ANNUAL REPORT 2020

भाकृअनुप
ICAR

भा.कृ.अनु.प.–केंद्रीय बकरी अनुसंधान संस्थान
मखदूम, फरह–२८११२२,मथुरा (उ.प्र.)

ICAR-CENTRAL INSTITUTE FOR RESEARCH ON GOATS

(AN ISO 9001:2008 CERTIFIED ORGANIZATION)
MAKHDOOM, P.O. FARAH-281122, MATHURA (U.P.) INDIA

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FOREWORD

Annual report 2020, ICAR-CIRG, Makhdoom, Mathura showcases various activities and its research achievements. During this period, we have endured the most dreadful challenge of COVID-19 pandemic. The pandemic has its effect on various domains, but the institution was kept ready to tackle the challenges and all COVID-19 appropriate guidelines were strictly adhered to. Our major task is research and extension in the area of goat husbandry and production. Since its inception the institution is working for the genetic improvement of major breeds of India through scientific breeding and selection process. National training programme is an important initiative by ICAR-CIRG which aims at skill development of youth farmers and entrepreneurs in strengthening the activities related to goat rearing as successful enterprise. During this pandemic, the training programme has been catered through online mode. Research programmes are undertaken as per the approved mandate on genetic improvement, reproduction management, and technologies to improve reproductive efficiency, low cost feed formulation, mitigation of climate change and its effects on goat production, disease diagnostics for efficient identification of infectious and metabolic diseases in goats, popularization of available technologies on goat production and management to various stakeholders.

Besides, we are also working in the area of goat based integrated farming system by combining with desi chicken. An economic model is being computed which will be a technology ready to showcase to the interested farmers. A positive research environment is created by keeping in mind the necessities of the farmers and their economic improvement in terms of sustainable goals for livelihood security. And for the same reason, all the CIRG developed technologies were commercialized to interested firms and are available in the market, and moreover their sales are increasing over the years. This shows the importance of farmer need based technologies that could create a huge impact in their socio-economic structure. ICAR-CIRG is also highly privileged to obtain two patents for its highly revered technologies on herbal formulations with antibacterial activity for animals. With this, we have three patents obtained so far till the reporting period, and ICAR-CIRG is proud of the inventors and the team that has worked hard for this endeavour. The production performance in terms of weight gain and milk production has improved in important breeds like Jamunapari and Jakhrana thanks to the genetic selection over the years coupled with ideal management and health. Another important breed of goat Jakhrana has showed promising potential in terms of milk production and

Integrated research on goats reared under the geo-climatic conditions in the native breeding tract is very important to study its genetic performances and hence AICRP on goat improvement has been handled by ICAR-CIRG with over 20 units spread across various states and regions of the country. Through AICRP, Inclusive technologies pertaining to the specific region has been validated with more importance to the traditional rearing with a modern outlook to improvise the performance output.

Assisted reproductive technologies are another important research area, where ICAR-CIRG is working for several years. We are committed to artificial insemination in goats owing to its advantage to make available the superior quality semen from high performing breeding males. Special training programmes related to AI is being conducted for skill development of interested entrepreneurs in this area. Research on stem cell and CRISPR technologies for doubling the muscle mass in goats is also undertaken. Shelter management using plastic modules were also tested for better ambience in goats with low climate related stress and less gastro-intestinal parasitic load.

Animal health and its well-being is perceived as important tool for maximising the output from production animals despite its quality germplasm. Animal health interventions including timely screening of animals for brucellosis, endoparasites, Johne's disease, coenurosis is done through service project. Also the major work is to offer treatment, prophylaxis, dipping, deworming and diagnostic screening in a time to time manner. Many novel diagnostics developed in-house were validated in CADRAD, ICAR-IVRI and many other institutions were applied in quick, specific and accurate diagnosis of important infectious diseases affecting small ruminants. Novel herbal based formulations are another are the division is working since two decades and developed, commercialized and patented them. Area specific mineral mixture, reduced methane emission and low cost feed formulation are the key areas of animal nutrition handled in ICAR-CIRG. Besides novel rumen microbes with specific activity are identified, characterized and accessioned at NCVTC. Specific feeding strategies were developed depending upon the physiological need of the animal and also to attain the performance potential from high quality germplasm. Meat and milk products that were having value-addition and health benefits were developed, especially low sodium meat products, products that are stable at room temperature with high shelf life, enriched whey based drinks, goat Mozarella cheese are ready for commercialization.

Attracting all the stakeholders to take up goat farming as an remunerative form of investment and entrepreneurship has a very high scope and ICAR-CIRG is working in this direction to popularize, create awareness through skill development programs. Farmers, livestock keepers, youth entrepreneurs have attended many training programmes, farm visit, demonstrations etc. Farmer's single window helpline is handling regular calls from farmers on all working days and immediate suggestions and expert advice is provided to them. Besides scientists are attending television and radio talks to disseminate the latest development and important messages to livestock owners.

In a positive note, I thank all the stakeholders who have supported the institution to make popular among the goat keepers. I also extend my gratitude to Dr. Trilochan Mohapatra, Director General, ICAR and Honorable secretary DARE, Dr. B.N. Tripathi, DDG (AS), Dr. V.K. Saxena ADG (APB), Dr. Ashok Kumar ADG (AH), Dr. A.K. Tyagi ADG (ANP). I am also indebted to the supports of all the heads of divisions, Incharge PME, Incharge AKMU, Incharge ITMU in supporting the preparation of the document. Finally, I also wish to thank the whole editorial team of the Annual report 2020 for their efforts in compilation of documents.

(Dr.B.Rai)

DIRECTOR

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2 EXECUTIVE SUMMARY

2.1 GOAT BREED IMPROVEMENT

Nucleus flock of Barbari goat is maintained under semi-intensive feeding system under AICRP on Goat Improvement. The opening and closing balance of flock was 644 and 632 on 1st January 2020 and 31st December 2020. The 363 kids were born from 219 doe's. Flock growth was 162% and kidding rate was 1.66%. A total 227 goats (115 male and 112 females) were provided to farmers and other stake holders for goat improvement and enhancing farmer's income. Overall flock culling and mortality rate in the year was 2.48 and 3.77%. Averages age at first service, weight at first service, weight at first kidding, age at first kidding, first kidding interval and gestation period were 412.02±9.91 days, 21.28±0.39 kg, 23.83±0.46 kg, 560±10 days, 296.01±7.15 days and 146.10±0.42 days, respectively. Multiple births were 78% of total kids born. Kidding efficiency (%) on the basis of does available and doe's tupped were 124.0 and 145.0%. The selection differential for 9 months body weight was 5.8 kg and that of the dam's 90 days milk yield was 9.75 liters. The least squares means of body weight of kids at birth, 3, 6, 9 and 12 month of ages for kids born in year 2020 were 1.73±0.02, 7.74±0.09, 12.99±0.22, 16.79±0.31, 22.35±0.25 kg respectively. The h^2 estimates of growth traits were moderate ranged from 0.11 to 0.27. Least square mean for 90 days milk yield, 140 days milk yield, total lactation yield and lactation length in 2020 were 73.54±1.05 litre, 109.33±1.62 litre, 115.94±1.85 litre and 160.81±1.74 days, respectively. There was a significant and consistent improvement in all lactation traits from 2016 onwards. The Total milk production in the year 2020 was 13621.0 litres. Package of practices were developed and transferred to field for obtaining higher survival, growth, lactation and reproductive performances.

There were 45 multiplier flocks (MFU) of Barbari goat breed were established for genetic improvement, conservation and promoting scientific goat farming, development of goat based business and livelihood models in 6 states of India. Total revenue generated in the year was Rs. 2070179.00.

The opening balance of Jamunapari nucleus flock was 602 and closing balance was 532. During the period 265 kids were born from 200 does out of which single, twin and triplet born kids were 52.07%, 44.53% and 3.40%, respectively. There were 114 male and 95 female were supplied for various livestock developmental agencies for genetic improvement and conservation of Jamunapari goats in the field. Averages age at first service, weight at first kidding, age at first kidding and gestation period during the year were 760.45±44.39 days, 33.80±0.69 kg, 931.89±51.44 days and 152.87±3.60 days, respectively.The least squares means of body weights of kids at birth, 3, 6, 9 and 12 months of age in the year were 3.45±0.05 kg, 10.90±0.15 kg, 14.10±0.23 kg, 20.21±0.46 kg and 24.06±0.52 kg, respectively. The h^2 estimates of growth traits were moderate ranged from 0.19 to 0.26. The least squares means of milk yield in 90 days, 140 days, total milk yield and lactation length were 75.38±1.84 litre, 111.46±2.99 litre, 98.54±3.51 litre and 161.04±3.24 days, respectively. The selection differential for 9 months body weight was 9.32 kg and dam milk yield at 90 day was 12.16 litre. The overall annual culling and mortality of the flock was 2.65 and 8.07. During the year 6878.0 litre milk was supplied to GPT for sale and processing. Revenue generated was Rs 1911603.00 in the year.

The overall mortality in the flock.The opening and closing balance of Jakhrana flock was 156 and 190 and 73 kids were born from 47 kidding. The kidding rate of these goats was 1.55. During the year 12 buck and 09 does were supplied to the farmers. The overall least squares means at birth 3, 6, 9 and 12 months of ages were 2.82±0.04, 9.24±0.15, 15.24±0.66, 18.27±0.77 and 23.25±0.57 kg, respectively. The overall means of milk yield in 90, 120 and 150 days were 98.91±4.19, 116.50±6.86 and 128.55±11.71 litre, respectively. The milk supplied to GPT lab was 4098 litre was 2.26 %.

The opening and closing balance in Muzaffarnagari sheep was 516 and 573 in the year. During the year 266 lambs were born and overall mortality was 3.84%.The overall least-squares means of body weights of lambs at birth, 3, 6, 9 and 12 month age were 3.47±0.20, 15.84±0.21, 25.42±0.29, 30.96±0.34 and 37.40±0.34 kg, respectively. The overall least squares means for lamb's 1st and 2nd six monthly and adult annual clips were 466.11±7.76, 535.85±7.27 and 1280.28±18.92g, respectively. The averages for weight at first service, age at first lambing, ewes' weight at lambing and inter lambing period were 32.2kg, 470 days, 626 days, 34.6kg and 325 days, respectively. A total of 92 males and 58 females were supplied to farmers for improvement in field. During year revenue of Rs. 13, 88,995 were generated.

A cross-breeding experiment among indigenous breeds (Sirohi x Barbari and Sirohi x Jamunapari) was initiated this year. The initial results indicated that body weights of Sirohi x Barbari crossbred kids were marginally (10 to 14.4%) higher than Jamunapari x Barbari kids. However, growth performances (body weights) of Jamunapari x Barbari and Sirohi x Barbari kids after 6 months of age were not significantly higher than growth performance of Barbari kids. The live weight, empty body weight and carcass weight of Sirohi x Barbari kids maintained under semi-intensive up to 12 months of age were significantly higher than Jamunapari x Barbari male kids however dressing% were same in both crossbred group.

2.2 GOAT HEALTH MANAGEMENT

Animal Health division has a primary mandate of healthcare, diagnosis and control of diseases affecting goats in livestock units of the institute as well as the field. During the reporting period, 1635 biosamples were collected and tested for various disease conditions and three field outbreaks were attended by experts from the division. Of these, 46.66% (763/1635) samples were found to be positive for various diseases, including 61.53% (104/169) sera and 32.35% (121/374) faecal samples and 53.84% (21/39) milk samples positive for JD, and average of 12.85% (27/210) (sera-SAT & Swabs-qRT-PCR combined) positive for brucellosis, and 6.16% (21/341) positive for coenuruses.The Brucella incidence in livestock units stood at 14.28% of the samples tested from breeding animals. Pneumonia is an important syndrome that affects the animals especially young kids, which was studied and the causative agent were identified as *Mannhemia hemolytica, Pasteurella multocida*, etc. and a package of practices for treatment, control and its management has been developed.

For addressing one of the important diseases of goats due to intensification of rearing is enterotoxaemia, a novel vaccine development is underway and for this a restriction free cloning with seamless upscaling efficiency is being developed targeting partial epsilon toxin. Effect of nutraceutical supplementation on the health and immunity of goat kids on growth, health, behaviour and serum parameters were recorded. This will help in mitigating the weaning stress and associated health problems and production loss in young kids. A phyto-pharmaceutical product developed is being tested for its effectiveness in both subclinical and clinical mastitis in lactating does. The topical application was very effective in reducing the inflammation and production loss during subclinical mastitis. Detection of abortion causing pathogens and recording them would provide accurate information of the control strategies

followed in the farm-setup, and for this a multiplex PCR that detects are *Brucella melitensis*, *Brucella abortus*, *Coxiella burnetii*, *Chlamydophila* spp. and *Campylobacter* spp in a single tube is being developed in the institute funded project.

Under the OPZD project, two states were epidemiologically studied for the incidednce of Johne's disease viz., Rajasthan and southern coastal Puducherry. In coastal region the higher occurrence of JD was recorded in indigenous breeds of goats (35.48%, 11 out of 31 goats screened) compared to Non-descript goats (33.33%, 23 out of 69 goats screened). For *Mycobacterium avium* subspecies *Paratuberculosis* (MAP), 3 different test combinations were analyzed for the better indication of diagnostic test including Faecal ZN microscopy Versus IS*900* PCR, Serum indigenous ELISA Versus IS*900* PCR, Serum indigenous ELISA Versus Faecal ZN microscopy. Out of the three test combinations, the sensitivity and specificity of faecal microscopy to IS*900* PCR was found to be 44.12% and 93.94%. The sensitivity and specificity of serum indigenous ELISA to IS900 PCR was found to be 61.76% and 15.15%. The sensitivity and specificity of serum indigenous ELISA to ZN microscopy was found to be 73.72% and 22.22%. By all the three test combinations, the sensitivity of indigenous ELISA - Faecal ZN microscopy combination was the best.The risk factors for J.D.were studies which included animals under intensive system of rearing are 10.25 times more likely to develop JD ($P<0.006$) compared to semi intensive system of rearing. While Rajasthan a total of 101 Goats and 99 Sheep were sampled and processed for J.D. which showed, 54.5% and 31.31 % sero-positivity in goats and sheep respectively by IgG iELISA. Active and passive MAP shedders are difficult to differentiate by microscopy. Active infection can be differentiated by detecting live MAP in the unknown samples using mRNA PCR targeting important genes of MAP, and a TaqMan® probe based mRNA real time PCR was developed for assessing the actual infection status of animals.

Under this OPZD project, BRUCARE – a herbal product in the form of Bolus was developed to reduce shedding of Brucella and it was found to contain the spread of infection in small ruminants. In the field conditions, where no available mechanism is there for the goat keeper to control brucellosis, such herbal drug based package of practice could be a boon to the farmers in controlling Brucella abortions as well as containing the risk of zoonosis. Another prestigious international project was handled in the Division, which is INFAAR, and the work is based on the SoPs circulated to the collaborating centres, where we have processed 158 samples despite the pandemic situation strictly following the sampling plan in Mathura, Etawah and Firozabad districts of Uttar Pradesh. A total of 55 *Staphylococcus aureus* and 38 *Escherchia coli* isolates were confirmed based on molecular, phenotypic and genotypic AMR tests. Of the *S. aureus* isolates around 5.26 % were MRSA positive based on phenotypic AMR test and 21% were Vancomycin resistant based on genotypic AMR tests. While among *E.coli*, 3% were ESBL producing and 3.63% were AmpC beta-lactamase producing based on phenotypic AMR assays. *Cryptosporidia* is an important opportunistic protozoal pathogen that affects young goats and kids and is one of the major causes of diarrhea and poor growth. Nested PCR of 18ssu rRNA, HSP 70 and GP60 were standardized for diagnosis of *C. parvum* and other important species affecting goats.

2.3 NUTRITION MANAGEMENT

Potato (*Solanum tuberosum*) +Paddy (*Oryza sativa*) straw silage was prepared in the plastic silage bags by anaerobic fermentation. Feeding cum growth trial was conducted in male Jhakhrana goat on potato-paddy straw. Animals were fed with concentrate pellet and silage.The average daily gain of 37.03g was recorded on this silage. Results show that paddy straw can be utilized in silage preparation and can be fed to goats.

Under Veterinary type culture (VTCC-Rumen Microbes) seventeen isolates of rumen bacteria, isolated from goat's rumen liquor and fecal sample. They were identified and characterized on the basis of 16S rRNA gene amplification and sequencing of the amplified product. All cultures were screened for

carboxymethyl cellulase and *avicelase* activities in the supernatant of three days old culture. Based on the potential of these cultures in terms of fiber degrading enzyme activities, nine efficient bacterial cultures were submitted to coordinated unit at NIANP, Bangalore for accession number.

Lactation cum feeding trial was conducted on female Barbari goats on concentrate pellet incorporated with cotton seed cake and effect on milk production constituents, blood metabolites and reproductive hormones was studied. There was no significant effect of cotton seed cake feeding on milk fatty acids, plasma metabolites and reproductive hormones like FSH, Luteinizing hormone, Progesterone and Estradiol in lactating goats. Moringa is highly nutritious & economic fodder for livestock & can be grown economically as fodder crop in semi-arid zone of country. Feeding trial of Moringa based complete feed in sheep has proved it, highly economical and productive.

Reduced-fat milk paneer was prepared through replacement of full-fat milk with skimmed milk and added guar gum. A total of five product i.e., FF (paneer from full-fat goat milk without GG), FFSMG11 (paneer from full-fat and skimmed goat milk in 1:1 ratio + GG), FFSMG13 (paneer from full fat and skimmed goat milk in 1:3 ratio + GG), SMG (Skimmed goat milk + GG) and SM (Skimmed goat milk without GG), were prepared using full-fat goat milk, skimmed goat milk and their combinations with or without guar gum (0.075%).The reduced-fat goat milk paneer added with guar gum (except body and texture score for treatment SMG) received sensory scores higher than very good (>7) with better overall acceptability than the full-fat counterpart. Effect of acidulants on the physiochemical, colour and textural qualities of goat milk mozzarella cheese was studied. Physicochemical, colour, texture profile analysis and rheological properties of goat milk mozzarella cheese prepared using acetic acid (CAA), citric acid (CCA) and lactic acid (CLA) for direct acidification.

Cost economization of forage production through non-monetary inputs was carried out on fod der cowpea, pearl millet and sorghum during the *kharif* season of 2020. Maximum green (30.11 t ha^{-1}) and dry (5.06 t ha^{-1}) fodder yield of fodder cowpea was obtained with 2nd week of June sown crop followed by 4th week of June sown crop. Cowpea harvested at 70 DAS was recorded maximum green (28.12 t ha^{-1}) and dry (5.01 t ha^{-1}) fodder yield; however, fodder cowpea harvested at 60 DAS was also recorded at par value of green (27.00 t ha^{-1}) and dry (4.65 t ha^{-1}) fodder yield with fodder cowpea harvested at 70 DAS. Fodder pearl millet maximum green and dry fodder yield was also recorded with 2nd week of June sown crop followed by 4th week of June sown crop. In cutting management schedule maximum green and dry fodder yield of fodder pearl millet was obtained with cutting schedule at 45 DAS. Sorghum fodder has maximum green and dry fodder yield with 2nd week of June sown crop followed by 4th week of June sown crop. Maximum green and dry fodder yield of fodder sorghum was obtained with cutting schedule at 55 DAS. Maximum values of crude protein yield (823 kg ha^{-1}) and ether extract yield (113 kg ha^{-1}) of fodder cowpea were recorded with 2nd week of June sown crop. Cowpea harvested at 70 DAS was recorded maximum crude protein yield (810 kg ha^{-1}) and ether extract yield (105 kg ha^{-1}); however, fodder cowpea harvested at 60 DAS was also recorded at par value of crude protein yield (769 kg ha^{-1}) and ether extract yield (104 kg ha^{-1}) with fodder cowpea harvested at 70 DAS Similarly, in fodder pearl millet maximum values of crude protein yield and ether extract yield of fodder pearl millet were recorded with 2nd week of June sown crop and in cutting management schedules fodder pearl millet harvested at 45 DAS was recorded maximum values of all these nutritional parameters.

Polyhouse type dryers are used for drying different farm produce. The polyhouse dryer has been designed technically for shape, size and orientation.The proposed dryer is natural convection Polyhouse Solar Dryer (PSD) designed for drying green fodder and grasses from about 75-90% initial MC to 10-14% final MC(db) . It will have rectangu

lar base with curved top surface walk-in type polyhouse dryer for drying green fodder in batches. The cladding material should be UV stabilized and safe against damage caused by monkey and other wild animals prevailing in this region. There will be two layers of drying platform and solar powered and sensor controlled exhaust fan formoving out the moist air.

2.4 GOAT REPRODUCTON AND ARTIFICIAL INSEMINATION

During the year 2020, the activities of under different Institute and External funded projects were conducted in the Division. In a DBT Project on 'Development of novel semen extender to optimize post thaw quality for enhancement of productivity and multiplication of superior goat germplasm, the variation in the pH and antioxidant capacity of goat semen was analysed when stored in liquid state at refrigeration temperature. It was observed that the pH of diluted semen was decreases significantly from initial pH-6.66±0.03 to pH-6.06±0.03 on 5th day of liquid storage at refrigeration temperature and seminal parameters were below the acceptable level of artificial insemination. Sperm membrane lipid peroxidation due to the detrimental effect of reactive oxygen species increased during different days of storage as evidenced by low MDA concentration. Moreover, effect of IGF-1 fortification in semen diluent on post thaw qualities, antioxidant capacity and DNA integrity of Jamunapari buck semen was analyzed. It was detected that sperm motility, live sperm count, acrosomes integrity, hypo osmotic swelling positive spermatozoa, malonaldehyde (MDA), protein carbonyl content, TUNEL positive sperm were in post thaw semen were differed significantly ($P<0.05$) at different concentration of IGF-1 and were significantly ($P<0.05$) highest in 250 ng/mL of IGF-1. In another experiment, biotin fortification to goat sperm preparation medium reduces DNA damages, mitochondrial membrane potential and lipid peroxidation was studied.

In a project on "Conservation and phenotypic documentation of Mirzapuri goat breed", collection of base line data of Mirzapuri goat was initiated. Where as in an Institute project on "Augmentation of Buck fertility through use of polyherbal preparations", in vitro experimental trial was conducted using Shatavari aqueous extract. A significant improvement in motility, viability, acrosomal integrity and plasma membrane integrity in treatment groups using Shatavari aqueous extract was achieved at post thaw stage in comparison to control group.In another DBT funded project on Establishment of efficient culture and transplantation system for male goat germ-cells,differential effects of extracellular matrix proteins on in-vitro culture and growth characteristics of caprine male germ-cells.The beneficial effects of vitronectin with respect to proliferation, viability, transcriptional response, and maintenance of undifferentiated and pluripotent characteristics of cmGCs during the culture.

In a different experiment under this project, the effect of low oxygen tension on proliferation, stemness and multilineage differentiation of caprine male germline stem cells was studied and found that the survival and proliferation were significantly promoted and PDT was reduced ($p < 0.05$), thus yielding a higher number of viable cells with larger colonies under hypoxia. Furthermore, expression of pluripotency and adhesion markers was distinctly increased when cells were grown under condition with lowered O_2. Conversely, the presence of multilineage differentiated regions and expression of differentiation specific key genes were significantly ($p < 0.05$) reduced under hypoxic conditions. In a DST funded project, transcriptome profiling of spermatozoa for the development of biomarker for the selection of fertile buck was done.

As an activity of the Institute project Development of goat based integrated farming system model a goat based integrated farming system model i.e. 'On-Farm Fodder Production Technology' in Kharif Season for 20 goats and its followers in peri-urban area through IFS approach was developed. Similarly, in an AICRP on Plastic Engineering Technology, Development and Evaluation of Portable Plastic Enclosure for Improved Kid/Lamb Rearing using sandwiched por

table plastic panel technology for protecting goat kids from cold stress was done. For this, growth trail of three months old weaned kids in different enclosure during winter and investigation and successful designing and development of plastic flooring based two tier housing system was achieved. Besides this, the scientists of this Division were involved in generated and compilation of Meteorological Observations on daily basis.

2.5. TECHNOLOGY TRANSFER TO THE FARMERS DOOR STEP

Under transfer of technology programmes, goat farmers were contacted and discussed regarding scientific goat rearing practices. Farmers-Scientist interaction meets, goat health camps, awareness camps on *Swacchta Abhiyan* and COVID-19 were organised.Large number of goats were dewormed and treated against different ailments under these health camps.CIRG technologies were disseminated to large number of beneficiaries. Under DST project, ten (10) *Kisan Gosthis*, COVID-19 awareness camps, women empowerment camps were organised. Women goat farmers based SHGs were formed and local natural resource based feed developed for goats in Uttarakhand state. COVID-19 protection kits were distributed among goat farmers in project area. Technical literature on different aspects of scientific goat farming were developed and provided to farmers, trainees, entrepreneurs and other stakeholders. Goat meat supply chain study was conducted to understand cost/ margins of actors engaged along goat meat supply chain. Data were collected from goat rearing households to assess economic impact of health calendar developed by ICAR-CIRG in Mathura district.

Large number of goat farmers received inputs in the form of health kits, mineral mixture, technical literature and consultancy under farmers's programmes conducted by the institute. ICAR-CIRG technologies were showcased in National Dairy Mela at Karnal and *Pasu Krishi Vigyan Mela* at ICAR-IARI, New Delhi. Three (3) national training programs on scientific goat farming were organised in which 192 farmers from 14 states were successfully participated. One sponsored training programme was organised with 32 goat farmers from Satna district of Madhya Pradesh. Synergy developed with KVKs, NABARD, State Animal Husbandry Department, Uttarakhand Sheep and Wool Development Board (USWDB), CSIR-CIMAP, local NGOs and Agricultural Universities during organization of extension programmes.

3 CIRG CHARTER

VISION

To develop - the Goat- as a source of livelihood and nutritional security for the prosperity of India.

MISSION

Improvement in productivity of goat through research, extension and HRD support.

MANDATE

To undertake Research, Training and Extension Education Programmes for improving milk, meat and fiber production of goats and to develop processing technologies of goat products.

QUALITY POLICY

CIRG is committed to enhance goat productivity through research, extension and HRD support for the benefit of society, industry and scientific community.

Towards this, we shall,

- Continue to align our actions with organizational values
- Implement QMS as a platform for improving performance standard
- Continually improve our performance by periodical review of quality objectives
- Actively involve and adequately empower all personnel.

OBJECTIVES

- To undertake basic and applied research in all disciplines relating to goat production and products technology.
- To develop update and standardize area specific package of practices on breeding, feeding, management prophylactic and curative health cover of goats.
- To impart National and International Trainings in specialized fields of goat research and development.
- To transfer technologies for improving milk, meat and fibre production and value addition of goat products.
- To provide referral and consultancy services on goat production and product technologies.

4 CIRG: AN INTRODUCTION

The Indian Council of Agricultural Research established a National Goat Research Centre at Makhdoom, Farah in Mathura district of Uttar Pradesh on 12th July, 1976. The Centre got the status of a full-fledged Institute on 12th July, 1979 and named as Central Institute for Research on Goats. The Institute is located at equidistance from two famous places – Mathura (25 Km), the birth place of Lord Krishna, and Agra (32 Km) the abode of world famous Taj Mahal. Director is the head of Institute and its apex body like IMC, RAC and QRT guide research and other activities. This institute has four research divisions and one section including well equipped Library, AKMU, PME cell, Agricultural farm, ITMU, Livestock farm and Health Section to fulfill the mandate and responsibilities. The Coordinating unit of All India Coordinated Research Project on goat improvement is also located at CIRG. The project aims at improving production performance of different breeds of goats distributed in different regions of the country under farm and field conditions. The Institute is well connected with modern information and communication facilities comprising landline phones 0565-2763380, 2763323 and helpline 0565-2763320. The profile of the Institute can be visited at www.cirg.res.in.

HIGHLIGHTS OF ACHIEVEMENT

The institute has developed number of pro farmer's packages of practices technologies; and commercially viable technologies for goat improvement in the country. 20 patents have been filed; twelve technologies have been commercialized for larger production. Other important technologies such as Value added goat meat and milk products, diagnostics for brucellosis and JD, herbal formulation, intravaginal pessaries etc. are under process of commercialization. Some of the major achievements are as follows:

- Multiplication and conservation of elite germ plasm of Jamunapari, Barbari, Sirohi and Jakhrana breed of goat for genetic improvement of indigenous goats.
- Established germ-plasm resource improvement and conservation centers (multiplier flocks) of Barbari goat breed in fields.
- Analyzed milk composition traits such as protein, fat and SNF in different breeds and association of protein percentage with different allelic combinations.
- Positive genetic improvement trend in body weight at birth, at 3, 6, 9, and 12 month of age in Jamunapari and Barbari goats.
- Significant improvement in milk yield in Jamunapari, Barbari and Jakhrana goats compared to their base population performance.
- Refined semen freezing protocol involving 7.5% (v/v) egg yolk and glycerol 5.4% (v/v) with 100 million sperms/dose of 0.25 ml French mini straw resulted in overall post thaw motility of 50.55%, irrespective of four breeds viz. Jamunapari, Barbari, Jakhrana and Sirohi goats.
- Artificial Insemination (A.I.) with Frozen Semen in 149 goats of different breeds resulted in successful conception in 52 goats with a

- a success rate of 35.32% on actual kidding basis.
- Developed a new method for isolation of mesenchymal stem cell (MSCs) from goat bone marrow.
- Established genetic origin of Indian goat breeds and genetic variation in Myf, leptin, Pit I, FecB, SCD gene and HSP genes in Indian goats.
- Developed complete feed pellet for efficient growth (80g/d) in finisher kids. Strategic supplementation of concentrate mixture @ 1.2% of the body weight for better growth and meat quality of Barbari goats.
- Better dressing percentage and meat quality by supplementation of area specific mineral mixture under intensive goat rearing system.
- Enriched goat meat nuggets and goat meat sausages with omega 3 fatty acids.
- Standardized retort processing of goat meat curry and goat milk paneer curry which has non refrigerated shelf life at room temperature.
- Identified anti-methanogenic feed resources for goat production system.
- Developed higher bio-mass producing fodder system (Guar+Lobia+Sunhamp) for goats under rain fed conditions and Morus alba based cost effective agro-forestry system for sustainable goat husbandry in semi-arid and rain fed areas.
- Developed package of practices and dynamic health calendar for goat farmers.
- Developed highly sensitive indigenous molecular diagnostic tests for Brucellolsis and Johne's disease in goats.
- Developed database repertoire for *Clostridium perfringens* strains prevalent in causing Enterotoxaemia in goats.
- Developed sensitive and specific diagnostic assay (purified toxin based iELISA and peptide based iELISA) for detection of anti-epsilon antibodies in order to assess protective antibody titer against enterotoxaemia post-vaccination.
- Developed Johne's disease vaccine using native strain of JD organism.
- In an attempt to develop phage-based therapeutic agent against neonatal colibacillosis in goat-kids, three phages viz. *E. coli* Phage/ CIRG/11, *E. coli* Phage/CIRG/3 and *E. coli* Phage/CIRG/12 showed highly encouraging lytic activity against pathogenic *E. coli* isolates.
- Developed herbal medicine formulations for diarrhoea, septic wound, acaricide, anthelminitic and stress management.
- Developed prebiotic (Mannan oligosaccharide) and herbal based formulation (IMU-4 bolus) for enhancement of immunity in goat kids.
- Created baseline data on commercial goat farming.
- Developed base-line data from farmers of selected districts of Bihar and Uttar Pradesh for goat meat/milk value chain analysis in order to improve socio-economic condition of goat rearers, traders, butchers and other stakeholders under ICAR-ILRI collaboration programme.

Following technologies have been commercial ized under commercialization:

COMMERCIALIZED TECHNOLOGIES:

1.Alquit®- An eco-parasiticidal product for the control of ecto-parasites *viz* Ticks and Lice in animals has been commercialized to M/S Natural Remedies Private Limited, Bengaluru.

2.GMIN®- An area specific mineral mixture for Uttar Pradesh commercialized to M/S Girraj Industries, Sirsaganj, U. P.

3.HEALEX-FR®- An ointment/gel for external injuries, and wounds for animals,

commercialized to M/S Girraj Industries, Sirsaganj, U.P.

4. **Diarrionex-HS®-** This is an extract base herbal anti-bacterial anti-diarrhoeal powder for management of diarrhea in animals commercialized to M/S Girraj Industries, Sirsaganj, U. P.

5. **Goat milk based soap (Ajas)** – three variants of soap i.e. Ajas beauty, Ajas green and Ajas antiseptic soaps have been commercialized to M/S BVG Life sciences, Pune (M.S.).

6. **Johne's disease Vaccine (Bio JD gel ®)**– This Killed vaccine is developed by using native strain of *Mycobacterium avium subspecies paratuberculosis* for animals transfer to M/s Biovet, Bangaluru for vaccine production.

7. **IMU-4®** Herbal immunomodulatory bolus: This herbal formulation is developed to improve the immunity in animals. This bolus reduces the pregnancy stress and improves the immunoglobulins in pregnant dam and colostrum quality to protection for neonatal infection. This product was developed under ICAR-AINP on 'neonatal mortality in farm animals' project. This product is commercialized and available in Indian market by Brands Name of "IMU-4" Bolus by M/S Girraj Industries, Sirsaganj, U. P.

8. **Wormolex® bolus and liquid** (Herbal anthelmintic bolus)– Herbal dewormer in bolus and liquid form , commercialized by M/S Girraj Industries, Sirsaganj, U. P.

9. **Meggatex® Herbal acaricidal liquid**– This formulation effectively eliminates 90-100% ticks/lice in naturally infected animals in single topical application. This drug is commercialized by M/S Girraj Industries, Sirsaganj, U. P.

10. **Semen freezing technology and Artificial insemination in goats**– Goat Semen Diluent Composition (TCFEYG) and Cryopreservation Protocol technology transferred to M/S Aegipan Animal Biocare Pvt. Ltd. Hooghly, West Bengal India.

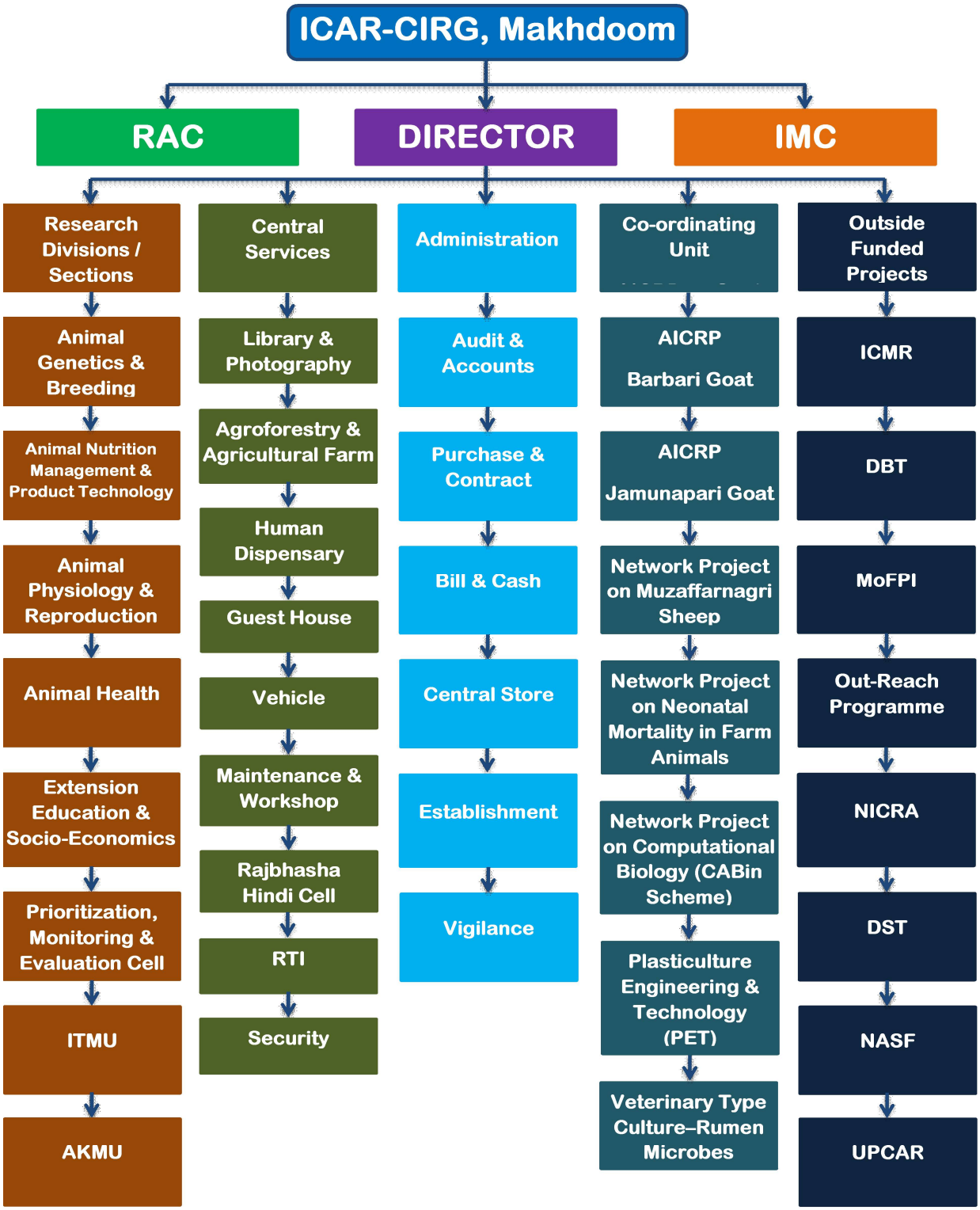
UNDER COMMERCIALIZATION

- BRUCHEK: A Dot-ELISA Kit for detection of brucellosis in goats and Sheep
- Diagnosis of para tuberculosis ELISA KIT (Serum and Milk)
- Stressol-G: An Herbal Antistress Formulation
- Helmokil: Herbal anthelminitic bolus
- IMU-4 : Herbal immunomodulatory bolus
- Ectofree : Herbal Acaricidal liquid / Sprey
- Intra vaginal pessaries for oestrus synchronization in goats.
- Goat meat Pickle
- Goat meat Nuggets
- Herbal Goat meat Nuggets
- Goat meat Sausage
- Goat meat Patties
- Meat Shami Kebab
- Meat Murukku
- Meat Nimkee
- Meat/Milk Biscuits
- Goat Feeders for Better Feed Utilization
- Pelleted Complete Feed Technologies for Sustainable Goat Production under intensive feeding system.

AWARD AND ACHIEVEMENTS

- ICAR's Sardar Patel Outstanding Institute- 2010.
- ICAR-Rajshri Tandan Rajbhasha award for two successive years 2008 and 2009 – for significant achievement in popularization and progressive use of Rajbhasha (Hindi).
- NRDC National Societal Innovation Award, 2014 and 2018.
- ICAR–Rafi Ahmad Kidwai Award- 2016.
- VASVIK Industrial Award 2019 by IARI, New Delhi.
- Rajbhasha Gaurav Award (2015) to Dr. D K Sharma to his book Bakri-Bhed Rog: Chikitsa Evam Prabandhan. by Rajbhasha Vibhag Govt of India (Bestow by President of India) on 14 sept 2016.
- International Endeavour award-2018 by Government of Australia.

5 ORGANIZATIONAL SETUP



6 GENETIC IMPROVEMENT IN GOAT AND SHEEP

6.1 GENETIC IMPROVEMENT IN JAMUNAPARI GOAT

Jamunapari goat is one of the large size goat breeds of India, and is known for milk production in the subcontinent. These goats are also known as **"Queen of goats"** due its majestic look and appearance. The natural habitat of this breed is ravine locked Chakarnagar block of Etawah district in Uttar Pradesh. These goats are more adapted to vegetation shrubs and trees and perform well under similar semi-arid agro-climate conditions. It has been extensively utilized for genetic potential improvement of non-descript and low performing breeds in India and abroad.

6.1.1 Results and Achievements

The opening balance of the nucleus flock was 602 and closing balance was 532. During the period 265 kids were born from 200 does, in which 131 were males and 134 were females out of which single, twin and triplet born kids were 138 (52.07%), 118 (44.53%) and 09(3.40%), respectively. The population growth in the flocks was 75.83% during the year.

6.1.2 Breeding and Reproductive performance

Breeding and kidding efficiency on the basis of doe's available were 66.22 and 87.75 and on the basis of doe's tupped were 87.67 and 116.22%. The litter size was 1.33. Averages age at first service (AFS), weight at first kidding (WFK), age at first kidding (AFK) and gestation period (GP) during this year were 760.45±44.39 days, 33.80±0.69 kg, 931.89±51.44 days and 152.87±3.60 days, respectively, showing desirable and significant improvement in reproductive traits (Table 1). There were 13 to15% declines in age at first service and kidding in this year as compared to previous years. The year and season of birth had significant effect ($P<0.05$) on age at first service and kidding. Female born in season-I (spring) had less age at first service and kidding, similarly multiple born females also have higher age at first kidding.

6.1.3 Growth Performance of Kids under Semi-intensive Management System

The least squares means of body weights of kids at birth, 3,6,9 and 12 months of age in the year 2020 were 3.45±0.05kg,10.90±0.15kg,14.10±0.23kg, 20.21±0.46 kg and 24.06±0.52 kg,respectively (Table 2).

6.1.4 Growth Performance of Kids under Intensive Management System

The 9 Jamunapari male and 10 female kids at 3 months of age were put under intensive feeding management under which they were provided a dlib concentrate feed, green fodder and dry fodder. The mean of these male kids at birth, 3, 6, 9 and 12 month were 3.39±0.18, 9.51± 0.80, 15.61 ± 0.87, 24.61± 0.94 and 31.73 ± 0.98 kg, respectively. Corresponding mean of these female kids at birth, 3, 6, 9 and 12 month were 3.65±0.18, 8.95± 0.42, 14.85 ± 0.65, 21.25± 0.66 and 25.66 ± 0.51 kg, respectively.

6.1.5 Lactation Performance of Jamunapari Goats

The overall means of milk yield in 90 days, 140 days, total milk yield and lactation length were 75.38±1.84 litre, 111.46±2.99 litre, 98.54±3.51 litres and 161.04±3.24 days, respectively in the year 2020 (Table 3). Year, season and lactation order had significantly (P<0.01) influenced the milk production traits. Goat kidded in spring season yielded more milk yield than those which kidded in autumn season. The effect of type of kidding was non-significant on lactation traits. Low milk yield in this milch breed might be attributed to selection of many sires with poor dam milk yield in past many years. These males scored higher value due to their good body weight at 9 months of ages, and inclusion of many such male from feedlot (Intensive feeding) might have also biased their ranking towards body weight.

6.1.6 Selection Differential

There were 35 males selected on the basis of their 9 month weight, dams 90 days milk yield, type of birth and individual body score. The selection differential for 9 months body weight was 9.32 kg and dam milk yield at 90 day was 12.16 litres.

6.1.7 Mortality and Culling Status in Flock

The overall mortality of the flock during the year was 8.07% and annual culling rate was 2.65 %. The incidence of mortality was 4.46, 2.63, 2.12, 1.15 and 3.23% in 0-3, 3-6, 6-9, 9-12 months and adult respectively. The reason for more mortality is due to the reduction in culling of animals on health grounds. The major causes of death were gastro- intestinal (Enteritis, diarrhea, acidosis), respiratory (pneumonia), systemic disorder (septicemia, toxemia and peritonitis) and parasitic diseases.

Table 1: First parity Reproductive performance in Jamunapari Goats over the years

Overall mean / Factor	WFK (kg)	AFS (days)	AFK(days)	GP(days)
	34.48±0.48 (270)	825.11±30.64 (270)	995.46 ± 35.51 (270)	157.02±2.49 (270)
Year of Kidding	*	*	*	
2016	32.28±1.77 (9)	867.83±27.04 (9)	1008.19±13.99 (9)	152.72±9.17 (9)
2017	34.10±0.72 (58)	807.91±46.27 (58)	971.62±53.62 (58)	163.62±3.75 (58)
2018	34.22±0.69 (63)	830.52±43.88 (63)	994.27±50.85 (63)	156.65±3.56 (63)
2019	37.99±0.62 (75)	858.81±39.97 (75)	1071.33±46.32 (75)	159.25±3.24 (75)
2020	33.80±0.69 (65)	760.45±44.39 (65)	931.89±51.44 (65)	152.87±3.60 (65)
Season of Kidding		*	*	
1st	33.67±0.61 (158)	774.79±39.26 (158)	937.53±45.50 (158)	159.00±3.19 (158)
2nd	35.29±0.56 (112)	875.42±35.83 (112)	1053.39±41.52 (112)	155.06±2.91 (112)
Type of Kidding				
Single	33.53±0.46 (208)	839.04±29.44 (208)	1010.05±34.12 (208)	152.29±2.39 (208)
Twins	35.43±0.74 (62)	811.17±47.06 (62)	980.86±54.54 (62)	161.76±3.82 (62)
***P<0.01, *P<0.05*				

Values in parenthenis are number of observations

6.1.8 Superior Germ-plasm Supplied (Technology transfer)

During the reported year 209 superior goats (114 male and 95 female) were supplied for various livestock developmental agencies for genetic improvement and conservation of Jamunapari goats in the field conditions.

6.1.1.9 Milk Supplied

During the year **6878.0 litres** milk was supplied to GPT for sale and processing.

6.1.10 Revenue Generated

During the year a sum of Rupees 19,11,603 was generated from this unit.

Table 2: Least square means of body weight (kg) in Jamunapari goats at different ages

Overall Mean / Factor	Birth	3 Month	6 Month	9 Month	12 Month
	3.32±0.03 (1394)	**10.66±0.11 (1342)**	**14.51 ±0.16 (1204)**	**19.37±0.28 (1060)**	**23.88±0.33 (947)**
Year of birth **		**	**	**	**
2016	3.17^{a}±0.04 (351)	11.48^{a}±0.14 (339)	15.72^{a}±0.19 (330)	20.27^{a}±0.33 (318)	24.62^{a}±0.39 (298)
2017	2.94^{b}±0.04 (293)	10.35^{b}±0.14 (280)	13.63^{b}±0.21 (239)	17.17^{b}±0.37 (199)	21.97^{b}±0.46 (145)
2018	3.06^{b}±0.05 (213)	11.31^{a}±0.16 (210)	15.11^{a}± 0.23 (209)	20.20^{a}±0.39 (193)	26.24^{a}±0.45 (182)
2019	3.38^{c}±0.05 (273)	10.78^{b}±0.15 (260)	14.97^{a}±0.21 (243)	19.98^{a}±0.36 (232)	25.53^{a}±0.42 (210)
2020	3.45^{d}±0.05 (264)	10.90^{b}±0.15 (253)	14.10^{ab}±0.23 (183)	20.21^{a}±0.46 (118)	24.06^{a}±0.52 (112)
Season of birth *		*	*		
1	3.35^{a}±0.04 (654)	11.56^{a}±0.13 (635)	15.22^{a}±0.18 (595)	19.51±0.31 (560)	24.20±0.36 (524)
2	3.29^{b}±0.04 (740)	09.76^{b}±0.12 (707)	13.80^{b}±0.17 (609)	19.22±0.31 (500)	23.56±0.37 (423)
Sex of kid **		**	**	**	**
Male	3.47^{a}±0.04 (696)	11.11^{a}±0.12 (667)	15.42^{a}±0.17 (600)	21.08^{a}±0.30 (525)	25.96^{a}±0.35 (446)
Female	3.17^{b}±0.04 (698)	10.21^{b}±0.12 (675)	13.60^{b}±0.17 (604)	17.66^{b}±0.30 (535)	21.80^{b}±0.36 (501)
Type of birth **		**	**	*	
1	3.86^{a}±0.03 (664)	11.56^{a}±0.09(647)	15.39^{a}±0.13 (571)	20.21^{a}±0.23 (505)	24.54±0.27 (454)
2	3.30^{b}±0.02 (694)	10.37^{b}±0.08 (659)	14.26^{b}±0.12 (598)	19.09^{a}±0.21 (525)	23.55±0.25 (468)
3	2.80^{c}±0.09 (36)	10.05^{c}±0.30(36)	13.88^{c}±0.41 (35)	18.80^{b}±0.73 (30)	23.56±0.87 (25)
***P<0.01, *P<0.05*					

Different subscripts (a,b,…) indicate significantly different at ** (P<0.01) and at * (P<0.05). Values in parenthesis are number of observations.

Table 3: Lactation performance of Jamunapari goats over the year

Overall Mean / Factor	90d milk yield (L)	140dmilk yield (L)	Total milk yield (L)	Lactation length (d)
	74.02±0.93 (826)	108.81±1.39 (600)	107.32±1.64 (869)	162.64±1.51 (869)
Year of Kidding	*	*	*	
2016	71.69^{a}±1.63 (212)	104.50^{a}±2.11 (189)	105.43^{a}±2.91 (226)	166.83±2.68 (226)
2017	74.62^{ab}±1.88 (163)	108.30^{ab}±2.56 (131)	107.04^{ab}±3.32 (177)	163.78±3.05 (177)
2018	74.73^{ab}±2.15 (128)	113.07^{b}±3.12 (95)	113.09^{b}±3.83 (136)	159.20±3.52 (136)
2019	73.69^{ab}±1.99 (151)	116.72^{b}±3.20 (88)	112.48^{b}±3.43 (170)	162.33±3.16 (170)
2020	75.08^{b}±1.84 (172)	111.46^{b}±2.99 (97)	98.54^{a}±3.51 (160)	161.04±3.24 (160)
Season of Kidding	*	*	*	
1 (Spring)	79.63^{a}±1.32 (433)	116.95^{a}±1.96 (311)	111.89^{a}±2.34 (454)	161.56±2.16 (454)
2 (Autumn)	68.41^{b}±1.21 (393)	100.68^{b}±1.76 (289)	102.74^{b}±2.17 (415)	163.71±2.00 (415)
Type of Kidding				
Single	74.25±1.12 (530)	110.48±1.63 (394)	106.50±1.99 (559)	162.18±1.83 (559)
≥ Twin	73.79±1.39 (296)	107.14±2.08 (206)	108.14±2.49 (310)	163.09±2.29 (310)
***P<0.01, *P<0.05*				

Different subscripts (a,b,…) indicate significant different at ** (P<0.01) and at * (P<0.05). Values in parenthesis are number of observations

(AICRP (G): Improvement and Sire Evaluation of Jamunapari Goats for Milk Production)

(Dr. (s) M.K. Singh, Gopal Dass, P.K. Rout, R. Pourouchottamane, K. Gururaj, Ravi Ranjan)

6.2 GENETIC IMPROVEMENT OF BARBARI GOAT

Barbari breed of goat has attained special significance among progressive goat farmers due to high weight gain, prolificacy, early maturity, sufficient milk and suitability for stall feeding/intensive feeding and semi-intensive management. Nucleus flock of these goats is maintained under semi-intensive feeding system from 1993 under AICRP on Goat Improvement at Institute with prime aim to provide proven sires for breed improvement, conservation and development of technologies and package of practices for farmers flock

for enhancing income. During last 7 years activities have been intensified for development of business and livelihood models in farmers flock with the aim to promote scientific/ commercial goat farming in field. Thrust has also been given to increase lactation yield, lactation efficiency and kidding rate by implementing innovative selection and breeding practices.

6.2.1 Farm Management

Goats are maintained under semi-intensive management system under which concentrate ration, dry and green fodders are major items of supplementary feeding and provided to goats considering their age, sex and production/ reproduction stage. The floors of sheds are kachcha and soil of floor is scratched, removed and refilled with fresh soil one to two times in a year. Lime treatment performed 4 to 6 time and white washing of sheds was done annually. Watering channel is made of bricks and are open. Prophylactic health care measures adopted at unit includes vaccination against PPR, Enterotoxaemia, Goat pox, FMD and Haemorrhagic Septicaemia. The herd was screened for various infectious, non-infectious and parasitic diseases at regular intervals. Dipping and deworming of goats was performed to curb the ecto-parasites and endo-parasites at regular intervals. The breeding is carried out seasonally from 15th April to 30th June in summer and from 15th September to 30th November in autumn seasons of the year. Yearlings allowed for breeding when they attain 9 months of age and minimum 16 kg body weight.

6.2.2 Results and Achievements

The opening and closing balance of flock was 644 and 632 on 1st January 2020 and 31st December 2020. There were 363 kids born from 219 does with 162% flock growth. New temporary structures were also built during last year to manage kids due to disrupted labour availability on account of Covid-19 pandemic.

6.2.3 Reproductive and Breeding Performance

Least squares means for average age at first service (AFS), weight at first service (WFS), weight at first kidding (WFK),age at first kidding (AFK), first kidding interval (FKI) and gestation period (GP) during 2020 were 412.02±9.91 days, 21.28±0.39 kg, 23.83±0.46 kg, 560±10 days and 296.01±7.15 days, respectively (Table 4). Kids born in spring season and as single have significantly less age at first kidding than their counterparts. Females born as multiples took more age to attain puberty thus more AFS and AFK. Goats with > 18 kg body weight at kidding delivered higher weight per kidding and multiple births in a given period of time. The milk yield and lactation periods were also significantly higher of such females than those which have less than 18 kg body weight at kidding. Tupping percentage of goats was 85.3%. Goats deliver multiple births were 63.5% and kids born as multiples were 78%. Breeding efficiency on the basis of does available and doe's tupped were 71.23% and 83.5% respectively and kidding efficiency on the basis of does available tupped were 121% and 145% respectively. The liter size was 1.66.

6.2.4 Growth Performance (body weights)

The data on body weight at birth, 3, 6, 9, and 12 months of ages for 2016 to 2020 were analyzed for genetic and environmental factors. Year of birth and parity order has significantly affected body weight at birth, 3 and 6 month, season of birth on 3 and 9 months of age whereas type of birth and sex of kid from birth to 12 months of age. The least squares means of body weight of kids born in year 2020 were 1.73±0.02, 7.74±0.09, 13.00±0.22 and 16.79±0.31 kg, respectively at birth, 3, 6, and 9 months of ages (Table 5). Single born kids and males were significantly heavier than their counterparts however effect of

multiple born kids declines with the advancement of age. Barbari male and female kids under stall feeding attained up to 26.5 and 22.6 kg weight with an average of 22.75±0.97 and 20.07±0.62 kg body weight at 9 months of ages. The estimates of heritability (h^2) for body weight of kids at different ages indicating moderate level (0.11 to 0.27) of additive genetic variance for growth traits in this flock.

6.2.5 Milk Yield Performance

The data on lactation performance of does kidded during 2016 to 2020 were analysed for non-genetic effects using mixed model least square techniques. Overall mean for 90 days milk yield, 140 days milk, total lactation yield and lactation length were 64.48±0.80, 88.93±1.06, 89.45±1.21 litre and 145.64±1.14 days, respectively.Corresponding values of goats kidding in 2020 were 73.54±1.05, 109.33±1.62, 115.94±1.58 litre and 160.81±1.74 days, respectively (Table 6).Goats kidded in spring season produced significantly higher milk yield than those which kidded in autumn season. The estimates of heritability (h^2) for lactation traits were low to moderate (0.10 to 0.18) indicating careful selection and introduction of high performance animals from other flocks.

6.2.6 Selection Differential

The average 9 month weight of selected buck and population mean was 22.70 kg and 16.9 kg and orresponding values for 90 days milk yield was 81.5 and and 71.75 litre. Thus, the selection differential for 9 months body weight was 5.8 kg and dam's 90 days milk yield was 9.75 liters.

6.2.7 Mortality Rate and Causes

The overall mortality and culling was 3.37 and 2.48% (Table 7). The major causes of death were diseases of Gastro-Intestinal System (Enteritis, diarrhoea, acidosis), Respiratory System (Pneumonia), Systemic Disorder like Septicemia, Toxemia and Peritonitis and parasitic diseases.

6.2.8 Germ-plasm Distribution

During the year 227 superior goats (115 male and 112 female) were supplied for breed improvement and conservation of Barbari goats and popularization of commercial and livelihood goat models among farmers.

6.2.9 Milk Supplied

During the year 13621.0 litere milk was supplied to GPT for sale and processing.

6.2.10 Revenue Generated

During the year a sum of Rupees 2070179 was generated.

6.2.11 Effect of Suckling Frequency on Growth Performance of Kids

A study on suckling frequency (3 and 4 times against the practice of 2 times suckling) on growth performance (weight gain) of Barbari kids indicated no significant difference in the body weight of kids allowed for suckling twice, thrice and four times daily and the body weights in all three groups were comparable and non-significant (Table 9). It may be recommended that two times suckling after 7 days of birth is sufficient to meet out nutrition requirement of kids for optimum growth.

6.2.12 Technology/Management Practices Development and Transfer to Field

- Rearing of Barbari goats for commercial meat production on stall feeding in rain-fed regions of India.
- Artificial Insemination with frozen semen with > 40% conception.
- Multiplier Flocks acts as potent tool not only for genetic improvement and conservation but also as Breeder seed unit, Conservation and technology dissemination, linkage development and goat based specialized and integrated agri-business model. These multiplier flocks have been attracting large number of educated youth, retired officials and others in commercial goat farming. These farms are also increasing the visibility of Institute horizontally and vertically throughout in India. Data from such 5 multiplier flocks which were established in 2015 were analyzed for their growth, reproductive, milk production and survival rate for 2016 to 2019. All such reported farms were maintained their Barbari goats in stall feeding except one farm (Ms Bhudevi) which was kept on extensive production system. Amount, composition and period of concentrate ration and green fodder supply were varied over the farm. The higher productivity of Vrandavan farm is mainly attributed to better execution of breeding and management practices. Goat at these farms was allowed for breeding after 7 months of age. Results (Table 8) indicate higher body weight of kids at different growth stages at some of the farms was mainly due to feeding with higher concentrate ration and personal care. These farmer's sale their kids on the basis of their body weight (Rs.300 to 500/kg live weight) and also prepared 30 to 40% male kids for Eid (sacrifices), to which they provide 300-400 gram concentrate per kid/day during 3-6 months age and 500 to 600 gram concentrate/day during 6 -12 months age and 750-800 gm/day after 12 months. The reproductive, growth and lactation performances of these farms were presented in table-6, observed to be varied mainly due to highly variable management practices. Kids mortality at all multiplier flocks were high (12-19%) in first year of establishment however brought down below 5% in later years.

Technology Distribution, Adoption and Dissemination

Multiplier flock Farah, Mathura


Multiplier flock Banda, UP


Multiplier flock Pratapgarh, UP


Multiplier flock Karnal, Haryana

6.1.2.13 Package of Practices Developed

- ***Age and Weight at first Service***: Minimum 9 month age and 16 kg body weight at first conception resulted in significantly higher productivity (multiple birth, higher kid's birth weight, kid's survival, lactation yield and length).
- ***Suckling Frequency***: Newly born kids should be provided 10-12% milk of their body weight in 3-4 times up to 7 days of their birth and after that 02 times in a day. However, kids with lesser birth weight irrespective of their type of birth should be provided 3 times milking up to 15 days of their birth.
- ***Concentrate supplementation to growing females***: Supplementation of 250 and 300gram/day during 3-6 and 6-9 months of age to multiple born females helps them to attain 16 kg body weight up to 9 months of age thus reduce age at first service by 50 to 75 day without adverse effect on their productivity.
- ***Breeding Practices***: Ages at first service after 11 month do not have any beneficial effect on their lactation performance and their kid's growth.

TABLE 4: First parity reproductive performance in Barbari goats over the years

Overall Mean / Factor	Age at first Service (d)	Age at first kidding (d)	Wt. at first Service (kg)	Wt. at kidding (kg)	First Kidding Interval (d)
	415.47±3.89 (437)	**561.38±3.88 (437)**	**20.13±0.15 (437)**	**23.34±0.18 (437)**	**340.02±5.40 (296)**
Year of kidding		*	*	**	**
2016	399.31^{a}±8.13 (90)	544.81^{a} ±8.12 (90)	18.93^{a} ±0.32 (90)	22.02^{a} ±0.38 (90)	348.42^{a} ±9.17 (58)
2017	428.94^{b} ±9.03 (72)	574.34^{b} ±9.01 (72)	19.64^{a} ±0.36 (72)	22.58^{a} ±0.42 (72)	322.03^{abc} ±11.31(38)
2018	397.24^{a} ±6.88 (124)	542.37^{a} ±6.87 (124)	20.02^{b} ±0.27 (124)	23.01^{ab} ±0.32 (124)	298.01^{b}±7.15 (96)
2019	439.84^{b} ±7.98 (92)	585.08^{b} ±7.97 (92)	20.75^{b} ±0.31 (92)	25.25^{b} ±0.37 (92)	296.01^{b} ±7.05 (76)
2020	412.02^{ab} ±9.91 (59)	560.30^{ab} ±9.90 (59)	21.28^{b} ±0.39 (59)	23.83^{ab} ±0.46 (59)	-
***P<0.01, *P<0.05					

TABLE 5: Least square means of body weight (kg) in Barbari goats at different ages over the years

Overall Mean / Factor	Birth	3Month	6 Month	9 Month	12 Month
	1.82±0.011(1798)	**8.22±0.06(1735)**	**12.46±0.11(1426)**	**16.74±0.16(1282)**	**21.72±0.17(979)**
Year of birth	**	**	**		
2016	1.86±0.02 (422)	7.73±0.08 (408)	12.50±0.14 (368)	16.80±0.19 (356)	21.39±0.20 (334)
2017	1.93±0.02 (348)	8.72±0.09 (339)	12.64±0.16 (311)	16.99±0.22 (304)	22.23±0.24 (237)
2018	1.83±0.02 (384)	8.12±0.09 (373)	11.71±0.16 (306)	16.56±0.23 (256)	22.65±0.25 (213)
2019	1.74±0.02 (313)	8.80±0.09 (299)	12.45±0.16 (294)	16.57±0.24 (236)	21.62±0.25 (195)
2020	1.73±0.02 (331)	7.74±0.09 (316)	12.99±0.22 (147)	16.79±0.31 (130)	-
Season of birth		**		**	
1	1.82±0.01 (777)	8.34±0.07 (757)	12.49±0.13 (657)	16.24±0.18 (563)	21.83±0.21 (361)
2	1.81±0.01 (1021)	8.10±0.07 (978)	12.42±0.13 (769)	17.25±0.18 (719)	21.61±0.19 (618)
Sex of kid	**	**	**	**	**
Male	1.90±0.01 (942)	8.58±0.07 (903)	13.31±0.13 (733)	18.16±0.18 (668)	24.00±0.19 (472)
Female	1.74±0.01 (856)	7.87±0.07 (832)	11.60±0.13 (693)	15.32±0.18 (614)	19.45±0.19 (507)
Type of birth	**	**	**	**	**
1	1.95±0.01 (609)	8.91±0.06 (592)	13.40±0.12 (509)	17.68±0.16 (470)	22.49±0.18 (377)
2	1.79±0.01 (1113)	7.83±0.05 (1069)	12.13±0.09 (858)	16.45±0.13 (759)	21.45±0.14 (559)
3	1.70±0.03 (76)	7.91±0.15 (74)	11.85±0.28 (59)	16.10±0.40 (53)	21.24±0.43 (43)
***P<0.01, *P<0.05					

TABLE 6: Lactation performance of Barbari goats during over the years

Overall Mean / Factor	90d milk yield (L)	140dmilk yield (L)	Total milk yield (L)	Lactation length (d)
	64.48±0.80 (1131)	**88.93±1.06 (926)**	**89.45±1.21 (1060)**	**145.64 ± 1.14 (1060)**
kidding Year	**	**	**	**
2016	51.70^{a}±0.97 (252)	64.31^{a}±1.28 (202)	63.35^{a}±1.43 (253)	136.67^{a}±1.35 (253)
2017	57.65^{b}±1.04 (196)	78.50^{b}±1.37 (170)	75.07^{b}±1.51 (205)	139.98^{a}±1.43 (205)
2018	60.57^{c}±1.04 (196)	83.85^{c}±1.35 (230)	81.56^{c}±1.55 (257)	138.15^{a}±1.46 (257)
2019	78.96^{d}± 1.06 (256)	108.66^{d}±1.34 (215)	111.32^{d}±1.56 (225)	152.58^{b}±1.47 (225)
2020	73.54^{e}± 1.05 (201)	109.33^{d}±1.62 (109)	115.94^{d}±1.85 (120)	160.81^{c}±1.74 (120)
Season of Birth		*	*	
Season-1	65.56±0.91 (481)	90.58a±1.18 (408)	91.41a±1.35 (481)	147.20±1.27 (481)
Season- 2	63.41±0.84 (650)	87.28b±1.16 (518)	87.19b±1.31 (579)	144.07±1.24 (579)
Type of Birth	**			
Single	65.33±0.64(582)	90.91±0.89 (490)	89.81±0.96 (560)	143.81±0.90 (560)
Twin	62.05±0.57(525)	88.07±0.80 (416)	86.66±0.86 (478)	144.59±0.81 (478)
Triplet	66.07±2.21 (24)	87.80±2.90 (20)	91.87±3.35 (22)	148.52±3.16 (22)
***P<0.01, *P<0.05*				

Different subscripts (a,b,…) indicate significant different at ** (P<0.01) and at * (P<0.05). Values in parenthesis are number of observations

TABLE 7: Mortality and culling incidence over the years

Year	2014-15	2015-16	2016-17	2017-18	2018-19	2019	2020
Flock Strength	977	1090	1204	1154	1001	881	1007
Goats Died (N)	38	33	35	36	32	22	38
Mortality (%)	**3.8**	**3.0**	**2.9**	**3.10**	**3.20**	**2.49**	**3.77**
Culling (N)	56	50	82	61	91	34	25
Culling (%)	**5.7**	**4.6**	**6.8**	**5.2**	**9.09**	**3.86**	**2.48**

TABLE 8: Performance of Barbari goats at Multiplier farms

Name of Multiplier Flock	Bhudevi, Farah (Mathura)	Naeem, Farah (Mathura)	Radhey, Karnal (Haryana)	Rashid, Vrandavan (Mathura)	Vivek, Dholpur (Raj.)
Age at first Service (d)	267.49±3.70 (27)	276.61±3.0(83)	269.41±5.92 (103)	277.62±1.47(145)	261.21±4.28 (106)
Age at first kidding (d)	401.55±3.75(27)	421.87±4.0(83)	416.20±5.93 (103)	433.20±1.50(145)	398.47±4.35 (106)
Litter Size	1.37	1.42	1.62	1.54	1.63
Birth weight (kg)	1.53±2.23(53)	1.75±2.11(114)	1.68±3.42(376)	1.65±1.52(372)	1.47±2.22(243)
3M wt. (kg)	7.38±3.10(49)	7.21±2.17(108)	6.93±3.48(366)	7.60±1.25(358)	7.09±3.22(237)
6M wt. (kg)	12.32±2.14(45)	13.24±2.32(99)	14.29±2.42(361)	17.03±2.18(350)	14.25±3.15(230)
9M wt. (kg)	16.74± 2.15(99)	16.86± 1.5(203)	20.23± 2.45(357)	25.34± 2.17(347)	18.53± 1.135(226)
12M wt. (kg)	21.50±2.17(91)	23.57±1.2(194)	25.72±3.30(344)	34.46±2.28(331)	24.48±1.31(221)
45d MY (L)	32.52±3.42(67)	33.26±3.21(120)	37.12±2.31(193)	44.75±2.95(205)	39.29±3.84(135)
90d MY (L)	56.61±2.60(67)	60.05±2.46(120)	81.69±2.50(193)	74.21±1.13(205)	71.96±1.52(135)
Kids Mortality (%) (up to 6 M)	9	4.5	1.2	2.4	3.9
Adult Mortality (%)	5	2	1.5	1.0	1.2

Table 9: Growth Performance (kg) of kids fed on different milk suckling schedules

Suckling Frequency	Birth weight	7 days Body weight	14 days Body weight	21 days Body weight	28 days Body weight	Average daily gain (7th to 28th d)
Kids Growth Performance						
2 Suckling (57)	1.684± 0.038	2.40±0.05	2.95±0.06	3.29± 0.07	3.67± 0.08	60.65± 4.04
3 Suckling (67)	1.693± 0.031	2.42±0.04	2.95± 0.05	3.25± 0.06	3.59± 0.07	54.66± 2.45
4 Suckling (65)	1.811± 0.046	2.38±0.06	2.95± 0.07	3.33± 0.08	3.67± 0.09	61.61± 2.36

(AICRP (G): Genetic Improvement of Barbari Goats for Meat and Milk Production

(Dr. (s) M.K. Singh, R. Pourouchottamane, D.K. Sharma, A. K. Dixit, Ravindra Kumar, V. Rajkumar, S. P. Singh, Ravi Ranjan)

6.1.3 GENETIC IMPROVEMENT OF JAKHRANA

Jakhrana is a valuable milch breed and also used for meat due to its compact and large size bodyand high prolificacy rate. These goats are known for hardiness against climate and feed resources. The coat colour of the breed is black with white speckles on the ears. The breed derives its name from the name of village "Jakhrana" where it is found in pure forms. A small unit of Jakhrana goats is maintained at CIRG, Makhdoom for it's genetic improvement and in-situ conservation. The home-tract of Jakhrana breed is Jakhrana and it's surrounding villages in Bahrod Tahseel in Alwar district of Rajasthan. However flocks of these goats are also found in Narnaul, Gurgaon, Bhiwani and Rohtak districts of Haryana and adjoining areas of U.P.

6.1.3.1 Farm Management

The goats are kept separately according to sex, age and production/reproduction stages. Goats are maintained under semi-intensive management system under which concentrate ration, dry and green fodders are provided to goats considering their age, sex and production/ reproduction stage. Goats were also sent to 5-6 hour grazing. The size of sheds is 60^1 x 20^1 covered space and 60^1x40^1 open corral space. Floors of sheds are kachcha and soil of floor is scratched, removed and refilled with fresh soil one to two times in a year. Lime treatment performed 4 to 6 time and white washing of sheds was done annually. Watering channel of bricks and are open.

6.1.3.2 Results and Achievements

The opening and closing balance of the flock was 156 and 190. There were 71 kids, 92 adult females and 27 adult males available at closing balance. There were 73 kids born from 47 kidding in the year 2020-21. This is highly prolific breed as 51.06% doe's yielded multiple births. The kidding rate of Jakhrana goats in this year was 1.55. During the year 12 breeding buck and 09 breeding does were supplied to the farmers, government and non-government agencies for breed improvement in the field.

6.1.3.3 Growth Performances of Jakhrana Kids

Collected data on 130 kids born in 2020 was analyzed. The overall least squares means at birth during 2020 at birth 3, 6, 9 and 12 months of ages were 2.82±0.04, 9.75±0.14, 14.35±0.27, 19.03±0.32 and 23.65±0.31 kg, respectively. Year of birth has significantly affected body weight at 3, 9 and 12 month of ages. Effect of season was significant at 9 months of age only and magnitude of difference was also small (Table 10). Single born kids and males were significantly heavier than those born as multiple and female and maintained superiority for body weight up to 12 month however, magnitude of difference in body weight between single and multiple declines with the advancement of age. The effect of parity on kid's body weight and weight gains were significant. Magnitude of different among kids at birth and other ages was small for parity, might be due to higher age and weight at first kidding.

6.1.3.4 Lactation Performances of Jakhrana Kids

The overall means of milk yield in 30, 60, 90, 120 and 150 days were presented in table 11. Year, season and parity had significantly ($P<0.01$) influenced the milk production traits. There was significant decrease with large magnitude in all milk yield traits in 2020 as compared to 2019. Goat kidded in spring season yielded higher milk yield than those kidded in autumn season.Effect of kidding type was significant on lactation milk yield however, no

conclusive pattern obtained for type of kidding. Parity has significant effect on all lactation traits and linear association observed between milk yield and parity order.

6.1.3.5 Mortality in Jakhrana Flock

Data were collected from 221 animals. There was 2.26 % mortality in the Jakhrana flock during this year. Twelve animals were culled and two were transferred to GPT for meat.

Table 10: Least square means of body weight of Jakhrana kids

Overall Mean / Factor	Birth	3M	6M	9M	12M
	2.82±0.04(130)	9.75±0.14(129)	14.35±0.27(72)	19.03±0.32(70)	23.65±0.31(66)
Year of birth	NS	*	NS	*	*
2019	2.79±0.04(61)	10.32±0.22(61)	14.19±0.30(61)	19.17±0.35(59)	23.73±0.36(56)
2020	2.84±0.06(69)	9.24±0.15(68)	15.24±0.66(11)	18.27±0.77(11)	23.2±0.57(10)
Season of birth	NS	NS	NS	*	NS
1	2.8±0.05(58)	10.37±0.23(58)	14.65±0.31(58)	19.35±0.34(57)	23.68±0.35(54)
2	2.84±0.06(72)	09.25±0.15(71)	12.51±0.98(14)	17.59±0.80(13)	23.54±0.71(12)
Sex of kid	*	*	*	*	*
Male	2.98±0.06(57)	09.98±0.23(57)	14.68±0.52(29)	19.90±0.53(29)	25.05±0.46(27)
Female	2.69±0.05(73)	9.57±0.17(72)	14.13±0.29(43)	18.41±0.38(41)	22.68±0.36(39)
Type of birth	*	*	*	*	NS
1	2.93±0.07(38)	9.65±0.23(37)	13.47±0.51(21)	18.27±0.68(20)	23.56±0.61(19)
2	2.79±0.04(86)	9.86±0.18(86)	14.85±0.32(48)	19.45±0.36(47)	23.63±0.38(44)
≥3	2.45±0.23(6)	8.9±0.46(6)	12.66±0.33(3)	17.33±1.20(3)	24.5±1.89(3)

(*Significant at 5% level, NS-Non Significant)

Table 11: Means of milk production (litre) of Jakhrana goats

Factor	30d milk yield (L)	60d milk yield (L))	90d milk yield (L)	120d milk yield (L)	150d milk yield (L)
Overall Mean	43.12±1.57(84)	77.41±2.68(82)	105.21±3.73(75)	132.24±5.89(45)	152.37±7.52(34)
Year	*	*	*	*	*
Year 2019	46.59±2.76(41)	83.28±4.45(41)	111.35±6.03(38)	137.34±7.31(34)	157.48±8.55(28)
Year 2020	39.80±1.43(43)	71.54±2.75(41)	98.91±4.19(37)	116.50±6.86(11)	128.55±11.71(6)
Season	*	*	NS	NS	NS
Season-1	44.68±2.87(38)	79.92±4.43(37)	107.25±5.72(36)	131.08±6.82(34)	153.31±8.31(30)
Season- 2	41.82±1.62(46)	75.34±3.27(45)	103.33±4.92(39)	135.46±12.19(11)	145.33±16.52(4)
Type of birth	*	*	*	NS	NS
Single	39.68±2.29(39)	72.49±4.18(38)	101.24±6.32(32)	130.09±11.43(18)	143.74±15.09(12)
Twin	46.10±2.08(45)	81.65±3.37(44)	108.17±4.52(43)	133.68±6.38(27)	157.08±8.33(22)

(*Significant at 5% level, NS- Non Significant)

(Institute Project: Genetic Improvement and Seed Production of Jakhrana Goats for Milk and growth traits
(Dr. (s) Saket Bhusan, Gopal Dass, B. Rai and Nitika Sharma)

6.1.4. GENETIC IMPROVEMENT IN MUZAFFARNAGARI SHEEP

Muzaffarnagari, the heaviest mutton breed among 44 sheep breeds of the country, is mainly distributed in Muzaffarnagar and its adjoiningdistricts of Western Uttar Pradesh viz. Meerut, Bulandshahar, Saharanpur and Bijnor. Now, the animals of this breed are also found in and around Mathura and Agra districts of Uttar Pradesh and in some parts of Rajasthan, Haryana and Delhi states. The breed is generally reared for mutton production as wool production is low with coarse quality, thus not suitable for carpet manufacture. The institute has been maintaining Muzaffarnagari sheep flock under a "Network Project on Sheep improvement" since 1992 and presently the efforts are being made to improve the breed for higher mutton production through selective breeding.

6.1.4.1 Management of Flocks

Flocks were maintained under semi-intensive system of feeding management with 6-7 hours grazing supplemented with 100-500 concentrate in various stage and age group of the animals. Dry and green fodder was also offered as per the requirement. Ewes were bred during May-June and October-November followed by lambing in the months of October–November and March-April, respectively. The lambs were weaned at 2 months of age due to poor milk production as well short lactation period of their dams. All the sheds and corrals were disinfected frequently with lime. Regular treatment and prophylactic measures were practiced for vaccination against Enterotoxaemia, Foot and Mouth Disease, Sheep Pox, H.S., PPR etc. De-worming with different anthelmintic was practiced at pre-monsoon and post monsoon seasons and as and when required. Dipping was done after 15-20 days of each shearing. The opening balance was 516 which comprised of 143 males and 373 females and closing balance of 573 sheep had a stock of 157 males and 416 females.During the year 266 lambs were born and overall mortality was 3.84%.

6.1.4.2 Production Performance

The overall least-squares means of body weights of lambs at birth, 3, 6, 9 and 12 month age were 3.47±0.20, 15.84±0.21, 25.42±0.29, 30.96±0.34 and 37.40±0.34 kg, respectively (Table 12). The effect of sex and type of birth was significant ($P<0.01$) on all body weights whereas, year of birth and parity had significant ($P<0.05$) effect on 9 month and 3 month body weight of lambs. Male lambs gained higher weights than female lambs at all growth stages. Lambs born as multiples were also had significantly lower body weights at all stages as compared to those lambs which born as single. The average daily gain of Muzaffarnagari lambs during 0-3, 3-6, 6-12 and 3-12 months were 137.08±2.19, 105.61±2.14, 67.18±2.00 and 79.25±1.26g/d under semi-intensive feeding management. The overall average monthly body weights of adult males and females were respectively 55.6 and 38.2 kg.The overall least squares means for lamb's 1st and 2nd six monthly and adult annual clips were 466.11±7.76, 535.85±7.27 and 1280.28±18.92g, respectively. Sex and year of lambing had significant influence on all the lambs.

6.1.4.3 Reproduction Performance

The annual tupping and lambing on available basis were 98.3 and 94.7%. During this year, the twinning rate was 13.7%. The overall replacement rate was 36.3%, which was significantly higher than previous years. The averages for weight at first service, age at first service, age at first lambing, ewes' weight at lambing and inter lambing period were 32.2kg, 470 days, 626 days, 34.6kg and 325 days, respectively.

6.1.4.4 Growth Performance in Field

Data on body weights of lambs of adopted flocks and contemporary flocks under field were recorded. The overall mean of weight at birth, 3, 6 and 12 month age were 2.9, 13.4, 19.3 and 29.2 kg., respectively. The body weights from farmers flocks were significantly lower than Institute flock, might be due to grazing based rearing besides inadequate health care and housing.

6.1.4.5 Selection of Breeding Rams

Male lambs were ranked on the basis of their 6 month body weight and out of total, top 10 were selected for breeding purpose. The selection differential for 6 month weight was 9.1 kg. The populations mean and the average of selected sires was 25.2 & 34.3 kg. Selected rams were evaluated for various semen characteristics before using in breeding programme.

6.1.4.6 Distribution of Elite Germ- plasm and Revenue Generation

A total of **150 superior animals** (92 males and 58 females) were supplied to various developmental agencies and progressive farmers for genetic improvement of their flocks under field conditions. During year 2020, a **revenue of Rs. 13,88,995/-** was generated.

Table 12: Growth performance of Muzaffarnagari lambs (kg)

Particulars	Birth Wt.	3M Wt.	6M Wt.	9M Wt.	12M Wt.
Overall mean	3.50±0.20 (757)	16.14±0.13 (652)	25.24±0.20 (546)	31.18±0.24 (506)	37.04±0.24 (459)
Sex	**	**	**	**	**
Male	3.62±0.09 (380)	16.89±0.17 (330)	27.07±0.26 (266)	34.54±0.31 (240)	41.03±0.33 (197)
Female	3.42±0.09 (377)	15.39±0.18 (322)	23.41±0.26 (280)	27.82±0.30 (266)	33.05±0.29 (262)
Year	**NS**	**NS**	NS	*	**NS**
2018	3.52±0.20 (241)	16.32±0.22 (212)	25.31±0.32 (178)	32.03±0.39 (158)	36.60±0.38 (151)
2019	3.51±0.21 (250)	16.26±0.21 (220)	24.99±0.32 (167)	30.56±0.38 (154)	37.13±0.39 (130)
2020	3.47±0.20 (266)	15.84±0.21 (220)	25.42±0.29 (201)	30.96±0.34 (194)	37.40±0.34 (178)
Parity	**NS**	*	**NS**	**NS**	**NS**
I	3.38±0.18 (192)	15.48±0.25 (167)	25.15±0.36 (141)	30.88±0.43 (133)	36.64±0.44 (118)
II	3.55±0.19 (180)	16.32±0.24 (161)	25.14±0.34 (145)	31.32±0.41 (129)	37.22±0.42 (113)
III	3.56±0.19 (141)	16.48±0.27 (127)	25.76±0.39 (105)	31.93±0.47 (96)	37.82±0.45 (92)
IV	3.50±0.18 (120)	16.48±0.30 (100)	25.75±0.43 (83)	31.38±0.50 (80)	37.00±0.50 (74)
≥V	3.50±0.19 (124)	15.94±0.31 (97)	24.40±0.47 (72)	30.97±0.56 (68)	36.53±0.57 (62)
Type of Birth	**	**	**	**	**
Single	3.83±0.20 (540)	17.18±0.14 (476)	26.28±0.20 (410)	32.40±0.24 (383)	37.75±0.24 (350)
Multiple	3.18±0.20 (217)	15.10±0.23 (176)	24.19±0.34 (136)	29.96±0.41 (123)	36.34±0.42 (109)

(Project: Genetic evaluation and improvement of Muzaffarnagari sheep for body weight

(Dr. (s) Gopal Dass, Nitika Sharma, Vinay Chaturvedi, S.D. Kharche and Saket Bhusan)

6.5 CROSS BREEDING IN INDIGENOUS GOAT BREEDS

Farmers across states in India are doing cross-breeding among Indigenous goats for higher body weight gains and development of synthetic genotypes/strains/ breeds with demand in market and suitable for their own agro-climatic conditions. Some of the NGO's, universities and farmers have been claiming more survival, better growth and profit in keeping crossbred as compared to pure-bred goats. However, reliable information (data) on overall productivity and profitability in crossbred viz-a-viz purebred is not systematically studied. Crossbreeding among Sirohi and Barbari and Sirohi x Jamunapari is also practicing by good number of farmers. Keeping above points in view experiment on cross-breeding among indigenous breeds (Sirohi x Barbari and Sirohi x Jamunapari) was initiated at Institute.

6.1.5.1 Housing and Management:

The goats are kept separately according to sex, age and production/reproduction stages at Barbari goat unit. Goats are maintained under semi-intensive and Intensive management system under which concentrate ration, dry and green fodders are major items of supplementary feeding and provided to goats considering their age, sex and production/reproduction stage. Lime treatment performed 4 to 6 time and white washing of sheds was done annually. Watering channel is made of bricks and are open. Weaning of kids was performed at 3 months of age.Breeding of goats were done in breeding seasons through natural and frozen semen. Goats were vaccinated, dewormed and drenched as per Institute goat health calendar. Five Barbari females in each breeding season were allowed to cross with Jamunapari and Sirohi bucks.

6.1.5.2 Significant Achievement

- The body weights of Sirohi x Barbari crossbred kids were marginally (10 to 14.4%) higher than Jamunapari x Barbari kids. However, growth performances (body weights) of Jamunapari x Barbari and Sirohi x Barbari kids from 6 months of age were not significantly higher than growth performance of Barbari kids.
- The birth weight of both genetic groups (S x B and J x B) was significantly higher than birth weight of Barbari kids.
- Significant differences in body weights were observed in both crossbred genetic groups over the year, season, type of birth and sex of kids.
- The body weight of Barbari, Jamunapari and Barbari x Jamunapari kids male kids along with range in bracket at 9 months of age were 23.0±0.97 (19.5-26.5), 29.10±1.54 (18.0-33.0) and 22.57±1.21 (19.0-28.0) kg, respectively under intensive feeding management.
- The average daily weight gains during 3-9 month growth period along with range in bracket were 73.43±3.54 (62.7- 86.1), 94.10±7.52 (44.44- 113.9) and 74.24±5.26 (56.11- 97.22) in Barbari, Jamunapari and Barbari x Jamunapari kids under intensive feeding management.

- The carcass weight and dressing percentage along with range in bracket of Barbari, Jamunapari and Barbari x Jamunapari kid's male kids at 9 months of age were 8.83±0.56 kg (7.2-10.5) and 40.47±0.90% (37.3-43.5), 11.51±0.52 kg (9.55-14.8) and 47.28±0.49% (46.04-50.2), 8.61±0.38 kg (7.5-10.1) and 40.44±0.28% (39.04-41.7), respectively.
- The live weight, empty body weight and carcass weight of Sirohi x Barbari kids maintained under semi-intensive up to 12 months of age were significantly higher than Jamunapari x Barbari male kids however dressing% were same in both crossbred group. Sample size was small (3 to 4) in both the groups.
- Mortality among crossbred kids was significantly lower than pure bred Barbari or Jamunapari kids.
- More data on crossbred kids is required to arrive sound comparison in between different crossbred group as well as comparisons with pure-bred goats.

Table 13: Body weight of Jamunapari (J) x Barbari (B) kids at different ages over the years under semi-intensive management

Overall mean / Factor	Birth	3 Month	6 Month	9 Month	12 Month
	2.14±0.07 (45)	8.80±0.26 (45)	12.84 ±0.41 (44)	18.01±0.56 (41)	20.89±0.76 (24)
Year of Birth					
2018	2.28±0.21(12)	7.78±0.63 (12)	11.05 ±0.83 (11)	17.09±0.92 (8)	22.28±1.41 (8)
2019	2.21±0.11(16)	9.11±0.33 (16)	12.06 ±0.35 (16)	16.95±0.49 (16)	20.31±1.30 (8)
2020	1.99±0.06 (17)	9.22±0.35 (17)	14.74 ±0.63 (17)	19.44±1.14 (17)	20.09±1.27 (8)
Season of Birth					
1st	1.99±0.06 (17)	9.22±0.35 (17)	14.74 ±0.63 (17)	19.44±1.14 (17)	20.09±1.27 (8)
2nd	2.24±0.11(28)	8.54±0.35 (28)	11.65 ±0.40 (27)	17.00±0.44 (24)	21.29±0.96 (16)
Type of Birth					
Single	2.90±0.10 (5)	9.44±0.31 (5)	13.70 ±0.89 (5)	19.88±1.13 (4)	25.33±1.42 (3)
Twins	2.05±0.07(40)	8.72±0.28 (40)	12.73 ±0.45 (39)	17.81±0.61 (37)	20.26±0.76 (21)
Sex of Kids					
Male	2.25±0.10 (28)	8.99±0.28 (28)	13.20 ±0.48 (27)	19.30±0.68 (26)	23.88±1.08 (9)
Female	1.98±0.09 (17)	8.48±0.50 (17)	12.28 ±0.74 (17)	15.77±0.68 (15)	19.46±0.86 (15)

Table 14: Body weight of Sirohi x Barbari kids at different ages over the years semi-intensive management

Factor	Body weight of Crossbred kids (S x B)				
Overall mean	Birth	3M	6M	9M	12M
	2.38±0.10 (17)	9.35±0.51 (17)	13.39 ±0.70 (17)	19.37±0.78 (17)	24.89±1.07 (17)
Year of Birth					
2018	2.80±0.11(5)	11.00±0.42 (5)	16.20 ±0.82 (5)	21.50±0.72 (5)	26.86±0.98 (5)
2019	2.21±0.10(12)	8.67±0.60 (12)	13.22 ±0.69 (12)	19.07±0.81 (12)	23.65±1.32 (12)
Season of Birth					
2nd	2.38±0.10 (17)	9.35±0.51 (17)	13.39 ±0.70 (17)	19.37±0.78 (17)	24.89±1.07 (17)
Type of Birth					
Single	2.80±0.09 (7)	11.00±0.36 (7)	15.40 ±0.82 (7)	20.93±0.83 (7)	26.19±1.00 (7)
Twins	2.09±0.07 (10)	8.20±0.60 (10)	11.98 ±0.78 (10)	16.58±0.82 (10)	22.28±1.52 (10)
Sex of Kids					
Male	2.49±0.14 (10)	9.60±0.70 (10)	14.28 ±1.00 (10)	19.58±0.87 (10)	26.21±1.04 (10)
Female	2.23±0.14 (7)	9.30±0.77 (7)	13.11 ±0.73 (7)	17.64±1.22 (7)	21.57±1.41 (7)

Table 15: Comparative growth performance of Jamunapari, Barbari and their crossbred male kids

Breed	Birth Weight (kg)	3 M wt. (kg)	6 month weight (kg)	9 M wt. (kg)	ADG (g/d) (birth-3month)	ADG (g/d) (3-9 month)
Barbari (6)	1.65^{b}±0.08 (1.5-2.0)	9.53^{b}±0.39 (8.2-11)	16.57^{b}±1.12 (12.8-20.5)	23.0^{b}±0.97 (19.5-26.5)	87.59±5.08 (68.89-105.56)	73.43^{b}±3.54 (62.7- 86.1)
Jamunapari (8)	4.56^{a}±0.33 (3.5-6)	10.90^{a}±0.39 (9-12.5)	18.31^{a}±0.63 (15.5-21.0)	29.10^{a}±1.54 (18.0-33.0)	69.44±5.35 (55.6-100.0)	94.10^{a}±7.52 (44.44- 113.9)
JxB Crossbred (8)	2.06^{b}±0.11 (1.6-2.5)	9.47^{b}±0.34 (8.2-11)	15.91^{b}±0.66 (13.5-19.0)	22.57^{b}±1.21 (19.0-28.0)	85.00±3.82 (72.22-100.0)	74.24^{b}±5.26 (56.11- 97.22)
Mean	2.72 ±0.29	9.95±0.26	16.82±0.52	24.59±0.87	80.30±3.08	81.36±3.61

Different subscripts (a,b,…) indicate significant different at ** (P<0.01) and at * (P<0.05). Values in parenthesis are number of observations

Table 16: Comparative carcass characteristics of Jamunapari, Barbari and their crossbred male kids

Breed	Slaughter weight (kg)	Empty body weight (kg)	Carcass wt. (kg)	Dressing (%)	Fore quarter (kg)	Hind Quarter (kg)
Barbari (6)	21.75^{b}±0.99 (18.5-25.0)	17.85^{b}±0.91 (14.74-20.75)	8.83^{b}±0.56 (7.2-10.5)	40.47^{b}±0.90 (37.3-43.5)	5.02^{b}±0.34 (4.0-6.0)	3.82^{b}±0.22 (3.2-4.5)
Jamunapari (8)	24.63^{a}±0.89 (20.5-29.5)	21.37^{a}±0.89 (17.1-25.6)	11.51^{a}±0.52 (9.55-14.8)	47.28^{a}±0.49 (46.04-50.2)	6.46^{a}±0.32 (5.2-8.3)	5.24^{a}±0.23 (4.3-6.5)
JxB Crossbred (8)	21.31^{b}±0.97 (18.0-25.0)	16.92^{b}±0.90 (14.0-20.0)	8.61^{b}±0.38 (7.5-10.1)	40.44^{a}±0.28 (39.04-41.7)	4.89^{b}±0.27 (4.1-6.0)	3.73^{b}±0.11 (3.4-4.1)

Different subscripts (a,b,…) indicate significant different at ** (P<0.01) and at * (P<0.05). Values in parenthesis are number of observations

Table 17: Comparative growth and carcass performance of Barbari (B) X Sirohi (S) and Barbari (B) X Jamunapari (J) male kids under semi-intensive management

Parameter	Barbari X Sirohi (12 Month)	Barbari X Jamunapari (12 Month)
Live weight (Kg)	33.17 (3)	26.38(4)
Empty body Weight (Kg)	26.98(3)	21.71(4)
Carcass weight (kg)	15.41(3)	12.62(4)
Dressing percent (%)	47.40(3)	47.75(4)
Hind quarter weight (kg)	6.54(3)	5.31(4)
Four quarter weight (kg)	8.87(3)	7.31(4)

(Institute project: Crossbreeding among Indigenous Goat breed to evaluate their Productivity status and development of Synthetic breed for Broiler production)

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6.2 AICRP on Goat Improvement

The All India coordinated Research Project (AICRP) on Goat improvement is a long term Programme focused to bring out genetic improvement in natural habitat, to conserve goat genetic resources in their area of evolution and adaptation. The project explores genetic variation in local breeds through structured and systematic pedigree and performance recording of goats in the farmers flock. Presently, fifteen breeds and three local genotypes are covered through twenty one centers across the country, which are coordinated through a coordinating Unit, the Project Coordinating (PC) unit of the ICAR- AICRP on Goat improvement, at ICAR-CIRG, Makhdoom, Farah , Mathura. Three breeds i.e. Barbari, Jamunapari and Sirohi are maintained under semi- intensive farming system with optimum feeding to explore genetic potential of the breed in given environment. Remaining breeds viz. Assam Hill goat at Guwahati , Andaman goat at port Blair , Black Bengal at Kolkata and Ranchi , Gaddi at Palampur (HP) , Marwari at Bikaner, Himalayan goat at Mukteshwar, Osmanabadi at Phaltan (Satara district of Maharashtra), Sangamneri at Rahuri, Sirohi at Vallabhnagar (Udaipur), Ganjam at Bhubaneswar, Surti at Navsari, Malabari at Thrissur, Uttarakhand goat at pantnagar, Beetal goat at Ludhiana , Changthangi at Leh, J&K and Bundelkhandi at Jhansi are being improved under farmer's flock in their respective home tract. Nine units are working as partially TSP unit under Tribal sub plan fund of the project. Assam hill goat unit is also operational in NEH region. AICRP is operational at Leh-Ladakh region of Jammu & Kashmir for conducting research on goats producing Pashmina in temperate climate; similarly, we are also working in Andaman & Nicobar Island. The major thrust of the project is to build up long – term capacity of goat keepers through technology demonstration, capacity building, application of health management practices and introduction of genetically superior breeder goats for enhancing their production and reproduction potential on sustainable basis.

At present, goat production is facing diverse challenges in different agro climatic conditions and it is necessary to carry out research and development activity to increase farmer's income for better livelihood . The project has contributed in increasing population growth, milk production and body growth. Preventive health care measures with farmer's support have reduced morbidity and mortality in field flock. Under this programme, significant increase in income of goat farmers has been recorded and it has enhanced food security of all stakeholders.

Coordinating Centers of AICRP on Goat Improvement

S.N.	Centre	Location	TSP/NEH	Purpose
	A) Field Units			
1.	Andaman Goat Field Unit	ICAR-CIARI, Port Blair, A&N Island	Island Region	Meat
2.	Assam Hill Goat Field Unit	AAU, Khanpara, Guwahati, Assam	***NEH***	Meat
3.	Bengal Goat Field Unit	BAU, Kanke, Ranchi, Jharkhand	***Partially TSP***	Meat
4.	Black BengalGoat Field Unit	WBUV and FS, Kolkata, West Bengal	***Partially TSP***	Meat
5.	Changthangi Goat Field Unit	SKUAST, Kashmir, Leh-Ladakh, J&K	***Partially TSP***	Fibre& Meat
6.	Gaddi Goat Field Unit	HPKVV, Palampur, Himachal Pradesh	***Partially TSP***	Meat& Fibre
7.	Ganjam Goat Field Unit	OUAT, Bhubaneswar, Odisha	***Partially TSP***	Meat
8.	Himalayan Local Goat Field Unit	ICAR-IVRI Campus, Mukteshwar, Uttarakhand		Meat
9.	Malabari Goat Field Unit	KV&ASU Mannuthy, Thrissur, Kerala	***Partially TSP***	Meat& Milk
10.	Marwari Goat Field Unit	RAJUVAS, Bikaner, Rajasthan		Meat
11.	Osmanabadi Goat Field Unit	NARI, Phaltan, Maharashtra,		Meat& Milk
12.	Sangamneri Goat Field Unit	MPKV, Rahuri, Maharashtra		Meat& Milk
13.	Sirohi Goat Field Unit	RAJUVAS, College of veterinary sciences & AH Vallabhnagar, Rajasthan	***Partially TSP***	Meat& Milk
14.	Surti Goat Field Unit	N.A.U., Navsari, Gujarat	***Partially TSP***	Milk& Meat
15.	Uttrakhand Local Goat Field Unit	GBPUA&T, Pantnagar, Uttarakhand		Meat
16.	Bengal Goat field Unit	ICAR-RCER, Patna (New Centre)	***Partially TSP***	Meat
17.	Bundelkhandi Goat Field Unit	IGFRI, Jhansi (New Centre)		Meat
18.	Beetal Goat Field Unit	GADVASU, Ludhiana, Punjab(New Centre)		Milk& Meat
	B) Farm Units			
1.	Barbari Goat Farm Unit	ICAR-CIRG, Makhdoom, Uttar Pradesh		Milk& Meat
2.	Jamunapari Goat Farm Unit	ICAR-CIRG, Makhdoom, Uttar Pradesh		Milk& Meat
3.	Sirohi Goat Farm Unit	ICAR-CSWRI, Avikanagar, Rajasthan		Milk& Meat
	C) Project Coordinating Unit			
1.	Project Coordinator Unit	ICAR-CIRG, Makhdoom, Uttar Pradesh		


Changthangi Goat Unit, Leh
Gaddi Goat Unit, Palampur
Himalayan Goat Unit, Mukteshwar
Beetal Goat Unit, Punjab
Uttarakhand Local Goat Unit, Pantnagar
Marwari Goat Unit, Bikaner
Barbari Unit
Jamunapari Unit
Project Coordinator Unit, CIRG, Farah, Mathura
Sirohi Farm Unit, Avikanagar
Assam Hill Goat Unit, Assam
Sirohi Goat Unit, Vallabhnagar
Bengal Goat Unit, Patna
Surti Goat Unit, Navsari
Bhundelkhandi Goat, Jhansi
Bengal Goat Unit, Ranchi
Black Bengal Goat Unit, Kolkata
Ganjam Goat Unit, Bhubaneswar
Sangamneri Goat Unit, Rahuri
Osmanbadi Goat Unit, Phaltan
Field Unit
Farm Unit
Breed Covered: 15
States covered: 16
Malabari Goat Unit, Thrissur
Andaman Goat Unit, Port Blair

6.2.1. Andaman Goat Field Unit, ICAR-CIARI, Port Blair, Andaman & Nicobar Island

Andaman goat ûeld unit is operational at ICAR-CIARI, Port Blair, A & N Islands and working to improve production performance of goat in Island region. The unit is operational in 3 clusters such as Port Blair, Baratang and Nimbudera. The base line information on production and reproduction traits, managemental practices and disease pattern of Andaman local goats and socioeconomic status of goat keepers were recorded. Identification of animals was carried out in the adopted village. The closing balance of the registered ûock was 5785 goats in the entire three clusters. During the period 1274 kids were born with the population growth of 94.13%. The overall least square means of body weights (kg) at birth, 3, 6, 9 and 12 months of age were 39±0.09, 5.77±0.12, 9.52±0.25, 11.94±0.29 and 15.82±0.21, respectively. Age at first mating, weight at first mating, age at first kidding, weight at first kidding, kidding interval, service period and gestation period was 244.23±15.23 days, 11.41 ± 0.22 kg, 398.25 ±5.12 days, 16.47 ± 0.07 kg, 224.91±23.15, 80.90±4.75 days and 145.53± 1.13 days respectively. The kidding percentage of 143.69 on the basis of tupped does and the kidding rate of 1.50 was recorded during the period. The percentage of singles, twins and triplets were 52.0, 39.0 and 9.0, respectively. During the year a total of 7 superior bucks of Andaman local goats were distributed and 2 goats were exchanged in different villages of South Andaman cluster& Nimbudera cluster for genetic up-gradation of the Andaman local goats in the field. During the year, no major disease outbreak was reported in adopted villages. A total of 2419 goats were given the mineral mixture, 560 goats were treated for ectoparasite infestation and 2014 goats were given deworming. The overall mortality during the period was 2.3 %, however the highest mortality was observed in kids. The morality was mainly due to the diarrhoea, bloat and grass poisoning. A total of 8 training programmes/health camps/field day were conducted, of which 171 farmers were benefitted. Unit has contributed significantly towards the livelihood security through the technological intervention viz. increase in body weight at 12 month (4.98%), reduction in mortality (from 10.06 to 2.3%), increase in kidding rate (3.45%), total milk yield (18.06%) and increase in knowledge of scientific breeding, management and health practices.

6.2.2. Assam Hill Goat Field Unit, AAU, Khanpara, Guwahati, Assam

The unit is operational at AAU, Khanpara & unit with 5 cluster such as Batabari, District Darrang, Tetelia Gandhinagar, District Kamrup (Metro), Nahira, District Kamrup (Rural), Tepesia, District Kamrup (Metro) and Digholbori, District Morigaon and has population of 3154 goats during the year. The population growth of 109.80% was observed in the adopted villages. 675 adult does gave birth to 1064 kids. The rate of mortality was 6.03% for the reported period. A total of 358 animals were sold in the reported period with a total income of Rs.10,71,650.00 indicating an income of Rs. 2,993.44 per goat. Thirteen selected bucks of superior quality, have been distributed in the adopted villages and 9 numbers of existing bucks were exchanged among the units to avoid inbreeding. At present there are 52 numbers of superior bucks in the five field units distributed under the project AICRP on Goat improvement. Twenty five vaccination camps to immunize 15370 animals, 21 deworming camps to deworm 9021 animals and 27 treatment camps to treat 6843 animals were organised during the period for adopted as well as non-adopted animals. The overall least squares means of body weights (kg) at birth, 3, 6, 9 and 12 months were 1.30±0.01, 5.26±0.01, 7.94±0.02, 10.58 ±0.03 and 14.01±0.04 kg, respectively. The least square means of milk yield in 30, 60 and 90 days were 6.17±0.24, 9.28±0.3, 14.31±5.92 liter,respectively. The kidding rate was 1.58. The AICRP on Goat Improvement was successful enough to create awareness among the goat farmers through several extension activities like meeting, interactive sessions, training etc.

6.2.3. Barbari Goat Farm Unit, ICAR-CIRG, Makhdoom, Farah, Uttar Pradesh

Barbari breed of goat has attained special significance among progressive goat farmers due to higher weight gain, prolificacy, reproductive efficiency, early maturity, sufficient milk to nourish their kids and suitability under stall feeding/intensive feeding and semi-intensive management. The opening and closing balance of flock was 644 and 632 on 1st January 2020 and 31st December 2020. The 363 kids were born from 219 does in the year. Flock growth was 162% and kidding rate was 1.66%. A total 227 goats (115 male and 112 females) were provided to farmers and other stake holders. Overall flock culling and mortality rate in the year was 2.48 and 3.77%. Averages age at first service (AFS), weight at first service (WFS), weight at first kidding (WFK), age at first kidding (AFK), first kidding interval (FKI) and gestation period (GP) during this year were 412.02±9.91 days, 21.28±0.39 kg, 23.83±0.46 kg, 560±10 days, 296.01±7.15 days and 146.10±0.42 days, respectively. Multiple births were 78% of total kids born. Breeding efficiency on the basis of doe's available and doe's tupped were 71.23 and 83.5%, and kidding efficiency (%) on the basis of does available and doe's tupped were 124.0 and 145.0%, respectively. The least squares means of body weight of kids at birth, 3, 6, 9 and 12 month of ages for kids born in year 2019 were 1.74±0.02, 8.80±0.09, 12.45±0.16, 16.57±0.24, 21.62±0.25 kg respectively. Least square mean for 90 days milk yield, 140 days milk yield, total lactation yield and lactation length in 2020 were 73.54±1.05, 109.33±1.62, 115.94±1.85 and 160.81±1.74 days, respectively. Slightly higher mortality rate in the year was due to inappropriate culling process in the year. The Total milk produced from 1st January 2020 to 31st December 2020 was 13621.0 litres. There were 45 multiplier flocks (MFU) of Barbari goat breed were established for genetic improvement, conservation and promoting scientific goat farming, development of goat based business and livelihood models in 6 states of India. Total revenue generated in this year was Rs. 2070179.00

6.2.4. Black Bengal Goat Field Unit, WBUV and FS, Kolkata, West Bengal

The Black Bengal unit is operational at West Bengal Veterinary University, Kolkata. In 2020 with the addition of a new cluster in Chhotanagpur Plateau area (Ajodhya Hill) under Baghmundi Block of Purulia District, the project is now spread to five clusters covering 10 village centres i.e. Ayeshpur and Ganguria village (Nadia Cluster); Jatirampur and Rangabelia village (Sundarban Cluster); Manapara-Malapada and Dhangri-Ranidihi village (Jhargram Cluster); Purba Mallickpara-ICDS Para and Purba Mallickpara-School Para village (Dhupguri Cluster); Shimulbera and Kalijharna village (Ajodhya Hill Cluster). During 2020 there were 1586 registered does at Ayeshpur, Ganguria, Jatirampur, Rangabelia, Manapara-Malapada, Dhangri-Ranidihi, Purba Mallickpara-ICDS Para and Purba Mallickpara-School Para, Shimulbera and Kalijharna village. Amongst 707 farmers under the category of Schedule Caste (406 nos.), General (146 nos.), Schedule Tribe (129 nos.) and Other Backward Class (26 nos.) in five clusters Out of 1586 registered doe,1332 does were bred and 1511 kids were born from 824 kidding during 2020. The closing ûock strength was 3116 during 2020. The population growth rate of Black Bengal for 2020 is 118.86%.The average flock size of Black Bengal goat in adopted area was 7.36. The average body weight at birth, 3 month, 6 month, 9 month and 12 month were 1.274±0.002 kg, 5.280±0.006 kg, 7.659±0.007 kg, 10.803±0.009 kg and 13.355±0.013 kg respectively in 2020. The milk yield was 3.577±0.044 kg, 6.971±0.077 kg, 9.467±0.099 kg and 10.769±0.112 kg during first 15 days, 30 days, 45 days, and 60 days of lactation respectively. The average lactation period was 61.09±0.34 days. The average age at first service, age at first kidding, service period, gestation period, and kidding interval were recorded as 236.98±2.32 days, 385.31±2.46 days, 98.39±1.56 days,146.29±0.07 days and 243.41±1.54 days, respectively. The average kidding rate (litter size) was noticed as 1.83. Twin born kidding is maximum (52.55%)

followed by singlet kidding (32.65%), triplet kidding (13.83%), quadruplet kidding (0.73%) and quintuplet kidding (0.24%).Twenty bucks were selected from villages based on their 6 months body weight and prolificacy status of their dams from which 12 bucks were purchased and distributed in the adopted village units in addition to previous males for selective breeding. In addition to this, feeding pot (250 nos.), water bottle (144 nos.), umbrella (406 nos.), torch light (50 nos.) and shoe (75% nos.) were also distributed to tribal and SC farmers in adopted villages. About 93% farmers have the flock size of 1 to 3 does and 7 % farmers have 4 to 9 does. It is an indicator for sustainability of goat rearing among the farmers with flock size 1 to 3 does with their available resources. Sixteen nos. of mass deworming camp (covering 1897 goats), 8 nos. of vaccination camp (covering 982 goats) have been organized in adopted villages. Apart from this mineral mixture to all registered goats and concentrated feed to the pregnant does were provided. With the intervention of health care and prevention the overall mortality was 4.19 % in 2020. During this year five nos. of farmers training programme (534 farmers attended-duration 2 day), 17 nos. of gosthi meeting (238 farmers attended), and 17 nos. of seasonal advisory (164 farmers attended) were conducted in adopted villages.

6.2.5. Bundelkhandi Goat Field Unit, IGFRI, Jhansi, Uttar Pradesh

The unit is operational from May, 2018 at ICAR-Indian Grassland and Fodder Research Institute, Jhansi. During the year 2020-21 one more village, Nichrolli was adopted under Datia cluster with 20 households and 646 numbers of goats. The goats under field conditions are mostly kept on extensive system of management. Bundelkhandi goat is black in colour with medium to large sized compact body. Morphological characterization indicated that average body length, height, chest girth and paunch girth in males were 69.82, 78.27, 72.55 and 73.36 cm, respectively. In females, the corresponding values were 67.94, 74.13, 71.44 and 78.58 cm, respectively. Average body weights at birth, 3, 6, 9 and 12 month were 2.22, 9.55, 12.48, 17.16 and 20.19 kg respectively. Average daily milk yield was 0.551 kg and average kidding rate was 1.22. The singlet and twining percentage was recorded as 78 and 22%, respectively. Animals of adopted villages were provided with health coverage under field conditions, namely vaccination against PPR (600 animals), ET (1381 animals), FMD (400 animals) and deworming against endo-parasites (1253 animals), besides periodic treatment (1610 cases) of animals suffering from different diseases/ sickness. Groundnut (Arachis hypogaea) haulms, which were introduced as a strategic supplementary feed during winter season in Parasari village was extended/ up scaled to goat famers of other adopted villages to reduce suffering from cold stress. Participation was taken in an awareness-cum-interactive meeting/kisan mela of Institute, where goats farmers were informed about importance of conserving local black Bundelkhandi goats and scientific goat rearing and health management practices, besides providing literature.

6.2.6. Changthangi Goat Field Unit, SKUAST, Kashmir, Leh-Ladakh, Jammu & Kashmir

The unit is operational at HAMARI, SKUAST, Kashmir, Leh-Ladakh, with the main objective of breed improvement for pashmina fibre and meat production. Keeping in view the vast hostile terrain of Changthang region (the habitat of Changthangi Goat) and extensive system of rearing whole Ladakh area was divided into four major zones having 3-4 clusters/ villages in each zone. Zone-I with three major clusters/villages viz. Kharnak, Samad and Korzokwas the initial set up of the project and this Year Zone-II comprising of Gya, Rongo, Hanley, Chumur and Nidder clusters were adopted. This year, addition of newborn male kids (1235) and female kids (1218) and by age group resulted in a total addition of 3053 by birth/age totaling to 3785 goats. The closing balance as on 31.12.2020 was 14616. The overall population growth for this year was 59.04%. The average body weight at birth, 3, 6, 9 and 12 month were 22.46±0.19, 6.57±0.20, 9.57±0.22, 12.96±0.14kg and 16.52±0.17kg respectively. The average pashmina production of all the three clusters for the year was recorded as 273±11.10g. The number of does available for breeding purpose for

the year 2020 was 3426 out of which 2985 does kidded. There was 2971 single born and 14twining. The overall kidding percentage among the registered goats in all the 4 clusters was 82.54% with an overall litter size of 1.0071.The age at first mating (in days) ,weight at first mating (in kgs), age at first kidding (in days) and weight at first kidding (in kgs) was recorded as 555.26±21.02, 24.95±1.13, 704.38±2.11 and 25.22±0.08 respectively. The average gestation period, service period and first kidding interval was 153.51±0.20, 173 days and 361±1.16 days respectively. During the year, the overall mortality rate was recorded as 3.84%. During the year, the overall mortality rate was recorded as 5.52%.Most of the mortality attributed this year was due the intense cold weather and lockdown of Covid 19 in Changthang area which resulted in covering of pasture with a layer of snow and thus resulted in acute fodder shortage and mortality due to lack and unavailability of vet aid. The health management during this year, which includes general treatment, vaccination, dosing and dipping, was done for all the goats in all the clusters was (approximately 10460goats) from time to time. The compost making from goat manure has been done successfully at farm for the last four years. This year 15 improved bucks were distributed to the farmers.

6.2.7. Gaddi Goat Field Unit,HPKVV,Palampur, Himachal Pradesh

The unit is operational at college of veterinary science, HPKVV, Palampur, Himachal Pradesh. The unit has 5 clusters at Chamba, Kangra, Kullu, Bilaspur and Mandi. The closing balance as 31.12.2020 was 1602 animals. The least squares means during 2018-19 for body weights at birth, 3, 6, 9 and 12 months of age were 3.12±0.02, 15.54±0.07, 19.88±0.09, 24.80±0.14 and 27.83±0.24 kg, respectively. For breeding inputs, a total of 35 male kids of 4-6 months age group were purchased from farmer's flocks after primary selection on the basis of morphological characteristics and better/ higher growth rates during the year 2020. These male kids were then transferred to Palampur center at CSKHPKV Livestock Farm for subsequent rearing up to the age of sexual maturity, following farmers as a breeding input in the year all standard management practices. After final selection, a total of 26 males were finally distributed to 26 different farmers as a breeding input in the year 2020.All selected animals were provided health coverage under migratory field conditions viz. vaccination against PPR (1935 doses), deworming (1820 animals) against endo-parasites after fecal sample analysis, periodic health checkups etc. Strategic supplementary feeding was also provided in the form of mineral mixture (285 kg) and concentrate feed (64.5 qtls.). The overall population growth was observed to be 106.79%. The overall incidence of mortality, abortion and kidding was found to be 5.93, 3.54 and 75.29 % respectively. The incidence of twin birth recorded was 19.53 %. The kidding percent of the flocks were observed to be 75.29 and kidding rate as 1.21. Under capacity building, 4 training camps, 4 health camps and 2 gosthi's were organized under field conditions and an exposure visit of the farmers and field staff was arranged to CIRG, Makhdoom.

6.2.4. Ganjam Goat Field Unit, OUAT, Bhubaneswar, Odisha

The All India Coordinated Research Project on Ganjam goats was operating in three clusters of Ganjam district, the native tract of Ganjam breed of goat. In the current year there are 103 number of registered farmers namely Chhatrapur, Rambha, Khallikote and Jeerabadi, Out of the total farmers 98 farmers are old farmers and 5 farmers are new farmers. The overall means of body weights of goats were 2.77±0.07, 6.67±0.09, 9.90±0.12, 14.59±0.15 and 18.52±0.48 kg for weight at birth,3 month, 6 month, 9 month and 12 month of age respectively for the year 2020.The improvement in body weights at 9 month age and one year age has been 2.27 kg and 4.60 kg respectively compared to the base year 2001-02.The number of kids born were 1603 from 1811 breedable does from all the three centres of Chhatrapur, Rambha and Khallikote with kidding percentage 88.13 percent in the current year. Kid mortality is controlled around five to six percent over the years and this year it is 2.98 percent only. The overall average milk yield of Ganjam goats at 30 days

and 60 days were 6.37±0.13kg and 12.56±0.39kg respectively. A total of 9400 vaccinations were done against PPR, goat pox, HS and FMD and 10790 deworming dosages were administered. A total of 1863 goats were treated and so were 953 other animals this year. The health coverage programme is routinely carried out. Pedigree recordings were being done for the 173 breeding bucks and birth weights of 1364 progenies, weight at three months of 653 progenies and weight at 6 months of 442 progenies, Weight at 9 month of 519progenies and weight at 12 months for 374 progenies were recorded and genetic parameters were estimated. A total of three farmers' training programme were organized at Rambha on, at Rambha on 7th February 2020 and at CVSc & AH, OUAT on 15th and 16th February 2020; and one at R Udaygiri where a total around 100 goat farmers of nearby area were trained on scientific goat rearing practices. A total of 29 young bucks around 1 years of age having average superiority of atleast +2.5kg higher body weight than the average of the flock at 3 month stage were distributed.

6.2.9. Jamunapari Goat Farm Unit, ICAR-CIRG, Makhdoom, Farah, Uttar Pradesh

Jamunapari goat is large size breed, known for its milk production. Selective breeding programme is carried out at CIRG to improve the production performance. The flock strength of nucleus herd of Jamunapari goats at CIRG for the year 2020 was 575. The population growth of the flocks was 75.83% in the year. The overall flock mortality from January 2020 to December 2020 was 8.07% and annual culling rate was 2.65%. The least squares means body weights of kids at birth, 3, 6, 9 and 12 months of age were 3.45±0.05 kg, 10.90±0.15 kg, 14.10±0.23 kg, 20.21±0.46 kg and 24.06±0.52 kg, respectively. Year, season of birth, type of birth sex and Parity of dam had significant effect (P<0.01) on kid's body weight up to 12 months of age. Males had higher body weight than females at all the ages. Year by parity interaction had significant effect (P<0.01) on body weight at the age of Birth weight. Year and season of kidding had significant (P<0.01) effect in all the lactation traits. Goats kidding in spring season has significantly more milk yield than those doe's which kidded in autumn season. Parity do has significant effect on milk yield over the years indicating that 1st kidders have significantly lesser milk yield than their counter parts doe's. The effect of type of kidding was non-significant on lactation traits. Least squares means of part lactation milk yield in 90 days and 140 days were 75.38±1.84 litre and 111.46±2.99 litre, respectively during the year 2020. Year of kidding had highly significant (P<0.01) influence on both the milk yields. Parity had significant effect on milk yield over the years. The season of kidding had highly significant (P<0.01) on lactation traits. The effect of type of kidding was non-significant on lactation traits. During this year, a total of 200 does kidded and delivered 265 kids, out of which single, twin and triplet born kids were 138 (52.07%), 118 (44.53%) and 09(3.40%), respectively. Reproductive performance of Jamunapari goats in terms of breeding efficiency and kidding percent on the basis of does selected for breeding were 87.72% and 116.22 respectively. The kidding rate was 1.33.

6.2.10. Malabari Goat Field Unit, KV&ASU Mannuthy, Thrissur,Kerala

The unit is operational at KV&ASU Mannuthy, Thrissur, Kerala. The unit is operational at Thalassery, Thaliparamba, Badagara, Perambra, Thavanur and Tanur located in Kannur, Kozhikode and Malappuram districts in northern and central parts of Kerala. The registration of farmer's flock was carried out in six field centres. The elite germplasm centre was maintained at Goat and Sheep Farm, College of Veterinary and Animal Sciences, Mannuthy, Thrissur. Two organized farms with more than 100 goats under NGOs at Kottakkal, Malappuram district and Pudukad, Thrissur district have also been included during the year 2012 and 2018, respectively. Total of 264 farmers have been registered under the project and provided with inputs in term of breeding, feed, feed supplements and health coverage. The closing balance was 3318. About 1111 adult females have been brought under insurance coverage. Total of 10 bucks of Malabari breed was

selected on the basis of 6 and 9 months body weight and distributed to farmers of various field centres. During 2020, 1076 kids were born from 629 kidding of which 569 were females. Overall population growth recorded was 95.40% and about 34.76 % of the animals were sold during the year. The overall mean body weight recorded at birth, three, six, nine and twelve months of age were 2.38 ± 0.04, 8.90± 0.16, 15.50 ± 0.16, 22..78 ± 0.65 and 23.98 ± 1.23kg, respectively. The average daily milk yield recorded was 0.49 ± 0.08 litres. Mean lactation yield was 76.70±5.50 litres with lactation length of 85.40±6.40 days. The overall mean age at first service and age at first kidding were 248.20±12.30 and 396.10 ±12.80 days, respectively. Mean gestation period and inter kidding interval were 149.70±0.20 and 276.50±12.80 days, respectively. The kidding rate was 1.69. Percentage of singles, twins, triplets and quadruplets were 37.04, 55.48, 7.47 and 0.15 respectively. Multiple births were highest at Tanur (72.80%) followed by Vadakara (66.70%) and Thalassery (65.38%) cluster. The mortality rate was 2.07% in the project area. 127 farmers with 5 days duration. Besides, regular seasonal advisories were facilitated through phone. Field investigations/visits were made as per the need to address the problems in collaboration with Animal Husbandry department.

6.2.11. Marwari Goat Field Unit, RAJUVAS, Bikaner, Rajasthan

The unit is operational at RAJUVAS, Bikaner. The unit is operational in ûve clusters such as Deshnok, Daiya, Kalayansar, Raisar, Kan Singh Ki Sird and Jaimalsar. Jaimalsar is the new center established during this year. The performance recording on growth, milk yield, reproduction and health were carried out on 2100 breedable does. The 76 farmers were registered under the unit. Twenty eight new bucks were distributed to registered farmers in adopted areas for breed improvement during the year. The population growth was 88.50 %. The overall body weights at different stages of growth were 2.59+1.073 at birth, 8.30+2.244 at 3 month, 14.11+1.727 at 6 month, 18.38+1.408 at 9 month and 23.59+0.215 at 12 month of age The body weight at birth was improved by 16.08 % over the baseline performance (2.257 kg). 31.44±0.333 liters in 30 days, 61.16±0.833 liters in 60 days, 78.27±1.350 liters in 90 days and 83.48±0.260 liters in lactation length 106.90+0.260 during 2020. The kidding percentage and kidding rate was 96.24 % and 0.97, respectively. The average age at first mating was 328.94±4.165 days with body weight of 27.14±0.197 kg whereas the average age at first kidding was 479.26±4.149 days with body weight of 30.41±0.187 kg. The first kidding interval observed 353.29±6.546 days during 2020. The incidence of abortions and stillbirths were 1.67 % in the registered farmer's flock. The registered goat breeders were provided preventive and curative health coverage. The total numbers of case covered under health coverage were 34381 which included both prophylactics (55.32 %) and curative (44.68%). Out of total 19021 prophylactic measures, 2100 goats were treated for ecto-parasite, 2400 goats were vaccinated for FMD, ET and Goat pox each and 1974 goats were vaccinated against PPR vaccination. All the registered goats were dewormed twice a year i.e. June-July and Oct.-Nov. Three trainings were conducted to avoid gathering of people due to Corona. Although, farmers were contacted individually regularly.

6.2.12. Osmanabadi Goat Field Unit, NARI, Phaltan, Maharashtra

The unit is operational NARI, Phaltan. Osmanabadi ûeld unit is operational in different clusters such as Ahmednagar, Beed, Pune and Satara districts. This year the Osmanabadi goat field unit adopted one new cluster - Malshiras taluka in Solapur district. The production performance of goats in farmers' flocks was assessed in the low rainfall, drought-prone, dry, Deccan plateau regions of five districts in Maharashtra State viz.Ahmednagar, Beed, Pune, Satara and Solapur districts. Six hundred forty-four adult does (117 in Ahmednagar, 29 in Beed, 169 in Pune, 34 in Satara and 295 in Solapur districts respectively) are being recorded. These belong to 132 goat keepers, indicating that about 4.87 goats are reared per

household on average. 981 Kids were born in 609 kiddings during 1 January 2020 to 31 March 2021, making the average litter size 1.61. The closing balance is 1272 goats in total (comprising 312 males and 960 females). Overall mortality was 1.9%. Seven Osmanabadi bucks were purchased during the period 1 January 2020 to 31 March 2021, with six months weights of 18.6 kg. to 35.2 kg and with average six months weight 24.4 kg. From January 2020 to 31 March 2021, total 2,861 Osmanabadi buck straws were supplied to A.I. technicians, farmers and entrepreneurs for breeding Osmanabadi goats. The least squares meansof 90-day milk yield of Osmanabadi does was Osmanabadi does to be 102.4 kg with 1632 records. This was measured using the weigh-suckle-weigh method. This establishes the Osmanabadi breed to be among the top five dairy goat breeds in India. The least squares mean 90-day milk yields of does having singles, twins and triplets were 68.1, 103.4 and 135.8 kg respectively, indicating that milk yield increases with the number of kids. The heritability of 90-day milk yield was estimated to be 0.17±0.04. We have published 15 information booklets/ leaflets in Marathi language to give information to goat keepers on better goat management practices. Regular preventive health care of goats was carried out in all villages including vaccinations, deworming and spraying against ecto-parasites. Goat keepers were trained in preventive health care of goats and first-aid treatment so that they can care for their goats themselves instead of having to rely on others.

6.2.13. Sangamneri Goat Field Unit, MPKV, Rahuri, Maharashtra

The unit is operational at MPKV, Rahuri and the unit has six clusters viz. Sangamner, Shrirampur, Rahuri, Belha, Sinnar and Sakurmandava. The programme was initiated by registering 500 does located in the breeding tract and 4257 breedable does were registered during report period. The area under execution is divided in six centres (clusters) viz; Sangamner, Shrirampur, Rahuri, Belha, Sinnar and Sakurmandava covering three districts i.e. Ahmednagar, Nasik and Pune. Total 77 breeding bucks were rotated in the field during 2020 and total 3116 births were obtained in the field. The overall least square means for birth, 3, 6, 9 and 12 month body weights were 2.52 ± 0.02, 10.70 ± 0.10, 15.37 ±0.16, 19.48 ± 0.37 and 23.78 ± 0.38 kg respectively. All the non-genetic factors i.e. village cluster, year of birth and season of birth exerted significance influence ($p<0.01$) on body weights upto six month of age, while sex and sire influenced the body weights significantly ($p<0.01$) up to 12 months of age. The overallmeans for age at first conception and age at first kidding were 252.29±18.19 and 413.38±19.89 days, respectively. While the service period and kidding interval were 121.18±5.12 and 268.21±5.56days, respectively. The numbers of kids per kidding were 1.68. The non-genetic factors i.e. village clusters, year of birth and season of birth had significant influence on pre-partum traits. The overall 90 days milk yield was 101.87±2.03L however during 2020 it was 121.98 L.

6.2.14. Sirohi Goat Farm Unit, ICAR-CSWRI, Avikanagar, Rajasthan

The opening balance of flock strength on 01.01.2020 was 267 males and 504 females totalling 771 animals. The closing balance as on 31.12.2020 was 294 males and 565 females totalling 859 animals. The least squares means of birth, 3, 6, 9 and 12 month body weight were 2.84±0.04, 12.47±0.22, 20.91±0.38, 26.78±0.44 and 31.54±0.44 kg, respectively. Males were heavier than the females at all stages of growth. The overall least squares means for milk yield of does kidded during 2015-16 to 2019-20 at 90 days (90DMY), 150 days (150DMY), Total lactation (TLMY) and Lactation length (LL) were 74.71±0.46, 104.30±0.68, 106.29±0.97 litre and 165.80±1.48 days, respectively.Out of 265 does available for breeding, 250 were tupped and 216 kidded with 50 giving birth to twins during 2020 major season breeding. The tupping percentage was 94.34. The breeding efficiency was 91.30 and 97.06%, on the basis of does available and does tupped. The kidding percentage was 104.35 and 110.92% on the basis of does available and

does tupped, respectively. The litter size was 1.22. The mortality rates in 0-3, 3-6, 6-12 month age group and in adults were 2.86, 2.54, nil and 2.03 percent, respectively. The overall mortality rate irrespective of any age group was 3.53 percent. A total of 132 animals comprising of 95 males and 37 females were sold to the progressive farmers, Government and non-government agencies for improvement of their goats for meat and milk production. The total revenue generated from sale/transfer/culling of different items like animals, milk etc. during the year was Rs. 19,79,377.00.

6.2.15. Sirohi Goat Field Unit, College of Veterinary Sciences & A H, Vallabhnagar, Rajasthan

The unit is operational at College of Veterinary Science, Vallabhnagar. The unit has five clusters viz. Devgarh, Karget, Bojunda Bhadsoda Barapal Farm. The registration of farmer's flock and the identification of animals were carried out in clusters. The closing balance of the registered flock was 2890 animals including 1842 adult females. During report period, 1014 kids were born out of which 532 were males and during report period population growth were 78.22%. Total 374 males were sold out of which maximum 338 males were sold from 6-12 month age group. The least square means for body weight at birth, 3, 6, 9 and 12 months of ages were 2.34±0.03, 11.52±0.28, 15.38±0.37, 18.90±0.46 and 22.76±0.47 kg, respectively. Year, season, sex of kid and type of birth had significant effect on the body weights. Single born kids were significantly heavier than the multiple born kids at all the ages. Male kids were also significantly heavier than the female kids at all the ages. The overall least square means for milk yield over 30 days, 60 days, 90 days, 150 days, lactation yield and lactation length were 21.03±1.46, 43.90±2.74, 63.93±3.68, 97.61±4.35, 99.61±4.27 lit. and 152.47±1.03 days, respectively. Period, Season of kidding, type of birth had significant effect on milk yield. The lactation order played a significant role in milk yield. Whereas non-significant effect of lactation order was observed on lactation length. he overall least square means for age at first mating, weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period of test progenies were 514.4±10.6 days, 28.0±0.1 kg, 661.9±10.6 days, 29.9±0.1 kg, 229.2±3.5 days 379.1±3.5 days, and 149.9±0.1 days, respectively.The kidding rate (litter size) was 1.10. During report period 5358 animals were dewormed, and 7299 treated to control ectoparasite. Further, 2251 and 1286 animals were vaccinated for ET & PPR, respectively. The overall mortality was 4.04%.

6.2.16. Surti Goat Field Unit, N.A.U., Navsari, Gujarat

The unit is operational at N.A.U., Navsari, Gujarat. The unit has six clusters viz. Bharuch, Karjan, Jambusar, Navsari, Bilimora and Vapi. The closing balance of the farm flock was 153 animals including 96 females and 57 males. Out of these 58 females and 27 males were breedable. During the year, 14 new white coloured goats had kidded for the first time. Total 26 males and 61 females of >12 months age were sold / distributed for breeding purpose in the breeding tract of the breed. Overall population growth of 88.31 % was recorded with the addition of 84 live kids. The mean for body weight (2020) at birth, 3, 6, 9 and 12 months of ages was 2.67 ± 0.05 (84), 5.76 ± 0.11 (85), 8.39 ± 0.15 (108), 11.28 ± 0.21 (85), 16.44 ± 0.33 (55) kg, respectively. The birth weight was found comparable with the previous year data. However body weight of 3, 6, 9 and 12 months was found to be comparative lower to the previous year. Kids born between July and October months revealed higher birth weight. The overall means for milk yield over 90 days, 140 days, lactation yield and lactation length was 87.97±4.15 (52), 139.28 ± 10.13 (24), 127.15±11.20 (52) liters and 119.15±8.13 (52) days, respectively. Surti goats with higher litter size were found to be better producer compared to their counter parts. Age at first mating, weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period were 520.21 ± 45.95 (14) days, 22.01 ± 0.76 (14) kg, 669.79 ± 46.15 (14) days, 25.34 ± 0.74 (14) kg, 171.74 ± 21.22 (66), 283.90 ± 13.20 (51),146.14 ± 2.65 (66) days, respectively. During year, From 84 kids bourn

during the year, 39 were as singlet, 26 were doublet and 1 was triplet. Total 26 breeding bucks along with 61 breedable females were provided to goat farmers in adopted villages at univerisity. In total, 437 germplasm including 98 males and 239 females had been supplied by Surti field unit during last six years. During current year 516 animals were dewormed, vaccination with 127 doses of FMD, PPR and HS vaccine had been carried out in the goats maintained at Surti farm unit. Overall mortality was observed as 4.73, 1.67 and 3.46 % in 3-6 months, 6-12 months and adult animals respectively. Four (4) training of one day period entitled "Profitable goat farming through scientific methodologies" was organized by Surti farm unit in which 116 female tribal farmers had participated. Additionally, three (3) one day on field trainings benefiting 97 farmers were conducted. With continuous bilateral efforts from farmers and Surti field unit, around some village level goat cooperatives had been started in these villages.

6.2.17 Uttarakh and Local Goat Field Unit, GBPUA&T, Pantnagar, Uttrakhand

The unit is operational at GBPUA&T, Pantnagar. The unit is operational at 5 clusters viz. viz. Bara, Tilpuri, Bhimtal, Kunda and Majhera. A total of 1,626 kids using 95 bucks and 1,359 doe have been produced during reporting period. The mean values for body weights were 2.17±0.01, 10.83±0.05, 15.45±0.06, 19.32±0.06 and 23.55±0.09 kg at birth, 3, 6, 9 and 12 months of age, respectively. The average milk yield up to 30, 60, 90 and 120 days were found as 12.46±0.08,27.77±0.12, 47.87±0.22 and 60.48±0.43 litre, respectively The average lactation length and lactation yield were 120.44±5.62 days and 58.85±0.84 litre, respectively. The average age and weight at first mating were recorded as 272.76±2.02 days and 21.44±0.13 kg, respectively. Kid mortality between 0-3 months was recorded as 10.01% and adult mortality as 4.59% with total flock mortality as 7.40%. The kidding rate has been recorded as 1.63 (163%) with remarkably higher number of twining and triplet kiddings as 53.56% and 3.71% respectively. A nucleus flock of Pantja goats has been established at Pantnagar, wherein 36 females and 30 males are being maintained. Various inputs like mineral mixture (57 bags, each of 1 kg), medicines (antibiotics, anthelmentics, antidiarrhoeals, analgesics, etc.), 683 doses of PPR vaccines, feeding tubs (36) and buckets (34) have been distributed in the project area.

6.2.18. Bengal Goat Field Unit, ICAR-RCER, Patna

All India Coordinated Research Project on Goat Improvement was started at ICAR Research Complex for Eastern Region, Patna in the year 2018-19. The centre, being at initial years, attention was paid on strengthening the five clusters initially established, building rapport with the goat farmers in the centers and consolidation of activities. The population growth in the selected villages expanded to the tune 141.56 % with new addition of breedable does and new births. The mortality was controlled within 4 % due to comprehensive efforts of vaccination, deworming, timely therapeutic interventions and awareness programme. The average body weight at 3 and 6 months of age increased from 4.11±0.15 to 4.19 ±0.25 kg and 6.15±0.26 to 6.21±0.24 kg, respectively. Average lactation milk yield was 21.02±0.77 kg. With respect to reproduction parameters, there were no significant gains during the reported year. Significant increase in the socio-economic conditions of goat farmers registered under the project was also observed.

(Dr. P.K. Rout, Incharge Project Coordinator, AICRP on Goat Improvement)

6.3 TECHNIQUES FOR AUGMENTATION OF FERTILITY IN GOATS

6.3.1 Enhancement OF Productivity and Multipliaction of Superior Goat Germplasm

Liquid storage at refrigeration temperature reduces pH and antioxidant capacity of goat semen

The presence of antioxidant in cell cytoplasm preserves from oxidative damage. However, sperm cells lose these enzymes during preservation, becoming more susceptible to per oxidative processes that compromise their survival and fertility. Liquid stored semen can be an alternative to frozen thawed semen for artificial insemination. Lower pH can reduce sperm motility and metabolic activity, which is good for keeping spermatozoa viable during manipulation or preservation. Monitoring extender pH at different times of semen storage and modeling its variation according to nonlinear models is of great importance for protocol optimization for long-term liquid semen preservation. The objective was to observe the effect of pH and malonaldehyde (MDA) production during liquid semen storage at refrigeration temperature in chemically defined extenders on Barbari goat sperm viability and fertilizing potential. Ejaculates were collected and were extended with tris- citric acid- fructose diluent with (20%) or without egg yolk. Sperm concentrations were adjusted to 1×10^{8} ml^{-1} and diluted semen was kept at 5°C for 5 days. Sperm motility, live sperm count, acrosomes integrity, hypo osmotic swelling positive spermatozoa, pH of diluted semen and MDA were calculated in diluted semen at 24 hr of interval. Analysis of data using SPSS 16 showed that Sperm motility, live sperm count, acrosomes integrity, hypo osmotic swelling positive spermatozoa and MDA were differed significantly ($P<0.05$) at different pH level of diluted semen and days interval. The pH of diluted semen was decreases significantly ($P<0.05$) from initial pH-6.66±0.03 to pH-6.06±0.03 on 5th day of liquid storage at refrigeration temperature and seminal parameters were below the acceptable level of artificial insemination. Liquid storage of semen quality deteriorated day by day due to decrease in pH level and 20% egg yolk protect from the detrimental effect of cooling. Egg yolk coagulating enzyme catalyzed the release of fatty acids from egg yolk lipids, leading to a decrease in pH. Sperm membrane lipid peroxidation due to the detrimental effect of reactive oxygen species increased during different days of storage as evidenced by low MDA concentration. So, the liquid storage of semen quality deteriorated day by day due to decrease in pH and antioxidant capacity of semen and egg yolk protect from the detrimental effect of cooling.

Table1: Effects of pH during liquid storage at refrigeration temperature on fertilizing potential and viability of Barbari goat sperm (Mean ± SE)

Days	0	1	2	3	4
pH	6.66±0.03^{a}	6.26±0.03^{b}	6.20±0.03^{bc}	6.16±0.03^{c}	6.06±0.03^{d}
Motility	82.86±1.01^{a}	73.57±1.43^{b}	67.86±1.49^{b}	57.86±3.76^{c}	45.71±2.54^{d}
Live	85.32±0.99^{a}	75.09±2.15^{b}	71.89±2.95^{b}	60.48±4.97^{c}	51.18±3.77^{c}
HOS	77.13±1.69^{a}	74.05±2.22^{a}	68.96±2.90^{a}	57.82±4.12^{b}	43.93±2.81^{c}
Acrosome	79.60±0.65^{a}	73.92±3.65^{ab}	66.29±3.18^{b}	56.45±4.53^{c}	45.33±3.08^{d}
MDA	3.65±0.40^{d}	5.17±0.35^{c}	5.99±0.54^{bc}	7.09±0.65^{b}	8.99±0.31^{a}

*Different superscript differ significantly within a row

Effect of IGF-1 fortification in semen diluent on post thaw qualities, antioxidant capacity and DNA integrity of Jamunapari buck semen

The role of nutrient-related metabolic hormones such as insulin, growth hormone and insulin-like growth factors on the gamete function has been focused to improve reproductive efûciency in farm animals. IGF-I has an antioxidant effect and maintains sperm motility. The presence of antioxidant in cell cytoplasm preserves from oxidative damage. However, sperm cells lose these enzymes during preservation, becoming more susceptible to per oxidative processes that compromise their survival and fertility. The objective was to assess the effect of various concentrations of IGF-1 on seminal parameters and mitochondrial membrane potential (MMP), oxidative status, DNA integrity after freeze-thawing of Jamunapari buck semen. Ejaculates were collected and were extended with tris- citric acid- fructose diluent with (20%) or without egg yolk. Sperm concentrations were adjusted to 1×10^8 ml^{-1} and diluted semen was cryopreserved in liquid nitrogen and stored. Sperm motility, live sperm count, acrosomes integrity, hypo osmotic swelling positive spermatozoa, malondialdehyde (MDA), protein carbonyl content (PCC), TUNEL positive sperm is calculated in post thaw semen. Analysis of data using SPSS 16 showed that Sperm motility, live sperm count, acrosomes integrity, hypoosmotic swelling positivespermatozoa, malonaldehyde (MDA), protein carbonyl content, TUNEL positive sperm were in post thaw semen were differed significantly ($P<0.05$) at different concentration of IGF-1 and were

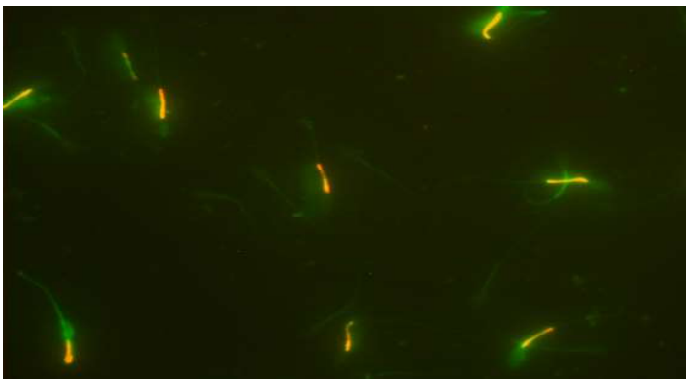


Fig. 1 MMP of goat spermatozoa evaluated by JC-1. Sperm with low MMP.

IGF-1 protects sperm membrane lipid peroxidation by reducing the detrimental effect of reactive oxygen species evidenced by low MDA and PCC. Reduction in the antioxidant capacity of sperm after freezing-thawing results in free radical-mediated oxidative stress, which causes DNA fragmentation along with compromised sperm functional capacity.

Table2: Effect of IGF-1 on post thaw semen qualities (Mean ± SE)

Conc.	Post thaw Motility %	Live %	HOS %	Acrosome %	TUNEL +ve %	MDA (µM)	MMP %	PCC(nmole/mg protein)
0 ng	41.25± 1.96^{bc}	43.63± 1.92^{bc}	41.18± 1.90^{c}	44.99± 1.86^{bc}	23.75± 0.85^{a}	13.22± 0.89^{c}	29.94± 1.11^{c}	3.12± 0.06^{b}
50 ng	37.92± 1.56^{c}	41.60± 1.88^{c}	42.32± 1.84^{bc}	42.47± 1.74^{bc}	22.00± 0.91^{ab}	19.51± 0.97^{b}	28.44± 1.15^{c}	3.11± 0.09^{b}
100 ng	44.58± 1.89^{b}	49.55± 2.43^{ab}	48.33± 2.46^{ab}	49.14± 2.36^{b}	21.75± 0.48^{ab}	22.39± 1.25^{ab}	28.12± 1.51^{c}	3.05± 0.10^{b}
150 ng	40.83± 2.37^{bc}	43.66± 2.79^{bc}	42.11± 2.42^{bc}	43.18± 2.75^{bc}	21.00± 1.08^{b}	23.28± 1.09^{a}	41.94± 1.89^{ab}	3.43± 0.13^{a}
200 ng	42.50± 1.68^{bc}	44.63± 2.20^{bc}	44.54± 2.19^{bc}	44.42± 2.25^{bc}	18.25± 0.85^{c}	24.41± 1.03^{a}	39.81± 1.75^{b}	3.07± 0.09^{b}
250 ng	51.67± 1.28^{a}	55.31± 1.41^{a}	53.68± 1.88^{a}	56.47± 1.91^{a}	15.75± 0.63^{c}	9.10± 0.77^{d}	45.31± 0.99^{a}	2.17± 0.04^{c}
300 ng	39.17± 2.12^{bc}	40.13± 3.12^{c}	41.53± 2.33^{c}	40.42± 2.26^{c}	18.25± 0.85^{c}	19.59± 0.79^{b}	26.56± 1.08^{c}	3.55± 0.06^{a}

*Means value with different superscript differed significantly within a column ($P< 0.05$)

Biotin fortification to goat sperm preparation medium reduces DNA damages, mitochondrial membrane potential and lipid peroxidation

The objective was to enhance the life and fertility potential of cryopreserved goat sperm by fortification of biotin in sperm medium and to assess the effect of various concentrations of biotin fortification on mitochondrial membrane potential (MMP), oxidative status and DNA integrity. Ejaculates (N 60) were collected and were extended with Tris- Citric acid- Fructose diluent. Biotin in different concentration were added in sperm preparation medium (0 µM, 1 µM, 2 µM, 3 µM and 4 µM). Sperm concentrations were adjusted to 1×10^{8} ml^{H1} and diluted semen was equilibrated at 5°C for 4 h before being cryopreserved in liquid nitrogen. The sperm motility, live sperm count, acrosomes integrity, hypo osmotic swelling positive spermatozoa and malonaldehyde (MDA), protein carbonyl content (PCC), DNA integrity and MMP were differed significantly ($P<0.05$) at different concentration of biotin and were significantly ($P<0.05$) highest in 3 µM of biotin. The fortification of biotin reduced the detrimental effects of freezing stress on motility, viability, plasma membrane and acrosome integrity. Biotin protect sperm membrane lipid peroxidation by reducing the detrimental effect of reactive oxygen species evidenced by low MDA, PCC, MMP and DNA damages. So, biotin may be used for routine goat semen freezing protocol to get optimum post thaw quality.

Table 3: Effect of biotin on post thaw semen qualities (Mean ± SE)

Conc (Biotin µM)	Post Thaw Motility %	Live %	HOST %	Acrosome %	MMP %	TUNEL +ve %	MDA (µM)	PCC(nmole/mg protein)
0 µM	42.00± 0.95^{ab}	43.48± 1.56^{b}	46.52 ±1.31^{a} b	44.53±1.69^{b}	26.50±1.17^{b}	23.50±0.64^{a}	22.53±2.25^{ab}	3.39± 0.48^{a}
1 µM	38.33± 2.42^{b}	42.02± 3.03^{b}	42.61 ±2.57 b	41.77±2.15^{b}	28.50±1.13^{b}	22.00±0.58^{ab}	24.54±3.61^{a}	3.38± 0.64^{a}
2 µM	38.67± 2.26^{b}	41.83± 2.15^{b}	43.47 ±1.30 b	43.75±1.94^{b}	30.25±1.81^{b}	20.25±0.63^{bc}	23.67±3.97^{ab}	3.12± 0.34^{b}
3 µM	47.67± 1.88^{a}	51.90± 2.28^{a}	51.86 ±1.96^{a}	52.02±2.32^{a}	43.19±0.62^{a}	19.00±0.58^{c}	14.13±2.19^{b}	2.14± 0.20^{c}
4 µM	44.00± 2.93^{ab}	43.90± 2.89^{b}	43.28 ±2.57 b	47.84±3.40^{ab}	27.81±1.35^{b}	22.00±0.41^{ab}	20.35±3.27^{ab}	3.33± 0.50^{a}

Means value with different superscript differed significantly within a column ($P< 0.05$)

(Externally Funded (DBT) Project: Development of novel semen extender to optimize post thaw quality for enhancement of productivity and multiplication of superior goat germplasm)
(Dr. (s) Ravi Ranjan, S.P. Singh, S. D. Kharche and M. S. Chauhan)

6.3.2 Conservation and Phenotypic Documentation of Mirzapuri Goat Breed

The funding agency of project is Uttar Pradesh Council of Agriculture Research (UPCAR). The Institute has received the budget in October 2020. Goats are considered as poor's man cow. It is the source of livelihood for the poor farmer's especially in eastern UP. The indigenous breeds of eastern UP are locally well adopted however their reproduction and production potential are not up to the marked. Further, farmers are not aware about the benefits of artificial insemination and consequences of indiscriminate breeding. All these lead to economical loss for the goat keepers. The Mirzapuri goat population appears to be distinct from already known goat populations, so a systematic survey is needed. The information related to demographical and geographical distribution, age and sex wise distribution, native habitats, management practices (feeding, housing, mating system etc.), utility (Hair/ Meat/Milk/Skin/Fibre etc.), socio-economic profile of the communities rearing the breed, morphological/ physical characters (colour, coat type, head, ear and horn profile etc.) and performance (body weight at different age, body measurements, carcass characters, dairy and reproductive performance) of Mirzapuri breed/population has not been documented. After confirming distinctness of this population by assigning the breed status, a suitable breeding program can be designed for their genetic improvement and conservation. Moreover, useful characters of the breed may be utilized for upgrading of non-descript population of this area. The collection of base line data has been initiated in the project.

(Dr. (s) Chetna Gangwar, S.D. Kharche, A. K. Dixit, B. Rai, Priya Ranjan, Mahipal Chaubey and Anshumn Kumar)

6.3.3 Polyherbal Preparations in Buck Fertility

During the period under report, a total of 560 semen doses of Buldenkhandi and Jamunapari bucks were prepared and cryopreserved. Out of these frozen semen doses 320 semen straws were used for post thaw semen evaluation of different parameters under different treatment regime/groups. Under reporting period, invitro experimental trial was conducted using Shatavari aqueous extract.For this 7 ejaculates from each 6 Jamunapari and 6 Buldenkhandi bucks were Under reporting period, invitro experimental trial was conducted using Shatavari aqueous extract. For this (n=84) 7 ejaculates from each 6 Jamunapari and 6 Buldenkhandi bucks were collected. Ejaculates showing mass motility > 3 were pooled for each breed for minimizing the individual effect.Then each pooled semen sample was split into 4 parts and diluted in 3 treatment groups and one control group.

Treatment groups (T1-500mg/100ml TRIS buffer, T2-250mg/100ml TRIS buffer, T3-125mg/100ml TRIS buffer, C-0 mg/100ml TRIS buffer) having different concentration of Shatavari aqueous extract and while control group was not containing any Shatawari extract. Sperm concentrations were adjusted to $1x10^8$/ml in each group and diluted semen was equilibrated at 5ºC for 4 h prior to cryopreservation. Semen samples were evaluated at three different stages i.e. after dilution, after equilibration and after cryopreservation. There was significant improvement in motility, viability, acrosomal integrity and plasma membrane integrity in treatment groups at post thaw stage in comparison to control group. Overall, higher post thaw motility, viability, acrosomal integrity and plasma membrane integrity was recorded in T3 group (125mg/100ml) as compared to other treatment groups. Statistical analysis was done by using SPSS computer software package (IBM SPSS, Version 22; SPSS Inc., Chicago, IL,USA). Analysis of variance (ANOVA) was done to compare difference in various parameters among all the groups.

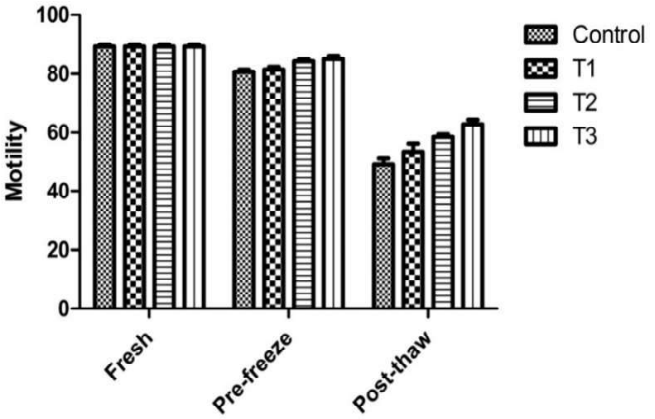


Fig. 2. Effect of Shatavari extract on sperm motility at different semen cryopreservation stages

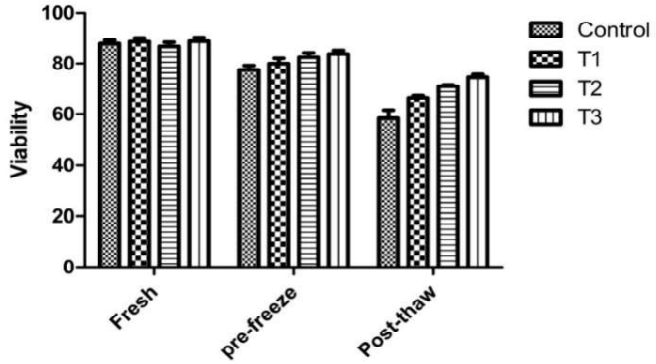


Fig. 3. Effect of Shatavari extract on sperm viability at different semen cryopreservation stages

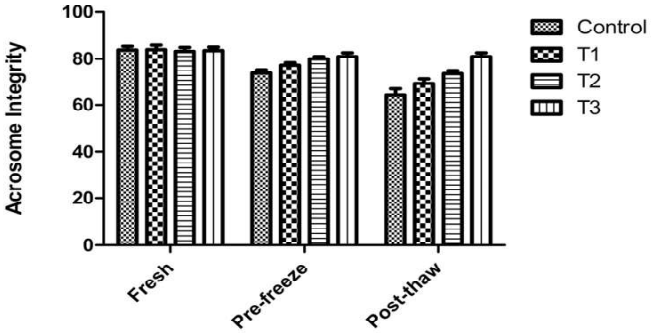


Fig. 4. Effect of Shatavari extract on sperm acrosomal integrity at different semen cryopreservation stages

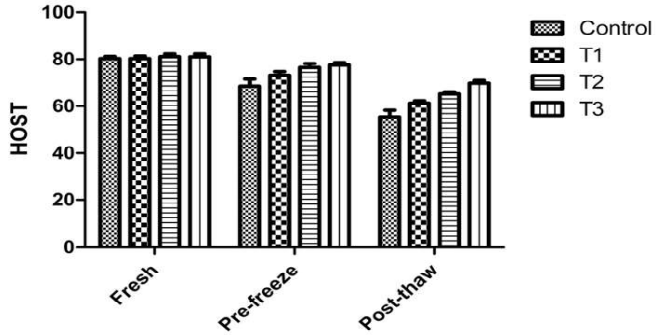


Fig. 5. Effect of Shatavari extract on sperm plasma membrane integrity at different se men cryopreservation stages

(Institute project: Augmentation of Buck fertility through use of polyherbal preparations)
(Dr. (s) Chetna Gangwar, Ashok Kumar, S.D. Kharche, Ravi Ranjan and S.P. Singh)

6.3.4 PSEUDOPREGNANCY IN GOATS

Incidence of pseudopregnancy was evaluated in Jamunapari goats. A total of 195 adult goats were selected for this purpose. The goats were divided into 2 groups (Group I-Confirmed pregnant goats, n=121 and Group II- Goats reported nonpregnant, n=74). The animals from Group I were pregnant and confirmation is done by abdominal palpation as these animals were in advance stage of pregnancy (4 months and above). Further, kidding was also recorded to rule out the any condition of cloud burst/pseudopregnancy. The goats from Group II were examined for their reproductive organs through ultrasonography. In this group 6 goats were found pregnant and other 68 goats were non pregnant. We did not find an anechoic image (fluid filled) without fetus or cotyledon in the uterine horn, however, the repeated examination of uterus was carried out after 15 days of initial examination through ultrasonography for further confirmation. In the animals examined, no case of pseudopregnancy was observed.

S.No	Observations recorded	Numbers
1.	No. of goats screened	195
2.	No. of animals confirm pregnant (GI)	121
3.	No. of animals reported non pregnant (GII)	74
4.	No. of animals screened through USG	74
5.	No of pseudopregnant animals out of screened animals	0
6.	No. of pregnant animals out of screened animals	6
7.	No. of nonpregnant animals out of screened animals	68

Fig.6. Non pregnant goat uterus

Fig. 7. Pregnant goat uterus

The study was concluded with that there was no incidence of pseudopregnancy in Jamunapari goats maintained at CIRG. The study with more no of animals of different breeds and in different season, will provide results about the occurrence of pseudopregnancy at organized goat flocks.

(Institute project: Assessment of incidence of pseudopregnancy in goats)

(Dr. (s) Chetna Gangwar, S.D. Kharche, Ravi Ranjan, S.P. Singh, N.Ramachandran, and M.K. Singh)

6.3.5 Culture and Tranplantation System for Male Goat Germ-Cells

Differential effects of extracellular matrix proteins on in-vitro culture and growth characteristics of caprine male germ-cells

In this study, we investigated the effects of extracellular matrix (ECM) proteins on *in vitro* growth and proliferation of caprine male germ-cells (cmGCs) obtained from pre-pubertal testis by a two-step enzymatic digestion, and enriched by differential plating and percol-density centrifugation methods. First, a culture system for cmGCs was optimized and then, to investigate undifferentiated state, stemness, and proliferative ability of cmGCs grown onto the non (control), rat-tail collagen (RTC), collagen IV (COL IV), laminin (LAM), fibronectin (FIB), and vitronectin (VIT) coated plates, alkaline phosphatase (ALP) activity, immunofluorescence (OCT-4 and UCHL-1), and expression profile of GC-specific (PLZF, UCHL-1), pluripotent (OCT-4), and undifferentiated spermatogonia (THY-1, BCL-6B, and ID-4)] marker genes were detected. Further, to investigate cell viability, total and live/dead cell counting were performed. The number and diameter of colonies were evaluated after 5 days of culture during P3. All the ECM proteins, significantly affected cell viability, proliferation (except RTC), and expression of pluripotency marker genes; however, they did not affect the expression of BCL-6 and ID-4 genes.

The largest colonies with the highest number of viable cells and more expression of ALP, OCT-4, and UCHL-1 were observed in the VIT group compared to the other groups. In conclusion, the present study revealed the beneficial effects of VIT with respect to proliferation, viability, transcriptional response, and maintenance of un-differentiated and pluripotent characteristics of cmGCs during the culture. Thus, our findings provide an important understanding of the ideal culture condition to achieve better growth and maintenance of cmGCs.

Thus, we demonstrated the comparative significance of signalling derived from ECM proteins on the growth, survival, and maintenance of cmGCs in an undifferentiated state. This study demonstrated that, VIT is a more suitable matrix protein for large-scale production of undifferentiated cmGCs with a high survival rate. These results provide a basis for the development of more specialized culture systems for cmGCs and other testicular cells. Moreover, these results will help to develop a suitable cellular niche supporting the self-renewal of cmGCs and stimulating cmGCs differentiation into various lineages. Accordingly, additional studies with or without a combination of different ECM proteins will be required to substantiate our findings and to identify the mechanism of molecular interactions among the ECM proteins and the adherent cells.

Table 4: The effect of ECM on growth of cmGCs in culture during passage 3

ECM	> 90 % confluency at day	Dead cell count* ($\times 10^5$)	Viability (%)*
Control	7.7 ± 0.48^{a}	4.44 ± 0.78^{a}	72.0 ± 3.3^{a}
RTC	7.1 ± 0.34^{a}	4.12 ± 0.54^{a}	74.0 ± 2.9^{a}
COL IV	6.5 ± 0.29^{b}	3.46 ± 0.49^{a}	80.8 ± 3.7^{b}
LAM	6.0 ± 0.41^{b}	2.92 ± 0.64^{b}	79.5 ± 2.3^{b}
FIB	5.5 ± 0.29^{bc}	2.57 ± 0.61^{b}	82.3 ± 4.4^{b}
VIT	4.8 ± 0.25^{c}	2.24 ± 0.27^{b}	90.3 ± 2.1^{c}

The results are mean ± SEM

cmGCs (caprine male germ cells), RTC (rat-tail collagen), COL IV (collagen IV), LAM (laminin), FIB (fibronectin), VIT (vitronectin)

Independent sample t-test was used for statistical analyses

Data with different superscripts (a, b, c within each column), differ significantly ($p < 0.05$); n = 4 replications

* The values of the dead cell count and viability are presented at ~80% confluency

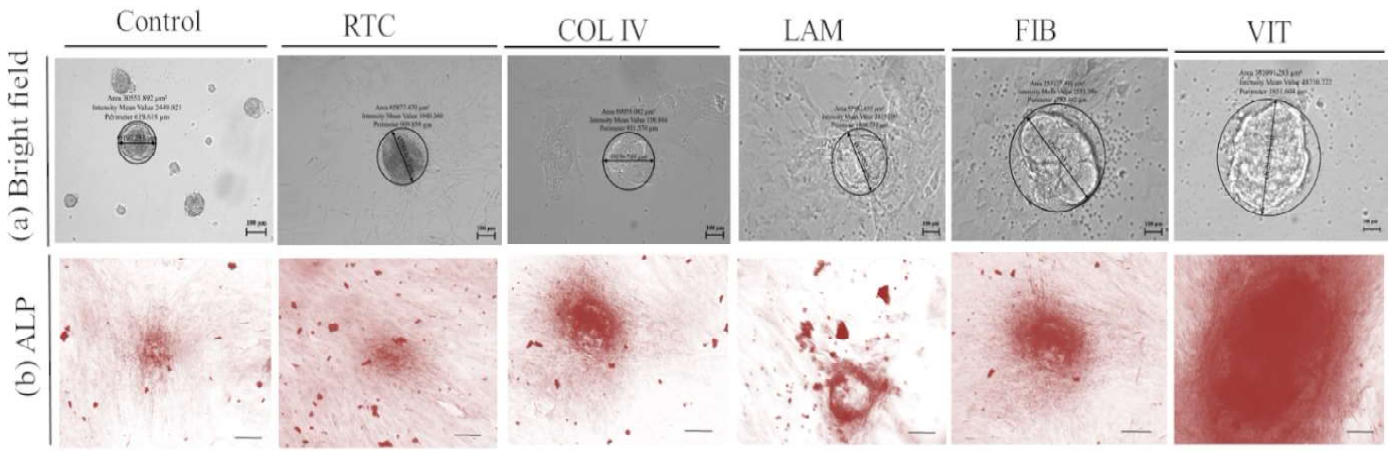


Fig. 8. (a) Phenotypic characteristics of germ cell (GC) colonies obtained by co-culturing of GCs onto the Sertoli cell feeder layer after a 5 days of culture during P3. The representative colonies in the red circle arrows indicate cmGC colonies grown over plastic or coated surfaces with different ECM proteins. Scale bar: 100 µm. **(b)** Effects of ECM proteins on the maintenance of alkaline phosphatase (ALP) activity in cmGCs. Cells (1×106 cmGCs) were seeded onto non or ECM [rat tail collagen (RTC), collagen IV (COL IV), laminin (LAM), fibronectin (FIB), and vitronectin (VIT)] coated culture plates and incubated for 5 days before the AP activity was analyzed. cmGCs cultured on VIT-coated culture plates showed a significant increase in AP activity after 5 days of culture. However, a significant decrease in AP activity post-5 days of culture was detected in putative germ cells cultured on non-coated culture plates. ECM= extracellular matrix; AP= alkaline phosphatase; cmGCs= caprine male germ cells; RTC= rat-tail collagen; COL IV= collagen IV; LAM = laminin; FIB = fibronectin, VIT = vitronectin.

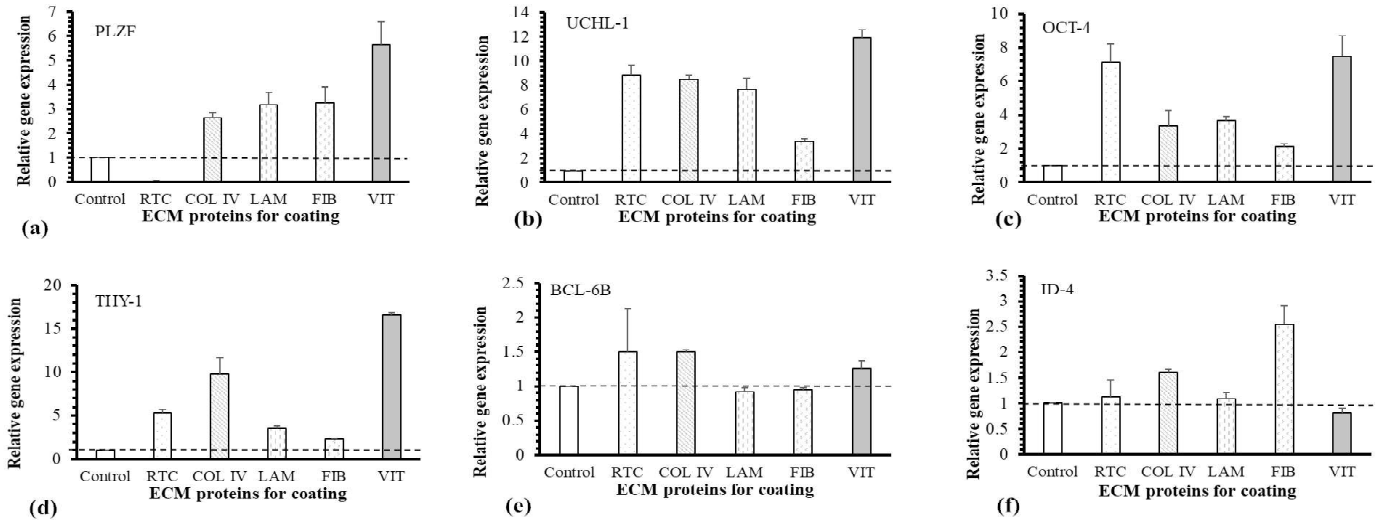


Fig. 9. Comparison of GCs-specific gene transcription levels in cmGCs cultured onto the ECM protein-coated plates for 5 days during P3. Cells (1×10^6 cmGCs) were seeded onto non-, RTC, COL IV, LAM, FIB, and VIT coated culture plates and incubated in for 5 days. Subsequently, transcription levels of GCs-specific genes were estimated at day 5 of the culture of P3 using real-time PCR. In case of cmGCs cultured for 5 days (B), cmGCs experiencing VIT-derived signaling showed the highest mean transcriptional level of PLZF, UCHL-1, OCT-4, andTHY-1. Moreover, (C), although no significant decrease in BCL-6B expression was observed in LAM and FIB coated plates, its highest transcriptional levels were observed in cmGCs cultured onto the RTC and COL IV, and FIB coated plates.

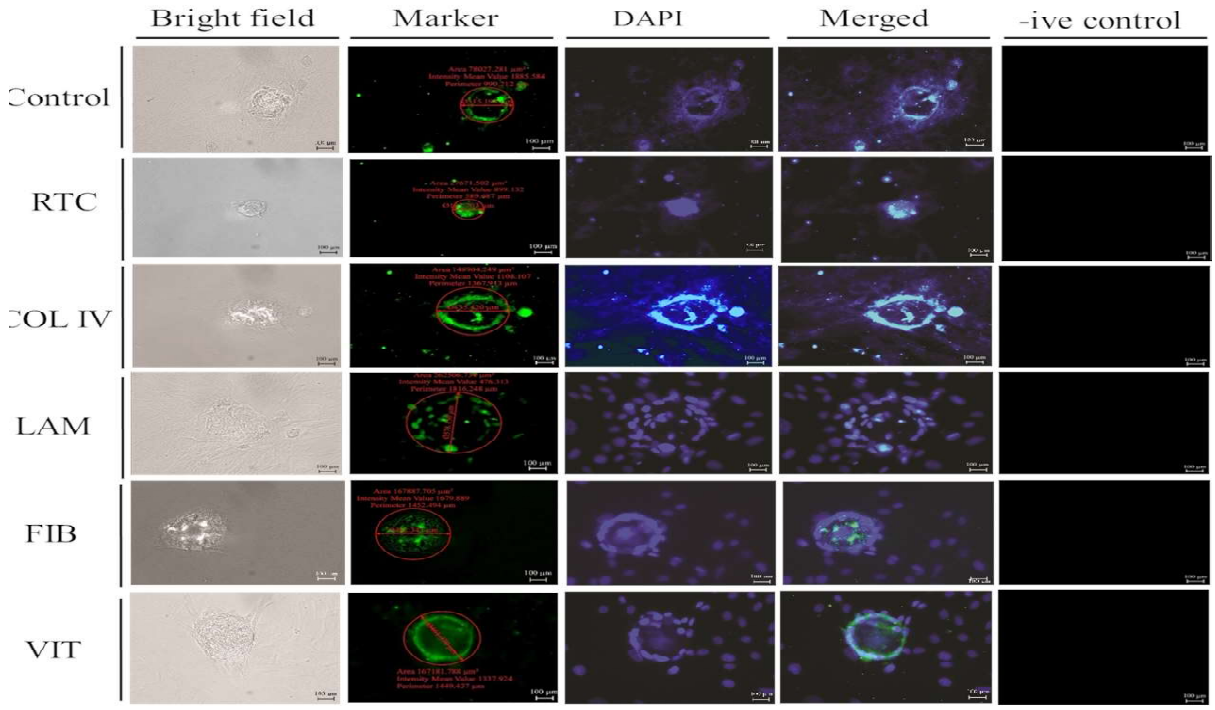


Fig. 10. Representative images of immunofluorescence staining of cultured cmGCs stained for germ cell surface marker (UCHL-1). Cells were grown on the 24 well culture plates uncoated (control), or coated with extracellular matrix proteins (RTC = rat tail collagen; COL IV = collagen IV; LAM = laminin, FIB = fibronectin, VIT= vitronectin). After 5 days of culture at P3, cells were stained for cell surface marker with specific primary antibody (rabbit anti-UCHL-1 antibody) and Alexa flour 488 secondary antibody followed by counter-stained with DAPI. Merged images are after double-immunofluorescence staining with anti-primary antibody and DAPI. Cells positive for specific marker appear green and DAPI positive cells stained blue. In a negative (-iv) control, the primary antibody was excluded. Scale bar, 100 µm.

Effect of low oxygen tension on proliferation, stemness and multilineage differentiation of caprine male germline stem cells

The milieu of testicular germline stem cells (mGCs) is characterized as low oxygen (O_2) environment, whereas, *in-vitro* expansion of these cells is typically performed under culture systems with the atmosphere of 20-21% O_2 (normoxia). Here, to address the influence of low O_2 environment, we evaluated the culture and multilineage differentiation characteristics of enriched caprine mGCs (cmGCs) under hypoxia (5% O_2) and hypothesized that when compared to normoxia (21% O_2), dedicated hypoxia will potentiates the functional characteristics of cmGCs. For this, in addition to the study of growth characteristics and population doubling time (PDT), cmGCs were evaluated for their viability, proliferation, senescence, and expression of key markers for adhesion (β-integrin and E-cadherin) and stemness (OCT-4, THY-1 and UCHL1; through immunocytochemistry and qRT-PCR) in both the culture conditions. Moreover, the extent of differentiation under specific culture media for neurogenic, adipogenic, and chondrogenic differentiation was assessed by specific staining and expression of differentiation-specific marker genes. The survival and proliferation were significantly promoted and PDT was reduced ($p < 0.05$), thus yielding a higher number of viable cells with larger colonies under hypoxia. Furthermore, expression of pluripotency and adhesion markers was distinctly increased when cells were grown under condition with lowered O_2. Conversely, the presence of multilineage differentiated regionsand expression of differentiation specific

key genes were significantly ($p < 0.05$) reduced under hypoxic conditions. These data demonstrate that culturing cmGCs under hypoxic condition augments the proliferation, viability, growth rate, and expression of pluripotency and adhesion markers as compared to normoxia. Overall, low O_2 tension augments the self-renewing capacity and stemness properties but not the multilineage differentiation potential of cmGCs. These data are important for the development of robust methodologies for *ex-vivo* expansion and differentiation of cmGCs with improved function for clinical applications.

Our results indicate that under hypoxic conditions, cmGCs overexpress key makers of stemness and adhesion, thereby positively influencing their self-renewal and proliferation.

Nonetheless, differentiation of cmGCs into different cell types is inhibited by hypoxic culturing. Thus, faster expansion of cultured cmGCs coupled with the differential expression pattern of stemness, adhesion, and differentiation-specific key markers in cmGCs provides correlative evidence that low O_2 microenvironment (5% O_2) provides a better culture condition for the self-renewal and proliferation of cmGCs without adversely affecting their stemness properties. Overall, low O_2 tension is supportive for maintaining proliferation and stemness but not for multilineage differentiation (plasticity) of this stem cell population. These observations add to the understanding of cmGCs responses to defined culture conditions, which is the most critical issue for their maintenance and clinical applications.

Table 5: Morphometry of cmGCs grown under either normoxic or hypoxic culture conditions

Morphometric variables	d 7		d 14	
	Normoxia	Hypoxia	Normoxia	Hypoxia
Area (μm^2)	5298.01 ± 368.58^a	61995.60 ± 32760.11^b	13511.75 ± 1739.63^c	214943.48 ± 96669.10^d
Intensity	2938.62 ± 98.32^a	17466.69 ± 15085.11^b	2243.07 ± 141.28^a	2792.23 ± 159.19^a
Perimeter (µm)	257.71 ± 9.07^a	800.19 ± 263.39^b	410.34 ± 26.56^c	1497.91 ± 478.19^d
Diameter (µm)	82.10 ± 2.90^a	254.71 ± 83.84^b	130.62 ± 8.45^c	476.80 ± 152.21^d

The results are mean ± SEM

cmGCs (caprine male germline stem cells)

Independent sample t-test was used for statistical analyses

Data with different superscripts (a b, c and d within each column), differ significantly ($p < 0.05$); n = 6 replications

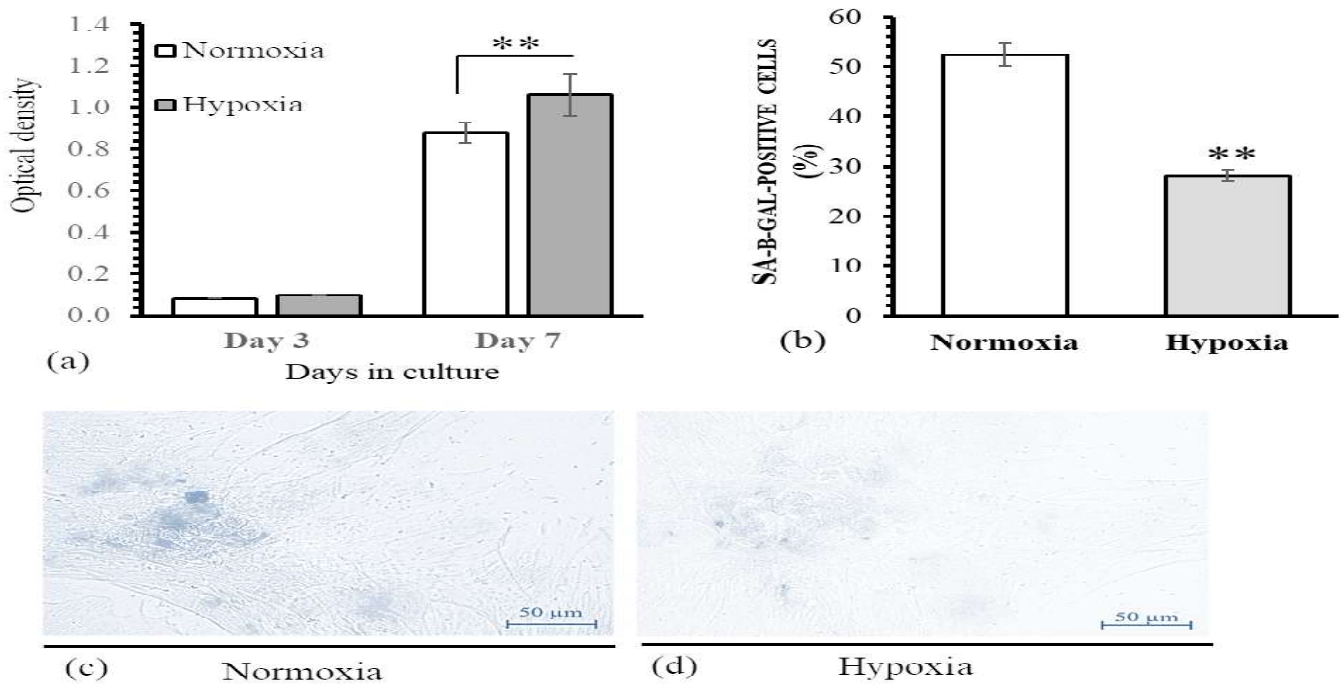


Fig. 11. (a) MTT assay for cell growth and viability. Optical density of the Caprine male germline stem cells (cmGCs) growing under normoxic or hypoxic culture conditions after day 3 and 7 of cell seeding. Results are presented as mean ± SEM (**: $p < 0.01$). (b-d) Cellular senescence occurring during culture of cmGCs. **(b)** Quantification of Figure **(c-d),** data are presented as mean ± SEM of three independent experiments and statistical differences were calculated significant as **: $p < 0.01$. Representative images of senescence-associated (SA)-β-GAL staining at d 7 of cmGC culture in normoxic **(c)** or hypoxic **(d)** conditions. Senescent cells are stained with dark blue color, scale bar: 50 µm.

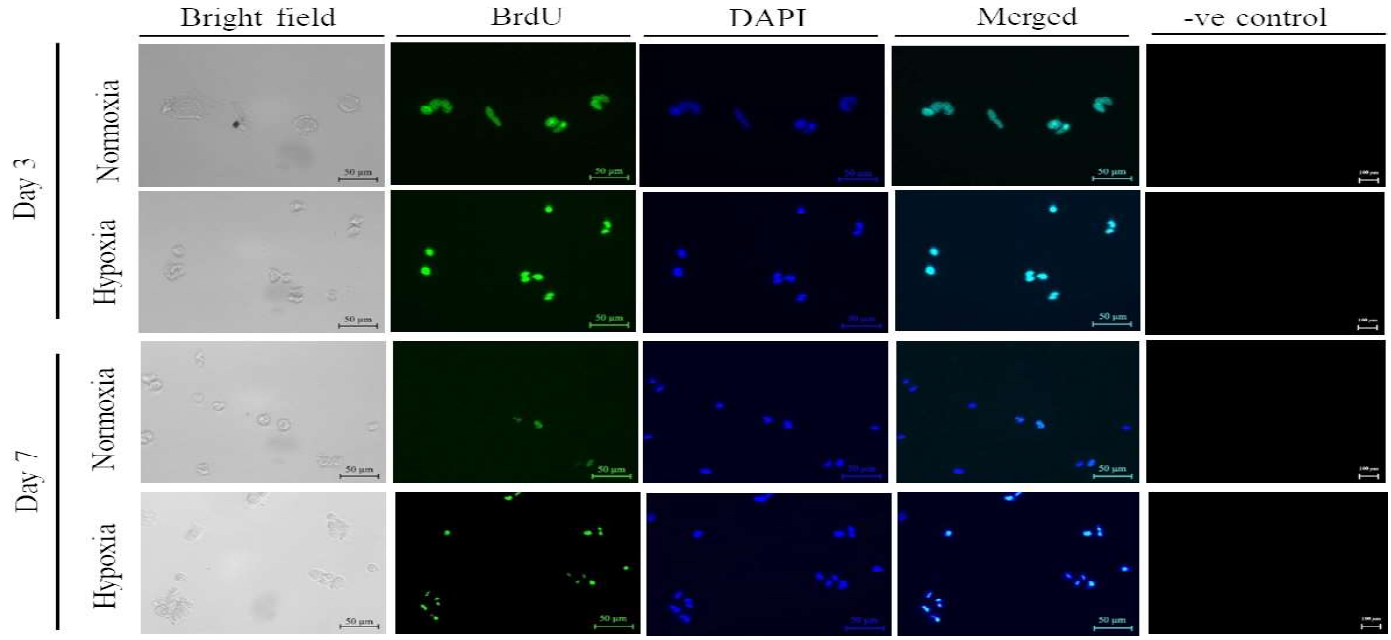


Fig. 12. Representative images of BrdU proliferation assay of cmGCs cultured in normoxic or hypoxic conditions at day 3 and d 7 of culture. For negative (-ve) control, all the steps were followed except use of the primary antibody (rabbit anti-BrdU antibody). scale bar: 50 µm.

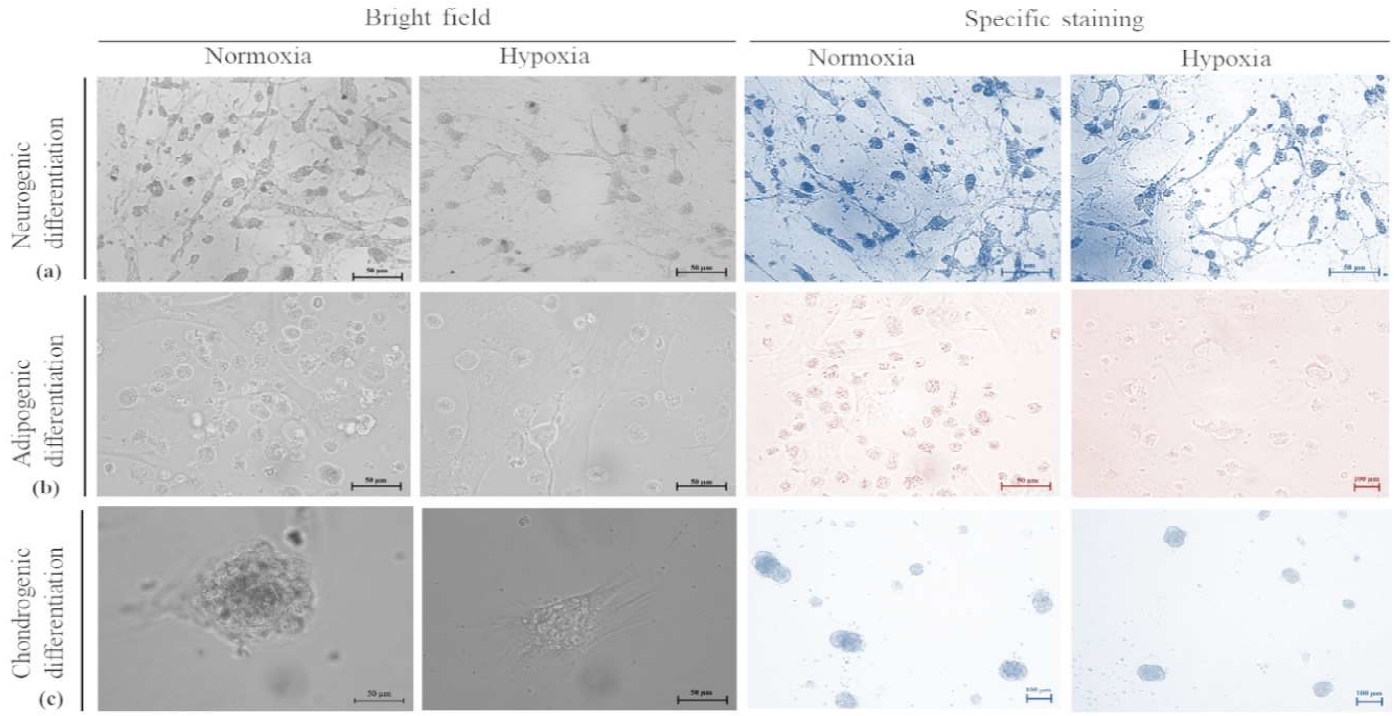


Fig. 13. Representative images of morphology of differentiation cmGCs in culture. Appearance under the microscope (bright field) and specific staining properties were used to identify the cells. Cells were grown on the 24 well culture plates under normoxic or hypoxic condition. After 15 days of culture in corresponding differentiation media at P3, the cells were stained for specific staining (**a:** Neuronal differentiation: Toluidine blue; **b:** Adipogenic differentiation: Oil Red O, and **c:** Chondrogenic differentiation: Alcian blue). Scale bar, 50-100 µm.

(Externally Funded (DBT) Project: Establishment of efficient culture and transplantation system for male goat germ-cells

(Dr. (s) S.P. Singh, S.D. Kharche, Ravi Ranjan, M.K. Singh and M.S. Chauhan).

6.3.6 Production of Clone Goat Embryos

The core benefits of animal cloning are its use to make essentially identical copies of an animal with superior traits, production of transgenic animals to obtain variety of therapeutic proteins/biomaterials and to multiply endangered animal species. Animal cloning technique is also expedient to generate group of genetically identical animals that can be used both to further understand the physiopathological processes and to conduct initial tests on treatments. Though, the reproductive cloning has several potential applications, there are still numerous technical challenges.The knowledge generated through the proposed projectwill be used to establish and optimize protocols for production of good quality clone goat embryos that take into account the changing needs of the developing embryo and their subsequent development after transfer in to the recipient animals. With this information, this project is recently (October, 2020), started at our Institute with the objectives 1) To generate clone goat embryos and 2) To assess developmental potential of clone embryos after transfer into the recipient goats.The expected output of the project would be 1) establishment of an important strategy for ex situ conservation and faster multiplication of elite germplasm of important goat breeds of

the country) the successful establishment of clone embryo culture and their efficient transplantation in to recipient animals may be extended to other animal species in which current genetic modification techniques are impossible or inefficient, 3) Information about the developmental competence of the clone goat embryo will be obtained and 4) The proficient methodology for preparation of suitable recipient female goat for clone embryo will be developed.

During the period of 2 months of period under report, the donor animals (elite Jamunapari bucks of about 1 year of age) with known pedigree were selected. Their monthly body weight are being recorded and compared with the control animals. The protocols for collection of skin samples and fibroblast culture were prepared and part of the required chemicals were procured with the provide fund for this project.

(Institute Project: Production of clone goat embryos and assessment of their survival after in vivo transfer

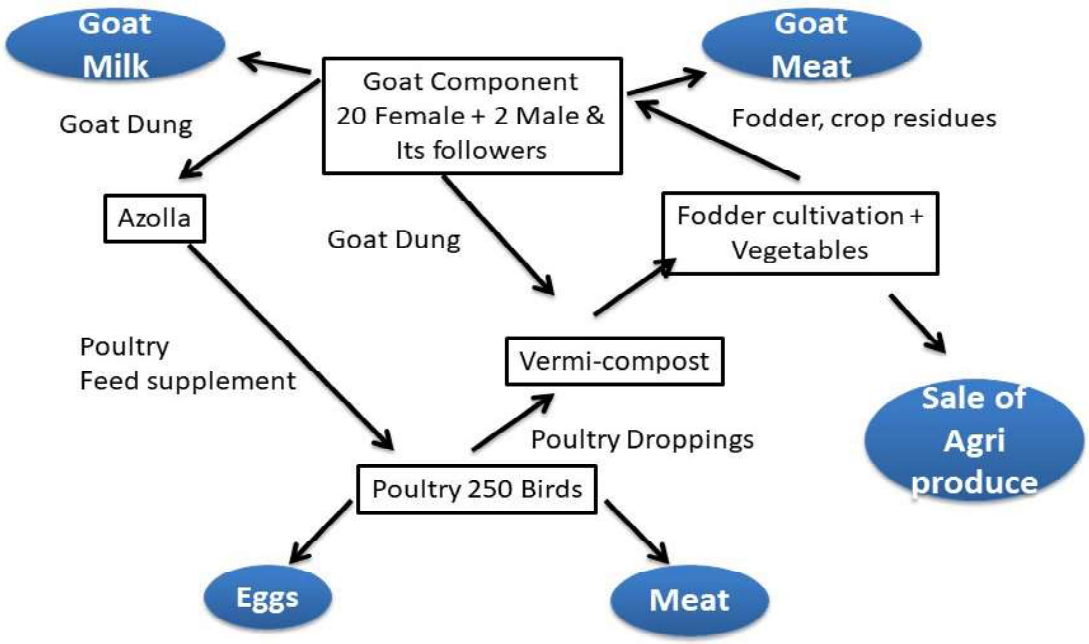
(Dr. (s) S.P. Singh, S.D. Kharche, Ravi Ranjan, Y.K. Soni and Chetna Gangwar)

6.3.7 Integrated Farming System

Presently, in ICAR-CIRG, hundreds of youths and farmers are undergoing national training on commercial goat farming and are interested in taking up goat rearing as an enterprise. The present project is taken up to find how best we can improve the returns from goat farming by incorporating subsidiary activities of rearing poultry, treat ment/utilization of waste generated from goat/poultry through the vermi-compost technique and azolla cultivation which in turn could improve the fertility of the land and high-protein azolla as means to reduce the input requirement in feeding poultry.

Components of IFS model

1. 20 female Barbari goats + 2 Males and its followers
2. 250 chabro chicks
3. One acre of land for cultivation of fodder and grains
4. Vermi compost units
5. Azolla units



Goat component: A total of female non pregnant Barbari goats brought from Barbari Farm Unit to newly developed Integrated farming system unit on 1st October 2020 and were bred. Presently all the females were pregnant (on basis of Non Return Rate)

Poultry Unit: A total of 250 CHABRO six week old chicks are bought from Department of Poultry Science, College of veterinary science, DUVASU, Mathura and reared in IFS Unit. The male birds were sold for meet purpose after completion of twelve weeks of age on phased manner. The female birds are retained for egg production which will start by end of February 2021.

Returns from Sale of birds for meat purpose: Market preference for desi chicks is that birds should be in 1.5 to 2.0 kg body weight range. Hence birds should be sold between 12 to 16 weeks of age when FCR ranges from 2.92 to 3.53 and if farmer sells 1000 chabro birds, net gain ranges from Rs. 1.29 lakhs to 1.37 lakhs per year.

Age in weeks	Body weight per bird (kg)	FCR (feed consumed (kg) per kg of body weight gain)	Feed cost per bird	Sale price of one bird (Institute rate)	Net Profit per bird @ RS. 160/- per kg live weight (Institute rate)
12	1.593	2.925	125.03	254.93	129.91
15	1.948	3.413	178.28	311.62	133.34
16	2.103	3.535	199.47	336.53	137.06

Fodder and grain component

Development of On-Farm Fodder Production Technology in Kharif Season for 20 goats and its followers in peri-urban area through IFS approach

The present study was conducted with the objective of Identifying best combination of leguminous and non-leguminous crops, distribution of area under different crop components for maximizing the productivity. The On-Farm feed and fodder production from one acre of land was standardized by developing the following five concept/methodology for fodder and grain production –

1. Fodder Maize + Cowpea intercropping system
2. Fodder Sorghum + Cowpea intercropping system
3. Fodder Pearl millet + Cluster bean intercropping system
4. Maize grain production using the concept of Fertilizer Applying Timings and Fertilizer Doses
5. Developing the concept of fencing the boundary area of field using Hybrid Napier grass for lean period fodder supply.

The details of the treatments for developing each concept was given below:

Fodder Maize + Cowpea intercropping system	Sorghum + Cowpea intercropping system	Pearl millet + Cluster bean intercropping system	Maize grain production for substituting cereal component of concentrate feed

Treatments	Treatments	Treatments	Treatments
Sole Maize	Sole Sorghum	Sole Pearl millet	Fertilizer applying timings
Sole Cowpea	Sole Cowpea	Sole Cluster bean	Fertilizer Doses
Maize + Cowpea (1:1)	Sorghum + Cowpea (1:1)	P. millet + C. bean (1:1)	**Fencing of area with hybrid Napier for lean period**
Maize + Cowpea (2:1)	Sorghum + Cowpea (2:1)	P. millet + C. bean (2:1)	
Maize + Cowpea (1:2)	Sorghum + Cowpea (1:2)	P. millet + C. bean (1:2)	
Maize + Cowpea (2:2)	Sorghum + Cowpea (2:2)	P. millet + C. bean (2:2)	
Maize + Cowpea (3:1)	Sorghum + Cowpea (3:1)	P. millet + C. bean (3:1)	
Maize + Cowpea (1:3)	Sorghum + Cowpea (1:3)	P. millet + C. bean (1:3)	
Maize + Cowpea (3:3)	Sorghum + Cowpea (3:3)	P. millet + C. bean (3:3)	

The results in terms of green fodder yield per unit area, Nutritive yield of different cereal-legume combinations, effect of different intercropping combinations on equivalent yield and economics were recorded to find the best combination

Best combination techniques of different cereals – legumes crops for sustaining goat fodder requirements

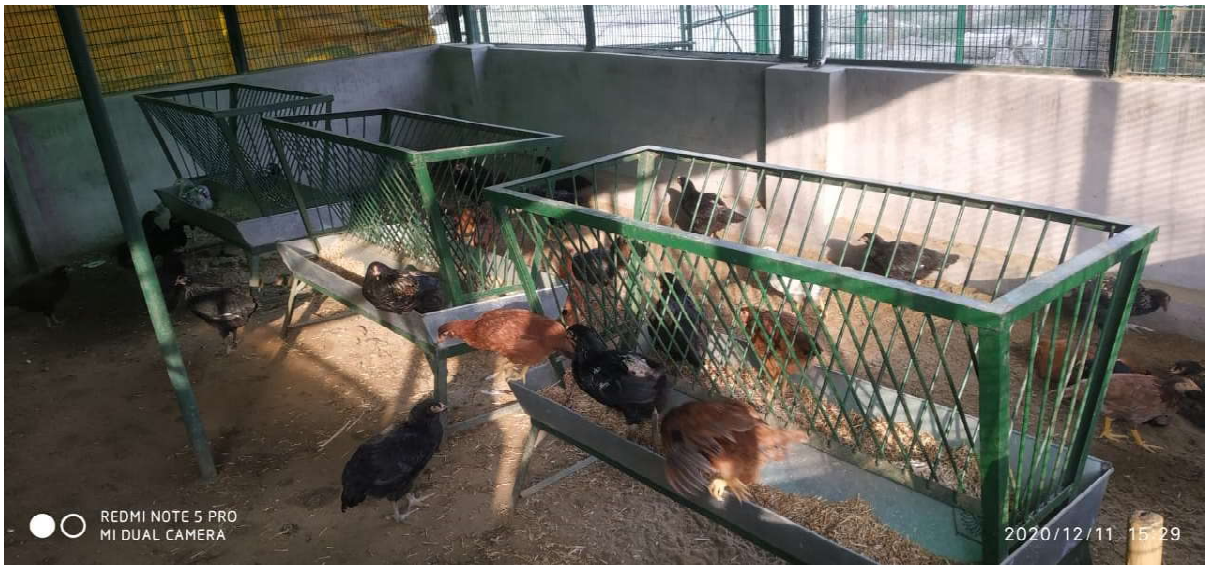
Based on the results, the following combination of crops along with cultivated area were standardized and this technology will provide required amount of green fodders as well as required amount of cereal grains needed to substitute the maize portion of commercial concentrate feed for six months during kharif period.

Best crop combination	Area cultivated	Non leguminous green produced (kg)	Leguminous green produced (kg)	Total green produced (kg)
Maize: cowpea (2:1)	605 sq. m	1770	520	2290
Sorghum: Cowpea (2:1)	605 sq. m	2170	500	2670
P. millet: C Bean (2:1)	605 sq. m	2200	440	2640
Grand total	1815 sq. m	6140	1460	7600
Green requirement for 20 adult goat + 30 followers (20 adult x 1 kg x 180 days) + (30 followers' x 0.70 kg x 180 days) = 3600 + 3780 = 7380 kg Hence self-sufficient.				
Hybrid Napier as green fencing of the area provides additional green fodder for lean period.				
Maize Grain Production	1700 sq. m	Total grain production: 765 kg		
Concentrate requirement: (20 adult x 300 g x 180 days) + (30 followers' x 200 g x 180 days) = 1080 + 1080 = 2160 kg Maize grain requirement in concentrate: 35 % parts (2160 kg x 0.35) = 756 kg. Hence self sufficient				

Azolla Units: An amount of 5 to 6 kg azolla (on wet basis) was harvested every weak which is used to supplement the poultry feed.

Vermi compost unit: a total of four quintals of vermi compost was produced during the period which will be utilized for fodder cultivation.

Poultry feeding on the left over goat feeds



Vermicompost Unit

Maize Production

Azolla Production

Maize Cow pea intercropping

Pearl millet Cluster been intercropping

(Institute Project: Development of goat based integrated farming system model)

(Dr. (s) R. Pourouchottamane, Mohd. Arif, B. Rai, K. Gururaj, Arvind Kumar, M.K. Singh and A.K. Dixit)

6.3.8 AICRP on Plastic Engineering Technology

6.3.8.1 Investigation 1- Development and evaluation of portable plastic enclosure for improved lamb rearing

Sandwiched portable plastic panel technology for protecting goat kids from cold stress

Extreme cold weather condition adversely affects the comfort, health and performance of goats especially new born kids. The normally recommended minimum temperature inside shed for kids up to 3 months' age should be above 10°C. Accordingly, the sheds in organized farms are given additional protection using gunny bags, thatch panels, heating system etc. However, small goat keepers who does not have permanent shelters or migratory farmers faces huge loss due to kid mortality and for them, this portable plastic enclosure using sandwiched plastic panels technology was developed. This technology uses the principle of thermal insulation properties in conserving the heat generated by the goat kids and heating up the enclosure to the desired temperature.

Growth trails conducted in sandwiched portable plastic panels

A total of 27 weaned kids (three months of age) were randomly alloted to three groups of 9 each in PPE sandwiched with foam, PPE sandwiched with wool and regular kidding shed during end of December 2019 to February 2020 after a 14 days' adaptation period. The daily microclimatic parameters, weekly body weight gain were recorded to assess the growth in kids during winter inside portable plastic enclosures. The fortnightly physiological responses, body surface temperature and blood sampling were done to assess the comfort of kids inside the enclosures.

Table 6: Growth trail of three months old weaned kids in different enclosure during winter

Parameters	Kidding Shed	Plastic Portable Enclosure (Foam)	Plastic Portable Enclosure (Wool)
Initial Body Weight	**12.02±0.93**	**12.40±1.10**	**12.19±0.69**
1st weak	12.39±1.24	12.57±1.19	12.39±0.72
2nd weak	12.58±1.21	12.87±1.21	12.78±0.76
3rd weak	13.46±1.31	13.38±1.27	13.23±0.75
4th weak	13.90±1.33	14.11±1.31	13.76±0.75
5th weak	14.23±1.34	14.55±1.89	14.20±0.76
6th weak	14.91±1.36	14.78±1.31	14.69±0.80
7th weak	15.93±1.46	15.86±1.36	15.89±0.82
Final Body weight	**16.27±1.49**	**16.13±1.31**	**16.27±0.83**
Average daily gain (g/day)	78.60±4.30	72.02±3.31	75.51±4.52

Growth of the kids housed in low cost PPE enclosures are as comparable as that of conventional kidding shed thereby inferring that these low cost detachable and portable enclosure can be used for housing the kids in winter season.Cardinal physiological signs like heart rate, respiratory rate and rectal temperature round the clock were recorded at morning 4.00 AM and it was observed that there are no significant differences in the animals housed housed in different enclosures and it can be concluded that kids can be housed in portable plastic enclosures without compromising its growth, physiological wellbeing and welfare of the kids. Similarly, there is no variations in different haematological values as well as hormone levels especially those involved in regulating metabolic activities like TSH, T 3 and T 4. The goat keepers who do not not have permanent shelters and who rear goats on migratory system shall have temporary enclosures made of cost effective winter protection panels for having optimum growth in kids.

Investigators: (Drs.) N. Ramachandran (upto 30/08/2020), R. Pourochattamane (01/09/2020 onwards), Arvind Kumar, S.P. Singh, B.Rai and Ravi Ranjan)

6.3.8.2 Investigation 2- Development of plastic flooring based two tier housing system

The space constraint is one of the major problem faced by the farmers/ entrepreneurs who wants to start goat farming in peri-urban and urban areas. There is a need to use space judiciously and in order to solve this problem, the present investigation was designed with objective of developing two tier housing system for goat housing.The plastic flooring based two tier housing system was designed, conceptual drawing made and fabrication carried out in the Experimental shed of APR Division. The growth trail along with hemaetological, biochemical and hormonal investigations will be initiated in 2021 to quantify the performance of animals in this newly developed two tier housing system.

(Externally funded project: AICRP on Plasticulture Engineering and Technology)

(Dr. (s) N. Ramachandran (up to 30/08/2020), R. Pourouchottamane (01/09/2020 onwards), Arvind Kumar, S.P. Singh and B. Rai)

6.3.9 Trancriptome Profiling of Spermatozoa for the Development of Biomarker for the Selection of Fertile Buck

- **Bucks classified as good, medium and poor based on microscopic and macroscopic characteristics** (Good having initial progressive motility, live %>70, Medium having initial progressive motility, live %>50 <70 and Poor having initial progressive motility, live % < 45**).**
- **Classification of Bucks based on fertility characteristics** (The bucks were classified as good medium and poor based on No of services/ conception, No of kids produced and Period of utilization**)**

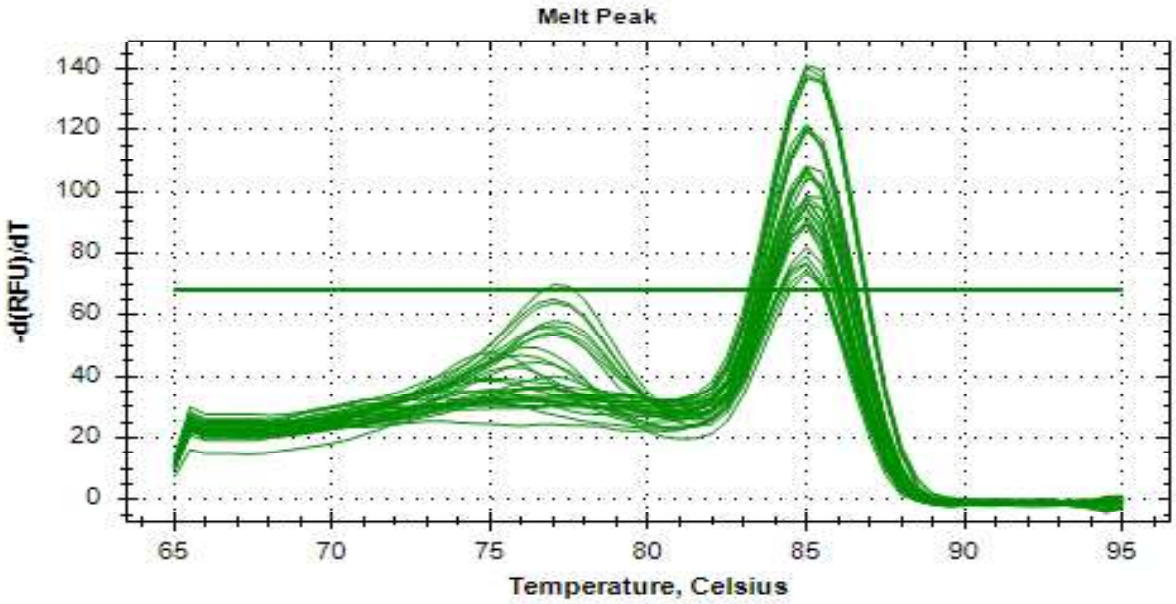


Fig. 14. The expression levels of SOX9 in good and poor fertility bucks

Table 7: Initial progressive motility, live percentage, abnormality and concentration (Mean±SE) of Jamunapari and Barbari bucks

SNo	Animal No	IPM(%)	Live(%)	Abnormality	Sperm density (million/ml)
1.	B1	86.67±1.67	91.33±1.33	1.67±0.33	3909±33.53
2.	B2	83.33±1.67	79.33±0.67	1.67±0.33	3741±30.57
3.	B3	41.67±1.67	40.33±0.33	9.67±0.33	3582.33±36.49
4.	B4	83.33±1.7	89.33±0.67	1.3±0.88	3508.33±46.04
5.	B5	71.67±1.67	71.33±0.33	1.33±0.33	3279±31.34
6.	B6	61.67±1.67	63.33±1.66	5.33±0.33	3957.33±55.26
7.	B7	63.33±1.67	63.33±1.66	1.67±0.33	3469.33±73.87
8.	B8	66.67±1.67	66.67±3.33	5.67±0.33	3284.67±42.78
9.	B9	86.67±1.7	85±2.88	1.67±0.33	3474±43.96
10.	B10	61.67±1.67	57.33±0.67	7.67±0.33	3081±35.07
11.	B11	76.67±1.67	73.33±3.33	1.67±0.33	3448.67±64.86
12.	B12	43.33±1.67	47.67±0.33	11.67±2.03	3278±33.95
13.	B13	63.33±1.67	58.33±1.66	5.33±0.67	3284.67±36.41
14.	J1	88.33±1.67	92±1.15	1.67±0.33	3855.33±47.96
15.	J2	83.33± 1.67	79±1.58	1.67±1.76	3708.67±33.33
16.	J3	43.33±1.67	45±1.00	8.67±0.88	3520±62.07
17.	J4	83.33±1.67	82.33±3.84	1.33±0.88	3455.67±65.55
18.	J5	78.33±1.67	78±1.53	2.67±0.33	3348.67±37.17
19.	J6	86.67±1.67	83.33±1.67	2.11±0.58	3943.33±61.98
20.	J7	80±2.89	78.33±1.67	1.67±0.33	3502±47.26
21.	J8	83.33±1.6	77±1.53	3.33±1.45	3291.33±36.29
22.	J9	81.67±1.67	79±2.08	2.0±0.58	3441.33±67.84
23.	J10	81.67±1.67	78.33±1.67	2.67±0.67	3342.67±42.83
24	J11	73.33±3.33	71.67±1.67	2±0.58	3385.67±89.37
25.	J12	60.33±0.33	58.33±1.67	5.67±0.88	3221±57.17
26.	J13	86.67±1.67	81.67±1.67	2.33±0.33	3780.67±33.35

Table 8: Classification of buck as good, medium and poor based on TOB, parity and fertility rate

Animal No	Type of birth	Parity	Does kidded	Does matted	Fertility rate	category
B1	Single	2	68	78	87	Good
B2	Twin	2	8	10	80	Good
B3	Single	1	19	31	61	Medium
B4	Single	1	23	37	62	Medium
B5	Single	4	12	22	55	medium
B6	Twin	2	16	29	55	Medium
B7	Twin	6	5	7	71	Good
B8	Single	3	6	15	40	Poor
B9	Twin	1	20	32	63	Medium
J1	Single	2	22	31	71	Good
J2	Twin	1	6	9	67	Medium
J3	Twin	6	21	25	84	Good
J3	Single	4	38	50	76	Good
J4	Single	1	67	79	85	Good
J5	Twin	3	7	9	78	Good
J6	Single	2	35	42	83	Good
J7	Single	4	43	58	74	Good
J9	Single	7	7	12	58	Medium
J10	Twin	9	62	68	91	Good

(DST WOS-A Scheme Project: Transcriptome profiling of spermatozoa for the development of biomarker for the selection of fertile buck)

(Dr. (s) Sonia Saraswat and S.D. Kharche)

6.4 NUTRITIONAL INTERVENTIONS FOR IMPROVED GOAT PRODUCTION

6.4.1 Network Program on Veterinary Type Culture

Rumen liquor and fecal sample collected from goats which were maintained under intensive feeding system with normal straw diet supplemented with milk whey protein and semi intensive system in village, allowed for grazing during day time respectively. Rumen bacteria were cultivated & isolated on anaerobic non defined medium. Isolation and cultivation process was done under anaerobic chamber and roll tubes.

Pure cultures of different isolates of rumen bacteria were subjected for extraction of DNA. This DNA was used for amplification of 16S rRNA gene using relevant primers (F-S*-univ-530a-S- 16 and R- S*-univ-1392-a-A-15) and amplified products were subjected for sequencing of desired genes. Characterization of rumen bacteria was done on the basis of gene sequence using NCBI data base.

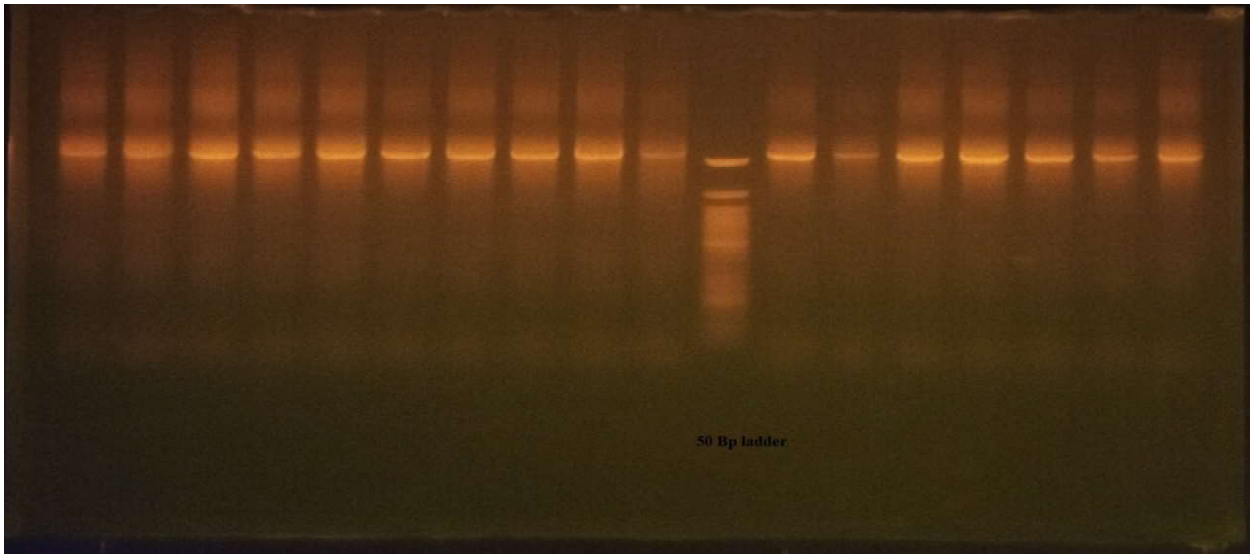


Fig 1. PCR product of 17 bacterial culture with 50 Bp DNA ladder

Seventeen isolates of rumen bacteria, isolated from goats, were identified and characterized on the basis of 16S rRNA gene amplification and sequencing of the amplified product. All cultures were screened for carboxymethylcellulase and avicelase activities in the supernatant of three days old culture (Table 2). Based on the potential of these cultures in terms of fiber degrading enzyme activities, nine efficient bacterial cultures were submitted to coordinated unit at NIANP Bangalore for accession number (Table 1).

Table 1: Rumen bacteria isolated from the goats

S.No	Bacteria name	Culture ID	Isolate no
1	*Clostridium sartagoforme* strain CBA7517	RV9	RV9 (20-21)
2	*Clostridium sartagoforme* strain XN-T4	RV10	RV10 (20-21)
3	*Clostridium sartagoforme* CBA7517	RV11	RV11(20-21)
4	Clostridium cochlearium DSN5	RV12	RV12 (20-21)
5	*Clostridium sartagoforme* CBA7517	RV13	RV13 (20-21)
6	*Clostridium sartagoforme* CBA7517	RV14	RV14 (20-21)
7	*Clostridium cochlearium* NCTC13027	RV15	RV15 (20-21)
8	*Clostridium sartagoforme* CBA7517	WB6	WPB6 (20-21)
9	*Clostridium sartagoforme* JCM 1413	WB9	WPB9 (20-21)

Table 2: Enzyme activity of isolated bacterial cultures

S.No	Bacteria name	Isolate no	CMC (µmolglu/min/ml)	Avicelase (µmolglu/min/ml)
1	*Clostridium sartagoforme* strain CBA7517	RV9 (20-21)	1.02792	0.40692
2	*Clostridium sartagoforme* strain XN-T4	RV10 (20-21)	4.20516	2.77541
3	*Clostridium sartagoforme* CBA7517	RV11(20-21)	2.65987	1.07847
4	Clostridium cochlearium DSN5	RV12 (20-21)	2.34215	0.19029
5	*Clostridium sartagoforme* CBA7517	RV13 (20-21)	1.51895	5.66381
6	*Clostridium sartagoforme* CBA7517	RV14 (20-21)	2.64543	1.69948
7	*Clostridium cochlearium* NCTC13027	RV15 (20-21)	2.41436	5.42551
8	*Clostridium sartagoforme* CBA7517	WPB6 (20-21)	2.21217	2.35659
9	*Clostridium sartagoforme* JCM 1413	WPB9 (20-21)	1.05681	3.12201

These selected nine cultures were used for the major biochemical test (Table 3) for further characterization and its behaviour under different biochemical components. The API A20 strips were used for biochemical tests manufactured by Biomerieux, USA. This strip contains ready to use 21 biochemical test cupules which can produced color on reaction with the culture either negative or positive. Likewise nine cultures were subjected to nine strips for the biochemical reactions. Fig 2 & 3 shows two different cultures on the strips clearly indicating the negative and positive result can be correlated with the results.

Table 3: Biochemical test result of bacterial culture isolated from goat using API 20A KIT

Test/Cul	WPB6	WPB9	RV9	RV10	RV11	RV12	RV13	RV14	RV15
Indole	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Urea	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Glucose	+ve	+ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve
Mannitol	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Lactose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Saccharose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Maltose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Salicin	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Xylose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Arabinose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Gelatin	+ve	+ve	-ve	-ve	-ve	-ve	-ve	+ve	+ve

Esculin	-ve	+ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve
Glycerol	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Cellobiose	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Mannose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Melezitose	-ve	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve
Raffinose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Sorbitol	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Rhamnose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Trehalose	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Catalase	-ve	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve

Fig 2. API 20A strip for positive results

Fig 3. API 20A strip for negative results

(Externally funded project: Network Program on Veterinary Type Culture (Rumen Microbes)
(Dr. (s) Ravindra Kumar (From 1st Nov, 2020) U.B. Chaudhary (up to 31st Oct, 2020)

6.4.2 Development of Economical Pellet Feed Using Unconventional Protein Source for Goats

Lactation cum feeding trial was conducted on eighteen female Barbari goats (Age approx. 3-5 years and mean body weight 36.35 ±1.33 kg) for sixty days and effect on milk production constituents, blood metabolites and reproductive hormones. Animals were divided into three groups (Gr I, Gr II and Gr III) of six each as per completely randomized design. Three different type of concentrate pellet was formulated. Type I pellet was control, containing linseed cake as protein source while in type II and type III 50 and 100% of linseed cake was replaced with CSC, economical cake with good bypass protein respectively. All these pellets were made iso nitrogenous. Animals of Gr I was fed with type I concentrate pellet while Gr II and Gr III was fed with type II and type III pellet respectively. No difference in milk parameters was recorded. Blood sample was collected into a K_2 EDTA vacutainer tubes (BD,

Franklin lakes, USA) from all the experimental animals in the morning (before feeding) by jugular vein puncture. Centrifugation was performed at 2000 X g for 10 min and plasma was separated and stored at -20ÚC for further estimation of hormones and other metabolites assays. The concentration of plasma metabolites was estimated using commercial kits as per their protocol. The concentration of hormones like Progesterone & Estradiol (Calbiotech, USA) and FSH & LH (DRG, Germany) was calculated by performing competitive ELISA by following the manufacturer's protocol. The optical density was measured at 450nm by 800 TS microplate reader, BIOTECK, USA. The concentration of different blood metabolites and reproductive hormones in different group of goats is presented in table 4. There was no significant (P>0.05) effect of cotton seed cake feeding on plasma metabolites and reproductive hormones in lactating goats.

Table 4: Blood metabolites and reproductive hormone concentration in different group of lactating does

Attributes	Gr I	Gr II	Gr III	Significance
Glucose (mg/dL)	77.19±4.68	80.65±4.18	86.22±3.74	0.343
Total protein (g/dL)	7.90±0.22	8.32±0.28	7.73±0.16	0.212
Albumin (g/dL)	4.01±0.29	4.36±0.21	3.59±0.42	0.276
Urea (mg/dL)	42.67±1.63	41.04±2.06	36.63±1.19	0.063
DPPH (% inhibition)	13.89±1.07	16.63±1.24	14.33±3.28	0.628
AST(IU/L)	68.28±6.22	75.74±3.91	65.38±5.78	0.402
ALT(IU/L)	32.07±2.02	26.26±1.36	30.45±2.54	0.155
Reproductive hormones				
FSH(IU/L)	1.04±0.18	0.92±0.21	0.97±0.05	0.880
Luteinizing hormone(IU/L)	10.19±0.97	9.58±0.55	9.92±0.31	0.791
Progesterone (ng/ml)	1.73±1.09	1.28±0.44	1.32±0.70	0.898
Estradiol (pg/ml)	118±26.64	130.11±26.36	119.80±22.81	0.937

(Institute Project: Development of economical pellet feed using unconventional protein source for goats)

(Dr. (s) Ravindra Kumar, U.B. Chaudhary, Arvind Kumar, Nitika Sharma, A.K. Dixit and Chetna Gangwar)

6.4.3 Development and Evaluation of Potato Silage (*Solanum tuberosum*) in the Ration of Goat

Bulk quantity of Potato (Solanum tuberosum) +Paddy (Oryza sativa) straw+ DCP silage and maize (Zea mays) silage was prepared in the plastic silage bags by anaerobic fermentation for 60 days. Feeding cum growth trial was conducted in male Jhakhrana goat on potato-paddy straw. Twelve Jhakhrana goats (3-4months age, avg BW 8.77 kg) were divided into Gr I and Gr II of six each as per completely randomised design. Animals were fed with concentrate pellet and silage. Gr I was fed with maize silage while Gr II was fed with Potato-paddy straw silage. The duration of experimental feeding was ninety days. Body weight was recorded fortnightly. Initial body weight (kg) of Gr I and Gr II was 8.72, 8.83 respectively which changes to 12.90, 12.16 after 90 days of experimental feeding. The corresponding total body weight gain (kg) was 4.18 for Gr I and 3.33 for Gr II respectively. The average daily gain (ADG) was 46.48 g in Gr I and 37.03 g in Gr II. Fortnightly body weight changes in depicted in Fig 4. Total dry matter intake was also similar (P>0.05) in both the groups.

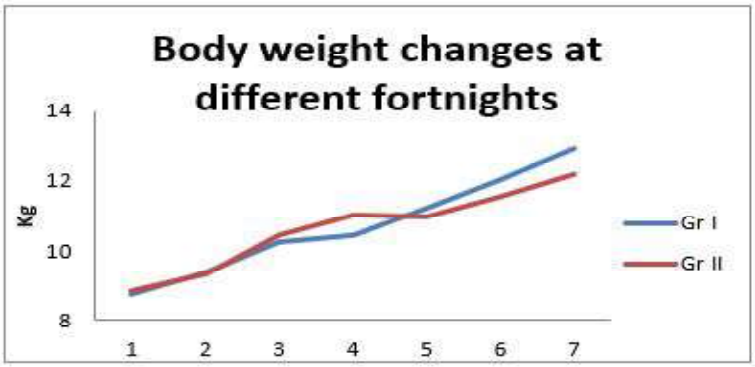


Fig. 4. Body weight changes at different fortnights

(Pilot project: Development and evaluation of potato silage (*Solanum tuberosum*) in the ration of goat)

(Dr. Ravindra Kumar)

6.4.4 Cultivation and Evaluation of Moringa as Goat Feed

Moringa dry biomass based complete feed was prepared using the mixture of 70% dry moringa biomass and 30% concentrate (Ground barley 97%, Min. Mix ,2.0%and slat,1.0%) sprinkled with water (5%). The mixture was fed in an electrical operated feed pelleted machine and the pellets of 8-10 mm width were prepared and stored for feeding of experimental animals.

Two separate experiments were conducted on growing Muzaffaranagari lambs and growing female Barbari goats to evaluate the effect of moringa based complete feed as ration for sheep and goats as per detail given below:

Effect of feeding moringa based complete feed on productivity of sheep

Thirty Muzaffaranagari lams at 4 months of age were divided in to control (10 in Numbers) and treatment (20 in Numbers) groups. During whole experimental period, data in terms of DM intake (daily) and body weight gain (Fortnightly) were recorded. Blood samples were collected from these animals for estimation of blood parameters, antioxidant property, blood glucose, protein and other biochemical parameters.

Table 5: Detail of feed offered to Sheep

1	Animal	Muzaffaranagari sheep 20 – Treatment 10 - Control
2	Age	4 months (120 Days) at start of exp.
3	Feeding habits & ration	Intensive system of feeding **Ration** **Treatment** - Moringa biomass : Barley (70:30) Adlib CP-11 **Control** – Gram straw ad lib, concentrate –300- 700g/day per animal as per requirement and green fodder-300g/d/animal. CP- **11.40**
4	Experimental Period	244 Days (up to 12 months of age)

During whole experimental period, data in terms of DM intake (daily) and body weight gain (Fortnightly) were recorded. Blood samples were collected from these animals for estimation of blood parameters, antioxidant property, blood glucose, protein and other biochemical parameters.

Table 6: Body weight and growth rate of sheep at 12 months of age

Attributes	Control	Treatment
Initial Body wt. (kg)	22.1±0.58 [a]	19.3±0.44[b]
Final body wt. (kg)	39.73±1.57 [a]	44.72±1.21 [b]
Avg. Weight gain (kg)	17.62	25.42
Growth rate	73.43	105.92
Total intake (kg) /sheep in 244 days	427.64	330.45
Intake (kg)/day/animal	1.73	1.34
FCR	24.26	12.99

The body wt. gain and growth rate of experimented and control sheep are presented in table no 5. These values indicated that during 8 months of experimentation, the treatment sheep gained significantly higher (25.42 Kg) body wt. than control (17.62kg). Similarly the growth rate 105.92 g/day in treatment sheep was found higher than the control (73.42 g/day). The dry matter intake was found lower in treatment group than control. Feed conversion ratio (1:12.99) was also found better in treatment sheep than control (1:24.26). These findings indicates that moringa based complete feed was more productive than traditional ration.

The units of haematological parameters were within the normal range in treatment and control group and there was no variation between two groups with respect of different parameters except WBC.

Table 7: Biochemical parameters of experimental groups

S.No.	Attributes	Control	Treatment
1	AST	78.17±1.73 [a]	74.57±2.52 [a]
2	ALT	27.80±1.99 [a]	21.03±1.55 [b]
3	Total cholesterol	78.52±1.41 [a]	73.03±1.06 [b]
4	HDL	61.70±1.63 [a]	64.33±1.58 [a]
5	Triglycerides	40.19±1.13 [a]	31.85±1.60 [b]
6	DPPH	53.93±2.46 [a]	58.64±1.78 [a]
7	Glucose	72.16±2.73 [a]	68.72±2.41 [a]

The units of total cholesterol and triglycerides were found significantly lower in treatment group which confirms the earlier findings that moringa biomass have anti-cholesterol property (Table 7). Significantly higher units of DPPH in treatment animals indicate the antioxidant property of moringa biomass. The values of AST and ALT were found within the normal range which indicated the normal health of the experimental sheep.

Table 8: Carcass component of experimentaland control sheep

Parameters	Control	Treatment	P value
Slaughter wt.(kg)	37.50±0.99[a]	48.68±1.58[b]	0.000
Empty body wt.(kg)	29.83±1.17 [a]	36.86±1.20 [b]	0.002
Carcass wt.(kg)	15.59±0.59 [a]	20.13±0.67 [b]	0.001
Carcass yield (%)	41.53±0.89 [a]	41.35±0.50 [a]	0.864

Value with different superscript differ significantly

These result indicated significantly higher value of slaughter wt., empty body wt., and carcass yield in treatment animals than control group. These values confirm the values of body wt gain which were significantly higher in treatment animals.

Performance of poor growing female goats under moringa feeding

Fourteen poor growing female Barbari goats at the age of 9 months and carrying an average body wt. of only 10.41 kg were selected for the study with the view, if these animals can be recover their normal growth by feeding moringa based complete feed. Prior to initiation of the experiment, these goats were receiving traditional ration as per their requirement but not performing normally. These animals were maintained under management and fed moringa based complete feed containing 70% moringa dry biomass and 30% concentrated.Experiment was initiated

during winter season and lasted for 170 days. The detail of the experimental plan is mentioned under table.9. The observation in terms of body wt. gain, intake and reproductive parameters were recorded during the experimental period of 170 days.

The animal gained a body wt. 7.99kg @47.01 g/day during 170 days of study. It was observed that prior to initiation of the experiment animals were receiving traditional ration as per their requirement but they were not able to transform these nutrients in to body wt. gain and were found under negative growth rate. The feeding of moringa based complete feed brought to these animals to normal growth. The growth rate of 47.01g/day per animal under moringa based complete feeding on intake of 660g/day and feed conversion efficiency of 1:14.09 is quite economic in comparison of any traditional ration.

The values of blood and biochemical parameters were compared with the similar no. of animals (control) of same breed, sex and age from breeding flocks of institute maintained under semi intensive system of feeding management and receiving diet & nutrients as per their requirement. The values of haematological parameters were not varied from control except RBC which were found significantly higher in treatment animals. These findings indicate the normal health of the goats in both the groups.

Table 9: Biochemical parameters of experimental groups

S.No.	Attributes	Control	Treatment
1	AST	123.94±4.33	126.69±4.23
2	ALT	27.05±1.59	29.46±1.62
3	Total cholesterol	75.22±1.14 [a]	70.61±1.12 [b]
4	HDL	53.33±2.11 [a]	61.37±2.15 [b]
5	Triglycerides	92.51±1.47	91.55±1.92
6	DPPH	28.47±1.01	28.04±1.54
7	Glucose	61.79±2.46	64.43±2.82

Value with different superscript differ significantly (P< 0.05)

The values of AST, ALT, DPPH and glucose were within the normal range in both the groups, however significantly lower and higher units of total cholesterol and HDL further confirms the anti-cholesterol activity of moringa.

Based on the above findings it can be concluded that moringa is highly nutritious & economic fodder for livestock & can be grown economically under intensive system as other fodder crop in semiarid zone & moringa based complete feed is highly economic and productive if fed to the growing sheep.

(Institute project: Cultivation and evaluation of Moringa as goat feed)

(Dr. (s) U.B. Chaudhary, Arvind Kumar, M.K. Singh, A.K. Dixit, V. Rajkumar, Ashok Kumar and Mohd. Arif)

6.4.5 Standardization of Goat Milk Cheese Processing and Value Addition of its By-product

6.4.5.1 Effect of skimmed goat milk level and added guar gum on the quality of reduced-fat paneer

In this study processing of reduced-fat milk paneer was attempted through replacement of full-fat milk with skimmed milk and added guar gum. A total of five product i.e., FF (paneer from full-fat goat milk without GG), FFSMG11 (paneer from full-fat and skimmed goat milk in 1:1 ratio + GG), FFSMG13 (paneer from full fat and skimmed goat milk in 1:3 ratio + GG), SMG (Skimmed goat milk + GG) and SM (Skimmed goat milk without GG), were prepared using full-fat goat milk, skimmed goat milk and their combinations with or without guar gum (0.075%). These products were evaluated for physico-chemical, colour, and textural properties. Physicochemical properties of reduced-fat paneer showed significant differences among different treatments. There were no significant differences in the pH value of paneer samples from various treatments. The product yield for reduced-fat paneer was significantly lower compared to the full-fat counterpart. Increasing the level of skimmed goat milk resulted in a decrease in product yield. The addition of guar gum in reduced-fat goat milk paneer led to an improvement in the product yield as evident from the significant difference in the product yield value for the skimmed goat milk paneer with and without guar gum. Significantly higher moisture, protein and ash contents, while lower fat content in the reduced-fat paneer was observed as the proportion of skimmed goat milk was increased. There was a significant increase in the moisture content of the product due to added guar gum.

The colour properties of goat milk paneer were significantly affected by skimmed goat milk level and added guar gum. An increase in the amount of skimmed goat milk decreased the hunter colour lightness value, and treatments FFSMG13, SMG and SM had a significantly lower lightness than full-fat paneer. On the other hand, guar gum addition in reduced-fat goat milk paneer significantly improved the lightness value. The redness value of treatments FF, FFSMG11 and FFSMG13 were significantly higher than treatments SMG and SM. The redness value of skimmed goat milk paneer was significantly improved on account of guar gum addition. Hunter colour yellowness values of the paneer among the treatments did not differ significantly.An increase in the hardness values of reduced-fat paneer was observed as the proportion of skimmed goat milk increased, and values for the treatments FFSMS13, SMG and SM were significantly higher in comparison to treatments FF and FFSMG11. Guar gum in the reduced-fat goat milk paneer resulted in a significant decrease in the hardness value. The adhesiveness value of treatment FFSMG11 was significantly lower than the treatments SMG and SM. No significant differences were observed in the adhesiveness values of treatments FF, FFSMG11 and FFSMG13. Similarly, there were no significant differences in the adhesiveness values of treatments FF, FFSMG13, SMG and SM. The springiness and cohesiveness values among treatments did not differ significantly. The increase in the skimmed goat milk proportion in the treatments increased their gumminess and chewiness values. Treatments SMG and SM had significantly higher gumminess value compared to FF and FFSMG11 paneer. The Gumminess value of FFSMG11 was statistically similar to treatments FF as well as FFSMG13. Chewiness also followed the trend of gumminess, and treatments FFSMG13, SMG and SM had significantly higher values than FF and FFSMG11 paneer. The incorporation of guar gum in the reduced-fat goat milk paneer significantly decreased the gumminess and chewiness values.

There were significant differences in the organoleptic attributes of full-fat and reduced-fat goat milk paneer prepared with or without guar gum. The treatments prepared with a combination of full-fat and skimmed goat milk along with guar gum received higher sensory scores as compared to goat milk paneer without guar gum. Treatments FFSMG11 and FFSMG13 had significantly higher flavour, juiciness and overall acceptability scores compared to FF paneer. Treatment SMG had significantly higher flavour and overall acceptability scores than full-fat paneer,

however, body and texture score was significantly lower. All the sensorial attributes of the treatment SM were significantly lower as compared to the other treatments.The reduced-fat goat milk paneer added with guar gum (except body and texture score for treatment SMG) received sensory scores higher than very good (>7) with better overall acceptability than the full-fat counterpart.

Table 10: Effect of skimmed goat milk level and added guar gum on physicochemical properties of reduced-fat paneer

Parameter	FF	FFSMG11	FFSMG13	SMG	SM
pH	5.85±0.03	5.87±0.02	5.86±0.02	5.87±0.03	5.85±0.02
Product yield (%)	$15.73±0.39^{a}$	$13.92±0.30^{b}$	$13.52±0.22^{b}$	$12.05±0.40^{c}$	$10.95±0.20^{d}$
Moisture (%)	$52.17±0.24^{e}$	$57.73±0.27^{d}$	$62.37±0.40^{c}$	$65.25±0.15^{b}$	$59.68±0.32^{a}$
Fat (%)	$24.13±0.12^{a}$	$14.89±0.46^{b}$	$7.12±0.13^{c}$	$1.82±0.04^{d}$	$1.67±0.18^{d}$
Protein (%)	$17.19±0.42^{e}$	$19.13±0.38^{d}$	$22.22±0.21^{c}$	$24.59±0.32^{b}$	$30.07±0.32^{a}$
Ash (%)	$1.62±0.01^{e}$	$1.70±0.01^{d}$	$2.01±0.02^{c}$	$2.11±0.01^{b}$	$2.29±0.01^{a}$

Mean ±SE bearing different superscripts in the same row differ significantly; FFP: Paneer from full-fat goat milk; FFSMG11: Paneer from a mixture of full-fat goat milk and skim milk (1:1), and guar gum; FFSMG13: Paneer from a mixture of full-fat goat milk and skim milk (1:3), and guar gum; SMG: Paneer from goat skim milk and guar gum; SM: Paneer from skimmed goat milk

Table 11: Effects of skim milk proportions and guar gum on the sensory characteristics of reduced-fat paneer

Parameter	FF	FFSMG11	FFSMG13	SMG	SM
Appearance	$7.13±0.07^{ab}$	$7.38±0.07^{a}$	$7.32±0.05^{a}$	$7.23±0.12^{a}$	$6.90±0.12^{b}$
Flavour	$6.94±0.11^{c}$	$7.22±0.05^{b}$	$7.56±0.04^{a}$	$7.35±0.04^{b}$	$6.64±0.10^{d}$
Body & Texture	$7.12±0.07^{a}$	$7.39±0.06^{a}$	$7.38±0.04^{a}$	$6.68±0.19^{b}$	$6.19±0.13^{c}$
Juiciness	$7.25±0.05^{b}$	$7.42±0.07^{a}$	$7.53±0.04^{a}$	$7.27±0.04^{b}$	$6.44±0.06^{c}$
Overall acceptability	$7.17±0.04^{c}$	$7.38±0.06^{b}$	$7.54±0.04^{a}$	$7.33±0.04^{b}$	$6.36±0.04^{d}$

Mean ±SE bearing different superscripts in the same row differ significantly; FFP: Paneer from full-fat goat milk; FFSMG11: Paneer from a mixture of full-fat goat milk and skim milk (1:1), and guar gum; FFSMG13: Paneer from a mixture of full-fat goat milk and skim milk (1:3), and guar gum; SMG: Paneer from goat skim milk and guar gum; SM: Paneer from skimmed goat milk

Fig. 5. Full-fat and reduced-fat goat milk paneer

6.4.5.2 Effect of acidulants on the physiochemical, colour and textural qualities of goat milk mozzarella cheese

In this study, we evaluated the physicochemical, colour, texture profile analysis and rheological properties of goat milk mozzarella cheese prepared using acetic acid (CAA), citric acid (CCA) and lactic acid (CLA) for direct acidification. The product yield for treatment CAA was significantly higher than CLA. However, differences in the yield of treatments CAA and CCA as well as CCL and CLA were non-significant. The cheese prepared by acidification with citric acid had significantly higher meltability as compared to other treatments. The moisture content of the treatment CLA was significantly lower than CAA. However, the moisture content in treatments CAA and CCA, as well as CCA and CLA, did not differ significantly. There were no significant differences in the fat and protein contents among the three products. Treatment CCA had significantly lower ash content than treatment CAA and CLA.The Hunter colour lightness value for cheese prepared using citric acid was significantly lower as compared to cheese from other treatments. However, redness and yellowness values among treatments remained statistically similar. Texture profile analysis of goat milk mozzarella cheese with three acidulants revealed that the hardness value for the treatment CCA was significantly lower than the other two treatments. The adhesiveness value for the treatment CLA was significantly higher as compared to treatments CAA and CCA. Springiness value for treatment CCA was significantly lower than CLA.

However, springiness values for treatments CAA and CCA as well as CAA and CLA did not differ significantly. All the treatments had statistically similar cohesiveness values. The gumminess and chewiness values for cheese prepared using citric acid were significantly lower when compared with cheese prepared using acetic acid and lactic acid. Strain amplitude sweep of cheese samples indicated that the limit of linear viscoelastic (LVE) was about 1%. There was a gradual decrease in the storage modulus (G') for all the treatments once strain increased beyond 1% level. Frequency sweeps on mozzarella cheeses demonstrate how viscous and elastic properties change with the rate of application of strain or with a timescale of deformation. G' and G'' increased with increasing frequency for all treatments. Loss modulus (G'') was always higher than storage modulus (G') throughout the range of frequency (0.1-10 Hz) which indicates that cheese samples behaved like a viscoelastic liquid with moderate frequency dependence. Both the moduli on cheese were affected by the type of goat milk used for cheese preparation, and their values were in the following order: CCA<CLA<CAA. Viscoelastic properties during the melting of goat milk mozzarella cheeses were studied by conducting temperature sweeps in the range of 20-90 °C. Both G' and G'' for cheese samples were decreased with temperature rise throughout the test temperature range.

Table 12: Effect of acidulants on physicochemical properties of goat milk mozzarella cheese

Parameters	CAA	CCA	CLA
Yield (%)	10.63 ± 0.18^{a}	10.43 ± 0.06^{ab}	10.17 ± 0.11^{b}
Meltability (cm)	19.50 ± 0.18^{b}	21.75 ± 0.34^{a}	18.60 ± 0.63^{b}
Moisture (%)	47.14 ± 0.11^{a}	46.57 ± 0.23^{ab}	46.20 ± 0.29^{b}
Fat (%)	24.08±0.58	23.92±0.24	23.83±0.40
Protein (%)	22.22±0.58	23.10±0.42	22.88±0.15
Ash (%)	1.77 ± 0.01^{a}	1.56 ± 0.01^{b}	1.86 ± 0.06^{a}

Mean ±SE bearing different superscripts in the same row differ significantly; CAA: Mozzarella cheese with acetic acid; CCA: Mozzarella cheese with citric acid; CLA: Mozzarella cheese with lactic acid.

Table 13: Effect of acidulants on texture profile analysis of goat milk mozzarella cheese

Parameters	CAA	CCA	CLA
Hardness (N/cm^2)	32.75 ± 0.97^{a}	20.54 ± 0.92^{b}	31.03 ± 1.99^{a}
Adhesive (Ns)	-0.52 ± 0.18^{b}	-0.40 ± 0.08^{b}	-0.09 ± 0.01^{a}
Springiness (cm)	0.90 ± 0.01^{ab}	0.85 ± 0.05^{b}	0.94 ± 0.01^{a}
Cohesiveness (ratio)	0.52±0.03	0.54±0.01	0.53±0.02
Gumminess (N/cm^2)	17.22 ± 1.32^{a}	11.08 ± 0.47^{b}	16.32 ± 0.90^{a}
Chewiness (N/cm)	15.59 ± 1.36^{a}	9.49 ± 0.74^{b}	15.41 ± 0.89^{a}

Mean ±SE bearing different superscripts in the same row differ significantly; CAA: Mozzarella cheese with acetic acid; CCA: Mozzarella cheese with citric acid; CLA: Mozzarella cheese with lactic acid

Fig. 6. Mozzarella cheese prepared with three acidulants

(Institute Project: Standardization of goat milk cheese processing and value addition of its by-product)

(Dr. (s) Arun Kumar Verma, V. Rajkumar and Dr. K. Gururaj)

6.4.6. Cost Economization of Forage Production for Goats through Agronomic Interventions

The experiments for cost economization of forage production through non-monetary inputs were carried out on fodder cowpea, pearl millet and sorghum during the *kharif* season of 2020. For maximizing the green fodder yield as well as nutritive value of green fodder with least investment on cultivation of these forage crops the following concepts and methodologies were developed.

6.4.6.1. Methodology/Management practices designed for fodder cowpea:

The following Methodology/Management practices were designed for reducing the cost of cultivation of fodder cowpea by increasing the yield of quality green fodder per unit area-

- *Date of sowing:* 2nd week of June, 4th week of June and 2nd week of July
- *Cutting Management*: Initial period of cutting 50, 60 and 70 days after sowing.

The results of the first year experiment revealed that maximum green and dry fodder yield of fodder cowpea was obtained with 2nd week of June sown crop followed by 4th week of June sown crop. In cutting management schedules fodder cowpea harvested at 70 DAS was recorded maximum green and dry fodder yield; however, fodder cowpea harvested at 60 DAS was also recorded at par value of green and dry fodder yield with fodder cowpea harvested at 70 DAS. The experiments further revealed that maximum values of crude protein yield and ether extract yield of fodder cowpea were recorded with 2nd week of June sown crop. However, 4th week of June sown fodder cowpea and 2nd week of June sown fodder cowpea recorded at par value of these nutritional parameters. In cutting management schedules fodder cowpea harvested at 70 DAS was recorded maximum crude protein yield and ether extract yield; however, fodder cowpea harvested at 60 DAS was also recorded at par value of crude protein yield and ether extract yield with fodder cowpea harvested at 70 DAS (Table 14).

Table 14: Effect of date of sowing and cutting management schedules on fodder yield and quality of cowpea

Treatments	Green Fodder Yield (t/ha)	Dry Fodder Yield (t/ha)	CP Yield (kg/ha)	EE Yield (kg/ha)
Date of sowing				
2nd week of June	30.11	5.06	823	113
4th week of June	27.38	4.70	758	101
2nd week of July	22.12	3.89	620	73
SEm±	0.83	0.16	38	4
CD (P= 0.05)	2.87	0.56	132	15
Cutting Management				
50 DAS	24.49	3.99	621	79
60 DAS	27.00	4.65	769	104
70 DAS	28.12	5.01	810	105
SEm±	0.71	0.16	32	4
CD (P= 0.05)	2.12	0.47	94	12

6.4.6.2. Methodology/Management practices designed for fodder pearl millet:

The following Methodology/Management practices were designed for reducing the cost of cultivation of fodder pearl millet by increasing the yield of quality green fodder per unit area-

- *Date of sowing:* 2nd week of June, 4th week of June and 2nd week of July
- *Cutting Management*: Initial period of cutting 45, 55 and 65 days after sowing

In fodder pearl millet maximum green and dry fodder yield was also recorded with 2nd week of June sown crop followed by 4th week of June sown crop. In cutting management schedule maximum green and dry fodder yield of fodder pearl millet was obtained with cutting schedule at 45 DAS (Fig. 7).

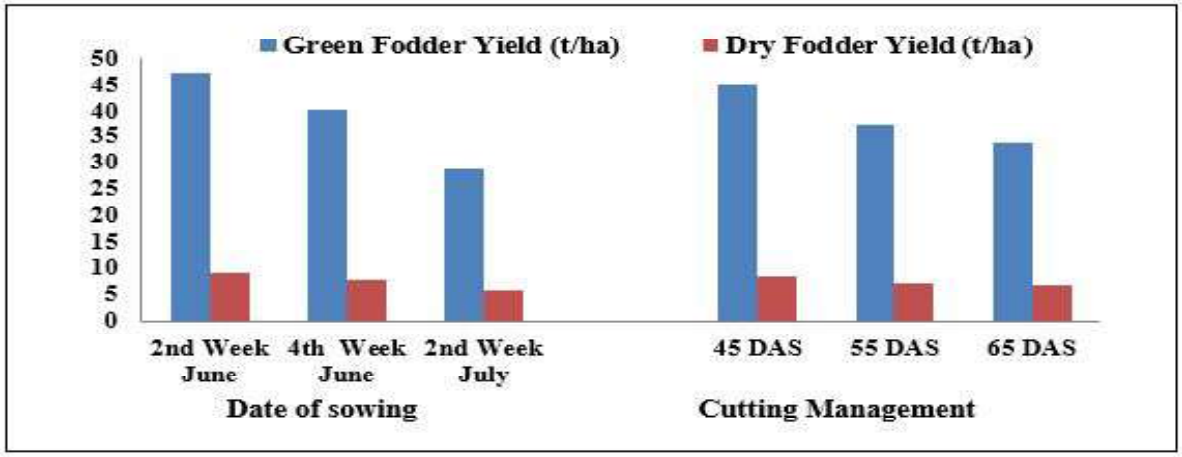


Fig. 7. Effect of date of sowing and cutting management schedules on green and dry fodder yield of pearl millet

Further, maximum values of crude protein yield and ether extract yield of fodder pearl millet were recorded with 2nd week of June sown crop and in cutting management schedules fodder pearl millet harvested at 45 DAS was recorded maximum values of all these nutritional parameters (Fig. 8).

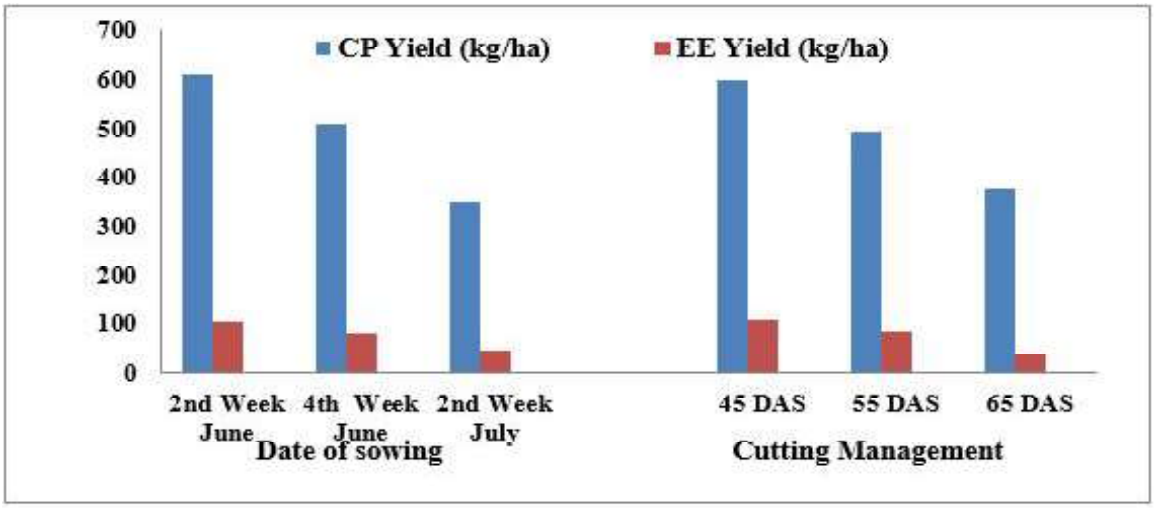


Fig. 8. Effect of date of sowing and cutting management schedules on nutritional yield of pearl millet

6.4.6.3. Methodology/Management practices designed for fodder sorghum:

The following Methodology/Management practices were designed for reducing the cost of cultivation of fodder sorghum by increasing the yield of quality green fodder per unit area-

- *Date of sowing:* 2nd week of June, 4th week of June and 2nd week of July
- *Cutting Management*: Initial period of cutting 55, 65 and 75 days after sowing

In fodder sorghum maximum green and dry fodder yield was also recorded with 2nd week of June sown crop followed by 4th week of June sown crop. In cutting management schedule maximum green and dry fodder yield of fodder sorghum was obtained with cutting schedule at 55 DAS (Fig. 9).

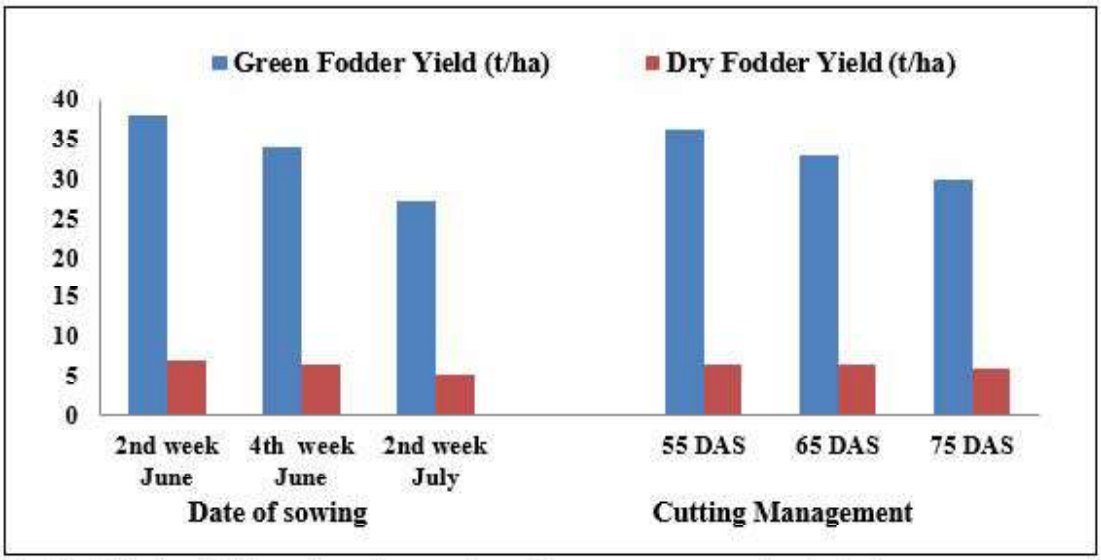


Fig. 9. Effect of date of sowing and cutting management schedules on green and dry fodder yield of sorghum

(Institute Project: Cost Economization of Forage Production for Goats through Agronomic Interventions in the region of Yamuna Ravines of Uttar Pradesh)

(Dr. (s) Mohd. Arif, Arvind Kumar and Ravindra Kumar)

6.4.7. Design and Development of Polyhouse Type Solar Dryer

Availability of fodder throughout the year is very much essential for commercial goat rearing on economic basis. Excess green fodder available during monsoon and other growing seasons need to be dried and preserved as hay for lean period feeding. Solar radiation is the environment friendly cheap source of energy available naturally that can be utilized for fodder drying. Polyhouse type dryers are already in use for drying different farm produce. The use of a solar tunnel drier led to a considerable reduction in drying time and better quality dried products in terms of colour and nutrition in comparison to products dried under the sun. Mechanical drying is costly in terms of both capital and operational cost. Therefore, a project on design and development of polyhouse solar dryer has been initiated to dry excess green fodder efficiently and economically for future use and make goat rearing more profitable.The polyhouse dryer has been designed technically for shape, size and orientation. The proposed dryer is natural convection Polyhouse Solar Dryer (PSD) designed for drying green fodder and

grasses from about 75-90% initial MC to 10-14% final MC(db) . It will have rectangular base with curved top surface walk-in type polyhouse dryer for drying green fodder in batches. The cladding material should be UV stabilized and safe against damage caused by monkey and other wild animals prevailing in this region. There will be two layers of drying platform and solar powered and sensor controlled exhaust fan for moving out the moist air.

Recording the initial and final moisture content, RH, drying time, colour change of fodder, fodder layer thickness will be carried out at scheduled time. Exhaust fan will be operated at different level of temperature and RH and drying performance will be recorded. Analysis of nutritional properties of the fodder will be carried out and compared with conventional direct sun dried fodder.

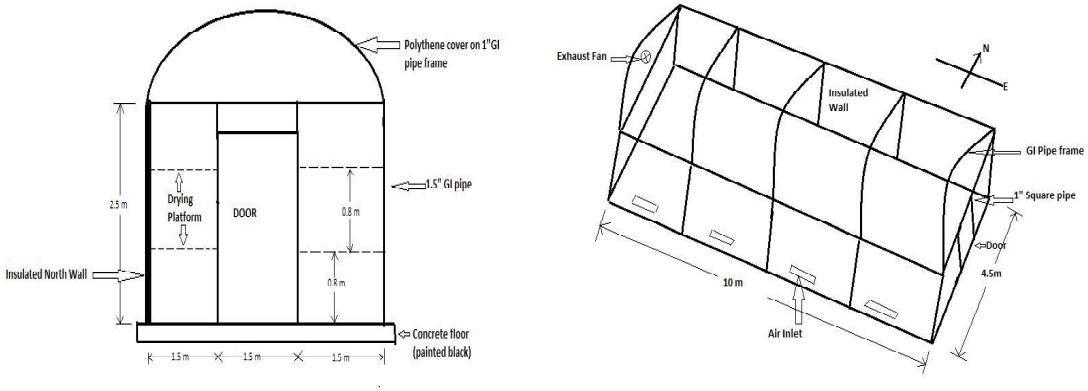


Fig. 10 Front view and orientation of Polyhouse Solar Dryer

(Institute Project: Design and development of polyhouse type solar dryer for fodder and other produce of goat farm)

(Dr. (s) Arvind Kumar, Mohd. Arif, R. Pourouchottamane and Ravindra Kumar)

6.4.8. Performance Evaluation of Developed Prototype of Power Weeder in Fodder Crops at ICAR-IGFRI, Jhansi

Power weeder developed at CIRG was tested for weeding in *moringa* fodder crop grown at the institute farm. On the recommendation of IRC it was sent to ICAR-IGFRI, Jhansi for third party evaluation. It is seen that weeds in forage crops reduce the quality, quantity and palatability of forage crops. Weed management in forage production and grass pastures involves integration of several practices. Mechanical weed control is an effective method to check the weeds as it helps to reduce drudgery involved in manual weeding, kills the weeds and also keeps the soil surface loose ensuring soil aeration and water intake capacity. Weeds when left unattended pose bigger challenge in case of forage crop grown for seed production. Weeds are also profuse seed producers and at the time of harvesting, weed seeds gets mixed with the crop seeds. Therefore, weeding is an important operation that become of prime importance when the crop is being taken for seed production in case of fodder to meet high quality of seed standards. Several types of weeders are in use that include power weeders for wet lands, rotary blade weeders for horticultural crops, walk behind tyne type weeders. In forage crops, row to row distance varies from 30 to 100 cm in different crops and there is the requirement to adjust the width of weeding element along with ease of movement of machine in standing rows of crop. The rotary blade power weeder developed at CIRG, Makhdoom was tested in sorghum fodder crop cultivated at ICAR- IGFRI, Jhansi and the findings are as follows.

An engine operated, walk behind, adjustable wheel base, rotary blade soil working type power weeder was used for weeding in the sorghum fodder crop. It was operated by 1.5 kW capacity petrol engine. In Sorghum crop, weeding was done 20 DAS when the crop has germinated and reached 8-10 cm height. Row to row distance was 50

Table 15: Performance of rotary power weeder in sorghum fodder crop

Sl. No.	Attribute	Value
1.	Row to row distance of crop, mm	500
2.	Distance kept between wheels (Outer), mm in sorghum field	400
3.	Average depth of soil cutting, mm	18-32
4.	No. of pegs in between the rotors	1
5.	Width of cut, mm	300-360
6.	Effective width covered, mm	430-440
7.	Forward speed, m/s	1.1
8.	Field capacity, ha/h	0.15
9.	Fuel consumption, l/h	0.6
10.	Weeding index, per cent, 20 DAH/ DAS	74
11.	Plant damage, per cent, 20 DAH/DAS	2.6
12.	Comments	Triangular wedge blade doesn't penetrate well in the ground in dry soil. It was replaced by peg type blade that followed rotors.
13.	Utility	Good weeder for up to 2 ha field possessing farmers

Fig. 11 Testing of CIRG Power weeder in sorghum fodder cultivated fields of ICAR-IGFRI, Jhansi

(Institute Project: Design and development of power weeder for improving economic fodder production for goats)

(Dr. (s) Arvind Kumar, U.B. Chaudhary, M.K. Singh, Mohd. Arif and A.K. Dixit)

6.5 DISEASE SURVEILLANCE, MOLECULAR ETIO-PATHOLOGY AND DIAGNOSTICS DEVELOPMENT

6.5.1. Pathological and Epidemiological Investigation of Goat Diseases

This Institute service research project envisages the systemic studies on the prevalence and monitoring of goat diseases by collection of biosamples, definitive diagnosis of disease/infection and compilation, maintenance and communication of precise information on these diseases. Major objectives are: i) Surveillance and investigation of goat diseases, and ii) Study on causes and pattern of mortality in goats.

ACHIEVEMENTS

Serosurveillance and disease investigation studies

- A total of 1635 biosamples were collected and tested for various disease conditions.
- Three disease outbreaks in field goats were attended for disease investigation and diagnosis and treatment advised.
- 46.66% (763/1635) samples were found to be positive for various diseases, including 61.53% (104/169) sera and 32.35% (121/374) faecal samples and 53.84% (21/39) milk.samples positive for JD, and average of 12.85% (27/210) (sera-SAT & Swabs-qRT-PCR combined) positive for brucellosis, and 6.16% (21/341) positive for coenuroses.
- A total of 463 faecal samples were subjected for parasitological examination, of which 85.31% were positive for coccidia, 15.76% for strongyles, and 3.88% for Moniezia species.
- Of 179 carcasses (153 goats & 26 sheep) necropsied, the causes of death diagnosed were enteritis, pneumonia, anaemia/weakness, septicaemia, autolysis, enterotoxaemia, trauma/internal injury, haemonchosis, coenurosis, hepatitis and others (including asphyxia, mastitis, hypothermia and electrocution).
- Among health activities, 4767 deworming, 4231 dipping, 783 coccidiostat, 17333 vaccination, and 5571 treatments were performed in the institute farm animals. Of morbid animals, the highest animals were affected with diarrhoea (67.35%) followed by fever/anorexia (10.27%), wound/abscess (8.58%), lameness (6.71%), Udder impetigo (1.13%), Mange/dermatitis (0.79%), Udder oedema (0.77%), bloat/tympany (0.74%), pneumonia (0.57%), and others.

Study on causes and pattern of motrtality in goats

A total of 179 animal carcasses (153 goats & 26 sheep) were necropsied during the period from 1st January, 2020 to 31st December, 2020. Of these, 69 (38.54%) were from Jamunapari Unit, 38 (21.22%) from Barbari Unit, 26 (14.52%) from Sheep Unit, 18 (10.05%) from AH Div. Expl. Shed, 15 (8.37%) from ANPT Div. Expl. Shed, 9 (4.78%) from APR Div Expl. Shed, and 4 (2.23%) were from Jakhrana Unit.

The causes of deaths diagnosed were enteritis (n=48, 26.81%), pneumonia (n=36, 20.11%), autolysis (n=18, 10.05%), anaemia/weakness (n=16, 8.93%), Accidental death/bloat (n=12, 6.70%), toxaemia (n=11, 6.14%), septicaemia (n=10, 5.58%), haemonchosis (n=8, 4.46%), coenurosis (n=7, 3.91%), and others (n=13, 7.26%) including Paralysis, Acidosis, Hepatitis, Shock, Asphyxia, Ruminal impaction etc.

Among the necropsied, while comparing age-wise data, highest mortality was recorded in Adults (n=81, 45.25%), followed by 0-3 months (n=43, 24.02%), 3-6 months (n=28, 15.64%), and 6-12 months (n=27, 15.08%) age group. Sex-wise, overall mortality was higher in females (n=104, 58.10%) than males (n=75, 41.89%).The highest animals were affected with diarrhoea (59.20%) followed by wound(10.13%),fever(9.85%), lameness (9.58%), Udder ecthyma (2.57%), weakness (2.00%), pneumonia (1.41%), contagious ecthyma (0.73%), Mange/dermatitis (0.69%), and others (Fig. 1).

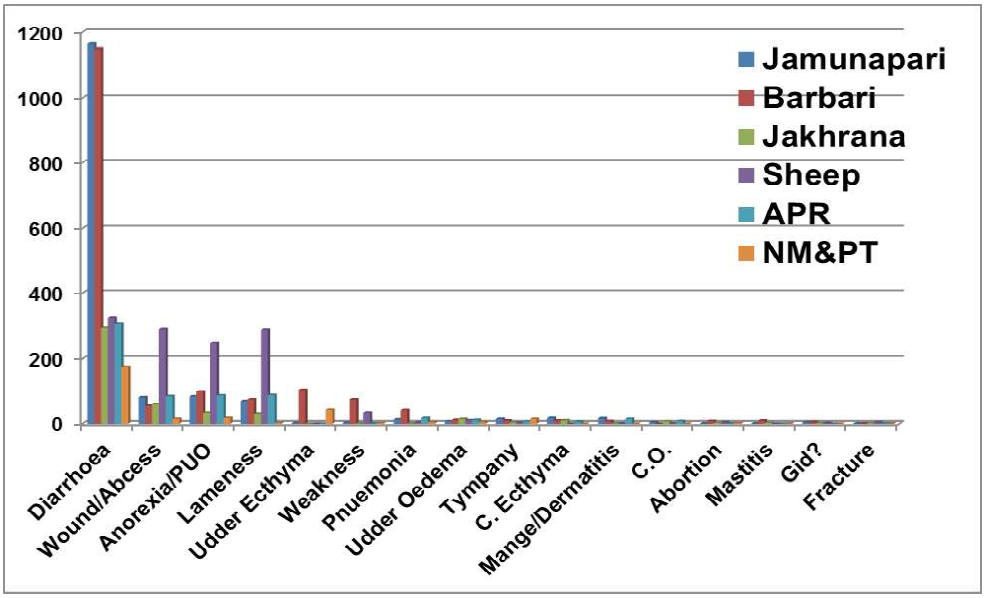


Fig.1. Depicting disease morbidity pattern in animals of various livestock Units/ Experimental sheds.

Brucella screening of small ruminants by various lab diagnostic tests

For serological based tests like Serum agglutination test (SAT) and iELISA, *Brucella melitensis* based antigens are used as per the OIE (2012) prescribed protocols. For brucellosis, three states (Rajasthan, UP and Pondicherry) were offered the services during the reporting period using SAT, ELISA and OMP31 TaqMan® probe qRT PCR. A total of 613 sera samples were subjected to SAT, of which 12.23% were positive for brucellosis, and 341 sera were subjected to iELISA which showed a positivity of 19.64%. Genital swabs were screened for shedding of Brucella using OMP31 TaqMan® probe qRT PCR and of the 160 samples tested, 32.05% were positive for Brucella. The results are presented in Table 1.

Table1: Brucellosis screening by SAT, iELISA and OMP31 TaqMan® probe real time PCR from various livestock units and field cases

S. No.	Livestock Unit/ Field place	SAT		Indirect ELISA		OMP31 TaqMan® probe qRT PCR	
		Sample tested (n)	Positives (%)	Sample tested (n)	Positives (%)	Sample tested (n)	Positives (%)
1.	**CIRG livestock units**	227	16.29% (37/227)	-	-	28	14.28% (4/28)
2.	**Bhadawari Farm, Etawah, U.P.** (goats)	10	30% (3/10)	-	-	-	-
3.	**Jatai, Firozabad**	5	40% (2/5)	-	-	-	-
4.	**Chandauli, Mugalsaray**	3	33.33% (1/3)	-	-	-	-
5.	**Gadaya, Village, Mathura**	7	00.00% (0/0)	-	-	-	-

6.	**Tantura, Mathura**	3	00.00% (0/3)	-	-	-	-
7.	**Mai Gurjar, Bhartpur**	3	00.00% (0/3)	-	-	-	-
8	**Churmura, Mathura**	20	10.00% (2/20)	22	45.45% (10/22)	-	-
9.	**Vrindavan, Salempur**	16	12.5% (2/16)	-	-	12	00.00% (0/12)
10.	**Bikaner**	199	-	199	15.57% (31/199)	-	-
11.	**Pondicherry**	120	23.33% (28/120)	120	21.66% (26/120)	120	40.00% (48/120)
	Total	**613**	**12.23% (75/613)**	**341**	**19.64% (67/341)**	**160**	**32.05% (52/160)**

Mycobacterium avium subspecies *paratuberculosis* (MAP) screening in Johnes disease (JD) suspected animals

A total of 275 fecal samples, 20 milk samples and 81 sera samples were screened for MAP from Johne's disease suspected animals across three states viz., Uttar Pradesh, Odisha and Madhya Pradesh using fecal microscopy, fecal IS900 TaqMan® probe real time PCR, milk smear microscopy, milk IS900 TaqMan® probe real time PCR, milk Indirect ELISA, serum iELISA. Indirect detection tests like iELISA revealed higher occurrence of MAP in serum (62.96%), followed by PCR (fecal- 36.58% and milk- 13.33%), and microscopy (fecal- 22.18% and milk- 0.00%) and. Complete results for MAP from JD suspected animals are presented in Table 2.

Table 2: Screening of MAP in JD suspected animals using various diagnostic tests

S.No	Sample source	Positives *n* (%)								
		Fecal			Milk				Serum	
		Total	Micro-scopy	PCR	Total	Microscopy		PCR	iELISA	Total	iELISA
						Direct	Pellet				
1	CIRG livestock units	206	26.69% (48/206)	36.58 % (15/41)	-	-	-	-	-	41	92.68% (38/41)
2	Gadaya, Village Mathura, U.P.	07	28.57% (2/7)	-	-	-	-	-	-	5	100% (5/5)
3	Bhadawari Farm, Etawah, U.P.	30	10% (3/30)	6.66% ()2/30	-	-	-	-	-	30	26.66% (8/30)
4	Vrindavan, Mathura, U.P.	10	40% (4/10)	-							

5	Salempur, Mathura, U.P.	15	13.33% (2/15)	-	15	0.0% (0/15)	-	13.33 % (2/15)	-	-	-
6	Jatai, Firozabad	7	28.57% (2/7)	-	5	0.0% (0/5)	-	-	-	5	0.0% (0/5)
	Total Faecal	**(n=275)**	22.18% (61/275)	36.58% (15/41)	**Total Milk (n=20)**	0.0% (0/20)	-	13.33 % (2/15)	-	**Total Sera (n=81)**	62.96% (51/81)

SCREENING OF COENUROSIS (GID) USING IN-HOUSE DEVELOPED TM16P-iELISA

Quick and early detection of coenurosis was done using TM16p-iELISA, which was developed using a 16 amino acid peptide from oncosphere antigen of *Taenia multiceps* at Animal health division. A total of 34 sera samples were subjected to TM16p-iELISA, of which 50.00% were positive for coenurosis. A detailed summary of the results are given in following table.

Table 3: Coenurosis screening by TM16p-iELISA from various livestock units

S.No.	Livestock unit/herd	TM16p-iELISA	
		Sample tested (n)	Positive (%)
1.	Jamunapari	23	47.82% (11/23)
2.	Jakhrana	1	00.00% (0/1)
3.	Barbari	9	55.55% (5/9)
4.	Sheep	1	100% (1/1)
5.	AP&R	-	-
6.	ANM&PT	-	-
	Field samples		
7.	Mathura	-	-
8.	Bhadawari	-	-
	Total	**34**	**50.00% (17/34)**

Parasitological tests of faecal samples

A total of 751 faecal samples were subjected for parasitological examination, of which 78.96% were positive for coccidia, 25.16% for strongyles, and 5.05% for Moniezia species. The details of results are presented in Table 4.

Table 4: Results of parasitological tests of biosamples

Livestock Unit	Total samples examined	Parasitic incidence		
		Coccidia % (n)	Stongyles % (n)	Moniezia % (n)
Barbari	257	75.87 (195)	19.45 (50)	5.05 (13)
Jamunapari	205	89.75 (184)	57.56 (118)	9.75 (20)
Jakhrana	58	93.10 (54)	12.06 (3)	3.44 (2)
ANPT	135	65.88 (88)	0.00 (0)	0.00 (0)
Sheep	96	75.00 (72)	18.75 (18)	3.13 (3)
Grand Total	**751**	**78.96 (593)**	**25.16 (189)**	**5.05 (38)**

Isolation and identification of microorganisms from biosamples

From 11 biosamples, collected from 11 animals (10 goats, 1 sheep), (including feces, liver, lung tissues, mastitis milk, pus, nasal secretions etc.) subjected to microbiological isolation studies, organisms such as *Klebsiella pneumoniae* & *Enterococcus* (from diarrhoeal feces), *Staphylococcus aureus and Streptococcus* (from milk), *Pasteurella multocida* & *Staphylococcus* (from pneumonic lungs) were isolated.

(Institute Project: Pathological and epidemiological investigation of goat diseases)

(Dr. (s) R.V.S. Pawaiya, D.K. Sharma, Ashok Kumar, Anu Rahal, K. Gururaj, A.K. Mishra, Nitika Sharma and V.K. Chaturvedi)

6.5.2. ICAR-Outreach Project on Zoonotic diseases (OPZD)

6.5.2.1 Epidemiological study of Johne's disease in goats using cluster sampling method in Puducherry (U.T.) and Bikaner, Rajasthan

Epidemiology of Johne's disease in goats through cluster sampling in Puducherry

During the study a total of 100 goats from 10 different clusters of Puducherry region were screened for Johne's disease by different diagnostic tests such as faecal smear ZN microscopy, IS900 PCR and indigenous ELISA. Out of 100 samples screened, 34 goats from six clusters were found to positive for JD by microscopy / and PCR. Also, seventy seven goats from all the ten clusters were found seropositive for JD by indigenous ELISA. The cluster wise occurrences of MAP in Puducherry region by different diagnostic tests were presented.Of the total samples screened from 10 clusters of Puducherry, 19 (19%), 34 (34%) and 77 (77%) goats were found positive for MAP by faecal ZN microscopy, IS900 PCR and indigenous ELISA respectively. by faecal ZN microscopy, IS900 PCR and indigenous ELISA respectively.. Out of 32 milk samples screened, 5 (15.35%) samples were found positive by indigenous ELISA and all the samples were found negative by both microscopy and IS900 PCR. The occurrence of JD was highest among the 2-3 years age group (35.29%, 18 out of 51 goats screened) followed by the goats in the age group of 1-2 years (33.33%, 7 out of 21 goats screened) and the goats more than 3 years of age group (32.1%, 9 out of 28 goats screened) with no statistical significance. A higher occurrence of JD was recorded in indigenous breeds of goats (35.48%, 11 out of 31 goats screened) compared to Non-descript goats (33.33%, 23 out of 69 goats screened). Similarly, occurrence of MAP was more in male

goats (46.15%, 6 out of 13 male goats) compared to female goats (32.18%, 28 out of 87 female goats).

6.5.2.1.1 Diagnostic sensibility based on the combinations of diagnostic tests used for MAP detection in Puducherry

For MAP, 3 different test combinations were analyzed for the better indication of diagnostic test. The diagnostic test combinations in the present study are

1. Faecal ZN microscopy Versus IS*900* PCR
2. Serum indigenous ELISA Versus IS*900* PCR
3. Serum indigenous ELISA Versus Faecal ZN microscopy

Out of the three test combinations, the sensitivity and specificity of faecal microscopy to IS*900* PCR was found to be 44.12% and 93.94%. The sensitivity and specificity of serum indigenous ELISA to IS900 PCR was found to be 61.76% and 15.15%. The sensitivity and specificity of serum indigenous ELISA to ZN microscopy was found to be 73.72% and 22.22%. By all the three test combinations, the sensitivity of indigenous ELISA - Faecal ZN microscopy combination was highest followed by indigenous ELISA – IS*900* PCR combination. Whereas, the specificity was highest in faecal microscopy – IS*900* PCR combination.

Table 5: Comparison of various diagnostic test combinations and their statistical analysis by Kappa agreement and Mc-Nemar test

S. No	Test combinations	Kappa value	Strength of agreement	Confidence interval (95%)	Mc-Nemar P value	Status
1	Faecal ZN microscopy - Faecal PCR	0.426	Moderate	0.241 to 0.611	0.0035	Very significantly different
2	Serum indigenous ELISA - Faecal PCR	-0.177	No	-0.326 to -0.027	<0.0001	Extreme significantly different
3	Faecal ZN microscopy - Serum indigenous ELISA	-0.019	No	-0.120 to 0.082	<0.0001	Extreme significantly different
4	Milk PCR – milk indigenous ELISA	0.00	Slight	0.00 to 0.00	0.0736	Not quite significantly different

6.5.2.1.1 Risk factors for Johne's disease in Puducherry

Univariate and multivariate regression analysis were performed to analyse the risk factors associated with the development of JD including the following parameters: general body condition, behaviour of animal, colour of the mucous membrane, nature of faeces, sex of the animal, lactational status, floor type, type of farming, system of rearing and herd size in the farm.

a) Risk factor for Johne's disease in Goats based on Univariate regression analysis

Univariate regression analysis of risk factors such as general body condition, behaviour of animal, colour of the mucous membrane, nature of faeces, sex of the animal, lactational status, floor type, type of farming, system of rearing and herd size in the farm**.**

All the parameters studied did not influence any significant risk for Johne's disease, except for the herd size. An increase in the size of the herd size will increase the chance of occurrence of JD by 1.023 times (P=0.005**) which is statistically significant based on the chi-squared test.

b) Risk factor for Johne's disease in Goats based on Multivariate regression analysis

Binomial logistic regression analysis was employed to predict the probability that an animal would be positive for JD. The predictor variables were general body condition, behaviour of the animal, sex of the animal, nature of faeces, floor type, system of rearing, type of farming and herd size (Table 6). The logistic regression model was statistically significant, $\div^2(9) = 25.5$, $P<0.002$. The model explained 31% (Nagelkerke R^2) of the variance in occurrence of JD.

The model was able to correctly classify 92 % of the positive cases and 38 % of the negative cases with an overall success rate of 74%. The type of farming ($P<0.01$**) and system of rearing ($P<0.01$**) added significantly to the prediction. Goats in mixed farming are 5.796 times more likely to develop JD ($P<0.007$) compared to only goat farming. Animals under intensive system of rearing are 10.25 times more likely to develop JD ($P<0.006$) compared to semi intensive system of rearing.

Table 6: Multivariate regression analysis of risk factors for JD

Risk factors	B	Sig.	Exp (B)	95% C.I. for EXP(B)	
				Lower	Upper
General body condition (1)	0.182	0.747	1.199	0.398	3.614
Behaviour of animal (1)	0.081	0.902	1.084	0.297	3.965
Nature of faeces (1)	0.653	0.321	1.920	0.529	6.967
Sex (1)	0.088	0.913	1.091	0.227	5.244
Floor type		0.260			
Floor type (1)	0.768	0.363	2.155	0.412	11.264
Floor type (2)	1.391	0.101	4.018	0.762	21.181
Type of farming (1)	1.757	0.007	5.796	1.625	20.666
System of rearing (1)	2.327	0.006	10.249	1.943	54.069
Herd size	0.013	0.279	1.013	0.989	1.038
Constant	-3.765	0.007	0.023		

Epidemiological study of Johne's disease in small ruminants using cluster sampling method in Bikaner district of Rajasthan

Similarly a study was conducted in Bikaner district of Rajasthan to study the overall occurrence of Johne's disease in Goats and Sheep. Cluster based sampling method was used from 12 villages of Bikaner district for assessing the sero-prevalence of J.D. in small ruminants (Table 7).

Village	Goats	Sheep
Napasar	8	13
Palana	9	10
Kolayat	3	12
Bhinasar	19	17
Udairamsar	8	2
Raisar	15	7
Ridmalsar	13	5
Jaimalsar	5	0
Jhaju	5	9
Udasar	9	9
Sagar	7	10
Gajner	0	4
Total	101	98

a) Sero-prevalence of Johne's disease in Goats of Bikaner district of Rajasthan

Similarly another state viz., Rajasthan was targeted with serum sampling (Goat, n=101, Sheep n=99) in various villages of Bikaner district. Among the sampled subjected to IgG iELISA, 54.5% and 31.31 % sero-positivity was observed in goats and sheep respectively. Analysis of age related data of Johne's disease positive goats in (n = 55) Bikaner, Rajasthan indicates towards higher sero-prevalence (61.5 per cent) in goats >12 months followed by 53 per cent 6-12 months and among the positive goats, 36.63% were bucks and 17.82% were does. Analysis of age related data of Johne's disease positive sheep in (n = 31) Bikaner, Rajasthan indicates towards higher sero-prevalence in >12 months i.e. 40 per cent (20/50) followed by 24.24 per cent 6-12 months and among the positive sheep, 18.18% were Rams and 13.13% were ewes.

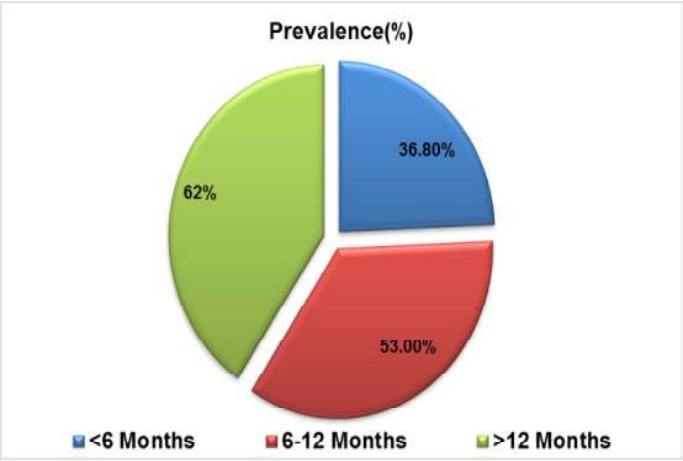


Fig. 2. Age wise sero-prevalence of Johne's disease in goats

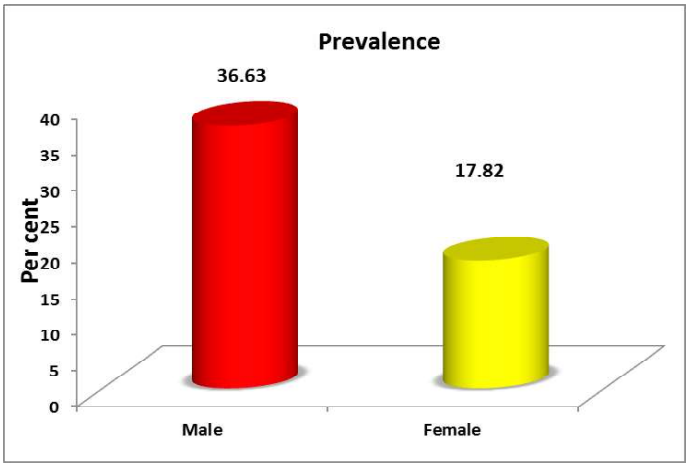


Fig. 3. Gender wise prevalence of Johne's disease in goats

Table 8: Age related sero-prevalence of Johne's disease in sheep

S.No.	Age (Months)	No of positive for Johne's disease in each group
1.	<6	18.75% (3/16)
2.	6-12	24.24% (8/33)
3.	>12	40% (20/50)

6.5.2.1 New diagnostic tools developed

i) Reverse transcription TaqMan® probe real time PCR for differentiation of active infection from passive shedding

Active and passive shedders are difficult to differentiate by microscopy. Active infection can be differentiated by detecting live MAP in the unknown samples using mRNA PCR targeting important genes of MAP. TaqMan® probe based reverse transcription real time PCR using Cy5 and HEX chemistries were targeted for IS900 and ModD genes of MAP respectively (Fig. 4). Known live and heat killed dead MAP cells were subjected to RNA extraction

and assayed for IS900 TaqMan® probe reverse transcription Real time PCR. Cqs of Dead cells were 35 and above compared to Cq of live cells which were between 19-26. Further standardization including Limit of detection, Heat inactivation duration, MAP spiked detection are being done. Two new primers and probes were designed targeting IS900 and ModD genes of MAP. The newly designed primers were compared with previously standardized primers using MAP positive RNA.

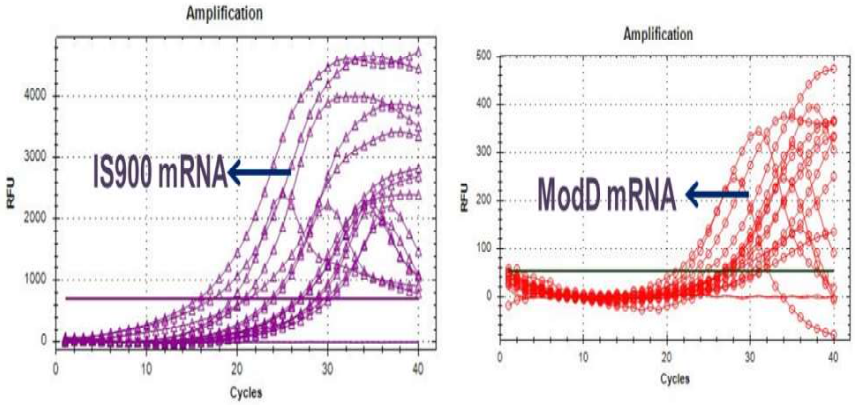


Fig. 4. TaqMan probe chemistry based real time mRNA PCR for IS900 (cy5), and ModD (Hex) genes of MAP

6.5.2.1 Development of herbal prototype for containing Brucella shedding

- Aqueous based herbal prototypes with a combination/individual herbal preparation were fed to does which showed Brucella positive (n=31) as per the screening test conducted above along with uninfected controls (n=5) and field quarantined Brucella infected controls (n=5).
- After the oral therapy, Brucella shedding was monitored for a further period of 45 days post treatment (dpt) using Limit of detection (LOD) based OMP31 TaqMan® probe realtime PCR by absolute quantification standard curve (fitted using known *Brucella melitensis* biovar 3 Ind1 strain).
- A significant reduction in shedding (*) was noticed in Brucella positive animals since 21 days post treatment with the Herbal Prototype
- In the field conditions, where no available mechanism is there for the goat keeper to control brucellosis, such herbal drug based package of practice could be a boon to the farmers in controlling Brucella abortions as well as containing the risk of zoonosis.

(ICAR-Outreach Project on Zoonotic diseases (OPZD): Zoonotic potential of Mycobacterium avium subspecies paratuberculosis, as the cause of Inflammatory Bowel Disease (Crohn's Disease) in human beings) (Dr. (s) K. Gururaj, A.K. Mishra and Dr. Anu Rahal)

6.5.3 All India Network Project on Neonatal Mortality in Farm animals

Epidemiology of Pneumonia in goat kids

A total of 30, 42, 38 numbers of goat kids of age group 0-1m, 1-3m and 3-6m were respectively screened for the respiratory illness based on the clinical symptoms like pyrexia, dullness, weakness, inanition, polypnoea etc. The season of sampling was during February- March 2021, where there was an increase in the day temperature up to 35°C while the night temperatures were less than 18°C. This transition in the weather has led to precipitation of respiratory illness in the flocks with rectal temperature ranging from 102-106°F in the goat kids.

The nasal swabs and throat lavages were collected and cultured for bacteriological studies. The bacterial species that has higher presence was *Staphylococcus* spp. in all the age groups with higher proportion of coagulase positives. *Pasteurella multocida* presence was higher compared to the *Mannhemia hemolytica* based on the screening tests by PCR. Among the affected, very less mortality was observed, with 0 (0%), 2 (4.76%) and 2(5.26%) kids succumbed in 0-1m, 1-3m and 3-6m old kids respectively.

Table 9: Etiological agents identified in different age group of goat kids with respiratory symptoms.

S.No.	Bacteriological agent	0-1m		1-3m		3-6m	
		Culture (n=30)	Direct swab PCR (n=30)	Culture (n=42)	Direct swab PCR (n=42)	Culture (n=38)	Direct swab PCR (n=38)
1.	*Staphylococcus* spp.	18 (60%)	23 (76.67%)	11 (26.19%)	16 (38.10%)	18 (47.37%)	22 (57.90%)
	Coagulase positive	3 (10.00%)	6 (20.00%)	2 (4.76%)	6 (14.29%)	4 (10.53%)	6 (15.79%)
	Coagulase negative	15 (50.00%)	17 (56.67%)	9 (21.43%)	10 (23.81%)	14 (36.84%)	16 (42.11%)
2.	*Pasteurella multocida*	3 (10%)	11 (36.67%)	2 (4.76%)	6 (14.29%)	2 (5.26%)	7 (18.42%)
3.	*Mannhemia hemolytica*	1 (3.33%)	2 (6.67%)	0 (0.00%)	3 (7.14%)	1 (2.63%)	5 (13.16%)
4.	*Streptococcus* spp	7 (36.67%)	14 (46.67%)	3 (7.14%)	12 (28.57%)	2 (5.26%)	7 (18.42%)
5.	*Mycoplasma* sp.	-	7 (23.33%)	-	15 (35.71%)	-	5 (13.16%)
6.	Diptheroids						
	Arcanobacter spp.	1 (3.33%)	1 (3.33%)	0 (0.00%)	1 (2.38%)	1 (2.63%)	1 (2.63%)
	Corynebacterium ovis	1 (3.33%)	3 (10%)	1 (2.38%)	3 (7.14%)	1 (2.63%)	3 (7.89%)

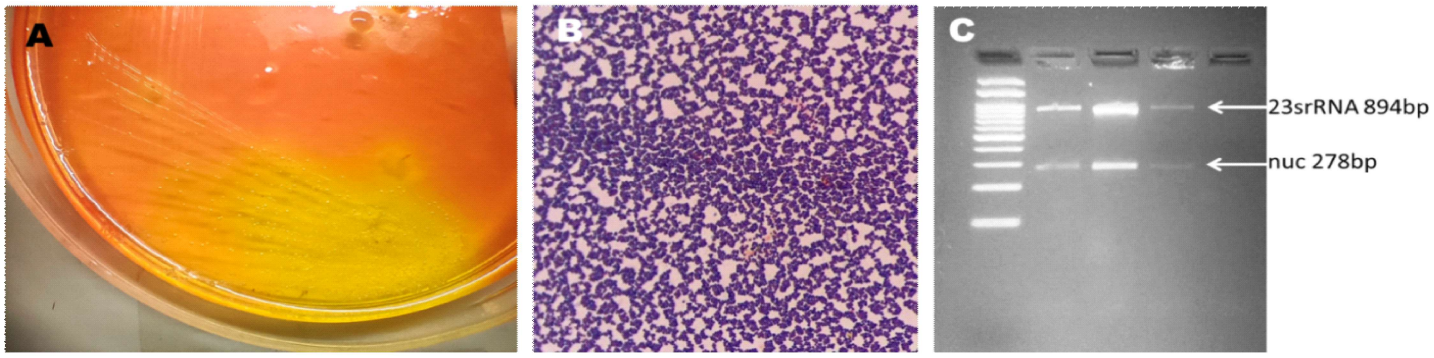


Fig. 5. *Staphylococcus* spp screening from nasal swabs: **A**. Mannitol salt agar showing yellow colonies surrounded by yellow zones suggestive of mannitol fermentation by Staphylococcus aureus, **B**. Gram stained smear showing gram positive cocci arranged in bunches, **C.** EtBr-TAE agarose gel showing 894bp 23SrRNA and 278bp (nuc) Thermonuclease gene specific for *Staphylococcus aureus*

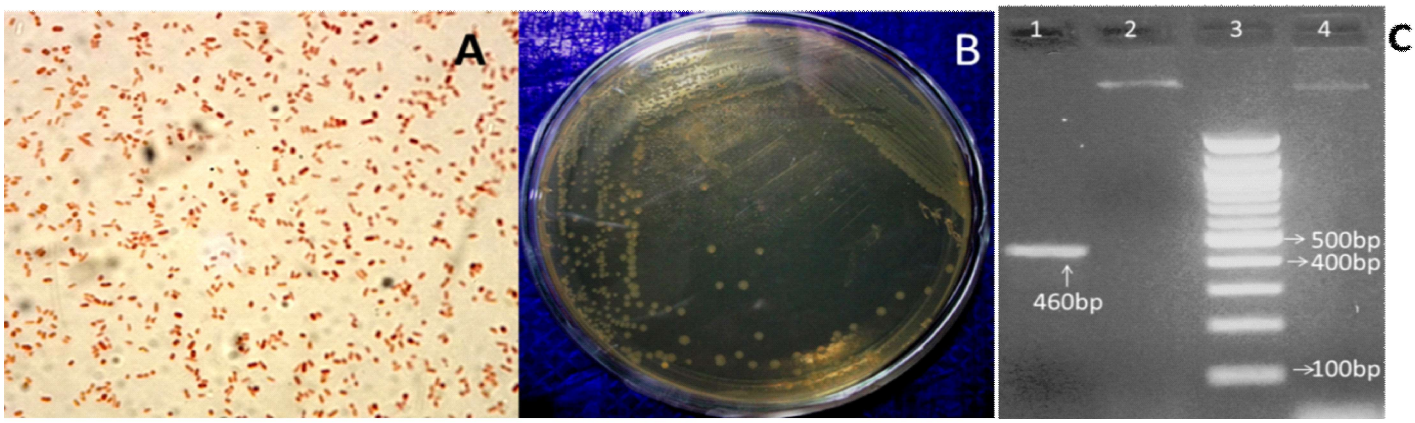


Fig. 6. *Pasteurella multocida* screening from throat lavage of goat kids **A**. Grams smear of *P.multocida* culture showing gram negative pleiomorphic bipolar rods. **B**. Small rounded raised colonies on BHIA, C – EtBr-TAE agarose gel showing 460bp *kmt1* gene positive for *P. multocida*.

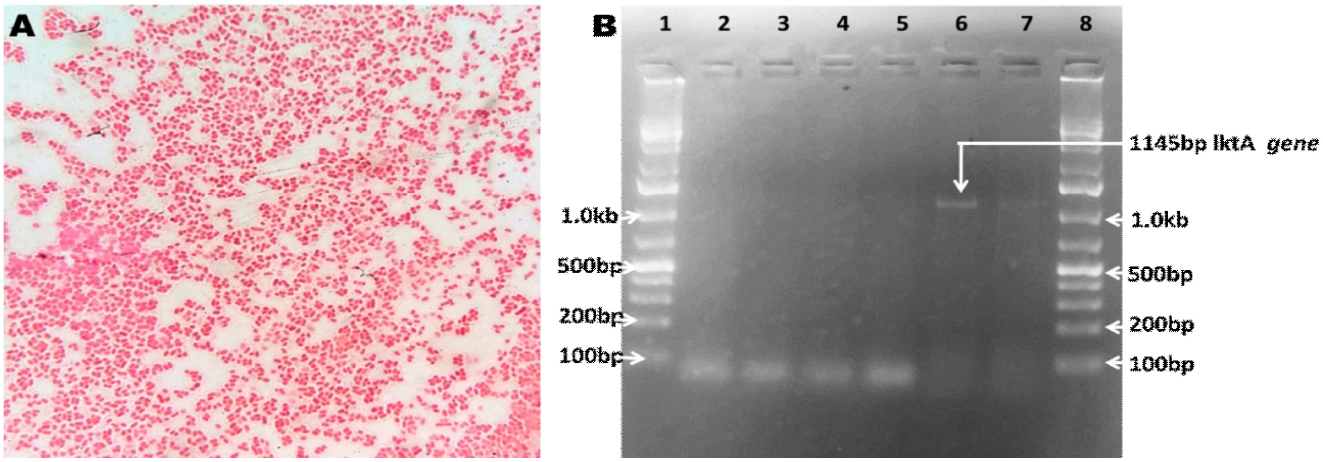


Fig. 7. Screening of *Mannheimia hemolytica* from nasal swabs/throat lavages of goat kids. **A.** *M. hemolytica* lactose fermenting colonies from MLA subjected to gram staining showing gram negative bipolar, pleiomorphic coccobacilli , **B**. Agarose TAE EtBr gel showing 1145bp amplicon of ***LktA*** gene specific for *Mannheimia hemolytica*

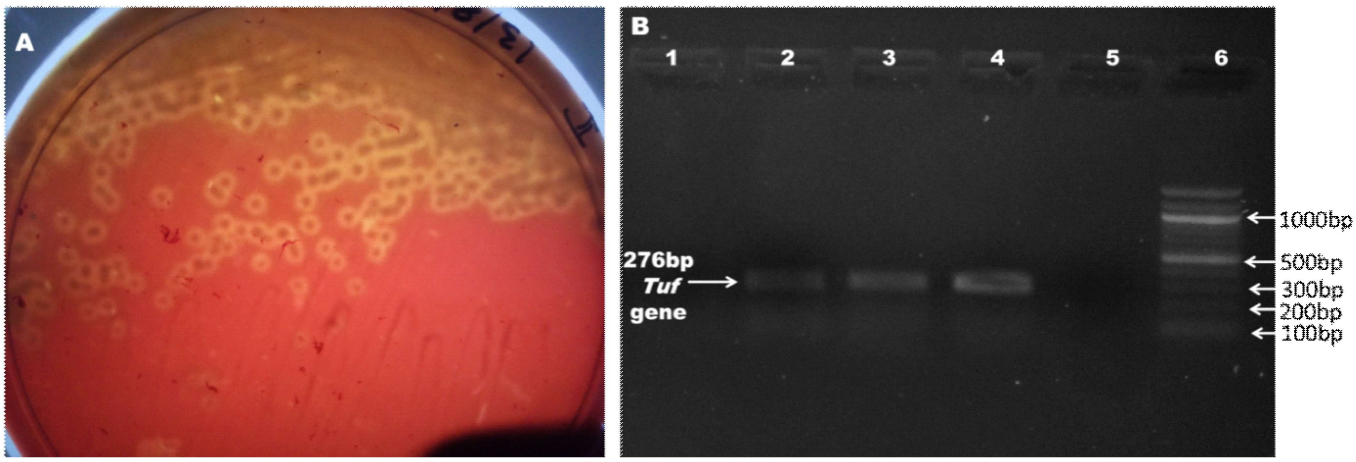


Fig. 8. *Streptococcus* spp screening from nasal swabs: **A**. 5% defibrinated sheep blood agar showing pin point colonies with greenish/ partial hemolysis (alpha-hemolytic Streptococcus), **B**. EtBr-TAE agarose gel showing 276bp *Tuf* (Elongation factor) gene specific for *Streptococcus* spp

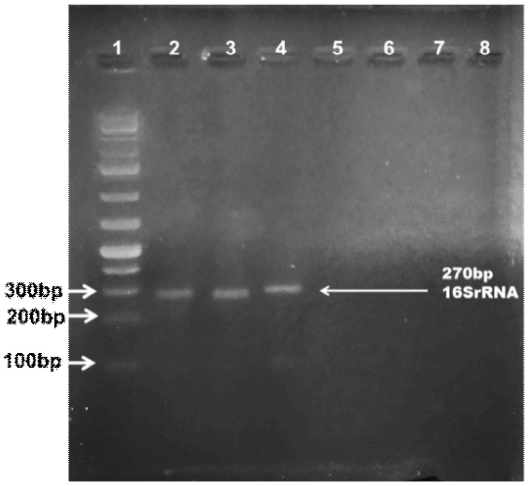


Fig. 9. *Mycoplasma* spp screening from nasal swabs/throat lavages. TAE agarose-EtBr gel showing 270bp 16SrRNA gene specific for *Mycoplasma* spp

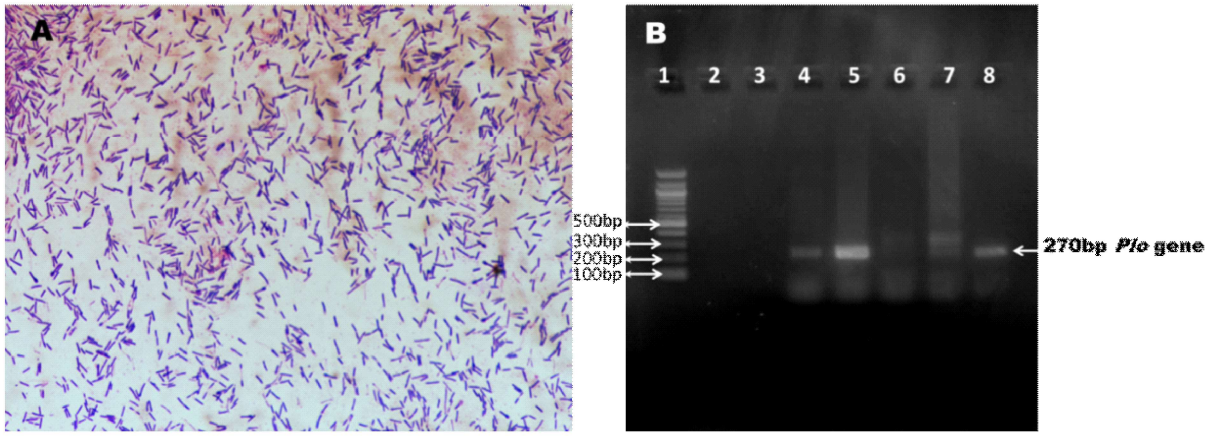


Fig. 10. Screening of *Arcanobacter pyogenes* from nasal swabs of goat kids. **A.** Gram positive long pleomorphic rods arranged as palisade **B.** Agarose TAE EtBr gel showing 270bp amplicon of ***Plo*** gene specific for *Arcanobacter pyogenes.*

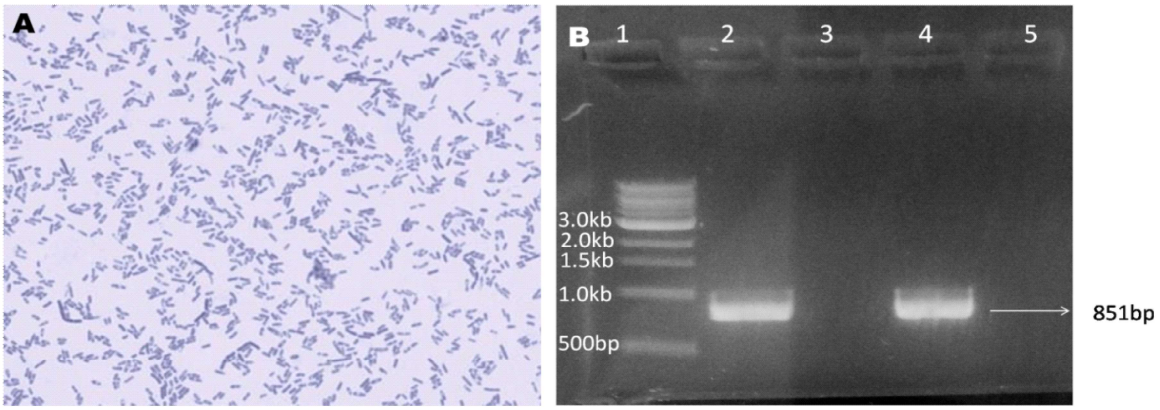


Fig. 11. Screening of *Corynebacterium ovis* from nasal swabs of goat kids. **A.** Gram positive pleomorphic rods arranged as palisade **B.** Agarose TAE EtBr gel showing 851bp amplicon of 16SrRNA gene specific for *Corynebacterium ovis.*

Treatment, control and management of respiratory illness

It was observed that pneumonia involved multiple etiologies of bacterial species ranging from gram negative to gram positive to mycoplasma. Further all the bacterial etiologies were typed by PCR which showed that they are pathogenic and complicate the respiratory process in young neonates. The members of pasteurellaceae family including *Mannhemia hemolytica* and *Pasteurella multocida* were both involved in certain cases with clinical signs. The mortality was kept under control by a proper regimen of antibiotics including Ceftriaxone-Tazobactam (bid for 5 days) in cases with very high rectal temperature and Oxytetracycline long acting (sid, every alternate day with a total of three doses) in cases with moderate rectal temperature along with anti-inflammatory-analgesics and supportive vitamins therapy were continued till the animals recovered. The un-weaned kids' (0-20 days old) dam was also screened for the respiratory symptoms and was separately treated to reduce the spread among other kids and dams. Moreover the housing was kept airy with good ventilation in the day time and proper protection from cold during night times were provided. The flock size was adjusted to reduce the horizontal spread among non-clinical animals, and the clinically ill animals were isolated and separately treated with the aforesaid regimen.

Table 10 : Clinical trial of oral herbal formulation in kid diarrhoea

Age group	Duration of Treatment (Average)	Recovery days (Average)	Recovery score *(Average)	No of case switch to antibiotic therapy
1-3 Month (9)	1-3 Days (1.22 Days)	1-4 Days (1.22 Days)	2-4 days (3.77 Days)	1
3-6 Month (12)	1-3 Days (1.66 Days)	1-5 Days (2.17 Days)	2-4 days (3.33 Days)	4

*Recovery score : +1 – poor ,+2 Moderate , +3 Good , +4 Complete Recovery

(Project: All India Network Project on Neonatal Mortality in Farm animals)

(Dr. (s) Ashok Kumar, R.V.S. Pawaiya, A.K. Mishra and K. Gururaj)

6.5.4. Development of Epsilon Toxin Based Novel Vaccine against Enterotoxaemia in Goats: A Bioinformatics Assisted Reverse Vaccinology Approach

Achievements

1. Development of restriction free cloning system for full and partial epsilon toxin gene of *C. perfringens*.
2. Construction of Etx full gene (675bp) inserts in vector pET28a(+) using splicing by overlap extension (SOE) PCR.
3. Amplification of megaprimer for partial and full length epsilon toxin coding region Fig. 12.

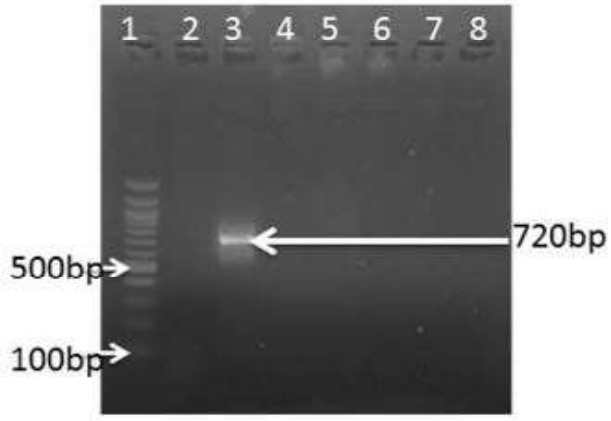


Fig. 12. Megaprimer amplification: ETX full gene amplicon (675bp) along with flanking plasmid chimera (45bp).

4. Inverse PCR using mega-primer and pET28a(+) plasmid.

   Inverse PCR was performed, with pET28a(+) Vector size of 5414bp. After inverse PCR, the size was 6089bp (5414bp+675bp) (Fig. 13).

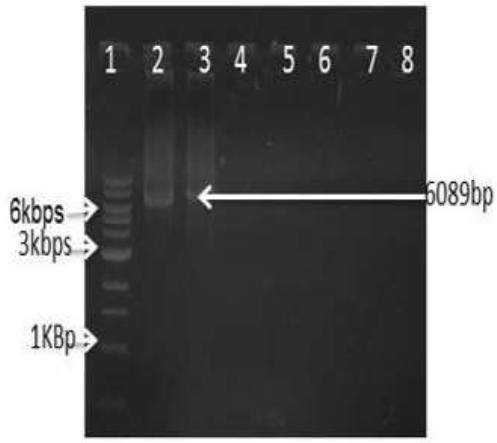


Fig. 13. Inverse PCR using mega primer and pET28a(+) plasmid.

5. Transformation of plasmid after treatment with *DpnI* restriction enzyme.

   The DpnI selectively cuts the GATC methylated residues from the parent vector (without ETX insert) leaving behind the inverse PCR generated un-methylated daughter vector. The plasmid was transformed into BL21 DE3 cells and analysed accordingly in LB agar with Kanamycin (Fig. 14). The recombinant clones were identified using partial ETX primer (284bp amplicon) (Fig. 15).

Fig. 14. Transformed plasmid into BL21 DE3 cells which was analysed in LB agar with Kanamycin.

6. Confirmation of ETX Cloned Vector

   The SOE-cloned plasmids were confirmed by RE analysis with *EcoRI* & *Hind III* enzyme. The cut and uncut uncloned plasmids Vs cut and uncut Etx cloned plasmids were confirmed for the successful SOE (Fig. 16). This will be used for induction of rETX expression and subsequently used for

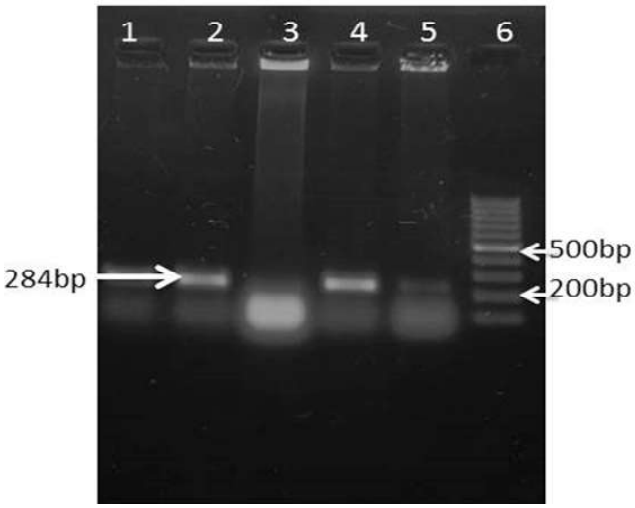


Fig. 15. Recombinant clones identified using partial ETX primer (284bp amplicon).

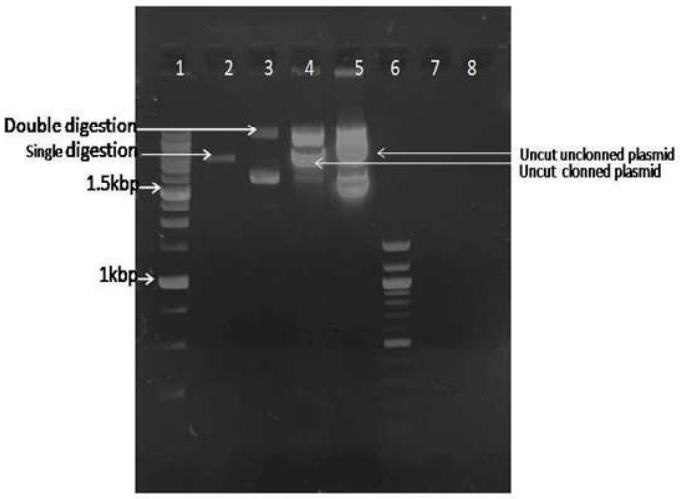


Fig. 16. The cut and uncut uncloned plasmids Vs cut and uncut Etx cloned plasmids were confirmed for the successful SOE.

Salient findings and interpretations of the current study

1. Development of restriction free cloning system for full and partial epsilon toxin gene of *C. perfringens*.
2. Amplification of megaprimer for partial and full length epsilon toxin coding region.
3. Splicing by overlap extension PCR (SOE-PCR) and Inverse PCR for generation of expression ready clones of ETX insert.

(Project: "Development of epsilon toxin based novel vaccine against enterotoxaemia in goats: A bioinformatics assisted reverse vaccinology approach" under the "Network project for Agricultural Bioinformatics and Computational Biology" of Centre for Agricultural Bioinformatics (CABin) Scheme)

(CPI: R.V.S. Pawaiya, PI: K. Gururaj, PI (from CABin, ICAR-IASRI, New Delhi): Sunil Kumar, Co-PIs (from ICAR-IASRI, New Delhi): U.B. Angadi, Mir Asif Iquebal)

6.5.5. Molecular Mapping and Epidemiology of Caprine Cryptosporidiosis in Tripura

Achievements

Faecal samples were collected from scouring neo-natal goat kids (n = 188) and the samples were processed using NSS sedimentation technique. Faecal smears were prepared, which were then stained by modified Ziehl-Neelsen technique, Modified Kinyoun technique and Negative staining technique and spore staining technique is being further refined. Count the live and dead oocyst in hemocytometer by using the trypan blue stain and then concentrated the oocyst using the sheather's sucrose flotation technique.Multipathogen etiology for diarrhoea was investigated. Nested PCR of 18ssu rRNA, HSP 70 and GP 60. Designed the primer and probe for COWP gene for RT-PCR and standardized the mRNA based PCR.

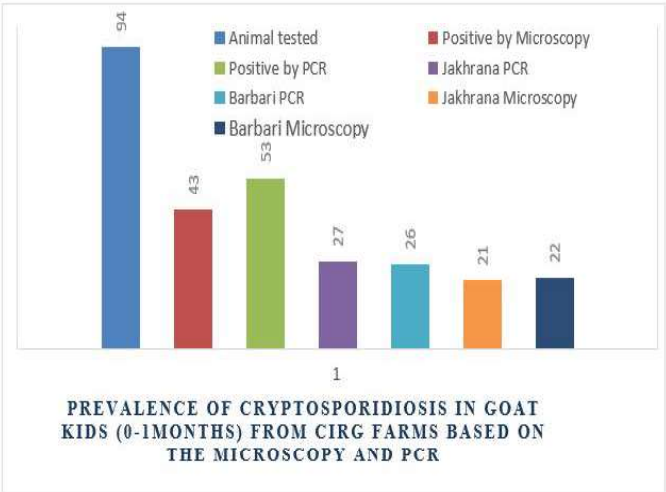


Fig.17. Cryptosporidiosis in goat kids (0-1months) screened by microscopy and conventional PCR

Table 11: Prevalence of Cryptosporidiosis in organized farm kids

Breed	Animals tested	Positivity	
		Microscopy	PCR
Barbari	94	45.74 (43)	56.38 (53)
Jamunapari	43	51.16 (22)	60.47 (26)
Jakharana	51	41.18 (21)	52.94 (27)
Total	188	46.23 (86)	56.38 (106)

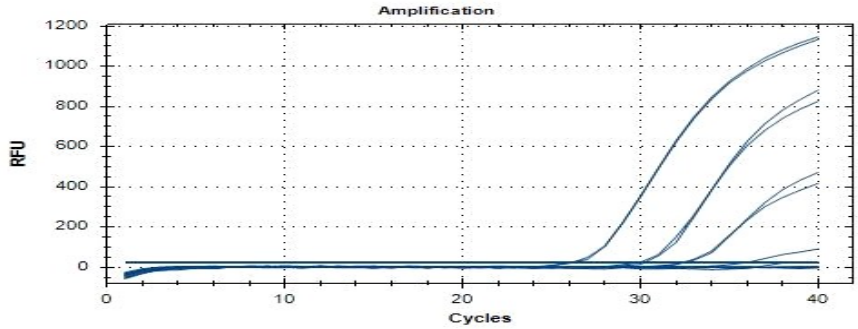


Fig. 18. Cycle quantification (CQ) plot for limit of detection (LOD) generated by reverse transcription Real time PCR (qRT-PCR) for COWP gene of Cryptosporidia

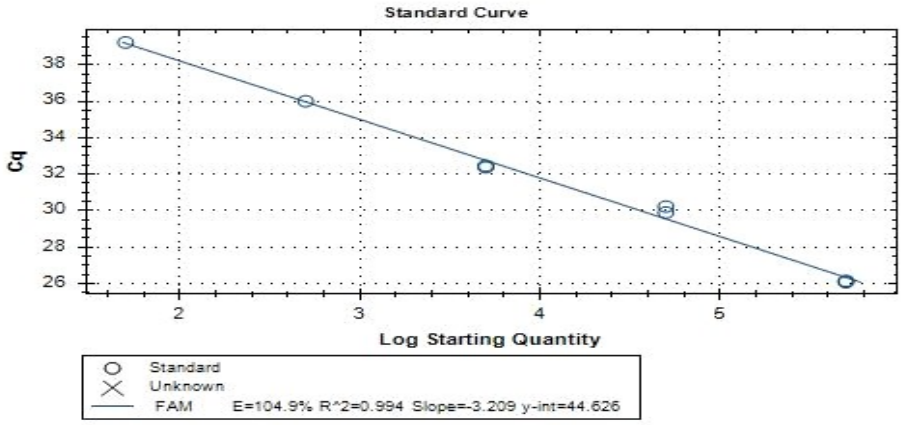


Fig. 19. Standard curve (with R^2=0.994) generated for limit of detection (LOD) sensitivity test conducted using reverse transcription Real time PCR (qRT-PCR) for COWP gene of Cryptosporidia

(Externally funded project: DBT Twinning Project on "Molecular mapping and epidemiology of caprine Cryptosporidiosis in Tripura")

(Dr. (s) Dinesh Kumar Sharma and K. Gururaj)

6.5.6 Development of Phyto-pharmaceutical Product for Bovine Mastitis

Achievements

In 2020, 162 milk samples from Barbari ICAR-CIRG sheds were screened for subclinical mastitis on the basis of California mastitis Test (CMT test), Somatic Cell Count (SCC; (using Newmanns stain) and Bacterial isolation from milk. Out of 162 samples, no case of subclinical mastitis was detected. Two cases of clinical mastitis were also reported in the Barbari sheds . The overall incidence of mastitis (clinical +subclinical) was calculated as 1.2% in the ICAR-CIRG herd. No case of clinical mastitis was reported in Jamnapari and Jakhrana goats.

Clinical Mastitis (Topical application) trial

The therapeutic clinical mastitis trial was conducted in two mastitis goats (parturated in February and March 2020). Milk samples, wherever possible, were collected and SCC was estimated. The blood samples of the normal goats, and test product (topically applied on entire udder) were collected and plasma samples were collected for the evaluation of inflammatory markers. The previous year data for disease control, those treated with Market product (topically applied on entire udder) was used for comparison.

Milk samples from both mastitis animals were cultured on BHI agar plate and large colonies of diphtheroids and small colonies of Gram positive cocci were found. Both animals received topical application of test product for 5 days. Signs of disease advancement were observed and immediately antibiotic therapy was added to the herbal treatment and two animals recovered.

(Externally funded project: DBT Project on Development of Phyto-pharmaceutical product for Bovine mastitis)

(Dr. (s) Anu Rahal and Nitika Sharma)

6.5.7 Evaluation of Nutraceutical Supplementation on Immune Status of Goat Kids

High morbidity and mortality in neonates are the most important roadblocks to the profitability of goat enterprise. At birth, neonatal goat kids are born agammaglobulinemic and have immature innate and adaptive immune system. Therefore, the present study was aimed at evaluating the effect of nutraceutical supplementation on the health and immunity of goat kids. A total of 36 kids included in the study were randomly divided into 3 groups. Group I (control) did not receive any treatment. Group II and III kids were administered prebiotics, and probiotics respectively. Nutraceutical supplementation was initiated on day 5 and continued upto day 35. Kids were allowed to stay with the doe only during suckling period (30 min/ period) both during the morning and evening during the pre-weaning stage. Blood samples were collected on day 5, 35 and 90 (DPK- days pertaining to kidding) of kidding to assess metabolites, oxidative stress markers (cortisol) and innate immune markers (Neutrophil: Lymphocyte NE: LY, acute phase proteins, interferon-gamma). The effects of nutraceutical supplementation on growth, health, behaviour and serum parameters were recorded. The therapeutic trial has been completed and the analysis of samples is under progress.

Achievements

- A questionnaire has been prepared in English and Hindi to gather data from organised goat farms/ Commercial farms and goat rearers.
- The retrospective epidemiological study was conducted on three goat breeds maintained at ICAR-CIRG viz. Barbari, Jamunapari and Jakhrana.During the study period (April, 2018 to March, 2021) a total 2315 goat kids were born out of which 63 kids died leading to overall mortality of 2.7 %.

- Considering the overall pre-weaning mortality, it was observed that most of the kids died due to enteritis (37.8 %) followed by pneumonia (29.2 %), septicemia (9.6 %), debility, anemia, abomassal bloat and other non-infectious causes (23.4%). However, different mortality pattern was observed in Jamunapari kids where most common cause of mortality was pneumonia and not gastro- instestinal diseases.
- In Barbari kids, mortality was found to be higher during first and third month of life (36%) than that in second month (27%) of life whereas in Jamunapari kids, highest mortality was observed during second month of life (40.86%) followed by that in third month (38.61%) and first month (20.53%).No appreciable difference was recorded between mortality rates of male and female kids which were 2.7 % and 2.52%. Highest mortality was observed in kids born as triplet/quadruplet (4.5 %) followed by that in twins (2.9 %) and singlets (2.0 %).
- Mortality rates of 2.1 %, 3.4 % and 2.1 % were observed in Jakhrana, Jamunapari and Barbari breeds respectively during the three year period. Mortality in goat kids born during first kidding season of the year (February to March) was 3.9 % whereas it was only 1.62 % in kids born during second kidding season of the year (September to October). Mean birth weight of Barbari and Jamunapari goat kids that died was lower than than that of population mean birth weights of respective breeds. While, in mean birth weight of Jakhrana kids that died was higher than than their population mean birth weight. When overall pre-weaning mortality of the three breeds was considered, highest mortality was observed in kids born to primiparous dams, followed by kids born to dams with parity e"5 and parity 2-4. However, in Barbari and Jakhrana breeds, highest mortality was observed in kids born to dams with parity e"5 followed by those born to primiparous dams and then least in those born to dams with parity 2-4. In Jamunapari breed the said order was found to be first parity followed by parity 2-4 and then in dams with parity e" 5.

(Institute Project: Evaluation of nutraceutical supplementation on immune status of goat kids)

(Dr. (s) Nitika Sharma, Ashok Kumar, Anu Rahal, Ravindra Kumar, Gopal Dass, Saket Bhushan, K. Gururaj and Anil Kumar Mishra)

6.5.8 Epidemiology of Abortion in Goats and Development of A Multiplex PCR Assay for Detection of Common Abortogenic Microbial Agents

Achievements

The aim of the project is to develop a multiplex PCR assay for the detection of common abortifacient microbial agents in goats. The targeted microbial agents are *Brucella melitensis*, *Brucella abortus*, *Coxiella burnetii*, *Chlamydophila* spp. and *Campylobacter* spp. Under the project, for collection of the epidemiological data on abortion in goats, "Bilingual Format in Hindi and English" was developed. Further, "Google Form" in Hindi & English was also developed to collect the data from the distantly located goat-farmers. More than 250 goat farmers/farms of Bharatpur (Rajasthan), Mathura, Agra, Firozabad (UP) were contacted for collection of the data, and still, data collection is in progress. The analysis of the data will be done after completion of the data collection. More than 240 biological samples (vaginal secretions, preputial secretions, fetal stomach content and placenta) were collected, and microbial genomic DNAs from the samples were extracted. Standardization of PCRs for detection of *Brucella melitensis*, *Brucella abortus*, *Coxiella burnetii*, *Chlamydophila* spp. and *Campylobacter* spp was done. Presence of *Coxiella burnetii* was not detected in any sample. Only two samples (preputial secretions) were found positive for *Brucella abortus* (Fig. 20). Only 9 samples (vaginal swabs = 5, stomach content = 4) were found positive for *Brucella melitensis* (Fig. 21).

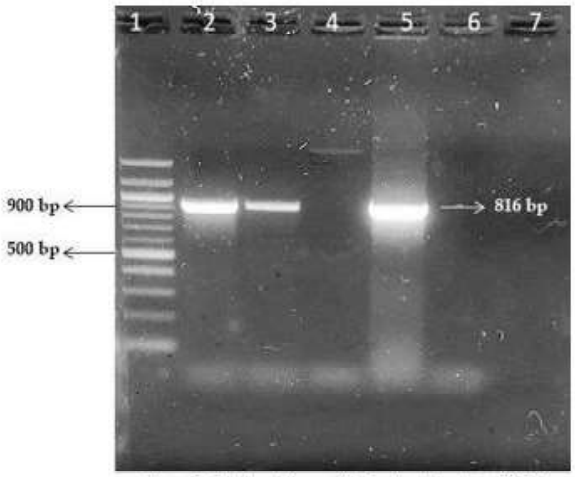


Fig. 1: Detection of *B. abortus* by PCR
Lane M: Molecular Weight Marker
Lane 2-3: Positive Samples
Lane 4, 6: Negative Samples
Lane 5: Positive Control
Lane 7: Negative Control

Fig. 20. Detection of *B. abortus* by PCR

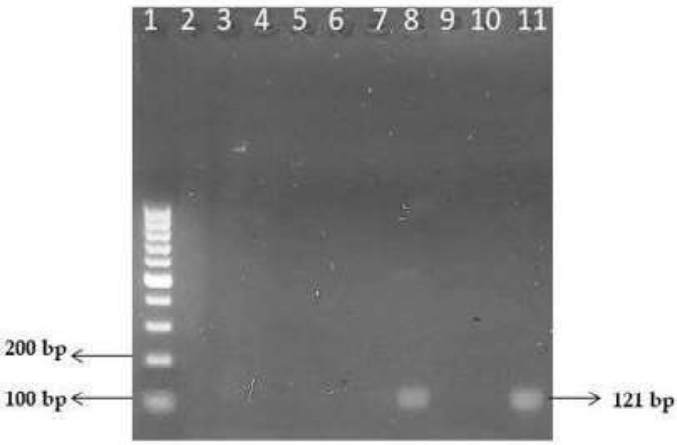


Fig. 2: Detection of *B. melitensis* by PCR
Lane 1: Molecular Weight Marker (100 bp)
Lane 2-7: Negative Samples
Lane 8 : Positive Sample
Lane 9-10: Negative Control
Lane 11: Positive Control

Fig. 21. Detection of *B. melitensis* by PCR

(Institute Project: Epidemiology of abortion in goats and development of a multiplex PCR assay for detection of common abortogenic microbial agents)

(Dr. (s) Anil Kumar Mishra, Ashok Kumar, K. Gururaj and V.K. Chaturvedi)

6.5.9. Indian Network for Fisheries and Animals Antimicrobial Resistance (INFAAR)

6.5.9.1 Sampling for INFAAR as per the SoP

During the reporting period, 158 samples were collected and processed despite the pandemic situation. Three out of the four districts committed in the sampling plan viz., Mathura (n=131), Etawah (n=16) and Firozabad (n=11)were targeted. A total of eight villages spanning across three blocks in the aforementioned districts of Uttar pradesh were sampled. A total of 55 isolates of *E.coli* and 38 isolates for *S. aureus* were obtained which were subjected to further AMR studies (Table 12).

6.5.9.2 *Staphylococcus aureus* isolates and its AMR analysis

All the Staphylococcus species isolated were subjected to molecular typing for confirmation of species (Fig. 22) and biochemical tests including catalase activity and coagulase typing. Further they were all screened for phenotypic tests including beta-lactamase production (Fig. 23), anti-microbial sensitivity tests using panel of antimicrobials as per CLSI standards earmarked in the SOPs and Methicillin resistance. Genotypic tests were also conducted which include *Mec*A gene for MRSA resistance (Fig. 24) and *Van*A/*Van*B gene for Vancomycin resistance (Fig. 25). The results obtained from phenotypic and genotypic AMR tests for *Staphylococcus* species are summarized (Table 13).

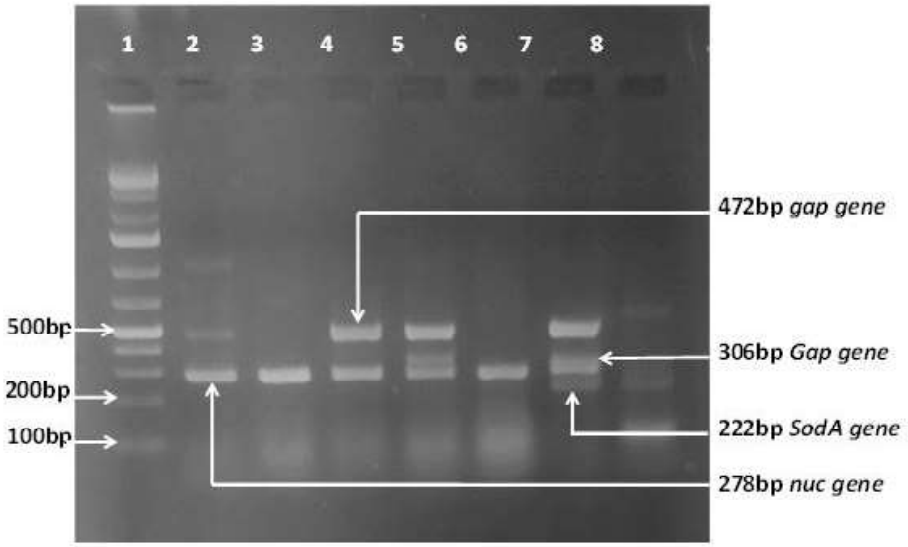


Fig. 22. Staphylococcus speciation conventional multiplex PCR. Lanes, 1- 100bp DNA ladder, 2-7 *nuc* gene (278bp), 4-5 *Gap* gene (472bp), 7- *Gap* (306bp), *Sod*A (222bp) gene

About 2 per cent of isolates were MRSA based on phenotypic AMR tests, while 5.26% were MRSA based on genotypic AMR tests and interestingly 21% of strains were vancomycin resistance.

Table 13: Phenotypic and genotypic typing of *S.aureus* for AMR patterns obtained from various domestic species

Type of test		n (%)	Type of sample and other details
	β-Lactamase	**01(2.63%)**	Goat semen/ Jamunpari/CIRG/ Mathura
	MRSA	**02 (5.26%)**	Goat Fecal/ Jamunapari /Gadaya/Mathura
Phenotypic tests	**Catalase/ Coagulase**	**36 (94.73%)**	Chicken, Goat/cloacal,fecal/Mathura
	Antibiotic Senstivity Test	**38 (100%)**	Goat, Cow, Buffalo Fecal/ Milk/ Barbari/ Jamunapari/ Mathura
Genotypic test	***MecA* gene PCR**	**02 (5.26%)**	Goat Faecal/ Jamunapari /Gadaya/Mathura
	***VanA/VanB gene* PCR**	**08(21.05%)**	Goat, Cow, Buffalo Fecal/ Milk/ Barbari/ Jamunapari/ Mathura

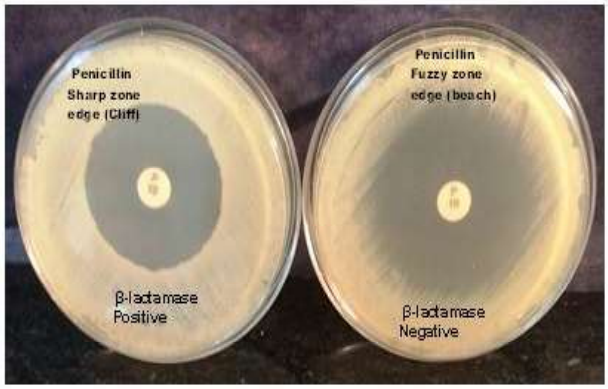


Fig. 23. Beta-lactamase typing of *S.aureus* isolates, with the left one showing beta-lactamase production due to the 'cliff' like zone edge, while the right plate is beta-lactamase negative due to the 'beach' like zone edge

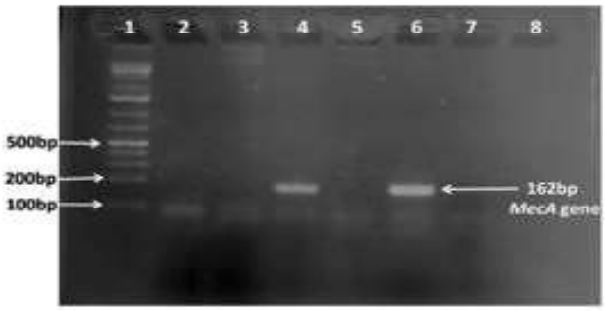


Fig. 24. MRSA genotyping based on *Mec*A gene conventional PCR. Lane 1- DNA Ladder, Lane 2-5 Unknown (Lane 4-positive- *Mec A* gene-162bp Isolate no.293 Goat semen), Lane 6- Positive control

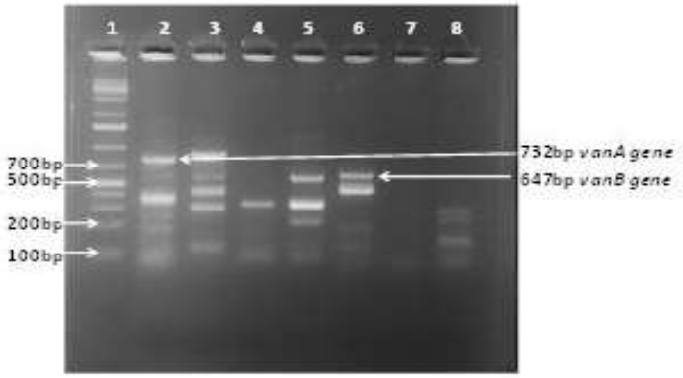


Fig. 25. VRSA genotyping based on *Van*A/ *Van*B gene conventional PCR. Lane1- DNA ladder, Lane2- *VanA gene*, Lane3-4- Unknown, Lane5-6- *VanB gene*, Lane7-8- Unknown.

Escherichia coli is another important gram negative microbe belonging to the family *Enterobacteriaceae* which has been extensively studied for its anti-microbial characteristics through various phenotypic and genotypic AMR tests. A complete detail on these parameters studies has been tabulated (Table 14). Phenotypic tests including ESBL typing, Imipenam MIC testing (Fig. 26) were done. Besides the *E.coli* was characterized using molecular tests including *E.coli* confirmation multiplex PCR (Fig. 27) and pathotyping multiplex PCR to decipher its virulence genes. Among the phenotypic tests anti-microbial sensitivity testing using Kirby-bauer disc diffusion test using the gram negative antimicrobial panel (Fig. 28) as per CLSI standards were conducted for all the isolates (n=55).Another important resistance parameter viz., phenotypic *Amp*C-β-lactamase test for *E.coli* by using anti-microbial disks like Cefoxitin and Cefotetan was done for screening the same. Phenotypic ESBL detection was done by Combined Disk diffusion and double disk Synergy test in *E.coli* using Ceftazidine, Cefoxitin and a combination including Ceftazidime-Clavulanic acid and Cefoxitin-Cloxacillin respectively. On the other hand, to identify the resistance at the genotypic level various polymerase chain reaction based tests were done including the AmpC gene detection, ESBL detection using multiplex-I, multiplex-II, multiplex-III and carbapenemase detection.

Table 14: Phenotypic and genotypic typing of *E.coli* (n=55) for AMR patterns and extended spectrum beta-lactamase (ESBL) obtained from various domestic species

Type of test		n (%)	Type of sample and other details
Phenotypic tests	ESBL	02 (3.63%)	Chicken, Goat/ fecal-cloacal/ Mathura/Etawah
	Combined Disk method	02 (3.63%)	Chicken, Goat/ fecal-cloacal/ Mathura/Etawah
	Double disk synergy test	02 (3.63%)	Chicken,Calf/cloacal-fecal/Mathura
	AmpC β-Lactamase	02 (3.63%)	Goat, calf- fecal/Mathura-Vrindavan
	Indole test	55 (100%)	Chicken, Goat/cloacal,fecal/Mathura
	Carbapenem resistant	0 (0%)	Chicken, Goat/cloacal,fecal/Mathura
	Antibiotic Senstivity Test	55 (100%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
Genotypic test	*NDM-1* gene PCR	21 (38.18%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	AmpC PCR	11 (20%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	BlaSHV gene	03(5.45%)	Chicken, Goat/cloacal,fecal/Mathura
	SHV variants including *SHV-1*	01 (1.81%)	Chicken, Goat/cloacal,fecal/Mathura
	TEM gene PCR	10 (18.18%)	Chicken, Goat/cloacal,fecal/Mathura
	OXA-1, OXA-4 and OXA-30 gene	06 (10.90%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	Mcase CIT gene PCR	03 (5.45%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	Mcase ACC gene	01 (1.81%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	MCTXMGP-1 gene	03 (5.45%)	Goat, Pig, Calf, Sheep, chicken/ Fecal, milk, nasal/ Mathura/Etawah
	MCTXMGP-9 gene	01 (1.81%)	Chicken, Goat/cloacal,fecal/Mathura
Pathotyping Test	*Stx 1, Stx 2, ial, eae, Bfpa'A', Lt gene*	16 (29.09%)	Chicken, Goat/cloacal,fecal/Mathura

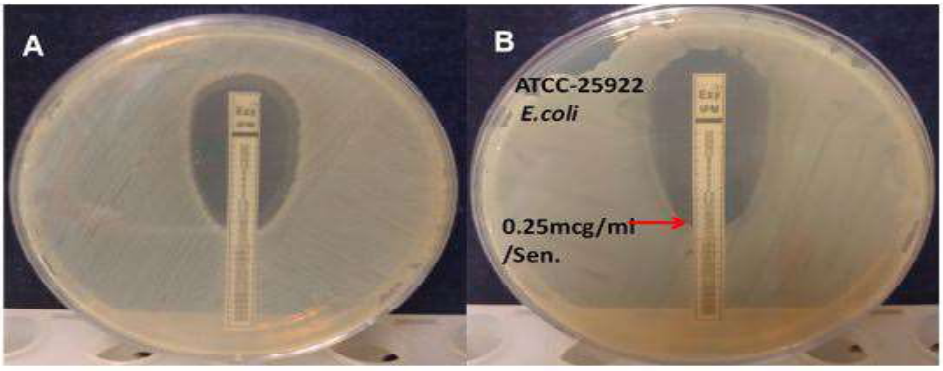


Fig. 26. A- *E.coli* Imipenam MIC testing using EZY Strip. *E.coli* (Isolate no. 281) Nasal swab tested showed an MIC of 0.38mcg/ml; **B**- *E.coli* Imipenam MIC testing using EZY Strip *for positive control* ATCC-25922 (Positive control Sensitive) tested by Imipenam MIC EZY Strip that showed an MIC of 0.25mcg/ml.

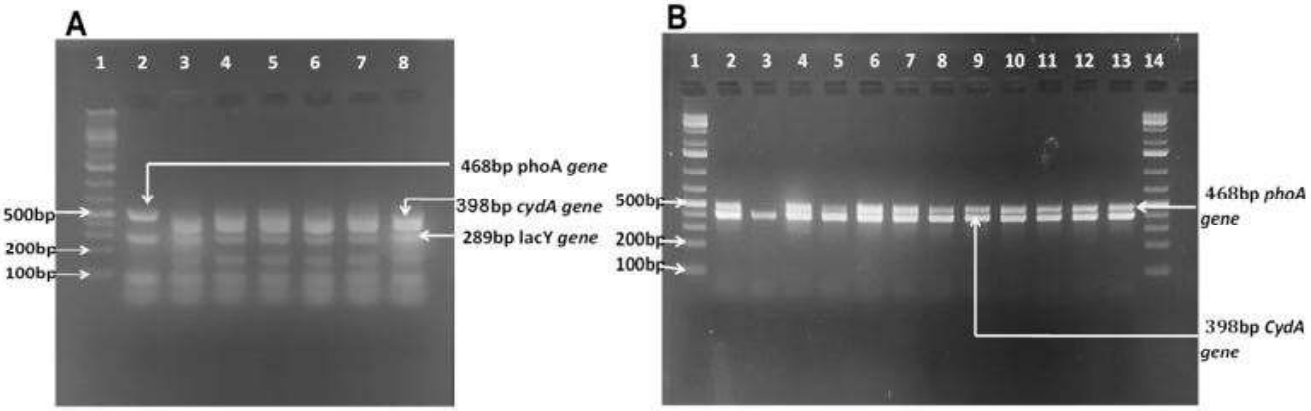


Fig. 27. A-*E.coli* confirmation mulitplex PCR (Genes: *lac*Y, *lac*Z, *cyd*A, *uid*A, *pho*A). Lane 1-DNA ladder, Lane 2-8 isolates positive for genes viz., *Pho*A (468bp), *Cyd*A (398bp) and *lac*Y (289bp obtained from monogastric species, poultry (lanes2-5) and pigs (6-8). **B**- *E.coli*

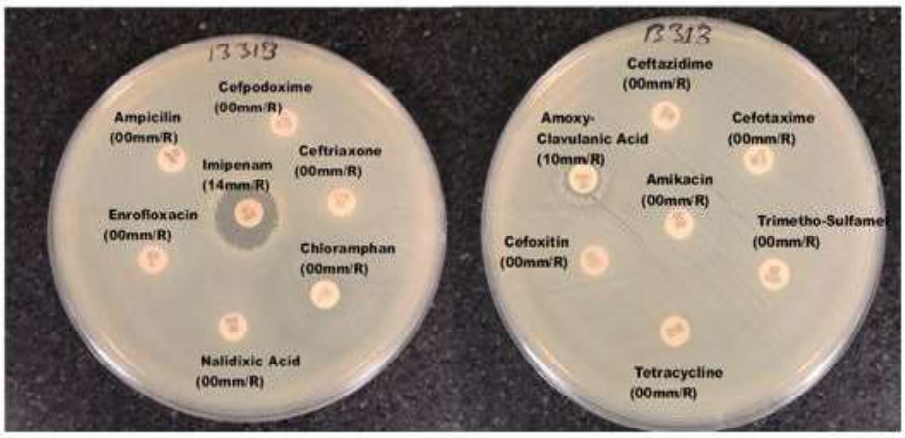


Fig. 28. Phenotypic Anti-microbial senstivity test conducted using the gram negative panel of anti-microbials for *E.coli* isolate no. 326 (Poultry fecal) which was found resistant to all the antimicrobials tested as evident from the zone of inhibtion from the photo.

Important observations on AMR during the reporting period

In *E.coli* isolates, the ESBL and *Amp*C beta-lactamase producing isolates were 3.63 % respectively and none were carbapenem resistant based on phenotypic AMR tests.Based on genotypic AMR tests, 38% were carbapenem resistant strains by NDM-1 gene PCR, while *Amp*C beta-lactamase producing isolates were 20%, SHV producing were 5.45%, TEM gene (18.18%), OXA-1like (10.90%), CIT (5.45%), ACC (1.81%), CTX-M gp-1 (5.45%), CTX-M gp-9 (1.81%). Among chicken cloacal swab isolates highest proportion of both genotypic and phenotypic AMR characteristics were observed in both *S.aureus* and E.coli isolates. This is followed by pigs, dairy cattle, organized goat flock and buffaloes. Least resistance was seen in unorganized goats followed by sheep. In the unorganized goat flocks, *S. aureus* from milk samples showed MRSA producing strains despite being coagulase negative. Vancomycin resistance produced in isolates which were already MRSA is of public health concern, which needs thorough study in the future.

(ICAR-FAO Joint project network "Indian network for fisheries and animals antimicrobial resistance" (INFAAR)

(K. Gururaj, A.K. Mishra, D.K. Sharma, Ashok Kumar and Nitika Sharma)

6.6 EXTENSION INTERVENTIONS FOR SUSTAINABLE GOAT PRODUCTION SYSTEM

6.6.1 Transfer of Technologies for Livelihood Security

On the basis of availability of number of goat keepers and goats, three villages namely, Amla Sultanpur, Nagla Medaki and Nagla Kishanpura of Farah Block District-Mathura, Uttar Pradesh were adopted for this study. During the period under report, three farmers- scientists interactions, three health camps, three Swachchh Bharat Mission Programme and three COVID-19 Awareness Programme were conducted and distributed mineral mixture to 67 goat farmers and literature on scientific goat farming and provided advisory service to 67 goat farmers in the adopted villages. Also, an interview schedule was developed, pre-tested and standardized for baseline data collection. Further, works carried out under different components were given here under:

6.6.1.1 Breeding Management

Transfer of technology programme was organized in the TOT village. During the programme, goat farmers were contacted and discussed regarding scientific goat farming. They were given the knowledge of goat breeds and their utility, selection of breeding stock for starting a goat farm, scientific management of kids and various factors affecting the goat productivity directly or indirectly.

During discussion, it was observed that goat farmers were not following scientific goat technologies and due to that they were getting low production and high mortality rate in their animals. In addition to this, the goat farmers were also given the knowledge about season of breeding. Having discussed all aspect of goat production, the farmers were suggested to start goat farm with the breed of his area, breeding them in proper time and season and scientific management of kids to make the goat farming more profitable.

6.6.1.2 Fodder Production

The farmers were benefitted through providing the scientific know-how of fodder cultivation, agroforestry and pasture management in their region. Appropriate techniques of fodder production from cultivated fodder crops and fodder trees along with cultivation of azolla were explained to them. For enhancing the productivity of animal and fodder crops farmers were advised to grow and feed both the cereals as well as leguminous fodder crops. Farmers were also advised to prepare hay and silage from the excess green fodder for the lean period. Fodder crop varieties, cultivation season, agronomical practices, fodder yield and physical identification of fodder crops and grasses of fodder importance were explained to the villagers. Cultural methods of weed control were also discussed with the farmers of adopted villages.

6.6.1.3 Reproduction component

In the adopted villages, the team organized the awareness camps, health camps and Kisangosthi. In all the villages the technologies developed by the institute on scientific goat farming were demonstrated.Along with this, the team talked to many ladies and appreciate their work in goat husbandry as they are the key player in goat production system. The team also demonstrated the women that how a dystocia can be removed in cases of goats and promoted them to make self-help group for supporting their fellow in adverse time. There were few problems in goats related to reproductive issues like abortions, anoestrus and repeat breeding etc. The possible remedies and the preventive measures of these diseases were discussed with the farmers.

6.6.1.4 Goat Product Technology Component

Under this component, It was emphasized that the profitability of goat production sustained only when the value addition of its products are taken care off. Value addition at village level can be carried. Explained the need of improving their breeding bucks and maintaining pure breeds fetch more values. Farmers were apprised about the need of selling their goats on weight basis. The need of preparing goat milk paneer and selling in the market at premium price was explained. Also explained the value added whey drink preparation after the preparation of paneer. Procedure for the same was also explained in brief. Need of nutritional security at village level also explained in brief. Also told about the value added meat products. Also stressed about the importance of establishing Women based Shelf Help Groups (WSHG's). Also told about the other WSHG's created around Farah and Mathura Block and their success stories. Also explained the role of WSHG's on value added goat products preparation and marketing. Also invited queries about value added products and their questions were suitably answered. The interaction with the farmers were quite informative and useful both the sides.

6.6.1.5 Goat Health component

Herd health management strategies are less adopted in goats reared under extensive rearing system due to lack of scientific knowledge and awareness among the goat-keepers of semi-arid region.Health interventions like vaccination, deworming and dipping can play an important role in reducing the morbidity and mortality of goats and thereby increase the goat productivity and income from goat production.

With this target, three health cum awareness camps were organised at the three adopted villages of Mathura district namely Nagla Amla Sultanpur, Nagla Medki and Nagla Kishanpura on 14.10.2020, 4.12.2020 and 29.12.2020 respectively. The goat health calendar developed by ICAR-CIRG was disseminated among the farmers during the health camps. Area specific mineral mixture, rumenotorics and other commonly used drugs were distributed to 67 goat-keepers during the health camps. In the adopted villages a total of 304 goats were dewormed during the period under report. During the three Health camps, 130 goats were treated for various ailments. The various ailments encountered were parasitic gastro-enteritis, non-specific diarrhoea, pneumonia, bloat and indigestion. Dipping with ectoparasiticides was advised to 110 goats. During the Health cum awareness camps the scientific herd health management strategies were propagated among the goat-keepers.

The farmers were imparted knowledge about the advantages of vaccination, dipping, deworming, area specific mineral mixture and iodized salt. The goat-keepers were encouraged to screen their animals for Brucellosis, JD, ectoparasitic infestation, endo-parasitic infection and other infectious diseases. The farmers were also sensitized about the concepts of social distancing, sanitization, isolation and quarantine which are vital in this period of COVID.

(Inst. Project:Transfer of Goat Technologies for Sustainable Livelihood and Enhancing Farmer's Income)

(Dr. (s) Braj Mohan, A.K. Dixit, Khushyal Singh, Ashok Kumar, Gopal Dass, Ravindra Kumar, R. Pourouchottamane, V. Rajkumar, Arvind Kumar, Nitika Sharma, Chetna Gangwar and Mohd. Arif)

6.6.2 Technological and Livelihood Improvement of Goat Farmers in Uttarakhand

After announcement of Unlock-II, the team started disseminating solutions/interventions for addressing challenges related to resilience of community in terms of health, socio-economic distress and livelihood. In this regard, the project beneficiaries were given COVID-19 prevention kit and awareness camps were organised in the villages maintaining social distancing and wearing masks. This kit contain- Surgical mask, cloth mask, Dettol hand washing soap, hand gloves, sanitizer, lime bag for spreading in goat shed and literature based on ministry of Home and Ministry of Ayush. We have also installed sign board containing information on Do and Don'ts to prevent from COVID-19. Farmers were also appraised for care of their goats during monsoon season. These interventions/activities have been divided into two groups:

Immediate (for the lockdown) interventions

- Whatsapp groups of goat farmers in Gharwal and Kumaon regions have been formed.
- Advisories for goat farmers on COVID-19 Pandemic have been circulated to all the farmer members.
- Goat management activities calendar for the months of March and April has been circulated.
- ***Arogya Setu*** App to fight against COVID-19 was circulated and asked to upload.
- ***Ayurvedic Upay*** to improve immunity against COVID-19 suggested by Ministry of AYUSH, Govt. of India has been circulated.

Intermediate (Unlock-II) intervention

- COVID-19 prevention kit contain- Surgical mask, cloth mask, Dettol hand washing soap, hand gloves, sanitizer, $KMnO_4$ lime bag for spreading in goat shed and literature based on ministry of Home and Ministry of Ayush.

Instalation of Sign Board on Do & Don'ts

Beside these activities Seven (7) *Kisan Gosthis* were organised in study villages of Garhwal and Kumaon regions.Goat farmers were appraised on utility of housing, feeders and other best practices of goat management. They were also sensitized on prevention of COVID-19 and importance of *Swacch Bharat Abhiyan.*

Women empowerment

Three Goat based SHGs namely Bhadraj, Bhadrakali and Bal Tulsi Goat based SHGs were formed with the help of local NGO (Balaji Sewa Sansthan). Three more SHGs were proposed and will be formed soon. Three (03) Gosthis were organised on *"Bakri Palan Dwara Mahila Shashaktikaran"* in Koti, Chiliyo and Dharda villages of Vikasnagar block of Dehradun district. Nine health camps were organised in study villages under which vaccination against PPR and FMD have been administered in goats. Goats were also treated for different ailments. Blood, fecal, milk and swab samples of goats have been collected for further study.

Plantation of fodder tree saplings

Fodder tree saplings were planted in the study villages. All the goat farmers and villagers were appraised on the importance of trees. The important trees which leaves are being used as fodder for goats were planted.

Baseline survey in Pithoragarh and Almora districts has been completed during this period. All the data on socio-economic, flock composition, production and productivity, nutrition of goats, marketing and incidences of predation were collected and analysed.

Development of local resource based goat feed

Cost effective local resource based goat feed was developed in Gharwal region.Feed includes tree leaves and local cereals in the ratio of 60:37. The rest was 2% mineral mixture and 1% salt.Tree leaves of Guryal (*Bauhinia variegata*), Bhimal (*Gravia optivia*) and Bakhli (*Anogeissus latifolia*) were used to prepare this feed.

A preliminary study on goat meat supply chain has been conducted in Dehradun. Goat market of Dehradun has been visited on the day of conduction. Goat meat shops were also visited for mapping goat meat value chain in Dehradun. Study revealed that goat market conduct on Tuesday and it is privately owned market. About 500 animals brought on market day with the variation of 40% increment during festive seasons. Supply side analysis indicated that 60% animals comes from Rajasthan via Delhi (60%) followed by bordering districts of UP and Punjab (25%) and from Uttarakhand local (15%). Demand for goats was found higher from butchers (55%) followed by local traders (25%), farmers/local residents (15%) and others (5%). Sale price of the goat was found to be Rs. 220 to Rs. 300/kg live weight. However, it varies as per weight, appearance, breed etc. Registration fee was charged Rs. 20/goat and it was paid by buyer. The major channel was found to be: Goat farmer/trader to and Butcher to Consumer. The producer's share in consumer's rupee was estimated to be 80.36%. Major constraints at traders side were - animal quality, loan, other facilities

Table 1: Mapping of meat goat supply chain

S.No.	Particulars	Value (Rs.)
1	Purchase price of goat @ Rs. 220-250/kg live weight (Average body weight 19-20 kg)	4500.00
2	Cost incurred	
a.	Registration fee	20.00
b.	Transportation charges	50.00
c.	Slaughter fee	50.00
d.	Feed etc.	15.00
e.	Other exp. (Rent, water & elect. Charges)	75.00
	Total (a to e)	210.00
3	Income	
a.	Sale of meat @ Rs. 475/ kg (11 kg)	5225.00
b.	Other parts	375.00
	Total (a & b)	5600.00
4	Net income per animal slaughter {(total of 3)-(1+ Total of 2)}	890.00

Source: Survey data

(DST Funded Project: Goat Based Technological and Livelihood Improvement in Uttarakhand State)

(Dr. (s) A.K. Dixit, M.K.Singh, Ravindra Kumar, V. Rajkumar, N. Ramachandran (up to August 2020), R. Pourouchottamane and Nitika Sharma)

6.6.3. Technology Impact and Livelihood Improvement

As per the technical programme, in total 20 villages have been randomly selected (10 intervention and 10 control) by generating random number technique. To conduct baseline survey in the selected villages, a questionnaire schedule (disease incidences and losses, economics of goat rearing and to capture other associated factors) was designed and developed. Schedule was pretested in nearby villages and changes/ improvements were incorporated accordingly. Baseline survey in intervention and control villages was completed. The important observations /findings of baseline survey are as follows: Economic analysis of baseline data indicated that goat production and management system in both the categories of villages i.e. intervention (10) and control (10) were more and less similar. Majority of goat farmers keep their goats under extensive management system. Goat farmers were not much aware on disease management practices particularly vaccination, deworming and other measures. The adoption of good health calendar or health management activities was almost negligible in all types of goat rearing categories in the study villages.The source of information, social participation and the awareness on goat health practice were not found to be strong.

Some self-help groups who are engaged with some other activities but also providing a little information on goat farming however, newspaper, TV programs, mobile phones, relatives/ friends were found to be the other sources of information and a small group of the farmers was found to be a little aware on deworming and vaccination. The availability of vaccine/ medicines/services and their high price was found to be the major constants for not adopting these scientific practices in their goats. The net income per animal per year over variable cost was Rs. 4744.00. However, it was found to be Rs. 5756/-, Rs. 4857/- and Rs. 4071/- for small, medium and large flock size respectively. Economics of goat rearing was found to be more and less viable among all the categories of goat farmers (1.63) and the benefit cost ratio is also varies from 1.54 to 1.78 among small , medium and large categories. This may be due to variation in flock size and management. The incidence of diseases and their associated losses were the major constants in enhancing the farmer's income. There is an opportunity for productivity enhancement and improving household income through minimizing economic loss due to diseases and ailments.

(Institute Project: Economic Impact of CIRG Technologies on Goat Production)

(Dr. (s) A.K. Dixit Co-PIs Braj Mohan, Ashok Kumar and K. Gururaj)

6.7 SERVICE PROJECT

6.7.1 Enhancing Livelihood Security of Farming Community through Livestock and Crop Integration using Proven Technologies

Livestock and agriculture is the main occupation of rural areas in Bareilly. There is no recognized breed of cattle, buffalo sheep, pig and poultry in the operational area. The prevailing livestock and poultry have poor productivity due poor technical know- how, indiscriminate breeding, inadequate feeding and poor health care. Injudicious uses of chemical fertilizers, pesticides, insecticides and weedicides in current agricultural practices have made soil infertile or less productive. Such excess use of pesticides is also adversely affecting human and livestock health as well as becoming threat to environment. Poor productivity and profitability compelling farmers for stressed migration. The programme was initiated to develop agribusiness and enterprises models in integrated and specialized farming models. Besides livestock and poultry, other agriculture commodities included in this programme are cereal, fodder, legume, horticulture, fish and vegetables.

Major objectives of programme are

1. To create awareness among farmers and rural youth about improved animal, poultry and crop husbandry technologies and their practices.
2. To improve local animal genetic resources using improved Germplasm and breeding practices with farmers' participation.
3. To enhance capacity building of farmers/rural youth/ women in the areas of value addition and marketing of livestock & agriculture produces.
4. To develop literature and extension material on transferable technologies and package of practices.
5. To evaluate the livestock and agriculture business interventions by participating institutes on farming community.

Activities assigned to ICAR-CIRG this year were supply of superior goats and sheep to project beneficiaries. On National Farmers day a mega programme was organized by IVRI in collaboration with ICAR-CIRG, MANREGA and District AH department in Majganva town in Bareilly district on 23rd December 2020. On this auspicious and National festival "Farmers day" a health camp and series of training session were conducted on large and small ruminant.

About 300 farmers (men and women) from 10 villages participated in this programme. Dedicated small ruminant farmers were also provided superior buck and rams.10 buck of Barbari, 5 Jamunapari, 5 Jakhrana and 20 ram of Muzaffarnagari sheep were provided to 40 project beneficiaries for genetic potential improvement of their goat and their village goat and sheep. Earthworm cultures were also distributed to hundreds of farmers to improve their soil fertility.

High yielding seeds of different crop-vegetable-pulse varieties were provided to project beneficiaries to conduct farm demonstrations, so that other may inspire for sowing their field with breeder or foundation seed to obtain high productivity and profitability. Concentrate ration 50 kg each and 2 kg mineral mixture from project fund and woollen blanket (By IFFCO) to more than 100 poor farmers were also gifted.

(Project: Enhancing Livelihood Security of Farming Community through Livestock and Crop Integration using Proven Technologies)

(Dr. (s) Ranvir Singh, IVRI, M.K. Singh, A.K. Dixit and Gopal Dass)

6.7. 2 Development Action Plan for Scheduled Caste (DAPSC) Scheme

The socio-economic development and protection of scheduled caste from discrimination and exploitation has been a high priority from the very start of the planning process. The Government of India has adopted a multi-pronged approach for the socio-economic development of the Scheduled Castes: social empowerment through educational development, economic empowerment through income and employment enhancing avenues and integrated development of scheduled caste (SC) majority villages.

The formation of this project is in accordance with the instructions and guidelines of Government of India vide its "A centrally sponsored scheme for the development of scheduled castes living below the poverty line". This project aims at increasing the income and reducing the poverty of scheduled caste beneficiaries through their skill development and agricultural production.

A. Survey and selection of beneficiaries:

Base line survey was conducted in 22 villages of Mathura district having complete or major SC population to select resource poor beneficiaries.The survey was carried out to study and record data on various socio-economic parameters *viz.* income, animal husbandry practices, animal's production level, crop production and other sources of income. All the beneficiaries were selected from scheduled caste community living below the poverty line. In the process of beneficiaries selection, the preference was given to poor widows, poor divyang and landless labourers. The SC persons having BPL card or Antyodaya card were verified in beneficiaries selection.

B. Input distribution:

During the year **2020**, a total of 5000 kg high yielding mustard seed, 100 medicine kit containing medicines for common diseases and de-wormers, 566 carry bags, 450 water bottles and 12 sheep/goat feeders were distributed. Most of the input distribution programmes were organized on important days like Mahila Kisan Diwas on 15th October, 2020 and Kisan Diwas on 23rd December, 2020.

Fig. 1. Input distribution at Bhim Nagar village

Fig. 2. Distribution of feeders at CIRG

C. Organization of trainings/ Demonstration/Workshop/Awareness camps/Exposure visits:

Trainings

Two training programmes of one day and three days duration were organized at Institute and at Balrai village of the Mathura District, respectively. A total of 170 scheduled caste beneficiaries participated which constituted 50 male and 120 females. These training programme were on 'Scientific Goat Farming' in which various lectures on goat breeding, feeding, health management, marketing and finance etc. delivered by the faculty of ICAR-CIRG, Makhdoom. After successful completion of the training progarmmes beneficiaries were provided the certificate of training.

Fig. 3. Organization of training programme and distribution of certificates to the participants

Workshop and Demonstration

One workshop and two demonstrations were organized during the reporting period. In these organizations, a total of 166 scheduled caste beneficiaries were attended the programmes. Out of total 166, the male participants were 30 and remaining 136 were female beneficiaries. All participants were taught about Scientific Goat Farming and demonstrated various technologies and institute activities related to sheep/goat production.

Fig. 4. Woman farmers at Sheep Unit

Exposure Visits

During this year, a total five exposure visits were organized on different occasions. In all visits, 350 scheduled caste beneficiaries participated. Out of 350 beneficiaries, male and female beneficiaries were 185 and 165, respectively. In exposure visits, participants were exposed to various scientific day to day activities of sheep and goat farm of the Institute and explained the role of sheep and goat in improving socio economic statutes of rural poor.

Fig. 5. Woman farmer on Exposure Visit at the institute and teaching by woman scientist

D. Celebration of Kisan Diwas

Under this scheme 'Kisan Diwas' was also celebrated in the institute on 23rd December, 2020. During celebration of Kisan Diwas, the participants were explained about the contribution of Ch. Charan Singh to the farmers and country.

Fig. 6. Shri Pooran Prakash, MLA, Baldev addressing the farmers on the occasion of Kisan Diwas

बकरी अनुसंधान संस्थान ने महिलाओं को बांटे सरसों के बीज

महिला सशक्तीकरण के लिए केन्द्रीय बकरी अनुसंधान संस्थान का अनूठा कार्यक्रम

अनुसूचित जाति के लोगों को बांटी औषधि किट

बकरी अनुसंधान संस्थान में मनाया किसान दिवस

Fig. 7.Newspaper Clips of some programmes

(Institute Project: Income improvement of resource poor scheduled caste beneficiaries through skill development and scientific agricultural and goat production)

(Dr. (s) Gopal Dass, Nitika Sharma, A.K. Dixit, Arvind Kumar, Mohd. Arif and Vijay Kishore)

6.7. 3 Development Action Plan for Scheduled Tribe (DAPST) Scheme

According to Census-2011, the scheduled tribe population in India was 104.3 million, constitutes about 8.6% of the total population of the country. A total of 98.3 million people belonging to scheduled tribes reside in rural areas whereas 10.5 million people in urban areas. The scheduled tribes are 11.3% of the total population of rural areas and 2.8% of urban areas. There are about 550 tribes in India. As per Socio-Economic Cast Census 2011, there were 19.74 million ST households in the country, constitute about 11% of total households of the country. The major source of income of ST households was cultivation (38%) and casual labour (51.3%) respectively. More than 95% ST households were having monthly income of highest earning household member was less than Rs.5000.

As per the guidelines received from ICAR, we have organised one day training programme for goat farmers of Sahariya Tribe in Lalitpur district of Uttar Pradesh. More than 80 goat farmers were participated. It was joint programme with CSIR-CIMAP Lucknow on 23rd January 2021. Under this programme, farmers were appraised on scientific goat practices with special reference to Bundelkhand region. Low cost techcnologies /practices were told to the farmers. The importance of medicinal plants and its increasing demand was addressed by the officials of CSIR-CIMAP, Lucknow. Goat medicine kit, mineral mixture, mineral blocks and technical literature on good practices were distributed to the farmers.

(Dr. A.K. Dixit Nodal Officer of DAPST and Dr. Ravi Ranjan , Co-PI)

7 RESEARCH PROJECTS

A. INSTITUTE FUNDED PROJECTS

S. N.	Project No.	Title of the Project	Scientist Team
1.	ANSC CIRG SIL 2020 003 00287	Augmentation of buck fertility through use of polyherbal preparations	**PI: Dr. Chetna Gangwar** Co-PI(s): Drs. Ashok Kumar, S.D. Kharche, S.P. Singh, Ravi Ranjan, Y.K. Soni
2.	ANSC CIRG SIL 2020 004 00288	Production of clone goat embryos and assessment of their survival after in vivo transfer	**PI: Dr. S.P. Singh ,** Co-PI(s): Drs. S.D. Kharche, Chetna Gangwar, Ravi Ranjan, Y.K. Soni
3.	ANSC CIRG SIL 2020 005 00289	Genetic improvement and seed production of Jakhrana goats for milk and meat production	**PI: Dr. Saket Bhusan** Co-PI(s): Drs. Gopal Dass, B. Rai, Nitika Sharma
4.	ANSC CIRG SIL 2020 006 00290	Cost economization of forage production for goats through agronomic interventions in the region of Yamuna ravines of Uttar Pradesh	**PI: Dr. Mohd. Arif** Co-PI(s): Drs. Arvind Kumar, Ravindra Kumar
5.	ANSC CIRG SIL 2020 007 00291	Design and development of poly house type solar dryer for fodder and other produce of goat farm	**PI: Dr. Arvind Kumar** Co-PI(s): Drs. Mohd. Arif, Ravindra Kumar
6.	ANSC CIRG SIL 2020 008 00292	Development of goat based integrated farming system model	**PI: Dr. R. Pourouchottamane** Co-PI(s): Drs. B. Rai, M.K. Singh, Mohd. Arif, K. Gururaj, Arvind Kumar, A.K. Dixit
7.	ANSC CIRG SIL 2020 009 00293	Pathological and epidemiological investigation of goat disease	**PI: Dr. R.V.S. Pawaiya** Co-PI(s): Drs. D.K. Sharma, Ashok Kumar, Anu Rahal, K. Gururaj, A.K. Mishra, Nitika Sharma, Vinay Chaturvedi
8.	ANSC CIRG SIL 2020 010 00294	Epidemiology of abortion in goats and development of a multiplex PCR assay for detection of common abortogenic microbial agents	**PI: Dr. A.K. Mishra** Co-PI(s): Drs. Ashok Kumar, K. Gururaj, Vinay Chaturvedi

9.	ANSC CIRG SIL 2020 011 00295	Standardization of goat milk cheese processing and value addition of its by-product	**PI: Dr. A.K. Verma** Co-PI(s): Drs. V. Rajkumar, K. Gururaj
10.	ANSC CIRG SIL 2020 012 00296	Economic impact of CIRG technologies on goat production	**PI: Dr. A.K. Dixit**, Co-PI(s): Drs. Braj Mohan, Ashok Kumar, K. Gururaj
11.	ANSC CIRG SIL 2020 013 00297	Transfer of goat technologies for sustainable livelihood and enhancing farmer's income	**PI: Dr. Braj Mohan**, Co-PI(s): Drs. A.K. Dixit, Ashok Kumar, Gopal Dass, Ravindra Kumar, V. Rajkumar, Nitika Sharma, Chetna Gangwar, Arvind Kumar, Mohd. Arif, R. Pourouchottamane, Khushyal Singh
12.	ANSC CIRG SIL 2020 014 00298	Evaluation of nutraceutical supplementation on the immune status of goat kids	**PI: Dr. Nitika Sharma** Co-PI(s): Drs. Ashok Kumar, Anu Rahal, Gopal Dass, Saket Bhushan, Ravindra Kumar, K. Gururaj, A.K. Mishra
13.	ANSC CIRG SIL 2020 016 00300	Cross breeding among indigenous goat breed to evaluate their productivity status and development of synthetic breed for broiler production	**PI: Dr. M. K. Singh** Co-PI(s): Drs. A.K. Verma, Ravindra Kumar, R. Pourouchottamane, Ravi Ranjan, Saket Bhusan, Mohd. Arif, Vinay Chaturvedi
14.	ANSC CIRG SIL 2020 018 00302	Evaluation of *Moringa olifera* in the ration of goats	**PI: Ravindra Kumar** Co-PI(s): Drs. Mohd. Arif, A.K. Verma, Arvind Kumar, M.K. Singh, Saket Bhushan, Nitika Sharma, B. Rai

B. AICRP PROJECTS

S. N.	Project No.	Title of the Project	Scientist Team
1.	ANSCCIRG COL 2012 021 00232	**ICAR AICRP (G):** Improvement of sire evaluation of Jamunapari goats for milk & meat production	**PI: Dr. M.K. Singh** Co-PI(s): P.K. Rout, Gopal Dass, R. Pourouchottamane, K. Gururaj
2.	ANSC CIRG COL 2012 022 00233	**ICAR AICRP(G):** Genetic improvement of Barbari goats for milk and meat production	**PI: Dr. M.K. Singh,** Co-PI(s): Drs. A.K. Dixit, S.P. Singh, Ravi Ranjan, Ravindra Kumar, N. Ramachandran, V. Rajkumar, R. Pourouchottamane

4.	ANSC CIRG COP 2015 001 00243	**ICAR-AICRP on PET Project:** Component 1- Assessment of plastic based structures and appliances on goat production Component 2- Development and evaluation of portable plastic encloser for improved kid/lamb rearing	PI: (Drs.) N.Ramachandran (upto 30/08/2020), R.Pourouchottamane (01/09/2020 onwards) Co PIs: (Drs.) Arvimd Kumar, S.P. Singh, B.Rai, and Ravi Ranjan PI: (Drs.) N.Ramachandran (upto 30/08/2020), R.Pourouchottamane (01/09/2020 onwards) Co PIs: (Drs.) Arvimd Kumar, S.P. Singh, B.Rai
5.	AICRP on goat improvement	AICRP on goat improvement Scheme	**PI: Dr. P.K. Rout ,** I/c Project Coordinator

C. ICAR- FUNDED PROJECTS

S. N.	Project No.	Title of the Project	Scientist Team
1.	ANSC CIRG COP 2016 011 00260	**ICAR FF:** Enhancing livelihood security of farming community through livestock and crop integration using proven technologies	**PI: Dr. M. K. Singh**, Co-PI(s): Drs. A.K. Dixit, Gopal Dass
2.	ANSC CIRG COP 2012 030 00242	**ICAR-** Veterinary Type Culture-Microbes (NAINP Bangalore, CIRG Makhdoom Collaboration)	**PI: Dr. U.B. Chaudhary** Co-PI: Dr. Ravindra Kumar
3.	ANSC CIRG COP 2012 024 00235	**ICAR Outreach Programme:** Zoonotic diseases	**PI: Dr. K. Gururaj** (From 01.07.18), Co-PI: Dr. A.K. Mishra, Anu Rahal
4.	ANSC CIRG COP 2015 004 00246	**ICAR-AINP:** Neonatal mortality in farm animals	**PI: Dr. Ashok Kumar** Co-PI(s): Drs. R.V.S. Pawaiya, A.K. Mishra, K. Gururaj
5.	ANSC CIRG SIL 2020 002 00286	**ICAR CABin:** Development of epsilon toxin based novel vaccine against enterotoxaemia in goats: A bioinformatics assisted reverse vaccinology approach	**PI: Dr. R.V.S. Pawaiya** Co-PI(s): Drs. K .Gururaj, (Sunil Kumar UB Angadi, Mir Asif Iquebal, ICAR-IASRI)

D. EXTERNALLY FUNDED PROJECT

S No	Project No.	Title of the Project	Scientist Team
1	ANSC CIRG SOL 2018 002 00276	**DST**- Transcriptome profiling of spermatozoa for development of biomarker for selection of fertile bucks	**Dr. Sonia Saraswat** Mentor: S.D. Kharche
2	ANSC CIRG SOL 2018 007 00281	**DST**-Establishment of efficient culture and transplantation system for goat germ-cells	**PI: Dr. S.P. Singh** Co-PI(s): Drs. S.D. Kharche, Ravi Ranjan, M.K. Singh
3	ANSC CIRG 2018 006 00280	**DST**-Molecular mapping and package of practices for controlling caprine cryptosporidiosis	**PI: Dr. D.K. Sharma,** Co-PI: Dr. K. Gururaj
4	ANSC CIRG SOL 2017 013 00274	**DST**-Designer goat meat products with non-refrigeration quality	**PI: Dr. V. Rajkumar** Co-PI: Dr. A.K. Verma,
5	ANSC CIRG SOL 2018 001 00275	**DST**- Goat based technological and livelihood improvement in Uttarakhand State	**PI: Dr. A.K. Dixit** Co-PI(s): Drs. M.K. Singh, Ravindra Kumar, Raj Kumar, N. Ramachandran, Nitika Sharma
6	ANSC CIRG SOL 2019 001 00283	**DST**-Minimizing the mitochondrial and DNA cryodamages of goat sperm by modified dilutor	**Dr. Pallavi Singh** **Mentor:** Ravi Ranjan
7	ANSC CIRG SOL 2020 001 00285	**DBT**-Development of novel semen extender to optimize post thaw quality for enhancement of productivity and multiplication of superior goat germplasm	**PI: Dr. Ravi Ranjan**, Co-PI(s): Drs. S.D. Kharche, S.P. Singh, M. S. Chauhan
8	ANSC CIRG COP 2020 015 00299	**NABARD:** Scientific Approaches for goat productivity improvement for enhancing farmers' income in Achnera and Etmadpur blocks of Agra District, Uttar Pradesh	**PI: Dr. A.K. Dixit,** Co-PI(s): Drs. M.K. Singh Ravindra Kumar, Ravi Ranjan R. Pourouchottamane, Nitika Sharma
9	ANSC CIRG COL 2020 017 301	**UPCAR:** Conservation and phenotypic documentation of Mirzapuri goat breed	**PI; Dr. Chetna Gangwar** Co-PI(s): Drs. Priya Ranjan Kumar, S.D. Kharche, A.K. Dixit, B. Rai

8 PATENT,TECHNOLOGIES DEVELOPED, COMMERCIALIZATION AND CONSULTANCIES (ITM UNIT)

8.1 PATENT GRANTED: This year Institute granted following two patents:

S.N.	Title	Name of first Inventor	Patent application No.	Date of Granted
1.	A synergistic anti-bacterial herbal preparation for animals	Dr. Ashok Kumar	340760 (2840/DEL/2010)	07-07-2020
2.	A herb based antibacterial preparation for veterinary use	Dr. Ashok Kumar	341364 (2841/DEL/2010)	13-07-2020

8.2 FIRST EXAMINATION REPORT (FER) SUBMITTED FOR FOLLOWING PATENTS

S.N.	Title of innovations	Name of First Inventor	Application number	Date of FER
1.	AJAS antiseptic-Goat milk based natural herbal antiseptic soap	Dr. Ashok Kumar	3256/DEL/2014)	30-01-2020
2	AJAS green-Goat milk based natural herbal beauty soap	Dr. P.K. Rout	3257/DEL/2014	17-01-2020
3	AJAS-Goat milk based natural beauty soap	Dr. P.K. Rout	3258/DEL/2014	29-01-2020

8.3 INSTITUTE SIGNED MOU WITH NATIONAL BIODIVERSITY AUTHORITY, CHENNAI FOR FOLLOWING PATENT APPLICATIONS

S. N.	Title	Patent application No.	Date of signing MoU with NBA
1.	Economic concentrate pellet feed with Brassica oil cake for ruminant feeding, chemical composition, production, protocol, storage and uses thereof. (3516/DEL/2013)	3490 (NBA, Chennai) 05.08.2019	20-07-2020

2.	Oil extracted meal (cake) less concentrate feed for ruminants, chemicals constituents, production, methodology, storage and uses.(3517/DEL/2013)	3492 (NBA, Chennai) 05.08.2019	13-08-2020
3.	Method of preparation of immunologically active adjuvant bound aqueous *Brucella melitensis* formulations and there use of.(201711041176)	3494(NBA, Chennai) 05.08.2019	20-08-2020
4.	Method for development of herbal immunomodulatory composition for goats	201811028895	20-11-2020
5.	Method for preparation for herbal anti stressor formulation for goat	201811028896	20-11-2020
6.	AJAS-Goat milk based natural beauty soap	3258/DEL/2014	20-11-2020

8.4 ITMC MEETINGS

One ITMC meeting was organised to present institute commercializable technologies.

Programme Organised for Technology Commercialize/Transfer	**Number of Participants**	**Date of Event**
ITMC meeting	ITMU –To discuss the possibility of technology " Goat Cervix Visualization Glass speculum" and suggested that some more data may be generated visibility for the possibility of commercialization This Discussion was attended by: ITMC Member	07-07-2020 (18th ITMC) ICAR- CIRG Makhdoom

8.5 THREE KISAN/ENTREPRENEUR MEETINGS WERE ORGANISED AT INSTITUTE TO PRESENT COMMERCIALIZABLE TECHNOLOGIES

- Gosthi on Institute goat production technologies with 64 Farmers/entrepreneurs from 13 States on 01.02.2020.
- Gosthi on Institute goat production technologies with 72 Farmers/ entrepreneurs from 14 States on 15.02.2020.
- Online Gosthi on Institute goat production technologies with 95 Farmers/entrepreneurs from 14 States on 05.11.2020.

8.6 TECHNOLOGIES UNDER COMMERCIALIZATION

- BRUCHEK: A Dot-ELISA Kit for detection of brucellosis in goats and sheep
- Diagnosis of para tuberculosis ELISA KIT (Serum and Milk)
- Stressol-G: An Herbal Antistress Formulation
- Goat meat Pickle

- Goat meat Nuggets
- Herbal Goat meat Nuggets
- Goat meat Sausage
- Goat meat Patties
- Meat Shami Kebab
- Meat Murukku
- Meat Nimkee
- Meat/Milk Biscuits
- Goat Feeders for Better Feed Utilization
- Pelleted Complete Feed Technologies for Sustainable Goat Production under intensive feeding system
- Intra vaginal sponge for Induction and Synchronization of estrus
- Economic complete pellet feed formulation with Azolla for ruminant feeding
- PARACHEK CARD-An eye mucosa colour based targeted selective treatment chart for goats
- Retort processed non –curry based goat products
- Retort processed goat meat curry Products
- Low salt shelf stable chevon pickle
- Gluten free goat meat product
- Chevon nuggets with healthier and balanced fat and fatty acids

Fig.1. Kisan/entrepreneur Gosthi on Institute goat production technologies on 01.02.2020

9 EDUCATION AND ACADEMIC COLLABORATIONS

9. 1 EDUCATION

During this year 07 Ph.D. (06 GLA, 01 Amity University) students are guided for conducting research under different Divisions/Sections of the Institute. Two students from RIVER, Puducherry conducting the part of research work for M.V.Sc. thesis. Students of different academic colleges and Veterinary Colleges visited the institute laboratories and livestock Units. Presently, this institute has academic collaboration with following institution:

1. DUVASU, Mathura
2. GLA, Mathura
3. IVRI, Izatnagar
4. NDRI, Karnal
5. Kamdhenu University, Gujarat
6. Banda University of Agriculture & Technology, Banda
7. Amity University, Jaipur (Rajasthan)
8. R.B.S College, Agra
9. SRR PG College (HNB Garhwal Central University), Srinagar
10. Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Puducherry
11. Chhattisgarh Kamdhenu Vishwavidyalay, Durg (Chhattisgarh)

Fig. 1. ICAR-CIRG MoU signed with RIVER, Puducherry on 28.01.2020

10 TRAINING AND SKILL DEVELOPMENT

10.1 National Training Programme

S.No	Name of training and duration	Sponsoring agency	Nature of participants	No. of participants	Duration
1.	86th National Training Programme	Self-financed	Farmers, entrepreneurs etc.	64 trainees from 13 states	31st January to 6th February 2020 (7 days)
2.	87th national Training Programme	Self-financed	Farmers, entrepreneurs etc.	72 trainees from 14 states	12-18th February 2020 (7 days)
3.	88th (1st Batch) 05 days National Training Programme on Scientific Goat Farming **(On line)**	Free of cost	Farmers, entrepreneurs etc.	56 participants (51 male +05 female) from 11 States	03-07th November 2020 (05 days)

10.2 Sponsoring Training Programme

S.No	Name of training and duration	Sponsoring agency	Nature of participants	No. of participants	Duration
1.	05 days training programme on scientific goat farming	ATMA, district- Satna (M.P.)	Goat farmers	32 farmers from Satna district	23-27th January, 2020

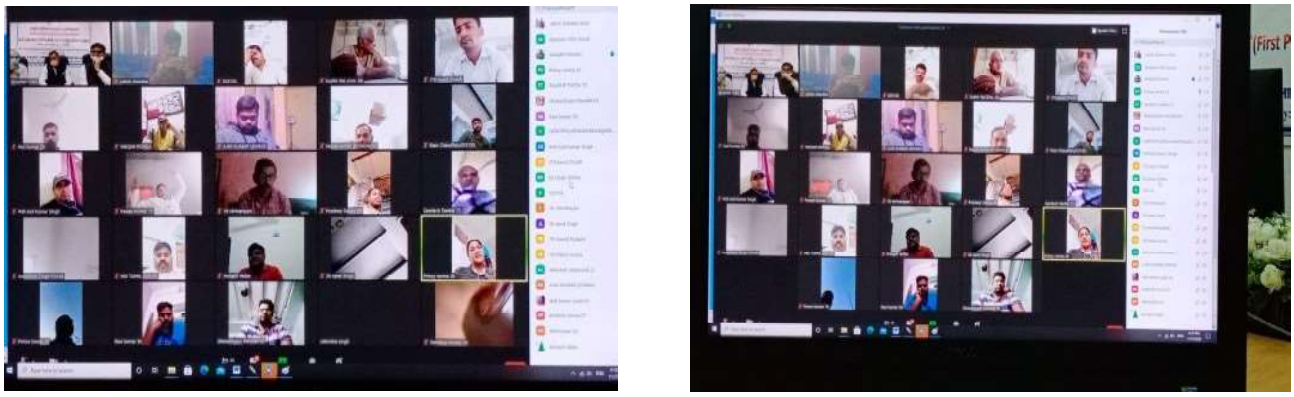


Fig. 1. Participants of National Training Programme on Scientific Goat Farming (On line mode)

11 TRAINING AND CAPACITY BUILDING

Under HRD programme, as the annual training programme, different categories of staff were provided training in referral institution in the country.

Category: Scientific staff

S.N.	Name of employee	Designation	Name of the training programme	Duration (days)	Organizing Institution
1	Dr. Ashok Kumar	Principal Scientist	Patent Searching, Drafting and Filing (29th May to 02nd June 2020)	Five days	Panimalar Institute of Technology, Tamilnadu
2	Dr. Ashok Kumar	Principal Scientist	MPD training on "On Implementation Of Access And Benefit Sharing Regulations In Agriculture Research: Awareness Cum Sensitization Workshop (7th to 10th July 2020)	Four days	ICAR-NAARM, Hyderabad
3	Dr. Mohd. Arif	Scientist	Design Thinking in Research Project Formulation and Implementation (25th to 29th August 2020)	Five days	ICAR-NAARM, Hyderabad
4	Dr. K. Gururaj	Scientist	Baclink component of the WHONET 5 for members of the Indian Network for Fisheries and Animals Antimicrobial Resistance (INFAAR)" on 23.02.2021	One day	INFAAR
5	Dr. K. Gururaj	Scientist	Understanding Basics of Antibiotics in Context of antimicrobial Resistance for INFAAR Members", from 22nd & 23rd June 2020.	Two days	INFAAR
6	Dr. Ravindra Kumar	Principal Scientist	DST sponsored training on "Science Administration Research Management (SARM)" from September 28 to Oct 09 2020.	Twelve days	Administrative staff college of India, Hyderabad

12 RESEARCH PUBLICATIONS

12.1 RESEARCH PAPERS

- Abraham G, Jaiswal P, Singh Y V, Yadav R K, Kumar Ravindra, Mudgal V and Singh P K. 2020. Perspectives on the utilization of *Azolla-Anabaena* system as feed supplement. *Indian Journal of Animal Sciences* **90**(9): 1213-1218.
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- Das A, Bhuyan D, Das P P, Simanta Koushik, Bula Das, Arundhati Phookan, Kharche S D, Singh S P and Chauhan M S. 2020. Comparing the stemness and morphobiometry of spermatogonial stem cells from Doom pig on different days of culture. *Czech Journal of Animal Science* **65**(2): 66–76.
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- Kharche S D, Dass G, Gangwar C, Jena D, Kushwah Y K, and Sikarwar A K S. 2020. Efficacy of two different estrus synchronization protocols for enhancing reproductive efficiency of anestrus ewes. *Indian Journal of Small Ruminants* **26(**1): 250-252.
- Kumar R, Yadav M R, Mohd Arif, Mahala D M, Kumar D, Ghasal P C, Yadav K C and Verma R K. 2020. Multiple agro-ecosystem services of forage legumes towards agriculture sustainability: An overview. *Indian Journal of Agricultural Sciences* **90**(8): 1367–1377.
- Kumar Ravindra, Kumar Arvind, Sudhakar, Anjali, Chakraborty S K and Gupta D L. 2020. Effect of pellet diameter on its physical characteristics and intake in goats. *Indian Journal of Animal Nutrition* **37** (3): 292-295.
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12.2 POPULAR ARTICLES

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- Bhusan S and Gopal Dass. 2020. Jamunapari goats. Ajamukh, Vol. 38, p-4.
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12.3 ABSTRACTS

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12.4 Lead/invited papers in seminars/symposia/workshop

- Dixit A K. 2020. Economics of goat farming under tradition and commercial setup with reference to North Eastern India. Online training for goat farmers of NE India. Integrated Goat Development Association (IGDA), Guwahati, Assam on 2nd August 2020.
- Dixit A K. 2020. Gandhian Model of Rural Development with special reference to goat farming webinar on "Gandhian Model of Rural Development" organized by ICAR-CIRG on 1st October 2020.
- Dixit, A K. 2020. Goat farming for sustainable livelihood security and improving farmers' income. National Webinar Cum Academia Student Interface on "Scientific Goat Farming" organized by Director Research Services, Chhattisgarh *Kamdhenu Vishwavidyalaya*, Durg (C.G.) on 10th July 2020.·
- Gangwar C. 2020. Bakriyon mein kritrim garbhadhan evum iske laabh" in online training programme organized by Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P) under the scheme Attracting and Retaining the Youth in Agriculture (ARYA) on 16 December, 2020.
- Gururaj K, Pawaiya R V S, Kumar A and Mishra A K. 2020. Lead paper on 'Peptide based diagnostics for livestock diseases: Will it be a game changer in the current pandemic scenario?' In: e-Compendium of the International e-conference on "Paradigm shift in Animal Disease Diagnostics: Veracious path in Disease prevention and Control" organized by Department of Veterinary Microbiology and Department of Veterinary Public Health and Epidemiology, Veterinary College and Research Institute, Tirunelveli from 07.10.2020 to 09.10.2020. Page 36-53.
- Gururaj K, Pawaiya R V S, Kumar A and Mishra A K. 2020. Peptide based diagnostics for livestock diseases: Will it be a gamechanger in the current pandemic scenario? Invited Lead Paper delivered online in the International e-conference on "Paradigm shift in animal disease diagnostics; Veracious path in disease prevention and control" organized by Veterinary College and Research Institute, Tirunelveli, (TANUVAS, Chennai), Tamil Nadu, India from from 7-9 October, 2020.

- Kumar, A and Rahal A. 2020. Can herbal immunomodulation be the solution for the incurable diseases like Brucellosis in animals? International eConference "Immunology in 21st Century for Improvising One-Health" held on 7-8 August 2020, jointly organized by Society of Immunology and Immunopathology, India, Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Meerut, India and Department of Animal Husbandry and Dairying (DAHD), Govt. of India, New Delhi.
- Pawaiya R V S, Gangwar N K, Gururaj K, Sharma Nitika, Kumar A and Sharma D K. 2020. Immunohistochemistry in animal disease diagnosis**"** Invited Lead Paper delivered online in the International e-conference on "Paradigm shift in animal disease diagnostics; Veracious path in disease prevention and control" organized by Veterinary College and Research Institute, Tirunelveli, (TANUVAS, Chennai), Tamil Nadu, India from from 7-9 October, 2020.
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- Ranjan R. 2020. Artificial Insemination in Goat-Present status and future prospect. Frozen semen technology in domestic animal, Webinar organised by Dantiwada Agriculture University, Sardar krushinagar. Gujarat-385506, 7-16 July, 2020.
- Singh M K and Chauhan M S. 2021. Exploring potential of small ruminant based dairy farming in India (on-line presentation). XVIII Annual Convention and National Webinar: Harnessing Potential of Indigenous Animal Genetic Resources for Enhancement of Productivity and Profitability. Organized By ICAR-NBAGR and SOCDAB. Page- 180-192.
- Yadav S, Kumar A, Singh V K, Yadav S K and Rahal, A. 2020. Interplay of oxidative stress and antioxidants during vaccination and challenge in mice mastitis model, at XI International Scientific Agriculture Symposium "Agrosym 2020" Virtual conference held on 8-9 October 2020, Bosnia and Herzegovina.

12.5 Technical folders/bulletin

- Chetna Gangwar, Vijay Kumar, Brajmohan, Vinay Chaturvedi, A.K. Dixit and S.D. Kharche. 2020. Bakriyon me Janan Sambandhi Samasyaen Evum Unka Nidan.
- Sharma D K, Paul S, Gururaj K, Sharma N, Sharma A, Roy S S, Angom B.and Debnath B C. 2020. Goat Husbandry, Cryptosporidiosis and Human Infection. Leaflet published by Director, ICAR-CIRG, Makhdoom
- Dixit A K, Kumar S, Singh M K, Sharma N and Kumar R, Chauahan A. 2020. *Bakriyon ke safal vipanan hetu aavasyak sujaav.* Published by ICAR-CIRG.
- Dixit A K, Kumar S, Singh M K, Sharma N Kumar R, Chauhan A. 2020. Bakriyon ke safal vipanan hetu aavasyak sujaav. Published by ICAR-CIRG.
- Dixit A K, Singh M K, Kumar R, Pourochottamane R, Rajkumar V, Ramachandran N, Paul S, Sharma N, Kumar S and Chauahan A. 2020. Vyagyanik Bakri Palan Kriyakalap Vivaranika. Published by ICAR-CIRG.
- Dixit A K, Singh M K, Kumar R, Ramachandran N, Sharma N and Kumar S. 2020. Vyagyanik vidhi dwara Bakri Palan: aay vridhi ka uttam sadhan. Published by ICAR-CIRG.
- Dixit A K, Singh M K, Kumar R, Ramachandran N, Sharma N, and Kumar S. 2020. Vyagyanik vidhi dwara Bakri Palan: aay vridhi ka uttam sadhan. Published by ICAR-CIRG.

- Dixit A K, Singh M K, Kumar R, Ramachandran N, Rajkumar V, Sharma N, and Kumar S. 2020. Uttarakhand Rajya Ke Liye Bakri Palan Nirdeshika. Published by ICAR-CIRG.
- Dixit A K, Singh M K, Kumar S, Kumar Ravindra and Sharma Nitika. 2020. *Uttarakhand Rajya kr Unnat Bakri Palako ke Saflta ki Kahani*. Published by ICAR-CIRG.
- Kumar R, Dixit A K, Kumar S and Sharma N. 2020. Uttarakhand Rajya ke vriksh: Bakri aahaar ke uttam strot. Published by ICAR-CIRG.
- Kumar R, Dixit A K, Kumar S and Sharma N. 2020. *Uttarakhand Rajya ke vriksh: Bakri aahaar ke uttam srot.* Published by ICAR-CIRG.
- Ramachandran N, Kharche S D, Ranjan R, Singh S P, **Gangwar C**, Soni Y K, Pourouchottamane R and Rai B. 2020. Shelter designand layout plan of individual buck shed for higher semen production in frozen semen stations.
- Rajkumar V, Dixit A K, Kumar Ravindra and Kumar S. 2020. *Bakri Mans Evam Dugdh Utpad.* Published by ICAR-CIRG.
- Ramachandran N, Dixit A K, Kumar Ravindra and Kumar S. 2020. *Uttarakhand Rajya me Bakri Awas Prabandhan.* Published by ICAR-CIRG.
- Sharma D K, Paul S, Gururaj K, Sharma N, Sharma A, Roy S S and Debnath B C. 2020. Goat Husbandry, cryptosporidiosis and human infection. Published by ICAR-CIRG.
- Sharma D K, Sharma N, Gururaj K, Mishra A K, Rahal A, Sharma A, Pawaiya R V S and Kumar A. 2020. Bakri palan, Cryptosporidium evam manav sankraman. Published by ICAR-CIRG.
- Sharma N, Dixit A K, Singh M K, Kumar R, and Kumar S. 2020. Uttarakhand Rajya mein navjaat bakri memnon ki dekhbhaal. Published by ICAR-CIRG.
- Sharma N, Dixit A K, Singh M K, Kumar R, and Kumar S. 2020. *Uttarakhand Rajya mein navjaat bakri memnon ki dekhbhaal.* Published by ICAR-CIRG.
- Singh M K, Dixit A K, Kumar R, Sharma N and Kumar S. 2020. Chegu evam Pantja: Uttarakhand Rajya mein bakri ki upyukt nasal evam unka prabhandhan. Published by ICAR-CIRG.
- Singh M K, Dixit A K, Kumar R, Sharma N and Kumar S. 2020. *Chegu evam Pantja: Uttarakhand Rajya mein bakri ki upyukt nasal evam unka prabhandhan*. Published by ICAR-CIRG.
- Singh M K, Dixit, A K, Kumar Ravindra, Sharma N and Kumar S. 2020. *Uttarakhand Rajya me Vegyanik Vidhi Se Bakri Palan*. Published by ICAR-CIRG.

12.6 Book/compendium/Reports/Manuals/Book chapters etc.

- Malik J K, Bharti V K, Rahal A, Kumar D and Gupta R C. 2020. Cyanobacterial (blue-green algae) toxins 467-78. Chapter In: Handbook of Toxicology of Chemical Warfare Agents Edited by Ramesh C. Gupta. Academic Press.
- Rahal A, Kumar D, and Malik J K. 2020. Neem Extract. Chapter in Nutraceuticals (Second Edition), edited by RC Gupta, pages 585-98, Academic Press.

12.7 **GENE BANK ACCESSION**

- BankIt2443682 Muzaffarnagri6_Ovar-DRB1*0402_allele MW821699
- BankIt2443682 Muzaffarnagri15_Ovar-DRB1*0401_allele MW821700
- BankIt2443682 Muzaffarnagri18_Ovar-DRB1*0101_allele MW821701
- BankIt2443682 Muzaffarnagri41_Ovar-DRB1*0101_allele MW821702
- BankIt2443682 Muzaffarnagri48_Ovar-DRB1*1001_allele MW821703

13 PARTICIPATION IN WORKSHOPS TRAININGS/SEMINARS/SYMPOSIA CONFERENCE/WEBINARS

- Dr. D.K. Sharma attended International e-conference "Insights in to the diagnosis and control of parasitic diseases for enhanced livestock production" held on 7-8 December 2020 organized by Veterinary College and Research Institute, Orathanadu, Thenjavur
- Dr. A.K. Dixit delivered lecture in National Webinar Cum Academia Student Interface on Scientific Goat Farming organised by Director Research Services, Chhattisgarh Kamdhenu Vishwavidyalaya, Durg (C.G.) on 10th July 2020.
- Dr. A.K. Dixit delivered lecture in Online training for goat farmers of NE India organised by Integrated Goat Development Association (IGDA), Guwahati, Assam on 2nd august 2020.
- Dr. A.K. Dixit organised Webinar on "Gandhian Model of Rural Development" on 1st October 2020.
- Dr. A.K. Dixit participated in Meeting of Regional Committee Region-I (Uttarakhand, Himachal Pradesh and UTs of Jammu & Kashmir and Ladakh) organised by ICAR New Delhi on 30th June 2020.
- Dr. A.K. Dixit participated in Special screening and discussion on how an all women's Milk Cooperative in India is transforming lives and gender roles. Screening on Swakrushi - reshaping gender norms in India organised by ILRI on 28th November 2020·
- Dr. A.K. Dixit participated in web clinic on ISTI portal on the focal themes "Agriculture production and innovation", "Post-harvest technology", "MSME & Economic" and "Social Infrastructure Sector" organised by DST on 19th & 20th November 2020.
- Dr. A.K. Dixit participated in webinar on Agricultural Development organised by ICAR-NIAP on 24th June 2020.
- Dr. A.K. Dixit participated in webinar on Agriculture Extension Priorities during COVID times organised under ICAR leadership on 3rd July 2020.
- Dr. Anil Kumar Mishra attended International e-Conference of SIIP-2020 on 'Immunology in 21st century for improving one health' organized by SVPAUT, Meerut on August 7-8, 2020.
- Dr. Anil Kumar Mishra attended International Webinar on 'Covid-19 on worldwide dashboard: pandemic that unites science together' organized by Malaysian Society of Parasitology & Tropical Medicine on August 26, 2020.
- Dr. Anil Kumar Mishra attended International Webinar on 'Iron metabolism and its disorders: from anaemia to hemochromatosis' organized by DUVASU, Mathura on August 31, 2020.
- Dr. Anil Kumar Mishra attended International Webinar on 'Microbiome, immunity and vaccines' organized by IAVMI on August 30, 2020.
- Dr. Arun Kumar Verma attended a webinar meeting on "NABL Accreditation of ICAR Laboratories" on July 22, 2020.
- Dr. Arun Kumar Verma participated online training programme on "Smart dairy farming: Boosting productivity through innovations" organized by NAHEP-CAAST, NAU, Navsari, Gujarat, India during 18-22 August 2020.
- Dr. Arvind Kumar participated in International Web Conference on "Soil Health Management for sustainable crop productivity" organized by Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar, India from 07th to 08th September, 2020.
- Dr. Arvind Kumar participated in International Webinar Series on "Moringa- A super food - Boon to mankind" organized by Department of Vegetables, Horticulture College and Research Institute (TNAU) in association with EDII Periyakulam Horti Business Incubation Forum held during 05-07 Oct, 2020.

- Dr. Arvind Kumar participated in the "National Web Conference on "Sustainable fodder production for improving the livelihood of small and marginal farmers" organized by Bihar Agricultural University, Sabour, Bhagalpur held on 26 November, 2020.
- Dr. Anil Kumar Mishra received award *"All India Monthly Article Writing Competition"* for the month of November, 2020 for the article entitled as "Goat Plague: PPR (Peste des petits ruminants) and its prevention and control" published by *epashupalan.com.*
- Dr. Anu Rahal co-organized Webinar On Wild life and human conflict: a long journey ahead Date: 16 August, 2020 Organised by : Society of Immunology & Immunopathology
- Dr. Anu Rahal participated in International eConference "Immunology in 21st Century for Improvising One-Health" held on 7-8 August 2020, Jointly organized by Society of Immunology and Immunopathology, India, Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Meerut, India and Department of Animal Husbandry and Dairying (DAHD), Govt. of India, New Delhi.
- Dr. Anu Rahal participated in webinar *corona evam atmnirbhar bharat-bhartiya vaigyaniko ke samaksh chunotiya evam avsar* organised by RSS, Braj on 4th july, 2020.
- Dr. Anu Rahal participated in webinar on, "Post pandemic challenges and opportunities in Animal Health" organized by Department of Veterinary Medicine, College of Veterinary & Animal Sciences, SVPUAT, Meerut on August 14, 2020
- Dr. Arun Kumar Verma attended a Brain-storming session on "Potential of non-bovine milk" organized by the National Academy of Agricultural Sciences (NAAS) and presented my views as speaker on "Untapped functional potential of goat milk" on June 29, 2020.
- Dr. Ashok Kumar attended webinar on "Nanotechnology in veterinary practice: Opportunities and challenges" organised by Indian Society for Veterinary Medicine (ISVM) on 11th July 2020.

- Dr. Ashok Kumar attended webinar on "Nanotechnology in veterinary practice: Opportunities and challenges" organised by Indian Society for Veterinary Medicine (ISVM) on 11th July 2020.

- Dr. Ashok Kumar attended webinar on "Patent prosecution challenges and strategies in India" Organised by the frontiers legal and turnip innovation on: 25th July 2020.
- Dr. Ashok Kumar attended webinar on the topic of "Predictive microbiology in food safety" on 27th June 2020 organised by Department of Basic And Applied Science, NIFTEM Kundli, Sonipat (Haryana).
- Dr. Ashok Kumar attended webinar on the topic of "Dilemma between publishing & patenting" on 05th August 2020 organised by IKP, Knowledge Park, Telangana.
- Dr. Chetna Gangwar participated in International e conference on "Immunology in 21st century for improvising one health organized by SVPUA&T, Meerut from 7-8 Aug 2020.
- Dr. Chetna Gangwar participated in National Symposium and XIV Biennial Conference of Association of Public Health Veterinarians (APHV) held on 24-25 Jan, 2020 at DUVASU, Mathura.
- Dr. Chetna Gangwar participated in National Webinar On "Conceptualization of Modern Anatomy: Theory & Practice" Organized by Department of Veterinary Anatomy, DUVASU, Mathura on 4-5 Aug 2020.
- Dr. Chetna Gangwar participated in Online Webinar organised by G.O.I on World Food Day and to celebrate 75th Anniversary of the Food and Agriculture Organization on 16 October 2020.
- Dr. Chetna Gangwar participated in webinar on 'Climate change and agroforestry- Impacts, implications and strategies' on 5th June 2020 organised by CSA Kanpur.
- Dr. Chetna Gangwar participated in webinar on 'Perspective of agroforestry for improved Mithun husbandry' on world environment day (5th June 2020), organised by NRC Mithun.

• Dr. Chetna Gangwar participated in webinar on 'The saga of artificial insemination in Indian dairying' organised by NDRI Karnal on World milk day (1st June 2020).

• Dr. D.K. Sharma attended International e-conference "Insights in to the diagnosis and control of parasitic diseases for enhanced livestock production" held on 7-8 December 2020 organized by Veterinary College and Research Institute, Orathanadu, Thenjavur

• Dr. D.K. Sharma attended International Webinar on "Novel approaches and emerging issues in parasitic diseases of veterinary and medical importance" held on 18 September 2020 organized by Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar, Karnataka.

• Dr. D.K. Sharma attended National webinar cum academia student interface on scientific goat farming held on July 10 2020 under the aegis of Chhattishgarh Kamdhenu Vishwavidyalaya, Durg Chhattishgarh.

• Dr. D.K. Sharma attended webinar on Response of DBT's Autonomous Institutes to COVID-19-Part-I" held on 21, August 2020 organized by India Alliance.

• Dr. Gopal Dass attended International webinar series on "Moringa- A super food - Boon to mankind" Organized by Department of Vegetables in association with Periyakulam Horti Business Incubation Forum from 5-7 October, 2020.

• Dr. Gopal Dass attended Online Webinar organized by G.O.I on World Food Day and to celebrate 75th Anniversary of the Food and Agriculture Organization on 16 October, 2020.

• Dr. Gopal Dass attended International webinar series on "Moringa- A super food - Boon to mankind" Organized by Department of Vegetables in association with Periyakulam Horti Business Incubation Forum from 5-7 October, 2020.

• Dr. Gopal Dass attended Online Webinar organized by G.O.I on World Food Day and to celebrate 75th Anniversary of the Food and Agriculture Organization on 16 October, 2020.

• Dr. K. Gururaj invited as an expert speaker to deliver lecture on 'Abortion in small ruminants' on 24th February, 2021 during 5 days International Online Training Programme on "Advances in small ruminant disease diagnostics, therapeutics and control measures" organized from 23rd to 27th February, 2021 by Post Graduate Institute of Veterinary and Animal Sciences, Akola, Maharashtra.

• Dr. K. Gururaj invited as an expert speaker to deliver the Lead Paper on "Peptide based diagnostics for livestock diseases: Will it be a game changer in the current pandemic scenario?" in the International e-Conference on "Paradigm shift in Animal Disease Diagnostics: Veracious path in Disease prevention and Control" organized by Veterinary College and Research Institute, Tirunelveli from 07.10.2020 to 09.10.2020.

• Dr. K. Gururaj participated and delivered oral presentation on topic 'Calcium signalling pathway leads to invasion and persistence of *Mycobacterium avium subspecies paratuberculosis* (MAP) infection in goats' during the International e-conference on 'Immunology in 21st century for improvising one health' jointly organized by College of Biotechnology, SVPUAT, Meerut, Department of Animal Husbandry and dairying (DAHD), Govt. of India and Society of Immunology and Immunopathology (SIIP), India.

• Dr. M.K. Singh delivered invited presentation to Principal Scientific Advisor to GOI, Ministry of Ag. & Farmers Welfare, New Delhi in a webinar on "Innovative & Strategic management practices to increase Farmers Income" on 8th September 2020.

• Dr. M.K. Singh delivered Key note in Webinar organized by ICAR-CIRG on Gandhian Model of Rural Development on 1st October 2020.

• Dr. M.K. Singh delivered presentation as invited speaker on "Growth, production and reproductive performance of goat breeds in India and breeding tools to enhance their productivity" in Webinar organized by Kamdhenu University, Durg, Chhattisgarh on 10th July 2020.

• Dr. M.K. Singh participated as invited panelist in the Brain-storming on Potential of Non-bovine Milk Organized by NAAS, Delhi on 29th June 2020.

• Dr. M.K. Singh participated in online training on "Training Management Information System (TMIS) for HRD Nodal Officers of ICAR" on 8th May 2020.

• Dr. M.K. Singh participated in the Brain-storming on Stray Cattle: Status and Strategies Organized by NADS(I) on 5th September 2020.

• Dr. Mohd. Arif participated in 3 days international webinar on "Achieving land degradation neutrality" organized by Indian Association of Soil and Water Conservationists (IASWC), Dehradun in collaboration with ICAR-Indian Institute of Soil and Water Conservation (IISWC), Indian Council of Forestry Research and Education (ICFRE), Dehradun from July 22-24, 2020.

• Dr. Mohd. Arif participated in International Web Conference on "Resource Management and Biodiversity Conservation to Achieve Sustainable Development Goals" organized by Academy of Natural Resource Conservation and Management (ANRCM), Lucknow from September 11-12, 2020.

• Dr. Mohd. Arif participated in International Web Conference on "Soil Health Management for sustainable crop productivity" organized by Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar, India from 07th to 08th September, 2020.

• Dr. Mohd. Arif participated in International Webinar on "Strengthening the Immune System against COVID-19 through Agricultural Innovations" organized by College of Agriculture, Fatehpur Shekhawati, Sikar, SKN, Agriculture University, Jobner (Rajasthan) on July 29, 2020.

• Dr. Mohd. Arif participated in International Webinar on "Moringa - A Super Food – Boon to Mankind" organized by Horticulture college and Research Institute, Tamil Nadu Agricultural University from October, 5-7, 2020.

• Dr. Nitika Sharma participated in International e-conference on "Insights into the diagnosis and control of parasitic diseases for enhanced Livestock Production".Organised by Department of Veterinary Parasitology, Veterinary College and Reasearch institute, Orathanadu, Thanjavur, from 7-12 December, 2020.

• Dr. Nitika Sharma participated in International SIIP e - conference on "Immunology in 21st century for improvising one health." Organized by SVPUA&T, Meerut and DAHD, new-Delhi from 7-8 Aug 2020.

• Dr. Nitika Sharma participated in International Web-Conference on "New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development (NTAEBSID-2020)"organised by Agro Environmental Development Society (AEDS) from 21-22 June, 2020.

• Dr. Nitika Sharma participated in International webinar on " Herbal Biomolecules: Novel food technologies in wake of CORONA pandemic." Organised by the AFSTI-Chennai, Chapter, TANUVAS and FSSAI, Chennai from 27-28 August, 2020.

• Dr. Nitika Sharma participated in International Webinar on Iron Metabolism and its disorders: From Anemia to hemochromatosis. Organised by Department of Veterinary Biochemistry, College of Veterinary Science and Animal husbandry, DUVASU, Mathura U.P on 31'st August 2020.

• Dr. Nitika Sharma participated in International webinar series on "Moringa-ASuper-food-Boon to mankind" Organised by Department of Vegetables in association with Periyakulam HortiBusiness Incubation Forum from 5-7 October, 2020.

• Dr. Nitika Sharma participated in Online National webinar on "Transboundary Animal diseases (TADs) and their control" Organised by VIPM and INTAS on 10 September 2020 at 3:30 pm.

• Dr. Nitika Sharma participated in Online Webinar organised by G.O.I on World Food Day and to celebrate 75th Anniversary of the Food and Agriculture Organization on 16 October 2020.

• Dr. Nitika Sharma participated in Presented Invited lecture on "Bakri ke rogs: Unka Bachav evam prabhandhan" in online training programme organized by Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P).

• Dr. Nitika Sharma participated in Presented Invited lecture on "Bakri ke memnon ke rog: Unka Bachav va prabhandhan" " in online training programme organized by Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P) under the scheme Attracting and Retaining the Youth in Agriculture (ARYA) on 16 Decemberr, 2020.·

• Dr. Nitika Sharma participated in Presented Invited lecture on "Bakri rog nivaran hetu deshi aushadiyon hetu upchaar vidhiyan" " in online training programme organized by Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P) under the scheme Attracting and Retaining the Youth in Agriculture (ARYA) on 18 Decemberr, 2020.

• Dr. R. Pourouchottamane participated in online midterm review meeting on AICRP on PET by DDG (Ag. Engi.) on 21st October 2020.

• Dr. R. Pourouchottamane participated in online training on "Training Management Information System (TMIS) for HRD Nodal Officers of ICAR" on 8th May 2020.

• Dr. Raj Veer Singh Pawaiya participated in Agricultural Scientists Meet in India International Science Festival 2020 (IISF-2020) organised online by Ministry of Science and Technology, Ministry of Earth Sciences, and Ministry of Health and Family Welfare, Government of India in collaboration with Vijnana Vharati (VIBHA) by Council of Scientific & Industrial research (CSIR) from 22-25 December, 2020.

• Dr. Raj Veer Singh Pawaiya participated in International e-Conference on "Immunology in 21st Century for improving one health" organized by Society of Immunology and Immunopathology (SIIP) in collaboration with Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Meerut and Department of Animal Husbandry and Dairying (DAHD), Govt. of India, New Delhi from 7-8 August, 2020 and Awarded Fellow of Society for Immunology and Immunopathology.

• Dr. Raj Veer Singh Pawaiya participated in Internationale-conference on "Paradigm shift in animal disease diagnostics; Veracious path in disease prevention control" organized by Veterinary College and Research Institute, Tirunelveli, (TANUVAS, Chennai), Tamil Nadu, India from from 7-9 October, 2020.

• Dr. Raj Veer Singh Pawaiya participated in National Webinar on "Transboundary animal diseases (TADs) and their control" organized by Veterinary Internal and Preventive Medicine Society (VIPM), at Veterinary College, Anand, AAU, Gujrat on 10 September, 2020.

• Dr. Raj Veer Singh Pawaiya participated in Online International Veterinary Pathology Congress – 2020 and XXXVII Annual Conference of Indian Association of Veterinary Pathologists and XI Annual Meeting of Indian College of Veterinary Pathologists and International Symposium on "Role of veterinary pathology in controlling emerging and re-emerging diseases of livestock and poultry: An one health approach" organized jointly by Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University, Seminary Hills, Nagpur- 440006, Maharashtra, India and Indian Association of Veterinary Pathologists and Indian College of Veterinary Pathologists from 26 to 29 December, 2020.

• Dr. Raj Veer Singh Pawaiya participated in Online Virtual Workshops focusing on "Regulatory approaches for agricultural and food/feed applications of animal biotechnology" in Session II on 'Genome editing regulatory approaches for animals' organized by Foreign Agricultural Service, USDA from 23-24 September, 2020.

• Dr. Ravi Ranjan APA National webinar on 25th November 2020. Theme: role of animal physiology towards national food security through production enhancement

• Dr. Ravi Ranjan attended APA National Webinar on 25th November 2020. Theme: role of animal physiology towards national food security through production enhancement. Theme: role of animal physiology towards national food security through production enhancement.

• Dr. Ravi Ranjan attended NAAS Webinar on Challenges to Farming Community under COVID-19 and impact on smallholder farmers: The pandemic threats to livelihoods as well as food security on 28 October 2020.

• Dr. Ravi Ranjan attended Virtual symposium on "Recent developments in buffalo research" jointly organized by the

Indian Society of Buffalo Development in collaboration with the ICAR-Central Institute for Research on Buffaloes (ICAR-CIRB), Hisar scheduled on 08-10-2020.

- Dr. Ravi Ranjan attended Webinar on Advanced semen analysis organised by IMV, India on June 8th, 2020.
- Dr. Ravi Ranjan attended Webinar on the occasion of World Food Day and 75th Anniversary of FAO.
- Dr. Ravi Ranjan attended Webinar on "Gandhian Model of Rural Development" held on 1st October 2020 on the celebration of 150th Birth Anniversary of Mahatma Gandhi.
- Dr. Ravindra Kumar delivered lecture on nutritional management of goats for maximizing productivity in national webinar conducted by ICAR-CIRG and Chattisgarh Kamdhenu University, Durg on July 2020.
- Dr. Ravindra Kumar participated in international webinar on 'Achieving land degradation neutrality from 22nd to 24th July conducted by IASWC, Dehradun.
- Dr. Ravindra Kumar Participated in International Webinar on "Achieving land Degradation Neutrality" from 22-24 July 2020 conducted by IASWC Dehradun.
- Dr. S.D. Kharche attended International webinar on "Let's end rabies through collaboration and vaccination" organized by MAFSU with knowledge partner Alembic on 28th September, 2020.
- Dr. S.D. Kharche attended International webinar on P.V. Narsimharao birth centenary celebrations on "Antimicrobial resistance: Future perspective" organized by P.V. Narsimharao Telangana Veterinary University, Telangana, Hyderabad in collaboration with Colorado state University and Intas Animal Health on 23rd October, 2020.
- Dr. S.D. Kharche attended National Webinar on "One health approach to control and elimination of rabies in India" organized by College of Veterinary Science and Animal Husbandry, AAU, Anand *in collaboration with* association for prevention and control of Rabies in India (APCRI) Held on September 25, 2020.
- Dr. S.D. Kharche participated in the ISVM Webinar on "Novel barrier formulations for veterinary applications" organized by Indian Society for Veterinary Medicine (ISVM) in association with Zydus AHL on 19th September, 2020.
- Dr. S.D. Kharche attended "National Webinar on Molecular & serological diagnosis of COVID-19" held on 6th October,2020 Organized by ISSAR chapter of West Bengal, Institute of Animal Health and Veterinary Biologicals 37, Belgachia Road, Kolkata-700037.
- Dr. S.D. Kharche attended a virtual mini-symposium on "Recent developments in buffalo research" organized by Indian Society for Buffalo Development (ISBD) in collaboration with ICAR- CIRB, Hisar on 8th October, 2020.
- Dr. S.D. Kharche attended International Online Symposium on "Present scenario of vulture conservation in India" organized by Department of Environmental Science Maharaja Ganga Singh University, Bikaner, India in collaboration with Department of Geography, West Virginia University, Morgantown, West Virginia, USA. On 5th September 2020 5:00 pm to 7:00 pm.
- Dr. S.D. Kharche attended international webinar on "Assisted reproduction: A tool for conservation of wild felids" jointly organized by Institute of wildlife research and training center, Nagpur and ISSAR Chapter Maharashtra on 26th August 2020.
- Dr. S.D. Kharche attended International Webinar on "Diagnosis & Management of Chronic Kidney Diseases" Organized by Veterinary Physiology and Biochemistry Department College of Veterinary Science & A.H., Anjora, Durg (Chhattisgarh).
- Dr. S.D. Kharche attended International Webinar on "*Echinococcus multilocularis* –a food born parasite of great concern" held on 29 October,2020 conducted by IDP-Cell NAHEP and school of public health and Zoonosis, college of veterinary science, GADVASU, Ludhiana, Punjab, India.
- Dr. S.D. Kharche attended International Webinar on "Learning from COVID-19: A one health approach for preventing future zoonotic epidemics" held on 28 October, 2020 conducted by IDP-Cell, GADVASU, Ludhiana, Punjab, India.
- Dr. S.D. Kharche attended Live Webinar on Management of peri-partum conditions in bovine by Dr R Ezakial Napolean Professor & Head Veterinary Clinical.

- Dr. S.D. Kharche attended Live Webinar on Management of peri-partum conditions in bovine by Dr R Ezakial Napolean Professor and Head Veterinary Clinical Complex Veterinary College and Research Institute TANUVAS, Namakkal organized by Intas Animal Health.
- Dr. S.D. Kharche attended National webinar on "Transboundary Animal Diseases (TADs) and their control" on Thursday,10th September, 2020 (From 3.30 PM onwards) by Dr. Vivek Kumar Gupta, Joint Director, CADRAD, ICAR, IVRI organized by Veterinary Internal and PrevenŸve Medicine Society (VIPM) along with Knowledge partner Intas Animal Health.
- Dr. S.D. Kharche attended National webinar on "Contemporary issues in teaching and extension during COVID-19 pandemic" from 30-31st May, 2020 organized by CVSc & AH, Mhow, NDVSU, Jabalpur.
- Dr. S.D. Kharche attended National Webinar on "Current scenerio and future challenges with emphasis on awareness about COVID-19 Pandemic" organized by The National Academy of Science, India held on 22nd December, 2020.
- Dr. S.D. Kharche attended online lecture on "Goal Setting and achieving" on Sep 18th 2020 Mrs. Radha Shankarnarayanan, CEO Smart Series, Bengaluru. The lecture is being organized under the Distinguished Lecture Series of CAAST-Advanced Centre for Livestock Health (World Bank funded NAHEP) at ICAR-IVRI.
- Dr. S.D. Kharche attended online lecture on "Neutralizing the threat of COVID-19" by Dr. Rohit K. Jangra, Research Assistant Professor, Albert Einstein College of Medicine, Bronx NY, USA on Sep 10th, 2020 at 04:00 PM (IST). The lecture is being organized under the Distinguished Lecture Series of CAAST-Advanced Centre for Livestock Health (World Bank funded NAHEP) at ICAR-IVRI,Izatnagar,Bareilly.
- Dr. S.D. Kharche attended online lecture on "Studying the neutralizing antibody response to SARS-CoV-2 and screening of virus entry inhibitors" Dr. Ritesh Tandon,Ph.D., FAHA, Associate Professor, Microbiology and Immunology, University of Mississippi Medical Center, . USA on Sep 2nd 2020 at 5:30. PM (IST). The lecture is being organized under the Distinguished Lecture Series of the World Bank Funded NAHEP project entitled "CAAST Advanced Centre for Livestock Health" at ICAR-IVRI, Izatnagar.
- Dr. S.D. Kharche attended participated in the International e-Conference on "Expanding horizons in physio-biochemical and molecular approaches for improving livestock health and production" organized by Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu, India from 19th to 20th, October, 2020.
- Dr. S.D. Kharche attended Participated in the National Webinar on Doubling the farmers' income through livestock sector – Prospects and potentials organized by Madras Veterinary College Campus, Chennai – 600 007, on October 01, 2020.
- Dr. S.D. Kharche attended two days National Webinar on "Basic to recent advances in veterinary andrology" organized by Dept. of ARGO, CVSc, AAU, North Lakhimpur, Assam on 19th & 20th September, 2020.
- Dr. S.D. Kharche attended webinar for Veterinarians on IVF in cow and buffaloes on 18th April, 2020 organized by JK Trust, India.
- Dr. S.D. Kharche attended webinar on "*Gandhian Model of Rural Development"* held on 1st October 2020 organised by ICAR-CIRG Makhdoom.
- Dr. S.D. Kharche attended webinar on "Air matters how air can make or mar life (Real life stories)" on July 4, 2020 organized by Trivector Biomed LLP – Noida.
- Dr. S.D. Kharche attended webinar on "Managerial strategies to combat infertility for sustainable reproduction in bovines" organized by CVSc & AH, Sardarkrushinagar Dantiwada Agricultural University, Gujarat and Veterinary Alumni Association Sardarkrushinagar (VAAS) on 29th May 2020.
- Dr. S.D. Kharche attended webinar on "Post COVID-19 animal husbandry & meat technology sector" organised by College of Veterinary Science and A.H. , Mhow (M.P.) from 21st to 23rd May, 2020.

- Dr. S.D. Kharche attended webinar on "Principles and practice of ultrasonography in dairy animal reproduction" organised by Southern Regional Station of ICAR-NDRI, BENGALURU and TANUVAS, Chennai.
- Dr. S.D. Kharche attended webinar on "Production diseases in farm animals- Part-I" organized by Intas and VCRI, TANUVAS, Salem, Tamil Nadu on 13th September, 2020.
- Dr. S.D. Kharche attended webinar on response of the DBTs Autonomous Institute to COVID-19 (part III) on 15th October, 2020.
- Dr. S.D. Kharche National Webinar on "Advancement in veterinary diagnostics-A journey in veterinary pathology" organized by Rajasthan University of Veterinary and Animal Science, Bikaner and Indian Association of Veterinary Pathology held on 14th October, 2020.
- Dr. S.D. Kharche National Webinar on "Parasites, production and environment" organized by College of Veterinary Science & A.H, Anjora, Durg (Chhattisgarh) held on 17th September, 2020.
- Dr. S.D. Kharche participated in a National webinar on "Adolescent health during COVID-19 pandemic" organized by ISSRF, Dept. of Zoology, University of Rajasthan, Jaipur on 19th September, 2020.
- Dr. S.D. Kharche participated in a webinar on "Updates on treatment and control of mastitis in bovine" organized by Continuing Veterinary education-Alembic Pharmaceutical Ltd on 3rd October, 2020.
- Dr. S.D. Kharche participated in the International e-Conference on "Expanding horizons in physio-biochemical and molecular approaches for improving livestock health and production" organized by Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu, India from 19th to 20th, October, 2020.
- Dr. V. Rajkumar participated in "Workflow for residual analysis on GCMS/MS organised by M/s Shimadzu Analytical India Private Limited on April, 30, 2020.
- Dr. V. Rajkumar participated in 'Science behind Pure Water" organised by M/s Merck Life Science Private Limited on May 14, 2020.
- Dr. V. Rajkumar participated in Brainstorming Session on "Potential of Non-Bovine Milk" organised by NAAS and convened by Dr. M.S. Chauhan, Director, NDRI, Karnal on June, 29, 2020.
- Dr. Yogesh Soni participated in e-workshop on "Application of ultrasonography in animal reproduction & AI in small ruminants" organised by VCRI (TANUVAS), Tirunelveli on 5th November 2020
- Dr. Yogesh Soni participated in Webinar on "A session on accessing Taylor & Francis journals" organized by Taylor & Francis Group on 15th September 2020
- Dr. Yogesh Soni participated in Webinar on 'Super stimulation in cattle for in vivo and in vitro embryo production' organized by Vetoquinol on 8th October 2020.

14 RECOGNITIONS/AWARDS/ PRIZES/HONOURS

National Award

- Braj Mohan received "Bharat Ratna Rajiv Gandhi Gold Medal Award" for Excellence in his respective field on the occasion of 74th National Unity Conference on Individual Achievement &National Development on 21st March, 2020 at Bangalore. Organized by Global Economic Progress & Research Association (GEPRA), New Delhi.
- CIRG Won IIIrd Prize for showcasing goat technologies in National Dairy Mela at ICAR-NDRI, Karnal, Haryana on 15-17 February, 2020.

Scoiety Fellowship Award

- Gopal Dass (2020). Elected for the post of Secretary, Indian Society for Sheep & Goat Production & Utilization (ISSGPU), Avikanagar during year 2020 for a period from 2020-22.
- K.Gururaj, Senior Scientist, Animal Health has obtained Life Membership of Society for Immunology & Immunopathology (SIIP); Membership No. SIIP/LM 323 dated 21 August, 2020.
- M K Singh (2020). SOCDAB FELLOW AWARD-2020 by Society for Conservation of Domestic Animal Biodiversity (NBAGR-Karnal) on 11th February 2021.
- RVS Pawaiya, Principal Scientist, Animal Health has obtained Life Membership of Society for Immunology & Immunopathology (SIIP); Membership No. 285 dated 27 July, 2020.
- RVS Pawaiya, Principal Scientist, Animal Health has obtained Life Membership of Indian Veterinary Association (IVA), Membership No. IVA/UP/115/2020 dated 28 August, 2020.
- RVS Pawaiya, Principal Scientist, Animal Health is the Member of Asian Council of Science Editors; Membership No: 91.12452; http://theacse.com; dated 21 March, 2021.
- RVS Pawaiya, Principal Scientist, Animal Health was awarded Fellowship of Society for Immunology & Immunopathology (SIIP) during International e-Conference organized by Society of Immunology and Immunopathology (SIIP) in collaboration with Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Meerut and Department of Animal Husbandry and Dairying (DAHD), Govt. of India, New Delhi from 7-8 August, 2020.


Society for Immunology and Immunopathology (SIIP)

In recognition of outstanding contributions in the field of Immunology and Immunopathology

Dr RVS Pawaiya
ICAR-CIRG, Mathura
has been admitted

FELLOW

of

Society for Immunology and Immunopathology

8th August 2020

Secretary-General

Appreciation Award

A.K Dixit and team received Appreciation letter from Chief Executive Officer (CEO), Uttarakhand Sheep and Wool Development Board (USWDB), Dehradun for excellent work in the field of goat development in study area DST funded project: Goat based technological and livelihood improvement in Uttarakhand State**.**

Gangwar C. 2020. Appreciation award in online training programme organized by Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P) under the scheme Attracting and Retaining the Youth in Agriculture (ARYA) on 16 December, 2020.

K. Gururaj received the **"Certificate of appreciation for Veterinary Corona warrior"** from **Alembic Pharma** for his dedication and services to animal care to maintain health, productivity and reproductive performance of animals during the challenging time and for playing pivotal role in public health by ensuring health of animals on the occasion of World veterinary day.

Nitika Sharma received **Certificate of Appreciation** from Rajmata Vijyayaraje Scindia Krishi Vishwavidyalaya, KVK, Gwalior (M.P).

Ravindra Kumar awarded with Certificate of Appreciation from Chhattisgarh Kamdhenu University, Durg.

Ravindra Kumar awarded with Certificate of Appreciation from Rajmata Vijayaraje Scindia Krishi Vishva Vidalaya KVK, Gwalior (M.P.)

Presentation Award

Gangwar C. 2020. Best oral presentation Award in the National Symposium and XIV Biennial Conference of Association of Public Health Veterinarians (APHV) held on 24-25 Jan, 2020 at DUVASU, Mathura.

Gangwar C. 2020. Best Hindi article award in e-pashupalan Aug 2020.

Gangwar C. 2020. Best Hindi article award in e-pashupalan Dec 2020.

K. Gururaj received "**Certificate of recognition**" for winning the article writing contest on the theme of 'World Veterinary day' for the month of 24 April, 2021 for the article entitled as "Vaishvik mahamari (Covid-19) ke dauran: ekikruth krishi pranali ek vardhaan" published by epashupalan.com. https://epashupalan.com/hi/9451/veterinary-education/during-the-global-pandemic-covid-19-integrated-agricultural-system-a-boon/

Nitika Sharma was the Winner for the month for All India English Article Writing Competition (Veterinary and animal Husbandry) in e-pashupalan for the month of November 2020.

Nitika Sharma was the Winner for the month for All India Hindi Article Writing Competition (Veterinary and animal Husbandry) in e-pashupalan for the month of September 2020.

A.K. Mishra was winner of "All India Monthly Article Writing Competition" for the month of November, 2020 for the article entitled as "Goat Plague: PPR (Peste des petits ruminants) and its prevention and control" published by epashupalan.com.

अनुज कुमार सिंह सिकरवार एवं मनोज कुमार सिंह 2020 भा.कश.अनु.प.–राश्ट्रीय पषु आनुवांषिक संसाधन ब्यूरो, करनाल हरियाणा द्वारा "भारत में बकरी पालन से ग्रामीण आबादी की आय दोगुनी परिदशष्य एंव संभावना" लेख के लिए द्वितीय स्थान प्रदान किया।

Young Scientsit Award

Dr. Nitika Sharma received Young Scientist Award for Excellence in Research 2020 at International Web-Conference on "New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development (NTAEBSID-2020)"organised by Agro Environmental Development Society (AEDS) from 21-22 June, 2020.

Dr. Ravi Ranjan received Prof S. S. Guraya Young Scientist Award. 2020. from Indian Society for Study on Reproduction and Fertility (ISSRF). 30th Annual meeting of the Indian Society for the Study of Reproduction and Fertility (ISSRF) from 14–16 February, 2020 at Shri Mata Vaishno Devi University (SMVDU), Jammu.

Academy Fellowship

S. P. Singh Received an award of **'Associate of the National Academy of Agricultural Sciences (NAAS)'** at NASC Complex, ICAR, New Delhi for the year 2020-2021.

Gangwar C. 2020. Awarded with the NAVS membership (2019-2020).

Recognition in technical/scientific journals

Nitika Sharma acted as the Editorial member (Invited) of Scientific Kheti.

15 FARM MANAGEMNENT UNIT

15. FARM MANAGEMENT UNIT

(AGRICULTURE FARM AND AGROFORESTRY- Dr. Arvind Kumar and Dr. Mohd. Arif)

Table 1: Major achievements in terms of fodder and grain/seed production (January to December, 2020)

Cultivation and supply of green fodder		
Through fodder crops	685.60 MT	**747.60 MT**
Through tree lopping	62.00 MT	
Seeds /grains		
Barley seeds	30.72 MT	**35.07 MT**
Oat seeds	0.86 MT	
Berseem seeds	0.27 MT	
Guar seeds	3.22 MT	
Straw (*Bhoosa*)		
Guar	9.80 MT	**14.40 MT**
Berseem	4.60 MT	
Agro-Forestry		
Plantation and gap filling	3407 Nos. of plant saplings of Aam, Neem, Peepal, Sahjan, Pakhar, Bargad, Goolar, Jamun, Ber, Deshi babool, Sahtut, Subabool etc. were planted/gap filled in the agriculture farm area, sheep unit, *mayur van* and other places of the institute.	
Plants sapling	Produced 3860 plant saplings of Neem, Peepal, Sahjan, Pakhar, Bargad, Goolar, Jamun, Ber, Deshi babool, Sahtut, Subabool, Gulab, bogunvillia etc. in the farm nursery.	
OTHERS		
Renovation and reclamation of farm land	2 acre undulating land was renovated through JCB work and made suitable for fodder cultivation.	
Auction	Rs. 1,55,500/- revenue generated through auction of Moonj-Phoos & Pamma	

MT- Metric tonne

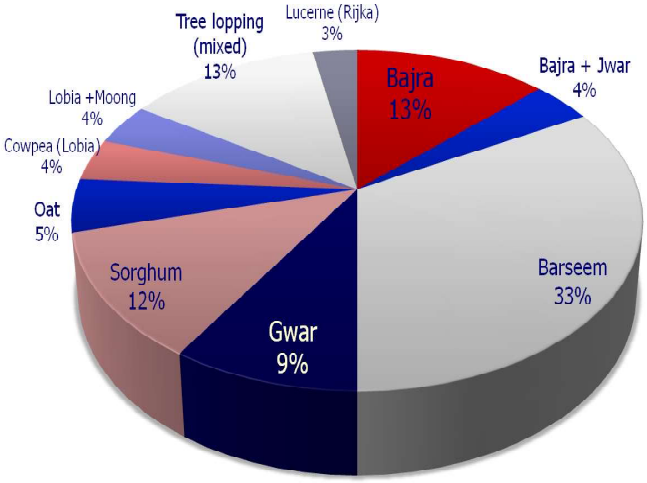


Fig. 1. Graph depicting crop wise green fodder supply to different livestock units

Table 2: Status of forage crops sown during January to December, 2020

Sr. No.	Crops	Area in acres			
		Zaid	Kharif	Rabi	Total area
1.	Moong + Lobia	-	2.50	-	**2.50**
2.	Bajra	8.60	-	-	**8.60**
3.	Jwar	3.00	3.00	-	**6.00**
4.	Napier bajra + Moong	0.25	-	-	**0.25**
5.	Guar	-	24.25	-	**24.25**
6.	Lobia	-	3.50	-	**3.50**
7.	Moringa Gap filling (with seed)	-	5.00	-	**5.00**
8.	Barley	-	-	43.35	**43.35**
9.	Oats	-	-	2.60	**2.60**
10.	Berseem	-	-	6.10	**6.10**
11.	QPM Maize	-	0.50	-	**0.50**
Total area		**11.85**	**38.75**	**52.05**	**101.65**

Table 3: Supply of feed grain and straw (bhoosa) during January to December, 2020

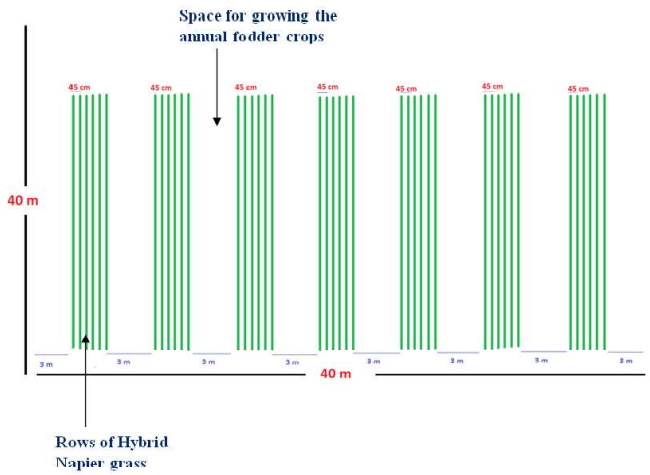
Sl. No.	Livestock unit	Grain in kg		Straw (Bhoosa) in kg	
		Barley	Oat	Guar	Berseem
1.	Jamunapari	9200	200	-	600
2.	Barbari	10021	180	-	4000
3.	Jakhrana	300	-	500	-
4.	Sheep unit	6805	375	-	-
5.	ANM&PT	2000	-	-	-
6.	AP &R	-	-	5500	-
7.	Goats Health	-	-	3000	-
8.	IFS	-	-	1500	
Total		**28326**	**755**	**10500**	**4600**

Other activities

1. 1200 trolley FYM (goat manure) lifted from different goat sheds and incorporated in the agriculture farm field for improving soil quality and productivity enhancement.
2. Replacement of 735 trolley soil from different goat sheds and filling on agriculture farm.
3. Laying and underground installation of 4" diameter PVC pipe for 600 m length on farm for improving irrigation and reducing water loss during conveyance.
4. Stone pitching of about 550 sq m sloppy side near pumping station at *Mayur Van* to prevent soil erosion and recurring maintenance.
5. The Unit is also managing 99 Nos. of MTS engaged in different sections of the institute.

Hybrid napier grass based demonstration model for green fodder production

Hybrid napier grass based demonstration model is developed for the goat farmers, entrepreneurs and other stake holder. The model is developed for encouraging the farmers to grow both annual and perennial fodder crops for round the year green fodder availability. In this model hybrid napier grass was planted at row to row spacing of 45 cm and plant to plant spacing of 15 cm. Total 6 rows were planted in each strip and the total number of strips in this model are 7. A spacing of 3 m was kept in between the napier grass strips for growing of annual leguminous fodder crops. The total length and width of the field are 40 m x 40 m.



Hybrid napier grass is a perennial thus provides green fodder throughout the year except during the severe winter. As it is a grass fodder it provides more carbohydrate and energy to the animals but less crude protein (6.8-7.3%). Therefore, growing of leguminous fodder crops in between the strips of napier grass provides more crude protein as well as diversity in fodder production. Leguminous fodder crops like cowpea, mung etc. can be grown during summer and kharif season whereas berseem, lucerene etc. can be grown during winter season. In this model from Napier grass + Cowpea a total of 188 qt; whereas from Napier grass + Berseem a total of 145 qt green fodder can be obtained. Although efforts are made to produce maximum green fodder yield from per unit area per unit time from this model.

This model permits to cultivate leguminous fodder in the space available in between the napier grass strips, which not only maintains the soil fertility but also provide both leguminous and grass fodder for enhancing goat production. It also permits to produce maximum green fodder yield from unit area. This model also ensures availability of green fodder throughout the year as it includes one perennial crop.

Cultivation of specific crops

QPM Maize

QPM maize was cultivated in ½ acres of farm area for utilization under IFS. The crop was sown in the month of July and harvested in October, 2020.

It was cultivated to explore the utility of QPM grain for goat and poultry feeding under IFS component.

Sahjan (*Moringa Oleifera)*

Sahjan (*Moringa Oleifera)* was cultivated as fodder crop in 10 acres of farm area.

Fig. 2. Cultivation of QPM maize

Fig. 3. Cultivation of Moringa as fodder crop

Inter cropping trial of different fodder crops

Combination of leguminous and non-leguminous crops were tried for maximizing the fodder productivity

Best crop combination	Area cultivated (sq. m)	Non leguminous green produced (kg)	Leguminous green produced (kg)	Total green fodder produced (kg)
Maize + cowpea (2:1)	605	1770	520	2290
Sorghum + Cowpea (2:1)	605	2170	500	2670
P. millet+ C. Bean (2:1)	605	2200	440	2640

Fig. 4. Maize + Cowpea inter cropping

Other services

- Supply of drinking water to the residential quarters and offices.
- Irrigation to the planted trees in the campus through water tankers.
- Supply of LPG cylinders to the residential quarters and laboratories.
- Providing tractor with trailer during *swachchhata abhiyan* and other occasions.
- Cleaning and maintenance of *Mayur van* site for face lifting of the institute.
- The section is also preserving excess green fodder by drying.
- Management of MTS engaged in different sheds and divisions.

Medicinal garden

(Dr(s). Nitika Sharma, Mohd. Arif, Arvind Kumar and Sugad Singh)

Medicinal Garden is established at the Agriculture Section, ICAR-CIRG, Makhdoom for collection, documentation and conservation of local medicinal plant species of semi-arid agro-climatic zone having ethno-veterinary importance. Approximately, 36 species consisting of 21 trees, 10 shrubs, 4 herbs and 1 climber have been planted and maintained in the medicinal garden. Medicinal Garden is maintained in order to conserve the traditionally used local medicinal plant species, utilise the waste and sandy soil for cultivation of medicinal trees and shrubs and to create awareness among members of society regarding the local medicinal plants and their ethno-veterinary uses. Plants traditionally used to treat goats diseases have been identified and maintained in the Medicinal Garden. Some important medicinal plants maintained at the herbal garden are:

Acacia nilotica (Babool), *Aloe barbadensis* (Aloe vera), *Annona squamosa* (Seethaphal), *Azadirachita indica* (Neem), *Calotropis procera* (Aak), *Casia fistula* (Amaltas), *Catharanthes roseus* (Sadabahar), *Adhatoda vasica* (Adusa), *Moringa oleifera* (Sahjan), *Murraya koenigi* (Meethi neem), *Ficus glomerata* (Gular), *Nyctanthus arbotritis* (Har-Shringar), *Ocimum sanctum* (Tulsi), *Phyllanthus emblica* (Amla), *Punica granatum* (Anar), *Ricinus communis* (Arandi), *Saraca indica* (Ashok), *Syzygium cumini* (Jamun), *Terminalia arjuna* (Arjun), *Tinospora cordifolia* (Giloy, Guduchi), *Feronia limonia* (Kaith), *Terminalia bellirica* (Baheda), *Tamarindus indica* (Imli) and *Balanites aegyptiaca* (Hingota).

Tinospora cordifolia (giloy) climber on *Azadirachta indica* (Neem tree) at Medicinal garden

16 METERIOLOGICAL OBSERVATIONS

Mean Monthly Meteorological Observations (January to December 2020)

Month	Max. Temp (°c)	Min. Temp. (°c)	Mean values at 7.30 AM			Mean values at 2.30 PM			Total monthly Rainfall (mm)	Total monthly Sun Shine hours	Number of rainfall days
			Temp. (°c)	Vapour Pressure (mm Hg)	R.H (%)	Temp. (°c)	Vapour Pressure (mm Hg)	R.H(%)			
JANUARY	19.71	6.19	9.10	7.65	93.74	19.87	9.94	61.77	10.59	140.10	3
FEBRUARY	25.93	14.00	10.93	8.21	88.48	25.74	10.41	43.03	0.00	216.50	0
MARCH	30.15	14.74	18.08	12.55	84.84	29.16	12.84	43.58	40.06	246.50	6
APRIL	38.57	20.47	24.82	14.23	62.30	36.92	13.37	30.27	4.42	267.30	1
MAY	42.53	24.32	29.94	16.84	56.03	39.23	16.16	33.06	32.54	273.40	5
JUNE	41.02	27.53	31.20	23.67	70.37	40.13	22.77	43.20	16.74	236.60	4
JULY	39.06	28.05	30.65	26.19	81.35	36.35	26.55	60.39	69.16	188.20	9
AUGUST	35.16	26.68	28.65	26.71	90.71	32.74	28.03	77.23	181.32	148.00	19
SEPTEMBER	38.18	26.10	28.63	25.20	86.40	36.87	24.13	52.43	47.06	246.70	4
OCTOBER	37.18	18.63	21.60	14.42	73.84	35.11	12.23	28.58	0.00	248.60	0
NOVEMBER	28.72	10.88	13.98	10.10	83.60	27.40	10.93	41.33	6.48	167.10	1
DECEMBER	24.69	7.13	10.92	8.77	87.90	23.53	10.65	47.52	0.00	180.40	0

Maximum temperature of 48.5 °c recorded during 24th to 27th May 2020

Minimum temperature of 1.5 °c recorded during 31st December 2020

Annual Rainfall of 408.37 mm in 52 days. (highest rainfall of 42.63 mm recorded on 12th July 2020)

(Generated and compiled by Dr. N. Ramachandran, Dr. R. Pourouchottamane and Mr. Ranjeet Singh YP 1)

17 RADIO TALKS AND TELEVISION PROGRAM

Gangwar C. 2020. Coordinated the Doordharshan team visit at CIRG for documentary preparation and delivered expert lecture. The programme was telecasted on DD Kisan channel on 6 Aug 2020. You tube link: https://www.youtube.com/watch?v=PZoAjckCAqA

Verma A. K. 2020. Coordinated the Doordharshan team visit at CIRG for documentary preparation and delivered expert lecture. The programme was telecasted on DD Kisan channel on 6 Aug 2020. You tube link: https://www.youtube.com/watch?v=PZoAjckCAqA

- Dass G. 2020. Participated in "Krishi Parikrama" about CIRG Books on Goat production at DD Kisan Channel 12.01.2021.
- Dixit A K. 2020. Delivered expert lecture on Extension activities organized by ICAR- CIRG, Mkahdoom. This programme was telecasted by DD Kisan Channel on 6th August, 2020.
- Gururaj K. 2020. Delivered television talk on "बकरियों में संक्रामक रोग" in the – कृषि शिक्षा और अनुसंधान: – कृषि की उन्नत तकनीकों, रोग निदान और उन्नत भीज के बारे में जाने: Doordarshan Programme in DD-KISAN telecasted on 16.07.2020.
- Singh M K. 2020. Delivered knowledge to goat farmers through live telecast on Hello Kishan Doordarshan by Ministry of Agriculture and Farmers Welfare on topic "Goat Farming" on 11-06-2020.
- Singh M K. 2020. Delivered knowledge to goat farmers through live telecast on Hello Kishan Doordarshan by Ministry of Agriculture and Farmers Welfare on topic "Goat breeds, breeding and management" on 20-08-2020.
- Singh M K. 2020. Delivered knowledge to goat farmers through live telecast on Hello Kishan Doordarshan by Ministry of Agriculture and Farmers Welfare on topic "Technological interventions for improving Goat Productivity" on 03-09-2020.

18 PARTICIPATION IN EXHIBITION/MELA

1. Participated in National Dairy Mela at ICAR-NDRI, Karnal, Haryana from 15-17 February, 2020 and Won 3rd Prize.

2. Participated in *Pasu Krishi Vigyan Mela* at ICAR-IARI, New Delhi from 01-03 March, 2020.

Technical Correspondence

About 440 inquiry letters (including e-mail) were received from different categories of aspirants covering different parts of the country on various aspects of goat production and replied suitably.

Visit Arrangement and Coordinator of the Farmer Single Window (A Service to Goat Farmers) at ICAR-CIRG, Makhdoom.

In total 2326 visitors were entertained and apprised them with research, extension and development activities of the Institute.

Helpline Calls

In all 348 calls were received regarding various aspects of commercial goat farming, improved goat production technologies, elite germ plasm and training programmes and replied suitably.

Other Extension Activities

1.Organization of two Goat Health Camps in Chiliyo and Koti villages of Vikas Nagar Block of Uttarakhand under DST project on 10th February, 2020.

2.Under MGMG Treatment of Sick animals, Swaksh Bharat Mission, advisory services and the goat keepers in adopted villages were sensitized about precautions or preventive measures to be taken during the ongoing tough time of COVID-19. Distributed masks and advised to hand wash using soaps.

3.Health Camp, Scientists- Farmers Interaction, Swaksh Bharat Mission, Distribution of mineral mixture, advisory services, distribution of literature on scientific goat farming and the farmers were sensitized about precautions on preventive measures to be taken during the ongoing tough time of COVID-19 and distributed mask and advised to hand wash using soaps on 14th October, 2020 at village Amla Sultanpur, Farah, Mathura, U.P.

4. Organization of Gosthi on "Women Empowerment through Goat Farming" (12 October, 2020) in Uttarakhand-under Department of Science and Technology (DST) funded project entitled: "Goat based technological and livelihood improvement in Uttarakhand State", Gosthis were organized on " Bakri Palan Dwara Mahila Shashaktikaran" in Koti and Chiliyo villages of Vikasnagar Block of Dehradun District. Large numbers of women goat farmers were participated in these gosthis. Lecture on role of women in goat farming was delivered and the participation of women in decision making at household, animal husbandry and other activities level were highlighted. The role of goat based women SHGs was also elaborated by the women staff of local NGO.

Goat health camp, COVID-19 awareness camp, Goat based SHG formation camp, Swach Bharat Abhiyan and other programmes were also organized. Goat medicine kits, mineral mixture, mineral blocks and literature on improved goat farming practices were distributed to the participants. The officials from Uttarakhand Sheep and Wool Board, NGO-BalajiSewaSanthan,Block level officers from NRLM and other members of local panchayat, local media persons were present on this occasion.

5. Organization of Goat Health Camps and Vaccination against PPR in adopted village of Vikas Nagar Block of Uttarakhand under DST project on 17th October, 2020.

6. Plantation of fodder plant in adopted village Vikasnagar Block of Uttarakhand under DST project on 18th October, 2020.

7. Organization of Goat Health Camps and Vaccination against PPR in adopted village of Yamkeshwar Block of Uttarakhand under DST project on 06th November, 2020.

8. Health Camp, Scientists-Farmers Interactions, Swaksh Bharat Mission, Distribution of mineral mixture, advisory services, distribution of literature on scientific goat farming and the farmers were sensitized about precautions or preventive measures to be taken during the ongoing tough time of COVID-19 and distributed mask and advised to hand wash using soaps on 04th December, 2020 at adopted village Nagla Medaki, Farah, Mathura, U.P.

9. Organization of Goat Health Camps and Vaccination against PPR in adopted village of Gangolihat, Pithoragarh block of Uttarakhand under DST project on 07th December, 2020.

10. Showcased ICAR-CIRG Goat technologies on 23rd December, 2020 on the occasion of Farmer's Day in Majhgawan Block, Amla District, Bareilly, U.P.

11. Health Camp, Scientists- Farmers Interaction, Swaksh Bharat Mission, Distribution of mineral mixture, advisory services, distribution of literature on scientific goat farming and the farmers were sensitized about precautions or preventive measures to be taken during the ongoing tough time of COVID-19 and distributed mask and advised to hand wash using soaps on 29th December, 2020 at adopted village NaglaKishanpur, Farah, Mathura, U.P.

Mera Gaon Mera Gaurav Scheme 2020

Coordinator: Dr. Braj Mohan

Co-coordinators:

- Dr. A.K.Dixit
- Dr. R. Pourouchottamane
- Dr. Khushyal Singh (from 29th September 2020)
- Dr. N. Ramachandran (up to 28th August 2020)

As per the guidelines of *Mera Gao Mera Gaurav* scheme, ICAR-CIRG formed eight (8) teams of the scientists (4 scientists in each team) and adopted 39 villages in Mathura and Agra districts of Uttar Pradesh and Bharatpur district of Rajasthan. The progresses of different teams of the scientists are as follows:

The Team VI comprising of members namely Dr. Braj Mohan (Team Leader) and Dr. N. Ramachandran along with opted member Dr Vijay Kishore for extending thorough health

examination to goats during rainy season. In this quarter, we visited only *Nagla Dharampal* on 24.7.2020 as this village has two traditional goat keepers with flock size of 50 each.and visited the goat flocks of Sh. Ramesh S/o Ram Singh (50 goats) as well as Sh. Bahadur S/O Sh. Mansoram (50 goats). All goats are non-descript and are of mixed breed type mainly Sirohi, Barbari and few Batishi breeds. The body condition of all goats in the range of 3-4 on 0-5 scale. One breeding buck with age of 3-5 years were used in the flock and were reared along with female goats. The team examined all goats one by one and provided therapeutic treatment to needy goats. Dewormed all goats and provided mineral mixture supplementation to weak goats.

All goats were reared under zero input system having 6-8 hrs grazing in Yamuna ravine belt. After grazing, all adult goatswere tied in open sky in front of their dwellingadjacent to Yamuna river and no supplement-ation is practiced. Therefore, sensitized the goat keepers to provide locally available cheaper grains, mineral mixture supplementation and deworming at least before and after rainy season for improving the body condition and weight gain. Moreover, the common dewormer boluses were also given to goat keepers for drenching to all goats after rainy season. Further, the villagers were sensitized about the ill-effects of parthenium/congress grass in and around the villages and requested to up-root all the plants before flowering stages during rainy season, as it is very easy to up-root during continuous rainfall. In addition, our team sensitized the Do's and Don'ts for protecting people from COVID-19 pandemic especially social distancing, use of face mask and frequent washing of hands using detergent soap.

Team VIII (October – December 2020)

A joint programme of MGMG with DAPSC was organized on 28.11.2020 in Nagla Sonpal village of farah block. The programme was attended by 100 farmers and they were given the knowledge on various aspect of goat production. During this programme, Dr. Gopal Dass, Principal Scientist spoke about goat breeds available in the country and their utility, selection of breeding stock for starting a goat farm, scientific management of kids and various factors affecting the goat productivity. Dr. D. K. Sharma, Principal Scientist & Head, Goat Health Division explained in detail about health tips and management aspects of kids to increase their survivals. He also gave the knowledge and importance of vaccination in goats. In addition to this, farmer participants were provided a medicine kit and their usage. During this programme goat farmers were also interacted and discussed about the problems faced by them in the goat rearing. From discussion, it was observed that goat farmers were not following scientific goat technologies and getting low production and high mortality rate in goats. After discussion, the farmers were advised to start goat farm with the breed of his area, breeding of goats in proper time and season, scientific management of kids and proper care & vaccination of goats for making goat farming more profitable.

19 SUCCESS STORIES

19.1 Success story of Sh. Bhagat Singh, Dehradun (Uttarakhand)

Address :- Village - Koti, Post - Horowala Block - Vikas Nagar, District - Dehradun (Uttarakhand)

Bhagat Singh's grandfather, a resident of village Koti of Vikas Nagar block in Dehradun district of Uttarakhand state, started goat rearing from 2 indigenous hill goats in 1940, about 80 years ago. And he got this inspiration from the nomadic shepherd coming from Uttarkashi and it was he who told to the fellow villagers about the possibilities of goat rearing in the hilly areas of Uttarakhand. After initial difficulties, he had such experience of goat farming that he made goat farming as a business. Goat rearing in the rural environment of Uttarakhand is not only a source of sustainable income for Bhagat Singh's family, but also saves his family from being a victim of malnutrition. Bhagat Singh ji has about 40 years of experience in goat rearing. He told that I raised sheep as well as goats and also produced wool. But not being able to sell sheep's wool on time became problem. Due to which he left sheep rearing completely. At present, Bhagat Singh has 50-60 goats and goats of indigenous Pahari and Chengu breed. Bhagat Singh takes special care of his goats. They graze their goats in the forest in the mountains for about 6-7 hours a day and this period lasts throughout the year. Apart from this, logging from the forest to the newborn lambs, goats and pregnant goats feed the leaves of trees as fodder, which is a good source of protein, vitamins and minerals and costs less. Earlier, goats were reared only by grazing in the forests. He used to treat goats with indigenous and home remedies. To increase the weight of goats by feeding them, 100-150 grams of concentrtae per day made from maize, maduwa, barley etc.Medicines and vaccines are given to prevent diseases. To reduce the foul odor in the goat enclosure, dry grass and leaves is spread on the floor. Bhagat Singh faced a lot of difficulties in goat rearing, in which the mortality rate of newborn kids and the animals killed by predators. However, the government gives some part of the price of goats killed by wild animals to the goat farmers as a contribution. The average weight of goats is 35-40 kg. At the time of Magh month and worship, the price of goats ranges from about 12 to 16 thousand rupees. He explains that on an average, Rs 2 - 2.5 lakh earns from goat business. He further explains that the project funded by the Department of Science and Technology, Govt. of India, which is being run by the ICAR-Central Institute for Research on Goats (CIRG) Makhdoom, Farah, Mathura, Uttar Pradesh in our district, named contributed a lot to his success.He further explains that under this project we were also given training on goat rearing in which breeding, housing, nutrition, health, marketing and general management etc. were told. Furthermore, time to time, all the scientists, research workers and employees associated with this project also observe the farmers' seminar.

(Coordinators: A.K. Dixit, M.K.Singh, Ravindra Kumar, V. Rajkumar, N. Ramachandran, R. Pourouchottamane, Nitika Sharma, Sandeep Kumar and Amit Kumar)

19.2 Success story of Smt. Kamala Devi, Dehradun (Uttarakhand)

Village – Chilio, Post – Ashok Ashram,
Block – Vikas Nagar,
District – Dehradun (Uttarakhand)

Goat rearing is a boon in making women self-reliant in hilly areas

About 10 years ago Mrs. Kamala Devi started goat rearing with 5 goats of indigenous hill breed and one Biju goat. The total cost of which came to 72 thousand rupees. She tells that she takes special care of her goats. He takes the goats to graze in the forest for 6 to 7 hours every day and the tree leaves are offered to the goats. Apart from this, 100 grams of grain (locally grown maize, wheat etc.) is given per goat per day due to which their animals are quite healthy and shiny. I clean the enclosure daily so that no parasites can grow in the enclosure. In addition to home treatment of goats, vaccination, internal and external anti-parasite medicines are also given from time to time.

Despite landless, she maintains her family well on the earnings from goat rearing. And she herself has become independent. Presently, I have 20 goats in which 4 Khasi, 2 breeding bucks, 8 goats and 6 kids. Apart from this, some chicks were received under a scheme of Animal Husbandry Department. At present 20 chickens are easily kept in the house with the same resources. In which there are 12 egg-layers and 8 chickens.

She tells that the biggest obstacles encountered while taking the goats for grazing, in which wild animals (tigers, leopards, guldars) are prominent. Apart from this, there was non-availability of better price in the beginning, lack of technical knowledge in goat rearing and no financial assistance from the government, etc.

She further tells that in spite of many challenges and difficulties, she did not give up courage and kept on rearing the goat. I started taking my goats for grazing in the form of a herd along with other goat farmers of the village. She kept a dog with the herd, which reduced the fear of wild animals. I feed my family by my own efforts. And I have become self-dependent because of goat rearing. Presently, she earns about Rs.40-50 thousand annually and maintain goat flock close to 20 and from poultry, she earn 10 to 15 thousand by selling chicken and eggs. Overall annual income ranges from 50 to 65 thousand. She expressed thanks that our village was selected under the project being run in our district by the scientists of Central Goat Research Institute, Makhdoom, Farah, Mathura, Uttar Pradesh. He further explains that under this project we were also given training on scientific goat rearing.

After training, there was a lot of improvement in health care, nutrition management, care of young goats, breeding management, buying and selling etc. And all the scientists, research workers and employees associated with this project keep coming from time to time, for whom I thank and thank wholeheartedly. And I hope that you will continue to guide us in the same way in future also.

(Coordinators: A.K. Dixit, M.K. Singh, Ravindra Kumar, V. Rajkumar, N. Ramachandran, R. Pourouchottamane, Nitika Sharma, Sandeep Kumar and Amit Kumar)

19.3 Success story of Sh. Kallu Ram, Dehradun (Uttarakhand)

Address :- Village – Kol, Post – Matogi, Vikas Nagar, Dehradun (Uttarakhand)

Kalu Ram born in a Dalit family of village Kol in Dehradun district, now, he is a successful goat farmer. He told that he is rearing goats since last 15 years started in 2004 with 5 indigenous hill and mixed Chengu breed goats. Kallu Ram further explains that today he has 80 goats in the healthy condition, in which there are 40 adult goats and 22 breeder and khasi goats and 18 kids, which are still less than 3 months old. He has only Chengu cross-breed and indigenous hill species. Kallu Ram takes special care of his goats. He says that, he grazes the goats in the forest and mountains for about 6-7 hours a day and this time is throughout the year. Along with grazing, he gives 150 grams of grain per goat per day, due to which the goats are healthy and weighty now. They used to supplement during autumn. Small kids who do not go for grazing, fed green leaves of trees (Bhimal, Baanj and Guryal). Kallu Ram faced a lot of difficulties in goat rearing, in which the mortality rate of newborn kids and the death rate of animals killed by wild animals (tigers and guldars) is prominent.He further explains that breeders and castrated goats are sold at the time of Magh month and *Pooja* and females are sold only in old age.In this way, he earns about 1.5 -2.0 lakhs annually from goat rearing. Earlier, goat were reared only by grazing in the forest, but after project launch in year 2018, he taught on scientific goat rearing practices in hill regions during training, kisan gosthis and goat health camps organised by ICAR-CIRG under this project. Medicine kits, goat feed, mineral mixture and mineral blocks were distributed among all of goat farmers in the village.

(Coordinators: A.K. Dixit, M.K.Singh, Ravindra Kumar, V. Rajkumar, N. Ramachandran, R. Pourouchottamane, Nitika Sharma, Sandeep Kumar and Amit Kumar)

19.4 Success story of Mrs. Asima Khatoon W/O Mr. Mohamad Aslam Khan

Barbari Goat based Integrated Livelihood Model in Bundelkhand

Name of Farm: Bundelkhand Jaivaik Krishi Farm

Date of Start: November 2018

Initial Investment: 7 lakhs

Name of Technology/ Process/ Model: Goat based Integrated Agricultural Farming

Major Activities:

Production and supply of pure-bred Barbari Male and Females to goat Farmers of Bundelkhand.

Production and sale of organic pulses, grains, oil.

Development and popularization of water conservation techniques and models in farmer's field.

Demonstration and dissemination of integrated (crop, livestock, fish, Water harvesting) techniques and models.

Challenges

बकरी पालन कर कई परिवारों को रोजगार दे रहे असलम

मथुरा से ट्रेनिंग लेकर चालू किया आधुनिक बकरी पालन, गायों से मोह भंग, बकरी में बढ़ा रुझान, उन्नत नस्ल की बकरी को बढ़ावा

खास खबर

25 से 30 प्रतिशत लाभ

बकरी की लेंड़ी की खाद 10 रुपये किलो

डीएम ने भी किया सम्मानित

Selection of breed suitable under intensive feeding management in rain-fed and arid region of Bundelkhand. Barbari breed of goat was chosen as per recommendation of Principal Investigator of AICRP Barbari project on account of its good performance under intensive stall feeding and very good demand for meat in market and of live animals among farmers.

Non- availability of pure-bred and high potential male and female of Barbari goat in field. Sixteen animals including a buck, adult female and growing kids were made available by Institute under Multiplier Flock Scheme of the project.

Initiatives

Acquiring Knowledge and Skill. I visited Institute and Barbari goat farm in 2018 and shown my interest in Barbari based commercial goat farming. As per Principal Investigator, Barbari project guidance I attended National training on commercial goat farming in 2018.After that I started my own farm at Banda and remains in regular touch with Project Investigator and other scientists in designing of goat shedes, initial flock strength, buck: female ratio, breeding of females with respect to month/ seasons, care of pregnant and lactating females, kids management etc. Breeding, production feed consumption and sale data was recorded which includes body weight at 3 month interval up to 12 months of age, milk yield at 15-days interval, breeding of female with sire, date of breeding, type of birth etc. as per scheme agreement.

Results and Interesting facts

1. No kid and adult goat mortality in last 2year.

2. Body weight of male at 3, 6, 9, 12 months of age were 6.9, 9.94, 15.2 and 20.33 kg and corresponding body weight of females were 6.53, 9.87, 14.1 and 19.74 kg, respectively.

3. The body weight of male kids provided by CIRG at 6, 9 and 12 months of age were 15.7, 18.2 and 23.4 kg and corresponding body weight of female were 13.8, 17.6 and 21.2 kg.

4. Incidence of multiple births in 1st lactation was 30% and 62% after 1st parity.

5. Rearing cost of farm born kid up to one year was approximately 4800/kid and of adult goats were 5400 rupees/ animal/year.

6. Sale price of Barbari breeding male at 14-18 months of age is Rs 14000 to 18000 and for female is Rs. 10000 to 12000. There is huge demand of these animals in Bundelkhand under intensive management system. Only breeding male and females were sold for multiplication of seed production purpose.

7. I am also selling goat manure @ Rs 8/kg after earthworm treatment.
8. Every day on average 5 to 6 persons visiting my farm and getting inspiration, motivation and technical support.

Integrated Farm activities involving grain-pulse and oil crops, goat, indigenous cow, fish, poultry and water conservation have been appreciated by several state and national agencies. Me and my wife was also conferred for IARI Innovative Farmer Award in 2020 by **Shri Kailash Choudhary,** Hon;ble Minister of State Agriculture and Farmers welfare, Govt. of India for sustainable integrated farming model, in which Barbari goat farm was major contributor.
9. My slogan is " Think Globally and Act Locally"

(Cooridator: M. K. Singh, M. S. Dige, S.P. Singh, Ravi Ranjan, Nitika Sharma and A.K. Dixit)

19.5 Success story of Sh. Naeem Qureshi

- Name of the beneficiary – Naeem Qureshi
- Father's name – Sh. Rashid Ahmed
- Address – Vyapari Mohalla, Farah, Mathura
- Educational qualification – Higher secondary
- Ancestral occupation – Purchase & sale of goats and selling of goat meat
- Name of Farm – Barbari Goat Farm, Farah, Mathura (Uttar Pradesh)

I was engaged in goat farming business since childhood with my father in Mathura–Agra districts. After grown up, I actively followed my ancestral business in other states of North India. In last 4-5 years, I have visited the farms of multiplier flock scheme being run by the AICRP Barbari unit and inspired to start my own farm. I requested Principal Investigator, Barbari Goat Unit to become me a member of multiplier flock scheme. He asked me to attend the national training on goat farming from the institute. I attended the national training on goat farming in 66th Batch in May 2015 and after that housing for barbari goats were built in which provisions of separate sheds for male, female, and kids made according to the terms of multiplier flock scheme.I was provided 6 adult female, 6 male (3-6 months), 6 female (3-6 months) and 2 breeding buck under the barbari multiplier flock scheme in the year 2018. I brought 15 other adult female barbari goats from Aligarh, Hathras and Etah. As per the conditions of the scheme, I administered PPR, ET and FMD vaccination on time and dewormed goats before and after rainy season. I also provided the data of growth weight, no. of kids born, no. of pregnant goats etc. to the principal investigator at every three months interval. Presently, I have 60 adult female, 33 kids (3-9 months) and 2 breeding bucks of barbari. My aim is to achieve strength of 100 adult goats in my farm. Meanwhile, I have sold 3 male @ Rs. 12000/male and 7 female @ Rs. 9000/female to other farmers.

The reason behind choosing goat farming as a business

There was a huge demand for purebred barbari goat from various states of Northern India for goat farming. As goats can be reared at home easily and there is also a good demand for their meat.

Challenges

Unavailability of high-quality purebred barbari male and female in fields.

The mortality rate in newborn kids (0-3 months) was about 25-30 per cent.

Younger kid (3-6 months) had a lower weight gain

Initiatives

The high quality purebred animals obtained from AICRP Barbari Unit boosted my moral

The cause of mortality in newborn kids (0-3 months) is due to their premature birth (April to August and December-January). After joining the scheme, the goats were bred only in September to November and May-June. As a result, kids were born in October-November and February-March. Special care was also given to the newborn, due to which not even a single case of kid mortality occurred during 2019-20.

The reason behind the small increase in the weight of kids (2-6 months) was to keep them with adult goats or interchanging the sheds of kids and adult goats. During the farm visit, Principal Investigator told that kids and adult goats should not be kept together and the kid should be housed in a separate shed.

Results and benefits

In the first year of joining the scheme, no kids and adult goats died on my farm. The weight of barbari male and female given by the institute at the age of 6, 9 and 12 months was 15, 19.6 and 28 kg; and 13, 17 and 24 kg, respectively. Further, the average weight of barbari kids born at the farm was 7.5, 16, 19 and 25 kg at the age of 3, 6, 9 and 12 months, respectively. I am providing goats and their kids provided by the institute for the seed development purposes. Meanwhile, I also cross the goats purchased from the village with barbari buck provided by the institute and sell its kids to the other farmers on average of Rs.10000 to12000/- from this I get the benefit of Rs. 5000 to 6000 per animal. I prepare 20 animals for Eid festival and their weight reaches up to 75 kg in 15 months, I sell these animals @ Rs. 22,000/animal and from this practice I save Rs. 10,000/animals in one and a half years.

Learning by experience

There should be a separate shed for kids (2-6 months) and adult goats should be housed away from them.

Take out the goats which have higher milk, for domestic use.

Excessive milk feeding cause diarrhea in kids.

The goats should be bred only in April to June (summer) and September to November (winter).

Clean the sheds regularly.

Lahori salt is useful for the good growth of kids.

(Coordinators: M.K. Singh, M.S. Dige, Nitika Sharma, Mohd. Arif and A.K. Dixit)

19.6 Success story of Sh. Santosh Singh

Name of Farm: Maha-Kali Goat and Dairy Farm **(Progressive Goat Farmer)**

Name of Goat Farmer: Mr. Santosh Singh S/o. Mr. Ramnaresh Singh

Farm Address: Pure Dikhatan, Mangapur, Udaipur, Pratapgarh, Uttar Pradesh

Date of Start: October 2018.

Initial Investment: Rs. 5.0 lacs

Education: Graduation

Name of the Technology/Process: Goat-Dairy-Crop based integrated model

Major Economic Activities:

(i) Supply of pure-bred Barbari goats to new goat farmers.

(ii) Production of surplus males for EID (Sacrifices)

Current Farm Strength: 145 goats including kids

Inspiration:

I want to set-up my own agri based business from my childhood. So I began with dairy farm in 2015-16. Over the period I realized dairy farming is far more expensive in terms of recurring and non-recurring cost. Later on I visited some poultry, fishery and goat farms and finally chose goat farming as major occupation. My wife also advised me to take up goat farming and she supports me in farm management activities.

Challenge:

1. I started goat farm with 20 goats purchased from field which were 70-85% Barbari. I faced a lot of difficulty in getting pure bred Barbari goats from field/market. Pure bred Barbari goats though available at some farm but price were very high, un-vaccinated and with no pedigree and performance records.

2. The goat purchased from field showed high rate of abortion and poor growth of kids. Kid and adult mortality were also high 25 and 12 %, respectively during first year.

3. Non-supportive and very tough credit process

4. Availability of vaccine was irregular in market and was available with lot of efforts.

5. Proper and well extended market for castrated male for Eid.

Initiatives: After initial setback, I visited ICAR-CIRG Makhdoom in 2019 and apprised Principal Investigator, Barbari Goat unit of AICRP. He provided valuable information, knowledge and literature and promised me to provide high merit and pure bred Barbari male and females under ***Multiplier Flock Scheme of Barbari goat of ICAR-AICRP on Goat Improvement***. Initially he provided 3 males and 8 females in 2019 and promised me to continue their support based on farm progress. They properly sensitized me for breeding plan (age and months of breeding and service period), timely vaccination, deworming, hygiene of sheds, care of neonatal especially multiple born kids. I have made proper partition in sheds to keep goats according to age and sex and do not alter kid and adult shed. I am regularly providing data and apprising him with farm progress as per agreement between farmer and Principal Investigator Barbari goat Unit,

Results and Interesting facts:

At present, I have 90 adult females, and 8 breeding males and 65 kids and all are being maintained under semi-intensive feeding. Due to proper adoption of breeding practices, health measures, kidding of goats in climatically favourable seasons and proper housing the kid and adult mortality at my farm is below 2% from last 2 year. The average body weights of breeding male at 12 months were ranged from 22-25 kg, castrated male from30-38 kg at one year and that of female from 18-22 kg. The body weight of castrated male at about one and half year of age is ranged from 40 to 50 kg. The average cost of production per male and female up to one year was Rs. 7000 and Rs 7500. The net profit per goat varied over the year from Rs 6000 to 8000. Lot of farmers are regularly visiting my farm and learning farm management practices

being practiced at my farms. I am also selling a small unit of Barbari goat to nearby farmers. Sale of castrated male is also good source of income, however it is affected by high price fluctuation. So far 126 farmers have visited my farm and 21 are working on it. As per agreement, I have also support a farmer to establish a breeding unit of Barbari goat and now he has 45 goats. We are also working on semi cooperative Barbari goat with target of 1000 Barbari in our block with the participation of 12 farmers. At present I am earning 3.5 to 4.0 lac net profits/ per year from 70 adult goats.

Lesson learnt:

1. Breeding of goats in unfavorable kidding seasons such as December, January, February, March, July and August resulted in high mortality and poor growth of kids.
2. Always purchase pure-bred, high genetic potential and vaccinated goats from field.
3. Balanced feeding with concentrate, green fodder and dry fodder is important for overall goat productivity.
4. Overfeeding, sudden changed feeding, overcrowding should be avoided.
5. Market linkage development, timely vaccination and prompt treatment of sick goats are important to earn more profit.

Expectations:

1. Minimum 18 female and 2 male should be provided to establish seed multiplier unit.
2. Institute should interfere for simplifying credit process at least up to 3 to 5.0 lacs

(Coordinators: M.K. Singh, M.S. Dige, A.K. Dixit, Nitika Sharma and Mohd. Arif)

20 SWACHH BHARAT ABHIYAAN ACTIVITIES

Institute staffs were sensitized periodically for maintaining personal hygiene as well as cleanliness in institute premises. Dr. B. Rai, the Director of the Institute constantly monitored and motivated the institute staff to take strict precautions and to follow COVID-19 protocols.

Institute has observed one week (25th September to 2nd October, 2020) program to celebrate the two-years long commemoration of 150th Birth Anniversary celebration of the 'Mahatma Gandhi Ji'. During this event several activities were organized like sanitation and plantation drive within the institute premises, expert lecture on Gandhian philosophy, Drawing competition for children on the theme "Bapu Ki Bakri", Essay Competition with the theme "Bapu Ke Atma Nirbhar Bharat ka Vartman Paripeksha mein Mahatta", Webinar on "Gandhian Model of Rural Development" and Online Swachhta Pledge were organized.

During the period several activities were organized like; Cleanliness drive was carried out in the offices, corridors and premises of the Institute as well as different work places, Sanitary workers of the Institute were sensitized towards spread of infection and made aware to take appropriate precautionary measures during cleaning within the premises and were equipped with Masks and Hand gloves for their safety and also to prevent spread of any kind of infection, demonstration of decomposting unit installed within the institute premises was done with proper segregation and disposal of bio-degradable and non-biodegradable wastewas ensured within the institute premises, generation of wealth through waste was achieved through vermicomposting unit utilizing goat dung, Awareness campaign on recycling of waste water and its use in kitchen gardens, backyard cultivation was carried out within the institute premises in a move to enhance water productivity.

Swachhta Pakhwara was also celebrated from 16th to 31st December, 2020. All the staff took the Swachhta Pledge in front of main laboratory building of the Institute. Director, ICAR-CIRG graced the occasion and urged all the staff to participate actively during Swachhta Pakhwara to make it a grand success and keep the campus clean and green.

A demonstration programme on "Briquetting Technology for waste Biomass Utilization" was organized on 22nd December, 2020 under the theme"Waste to Wealth",Institute has celebrated Kisan Diwas on 23rd December, 2020 in it total 130 farmers participated in the event.The event was graced by the presence of MLA Baldeo,Shri Puran Prakash ji and the Director of the

Drawings made by children during 'Clean India Mission' essay competition

21 INSTITUTE EVENTS

1. Foundation day of the Institute Celebration 12 July, 2020

The ICAR-Central Institute for Research on Goats, Makhdoom was founded on 12th July, 1979. Therefore, Institute Foundation Day celebrated every year on 12th

2. Independence Day Celebration

Independence Day of the nation was celebrated on 15.8.2020 in the Institute with full vigour and fanfare. Dr. B. Rai, Director of the Institute unfurled the flag and addressed the employees of the Institute.

3. Mahila Kisan Diwas

ICAR-CIRG, Makhdoom organized Mahila Kisan Diwas on 15th October, 2020.

4. Awareness Camp:

Institute organized awareness camps on the theme entitled "Prevention of Corona in the society". In these camps a total of 330 scheduled caste beneficiaries attended the camps.

5. Celebration of One Week Program "150th Birth Anniversary of Mahatama Gandhi" (Dr. A.K. Dixit, Nitika Sharma, Mohd. Arif, Arvind Kumar, Yogesh Soni)

ICAR-CIRG, Makhdoom has been celebrated one week program (25th September- 02 October 2020) to celebrate the two-year long commemoration of 150th Birth Anniversary Celebration of Mahatma Gandhi, which has concluded on 2nd October, 2020. The following programmes/activities were organised during the week:

Day-1 (25-09-2020): Lecture by Dr. H. A. Tiwari on Gandhi Ji and Goat Farming

On the first day programme on 25th September, a lecture was delivered by Dr. H.A. Tiwari, Goat Health expert. The lecture was attended by CIRG scientists, technical and supporting staff, young professionals and students following proper social distancing. In his lecture he emphasized on how cleanliness and proper diet helps in productivity enhancement and better health of goats. He also express that the health refers to the physical and psychological well-being, whereas hygiene refers to good practices that prevents disease and lead to good health, especially cleanliness, proper disposal of waste material and supply of drinking water.

Day-2 (26-09-2020): Sanitation and Cleanliness Drive

In commemoration of 150th birthday anniversary of Mahatma Gandhi, Sanitation and cleanliness drive was performed on 26.09.2020 in the ICAR-CIRG Campus, wherein all the staff of the Institute took part and contributed significantly. The drive was performed in and around the office buildings, residential quarters, farm premises and outside the main entrance gate of the Institute. On this occasion Director of the Institute, Dr. B. Rai urged the staff to minimize the use of plastics in order to keep the campus clean, green and plastic free.

Day-3 (27-09-2020): Plantation Drive at Mayur Van

The 3rd day programme included plantation at Mayur Van. On this occasion a number of tree saplings were planted by the Director, Scientists and other officials of the institute. Planted trees include *Jamun, Pakar, Bargad* and *Peepal* which are good for protecting environment and useful for feeding goats by lopping vegetative part during winter when there is scarcity of green fodder.

Day-4 (28-09-2020): Lecture on Gandhian Philosophy

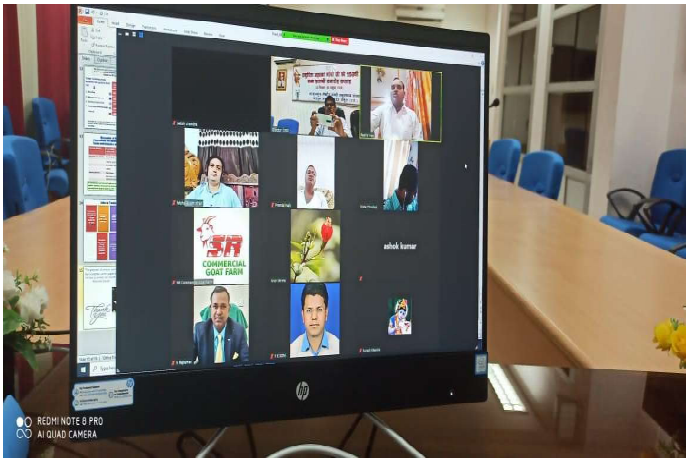
On the first day programme on 28th September, a lecture was delivered by Dr. B.Rai, Director (Actg) ICAR-CIRG. The lecture was attended by CIRG scientists, technical and supporting staff, young professionals and students following proper social distancing. Dr. Rai elaborated Gandhian philosophy of rural India. He told about Gram Swaraj and its important component. Gandhian vision on rural India is relevant in twenty first century also.

Day-5 (29-09-2020): Drawing Competition with the theme "Bapu Ki Bakri"

As per the schedule the drawing competition was organised for the school children (wards of the ICAR-CIRG staff) on the theme 'Bapu ki Bakri' to create awareness among the children about the teachings of Mahatma Gandhi. A collage of chosen paintings and sketches is presented:

Day-6 (30-09-2020): Essay Competition on "*Bapu ke Atm Nirbhar Bharat Ke Vartman Paripaikh mein Mahatta*"

As per the schedule Essay competition with the theme "Bapu ke Atam nirbhar Bharat ka Vartman Paripeksha mein Mahatta". The ICAR-CIRG staff, RAs, SRFs and Young Professionals participated with great enthusiasm in the competition. During the competition social distancing norms were strictly followeed.

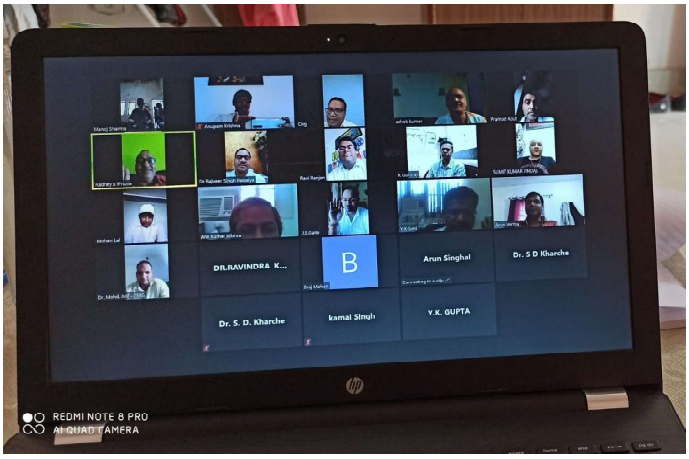


Day-7 (01-10-2020): Webinar on "Gandhian Model of Rural Development"

As per the schedule webinar on Gandhian Model of Rural Development was organised. A series of lectures were delivered by the scientists. The progressive goat farmers from Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh and Odisha and presented their views on Gandhi ji and goat production in India with special reference to sustainable livelihood. A talk on Gandhian Model of Rural Development was delivered by Dr.A.K.Dixit, Principal Scientist. Scientists, technical staff, students, farmers and other staff were participated.

Day-8 (02-10-2020): *Swachhta* Oath

On the final day 2nd October, Swachhta Oat has been taken by all the staff through Zoom Meeting and prize distribution on 3rd October.



22 IMPORTANT MEETINGS

PRIORIZATION, MONITORING AND EVALUATION CELL

A. Research management and coordination

This is major activity relate to manage research projects (Institute / out funded project and coordination of IRC, RAC and other related meetings). During the year institute is running 14 research projects under Institute funding and 20 research projects with extra mural funding.

B. HRD and training

This unit provides opportunity for training and capacity building of all class of employee considering their skill deficiency areas for best performance in the institute. Annual training plan (ATP) is being prepared as per the guideline of ICAR and executed it. Under Training cell, national training being organized for farmers and other sponsored programmes.

C. Institute Technical Management Unit (ITMU)

This unit assigned to Intellectual Property Management and transfer / commercialization of Agricultural Technology under "National Agriculture Innovation Foundation (NAIF)" project of ICAR. It manages the innovation, showcase the intellectual assets and pursue matter related to IP management and transfer / commercialization of technologies.

D. Academic and collaboration

This unit assigned the student admission for training and dissertation for different degree/ programme (M.Sc., M.V.Sc. and Ph.D.) and academic / training collaboration with institute, universities, NGOs and progressive farmers.

1. INSTITUTE RESEARCH COMMITTEE (IRC)

The Annual Institute Research Committee meeting of ICAR-CIRG was held on 25-27 June, 2020 and half yearly IRC held on 17-18 December, 2020 under the chairmanship of Dr. B. Rai, Director, ICAR-CIRG, Makhdoom. Dr. Ashok Kumar, I/c PME Cell of the Institute extended formal welcome to participate and presented the research progress & achievements. The Director in his introductory address highlighted the importance of institute IRCs, provides an opportunity to interact with the scientists of other divisions, to know about their work, projects running in different divisions and overall research achievements of the institute. This also helps to develop good projects and to avoid repetition of work.

Fig.1 Institute Research Council meeting in the ICAR-CIRG on 17.12.2020

2. QUINQUENNIAL REVIEW TEAM

The Indian Council of Agricultural Research (ICAR) appoints an external review committee of senior professionals called the Quinquennial Review Team (QRT) to carry out a comprehensive review (achievement audit) of the organization every five years. For conducting the Quinquennial review of Central Institute for Research on Goats, Makhdoom, Farah, Uttar Pradesh, ICAR constituted the Quinquennial Review Team vide office Order No. F.No.AS.18/6/2019-IA-I dated 23-9-2019. The regular meeting were organised at Institute.

S. N.	Name and Address of the Expert	Status
1	Dr. P. Thangaraju, Former Vice Chancellor, TANUVAS & Pro Vice Chancellor, SRM University Mob. 9444011997, E-mail: ptrajuagb@ gmail.com	Chairman
2	Dr. D. Swarup, Former Director, ICAR, Makhdoom, Mathura Mob. 7829680777, E-mail: devendra.swarup@gmail.com	Member
3	Dr. B.S. Prakash, Former ADG (AN&P), ICAR, New Delhi. Mob. 9999979013, E-mail: bsprakash1001@gmail.com	Member
4	Dr. K.T. Samapth, Former Director, NIANP, Bengaluru Mob. 9886617201, E-mail: ktsampath50@gmail.com	Member
5	Dr. J.V. Solanki, Former Dean & Professor, Animal Genetics, Veterinary College, AAU, Anand, Gujarat. Mob. 7567710670, E-mail: jvsolanki49@gmail.com	Member
6	Dr. Avinash Anand, CEO, Uttrakhand Sheep Development Board, Dehradun, Uttarakhand, Mob. 9358102780 E-mai: ceouswdb@gmail.com	Member
8	Dr. Ashok Kumar, In-charge, PME Cell, Central Institute of Research on Goats, Makhdoom- Farah. E-mail: pmecirg@gmail.com	Member - Secretary

IIIrd Quinquennial Review Team Meetings on 22.02.2020

23.Distinguished Visitors

Name of Visitor	Address	Date of visit
Shri Shankar A. Pande	Chief General Manager, NABARD Uttar Pradesh	25th December 2020

Shri Shankar A. Pande, Chief General Manager NABARD, Lucknow and Dr. Puneet Mishra DDM (Agra) during his visit at CIRG

24. Women Cell

WOMEN'S COMPLAINT COMMITTEE

Women's Complaint Committee is meant to redress the gender related grievances of the women employees of ICAR-CIRG under the Sexual Harassment of Women at Workplace Act, 2013 and to provide them a congenial environment at their workplace. The Women's Complaint Committee of ICAR-CIRG has been reconstituted on 25th October, 2019 with following members:

1. Dr. Anu Rahal, Principal Scientist, ICAR-CIRG: Chair person
2. Dr. Nitika Sharma, Scientist, ICAR-CIRG: Member
3. Dr. Chetna Gangwar, Scientist, ICAR-CIRG: Member
4. Dr. Braj Mohan, Principal Scientist, ICAR-CIRG: Member (SC/ST Liaison Officer)
5. Mr. Agnivesh, AO, ICAR-CIRG: Member Secretary
6. Dr. Madhu Tiwari, DUVASU: External Member

No complaints were received during the Academic year 2020-21.

25 हिन्दी पखवाड़ा

संस्थान में वर्ष 2020 के दौरान हिन्दी पखवाड़ा के अन्तर्गत होने वाली गतिविधियां

हिन्दी पखवाड़ा

संस्थान में दिनांक 14.09.2020 (हिन्दी दिवस) के अन्तर्गत हिन्दी पखवाड़ा के कार्यक्रमों का आयोजन दिनांक 14.09.2020 से 28.09.2020 तक निम्नवत विवरण के अनुसार किया गया।

1. दिनांक 14.9.2020 को एक विचार संगोष्ठी का आयोजन किया गया जिसमें संस्थान के विभिन्न वैज्ञानिकों, अधिकारियों, कर्मचारियों व आमंत्रित अतिथियों द्वारा 'राष्ट्र विकास में हिन्दी का महत्व' पर अपने विचार प्रकट किये गये तथा अन्त में संस्थान के निदेशक द्वारा अपने उद्बोधन में हिन्दी को अपने देश की एकता को जोड़ने वाली एक कड़ी तथा पहचान बताते हुए संस्थान के सभी कर्मियों को शत–प्रतिशत हिन्दी में कार्य करने हेतु आह्वान किया गया।

2. दिनांक 16.09.2020 को राजभाषा से सम्बन्धित वश्त्तचित्र, सेतु व हिन्दी गांधी और गुलामी का चलचित्र प्रदर्शन समस्त कर्मचारियों के लिए संस्थान में किया गया।

3. दिनांक 18.09.2020 को हिन्दी निबन्ध प्रतियोगिता (विषयः कोविड–19 के रोकथाम में आरोग्य सेतु का महत्व) का आयोजन किया गया, जिसमें संस्थान के वैज्ञानिकों,अधिकारियों, कर्मचारियों एवं बच्चों द्वारा सहभागिता की। जिसमें श्री जितेन्द्र सिंह गेट, श्री संदीप कुमार, श्री अभिमन्यु क्रमशः प्रथम, द्वितीय एवं तश्तीय स्थान पर रहे व कु. शालिनी वर्मा, श्री नितिन, श्री विजय कुमार को सांत्वना पुरस्कार से सम्मानित किये गये।

4. दिनांक 21.09.2020 को हिंदी टिप्पण एवं प्रारूप लेखन प्रतियोगिता का आयोजन किया गया, जिसमें संस्थान के अधिकारियों, कर्मचारियों एवं छात्र/छात्राओं ने सहभागिता की तथा श्री जितेन्द्र सिंह गेट, श्री पंकज शर्मा एवं श्री सतीश चन्द्रा क्रमशः प्रथम, द्वितीय एवं तृतीय स्थान पर रहे व श्री धर्मेन्द्र सिंह, श्री अभिमन्यु, श्री सुगड़ सिंह, श्री नितिन को सांत्वना पुरस्कार से सम्मानित किये गये।

5. दिनांक 23.09.2020 को प्रश्न मंच प्रतियोगिता का आयोजन किया गया जिसमें वैज्ञानिकों, अधिकारियों, कर्मचारियों, एवं छात्र/छात्राओं ने सहभागिता की। इस

प्रतियोगिता में सहभागिओं से राजभाषा एवं सामान्य ज्ञान से सम्बन्धित प्रश्न पूछे गये।जिसमें डा. पल्लवी सिंह, श्री दीपक कुमार, श्री पंकज शर्मा क्रमशः प्रथम, द्वितीय एवं तृतीय स्थान पर रहे व श्री बदन सिंह, श्री सुगड़ सिंह, मनीष कुमार को सांत्वना पुरस्कार से सम्मानित किये गये।

6. दिनांक 25.09.2020 को एक दिवसीय हिंदी कार्यशाला का आयोजन किया गया जिसमें संस्थान के

तकनीकी अधिकारी व कर्मचारी, प्रशासनिक अधिकारी, कर्मचारियों, आर.ए., एस.आर.एफ. व छात्र/छात्राओं ने सहभागिता निभायी, जिसमें डा. हरिऔध तिवारी, पूर्व मुख्य तकनीकी अधिकारी, आगरा द्वारा 'राजभाषा निति एवं अनुपालन' पर एक व्याख्यान दिया गया।

7. दिनांक 28.09.2020 को हिन्दी पखवाड़ा समापन समारोह एवं प्रमाण पत्र वितरण का आयोजन किया गया, जिसमें संस्थान के समस्त वैज्ञानिकों, तकनीकी अधिकारी व कर्मचारी, वरिष्ठ प्रशासनिक अधिकारी व कर्मचारियों ने सहभागिता निभायी एवं दिनांक 14 सितम्बर, 2020 से प्रारम्भ हुए इस हिन्दी पखवाड़े के दौरान समस्त सफल प्रतिभागियों को संस्थान के कार्यवाहक निदेशक डा. भुवनेश्वर राय एवं अन्य वरिष्ठ अधिकारियों द्वारा प्रमाण पत्र प्रदान किये गये। पुरस्कार राशि परिषद के दिशानिर्देश अनुसार पुरस्कार राशि प्रथम 2000.00, द्वितीय 1500.00, तृतीय 1100.00 एवं सांत्वना 800.00 (चार पुरस्कार) विजयी प्रतिभागियों के खाते में स्थानांतरित किये जाने की घोषणा की।इस अवसर पर कार्यवाहक निदेशक महोदय ने अपने उद्बोधन में कहा कि किसी भी देश की एकता एवं विकास के लिए उस देश की राष्ट्रभाषा का समश्द्ध होना अति आवश्यक है। अतः हम सभी का कर्तव्य है कि हिन्दी को राष्ट्रभाषा के पद पर आसीन करने के लिए हर सम्भव प्रयास करें तथा संस्थान मे निर्धारित लक्ष्यों के अनुरूप हिन्दी में कार्य करते हुए हिन्दी के कार्यान्वयन को आगे बढ़ाना सुनिश्चत करें। हमेशा याद रखें कि दैनिक व्यवहार में हिन्दी भाषा का प्रयोग हीनता नहीं बल्कि गौरव का प्रतीक है।

1 जनवरी से 31 दिसम्बर, 2020 तक आयोजित राजभाषा हिन्दी से सम्बन्धित त्रैमासिक बैठक

राजभाषा अधिनियम के अन्तर्गत संस्थान की राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन क्रमशः दिनांक 13 मार्च, 2020, दिनांक 07 सितम्बर, 2020 एवं दिनांक 10 दिसम्बर, 2020 को संस्थान निदेशक (कार्य.) एवं अध्यक्ष संस्थान राजभाषा कार्यान्वयन समिति की अध्यक्षता में सम्पन्न हुयी। इन बैठकों में संस्थान के समस्त विभागाध्यक्ष, अनुभाग प्रभारी व संस्थान राजभाषा कार्यान्वयन समिति के सदस्यों ने सहभागिता की। बैठकों के दौरान संस्थान में हिन्दी के प्रगामी प्रयोग को बढ़ावा देने हेतु किये गये कार्य कलापों पर गहन विचार–विमर्श किया गया तथा संस्थान निदेशक द्वारा समस्त वैज्ञानिकों, अधिकारियों व कर्मचारियों को संस्थान के 'क' क्षेत्र में स्थित होने के कारण अपना शत–प्रतिशत कार्य हिन्दी में करने हेतु निर्देशित किया गया तथा प्रशासनिक अधिकारी व प्रशासन के अन्य अधिकारियों एवं कर्मचारियों को प्रत्येक दशा में धारा 3(3) का अनुपालन करने के लिये निर्देशित किया गया।

26 STAFF

26.1 STAFF POSITION

S. No.	Class of Posts	Total Posts Sanctioned	Total employees in the position	Total post Vacant
1.	Scientific Post	**44+1=45**	**27**	**18**
a	Scientist	32	18	14
b	Senior Scientist	08	07	01
c	Principal Scientist	04	02	02
d	RMP	01	00	01
2.	Technical	**55**	**26**	**29**
a	Category-I	50	23	27
b	Category-II	02	02	00
c	Category-III	03	01	02
3.	Administrative Posts	**29**	**21**	**08**
a	Category "A"posts SAO/AO/F&AO	03	02	01
b	Category "B" posts AAO/PS	04	03	01
C	Category "C"posts Assistant/UDC/PA/JAO/Steno/LDC	22	16	06
4.	Supporting Skilled Staff	101	98	03
	Total	230	172	58

26.2 Budget & Utilization for the Year 2020-21 (Rs. in Lakh)

Head	RE 2020-2021	Expenditure				
		Other than NEH, TSP and SCSP	TSP	NEH	SCSP	Total
1- GIA-Capital	34.00	0.00	0.00	0.00	0.00	0.00
2- GIA- Salary	2025.00	2024.00	0.00	0.00	0.00	2024.00
3- GIA General	0.00	0.00				0.00
i) Others	577.80	483.30	23.99	25.00	44.80	577.09
ii) Pension	783.00	783.00				783.00
Grand Total	3419.80	3290.30	23.99	25.00	44.80	3384.09

26.3 Budget & Utilization for the year 2020-21 in respect of AICRP Goat Improvement Makhdoom (Rs. In Lakhs)

Head	RE 2020-2021	Expenditure				
		Other than NEH, TSP and SCSP	TSP	NEH	SCSP	Total
1- GIA-Capital	12.00	0.00	0.00	0.00	0.00	0.00
2- GIA- Salary	0.00	0.00	0.00	0.00	0.00	0.00
3- GIA General	0.00	0.00	0.00	0.00	0.00	0.00
i) Others	432.00	271.64	80.00	40.00	40.00	431.64
ii) Pension	0.00	0.00				0.00
Grand Total	444.00	271.64	80.00	40.00	40.00	431.64

26.4 Financial Statement for the year 2020-21(Rs. In Lakhs)

Recurring	RE 2020-2021	Expenditure				
		Other than NEH, TSP and SCSP	TSP	NEH	SCSP	Total
Establishment charges	1677.36	1676.37	0	0	0	1676.37
Wages	347.64	347.63	0	0	0	347.63
Pension	783.00	783.00	0	0	0	783.00
OTA	0.00	0.00	0	0	0	0.00
TA	4.00	4.00	0	0	0	4.00
Other Charges	573.30	478.82	23.99	25	44.8	572.61
HRD	0.50	0.48	0	0	0	0.48
Total	3385.80	3290.30	23.99	25.00	44.80	3384.09
						0.00
Non Recurring	0	0.00	0.00	0.00	0.00	0.00
Equipment	34.00	0.00	0.00	0.00	0.00	0.00
Furniture	0.00	0.00	0.00	0.00	0.00	0.00
Library Books& Journals	0.00	0.00	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00	0.00	0.00
Work	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00
Total	34.00	0.00				0.00
Grand Total(A+B)	3419.80	3290.30	23.99	25.00	44.80	3384.09

26.5 Revenue Generation for 2020-21

26.5.1 As Per Usual Formats

S.No.	Particulars	Amount (Rs.)
1	Sale of farm produce	5863079.23
2	Sale of fish & poultry	653581.10
3	Sale of publication and advertisement	133627.00
4	License fee	562382.00
5	Interest earned on loans & advances	440875.00
6	Leave salary and pension contribution	310974.00
7	Application fee from candidates	800.00
8	Diploma Charges	258000.00
9	Unspent balance of Grants of previous years	2746975.00
	Interest earned on short term deposits	2106052.00
	a) Training	1081002.72
	Recoveries of Loans & Advances	62872.00
	Total	595564.00
		14815784.05

26.5.2 As Per New Guidelines Issued by ICAR, the Revenue Generation for the Year 2020-21 is as follow:

Particulars	Amount (Rs.)
Income from Sale & Services	7630223.05
Income From fee/ Subscription	26600.00
Income from royalty	13327.00
Grand Total	7670150.05

27 CIRG PERSONNEL

ADMINISTRATION AND MANAGEMENT	
Dr. B. Rai	Director (acting)
Dr. S. D. Kharche	Vigilance Officer
Mr. Sumit Kumar Jindal	Sr. Administrative Officer
Mr. Agnivesh	Administrative Officer
Mr. A. K. Sharma	Asstt. Admn. Officer
Mr. Radhey Shyam Bhatt	Financial Account Officer
Mr. Roney Alfred	Private Secretary
ANIMAL GENETICS AND BREEDING DIVISION	
Dr. Saket Bhushan	Principal Scientist & Head
Dr. P. K. Rout	Principal Scientist
Dr. Gopal Dass	Principal Scientist
Dr. M. K. Singh	Principal Scientist
Mr. V. K. Sharma	Technical Officer T-5
ANIMAL PHYSIOLOGY AND REPRODUCTION DIVISION	
Dr. S.D. Kharche	Principal Scientist & Head
Dr. R Pourouchottamane	Principal Scientist
Dr. Ravi Ranjan	Sr. Scientist
Dr. S. P. Singh	Sr. Scientist
Dr. Chetna Gangwar	Scientist
Dr. Yogesh Kumar Soni	Scientist
ANIMAL NUTRITION MANAGEMENT & PRODUCT TECHNOLOGY DIVISION	
Dr. B. Rai	Principal Scientist & Head
Dr. Ravindra Kumar	Pr. Scientist
Dr. V. Rajkumar	Sr. Scientist
Dr. Arvind Kumar	Sr. Scientist
Dr. A. K. Verma	Scientist
Dr. Mohd. Arif	Scientist
Mr. Dori Lal Gupta	ACTO
Mr. Suraj Pal	ACTO

ANIMAL HEALTH DIVISION	
Dr. D. K. Sharma	Principal Scientist and Head
Dr. Ashok Kumar	Principal Scientist
Dr. R. V. S. Pawaiya	Principal Scientist
Dr. Anu Rahal	Principal Scientist
Dr. K. Gururaj	Sr. Scientist
Dr. A. K. Mishra	Scientist
Dr. Nitika Sharma	Scientist
Dr. Vinay Chaturvedi	ACTO
Mr. Vijay Kishore	Sr. Technical Officer T-6
Mr. T. K. Gautam	Sr. Technical Officer T-6
EXTENSION EDUCATION AND SOCIO- ECONOMICS SECTION	
Dr. Braj Mohan	Principal Scientist & I/c
Dr. A. K. Dixit	Principal Scientist
Dr. Khushyal Singh	Sr. Scientist
AICRP ON GOAT IMPROVEMENT	
Dr. P. K. Rout	Principal Scientist & PC
Dr M. K. Singh	Principal Scientist
Dr. Gopal Das	Principal Scientist
NETWORK PROJECT ON SHEEP	
Dr. Gopal Dass	Principal Scientist
PRIORITIZATION, MONITORING AND EVALUATION (PME) CELL	
Dr. Ashok Kumar	Principal Scientist & I/c
Dr. P. K. Rout	Principal Scientist
Dr. Nikita Sharma	Scientist

INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)	
Dr. Ashok Kumar	Principal Scientist & I/c
RTI Cell	
Dr. A. K. Dixit	Principal Scientist & Transparency Officer, Nodal Officer CPGRAM
Shri Sumit Kumar Jindal	Senior Administrative Officer &CPIO
FARMERS TRAINING CELL	
Dr. Anupam Krishna Dixit	Principal Scientist & Nodal Officer
Dr. R. Pourouchottamane	Principal Scientist & Co-Nodal Officer
Dr. Khushyal Singh	Sr. Scientist
Dr. Chetna Gangwar	Scientist
AGRICULTURE KNOWLEDGE MANAGEMENT UNIT (AKMU)	
Dr. R. V. S. Pawaiya	Principal Scientist & I/c
Mr. Satish Chandra	ACTO
HUMAN RESOURCE DEVELOPMENT (HRD) CELL	
Dr. R. Pourouchottamane	Principal Scientist & Nodal Officer
Dr. M. K. Singh	Principal Scientist & Co-Nodal Officer
MAINTENANCE	
Dr. Y. K. Soni (w.e.f. 28.08.2020)	Scientist & I/c
Mr. Lal Singh	Sr. Technical Officer T-6
SECURITY SECTION	
Dr. Gopal Dass	Pr. Scientist & I/c
MEDICAL DISPENSARY	
Dr. Ashok Kumar	Principal Scientist & I/c
LIBRARY	
Dr. R Pourouchottamane	Principal Scientist & I/c
Prem Babu	SS Gr- 1

AGRICULTURE FARM	
Dr. Arvind Kumar	Senior Scientist & I/c
Dr. Mohd. Arif	Scientist
Mr. Sugad Singh	Technical Officer T-5
HORTICULTURE SECTION	
Dr. R. Pourouchottamane	Scientist & I/c
Mr. Hukam Singh	Technical Officer T-5
VEHICLE SECTION	
Dr. K. Gururaj	Scientist & I/c
SUPERANNUATION	
Dr. U.B. Chaudhary	Principal Scientist retired on 31.10.2020
Mr. Mohan Lal	Retired on 31.05.2020
Mr. M.P. Agarwal	Retired on 30.06.2020
TRANSFERS	
Dr. N. Ramachandran, Sr. Scientist	Transferred on 30/08/2020
RESEARCH SCHOLARS AND YOUNG PROFESSIONALS	
Sonia Saraswat	Women Scientist
Pallavi Singh	Women Scientist
Mahima Verma	Research Associate
Kamendra Sawrup	Senior Research Fellow
Parul Dubey	Senior Research Fellow
Atul Bhardwaj	Senior Research Fellow
Sandeep Kumar	Junior Research Fellow
Manish Kumar	Junior Research Fellow
Rakesh Kaushik	Young Professional-II

Dimple Anadani	Young Professional-II
Akhilesh Maurya	Young Professional-II
Tanuja Kushwah	Young Professional-I
Shalini Verma	Young Professional-I
Ankit Bhardwaj	Young Professional-I
Uttam Singh	Young Professional-I
Praveen	Young Professional-I
Anjali Pachori	Young Professional-I
Vikram	Young Professional-I
Vashnavi Garg	Young Professional-I
Manvender Kumar	Young Professional-I
Ashutosh Mishra	Young Professional-I
Narendra Pratap	Young Professional-I
Devki Nandan	Young Professional-I
Akriti Dixit	Young Professional-I
Faheem	Field Assistant
Pankaj Sharma	Young Professional-I
Abhimanyu	Young Professional-I
Nitin Kumar	Young Professional-I
Dharmendra	Young Professional-I
Parmod	Young Professional-I

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