte and 110 kg oat seed produced.		
4.13	Production of green forage		**560**	Year round green forage production was done (1160 MT)		
4.14	Study on hydroponic fodder production and use in dairy Animal		**170**	250 kg maize seed was used for hydroponic fodder production. In average one kg seed produced 4 kg fodder.		
4.15	Study on different agent to add value to silage (urea + molasses, probiotic culture, yeast etc.)		**170**	35 metric ton silage was produced.		
4.16	Routine recording of feeding and milk production		**40**	Milk production and feeding record were maintained.		
4.17	Maintenance and evaluation of Terai cattle and its crossbred		**815**	20 female and 3 male pure terai were maintained. Similarly 3 Terai HF and 1 Terai Jersey cross were produced.		
4.18	Maintenance of pedigree record and updating of data management		**37**	Pedigree record register well maintained.		
4.19	Effects of feeding milk replacer on body growth and its economic feasibility in dairy calves		**328**	Feeding completed in 3 calves and 9 calves are under trial		
4.20	Growth records of calves		**68**	Daily growth rate of calf was 283 gram.		
5	**Study on Existing Situation of Heat Stress Management of Crossbred Cattle in the Dairy Pocket Area of the Terai Region During the Summer Months**	**Mr. B.R. Acharya**	**325**		**Time Bound**	
5.1	Heat stress management trial conduct		**113**	Trial completed		
5.2	Blood parameter analysis		**170**	Lab analysis completed		

5.3	Economic analysis of cost of production		**42**	Combined fan cooling and sprinkle group were more economic.		
6	**Development of Year Round Cost Effective Forage Based Milk Production Technology for Crossbred Cattle**	**Mr. B.R. Acharya**	**489**		**Time Bound**	
6.1	Collection and cultivation of winter legume and non-legume forages germplasm		**110**	Oat, pea and vetch were collected and cultivated.		
6.2	Yield assessment of winter forage		**27**	Per hectare productivity of oat, vetch and pea was 25.23, 19.65 and 22.77 ton respectively.		
6.3	Economic analysis of winter forage		**33**	Per kg production cost of oat, vetch and pea was found to be Rs.1.70, 3.23 and 3.10 respectively.		
6.4	Collection and cultivation of summer/ rainy season legume and non-legume forage		**150**	Rice bean, teosinte, maize, sorghum and bajra were cultivated.		
6.5	Prepare different feeding regime and conduct feeding trial at different season		**86**	Feeding trial conducted twice a year.		
6.6	Performance recording, milk parameter analysis and monitoring		**37**	All data were recorded.		
6.7	Cost benefit analysis of feeding trial at different season		**25**	Feeding trial's cost benefit analysed.		
6.8	Cost benefit analysis of silage preparation and milk production.		**21**	Silage prepared		
7	**Development of Package of Practise for Yak/Chauries**	**Dr. Y.R. Pandeya**	**790**		**Time Bound**	
7.1	Meeting with collaborators for package development		**65**	Meeting with collaborators completed in NASRI Hall Khumaltar, Lalitpur.		

7.2	Group meeting with stakeholders in each project district		**235**	Group meeting conducted at Taplejung.		
7.3	Application of Package activities		**490**	Package activities started at Taplejung.		
8	**Assessment of Major Reproductive Hormones in Cyclic and Non-cyclic Crossbred Dairy Cows**	**Dr. Y.R. Pandeya**	**1020**		**Time Bound**	
8.1	Identification of cyclic and non-cyclic cows		**10**	15 cyclic and 5 non-cyclic cows identified		
8.2	Assessment of major reproductive hormones		**902**	Serum collection completed in 6 cows (3 cyclic & 3 non-cyclic).		Unable to buy test kits due to COVID-19
8.3	Hormonal treatments in identified cyclic and non-cyclic cows		**97**	Incomplete		”
8.4	Fertility evaluation/ examination		**11**	Incomplete		
9	**Multilocation Project**	**Mr. B.R. Acharya**	**891**		**Time Bound**	
9.1	Genetic evaluation of Lulu cattle		**891**	Highest milk production of Lulu cattle was reported to be 4 liter/day		
10	**Status of Haemoprotozoans in Dairy Cattle of Nepal**	**Dr. C.R. Pathak**	**785**		**Time Bound**	
10.1	Blood smear preparation		**215**	Incomplete		Due to COVID-19
10.2	Serological Diagnosis: Rapid test kit/ELISA		**65**	Incomplete		
10.3	Blood profile test		**190**	Incomplete		
10.4	Molecular detection of different protozoa		**40**	Incomplete		
10.5	Treatment trail in positive animals: parvaquinone/Butalax for *Theileria*, Diminazine acetaurate/ Berenil for *Babesia* and OTC in case of *Trypanosoma* positive cases.		**275**	Incomplete		

11	**Isolation and Molecular Characterization of Siga Toxin Producing *E.coli* O157:H7 in Milk**	**Dr. C.R. Pathak**	**400**		**Time Bound**	
11.1	Collection and preparation of samples from raw milk from cow		**165**	100 milk sample were collected		Due to COVID-19 unable to buy PCR test kit
11.2	Bacterial isolation		**35**	*E. coli* was found		
11.3	Characterization for *E. coli* O157:H7		**30**	Incomplete		
11.4	DNA Extraction		**70**	Incomplete		
11.5	Multiplex Polymerase Chain Reaction (mPCR) and Gel Electrophoresis		**100**	Incomplete		
12	**Evaluation of Protective Immunity and Longevity of Hemorrhagic Septicemia (H S) Vaccine Commonly used in Nepal**	**Dr. M.P. Acharya**	**835**		**Time Bound**	
12.1	Study design and Pre-vaccination sera sampling		**35**	Sera sample were collected according to protocol		
12.2	Vaccination		**140**	All together 200 cattle were vaccinated		
12.3	Post-vaccination sampling (21st day) and in every months for 6 months		**140**	Completed		
12.4	ELISA test for antibody titer and Data analysis		**520**	Incomplete		Due to COVID 19

Annex 3.2. Summary Progress of Special Research Projects and Activities in 2076/77 (2019/20)

Name of project/ activity	Project/Activity leader	Begin Year	End year	Budget allocated for this year	Major progress/ Achievements
Not any					

Annex 4.1. Production of (commodity/product) in FY 2076/77

SN	Commodity /Product	Variety/Breed	Type (Breeder/ Foundation/ Blood level)	Unit	Target Quantity	Produced Quantity
1	Calves	Jersey Cross HF Cross Terai HF Cross Terai Jersey Cross Lulu Pure Terai Pure	- - - 50% - 50% -100% -100%	No.	30	49
2	Grasses	Green grasses	Annual and Perennial	MT		1160
3	Milk	Whole milk		Lit.	80000	123475.70
4	Paneer		-	kg	-	417.93
5	Khuwa	-	-	kg	-	131
6	Ghee	-	-	kg	-	21.50
7	Dahi	-	-	Lit.	-	46.5
8	Ice cream			kg		-
9	Rasbari			Piece		500
10	Silage	-	-	MT	-	35
11	Forage Seed			kg	300	360
12	Manure	-	-	kg	-	

Annex 4.2. Distribution of (commodity/product) in FY 2076/77

SN	Commodity/ Product	Type	Quantity	Major stakeholders	Distributed district
1	Male Calf	Jersey Cross, Holstein Freisian Cross	12	Farmers	Chitwan & Makawanpur
2	Seeds	Teosinte	10 kg	Farmers, Seed suppliers/ marketers, Offices	Chitwan & Rasuwa
		Oat	40 kg		

Annex 5.1. Training/Workshop/Seminar Organized in FY 2076/77 (2019/20)

S. N.	Name of Training/ Workshop/ Seminar	Duration	Target group	Location	No. of Participants
1	Village level workshop on Cattle production and management	1 day	Farmers and Government Technician	Madi, Chitwan	25

Annex 5.2. Services Provided in FY 2076/77 (2019/20)

SN	Laboratory/field test/ counseling services provided	Numbers	Major clients
1	Farm observation and technical briefing	4950	Farmers, Students, Entrepreneurs, Extension officials, NGOs
2	Laboratory skills, pregnancy diagnosis, disbudding, weight and age determination	30	B.V.Sc. & A.H. Internee
3	Laboratory skills/ ELISA test	2	M.V.Sc. /M. Sc. An. Sc. Students
4	Treatment and lab skills	10	J.T.A. OJT (students)
	Total	**4992**	

Annex 5.3. Publications in FY 2076/77 (2019/20)

SN	Name of publications	Type	Language	Authors	No. of copies
1	Annual Report 2075/76	Book	English	NCRP	100

Annex 5.4. Information Disseminated Through Media in FY 2076/77 (2019/20)

SN	Information disseminated/Media coverage	Type	Name/ Type of media	Date

Annex 5.5. Visits of the Office/Station by Farmers, Extension Officials/Technicians, Entrepreneurs, Cooperatives, Farmer Groups, NGO/CBO Officials etc.

SN	Category	Number	Districts	Areas of major interest
1	Farmers	1413	Different districts of country	Cattle raising and farm visit.
2	Extension Officials	102	Kathmandu, Lalitpur, Pachthar, Rukum	Cattle husbandry Practices
3	NGOs Officials	104	Pyuthan, Rasuwa, Gorkha, Gulmi, Janakpur	Cattle husbandry practices
4	Students and Instructor	3373	Nepal Poly- technique Institute and other technical Schools	Farm visit, Cattle husbandry practices
	Total	**4992**		

Annex 6. Training/Workshop/Seminar Attended by Staff in FY 2076/77 (2019/2020)

SN	Name of Staff	Position	Name of training/ seminar/workshop	Duration	Place/ Country	Organizer
1	Dr. Yagya Raj Pandeya	Technical Officer (T-6)	Pedigree Performance Evaluation Training	25 Sep- 1 Oct, 2019	Hariharbhawan, Lalitpur	NLSIP & AITC
2	Dr. Yagya Raj Pandeya	Technical Officer (T-6)	SAADC-19	8-11 Nov, 2019	Pokhara, Nepal	Nepal Veterinary Association
3	Dr. Yagya Raj Pandeya	Technical Officer (T-6)	Asian Regional Conference on Goats (ARCG-19)	20-23 Oct, 2019	Chitwan, Nepal	IGA & AFU
4	Dr. Chet Raj Pathak	Technical Officer (T-6)	SAADC -19	8-11 Nov, 2019	Pokhara, Nepal	Nepal Veterinary Association
5	Dr. Chet Raj Pathak	Technical Officer (T-6)	A Workshop on Experinmental Biotechnology	27-31 Jan, 2019	Kathmandu, Nepal	Central Department of Biotechnology, TU.
6	Mr. Kapur Bhusal	Junior Technician (T5)	Statistical Analysis and Low Cost Feed Formulation for Project Leaders	9-13 Dec, 2019	Khumaltar, Nepal	NASRI

Annex 7.1. Regular Annual Budget and Expenditure Record of FY 2076/77 (2019/20)

CURRENT EXPENSES				
Code no	**Budget Heads**	**Annual budget (Rs.)**	**Expenses (Rs.)**	**Balance (Rs.)**
21111	Staff Basic Salary	14375000	10778369.8	3596630.2
21132	Staff Dearness Allowance	888000	516939.2	371060.8
21139	Other Allowance	80000	16500	63500
21121	Staff Uniform Expenses	370000	220000	150000
22111	Water and Electricity Cost	600000	577114.2	22885.8
22112	Communication Expenses	287000	282190	4810
22212	Fuel and Lubricant (Vehicle)	504000	465074.68	38925.32
22213	Repairs & Maintenance Cost	320000	281878	38122
22214	Insurance and its Renewal	150000	133647.4	16352.6
22221	Machinary and Equipment Maitenance	340000	256230	83770
21213	Insurance	178000	108800	69200
22311	Office Expenditure	680000	454965	225035
22312	Livestock Feed Expenditure	10928000	9107223	1820777
22313	Books and Materials Cost	100000	98762	1238
22314	Fuel (for other use)	250000	207723	42277
22231	Public Property Repairs & Maintenance	700000	680547	19453
22413	Miscellaneous Service Expenses	1195000	1137003	57997
22512	Training/Workshop	100000	50020	49980
22521	Labor Cost	6040000	5548952	491048
22521	Lab Equipment	2925000	424754	2500246
22521	Farm Equipment	2997000	2824954.32	172045.68
22611	Monitoring and Evaluation	200000	10000	190000
22612	Travel Expenses	2538000	1571455	966545
22711	Miscellaneous Expenses	125000	124388	612
	Total	**46870000**	**44676149.92**	**14155850.08**

CAPITAL EXPENSES				
Code No.	**Budget Heads**	**Annual budget (Rs.)**	**Expenses (Rs.)**	**Balance (Rs.)**
31112	Building and Construction Cost	2000000.00	1933272.00	66728.00
31113	Capital Maintenance Expenditure	25000.00	246169.00	3831.00
31123	Furniture and Fixture Cost	400000.00	392223.00	7777.00
31121	Vehicle	24000.00	23956.00	44.00
31122	Machinary Equipment	3982000.00	3660668.00	321332.00
31159	Public Construction Expenditure	1500000.00	1466278.00	33722.00
	Total	**8156000.00**	**7722566.00**	**433434.00**

Annex 7.2. Special Project Budget and Expenditure of FY 2076/77 (2019/20)

(In '000 Nepalese Rupees)

Name of the project	Funded by	Project period	Annual budget	Expenses

Annex 7.3. Revenue Status of FY 2076/77(2019/20)

S.N.	Sources of Revenue	Revenue Collected (Rs.)
1	Milk	6751246
2	Dairy Products	359389
3	Manure	6090
4	Male Calves/Bull	7000
5	Teosinte Seed	28050
6	Napier Sets	783
7	Oat Seed	25000
8	Setaria	150
9	Signal Grass	150
10	Books	500
11	Tender	74200
12	Seminar Hall Rent	26000
13	Beruju & Credit Reimbursement	143422.28
14	Others (Old Newspapers, Plastic Sacs)	4570
15	Bank Interest	94559.64
	Total	**7521109.92**

Annex 7.4. Beruju Status of FY 2076/77 (2019/20)

Beruju	Amount (Rs. in thousands)	Remarks
Beruju till 2061	1494.87	
Beruju from 2060/61 to 2070/71	10213.64	
Beruju till 2075/76	12511.196	
Beruju in 2076/77	7263.983	
Beruju cleared in 2076/77	6126.396	
Remaining total Beruju	13648.783	

Annex 7.5. Human Resources Chart at NCRP

SN	Post	Group	Number of post	Post fulfilled	In	Out	Vacant Post
1	Principal Scientist	LPPM	1	0	0	1	0
2.	Senior Scientist	LPPM	1	0	2	1	0
3.	Scientist	LPPM & AB	3	0	2	2	1
4	Senior Technical Officer	LPPM	1	1	0	0	0
5	Technical Officer	LPPM, Veterinary and PFAF	4	2	0	0	2
6	Account Officer	Admin & Finance	1	1	0	0	0
7	Admin Officer	Admin	2	2	0	0	0
8	Junior Technician (JT)		5	3	0	0	2
9	Junior Technical Asst. (JTA)		4	4	0	0	0
10	Technical Helper	-	12	7	0	4	1
11	Admin Helper	Admin	1	0	0	0	1
12	Driver Heavy	Admin	1	0	0	1	0
13	Driver Light	Admin	1	0	0	1	0
	Total		**37**	**20**	**4**	**10**	**7**

Annex 8. Monthly Agro Meteorological Data of the Station in FY 2076/77 (2019/20)

Parameters	Months											
	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Maximum Temp. (°C)	36.67	33.26	35.36	32.30	31.35	28.69	22.80	20.31	24.7	30.04	33.53	32.95
Minimum Temp. (°C)	27.13	26.24	27	25	22.18	17.36	10.57	10.31	11.34	17.05	21.15	23.43
Rainfall (mm)	13.3	30.57	10.40	18.68	4.13	0	24.8	11.18	7.3	6.76	9.71	18.30

Lab work for bacterial identification in NCRP lab


Cattle grazing in NCRP Pastureland


Achhami cattle in NCRP farm


Plantation of Super Napier in NCRP farm


Hydroponics harvesting in NCRP farm


Stylo cultivation in NCRP farm


Nutrition lab in NCRP, Rampur


Cattle serum sample collection in Madi, Chitwan

Terai & Jersey Crossbred Female Calf (F1)

Terai & Holstein Friesian Crossbred Female Calf (F1)