Central Sheep and Wool Research Institute
Avikanagar 304 501 Rajasthan
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Central Sheep and Wool Research Institute
Avikanagar 304 501 Rajasthan
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Published By

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Dr S. A. Karim
Director
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Avikanagar 304 501 Rajasthan
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**Senior Administrative Officer**  
Member Secretary  
CSWRI, Avikanagar Rajasthan
Distinguished Visitors
सारांश
Executive Summary

The Central Sheep and Wool Research Institute, Avikanagar is one of the Animal Science Institutes of Indian Council of Agricultural Research, New Delhi. It was established in 1962 to conduct basic and applied research on all aspects of sheep and rabbit production and product utilization. The research and extension activities of the Institute are periodically reviewed by the Research Advisory Committee (RAC) constituted by the ICAR. The Institute Management Committee (IMC) supervises the administration and other activities of the Institute. Quinquennial Review Team (QRT) constituted by the Council reviews the research work carried out in the Institute during the plan period and suggests administrative, research and technical reforms to address the mandate of the Institute. The Institute has sanctioned post of 91 scientific, 154 technical, 87 administrative staff to meet the assigned research priorities and implementation of research programmes. To accomplish the assigned research mandate of the Institute, Rs 270 lakh under plan and Rs 1904.26 lakh under non-plan was allocated to the Institute during the year 2009-10. The Institute has generated revenue of Rs 88.67 lakhs through sale of farm produce, technologies, animal products, imparting training and extending consultancy services during the year 2009-10.

The Institute has made considerable progress in genetic improvement of native sheep breeds, development of prolific sheep for enhancing mutton production, nutritional manipulation for enhancing mutton production in growing lambs and spent ewes, development of agro-forestry system for improving fodder production, round the year breeding, three lamb crops in two years under accelerated lambing system, genome analysis of sheep breeds by molecular methods, genetic improvement of resistance to *Haemonchus contortus*, epidemiological investigation on diseases of sheep, goats and rabbits, development of carpet, technical textiles and apparels from indigenous wool, utilization of spent sheep meat for value added products and improvement of productivity of sheep and rabbit under field condition through transferable technologies.

Mutton production potential of sheep can be increased by increasing number of lambs per lambing. Total body weight of 62.6 kg at 6 month and 95.0 kg at 12 month of age was harvested from triplet lambs of Garole X Malpura prolific sheep as against 24.86 and 37.47 kg from single lambs of non-prolific Malpura sheep. Gross income of 14 and 41 % more was recorded in GM bearing twins and triplets and 26 % in GMM bearing twins than Malpura sheep. This indicates great potential of augmenting mutton production by introgression of prolific gene from Garole in non-prolific mutton breeds. In prolific sheep project, terminal three breed crosses have been developed. GMM and Patanwadi breed crosses attained 20.34 kg body weights at 3 month, 30.15 kg at 6 month and 41.00 kg at 12 month of age.

Chokla is one of the best carpet wool producing breed. Annual greasy fleece yield of 2.43 kg with ------- fibre diameter and ------- medilation in Chokla sheep achieved.

Body weights of 24.86 and 37.47 kg at 6 and 12 months of age in Malpura sheep was achieved. The performance of Bharat Merino has been improved after shifting in temperate climate of Kodai hills. Body weights of 26.90 and 34.44 kg at 6 and 12 months of age and annual greasy fleece yield of 2.90 kg in rams and 2.02 kg in ewes was achieved.

Annual wool yield of 877 g in German Angora with staple length, fibre diameter and guard hair of 6.06 cm, 13.01 µ and 5.16 % was attained and further efforts are continued to achieve wool yield of 1.00 kg annually. In broiler rabbits (White Giant and Soviet Chinchilla) slaughter weight of 1.93 and 1.89 kg at 12 weeks of age attained under organised feeding and management. The efforts are continued to achieve 2.00 kg weight at 12 weeks of age.

*Prosopis juliflora* is widely distributed across the country, leaves and pods of *P. juliflora* were tried as feed in ration of sheep. Dried pods of *P. juliflora* can be incorporated in concentrate mixture up 30 to 40 %.

Incorporation of dried probiotic in lambs ration improved growth by 5-8 %, feed efficiency 3-9 % and reduced feed cost per kg live weight gain by 6-12 % and also controlled diarrhea incidences.
In fattening of spent sheep before slaughter, attempts are continued for reducing feed cost by utilizing local feed resources and also by incorporating unconventional energy and protein source.

Minerals are chelated to protect its degradation in the rumen and digestive tract of animals and increase its bioavailability to system. The chelated mineral reaches the plasma intact and separates at the site of action. Chelated copper and zinc minerals slightly improved in feed uptake, feed efficiency and body weights in lambs.

Under programme of manipulating ovulation for increasing twinning in sheep, Ovagen in conjunction with Prostaglandin F2α indicated the possibility of inducing multiple births through controlled ovulation. Under the programme of accelerated lambing system harvesting of 3 lamb crops in two years, second breeding after first lambing was successfully performed in 58.3% ewes with in targeted period of eight months. All the ewes were mated second time within inter-service period of 271 days.

The development of resistance line against Haemonchus contortus in Malpura and Avikalin sheep indicates in spite of no anthelmintic intervention in the R-line the FEC never reached the threshold level during the year suggesting that these animals could be maintained without anthelmintic drench.

The morbidity and mortality losses in the Institut flocks brought down to manageable levels by effective implementation of prophylactic measures and improvement of management practices. The annual equivalent average death rates (EADR) per 1000 animal days at risk were 0.2558, 0.1627 and 1.796 in sheep, goat and rabbit, respectively. The overall expenditure (per head / annum) on health management remained Rs. 44.71, 32.17 and 12.59 for sheep, goat and rabbit, respectively.

Single drench / annum during mid to late monsoon against 3-4 drenching in field flocks was successful implemented in Institute and field flocks. Further attempts were made to reduce the use of anthelmintics in flock by targeted selective treatment (TST). Colour chart developed for identification of severity of Haemonchus contortus in sheep and its effectiveness in adult sheep for implementation in large scale was evaluated.

Carpet yarn produced from Avikalin: nylon (90:10) fibre gave better performance compared to pure Avikalin wool and Avikalin: Chokla wool. Hand-knotted carpet of 144 knots/ inch² was developed using wool: nylon blended yarn. Carpet made from blended yarn of Magra wool-nylon (90:10) gave higher resiliency and compressibility and lower abrasion loss as compared to other blends.

The extracts of Silver oak, Madder and Myrobolan as eco-friendly natural dyes for woollen products with antimicrobial and anti moth properties were explored.

Traditional charkha was renovated to reduce the friction thus provides smoothness in movement and improves >20 % productivity of spinning of pashmina yarn as well as reduce the drudgery of spinner.

Attempts were made for utilization of meat of spent sheep in product preparation and value addition. Nuggets, salami and sausage meat products of growing and spent sheep were prepared. Urea and molasses as replacement of costlier cake can be used in the feed of spent sheep for economizing feed cost without any adverse effect on meat yield and quality. The incorporation of 2% or 4 % rumen protected fat in feed of lambs did not improve the carcass quality and composition.

Under transfer of technology programme for dissemination of improved technologies in farmer flocks, Thirty five Malpura rams, 56 Avikalin rams and 66 Sirohi bucks were sold to farmers and different agencies for genetic improvement of flocks.

The cost effective indigenously developed progesterone impregnated sponges were used for inducing and synchronizing estrus in field sheep flocks. Artificial
insemination using chilled diluted semen of elite Malpura ram was popularized in the native tract.

The demonstrations on improved varieties of fodder crop were laid in the villages.

Range managed weaner lambs in villages are deprived of adequate nutrition for attaining desirable weights at slaughter. Demonstration on concentrate supplementation in weaner lambs were laid for achieving higher weights at slaughter and also protecting them from early desposal and mortality losses.

In present scenario of feed resource scarcity under prevailing climate change effect, sheep on range lands suffers from nutrition inadequacy especially during lactation and pregnancy reflecting in poor birth weights of lambs and milk yield and its adverse effect on subsequent lamb growth. Demonstrations of supplementation of concentrate mixture to lactating and pregnant sheep were laid and its beneficial effect on animal performance was demonstrated.

Poor nutrition of sheep flocks on pasture in region adversely affected the reproduction, flushing of sheep with 400g of concentrate before 30 days of breeding season bring all sheep into estrus and lambing was achieved in all the animals.

Mortality losses in field flock because of nutritional inadequacy, out breaks of diseases, climate changes and drought caused economic losses to farmers. Effective implementation of ET, sheep pox and FMD vaccination in sheep flocks and deworming against GIN and drenching against flukicide controlled annual mortality in TOT flocks to 5.60%.

Farmers under prevailing drenching practices adopt 3-4 drenching per annum for controlling parasites in sheep. Frequent drenching increase the problem of drug resistance, burden on animals and medicine cost. The implementation of a single strategic drench with appropriate anthelmintic after mid monsoon managed the GI nematodes in field flocks.

Broiler rabbit farming is gaining momentum in southern states. About 450 rabbit farms established with the help of genetic resource, training and other support of SRR station.
About the Institute

The Central Sheep and Wool Research Institute is a premier Institute of Indian Council of Agricultural Research (ICAR) engaged in research, education and extension activities on sheep and rabbits. It was established in 1962 at Malpura in Rajasthan. Now campus is popular by the name of Avikanagar. The campus is spread over an area of 1510 hectare. It has three Regional Research Centres in different climatic zones of the country to develop region specific technologies. North Temperate Regional Station (NTRS) was established in 1963 in temperate region at Garsa, Kullu in Himachal Pradesh. The Southern Regional Research Centre (SRRC) was established in 1965 in sub temperate region at Mannavanure in Tamil Nadu. Arid Region Campus (ARC) was established in 1974 at Bikaner in arid region of Rajasthan. The Institute and its sub-stations have been working for enhancing the productivity of sheep and rabbit by applying scientific methods and developing new technologies.

The Institute has evolved new strains of sheep viz. Avikalin and Bharat Merino. The practices were developed for scientific breeding, feeding and management for improving the production traits of native sheep viz., Malpura, Marwari, Magra and Chokla. The evolution of a prolific sheep from Malpura using Garole germplasm is in progress. Some of the important technologies developed by the Institute are: Intensive lamb production for mutton, complete feed block for feeding of animals during scarcity, maximization of fodder production through multi-tier agro forestry system, artificial insemination, embryo transfer technology in sheep, cost effective worm control program, disease data information system for organized sheep and goat farms and wool and hair blended woollen products.

Mandate

1. To undertake basic and applied research on all aspects of sheep and rabbit production,
2. To develop, update and standardize meat, fibre and pelt technologies,
3. To impart trainings on sheep and rabbit production and utilization,
4. To transfer improved technologies on sheep and rabbit production to farmers, rural artisans and development workers, and
5. To provide referral and consultancy services on production and products technology of sheep and rabbits.

Budget

Budget sanctioned and expenditure for the period 2009-10 under plan and non-plan heads is detailed below:

Budget sanctioned and expenditure during the 2008-09 and 2009-10 (Rs. in lakh)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>2008-09</th>
<th>2009-10</th>
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<td>Sanctioned Budget</td>
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<tr>
<td>Non-Plan</td>
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<tr>
<td>Plan</td>
<td>390.00</td>
<td>270.00</td>
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<tr>
<td>Total</td>
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<td>2174.26</td>
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<td>Total Expenditure</td>
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<tr>
<td>Non-Plan</td>
<td>1445.50</td>
<td>1904.26</td>
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<tr>
<td>Plan</td>
<td>387.28</td>
<td>270.00</td>
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<tr>
<td>Total</td>
<td>1832.78</td>
<td>2174.26</td>
</tr>
</tbody>
</table>

Resource Generation

Total receipt through sale of farm produce, consultancy and training charges was Rs 141.57 lakh during 2008-09 and Rs 88.67 lakh during 2009-10.

Manpower
Staff strength under different categories as sanctioned, filled and vacant is shown in table.

Staff strength in the Institute as on 31.03.2010

<table>
<thead>
<tr>
<th>Categories</th>
<th>Sanctioned</th>
<th>Filled</th>
<th>Vacant</th>
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<tbody>
<tr>
<td>Director</td>
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<tr>
<td>Principal Scientist</td>
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<tr>
<td>Senior Scientist</td>
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<tr>
<td>Scientist</td>
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<tr>
<td><strong>Total</strong></td>
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<tr>
<td>Technical</td>
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<tr>
<td>Administrative</td>
<td>87</td>
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<tr>
<td>Supporting</td>
<td>196</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td><strong>528</strong></td>
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</tbody>
</table>

Library
Projects

Dual type Avikalin sheep for meat and wool production
L.L.L. Prince, A. L. Arora, Ashish Chopra (Upto 20.01.2010), Chandan Paswan, C.P. Swaranankar, S.L. Sisodia (Upto 04.08.2009) and M. K. Shrivastava (From 18.08.2009)

Genetic improvement of Malpura sheep for mutton production
A. L. Arora, Gopal R. Gowane (Upto 31.08.2009), Ashish Chopra (Upto 20.01.2009), Ved Prakash, C. P. Swaranankar, M. K. Tripathi (Upto 22.06.2009) R.S. Bhat (From 23.06.2009) and M.K. Shrivastava (From 02.04.2009)

Improving prolificacy in sheep for mutton production
Sub-Project: Improving prolificacy in Malpura sheep through Garole inheritance and enhancing milk production using Patanwadi sheep
A. L. Arora, L. L. Prince, Ved Prakash, Chandan Paswan, C. P. Swaranankar, Jyoti Kumar (From 31.07.2009), M.K. Shrivastava (From 02.04.2009) and Ram Rai Sharma

Sub-Project: Improving prolificacy in Malpura sheep through Kendrapada inheritance
L. L. Prince, Ashish Chopra (Upto 20.01.2010), Chandan Paswan and Rajeev Kumar

Evaluation and improvement of Chokla sheep for carpet wool (Net Work Project on Sheep Improvement)
L. L. Prince, A.L. Arora, Chandan Paswan, Ved Prakash, D. Mondal (Upto 17.05.2009), G.G. Sonawane (From 30.06.2009) and O. P. Koli

Improvement of Marwari sheep for carpet wool production through selection (ARC Bikaner) (Network Project)
H. K. Narula, P. R. Sharma, M. Ayub and Vimal Mehrotra

Improvement of Magra breed of sheep for carpet wool production under farm condition (ARC, Bikaner)
H. K. Narula, P. R. Sharma, R. K. Sawal, K.C. Sharma, Vimal Mehrotra and M. Ayub

Improvement of Synthetic sheep for meat and wool production under sub-tropical climate (NTRS, Garsa)
S.K. Niranjan, S.R. Sharma and S.Saha

Genetic improvement of Angora rabbits for wool production in sub temperate climatic conditions (NTRS, Garsa)
S.K. Niranjan, S.R. Sharma, P S Oberoi (Upto 17.03.2009) and S. Saha (From 01.07.2009)

Demonstration Unit of Bharat Merino (SRRC, Mannavanur)
N. Swain, A. S. Rajendirn S Rajapandi and K.Narayanan (From 19.01.2010)

Genetic improvement of Sirohi goats for meat and milk production
A. L. Arora, Gopal R. Gowane (Upto 31.08.2009), Chandan Paswan, Ashish Chopra (Upto 20.01.2010), Fateh Singh (From 30.06.2009), Suresh Kumar and S.S.R. Naqvi
Dual type Avikalin sheep for meat and wool production

The overall least square means for body weights at birth, 3, 6, 9 and 12 months of age were 2.93, 15.85, 26.71, 31.47 and 39.74 kg respectively. Overall means for average daily gain during 0-3, 3-6 and 6-12 months were 143, 113 and 84 g respectively. Overall least square means for first six monthly and adult six monthly greasy fleece yields were 950 and 754 g respectively. The overall means of fibre diameter and medullation in adult sheep were 31.25 µ and 32.02 % respectively. The overall fibre diameter, medullation and staple length in male hoggets were 31.81 µ, 32.36 % and 5.31 cm and in female hoggets were 30.40 µ, 32.37% and 5.35 cm respectively. Breeding rams with > 35 % medullation and 35 µ fibre diameter were used in the breeding programme for improving in the wool quality traits. Tapping rate in flock was 94.5% and lambing rates on ewe’s available and tupped basis were 83.8% and 86.9 % respectively. Overall survivability during 0-3, 3-12 months and > 12 month were 89.36% and lambing rate in flock was 95.6 and 3.8%. Fifty five breeding rams were sold to progressive farmers of Karnataka state for improvement of their flock.

Evaluation and improvement of Chokla sheep for carpet wool

Overall least square means of body weights at birth, weaning, six, nine and twelve months of age were 2.88, 14.28, 25.04, 26.80 and 31.61 kg respectively. Average daily gain during 0-3, 3-6 and 6-12 months were 126, 118 and 39 g respectively. The least square means of greasy fleece yield for first six monthly, adult six monthly and adult annual were 1.51, 1.20 and 2.43 kg respectively. Lambing rates on ewe’s available and tupped basis was 94.81 and 97.51% respectively. Overall survivability during 0-3, 3-12 months and > 12 month were ---, ------ and --------% respectively. Overall survivability and culling in the flock was ------ and -------%. 

Genetic improvement of Malpura sheep for mutton production

Least squares means for body weights at birth, 3, 6 and 12 months of age were 3.03, 16.04, 24.86 and 37.47 kg respectively. Least square means for first and adult six monthly greasy fleece yields were 571 and 406 g. Tapping rate was 92.61% and lambing on ewe’s available and ewe’s tupped basis were 82.18 and 89.1% respectively. Twinning rate was 3.49 % in the flock. Average age at first service, fertile service and lambing was 589, 625 and 776 days respectively during 2000-2007. Overall survivability during 0-3, 3-12 months and adult age was 97.9, 95.7 and 93.0% respectively. Overall survivability and culling in the flock was -------- and -------%. ---------- breeding rams were sold to farmers for improvement of their flocks.

Improving prolificacy in sheep for mutton production

Least-square means for body weights at birth, 3, 6, 9 and 12 months of age were 1.81, 9.48, 16.91, 22.23 and 26.15 kg in Garole X Malpura (GM); 2.29, 12.30, 19.06, 24.58 and 30.21 kg in GM X Malpura (GMM); 2.12, 11.31, 18.16, 23.32 and 29.01 kg in Malpura X GM (GMM) crosses respectively. Body weight of GMM lambs at birth, 3, 6 and 12 months of age increased over GM half-breds by 26.52, 29.75, 12.71 and 15.52 % respectively. Average weights of GMM X Patanwadi lamb at birth, 3, 6, 9 and 12 months of age were 3.34, 20.34, 30.15, 32.33 and 41.00 kg respectively. First six monthly greasy fleece yields in GM, GMM and MGM were 355, 583 and 473g respectively and in Patanwadi and GMM X Patanwadi were 514 and 607g respectively. Overall survivability (irrespective of age) in GM, GMM and MGM were 94.09, 95.76 and 96.11% respectively and in A (GMM X Patanwadi) was 100 %. Tapping rate was 89.36% and lambing rate on ewes available and ewes tupped basis were 85.29 and 92.06 % in GM crosses;
84.7, 78.9 and 90.0 % in GMM; 83.3, 82.9 and 97.5 % in MGM and 86.3, 81.8 and 94.7% in Patanwadi sheep respectively. Lambs born as twins were 34.7 % and as triplets were 5.08 % in GM. Lambs born as twins in GMM, MGM and Patanwadi were 28.8, 24.3 and 27.7 % respectively. The EPE in GM, MGM and GMM at birth was 2.79, 3.07 and 2.92; weaning was 13.41, 17.17 and 15.48; 6 month was 21.45, 22.08 and 23.19 and 12 months age was 29.36, 30.85 and 32.78 kg respectively. Gross income in GM bearing twins and triplets was 14 and 41 % and GMM bearing twins was 26 % more than Malpura sheep.

A sample survey was conducted in randomly selected villages of Kendrapada, Cuttack, Bhadrak, Khurda and Puri districts of coastal Orissa. Average body weights of lambs at birth, milk, 2, 4 and 6 teeth ages were 1.93, 14.44, 16.44, 18.00 and 19.66 kg respectively.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Birth wt</th>
<th>Weaning wt</th>
<th>6 month wt</th>
<th>12 month wt</th>
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<tbody>
<tr>
<td>Malpura</td>
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<tr>
<td>Garole x Malpura</td>
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<tr>
<td>GM x Malpura</td>
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<tr>
<td>Malpura x GM</td>
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<td>Chokla</td>
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<tr>
<td>Bharat Merino</td>
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<table>
<thead>
<tr>
<th>Particulars</th>
<th>First six monthly GFY</th>
<th>Adult annual GFY</th>
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<td>Malpura</td>
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<td>Garole x Malpura (GM)</td>
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<td>Bharat Merino</td>
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Reproductive performance of native sheep

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Topping rate (%)</th>
<th>Lambing rate (%) (On available basis)</th>
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<td>Garole x Malpura (GM)</td>
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**Marwari sheep for carpet wool production**

Overall least square means of birth, 3, 6, 9 and 12 month weights were 2.91, 15.09, 21.14, 26.42 and 29.61kg respectively. The tupping, lambing on available and bred basis were 98.97, 90.25 and 90.67 %. The least square means for adult spring, autumn, annual and lambs I and II clips were 751, 524, 1288 and 426 and 665 g, respectively. Overall survivability, culling and sale were 95.66,
6.42 and 11.60 % respectively. A total of 44 rams and 46 malehoggets were sold to Veterinary College, Bikaner, government agencies and farmers for genetic improvement in the flocks of farmers in the breeding tract of Marwari breed and Andhra Pradesh.

**Magra for meat and carpet wool production**

Overall least square means of birth, 3, 6, 9 and 12 month weights were 2.96, 15.70, 23.37, 27.25 and 29.83 kg respectively. The tupping, lambing on available and bred basis were 99.67, 90.32 and 90.61 % respectively. Three times shearing was adopted in Magra flock during year 2009. The least square means for adult annual, lambs I, II and III clips were 1954, 617, 527 and 551 g respectively. Overall least square means for fibre diameter, hetero fibres, hairy fibres, medullation, staple length and crimp were 30.62 µ, 26.90%, 8.46%, 35.16%, 5.34 cm and 1.13 per cm respectively. Overall survivability, culling and sale were 98.16, 9.06 and 12.32 % respectively. A total of 86 Magra rams and hogget were supplied to the government agency, network project on Magra farmers for the genetic improvement of the farmers flock.

**Synthetic sheep for meat and wool production under sub- temperate climate**

Overall birth, 3, 6, 9 and 12 month weights were 3.47, 18.27, 27.70, 31.84 and 35.00 kg respectively. Tupping and lambing were 98 and 92% respectively. Overall weights of ewes at service and lambing were 35.12 and 38.18 kg respectively. Greasy fleece yield for first six monthly clips was 1.028 kg and adult greasy fleece yield in GS and BM was 1.872 and 1.787 kg respectively. Staple length, fibre diameter and medullation for BM and GS crosses were 4.69 and 4.62 cm, 20.00 and 19.81 µ and 1.12 and 0.30% respectively.

Average body weight gains of migratory adult females was 9.56 kg and exceptionally higher than non-migratory flock. Under migration, highest adult body weight of 41.14 kg was recorded in September month. Annual greasy fleece yield was 1.942 kg, which was significantly higher for migratory than non-migratory flocks. Under migration, body weight and wool yield of female lambs at six month of age were 29.04 and 1.088 kg respectively. A total of 54 (46M+8F) sheep were sold to farmers for genetic improvement of their flocks.

**Bharat Merino at Kodai hills**

Overall body weights of Bharat Merino at birth, 3, 6 and 12 month of age was 3.57, 18.27, 26.90 and 34.44 kg respectively. The annual tupping over both the breeding season was 95.54% with an average weight of 38.27 at mating. The lambing on the basis of ewes bred was 82.00% with an average weight of 41.96kg. Overall survivability between 0-3, 3-6, 6-12 months and adults was 90.3, 100.0, 100.0 and 95.3% respectively. Annual greasy fleece yield among rams was 2.90 kg and in ewes was 2.02 kg with clean fleece yield of 73.84%. A total of 152 sheep were sold for breeding purpose to 30 farmers of Tamil Nadu and Karnataka.

**Sirohi goats for meat and milk production**

Overall least square means for the live weights at birth, 3, 6, 9 and 12 months of age were 3.04, 11.59, 16.89, and 20.63 and 25.79 kg respectively. The pre-weaning gain was 90 and post-weaning was 52g. In feedlot study post weaning (3-6 months) gain was 143g and feed conversion efficiency was 14.67%. Dry
matter intake was 7.57 kg for each kg of live weight gain. The milk yield in the
does was 83.01 kg for 90 day and 101.99 kg for 150 day of lactation period. The
tupping and kidding on the basis of doe's available were 91.2 and 84.3 %
respectively. The mortality rate during 0-3, 3-6, 6-12 month of age and in adults
was 3.83, 0.47, 3.38 and 2.60% respectively. Overall mortality rate was 2.31 %.
A total of 66 elite breeding bucks and 42 does were sold to progressive farmers,
government and non-government agencies for improvement of their flock for
meat and milk production.

Angora rabbits for wool production in sub-temperate climatic conditions

The doe weights at service and kindling were 3.42 and 3.57 kg respectively in
German Angora. The litter size at birth and weaning were 4.80 and 4.40
respectively. The litter weights at birth were 286.8 g. The kit survivability was
90%. Overall body weights at 42, 84, 126 and 168 days were 0.72, 1.48, 2.13
and 2.61 kg respectively. Annual wool yield was 877.55 g in GA and significantly
higher than RA and BA. Clip wool yield of adult GA were 188.7, 196.2, 155.4,
162.7 and 174.3 g respectively. Overall hair yield of GA progeny in I, II and III
clips were 23.13, 88.09 and 150.92 g respectively. Overall staple length, fibre
diameter and guard hair of GA fibre were 6.06 cm, 13.01 µ and 5.16 %
respectively. Under comparative analysis, growth, wool yield and reproduction
of NTRS flock were found significantly higher than farmers. A total of 333 (179
male+154 female) GA and 2 RA animals were sold to the farmers.

Comparison of different parameters of Angora rabbits between Farmer’s and
NTRS

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Farmer’s Angora</th>
<th>NTRS Angora</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 days weights (kg)</td>
<td>0.45±0.01 (31)</td>
<td>0.72±0.01 (344)</td>
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<tr>
<td>84 days weight (kg)</td>
<td>1.34±0.03 (31)</td>
<td>1.48±0.01 (336)</td>
</tr>
<tr>
<td>168 days weight (kg)</td>
<td>2.24±0.02 (31)</td>
<td>2.61±0.01 (31)</td>
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<tr>
<td><strong>Production</strong></td>
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<td></td>
</tr>
<tr>
<td>Progeny I clip (g)</td>
<td>8.58±0.43 (31)</td>
<td>23.13±0.36 (335)</td>
</tr>
<tr>
<td>Progeny II clip (g)</td>
<td>48.30±1.28 (31)</td>
<td>88.09±1.60 (335)</td>
</tr>
<tr>
<td>Progeny III clip (g)</td>
<td>110.60±2.61 (31)</td>
<td>149.43±1.29 (213)</td>
</tr>
<tr>
<td>Annual wool yield (g)</td>
<td>615.58</td>
<td>877.55</td>
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<tr>
<td><strong>Wool quality</strong></td>
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</tr>
<tr>
<td>Staple length (cm)</td>
<td>5.33±0.08</td>
<td>6.06±0.06</td>
</tr>
<tr>
<td>Fibre diameter (µ)</td>
<td>14.14±0.39</td>
<td>12.89±0.09</td>
</tr>
<tr>
<td>Guard hair (%)</td>
<td>5.50±0.90</td>
<td>5.16±0.32</td>
</tr>
</tbody>
</table>
Projects

Establishment of agro-forestry system for maximization of forage production

Sub-project: Effect of solar reflectance and CO₂ concentration on crop productivity under Ardu based agro-forestry system in semi-arid region
J.S. Mann, S.C. Sharma and H.S. Jat (Upto 30.08.2008)

Conservation and management of natural resources through agronomical manipulations

Sub-Project: Development of silvi-pasture system through agronomical manipulation for improving productivity of sloppy degraded land in semi arid conditions
S.C. Sharma, J.S. Mann, Roop Chand and H.S. Jat (Upto 30.08.2008)

Development of agro-horti pastures system sustainable to semi arid conditions
L.R. Meena, J.S. Mann, Roop Chand and H.S. Jat (Upto 30.08.2008)

Feed and fodder resource development for small ruminants in arid region

Sub-Project: Evaluation of different rejuvenation techniques of old sewan (Lasiurus sindicus) grasslands with organic and inorganic sources of nutrients in hot arid region
K. C. Sharma

Sub-project: Effect of irrigation scheduling on the sewan (Lasiurus sindicus) grass seed productivity and its viability
K. C. Sharma

Sub-project: Integrated nutrient management in oat (Avena sativa) and lucerne (Medicago sativa) in hot arid region
K. C. Sharma

Sub-project: Fodder production potential of fodder pearl millet (Pennisetum glaucum) and cluster bean (Cyamopsis tetragonoloba) in intercropping system under different planting pattern during summer in hot arid region
K. C. Sharma
Establishment of agro-forestry system for maximization of forage production

Effect of solar reflectance and CO$_2$ concentration on crop productivity under ardu based agroforestry system in semi-arid region
Averaged CGR and RGR at 15-30, 30-45 and 45-60 DAS, dry fodder yield (DFY), seed yield (GY), biomass production and biomass of the system did not vary considerably among various land use system, however these parameters were estimated higher in two and three tier agro forestry system in comparison to single tier. Growth indices of cenchrus i.e. CGR and RGR and its productivity viz. dry fodder, seed yield and biological yield also exhibited similar results. Further, different crops/crop combination shows significant variation in growth indices and yield parameters due in species difference. Biomass production of system showed significantly higher biomass when all the tested crops were taken in combination with cenchrus in the ratio 3:2. Correlation studies of land use system showed that biomass production was positively and significant affected by CGR 15-30, 30-45 and 45-60 DAS in three-tier system.

Tree-crop interaction in agroforestry system in relation to reflectance and CO$_2$ concentration and its effect on productivity of crop
Average fresh and dry weight at 60 DAS, CGR 45-60 DAS, RGR 45-60 DAS, moisture content during July, August, September and October 2009, dry fodder yield and biomass production were recorded the highest in association of ardu which were observed to be at par with siris association and with siris association and open field conditions in respect of dry fodder yield and biomass production. Further, of all the growth parameters & indices and dry fodder, seed yield and biomass productions were significantly differ among various tested crops due to species difference. Cenchrus seed yield was at par in open field, ardu and siris association. Guar seed yield also exhibited similar results. Correlation studies indicate that average DFY of all the tested crops (cowpea, cenchrus, guar, bajra) in any of agroforestry system highly dependent on DMA at 30, 45 and 60 DAS as their ‘r’ value showed significant and positive correlations.

Conservation and management of natural resources through agronomical manipulations
Development of silvipasture system through agronomical manipulation for improving productivity of sloppy degraded land in semi arid conditions
V-ditch contour bund registered 76.75 % 262.1 % and 240.2 % higher seed, dry fodder and biological yield, respectively over without V-ditch treatment in 2$^{nd}$ year of pasture establishment. Further, place of planting cenchrus at lower side contour bunds revealed 15.57 % and 16.70 % higher dry fodder and biological yields over upper side counter and 7.93 % and 7.88 % higher to that of middle side contour bunds, respectively. Further, in 3$^{rd}$ year of cenchrus pasture establishment dry fodder and biomass production was higher by 11.75 % and 11.67 % respective at below ‘V’ ditch in comparison to above ‘V’ ditch contour bund. In varying slope study, the highest dry fodder and biomass production of cenchrus was recorded up to 5 % land slope. Progressive increase in land slope (5% to 20%) significantly reduced these parameters.
Use of amendments for improving poor quality well water
Gypsum amendment and green manure crops brought about significant improvement in soil properties in terms of pH, electrical conductivity, organic carbon, density and major nutrients of the soil and ultimately increased the yields of tested crops. The gypsum used through saline water produced higher plant height, fresh weight and dry weight and yield of barley as compared to control.

Development of agro-horti pastures system sustainable to semi arid conditions

Rejuvenation of old established Ber orchard

Performance of crops in agro-horti pasture system
Averaged weight, dry weight per plant and averaged plant height at 15, 30, 45 and 60 DAS were not affected significantly due to fruit tree association and these parameters were observed at par with open field condition. Similar results were also observed in averaged CGR, RGR from 15-30, 30-45 and 45-60 DAS, average DFY, seed yield and biological yield. It suggest that fruit trees can easily be incorporated in arable crop as agro-horticulture system in semi arid conditions. Further, different growth and growth indices viz. fresh and dry weight, plant height at 15, 30, 45 and 60 DAS, CGR and RGR from 15, 30-45 and 45-60 DAS, DFY, seed yield and biological yields of various crops differ significantly due to species difference.

Feed and fodder resource development for small ruminants in arid region

Evaluation of different seeding and planting methods of sewan (Lasiurus sindicus) grass
Green fodder (128.9 q/ha) and dry matter (48.1 q/ha) yields of sewen grass by seedling transplantation method were significantly higher over seeding and planting methods and seed soaked sowing method. Total tussocks/ha (27.8 thousands/ha), number of tillers per tussock (114.5), tillers height (121.0 cm.) and tussock diameter (53.9 cm.) were also greater in seedling transplanting method. For small area, seedling transplantation and for large area seed soaking method is promising method of sowing sewan grass in hot arid region of Rajasthan.

Comparative performance of forage crops and grasses under agro-forestry Systems
The effect of fodder tree species viz., Khejri (Prosopis cineraria), Ardu (Ailanthus excelsa) and Rohida (Tecomella undulata) on the productivity of the fodder values grain crops viz., clusterbean (Cyamopsis tetragonoloba) and mothbean (Vigna aconitifolia) and grasses viz., sewan (Lasiurus sindicus) and cenchrus (Cenchrus ciliaris) showed grain, straw and grass yield under different fodder tree species were almost same and no special effect of any tree species was observed on the productivity of any of the crop or grass.

Production potential of fodder cropping sequences with or without ber plantation
Total green fodder and dry matter yields produced with ber plantation (GFY 332.5 q/ha and DMY 68.35 q/ha) were decreased to the tune of 9.82 and 11.8 per cent, respectively as compared to yield without ber plantation. Among fodder cropping sequences, pearlmillet as sole (GFY 425.5 q/ha and DMY 91.6 q/ha) or intercropped with clusterbean (GFY 416.3 q/ha and DMY 89.93 q/ha) produced higher total fodder yields. Among fodder cropping sequences, pearlmillet + clusterbean sequence recorded maximum value of SFY (443.5 q/ha).
Projects

Assessment of plane of nutrition and energy expenditure of grazing sheep in critical physiological stages and seasons to augment its productivity

Identification, evaluation, improvement and utilization of newer feed resources for sheep
Sub-project: Improvement of low quality roughage by cell wall degrading enzymes to enhance cell wall solubility and digestibility
A. Sahoo, O. H. Chaturvedi and S.G.S. Goyal (CIRCOT)
Sub-project: Exploration of Prosopis juliflora as newer / alternative feed resources for sheep
O. H. Chaturvedi, A. Sahoo and M. Asgar

Development of feeding system for improving quantity and quality of mutton and wool production
Sub-project: Development of microbial feed additives to manipulate lambs growth
M. K. Tripathi (Upto 22.06.2009), R.S. Bhatt, N.M. Soren, P.K. Jain and S.A. Karim
Sub-project: Exploitation of genetic potential of growth of native animals by challenge feeding
R.S. Bhatt, M. K. Tripathi (Upto 22.06.2009), N. M. Soren, P.K. Jain, S.A. Karim

Sub-project: Evolving feeding system for higher wool production

Nutrient input output relationships in sheep on pasture under arid ecology
R.K. Sawal

Nutritional studies for formulating economical feeding programme for sheep and rabbit reared in north temperate region of India
S. Saha and S.R. Sharma

AICRP on improvement of feed resources and nutrient utilization in raising animal production
A.K. Shinde S.K. Sankhyan and A. Sahoo

Network/Outreach project on Estimation of methane emission under different feeding systems and development of mitigation strategies
R.S.Bhatt and N.M.Soren

NAIP on Increasing nutrient availability from roughage based rations through enhancing rumen efficiency or reducing enteric methane production by use of secondary plant metabolites
M.K.Tripathi and N.M.Soren
Assessment of plane of nutrition and energy expenditure of grazing sheep in critical physiological stages and seasons to augment its productivity

The biomass yield of pasture during summer, monsoon and winter season was 10.14, 16.11 and 13.49 qDM/ha respectively. Crude protein content was higher (P<0.001) during August (9.40%) and lower during June (7.54%). NDF and ADF contents of the pasture forage were higher in June and lower in August. Crude protein contents of diet were significantly higher during August (14.98%) and lower during June (11.37%) but fibre fractions were higher in the month of August. The DM digestibility in dry ewes ranged from 58 to 70%. Similarly the CP digestibility ranged from 59.50 to 74.99% during summer and monsoon season respectively. Digestibility of DM, OM, CP, NDF and ADF of ewes were apparently higher in the pregnant and lactating than dry stage. The digestibility coefficients for all the nutrients were higher during monsoon as compared to summer season. DM intake was ranged from 446 to 542g in ewes depending upon the availability of pasture and nature of vegetation. DCP intake irrespective of physiological stages ranged from 2.20 to 2.38 g/kgW^{0.75} during summer and 3.97 to 4.87 during monsoon. Similarly MEI ranged from 1.82 to 1.88 MJ/ kgW^{0.75} during summer and 1.50 to 2.34 during monsoon.

Identification, evaluation, improvement and utilization of newer feed resources

Improvement of low quality roughages by cell wall degrading enzymes

The benefit of fortification of roughage or concentrate with commercially produced cell wall degrading enzymes was assessed. There were non-significant differences in nutrient intakes and utilization in rams supplemented fortified roughage or concentrate with commercial cell wall degrading enzymes.

Exploration of Prosopis juliflora (Vilayati babool) as newer/ alternative feed resources for sheep

Dried leaves and pods of Prosopis juliflora were used as replacement of guar straw at 10, 20, 30, 40 and 50% levels. Oven dried leaves of P. juliflora could replace 20% guar straw whereas pods could replace up to 50% levels. Sun dried ground pods of P. juliflora can replace 30 to 40 % concentrate mixture fed to rams @ 1 % of their body weight along with cenchrus hays ad libitum. Replacement of concentrate with dried pods of P. juliflora did not affect the nutrient intake, rumen fermentation and nutrient utilization patterns.

Development of feeding system for improving quantity and quality of mutton and wool production

Development of microbial feed additives to improve lamb growth
**Production of probiotic feed, drying and storage:** Liquid culture inoculated at 2 to 3 % levels in wheat bran and allowed to ferment in a thermo controlled Biologically Oxygen Demand (BOD) incubation at 25 to 30ºC for 65 to 72 hrs. The fermented product was dried under shed in sterilized conditions at 20 to 26ºC for 60 to 72 hrs. The fermented dried probiotic contained 4-14 ×10⁶ per gram of live yeast cells. Dried fermented probiotic stored below 37ºC and used for animal feeding.

**Feeding of fermented yeast probiotic:** Feed contains 1, 2 or 3 % of dried probiotic was fed to Malpura (13.6 kg BW; 82 days old) lambs from 90 to 180 days of age. The finishing body weight of the lambs ranged between 29.26 to 30.61 kg, with total gain of 15.06 and 17.25 kg and ADG of 154 to 176 g among the treatments. Fermented probiotic feed contained 4 to 14 ×10⁶ live yeast cells, allowing an intake of 3 to 6×10⁹ live yeast cells, improved growth by 5 to 8 %, feed efficiency by 3 to 9 % and cost of feed inputs per kg live weight gain reduced by 6 to 12 % and also control diarrhea incidences.

**Exploitation of genetic potential of growth of native animal by challenge feeding**

*Effect of different levels of fat supplementation on pre and post weaning growth of lambs*

Rumen protected fat supplementation during pre-weaning period in lambs did not improve weaning weight, average daily gain, daily dry matter intake and FCR. The improvement during post weaning period was observed and six month body weights at 0, 2 and 4% levels of supplementation were 25.6, 27.2 and 30.4 kg respectively. ADG, FCR and DMD improved with fat supplementation in post weaning lambs. In economic terms, return was higher at 2 % compared to 4 % levels of fat supplementation.

**Effect of replacing protein sources with urea on the body condition of spent ewes.**

Stall feeding of ewes in cafeteria system on concentrate @ 2.5 % of body weight and *ad lib* roughage and replacement of protein by urea + molasses @ 0.5 +7.5 % increased the body weight by 8.1±0.7 and 6.8±0.7 kg respectively which was 28.8 and 24.1 % higher over initial weights. Higher profit was recorded in high energy diet as compared to urea supplemented diet.

### Cost of Production and Economic analysis

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<thead>
<tr>
<th>Parameter</th>
<th>0 day</th>
<th>90 day</th>
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<th>T₁</th>
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<tbody>
<tr>
<td>Input cost (Rs)</td>
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<td>Concentrate</td>
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<td>Roughage</td>
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<td>120.3</td>
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<tr>
<td>Contractor charges</td>
<td>120</td>
<td>120</td>
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<td>Health care +Misc</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Total</td>
<td>903.9</td>
<td>867.9</td>
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<tr>
<td>Output cost (Rs)</td>
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<tr>
<td>Body weight</td>
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<td>Dressed weight</td>
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<tr>
<td>Cost @ Rs. 150/kg</td>
<td>1695</td>
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<td>Difference in output</td>
<td>-</td>
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<tr>
<td>Profit (Rs)</td>
<td>344</td>
<td>165</td>
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</table>
Evolving feeding system for higher wool production

Sulphur supplementation on wool production and quality
Sulphur supplementation did not affect the digestibility. DCP intake was significantly (P<0.001) improved with concentrate supplementation. The study showed that sulphur supplementation @ 0.3% in the concentrate mixture containing either at low protein or high protein did not improve performance or wool quality parameters.

Nutrient input output relationships in sheep on pasture under arid ecology

Sheep diet on arid pasture constituted of Ochthochloa compressa (60.9%), Aristida adscensionis (13.6%), Lasiurus sindicus (7.0%), Cenchrus ciliaris (3.9%), Panicum turgidum (0.5%) and among the edible bushes green/dry, Calligonum pollygonides (5.0%), fallen dry leaves of Aerva pseudotomentosa (2.5%) and fallen leaves of Zizyphus nummularia (2.1%), Lycum barbarum (0.8%) and Boerhavia diffusa (1.7%). Trees leaves of Prosopis cineraria (2.0%) were also constituted diet of sheep. Perennial grasses Lasiurus sindicus, Cenchrus ciliaris and Panicum turgidum constituted major portion of diet.

Nutritional studies for formulating economical feeding programme for sheep and rabbit reared in north temperate region of India

Restricted concentrate and ad lib green fodder feeding in Angora rabbits

The final body weight of adult Angora rabbit fed 126 and 140g concentrate mixture daily with ad lib green for a period of 10 weeks were 3.129 and 3.210 kg and wool yield 200 and 198 g respectively. No significant difference in body weights and wool yields was recorded.

Nutritional manipulation in pregnant ewes and its impact on birth weight of lambs, post natal growth

The birth weights of synthetic breed lambs supplemented concentrate mixture @ 480, 576 and 620g from 2 months of pregnancy to weaning of lambs were 3.69±0.19, 3.66±0.17 and 3.90±0.17 kg respectively.

Milk yield and composition of ewes maintained under different concentrate supplementations

The milk yield of lactating ewes supplemented concentrate mixture @ 480, 576 and 620g from 2 months of pregnancy to weaning of lambs was ............................

AICRP on improvement of feed resources and nutrient utilization in raising animal production

The beneficial effect of chelated minerals on growth performance of Malpura lambs under field condition was evaluated and demonstrated. Lambs were supplemented concentrate mixture @ 3.0% of BW containing 2% mineral mixture. Chelated Zinc and Copper minerals were used in place of inorganic source in the mineral mixture. Mineral contents of concentrate mixture containing chelated Zn and Cu was 0.37% Ca, 0.41% P, 0.20% Mg, 53.57ppm Cu, 47.53ppm Zn, 9.14ppm Mn and 307ppm Fe and that of non-chelated were 0.34% Ca, 0.40% P,
0.20% Mg, 19.17ppm Cu, 38.43ppm Zn, 9.79ppm Mn and 239ppm Fe. Average body weights of lambs at 45 days of age on chelated mineral mixture was 8.60 kg and on non-chelated mixture was 8.40 kg. Subsequent weights at 105 days were 16.19 and 15.72 kg with ADG of 126 and 122 g.

**Estimation of methane emission under different feeding systems and development of mitigation strategies**

*In vitro* ruminal total gas production in 96 h in tree foliage (Neem, Khejri and Gonda) having $t_{1/2}$ ($h^{-1}$) of 17.5 to 27.9 was 17.7 to 50.9 ml, in straw samples (Sorghum, Mustard, Wheat, Guar, Barley, Peral millet) having $t_{1/2}$ 11.3-26.4 was 37.3 to 42.4 ml and in crops *(chola, saunf*, green groundnut, Green gram leaves, etc) having $t_{1/2}$ of 9.0 to 14.1 was 25.2 to 41.6 ml.

**Use of secondary plant metabolites for increasing nutrient availability from roughage based rations through enhancing rumen efficiency or reducing enteric methane production**

Fennel, Ajowin and Dil straws showed good fermentability with higher TDOM values. A low gas production from Khejri and Pala leaves indicated incomplete fermentation reflecting higher PF values. Coriander and Dill at 20%, Ajowin and Fennel at 10-15% and Fenugreek and Cumin at 5% level had positive rumen fermentation but their effect on methane production and other fermentation metabolites needs to be estimated.

**Network programme on veterinary type culture-rumen microbes**

Objectives and guidelines of the project were framed and technical programme was finalized in the Interactive meet. Chemicals, glasswares and miscellaneous items were procured for initiating the work.
Projects

**Ram semen preservation and utilization**
Anil Joshi, Davendra Kumar, S.M.K. Naqvi and Rajani Kumar Paul
(From 28.8.2009)

**Sub project: Production and evaluation of ram semen**
Anil Joshi, Devendra Kumar and S.Saha

**Sub project: Ram semen preservation and evaluation**
Devendra Kumar, Anil Joshi and S.M.K. Naqvi

**Sub project: Isolation and characterization of membrane proteins of cryopreserved ram spermatozoa**
Rajani Kumar Paul, Anil Joshi and Davendra Kumar

**Sub project: Fertility trial with frozen-thawed ram semen**
S.M.K. Naqvi, Devendra Kumar and Anil Joshi

**Improving reproductive efficiency of sheep for augmenting production**
S.M.K. Naqvi, R. Gulyani, Sajjan Singh, S. Saha (Up to 30.06.2009),
Amminudeen (From 08.09.2009), Anil Joshi, S.R. Pareek, N.M. Soren
and S.A. Karim

**Effect of nutrition supplementation on ovulation rate in sheep**
S.M.K. Naqvi, N.M. Soren and S.A. Karim

**Sub Project: Optimization of ovulation for induction of twinning in sheep**
R Gulyani, S.M.K.Naqvi and Sajjan Singh

**Sub Project: Study on reproductive potential of Malpura sheep**
S.M.K. Naqvi, Anil Joshi and S.R. Pareek

**Sub project: In vivo production of embryos**
Sajjan Singh; R Gulyani and S.M.K. Naqvi

**Sub Project: Improvement of reproductive performance of Patanwadi sheep and production of three lambs in 2 years**
S.M.K. Naqvi, S. Saha (Up to 30.06.2009) and S.R. Pareek

**Sub Project: Transplantation of spermatogonial stem cells in rams**
Aminudeen (From 08.09.2009), Sajjan Singh and S.M.K. Naqvi

**Studies on multiple stresses on reproduction and production of sheep**
V.P. Maurya, V. Sejian, S.M.K. Naqvi, Davendra Kumar and R. Gulyani and Sajjan Singh

**Sub Projects: Effect of walking stress on the productive and reproductive efficiency of Malpura ewes**
V. Sejian, V.P. Maurya, and S.M.K. Naqvi

**Sub Project: Effect of thermal on physiological response, biochemical and endocrine profiles and reproductive performance of Malpura Rams**
V.P. Maurya, V. Sejian, Davendra Kumar and S.M.K. Naqvi

**Sub project: Effect of BCS on hormonal profile of adult Malpura rams**
V.P. Maurya, V. Sejian and S.M.K. Naqvi
Ram semen preservation and utilization

Production and evaluation of ram semen

The age of ram lambs significantly (P<0.05) influenced mass motility, sperm concentration, percent sperm motility, percent rapid motile spermatozoa, percent linearity, sperm velocities and beat frequency of spermatozoa, which were higher in 9-12 months old compared to 6-9 months old ram lambs. The mass motility, sperm concentration, percent sperm motility, percent rapid motile spermatozoa and sperm curvilinear velocity were significantly (P<0.05) lower in ram lambs of 25-30 kg body weight compared to ram lambs of 30-35 kg, 35-40 kg, and 40-45 kg body weights however the differences were non-significant. The interaction between body weight and age was significant (P<0.05) for percent sperm motility, percent rapid motile spermatozoa and sperm curvilinear velocity. Malpura and Patanwadi ram lambs of 9-12 months of age and above 30 kg body weight produced good quality semen.

Ram semen preservation and evaluation

Influence of diluent composition on sperm motion characteristics of short-term preserved ram spermatozoa

The semen samples diluted 1:1 with EYCG, EYTEST, EYTESTG and Ovixcell extenders and stored at 4-7°C. At 24 h of storage the percent motility and percent rapid motile spermatozoa were not significantly different in EYCG, EYTEST and EYTESTG while in Ovixcell they were significantly low (P<0.05) compared to 0 h stored samples. The differences in percent motility and percent rapid motile spermatozoa between EYCG, EYTEST and EYTESTG up to 48 h of storage were not significant. At 72 h of storage the differences between EYTEST and EYTESTG with respect to percent motility and percent rapid motile spermatozoa were not significant but were significant (P<0.05) with EYCG. Among the four diluents the percent motility, percent rapid motile spermatozoa, curvilinear velocity, average path velocity and straight line velocity were maximum in samples stored in EYTEST extender. The short-term preservability of ram semen up to 72 h of storage was optimum in EYTEST extender.

Isolation and characterization of membrane proteins of cryopreserved ram spermatozoa

Adult Malpura Semen was extended in 1:2 EYCG and EYMG extenders. A total of 17-22 polypeptide bands (7-9 major and 10-13 minor) ranging from 5 to 105 Kd were recorded.

Fertility trial with short-term preserved ram lamb semen

Semen collected in quick succession from Malpura lamb rams of 9-12 months of age diluted in 1:1 with EYCG extender. The diluted semen was stored at 4-7°C. The average motility (%), rapid motile spermatozoa (%) and curvilinear velocity (µm/s) at 0 and 12 h of stored semen were 84.5, 75.3 and 232.6; 86.8, 78.6 and 238.1; 82.0, 76.2 and 240.2; 87.3, 59.8 and 206.1; 83.3, 53.3 and 189.3 and 77.3, 47.7 and 163.0, respectively. Fertility trial was conducted for one cycle by per-os insemination of ewes exhibiting estrus using short-term preserved semen of lambs. A lambing per cent of 41.4 was achieved.

Fertility trial with short-term preserved semen of adult rams

Semen samples diluted in 1:1 with EYCG extender and preserved in liquid up to 48 h at 4 -7°C. The average motility (%), rapid motile spermatozoa (%) and curvilinear velocity (µm/s) at 0, 12, 24, 36, 48 and 60 h of stored semen were 89.3, 80.3 and 245.6; 86.8, 78.6 and 254.8; 82.7, 76.2 and 240.2; 87.3, 59.8 and 206.1; 83.3, 53.3 and 189.3 and 77.3, 47.7 and 163.0, respectively. Fixed-time artificial insemination was carried out for one cycle using 0, 24 and 48 h
of stored semen. The lambing percent of ewes inseminated using 0, 24 and 48 h of stored semen was 50.0, 37.5 and 20.0, respectively.

**Fertility trial with long-term preserved semen**

In order to improve catheter penetration through cervix for deep deposition of frozen-thawed semen, Dinoprostone, a naturally occurring prostaglandin $E_2$ ($PGE_2$) was applied topically on the os-cervix 30 min prior to TCAI and ketamine @ 3 mg/ kg BW I/m 10 min prior to TCAI. Ewes were inseminated for two cycles twice at 12 h interval. The depth of catheter penetration through the cervix was more in ketamine group (87.6 % full penetration) followed by Dinoprostone treated group (57.2 % full penetration) and control group (35.0 % full penetration). The conception rate on non-return basis was 14.2, 31.2 and 31.7 % respectively. Ketamine enhance catheter penetration through cervix but did not improve conception rate.

**Improving reproductive efficiency of sheep for augmenting production**

**Effect of nutrition supplementation on ovulation rate in sheep**

Concentrate supplementation @1.5 % of BW during summer season brings all the ewes into estrus and ovulation, reduced the time interval to onset of estrus and increased the duration of estrus. Number of ovulation per ewe was significantly ($P<0.05$) greater in supplemented (1.2±0.20) as compared to non-supplemented (0.7±0.15) group.

**Optimization of ovulation for induction of twinning in sheep**

**Efficacy of Ovagen in conjunction with Prostaglandin F2α in inducing twinning in Malpura ewes during autumn**

Ovagen (2.0 and 2.7 mg) in conjunction with Prostaglandin F 2α (PGF) increased number of ovulations to 1.57 and 1.85 compared to 1.12 in control. The lambing rate improved from 120 to 175 and 167% respectively. The percentage of ewes diagnosed pregnant through ultrasonography were 71.43 (control), 57.14 (2mg) and 83.33 (2.7mg) indicated the possibility of inducing multiple births through controlled ovulation.

**Study on reproductive potential of Malpura sheep**

**Testicular development and semen production in ram lambs**

Patanwadi ram lambs ejaculated semen in the artificial vagina at earlier age (196 days) as compared to Malpura (228 days). Circulating plasma level of testosterone was also relatively higher in Patanwadi growing lambs. Testicular growth viz., testicular length, breadth, circumference, volume and scrotal skin thickness increased steadily with the advancement of age. However, values for testicular volume and circumference were higher in Patanwadi lambs as compared to that of Malpura lambs. Testicular development of growing Patanwadi ram lambs is relatively faster than Malpura lambs.

**Attainment of puberty in Malpura and Patanwadi female sheep**

Patanwadi ewe lambs attained puberty at an early age (240 days) as compared to Malpura breed (270 days). All the ewes exhibited first estrus within nine months of age.

**In vivo production of embryos**

**Effect of age on superovulation and embryo production in sheep**

Superovulatory response and total ovarian response were similar in adult (Group 2) and aged ewes (>7 Years). However, only 50.0% ewes had > 2 CL in aged ewes in comparison to 62.5% in prime aged ewes. Percent egg
recovery and yield of transferable embryos were relatively low in aged animals in comparison to prime aged ewes.

**Estrus Induction and synchronization in sheep using intravaginal progestrone device in combination with PMSG or Estradiol depot**

Estrus was induced in acyclic ewes using indigenously developed intravaginal impregnated with progesterone alone and in combination with PMSG or estradiol in seasam oil injection. Onset of estrus (31.68 ± 2.38 h) in estradiol treated ewes was significantly higher (P<0.05) compared to the ewes treated with only vaginal sponges (22.50 ± 2.06 h v/s 21.00 ± 2.38 h). The estradiol treatment delayed onset and duration of ovarian response.

**Improvement of reproductive performance of Patanwadi sheep and production of 3 lambs in 2 years**

Progesterone impregnated intra-vaginal sponge + 200 IU PMSG used for induction of estrus in Patanwadi ewes. The conception rate was 82.3% in the ewes mated in natural estrus and 76.4% in induced estrus ewes. The lambing rate was 82.3 and 70.5% respectively. The twinning rates in natural and induced estrus ewes were 30.7 and 25.0%. After first lambing, second breeding was successfully performed in 58.3% ewes with in targeted of eight months period (232.7±2.14 days). All the ewes were mated second time within inter-service period of 271±9.68 days.

**Transplantation of spermatogonial stem cells in rams**

**Infusion of Trypan blue dye into rete testes of testicular epididymis**

This trial was undertaken to standardize the transfer of cells into rete testes of ram. Parietal tunic is incised with scalpel blade in oblique fashion to expose the testicle. The epididymis and tunica albuginea is then dissected bluntly followed by reflection of epididymis. Extra testicular rete testis is then located and opened by incision with a needle. A canulla is then passed through this incision into rete testis followed by infusion of dye through I/V set. After infusion of dye the testicle is opened through longitudinal sectioning and evaluated for successful/ unsuccessful deposition of dye into the rete testis. The criteria used for evaluation is that flooded rete testis indicates successful deposition, while empty rete-testis indicates a non-successful deposition.

**Studies on multiple stresses on reproduction and production of sheep**

**Effect of walking stress on the productive and reproductive efficiency of Malpura ewes**

Feed intake reduced significantly (P<0.05) under walking stress while water intake increased significantly (P<0.05). Body weight and average daily gain also showed significant (P<0.05) affected by walking stress. Hb and PCV increased significantly (P<0.05) while plasma glucose decreased significantly (P<0.05) in walking stress. Plasma AST and ALT increased significantly (P<0.05) in walking stress. Cortisol increased significantly (P<0.05) while T3 and T4 decreased significantly (P<0.05) under walking stress. However, reproductive hormones viz., estradiol and progesterone concentrations did not affect significantly.

**Effect of thermal on physiological response, biochemical and endocrine profiles and reproductive performance of Malpura Rams**

**Effect of thermal stress on productive and reproductive efficiency of Malpura rams**

Respiration rate, pulse rate, rectal temperature, sweating rate (body and scrotum) were significantly (P<0.05) higher in rams exposed to thermal stress.
as compared to rams maintained under shed. The dartos muscle extension was significantly (P<0.05) higher in thermally exposed rams. PCV, Hb and plasma glucose levels were significantly (P<0.05) lower in thermally exposed rams as compared to rams maintained in shed. The reaction time, ejaculation time, latency period, percent progressive motility and rapid motile sperm were significantly (P<0.05) lower in thermally exposed rams.

**Effect of BCS on hormonal profile of adult Malpura rams**

**Effect of BCS on metabolic and reproductive hormonal profile of Malpura rams**

The concentration of T\textsubscript{3} and T\textsubscript{4} were highest in rams of BCS 4.0 followed by BCS 3.0 and BCS 2.5 rams. The plasma testosterone and plasma cortisol were also significantly (P<0.05) increased in higher BCS rams as compared to rams of lower BCS.
Projects

Genome analysis of sheep breeds by molecular methods
L. Leslie Leo Prince, Rajiv Kumar (from 01.07.2009), Rajni Kumar (30.10.2009), Ashish Chopra (from 22.05.009 to 20.01.2010) and Ved Prakash (from 22.05.2009)

Sub project: Identification and molecular analysis of fecundity gene in prolific and non-prolific sheep
L. Leslie Leo Prince, Rajiv Kumar (from 01.07.2009), Rajni Kumar (30.10.2009)

Genetic improvement of resistance to *Haemonchus contortus* in sheep
D. Singh, C.P. Swarnkar, L.L.L. Prince, F.A. Khan, C. Paswan and A.L. Arora
Genome analysis of sheep breeds by molecular methods

Growth Hormone gene
Polymorphism in growth hormone gene studied in Avikalin, Malpura, Chokla, Magra and Sonadi. At A781G locus, AA and AB genotypes were found but no homozygous (BB) individuals were found in any of the breed (Fig 1). At A1575G locus, all samples of Avikalin, Malpura, Chokla, Magra and Sonadi were found homozygous (CC). No homozygous (DD) individuals and heterozygous (CD) were found. Genotype and gene frequency among different breeds were presented in table 1.

![Fig.1. Representative genotyping of GH gene at locus A781G resolved on 2\% agarose gel electrophoresis. Strands with 366 bp for AA genotype (Lanes 4 and 6), 422bp and 366bp for AB genotype (Lanes 1, 2, 3 and 5) appeared at this locus, Lane 7 represents undigested PCR product, L represents 50bp DNA ladder.]

<table>
<thead>
<tr>
<th>Locus</th>
<th>Genotype</th>
<th>Avikalin</th>
<th>Chokla</th>
<th>Magra</th>
<th>Malpura</th>
<th>Sonadi</th>
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<tbody>
<tr>
<td>A781G</td>
<td>AA</td>
<td>0.375</td>
<td>0.214</td>
<td>0.051</td>
<td>0.225</td>
<td>0.033</td>
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<tr>
<td></td>
<td>AB</td>
<td>0.625</td>
<td>0.786</td>
<td>0.949</td>
<td>0.775</td>
<td>0.967</td>
</tr>
<tr>
<td>A1575G</td>
<td>CC</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Allele</td>
<td>A</td>
<td>0.688</td>
<td>0.607</td>
<td>0.526</td>
<td>0.612</td>
<td>0.517</td>
</tr>
<tr>
<td></td>
<td>B</td>
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<td>0.393</td>
<td>0.474</td>
<td>0.388</td>
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</tr>
<tr>
<td></td>
<td>C</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Keratin Gene

Two regions of the keratin gene were amplified from ovine genomic to study the polymorphism at KRT 1.2 locus. Three genotypes (MM, MN & NN) were generated by the KRT 1.2 Msp I RFLP polymorphism (Fig 2). XX, XY and YY genotypes were generated by KAP 1.3 Bsr I RFLP polymorphism (fig 3). Eight breeds of sheep screened for KRT1.2 polymorphism and genotype and gene frequency are presented in table2. Significant breed difference is observed with respect to polymorphism in KRT 1.2 locus. Polymorphism study on KAP 1.3 gene is in progress.

<table>
<thead>
<tr>
<th>Locus</th>
<th>Genotype</th>
<th>Avikalin (42)</th>
<th>Chokla (40)</th>
<th>Magra (40)</th>
<th>Malpura (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRT 1.2</td>
<td>MM</td>
<td>0.619</td>
<td>0.425</td>
<td>0.525</td>
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<tr>
<td></td>
<td>MN</td>
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<tr>
<td></td>
<td>NN</td>
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<tr>
<td>Allele</td>
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<td>0.692</td>
<td>0.725</td>
<td>0.813</td>
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<td></td>
<td>N</td>
<td>0.191</td>
<td>0.308</td>
<td>0.275</td>
<td>0.187</td>
</tr>
</tbody>
</table>

Table 2 Genotype frequency of KRT 1.2 locus

Aromatase Gene

Aromatase gene (cyp 19) fragment were amplified from ovine genomic DNA as and restriction fragments were generated by the Bsp 1431 RFLP polymorphisms and which generated AA, AB and BB genotype (Fig 4). Polymorphism study is in progress.

Identification and molecular analysis of fecundity gene in prolific and non-prolific sheep

A total of 22 individuals of Garole sheep screened for the FecB mutation, out of that 7 were BB, 14 B+ and 1 ++ for the FecB gene. A total of 133 individuals of GM sheep screened for the FecB mutation, out of that 30 were BB, 82 B+ and 21 ++ for the FecB gene. Among GM (M), 5 was Fec\textsuperscript{BB}, 44 were Fec\textsuperscript{B+} and 54 were Fec\textsuperscript{++}. Among M (GM), 3 was Fec\textsuperscript{BB}, 24 were Fec\textsuperscript{B+} and23 were Fec\textsuperscript{++} (Table 3).

<table>
<thead>
<tr>
<th>Genetic group</th>
<th>Fec B genotype</th>
<th>Total</th>
<th>% carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BB</td>
<td>B+</td>
<td>++</td>
</tr>
<tr>
<td>Garole</td>
<td>7</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>GM</td>
<td>30</td>
<td>82</td>
<td>21</td>
</tr>
<tr>
<td>GM (M)</td>
<td>5</td>
<td>44</td>
<td>54</td>
</tr>
<tr>
<td>M (GM)</td>
<td>3</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>A (GMM x P)</td>
<td>0</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>
Fig. 2 Representative genotyping of KRT 1.2 locus. PCR products are digested with Msp I enzymes and resolved on 2.5 % agarose gel electrophoresis. L represents 50bp DNA ladder.
Genetic improvement of resistance to *Haemonchus contortus* in sheep

Monitoring the level of infection in naïve and exposed animals under natural conditions: During the year a total of 270 progenies (176 of Malpura and 94 of Avikal) belonging to 27 sires of Malpura and 26 sires of Avikal breed were evaluated for intensity of natural gastrointestinal nematode (GIN) infection from July to November, 2009 at monthly interval. Sire-wise pre-drench mean FEC during the month of September ranged from 1811.1±282.6 to
5020.0±946.3 in Malpura breed and from 1633.3±284.8 to 14525.0±3049.4 in Avikalin breed. Following termination of primary infection, all the animals were allowed to graze on naturally contaminated pasture and sire-wise mean FEC in exposed hoggets (November) ranged from 200.0±100.0 to 2600.0±672.1 in Malpura and from 433.3±88.2 to 2366.7±1870.2 in Avikalin exhibiting significant influence of sire on FEC.

Selection of divergent lines w.r.t. susceptibility to GIN: On the basis of sire-wise mean FEC (post-drench) the sires were ranked and progenies were selected for susceptible (S) or resistant (R) line. In Malpura breed for selected progenies the mean FECs were more than 5 times higher in S-line compared to R-line. Like-wise in Avikalin breed for selected progenies the mean FECs remained around 3 times higher in S-line compared to R-line.

With in breed variation (Heritability estimates): The FEC data for all the progenies born during 2004 to 2009 were pooled for estimation of heritability. The \( h^2 \) estimates for log transformed FEC in naïve animals were 0.390 and 0.406 for Malpura and Avikalin, respectively. In exposed animals the \( h^2 \) estimates for log transformed FEC were 0.399 and 0.375 for Malpura and Avikalin, respectively.

Performance of selected lines: Adult body weights in Malpura flock there was significant variation in body weights among both the line during September to January with higher body weight in animals of S-line compared to R-line, however in Avikalin flock the variation in monthly body weight remained non-significant. In comparison to initial body weight, at the end of year a net gain ranged from 5.44% (R-line) to 12.17% (S-line) in Malpura breed and from 7.16% (S-line) to 9.89% (R-line) in Avikalin breed. The mean annual GFY non-significantly ranged from 0.969±0.057 kg (R-line) to 1.011±0.063 kg (S-line) in Malpura breed and from 1.475±0.089 kg (S-line) to 1.616±0.071 kg (R-line) in Avikalin breed. Reproductive performance revealed that though tupping rate is almost similar in both the line (>95%) but lambing rate were moderately higher (90.00%) in R-line compared to S-line (85.19%). Based on observations from 2004-09, it was found that average annual mortality % ranged from 6.83±0.88 (R-line) to 8.07±2.09 (S-line) and average % culling / sale varied from 4.56±2.11 (R-line) to 5.93±2.52 (S-line).

The data on growth performance of animals selected during 2009 revealed non-significant difference at all stages in both the lines. The average daily gain (ADG) from birth to 12 month of age ranged from 95.45 g (S-line) to 97.59 g (R-line) and from 100.22 g (R-line) to 101.29 g (S-line) in Malpura and Avikalin breed, respectively. The annual GFY in selected progenies ranged non significantly from 1.364±0.062 kg (R-line) to 1.493±0.168 kg (S-line) in Malpura breed and from 1.847±0.137 kg (S-line) to 2.119±0.083 kg (R-line) in Avikalin breed.

Intensity of GIN in selected lines: In comparison to S-line, mean FECs for *H. contortus* remained 11.4% (May) to 70.2% (August) lower in R-line of Malpura sheep. Similarly, on comparison between two lines of Avikalin it was observed that in R-line monthly mean FECs remained 19.3% (Oct) to 68.4% (Jul) lower compared to S line. In spite of no anthelmintic intervention in the R-line the FEC never reached the threshold level (> 2000 epg) during the year suggesting that
these animals could be maintained without anthelmintic drench. On the contrary in animals of S-line the peak of infection was noticed in the month of July (passing the threshold limit) require anthelmintic intervention.

**Polymorphism of Ovar-DRB1 gene in selected lines:** Study was undertaken to observe the polymorphism of MHC Ovar-DRB1 in R and S lines developed against *H. contortus* and to measure the association of RE patterns with R and S lines in both breeds. The Ovar-DRB1 of 296bp was amplified through nested PCR using primers ERB1, HL031 and XRB1. It was found that Ovar-DRB1 is highly polymorphic in both the lines R and S lines in Malpura and Avikalin. Ovar-DRB1 was found to be monomorphic for RE EcoRI. The frequency of AB RE pattern was observed to be higher in almost all the enzymes in both the breeds except AA of SacI in S line and SacII in both the lines of Malpura and Avikalin. Although no association could be traced out between the frequencies of RE pattern and the lines in either of the breeds but some RE patterns have been found to be marginally non significant viz; RE pattern of SacI (p<0.07) and BstN1 (p<0.06) in Malpura.
Projects

Epidemiological investigation on economically important diseases of sheep, goats and rabbits
B.N. Tripathi (From 22.9.09), D. Singh, S. K. Dixit (From 8.10.09), F. A. Khan, D. Mondal (Up to 18.05.09), C. P. Swarnkar, G. G. Sonawane, Jyoti Kumar (From 20.06.09), Fateh Singh (From 20.06.09) and S. L. Sisodia (From 6.08.09)

Sub-project 1: Development of diagnostics and immunoprophylactics for control and prevention of paratuberculosis (Johne’s disease) in sheep and goats
B.N. Tripathi, G. G. Sonawane, Jyoti Kumar, Fateh Singh and Rajeev Kumar

Sub-project 2: Etiopathology, diagnosis and treatment of pneumonia in sheep
B.N. Tripathi, S. K. Dixit, G. G. Sonawane, Jyoti Kumar, Fateh Singh and Rajeev Kumar

Sub project 3: Role of nutrient supplementation in improving resilience and resistance of growing lambs against gastrointestinal nematode infections.

Epidemiological investigations on economically important diseases of sheep and rabbits in sub-temperate condition (NTRS Garsa)
S. R. Sharma and S. K. Niranjan

All India Network programme on gastro-intestinal parasitism
D. Singh, C. P. Swarnkar and F. A. Khan

All India Network project on blue tongue disease
G. G. Sonawane, Fateh Singh and S. L. Sisodia

Veterinary Type Culture
B. N. Tripathi, G. G. Sonawane and Fateh Singh
Epidemiological Investigation on Economically Important Diseases of Sheep, Goats and Rabbits

Mortality profile: The annual equivalent average death rates (EADR) per 1000 animal days at risk were 0.2558, 0.1627 and 1.796 in sheep, goat and rabbit, respectively. The EADR was comparatively low (0.2108) in native breeds followed by 0.2723 in crossbred and 0.3240 in Garole and its crosses. In sheep flocks, the major non-specific reasons for mortality were pneumonia, enteritis, impaction, suppurative pneumonia and toxemia / septicaemia. Among specific causes, JD, neonatal inanition and pneumoenteritis were major diseases accounted for 5.0, 3.8 and 2.5% of total deaths, respectively. The breed-wise EADR was minimum in Chokla sheep (0.1265) followed by Malpura (0.2108), GMM/MGM (0.2435), Avikalin (0.2723), Garole X Malpura (0.3899) and Garole (0.5033). Age-wise analysis revealed highest EADR in suckling (0.652) followed by weaner (0.287), adult (0.216) and hogget (0.044). In goats, the major cases of deaths were impaction, enteritis and pneumonia. In rabbit, the overall expenditure (per head / annum) on health management remained Rs. 44.71, 32.17 and 12.59 in sheep, goat and rabbit, respectively.

Histopathology: The sectioning of bone tissues from 17 animals exhibiting skeletal abnormalities could not be achieved due to technical difficulties however, there were no histopathological changes except fibrosis in spleen, degenerative changes in liver and atrophy of glomeruli, degeneration and vacuolation of tubules in kidneys of the normal and affected sheep. Small intestines collected from rabbits revealed coccidial oocysts, mucosal congestion and necrosis of epithelial lining cells. Liver revealed focal areas of necrosis/degeneration of the hepatocytes and congested central veins and sinusoids. Kidneys showed atrophy of glomeruli and degenerative changes in tubules. Broncho-pneumonia was observed in two cases. Congestion and emphysema were other lesions observed in lungs. Lungs from lambs of ARC, Bikaner grossly showed focal irregular areas of congestion and haemorrhage. Severe congestion/haemorrhage and fibrinous exudates/ oedema were observed in alveoli. Liver revealed hydropic degeneration of hepatocytes, congestion and oedema in some cases. Kidneys showed degeneration of tubules and oedema in one case.

Microbiology: All 61 sera samples (52 from Malpura sheep and 9 from Sirohi bucks) from newly purchased animals were found negative for Brucella infection. Intestinal and liver samples from representative enteritis cases from rabbit produced 25 bacterial isolates. Further characterization led to identification of 13 E. coli and 1 Pseudomonas sp. Eight impression smears from field flocks were found negative for anthrax. Out of twelve smears examined from field flock, four were found to be positive for Pasteurella sp. The blood samples from a field outbreak (Kota) showed no abnormality in differential leucocyte counts and no pathogenic bacteria were found. A sheep suspected for enterotoxaemia on PM examination revealed characteristic haemorrhagic enteritis and the presence of Clostridium perfringens organisms in intestinal impression smear.

Parasitology: Need based examination of faecal samples revealed predominant prevalence of strongyle worms (47.83%) in sheep and Eimeria spp (82.93%) in rabbit. The monthly incidence ranged from 38.1% (Sep) to 98.0% (Jul) for strongyle infection and nil (Sep) to 81.6% (Aug) for Eimeria infection in Patanwadi sheep. The mean intensity of strongyle infection varied from 142.9±58.6 (Sep) to 2582.9±389.6 epg (Jun).
Development of diagnostics and immunoprophylactics for control and prevention of paratuberculosis (Johne’s disease) in sheep and goats

Sheep showing clinical symptoms of paratuberculosis were routinely examined, identified and tested. During the period 136 sheep were tested by AGID, of which 6 found positive. Complete haematological examination of 37 sheep suspected to have JD were carried out. Total RBC, Hb and PCV were found to be significantly decreased in clinical cases. By direct smear examination from the samples received from postmortem 9 animals were diagnosed as positive for paratuberculosis and 2 were negative. On faecal smear examination, 12 animals were positive and 65 were negative for acid-fast bacteria.

Etiopathology, diagnosis and treatment of pneumonia in sheep

The pneumonic cases were diagnosed on the basis of postmortem lesions. A total of 58 lungs (sheep- 55, Goats- 3) and other organs such as liver, lungs, kidneys, spleen, heart and intestines were collected in 10% formalin. Out of these 11 sheep lungs showing gross lesions were processed for histopathological examination. Five cases showed pinkish exudates in alveoli, congestion, thickened interstitial space due to fibrous connective tissue proliferation and MNC infiltration and proliferation of alveolar epithelium resulting into fingerlike projections into alveoli. The affected area was glandular in appearance. These lesions were characteristic to ovine pulmonary adenocarcinoma (OPA) (Jaggsiekte). In two sheep fibrinous bronchopneumonia was observed and in another two sheep lesions of interstitial pneumonia were seen. Other organs such as spleen and lymph nodes revealed fibrosis, congestion/ haemorrhage. Oedematous fluid, degeneration of tubules and coagulative necrosis were observed in kidneys and degeneration and congestion of liver was observed in few cases.

A total of forty samples (34 lung tissue samples and 6 nasal swabs from clinical cases) were collected from dead and affected sheep for microbiological, pathological and molecular investigation. Twenty samples (14 from lung tissue and 6 nasal swabs) yielded 42 pure bacterial isolates (17 Gram positive and 25 Gram negative). Out of total 25 Gram negative bacterial isolates, 16 were presumptively identified as *E. coli* and one *Proteus* sp. along with unidentified isolates. Out of total 17 Gram positive isolates, 10 were presumptively identified as *Staphylococcus* spp. and one *Streptococcus* sp. along with nonspecific isolates.

Role of nutrient supplementation in improving resilience and resistance of growing lambs against gastrointestinal nematode infections.

The pathogenesis of *Haemonchus contortus* infection was studied in growing Malpura male lambs housed in collective pens under stall feeding. The animals were given *ad libitum* complete feed having 60:40 (rougahge: concentrate) ratio. The experiment involved 2 levels of infection (infected vs non-infected). A triple infection with 200 larvae of *H. contortus* was given three times a week for 8 week period. The lambs were slaughtered after 10 weeks, worm burden, eosinophil and globule leucocyte counts in abomasal tissues and carcass characteristics were assessed. The study showed that the pathophysiological effects caused by *H. contortus* infection were mild as revealed by the PCV, haemoglobin, serum protein, albumin and body weight values. Furthermore, no clinical signs such as mucous paleness and submandibular oedema were observed. Therefore, it is likely that either the larvae caused relatively mild infection and/or high protein diet (17% CP) withheld the effects of infection.
Epidemiological investigations on economically important diseases of sheep and rabbits in sub-tropical condition (NTRS Garsa)

The project aimed at developing the patho-epidemiological profile of sheep and rabbit diseases under the sub-tropical conditions. The morbidity and mortality were expressed as the equivalent average morbidity rate (EAMR) and equivalent average death rate (EADR) per 1000 animal days. In Angora rabbits, a total of 172266 animal days were recorded and the EAMR was calculated as 1.35 for 233 clinical cases recorded. Clinically, both non-specific and specific diseases/disease conditions were recorded with highest occurrence (53.6%) of affections of alimentary system in the form of anorexia, enteritis, etc. followed by general systemic state and affections of skin, sub-cut and musculoskeletal system (about 8% each). Under specific diseases, ear mange and sore hocks conditions were observed in 0.4 and 1.3% cases. The overall mortality rate (EADR) in Angora rabbit flock was 0.35 per 1000 animal days or 6.9% with 60 deaths. Age-wise, the mortality was highest in adults (68.3%) followed by weaner (25%) and grower (6.67%). System-wise, about 48.3% deaths were due to involvement of respiratory system while deaths due to alimentary causes were 25%. Among specific diseases, hairball and enterotoximia caused 3.33 and 6.67% deaths, respectively.

In sheep, a total of 83,931 animal days were recorded and the overall EAMR was 1.94 per 1000 animal days. Clinically, about 99% of the animals were diagnosed for non-specific diseases of different systems with highest clinical incidence of affections of skin, sub-cutaneous and musculoskeletal (41.7%) followed by alimentary (23.2%) and sensory (15.3%) systems. Mange was recorded in 1.2% cases. The overall EADR for sheep was 0.1 per 1000 animal days or 2%. Mortality due to specific cause viz. nasal bot infestation and Johne’s disease (11.1% each) was about 22%. Non specific causes of death were affections of respiratory system (66.7%) and uro-genital system (11.1%).

All India Network Programme on Gastrointestinal Parasitism

Preparation of bioclimatographs: Based on bioclimatograph this year, the period suitable for propagation of H. contortus and Trichostrongylus spp was from mid-June to late-August and from October to February, respectively in semi-arid and from late-June to August (H. contortus) and October to March (Trichostrongylus spp) in arid Rajasthan.

Testing of worm management programme in sheep flocks: The modified worm management programme was implemented and tested on farmer’s flocks (36 flocks) as well as in organized farms (6 flocks) in both the agroclimatic (arid and semi-arid) regions of Rajasthan. In addition this year epidemiological studies were also taken up in migratory flocks by adopting and monitoring a total of four flocks from arid Rajasthan. A total of 9823 faecal samples were collected and examined for GI parasites. The results revealed that the proposed programme (single strategic drench during mid to late monsoon) successfully controlled the parasitism in terms of incidence and intensity of infection and production parameters as compared to conventional 2-3 drench regime. The incidence of strongyle worms varied significantly between months in sheep flocks reared and managed by different systems (stationary/migratory; farm/field) in both the agroclimatic regions. On comparison of pattern between two agroclimatic zones it was observed that the incidence of strongyle infection in sheep flocks remained almost similar during monsoon but was higher in semi-arid region compared to arid region during the period from post monsoon to mid winter. In comparison to field flocks, farm flocks in arid Rajasthan revealed higher incidence of strongyle infection. In migratory flocks incidence of strongyle
infection was almost similar to stationary flocks during monsoon as both the categories of flocks were at the same location and in similar management system during monsoon however higher incidence was observed during the period from October to March. The annual incidence of *Trichuris* spp. ranged from 0.4% in arid farm to 1.7% in arid field. The incidence of *Strongyloides papillosus* was higher in farm flocks. In spite of flukicide drench, the annual incidence of *Amphistomes* remained higher in semi-arid region compared to arid region. The prevalence of *Schistosoma indicum* was marginally higher in arid region. The annual incidence varied from 1.5% (arid flocks) to 3.8% (semi-arid flocks). The annual incidence of *Eimeria* spp ranged from 28.6% (migratory flocks) to 34.3% (farm flocks). In all the situations, relatively higher incidence was recorded during the period from June to August. Among stationary flocks the monthly intensity of strongyle infection varied significantly from 2.4±1.6 epg in March to 661.5±52.9 epg in September (semi-arid), from 10.3±2.0 epg in February to 1188.9±139.7 in July (arid). In migratory flocks, the monthly intensity of strongyle infection ranged significantly from 77.4±11.5 epg in March to 1202.5±183.0 epg in July. Among farm flocks managed by targeted treatment (TT) approach, monthly FECs varied from 328.6±42.5 epg (May) to 2787.5±319.8 (August). Over-dispersion phenomenon in FECs was observed in field flocks of the both agroclimatic conditions. The proportion of animals having >1000 epg varied from nil (February - March) to 23.5% (June) in semi-arid region and from nil (December to March) to 31.1% (August) in arid region. On coproculture *H. contortus* was predominant parasite followed by *Oesophagostomum* and *Trichostrongylus* spp. Infectivity of pasture was noticed mainly during monsoon season.

**Production economics of worm management programme:** During the year 2009-10, the lambing rate ranged from 80.67% (arid) to 81.50% (semi-arid) in stationary field flocks kept under single drench / annum scheme. The annual % morbidity in field flocks varied from 38.31 (arid) to 55.64 (semi-arid) and the annual mortality varied from 6.15% (arid) to 12.93% (semi-arid) in flocks maintained under MWMP. On the other hand due to migration stress, exposure of animals to adverse climatic conditions, improper rest etc led to occurrence of higher mortality (17.97%) in migratory flocks. The disposal rate ranged from 26.16% (semi-arid) to 28.60% (arid) in stationary flocks and only 3.59% in migratory flocks. This year total annual expenditure / 100 sheep in stationary flocks varied from Rs. 16151.00 (semi-arid) to Rs. 47600.00 (arid) while in migratory flocks it was just Rs. 10512.00 and the net annual income / 100 sheep varied from Rs. 50047.00 (arid) to Rs. 70190.00 (semi-arid) in stationary flocks and Rs. 61314.00 in migratory flocks.

**Evaluation of flukicide intervention in sheep flocks of semi-arid Rajasthan:** During the year a total of 4299 samples from flukicide drenched flocks were examined and the magnitude of incidence in the year 2009-10 exhibited prevalence rate ranging from nil (November, December, February, March) to 10.3% (May) with overall annual incidence to the tune of 2.81% in treated flocks. Thus strategic inclusion of flukicide during March - May exhibited significant reduction in incidence of amphistomes during all the months.

**Performance testing of simulation and forecasting programme (FROGIN):**

The performance of the programme was evaluated in both agroclimatic zones of Rajasthan involving farm (stationary) and field (stationary and migratory) flocks. It gave precise prediction for gastrointestinal nematodes infection (particularly *H. contortus*) in host.

**Observations on the effect of Fec B gene / Garole inheritance on faecal egg counts in sheep:** This year study was initiated to study the polymorphism
of Ovar-DRB1 gene in sheep breeds having varying level of Garole inheritance and shown variation in resistance / resilience to *H. contortus*. Five restriction enzymes viz; *SacI*, *SacII*, *NciI*, *Hin1I* and *BstN1* were used. Ovar-DRB1 was found to be very polymorphic for all the enzymes. All enzymes *NciI*, *Hin1I*, *SacI*, *SacII* and *BstN1* produced three RE pattern each, of different molecular sizes. With *SacI* there was significant difference in genotypic frequencies among level of Garole inheritance. The frequency of AA genotype was maximum (77%) in Garole sheep compared to other breeds. The frequency of AB genotypes was higher in GMM and Malpura sheep (46%) compared to Garole (21%). *Hin1I* also produced AA, AB and BB RE pattern with frequencies to the tune of 14, 34 and 53% in Garole, 36, 54 and 10% in GMM and 31, 52 and 16% in Malpura sheep, respectively. The allelic frequency revealed significantly higher proportion of A allele in both GMM and Malpura sheep compared to B allele in Garole sheep. With *NciI* and *SacII* enzyme the genotypic and allelic frequencies remained almost similar in all the three breeds. *BstN1* RE pattern exhibited significantly higher proportion of AA genotype (57%) in GMM compared to Garole and Malpura sheep (<30%).

**Evaluation of targeted selective treatment in sheep against *Haemonchus contortus***: Following successful implementation of targeted treatment (single drench / annum schedule) during mid to late monsoon, it was planned to further reduce the use of anthelmintics in flock by developing a mechanism for targeted selective treatment (TST) through harvesting the benefits of over-dispersion phenomenon in FECs. This year the color chart developed earlier was applied for its effectiveness in adult sheep maintained in two flocks (450 adult sheep) and to observe the feasibility in implementation by different evaluators. On the basis of screening using eye color chart prepared in 2007-08, the proportion of animals in flocks exhibiting clinical anaemia (category 4 or 5) ranged from 2.90% in February to 10.10% in July. Effect of evaluators on implementation of TST exhibited that the difference among two evaluators in detecting the anaemic animals based on eye color chart was higher at initial (July) phase which became marginalized in succeeding months. The study demonstrated application feasibility of eye color chart by different evaluator.

The mean FECs in visually anaemic and un-drenched animals ranged from 660.0±243.7 (February) to 10583.3±2253.1 (August). On coproculture it was observed that predominant parasite was *H. contortus*. In un-drenched and visually anaemic sheep haematological profile exhibited that mean Hb, PCV, TEC, MCH, MCHC and MCV ranged from 5.61±0.18 (March) to 7.92±0.26 g% (July), 18.73±1.16% (October) to 24.60±0.82% (July), 3.06±0.29 (March) to 10.27±0.73 million/cmm (February), 9.59±1.93 (December) to 21.48±2.50 µµg (November), 26.20±1.97 (February) to 41.33±4.33% (November) and from 22.84±2.20 (March) to 52.33±4.29 µµg (November), respectively. The magnitude of erythrocytic indices revealed that in infected and un-drenched sheep majority of animals had either hyperchromic - macrocytic or normocytic - normochromic type of anaemia. Based on color chart, during the study period a total of 23.99% of the animals were drenched particularly during wormy season.

**Studies on biological control**: A total of 302 pooled faecal samples from farm (82) and field (220) flocks were screened for nematophagous fungi and 12 isolates of *Arthrobotrys oligospora* were obtained. The buffalo isolate of *A. Oligospora* was failed to exhibit gut survival ability when tested in sheep artificially infected with GIN (predominantly *H. contortus*) as there was neither reduction in larval number nor evidence of fungal growth in faecal culture.

**All India Network Project on Bluetongue Disease**
During the year 2009-2010, no outbreak of BTD was recorded at Institute farms and field flocks. The farmers were alerted about the BTD by showing clinical pictures and were advised to inform if they come across the clinical disease simulating BTD. A total of 1419 (sheep 1001 and goat 418) serum samples were collected from districts of Rajasthan. Out of these, 1080 sera (sheep-590 and goat-490) tested by I-ELISA revealed 36.10 % and 44.48 % seropositivity for BTV antibodies in sheep and goats, respectively. Out of 553 sera from Sawai Madhopur, Pali, Dausa, Udaipur, Jaisalmer and Tonk (Malpura) tested by I-ELISA for BTV antibodies, 193 (34.9 %) samples were found positive. In the field flocks, maximum and minimum seropositivity observed in Sawai Madhopur (49.6%) and Pali (20%), respectively. In the sheep flock of CSWRI farm, out of 37 sera, 20 (54.05 %) were positive by I-ELISA. Blood samples tested by Sandwich ELISA (IVRI, Mukteswar) showed 18 animals positive for BTV antigen alone and 9 sheep were positive by both tests.

Out of 490 goats of Sawai Madhopur, Dausa, Chittorgarh, Barmer and Karauli districts were tested by I-ELISA, 218 (44.48%) were positive. In the field goat maximum and minimum seropositivity were found in Sawai Madhopur (52.33%) and Karauli (35.77%) respectively.

**Isolation of BT virus:** A total of 8 BT suspected samples (inoculum /passage prepared from chick embryo) were investigated at CCS, HAU, Hissar with RNA PAGE, of which 2 were found positive. Four blood samples and foetal stomach contents were subjected to the BTV isolation. Inocula were prepared as per the standard method for the infection of Chicken embryonated eggs. I and II passages were carried out in embryonated chicken eggs for these inocula. All 8 inocula/passage suspected for BTV were tested in BHK-21 cell line, but no CPE was observed.

**Collection and identification of Culicoides:** A total of nine collections of suspected culicoides were made from CSWRI farms (8) and Dausa (1) district of Rajasthan. The midges were maintained in the preserved condition and sent to Zoological Survey of India, Kolkata for identification.

**Veterinary Type Culture**

B.N. Tripathi, G.G. Sonawane and Fateh Singh

Project has been initiated with the objectives of isolation and characterization of pathogenic microbes of veterinary importance.
Projects

Development of carpet pile, technical textiles and apparels utilizing indigenous wool blends

Sub project: Processing of wools and its blend for carpet pile, technical textiles home textiles and garments
D.B.Shakyawar, N.P.Gupta, L.Ammayappan and A.S.M.Raja

Sub project: Improvement in performance characteristics of wool and woollen products using different chemical treatments
L.Ammayappan, A.S.M.Raja and D.B.Shakyawar

Sub project: Development of decision-making software for woollen products
D.B.Shakyawar and N.P.Gupta

Sub project: Development of eco-friendly natural dyes for woollen products with antimicrobial and anti moth properties
A.S.M.Raja, L.Ammayappan and N.P.Gupta

A Value Chain on Enhanced Productivity and Profitability of Pashmina Fiber
D. B. Shakyawar, L. Ammayappan, A. S. M. Raja and N. P. Gupta
Development of carpet pile, technical textiles and apparels utilizing indigenous wool blends

Processing of wools and its blend for carpet pile, technical textiles home textiles and garments

The mean fibre diameter of Avikalin sheep ranged between 29 to 31 µ with 29 to 47 % medullation. The mean fibre diameter of Chokla sheep ranged between 29 to 35 µ, with medullation of 11 to 32%. A total of 2261kg of different qualities wool was processed in woolen spinning system into 3-4 Nm yarn for making blanket and carpet. A total of 1840 kg of yarn consisting of 14 different proposition of wool was produced using Woolen / DREF spinning. Among the blanket yarns produced from different wool mixes, blends of J & K wool: nylon: BM wool: Chokla wool (65:9:18:8) and Chokla: BM wool (50:50) produced better quality yarn. A total of 545 blankets manufactured using power loom/ hand loom. All the manufactured blankets were subjected to milling, scouring, stentering and decatising operations to improve their dimensional stability and hand related properties.

Carpet yarn produced from Avikalin: nylon (90:10) fibre gave better performance compared to pure Avikalin wool and Avikalin: Chokla wool. Hand-knotted carpet of 144 knots/ inch² was developed using wool: nylon blended yarn. Carpet made from blended yarn of Magra wool-nylon (90:10) gave higher resiliency and compressibility and lower abrasion loss as compared to other blends.

Bharat Merino wool and Angora rabbit hair was processed in semi worsted system into yarn density of 2/32, 2/40 and 2/48 Nm for shawl making. The spinnability of BM wool was improved up to 40% after blending with Angora rabbit hair. The shawls were then mildly scoured using non-ionic detergent and bleached with hydrogen peroxide (3gpl) followed by application of an optical brightening agent (Leucophor W) at the pH of 4-5, in the temperature range of 40-50°C. The shawls were finished with cationic softening agent (2gpl) at 40°C, pH-5 for 30 minutes in the winch machine. The softness was higher in shawl made from RH-BM (60:40) blend as compared to other blends.

Improvement in performance characteristics of wool and woollen products using different chemical treatments

Dyeing and finishing study of furnishing fabrics: An attempt has been made to dye the wool-cotton union furnishing fabric in solid shade using direct dye and cationic dye fixing agent. The dyeing was performed in a single bath in relation to four factors: leveling agent (Lyogen SMKI, 0.0-1.5% owm), electrolyte (sodium sulphate, 0-10%), dyeing temperature (85-95°C), and dyeing time (15-60 minutes) using Box and Behnken experimental design. The wool / cotton union fabric could be dyed in union shade with direct dye at 92°C in presence of Lyogen SMKI (1.5% owm), sodium sulphate (4-5% owm) for 45 minutes at neutral pH in one bath, which gave 61.60% dye bath exhaustion, 2.175 K/S value with moderate washing fastness (2-3) and good light fastness (6-7).

Dyeing and bleaching studies of rabbit hair-Bharat Merino blended yarn: The dyeing behaviour of three Rabbit hair and Bharat Merino blended yarns was made with Drimarine Blue RLI reactive dye. The dye uptake increased when the Rabbit hair proportion was increased from 28% to 60%. The developed Angora hair- Bharat Merino wool blended shawls were bleached with hydrogen peroxide and hydrogen peroxide followed by Leucophore W application methods. The application of Leucophore W than the hydrogen peroxide bleaching process increased the whiteness.
Development of decision-making software for woollen products

Software for carpet: The software developed using statistics module for predicting carpet performance upgraded and predicting error reduced from 10 to 5%. The software converted into web supported software. A protocol developed for studying the images of carpet before and after dynamic loading.

Development of eco-friendly natural dyes for woollen products with antimicrobial and anti moth properties

The carpet yarn of Avikalin wool was dyed with the extracts of Silver oak, Madder and Myrobolan. Wide spectrums of colour (yellow, brown and grey) were obtained with aluminium sulphate, stannous chloride and ferrous sulphate as well as without mordant. The antimicrobial efficacy of the dyed yarns was tested against *Staphylococcus aureus* and *Escherichia coli* by Agar diffusion method (AATCC147). The Silver oak dyed and myrobolan extract dyed without mordant sample showed zone of inhibition for the growth of *Staphylococcus aureus* (Fig. 1A). The madder extract dyed did not show any inhibition against the growth of *Staphylococcus aureus*. Among all the dyed samples, only silver oak dyed without mordant sample showed zone of inhibition against the growth of *Escherichia coli* (Fig. 1B).

Fig.1 A. Zone of inhibition shown by the silver oak and myrobolan against S. aureus  
B. Zone of inhibition shown by the silver oak and myrobolan against E.coli
A Value Chain on Enhanced Productivity and Profitability of Pashmina Fiber

To improve productivity of traditional charkha, a ball bearing on axel of the wheel was introduced to reduce the friction thus provides smoothness in movement. It improves >20 % productivity of spinning of pashmina yarn as well as reduce the drudgery of spinner. A technique for spinning of pashmina wool on machine was standardized using nylon fibre as additive. Yarn produced on newly developed padal charkha was found superior than traditional charkha in terms of uniformity and tenacity as well as elongation. Light weight handloom for shawl developed with higher efficiency improves weaving efficiency by 10%. Eight different newer designs were developed for kani shawl and distributed to stackholders for improving aesthetic value of shawl.

Dyeing of Pashmina blended shawl was carried out by natural dyes (Wal nut husk, pomegranate rind, onion skin and Saffron flower extracts) using different mordents. Without mordenting, colourant extracted from walnut and pomegranate gave creamy yellow and light brown colour on woollen fabric. Colorant obtained from Saffron flower gave parrot green colour as well as light yellow / red colour suitable for shawl. After mordanting, the colour of the fabric changed with increase in depth. Among mordents, FeSO₄ gave darker shade and Al₂(SO₄)₃ gave lighter shade and among technique, post-mordenting yields better results than others. There were no significant differences in washing fastness of dyed samples, while the K₂Cr₂O₇ mordent samples showed lower values for light fastness than others.
Projects

**Carcass evaluation of sheep, goats and rabbits**
S. Sureshkumar, A.K. Shinde S.A. Karim and M. Nasimuddin

**Technology development for utilization of animal products / by products for further processing of value added items**
A.K. Shinde, S. Sureshkumar, S.A. Karim and M. Nasimuddin
Effect of replacing protein sources in ration by urea and mollases on the carcass characteristics of spent ewes

To minimize the cost of feed input on fattening of spent ewes before slaughter, urea + molasses @ 0.5 +7.5 % as a replacement of protein and energy sources was used. Pre-slaughter weights, empty live weights, high carcass weights and dressing yield on ELW of spent ewes fed concentrate mixture @ 2.5 % of BW containing urea and mollases and slaughtered after 180 days of feeding were 33.84, 28.82 and 15.53kg and 53.77% and not adversely affected by incorporating urea in concentrate mixture. Loin eye area increased to 11.55 cm² as against 9.71 cm² on conventional feed. Primal cuts of half carcass in both the group were similar and ranged between leg 30-32%, loin 14.0-14.5%, rack 13-14%, neck and shoulder 23-24% and breast and shank 17-18%. Caul fat and kidney fats contents of carcass were 860 and 490g in conventional and 1.03kg and 600g in urea-mollases group. The different carcass cuts viz., leg, loin, rack, neck and shoulder and breast and shank in both the groups contained 53.0-53.5 % lean, 16.0-18.5% fat and 12-13% KOH bone. Urea and molasses can be used in the feed of spent sheep without any adverse effect on meat yield and quality.

Effect of rumen protected fat supplementation on the carcass traits of Malpura lambs

The rumen protected fat supplementation was tried in 3 moth old Malpura lambs for increasing meat yield and quality. Average pre slaughter weights of lambs at 0, 2% and 4% of rumen protected fat in feed were 29.80, 26.00 and 30.78 kg respectively at 180 days of slaughter. Hot carcass weights were 15.83, 13.57 and 16.60 kg in T1, T2, T3, respectively. Dressing yield on live weights as well as empty live weight basis was non-significantly higher in T3 lambs supplemented with 4 % rumen protected fat. The lean contents of leg, loin, rack, neck and shoulder and breast and fore shank were not significantly improved by rumen protected fat supplementation. The average lean, superficial, inter muscular fat and KOH bone content were 56.20, 10.38, 8.10 and 9.54% in 0%, 50.57, 10.66, 8.60 and 10.13% in 2% and 53.25, 10.73, 9.08 and 9.08% in 4% fat supplementation. The caul fat and kidney fat % were also higher with 4% fat. The supplementation of lambs with 2% or 4 % levels of rumen protected fat did not improve the carcass quality and composition.

Effect of different management system on carcass traits of Sirohi kids

Kid performances under intensive, semi-intensive and extensive system from 3-6 months were evaluated. Pre slaughter weights 22.82±0.934, 22.80±0.888 and 20.03±0.614 kg, hot carcass weights 11.08±0.487, 10.59±0.487 and 9.27±0.324 kg in intensive, semi-intensive and extensive systems, respectively. Dressing yield on PSW was 48.64±0.278 %, 46.38±0.591and 46.29±0.637 % respectively, while the dressing % on ELW was higher in intensive (57.42±0.53) than semi-intensive (56.81±0.59) and extensive (54.91±0.59) systems. Loin eye area was 9.6 to 10.6cm² and did not differ significantly. The PSW, HCW, dressing per cent on ELW were significantly (P<0.01) higher in intensive system. Primal cuts of half carcass were leg 30-32 %, loin 11.5-13.5%, rack 11-13 %, neck and shoulder 25-26 % and breast and shank 18-20 % and did not differ significantly (P>0.05) between systems. Caul fat and kidney fats were 0.12±0.026 and 0.058±0.013 kg in intensive, 0.115±0.038 and 0.053±0.022 kg in extensive systems and did not differ. The different carcass cuts viz., leg, loin, rack, neck and shoulder and breast and shank contained 55-59 % lean, 4-6 % separable fat and 14-18 % KOH bone respectively. The present study suggests that Sirohi kids maintained on
intensive or semi-intensive system provides quality carcass with higher meat yield.

**Technology development for utilization of animal products/ by-products for further processing of value added items**

Nuggets, salami and sausage meat products of sheep were prepared and evaluated for consumer’s acceptability. A total of 227.90 kg products was prepared and sold to consumers in the Institute and an amount of Rs.22790 was realized. In addition to products, the fresh meat of sheep, goats and rabbits was sold. A total of 166 sheep, 29 goats and 18 rabbits were slaughtered and the meat was sold after carcass evaluation. An amount of Rs.147249 from sale of mutton, Rs.19751 from sale of chevon and Rs. 2575 from sale of rabbit meat was realized. A total of Rs.192875 was realized through sale of fresh meat and products.
Projects

Integrated approaches for improvement in productivity of Sheep and Rabbit under field condition through transferable technologies

Sub-project: Improvement in sheep production through breeding and genetic manipulation
A.L. Arora, G.R.Gowane (Upto --------------), A. Chopra (Upto -------------------) and Ved Prakash

Sub-project: Improvement of sheep production in farmer's flock through physiological and reproductive techniques
Sajjan Singh and S. M. K. Naqvi, S. Saha (up to 30.06.2009)

Sub-project: Demonstration of fodder production technologies for improvement in sheep and rabbit production under field condition
L.R.Meena, J.S.Mann, S.C.Sharma and Roop Chand

Sub-project: Improvement in sheep production through improved feeding practices
O.H.Chaturvedi and S.K. Sankhyan

Sub-project: Improvement in sheep production through health technology
B.N. Tripathi, C. P. Swarnkar, Vinay Kumar and D. Singh

Sub-project: Improvement in wool utilization through indigenous wool products developed by local artisans
N. P. Gupta, R. K. Arora and D. B. Shakyawar

Sub-project: Improvement in broiler rabbits through demonstration and training
Rajeev Gulyani, Vinay Kumar and J. S. Mann

Sub-project: Improvement in socio-economic condition of sheep farmers through extension education and technical literacy programme
J.S.Mann, D. Sethi, L.R.Meena, D.C.Gupta, O.H. Chaturvedi, Suresh,A., Vinay Kumar, B.L.Sharma and R. L. Bairwa

Marketing of small ruminants in Rajasthan
D.C. Gupta and Suresh, A

Integrated approach for improvement in productivity of sheep under field conditions through transfer of technologies in arid region
R. K. Sawal, K. C. Sharma, H. K. Narula and M. Ayub

Integrated approach for improving productivity of Broiler/ Angora rabbit and sheep under field conditions through transferable technologies
S. R. Sharma, S. Saha and S. K. Niranjan

Transfer of technology for improvement in sheep, rabbits and wool production
N.Swain, A.S.Rajendiran, S.Rajapandi, K.Narayanan (from 19.1.10)

Performance evaluation of broiler rabbits under farm and field condition
N.Swain, A.S.Rajendiran, S.Rajapandi, K.Narayanan (from 19.1.10)
Integrated approaches for improvement in productivity of Sheep and Rabbit under field condition through transferable technologies

Improvement in sheep production through breeding and genetic manipulation
A total of 111 sheep flocks (26 flocks in Bhipur, 28 in Malpura, 28 in Sanwariya and 29 in Chanwandiya centres) were covered in TOT areas. Total sheep population across the age groups, breeds and centres was 6820. Average body weight of lambs at birth, 3, 6, 9 and 12 months of age was 3.36, 12.89, 17.16 and 20.91 and 26.42 kg. Corresponding body weights for Malpura were 3.51, 13.73, 16.89, 21.98 and 26.27 kg and for Kheri were 3.27, 12.47, 17.39, 20.07 and 26.54 kg respectively. Malpura lambs born from the sires supplied from Avikanagar were heavier than their counterparts in the field.

Table Performance of Malpura rams supplied by Avikanagar

<table>
<thead>
<tr>
<th>Trait</th>
<th>Birth Wt.</th>
<th>III Wt.</th>
<th>VI Wt.</th>
<th>IX Wt.</th>
<th>XII Wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progeny of field rams</td>
<td>3.46±0.02</td>
<td>13.55±0.20</td>
<td>16.85±0.31</td>
<td>21.49±0.21</td>
<td>26.14±0.16</td>
</tr>
<tr>
<td>Progeny of rams supplied</td>
<td>3.55±0.04</td>
<td>14.01±0.25</td>
<td>18.09±0.39</td>
<td>22.07±0.37</td>
<td>26.89±0.29</td>
</tr>
</tbody>
</table>

Average greasy fleece yield of first six month and adult clip was 463 and 613 g respectively. Total number of lambing recorded in TOT areas during the year was April (919), June (160), September (965), December (1684) and March (1349). About 78% of lambing occurred from December to April.

Improvement of sheep production in farmer’s flock through physiological and reproductive techniques
A total of 122 ewes (33 in Kacholia, 20 in Pratappura, 55 in Kuhada Bujrag villages) were induced and synchronized for estrus. Thirty five eustuous ewes during summer were synchronized for estrus using cost effective indigenously developed progesterone impregnated sponges. Out of these 85.71% animals expressed estrus and mated naturally with Malpura rams. A total of 50 animals were induced and synchronized at village Kuhada Bujrag. Out of these all animals expressed estrus but 5 of them were carrying uterine infection. These animals were not inseminated. Remaining animals were inseminated using chilled semen (Twice after 42 and 50 hr of post sponge removal). Twenty one lamb born from the artificial inseminations of 45 ewes. At Partappura 24 animals were induced and synchronized. Four animals were carrying infection; remaining 20 animals expressed estrus and inseminated with chilled diluted semen of Malpura Ram from CSWRI breeding flock. Out of these, 17 lambs were born.

Demonstration of fodder production technologies for improvement in sheep and rabbit production under field condition
A total of 143 field demonstrations were laid out at farmer’s field on improved varieties of fodder crops, use of chemical fertilizer and biofertilizers in fodder crops through out the year. Besides, 435 fodder and fruit tree saplings were supplied free of cost to encourage the agro-forestry system.
Field demonstrations on bajra fodder
A total of 30 field demonstrations were conducted on improved varieties of bajra to evaluate fodder production over traditional cultivar. MH-171, ICTP- 8203 and Avika Bajra-19 varieties increased green fodder to tune of 16.08, 27.40 and 46.56 % and dry matter by 17.85, 42.36 and 59.80 % over local varities.

Field demonstration on sorghum fodder
During kharif and summer seasons, a total of 27 field demonstrations on improved sorghum varieties Sudan sorghum grass (Krishma) and Pusa Chari - 23 were laid on farmer's field. The green fodder increased to the tune of 23.90 and 79.35 % and dry fodder by 45.74 and 53.76 % over the local variety.

Field demonstration on guar varieties
Six field demonstrations on improved varieties of guar viz. RGC- 936, RGC 1017 and local were conducted on farmer's field during kharif season. Green fodder yield of RGC 936 (171.14 q /ha) was higher than RG-C-1017 and local varieties of guar (160.23 and 137.25 q /ha).

Field demonstration on moong varities
SML-668 variety yielded more seed and stover than K851 and local varieties. The increase in seed and stover yield were 17.23 and 25.24 % in seed and 18.98 and 29.26 % in stover over local variety.

Field demonstration on cowpea
A total of 6 field demonstrations were conducted on improved and local varieties of fodder cowpea. The improved fodder cowpea variety K397 gave higher green and dry fodder yields than local variety. The increase in green and dry fodder yields were 68.35 and 52.43 % over local variety.

Field demonstration on barley fodder
A total of 14 field demonstrations were conducted on barley varieties namely RD-2035, RD 2717 and local. The maximum green and dry straw yield was recorded with RD 2717 variety as compared to local and RD 2035. Both the varieties were superior over local cultivar.

Demonstration on oat varieties
Higher green and dry fodder yields were recorded with Kent variety than local. The green fodder and dry matter yields were higher under second cut as compared to first cut. The total green and dry fodder yield of both cuts were higher in Kent than local variety.

Field demonstration on use of fertilizer in barley fodder
Application of nitrogen and phosphorus together @ 120:60 gave the highest green fodder and dry straw yield in comparison to other treatments. The increased in green fodder was 54.51 % and dry matter 54.52 % over control treatment.

Field demonstration on fertilizer application in oat
The combined application of organic and inorganic fertilizers increased green fodder and dry fodder yields of oat compared to use of organic and inorganic fertilizers separately. The highest green and dry fodder yield was recorded with application of nitrogen along with both organic fertilizers (Azospirillum and PSB) followed by 40 kg N + Azospirillum application.

Demonstration on Alfalfa
Thirty field demonstrations were conducted on T-9 and Anand- 2 improved varieties of Alfalfa. T-9 variety of Alfalfa gave higher green and dry fodder yields than Anand-2 and local.

Improvement in sheep production through improved feeding practices

**Demonstration on concentrate supplementation in lambs**

Range managed weaner lambs (2-3 months old) in villages were supplemented *ad lib* concentrate mixture for 90 days. The biomass yield of CPR was 1.96 q DM/ha. The initial body weights of lambs in both the groups were similar. Lambs gained 9.94 kg body weights under supplementation feeding as compared to 6.60 kg on CPR grazing alone during 90 days of feeding demonstration with average daily gain of 110 and 73g.

**Demonstrations on concentrate supplementation during late gestation and early lactation**

Malpura and Kheri ewes were supplemented concentrate mixture @ 400g daily during late gestation and early lactation after grazing on community rangeland. The biomass yield of CPR was 1.96 q DM/ha. The loss in body weights after lambing was 1.23 kg in supplemented group and 3.74 kg in non-supplemented group. The birth weights of lambs born from supplemented ewes were 3.54 kg as compared to 3.11 kg in non-supplemented ewes. Subsequent weights of lambs and milk yield of ewes were higher in supplemented group than non-supplemented group.

**Demonstrations on flushing of ewes**

Malpura and Kheri ewes were supplemented concentrate mixture @ 400g daily for one month as flushing ration. Concentrate supplementation increased body weights to 31.73 as compared to 28.02 kg in non-supplemented group. The lambing rates in flushed and non-flushed ewes were 100 and 90% respectively. The birth weight of lambs was marginally higher in flushed ewes.

Improvement in sheep production through health technology

**Morbidity profile of sheep flocks in TOT area**

Overall annual morbidity in TOT flocks was 60.62% and ranged from 43.49% at Malpura to 90.90% at Bhipur centre. The predominant conditions responsible for morbidity were enteritis, pneumonia, simple indigestion, wound, lameness, conjunctivitis, debility and facial mange.

**Mortality profile of sheep flocks in TOT area**

Out of 5607 sheep, a total of 314 sheep died during the year in field flocks of TOT area. Overall annual mortality in TOT flocks was 5.60%, ranging from 3.68% in Chawandia area to 8.86% in Bhipur area. The predominant causes responsible for mortality were pneumonia, enteritis, debility, pyrexia, tympany and ET.

**Rationalization of deworming practices in TOT flocks through epidemiological information**

A total of 1094 faecal samples from TOT flocks were screened for gastrointestinal (GI) parasites to facilitate the deworming at proper time through targeted treatment approach. The overall annual incidence for strongyle infection was 72.4%. The seasonal incidence ranged from 56.7% (summer) to 83.2% (monsoon). The implementation of a single strategic drench with appropriate anthelmintic after mid monsoon managed the GI nematodes in field flocks. *Strongyloides papillosus* (0.6%) and *Trichuris* (1.1%) recorded at low.
level. The seasonal incidence of *Moneizia* spp. varied from 0.9% (monsoon) to 3.7% (winter) with an overall annual incidence of 1.7%. Among flukes, *Amphistomes* were predominant and their incidence was common during summer and monsoon (21.9 and 11.6%) with an overall annual positivity of 11.9%. *Schistosomes* were recorded occasionally during June-July and February with annual incidence to the tune of 0.3%. The annual incidence of *Eimeria* oocysts was 53.3% with maximum incidence during monsoon (62.8%) followed by winter (43.1%) and minimum during summer (38.1%).

**Health camps**

Two health camps were organized in Tantiya and Amli villages. A total of 294 cases (219 sheep, 40 goat and 35 large ruminants) were treated for different ailments. In addition 699 sheep and goat were drenched with flukicide. In the camp a total of 82 farmers were benefited and demonstrated health management activities through poster presentation and scientists – farmers interaction.

**Sero-prevalence of Brucellosis in sheep flocks**

A total of 86 serum samples from field flocks (22 male and 64 female) were tested for brucellosis by RBPT and it was observed that the overall prevalence of Brucellosis was 5.8% and ranged from nil in female to 22.7% in male. The positive cases were found in Diggi, Tantiya, Hatgi and Bhawanipura villages.

**Prophylactics measures undertaken in sheep flocks of TOT area**

<table>
<thead>
<tr>
<th>Event</th>
<th>No. covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterotoxaemia vaccination</td>
<td>6478</td>
</tr>
<tr>
<td>Sheep pox vaccination</td>
<td>4950</td>
</tr>
<tr>
<td>FMD vaccination</td>
<td>1410</td>
</tr>
<tr>
<td>Deworming (GIN)</td>
<td>7800</td>
</tr>
<tr>
<td>Flukicide drench</td>
<td>2540</td>
</tr>
</tbody>
</table>

**Improvement in wool utilization through indigenous wool products developed by local artisans**

The blending trial of Bharat Merino: Angora rabbit hair was undertaken at M/s Shikhar handloom Co-operative Society, Rampur Bushair (HP). The blends run smoothly and 2/40’s Nm yarn was spun successfully. A hand knotted carpet of 6’ x 9’ size with 144 knots / inch and 12 mm pile height from Magra wool was prepared at the Bahera village. It possesses excellent resiliency and good aesthetic properties. The scientist of TMTC Division provided consultancy services to:

1. M/S Felt and Technical Textiles, Jaipur for setting up carbonizing plant. Revenue of Rs.15,000 was generated.
2. CWDB, Jodhpur for evaluation of projects.
3. M/S Shikhar Handloom Cooperative Society, Rampur Bushair, Himachal Pradesh. Revenue of Rs. 1.00 lakh generated under consultancy project for product development from wool and other speciality hair fibres.
5. Custom Department, Delhi for evaluating a shawl sample for its blend composition.
6. Rajasthan Khadi Gram Udyog Sansthan Shangh, Bajaj Nagar, Jaipur for evaluating fiber sample for its fineness, staple length and vegetable matter.

**Improvement in broiler rabbits through demonstration and training**

A total of 599 rabbits were sold to farmers for establishment of rabbit farms in the country. Twenty rabbit units were surveyed at Ajmer (8), Udaipur (1), Kota (1), Malpura (1), Jaipur (2), Maharashtra (1), Tonk (3), Jhunjhunnu (1) and Sikar (2). The total rabbit population in these rabbit units was 914. A total of 17 visits were made to these units to monitor and record their performance. Consultancy was also given telephonically and through correspondence regularly. The performance of these TOT broiler rabbit units was satisfactory though it was observed that the majority of the units were feeding less concentrate feed and more roughage. There was problem of availability of rabbit pellet feed in the market. The performance of broiler rabbits reared in the TOT units was recorded. The overall body weights among weaners, growers and adults were 419.75 g, 1.38 kg and 2.69 kg respectively, which is quite satisfactory. Among litter traits, the overall LSB and LWB were 5.82 and 323.03 g respectively.

**Extension education and technical literacy programme**

The following activities were undertaken for sheep farmers through extension education and technical literacy.

**Field visit:**
A team of Scientists and technical officers made regular visits in the adopted villages. The visits of 32 groups of farmers were organised in the Institute and in field area under HRD training programme.

**Sheep Mela, Kisan gosthi and Exhibition**
To disseminate improved sheep and wool processing technologies, 3 exhibitions were organized during Sheep Mela and Kisan Gosthi at Mandal (Bheelwara), NRCSS, Tabiji, Ajmer and Jaipur. One Kisan Gosthi was organized in the Institute. Live and pictorial exhibitions were also displayed in the Institute and in adopted villages during various functions like Sheep Fair, Field Day etc.

**Kisan gosth**
A total of 4 Kisan Gosthi were arranged in field area. Farmers, Scientists and Technical officers interacted to discuss about new technologies developed in the field of livestock.

**Press note**
Under the report period, 36 news items related to scientific research activities, training programmes of farmers and success story of Kisan etc. were released in various News papers.

**Field day**
Field Day was organized at CSWRI, Avikanagar. The progressive farmers and other target groups of the surrounding villages were invited to discuss and demonstrate technologies developed by the Institute.

**Off and on campus trainings**
Ten training programmes were arranged for farmers’ in the Institute and at four TOT centres viz. Dholi, Malpura, Chavandia and Sawariya. Farmers were imparted training in the field of animal health, animal nutrition, breeding and genetic, animal physiology and feed and fodder resource development for small ruminant production.
Lecture delivered
Under various training programmes in the Institute and outside, a total of 23 training programmes were attended by the subject matter specialists and delivered talk.

Preparation of Literature
A Prasar patra was published in Hindi for extension personnel, farmer, student, youth and made available to visitors during their visit to Institute and in Kisan Mela and Exhibitions. One calendar on sheep rearing practices was prepared and made available to farmers.

Photography and videography
Photography and videography were done during VIPs visit in the Institute, Kisan Mela, Sheep Fair, Kisan Gosthi, and Farmers Trainings and experimental sites.

Akashwani and Doordarshan programme
Three radio talks and one TV talk broadcast through All India Radio and Doordarsan on sheep husbandry.

Marketing of small ruminants in Rajasthan

Integrated approach for improvement in productivity of sheep under field conditions through transfer of technologies in arid region
An integrated approach for improving sheep productivity was demonstrated. Farmers were educated regarding improved sheep husbandry practices through training programme organized in the Institute. Two camps were organized in which small ruminants of the adopted village were screened for various ailments. Faecal samples were collected and appropriate measures for control of endo-parasites was taken. Animals were vaccinated for enterotoxaemia and sheep pox. Feed resource availability in the villages assessed and measures were taken to improve feed resource availability. The saplings of Zizyphus species and Prosopis cineraria were distributed. Wool samples were collected and analyzed and advised for producing wool quality.

Integrated approach for improving productivity of Broiler/ Angora rabbit and sheep under field conditions through transferable technologies.
Two training programs (one sponsored) on Angora farming were organized. Scientist participated in three exhibitions and demonstrated the activities of the station. Farmers under ATMA sponsored training programme were imparted
training and demonstrated rabbit and sheep husbandry practices. An interactive meet on challenges in specialty fibres (Pashmina and Angora) production and prospects of their utilization organized at Kullu on where farmers, NGOs, scientist participated and discussed on various issues. A total of 199 Angora rabbit and 55 sheep of superior germplasm were sold to farmers for improvement of their livestock. Technical expertise on sheep and rabbit farming was provided to farmers visited the station.

**Transfer of technology for improvement in sheep, rabbits and wool production (SRRC Mannavanure)**

A total of 939 breeding rabbits sold to 40 farmers of Tamil Nadu, Kerala, Andra Pradesh, Puducherry and Karnataka. A total of 152 Bharat Merino sheep sold to 30 farmers of Tamil Nadu, and Karnataka. The training programme on commercial rabbit production and practical training was imparted to 12 participants. Rabbit farms at Pappampatti (Palani), Maduthukulam (Udumalpet), Dharapuram, Palladam (Coimbatore), Gobi (Erode), Sathiamangalam and Rajapalyam were visited and technical guidance was provided to enhance the rabbit production under commercial systems. About 450 rabbit farms in southern India established with the help of station. Shearing for BM sheep was demonstrated to farmers. Nine sheep units established from BM sheep supplied by us in Tamil Nadu. Six batches of one-day training programme was organised for village Panchayat Presidents (325) of Tamil Nadu. A total of 85 farmers were trained on various aspects of sheep, rabbit and wool production under ATMA scheme. A team of 5 members headed by Mr.Santhanam, Programme Executive from Doordarshan POTHIGAI TV visited the centre and prepared a documentary film on sheep, rabbit, wool production and utilization. A total of 26 TV talks were telecasted on various aspects of sheep, rabbit and fodder production for the benefit of farming community.

**Performance Evaluation of Broiler Rabbits in farm and field conditions**

Mean live weights at 6 weeks of age were 0.926 and 0.913 kg and 12 weeks were 1.931 and 1.889 kg in WG and SC respectively. LSB and LWB were 7.28, 7.014 g and 351.76, 340.80 g in WG and SC respectively. LSW and LWW were 5.96 and 6.29 kg and 5.519 and 5.733 kg for WG and SC respectively. Mean weight at mating and kindling was 3.798 and 3.745 kg and 3.876 and 3.770 kg for WG and SC, respectively. The kindling rate was 67.0% in WG and 69% in SC breed. Overall kit mortality was 15.84%. Overall survivability of rabbits including kits was 93.0%. A total of 939 (WG-402 and SC-537) rabbits were sold to farmers for breeding purposes.


Maurya, V.P., Prince, L.L.L., Naqvi, S.M.K., Sejian, V., Kumar, D. and Joshi, A. 2010. Effect of body condition score on productive and reproductive performance of Avikalin ewes. *Indian Veterinary Journal* 87:189-190


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Sonawane, G.G. and Tripathi B.N. 2009. Comparison of efficacy of conventional and a quantitative real-time polymerase chain reaction (qRT-PCR) on tissues of pathologically characterized ovine paratuberculosis, IX International Colloquium on Paratuberculosis, ----------------Minneapolis, USA, pp 55.

Sonawane, G.G., Tripathi B.N. and Narnaware, S. 2009. Expression profile of certain cytokine genes in tissues of two distinct classes (paucibacillary and multibacillary) of ovine paratuberculosis, IX International Colloquium on Paratuberculosis, -----------------Minneapolis, USA, pp 139


**POPULAR ARTICLES**


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मान, जे.एस. एवं गीता, एल आर 2010 वन वराहान प्रगती से प्राकृतिक संसाधनों का टिकाने विकास कृषि अमूल्य मार्च 2010 पेज 15-17

मान, जे.एस. गुप्ता, डी शी एवं सुरेश ए 2010 पशुपतन पर कृषि जलवायु का प्रभाव, खेती 62(10):15-17

शर्मा, सुरेश चन्द्र, मान, जय सिंह एवं बैरवा, जै पी० 2009 अपरदन भूमियों का संरक्षण एवं कृषि उपयोग | अविपुंज शस्त्र अंक 2009 पेज 38-40

मान, जय सिंह, बैरवा, जै पी० एवं शर्मा, सुरेश चन्द्र 2009 बाड़ प्रभावित क्षेत्रों में उचित कृषि कियाए अपनाकर खेती करें | अविपुंज शस्त्र अंक 2009 पेज 42-45

बैरवा, जै पी०, मान, जय सिंह एवं रूपचन्द 2009 अफलन के कारण तथा इसके उपाय | अविपुंज शस्त्र अंक 2009 पेज 46-49

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मान, जय सिंह, शर्मा, सुरेश चन्द्र एवं बलुबेदी, रामेश्वर प्रसाद 2009 अकाल एवं अकालगत क्षेत्रों के प्रशासन | अविपुंज शस्त्र अंक 2009 पेज 58-59

बैरवा, रतनलाल, मान, जय सिंह एवं बैरवा, जै पी० 2009 जलवायु परिवर्तन का कृषि पर प्रतिकूल प्रभाव | अविपुंज शस्त्र अंक 2009 पेज 61

BOOK


BOOKS CHAPTERS

Book Chapters


Joshi, A., Kumar, D. and Naqvi, S.M.K. 2010. Stress factors influencing perseveration of ram semen: Approaches for ameliorating their adverse consequences. In: Climate Change and Stress management:


BULLETINS


TRAINING ATTENDED

S.M.K Naqvi attended the XIII Management Development Programme in Agricultural Research at Hyderabad, 17-23 December, 2009.

A. Sahoo undergone Post-doctoral Training programme under Australian Endeavour Research Fellowship at UniSA from 02.11.2009 to 01.05. 2010.

R.S. Bhatt undergone training on Development of Mitigation Strategies for Emission of Methane from Livestock at CSIRO, Division of Livestock Industries at Floreat, Western Australia from January 21 to April 21, 2010.

Sureshkumar S. attended training course on Emerging Technologies in Food Processing and Packaging at CCSHAU, Hisar from June 19-29, 2009.

Sureshkumar S. attended Hands-on Training and Orientation Programme on DRUPAL under AGROWEB Project at DIPA, ICAR, New Delhi from Mar. 9-12, 2010.


D B Shakyawar attended MDP workshop on policy and prioritization, monitoring and evaluation (PME) support to consortia based research in Agriculture from Oct. 5-9, 2009 at NAARM, Hyderabad.

TRAINING MANUALS

Naqvi, S.M.K., Kumar, D., Singh, S., Gulyani, R., Joshi, A., Aminudeen, Maurya, V.P. and Sejian, V. 2010. Artificial insemination and embryo transfer technology in sheep. CSWRI, Avikanagar, pp 89.


PATENTS

**Radio Talk:**

डा. एच. के. नरुला delivered a radio talk on भेड़ों की सामान्य बिमारियों एवं उनका बचाव broadcasted on **06/04/09** at AIR Bikaner.
Awards and Recognitions
AWARDS / RECOGNITION RECEIVED


Swarnkar C.P. Singh D. and Khan F.A. 2010. Epidemiology and management of gastrointestinal parasites in sheep flocks of arid Rajasthan. XX National Congress of Indian Association for the Advancement of Veterinary Parasitology, CCS HAU, Hisar, Haryana, 18 - 20 February (Best Paper Presentation Award).


विजय प्रकाश मौर्सी , वीरास्थवी सेंजिएल, सैयद मुहम्मद खुशाल नक्वी । 2009 । अन्तर्राष्ट्रीय वातावरण में जलवायु परिवर्तन का मेहनत के बीच उपस्थित पर प्रभाव । हिंदी सालाह समारोह, 14—22 सितंबर, केंद्रीय भंड एवं ऊन अनुसंधान संस्थान, अविकानगर में एक दिवसीय हिंदी में शोध एवं प्रदर्शन प्रतियोगिता में द्वितीय पुरस्कार प्राप्त किया ।

देवेन्द्र कुमार, अनिल जोशी व चैवद मुहम्मद खुशाल नक्वी । 2009 । अन्तर्राष्ट्रीय वातावरण में जलवायु परिवर्तन का मेहनत के बीच उपस्थित पर प्रभाव । हिंदी सालाह समारोह, 14—22 सितंबर, केंद्रीय भंड एवं ऊन अनुसंधान संस्थान, अविकानगर में एक दिवसीय हिंदी में शोध एवं प्रदर्शन प्रतियोगिता में द्वितीय पुरस्कार प्राप्त किया ।
Training Programmes, Meetings and sports Organised
**Practical Training Programme**

A training programme on Artificial Insemination and Embryo Transfer Technology in Sheep was organized for field veterinarian, Uttarakhand from March 3 to 17, 2010.

Three B.E. (Biotech) students completed their project work (4 months) from 25.02.2009 to 24.06.2009.

Four Msc (Biotech) students joined on 04.01.2010 and started their project work (4 months).

Training on Basic Techniques in Biotechnology was conducted for Three B.Sc (Biotech) third year Students from 04.05.2009 to 24.05.2009 (21 days).

Training on Basic Techniques in Biotechnology was conducted for Two B.Sc (Biotech) third year Students from 25.05.2009 to 23.06.2009 (30 days).

Training on Basic Techniques in Biotechnology was conducted for One B.Sc (Biotech) third year Student from 24.07.2009 to 22.08.2009 (30 days).

Training on Basic Techniques in Biotechnology was conducted for two BSc (Biotech) student from 12.10.2009 to 26.10.2009 (15 days)

Training on Basic Techniques in Biotechnology was conducted for one B.Tech (Biotech) student from 27.11.2009 to 26.12.2009 (30 days)

Training on Basic Techniques in Biotechnology was conducted for Four M.Sc (Biotech) third year Student (Jacob School of Biotechnology, Allahabad) from 15.01.2010 to 4.02.2010 (21 days).

A batch of 7 weavers artisans (stack holder) from Srinagar trained for weaving of pashmina shawl on improved handloom and design development for pashmina shawl during 20th Feb. to 3rd March 2010


A training programme for 18 trainees (stack holders) on Evaluation of animal fibre and their products with special reference to pashmina fibre was organized jointly with SKUAST during March 12-18, 2010.

Interactive Workshop organized on A Value Chain on Enhanced Productivity and Profitability of Pashmina Fiber Feb 1, 2010 at Jaipur.
Meetings

Research Advisory Committee Meeting
The meeting of the Research Advisory Committee (RAC) was held on February 20-21, 2009 at CSWRI main campus under the chairmanship of Dr. R. M. Acharya, former Deputy Director General (Animal Science), Indian Council of Agricultural Research (ICAR), New Delhi. Director welcomed the Chairman and Members of RAC and gave a brief review of the achievements of the Institute during the year 2008-09. He also informed the committee about the new initiative taken for improving research portfolio of the Institute. He expressed that the recommendations of the RAC would be of immense help in planning and prioritization of the research portfolio of the Institute especially in identification of research priority and thrust areas. The Chairman was requested to initiate the deliberations of RAC as per the agenda. The Chairman, Dr. R. M. Acharya, welcomed the members of newly constituted committee and started with brief introduction about the Institute’s research priority and role of RAC in critically evaluating the research program and suggesting frontier areas of research and extension for improving its functioning. All the Heads of the Division at main campus and Regional Stations and In-charge of scientific sections participated in the meeting. Heads/In charges of Division/ Section presented the brief resume of achievement and future line of action. Action Taken Report on the recommendation of the earlier RAC meeting held during August 5-6, 2008 pertaining to their respective divisions was presented and discussed. RAC Chairman and Members visited the Sheep Farms maintained under breeding projects and interacted and enquired about progress of ongoing projects and suggested for improving the production and ensuring supply of elite rams to farmers for genetic improvement of their flocks.

Institute Research Committee Meeting
The Annual Institute Research Committee Meeting was held from June 1-3, 2009 under the Chairmanship of Dr S. A. Karim, Director of the Institute. At the onset of meeting, he welcomed experts, all the Heads, In-charges and Scientists of Main Campus and Regional Stations. He informed the house that Livestock Farm Section has been created in the Institute to look after the routine management of sheep flocks maintained under various breeding projects. Moreover main objective of Farm Manager would be to insulate the animals against seasonal variability and provides optimum nutrition for optimizing/maximising production. The fodder production in the Institute over the period had declined due to obvious climate change, which was strengthened to ensure qualitative and quantitative improvement in supplementary feeding of sheep flocks during lean period and to do away with periodic procurement need from external agencies. Under prolific sheep projects Patanwadi sheep was procured from Gujarat for use as terminal cross for enhancing milk production. Kendrapada sheep is relatively heavier in weight having required distribution of prolificacy trait hence the genotype will be procured from Kendrapara region of Orissa to attain required adult weight in Malpura crosses for enhancing mutton production. Since scientists in the Animal Breeding and Genetics Division are now free from the responsibility of management of sheep flocks, they will be assigned the work of molecular genetics to strengthen research in frontier area of biotechnology. He expressed his satisfaction over research papers published by the scientists in the institute however non-performers should improve their publication and at least two papers per scientist should be published annually in the referred Journals.
Institute Joint Staff Council Meetings

Interactive meet on Challenges in Speciality Fibre (Pashmina and Angora) Production and Prospects of their Utilization

National Seminar on Stress Management in Small Ruminant Production and Product Processing

National Seminar on Stress Management in Small Ruminant Production and Product Processing was organized by Indian Society for Sheep and Goat Production and Utilization (ISSGPU) in collaboration with Central Sheep and Wool Research Institute (CSWRI), Avikanagar and Central Institute for Research on Goats (CIRG), Makhdoom from 29-31 January 2010 at Hotel Clarks Amer, Jaipur. A total of 205 participants across the country representing ICAR Institutions, Agriculture and Veterinary Universities, NGOs, Sheep and Goat Farmers, Woolen Industries and financial Institutions attended the National Seminar. The deliberations, discussion and presentation were made on various issues viz., Natural calamities and animal management, Nutritional stress and small ruminant production, Environmental stress and small ruminant production and reproduction, Small ruminant breeds and stress tolerance, Biotic and abiotic stress and small ruminant diseases, Transportation and handling stress and meat quality, Stress management in fibre processing and Economics and marketing of small ruminants and products.

Sports
Institute Research Projects and Outside Projects
MAIN CAMPUS

1. Dual type Avikalin sheep for meat and wool production
2. Genetic improvement of Malpura sheep for mutton production
3. Improving prolificacy in sheep for mutton production
4. Demonstration unit of Bharat Merino sheep in semi-arid climate of Rajasthan
5. Establishment of agro-forestry system for maximization of forage production
6. Conservation and management of natural resources through agronomical manipulations
7. Development of agro-horti pastures system sustainable to semi arid conditions
8. Assessment of plane of nutrition and energy expenditure of grazing sheep in critical physiological stages and seasons to augment its productivity
9. Identification, evaluation, improvement and utilization of newer feed resources for sheep
10. Development of feeding system for improving quantity and quality of mutton and wool production
11. Ram semen preservation and utilization
12. Improving reproductive efficiency of sheep for augmenting production
13. Studies on multiple stresses on reproduction and production of sheep
14. Genome analysis of sheep breeds by molecular methods
15. Genetic improvement of resistance to Haemonchus contortus in sheep
16. Epidemiological investigation on economically important diseases of sheep, goats and rabbits
17. Development of carpet pile, technical textile and apparels utilizing indigenous wool blends
18. Carcass evaluation of sheep, goats and rabbits
19. Technology development for utilization of animal products/ byproducts for further processing of value added items
20. Integrated approaches for improvement in productivity of Sheep and Rabbit under field condition through transferable technologies
21. Marketing of small ruminants in Rajasthan

ARID REGION CAMPUS, BIKANER

1. Improvement of Magra breed of sheep for meat and carpet wool production under farm condition
2. Feed and fodder resource development for small ruminants in arid region
3. Developing feeding system for improving sheep production under hot arid region
4. Assessment of reproductive efficiency of sheep in arid region

5. Integrated approach for improvement in productivity of sheep under field conditions through transfer of technologies

NORTH TEMPERATE REGIONAL STATION, GARSA

1. Improvement of synthetic sheep breeds for meat and wool production under sub temperate climate
2. Genetic improvement of Angora rabbits for wool production in sub-temperate climatic conditions
3. Epidemiological investigations on economically important diseases of sheep and rabbits in sub-temperate condition
4. Nutritional studies for formulating economical feeding programme for sheep and rabbit reared in north temperate region of India
5. Integrated approach for improving productivity of Broiler/ Angora rabbit and sheep under field conditions through transferable technologies.

SOUTHERN REGIONAL RESEARCH CENTRE, MANNAVANURE

1. Demonstration unit of Bharat Merino sheep
2. Transfer of technology for improvement in sheep, rabbits and wool production
3. Performance evaluation of broiler and angora rabbits in field conditions

AICRP/NWP/ NAIP/ IICP Projects /Others Projects

1. Network project on Evaluation and improvement of Chokla sheep for carpet wool
2. Network project on Improvement of Marwari sheep for carpet wool production through selection
3. Magra CWDB
4. Marwari CWDB
5. Angora rabbit CWDB
6. Bharat Merino CWDB
7. Shelter management
8. AICRP on Genetic improvement of Sirohi goats for meat and milk production
9. AICRP on Improvement of feed resources and nutrient utilization in raising animal production
10. All India Network programme on Gastro-intestinal parasitism
11. All India Network project on Blue tongue disease
12. Network programme veterinary type culture
13. Network programme on veterinary type culture-rumen microbes
14. NAIP on Rumen microbial diversity in domestic and wild animals and developing microbial consortia for improving energy efficiency of poor quality roughages (Lead centre at ARC, Bikaner and Collaborating centre at CSWRI, Avikanagar)
15. Network / Outreach project on Estimation of methane emission under different feeding systems and development of mitigation strategies
16. Intellectual property management and transfer/commercialization of agriculture technology scheme (upscale of existing component i.e. intellectual property right (IPR) under ICAR headquarter scheme on management on information services)

17. NAIP on A value chain on enhanced productivity and profitability of pashmina fibre.
Dr S.A. Karim                  Director

Animal Genetics and Breeding Division
Dr A.L. Arora                  Principal Scientist and Head
Dr L.L.L. Prince              Scientist SS
Dr G. R. Gowane               Scientist (Study leave)
Dr Ved Prakash                Scientist
Dr Ashish Chopra              Scientist
Dr Chandan Paswan             Scientist
Mr Nemi Chand Gupta           Technical Officer (T-5)

Animal Nutrition Division
Dr A. Sahoo                    Principal Scientist and Head
Dr A.K. Shinde                 Principal Scientist
Dr S.K. Sankhyan              Principal Scientist
Dr R. S. Bhatt                 Senior Scientist
Dr O.H. Chaturvedi             Senior Scientist
Dr N. M. Soren                 Scientist
Mr P.K. Jain                   Technical Officer (T-5)
Mr Mohd Asgar                  Technical Officer (T-5)

Animal Physiology and Biochemistry Division
Dr S.M.K. Naqvi                Principal Scientist and Head
Dr Rajeev Gulyani              Principal Scientist
Dr Anil Joshi                  Principal Scientist
Dr Aminu Deen                  Principal Scientist
Dr V.P. Maurya                 Senior Scientist
Dr Sajjan Singh                Senior Scientist
Dr Davendra Kumar             Scientist, SS
Dr V. Sejian                   Scientist
Dr Rajni Kumar Paul           Scientist
Er C.V.K.N. Rao                Instrument Engineer (T-9)
Mr S.R. Pareek                 Technical Officer (T-6)
Mr N.L. Gautam                 Technical Officer (T-5)
Mr Munir Ahmed                 Technical Officer (T-5)
Mr K.C. Sharma                 Technical Officer (T-5)

Animal Health Division
Dr B.N. Tripathi               Head
Dr Dhirendra Singh             Principal Scientist and Incharge Head
Dr F.A. Khan                   Senior Scientist
Dr S.K. Dixit                  Senior Scientist
Dr C.P. Swarnkar               Scientist SG
Dr G. Sonawane                 Scientist
Dr Vinodhkumar O. R.           Scientist (On study leave)
Dr Jyoti Kumar                 Scientist
Dr Fateh Singh                 Scientist
Dr S.L. Sisodia               Veterinary Officer (T-6)
Mr Gulab Chand                 Technical Officer (T-5)

Transfer of Technology and Social Science Division
Dr J.S. Mann                   Principal Scientist and Incharge
Dr D.C. Gupta  Senior Scientist
Dr L.R. Meena   Senior Scientist
Dr Suresh A.  Scientist
Mr Babu Lal Sharma  Technical Officer (T-7/8)
Dr Vinay Kumar  Technical Officer (T-6)
Mr Allahnoor Khan  Technical Officer (T-5)
Mr R.K. Meena  Technical Officer (T-5)
Mr O.P. Pandey  Technical Officer (T-5)

Textile Manufacturing and Textile Chemistry Section
Er N.P. Gupta  Principal Scientist and Incharge
Dr D.B. Sakyawar  Principal Scientist
Dr L. Ammayappan  Scientist, SS
Dr Raja  Scientist
Mr Nehru Lal Meena  Technical Officer (T-5)

Fibre Physics Section
Dr D.B. Sakyawar  Principal Scientist and Incharge
Dr A.K. Surya  Technical Officer (T-6)
Mr R.C. Mathur  Technical Officer (T-5)
Mr Aziz Ahmed  Technical Officer (T-5)

Meat Science and Pelt Technology Section
Dr A. K. Shinde  Principal Scientist and Incharge
Dr S. Sureshkumar  Scientist, SS
Mr M. Nasimuddin  Technical Officer (T-5)

Grassland and Forage Agronomy Section
Dr J.S. Mann  Principal Scientist and Incharge
Dr S.C. Sharma  Senior Scientist
Dr Roop Chand Balai  Scientist, SS
Mr K.S. Maurya  Technical Officer (T-5)
Mr Ratan Lal Bairwa  Technical Officer (T-5)
Mr R.P. Chaturvedi  Technical Officer (T-5)

Animal Biotechnology Section
Dr L.L.L. Prince  Senior Scientist and Incharge
Mr Satish Kumar  Scientist (On study leave)
Dr Mrs Rajni Kumari  Scientist
Dr Rajeev Kumar  Scientist

Research Coordination and Monitoring Unit
Dr A.K. Shinde  Principal Scientist and Incharge
Mr B.L. Bairwa  Technical Officer (T-5)

Livestock Farm Section
Dr A. K. Shinde  Principal Scientist and Incharge
Dr M.K. Shrivastava  Technical Officer (T-9)
Dr Om Prakash Koli  Technical Officer (T-7/8)
Mr Ram Rai Sharma  Technical Officer (T-5)
Mr Nanag Ram  Technical Officer (T-5)
Mr S.S.R. Naqvi  Technical Officer (T-5)

Farm Section
Mr Shyam Singh  Farm Superintendent(T-7/8) and Incharge
Mr R.B. Sharma  Technical Officer (T-5)
Mr H.R. Gour  Technical Officer (T-5)

Network Programme on Sheep Improvement Cell
Dr A.L. Arora  Principal Scientist and PC
Dr L.L.L. Prince  Scientist, SS
Mr Sita Ram Partani  Technical Officer (T-5)

National Agricultural Innovation Project Cell
Dr D. Singh  Principal Scientist
Dr C.P. Swarnkar  Scientist SG

Mega Seed Project Cell
Dr A.L. Arora  Principal Scientist and Head
Dr Ved Prakash  Scientist

ARIS and Computer Section
Dr S. Sureshkumar  Scientist (SS) and Incharge
Mr M.L. Jangid  Technical Officer (T-6)
Mr M.R. Solanki  Technical Officer (T-5)

Administration
Mr B.D. Phansal  Senior Administrative Officer
Mr Ravindra Singh  Assistant Administrative Officer
Mr Lalu Ram Koli  Assistant Administrative Officer

Estate Section
Er C.R. Gadhwal  Technical Officer (T-5)
Er K.K. Prasad  Technical Officer (T-5)
Mr Sultan Meena  Technical Officer (T-5)

Instrument and Electrical Unit
Dr L.R. Meena  Senior Scientist and Incharge
Mr G. S. Saxena  Technical Officer (T-6)
Er P.C. Verma  Technical Officer (T-6)
Mr Anoop Verma  Technical Officer (T-5)
Mr D. K. Shivnani  Technical Officer (T-5)

Workshop and Vehicle Section
Mr G.S. Saxena  Technical Officer (T-6) and Incharge
Mr Vijay Pal Singh  Technical Officer (T-5)
Security Section
Mr Rukmesh Jakhar Security Officer

Human Dispensary
Dr A. Sahoo Principal Scientist and Incharge

Horticulture Section
Mr Sita Ram Meena Technical Officer (T-5) and Incharge

Library Section
Mr R.A. Verma Technical Officer (T-6) and Incharge

Human Resource Development Section
Dr Rajeev Gulyani Principal Scientist and Incharge

Hindi Cell
Mr M.L. Gupta Assistant Director (OL) and Incharge

Right To Information Cell
Dr J.S. Mann Public Information Officer

Intellectual Property Right Cell
Dr F.A. Khan Senior Scientist and Incharge

Public Relation Cell
Dr S.C. Sharma Senior Scientist and Incharge
Mr M.L. Gupta Assistant Director (OL)

Women Cell
Dr J.S. Mann Principal Scientist and Incharge

Arid Region Campus, Bikaner
Dr R.C. Jakhmola Principal Scientist and Head
Dr R.K. Sawal Principal Scientist
Dr K.C. Sharma Senior Scientist
Dr H.K. Narula Senior Scientist
Mr Ajay Kumar Scientist, SS (On study leave)
Dr M.M. Harsh Scientist
Dr Mohd Ayub Technical Officer (T-9)

Dr P.R. Sharma Technical Officer (T-9)
Mr Vimal Malhotra Technical Officer (T-6)
Mr R.P. Sharma Technical Officer (T-5)
Mr T.C. Kachhawa Technical Officer (T-5)
Mr S.C. Gupta | Technical Officer (T-5)
Mr S.R. Chaudhary | Technical Officer (T-5)
Mr Shankar Lal | Technical Officer (T-5)

**Northern Temperate Research Station, Garsa**

Dr S.R. Sharma | Senior Scientist and Incharge
Dr Sidhartha Saha | Scientist, SS
Dr. S. K. Niranjan | Scientist
Mr Kishore Singh | Technical Officer (T-6)
Mr A. Mahajan | Technical Officer (T-5)
Mr Paine Ram | Technical Officer (T-5)
Mr Manoj Sharma | Technical Officer (T-5)
Mr T.N. Sharma | Technical Officer (T-5)
Mr Durga Singh | Technical Officer (T-5)

**Southern Regional Research Centre, Mannavanur**

Dr N. Swain | Principal Scientist and Incharge
Dr Rajendiran | Senior Scientist
Dr K. Narayanan | Scientist (On study leave)
Mr S. Rajapandy | Technical Officer (T-5)
Mr J. Ambothi | Technical Officer (T-5)
Mr M. Lorduraj | Technical Officer (T-5)