RAISING SHEEP IN KASHMIR

CHALLENGES & PROSPECTS

Compiled and Edited by:

Syed Shakeebah Kubra
Aijaz Ahmad Dar
M. Maroof Shah
Aabeen Sakina

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Papers presented in Colloquia and National Seminar on
"Small Ruminant Production and Disease Control:
Kashmir Perspective"

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Foreword

Prof. Nazir A. Ganai
Vice-Chancellor
SKUAST-Kashmir

Having achieved food security through green revolution, the emphasis has shifted to nutritional security. Newer concerns related to environment, climate change shrinking agricultural land and water resources limit the scope of increasing crop productivity to fulfill the quality protein requirement of growing population in coming decades. The onus therefore shifts to livestock sector particularly on small ruminants *viz* sheep and goat. However, concerns related to sustainability of small ruminant production systems *vis-a-vis* potential damage to environment are real and need immediate attention.

Simultaneously the zoonotic disease and animal welfare issues also need to be taken care-of. Innovation lead research and sustainable technologies are therefore going to play a key role in increasing quality food production, its preservation and value addition. Simultaneously the technologies generated need to be disseminated effectively. Automations need to be introduced to reduce the human drudgery, promote animal welfare and attract youth to this sunrise sector of Indian Agriculture.

I compliment the editors for compiling together the papers presented during colloquia and National Seminar on *"Small Ruminant Production and Disease Control, Kashmir perspective"* held at SKUAST-Kashmir in collaboration with Department of Sheep Husbandry and believe that this compilation addresses to various challenges the small ruminant sector is facing and suggests pragmatic and sustainable solutions to circumvent those challenges.

Foreword

Prof. J. P. Sharma
Vice-Chancellor
SKUAST-Jammu

In India, small ruminants (sheep and goat) contribute significantly to rural economy. In Jammu & Kashmir, this sector has enormous potential to provide entrepreneurial opportunities to educated youth considering the agro-geo-climatic conditions, and food habits of the local populace. However, research-based technologies vis-à-vis breeding, feeding, management and health care of livestock need to be transferred from lab to land for profitability and sustainability. Frequent scientist meetings, panel discussions, interaction with farmers can help the sector evolve better with changing priorities, one-health concept driven smart agricultural and farming practices, and evolving livestock-based enterprises.

It gives me an immense pleasure to learn that Directorate of Extension, SKUAST-Kashmir and Sheep Husbandry Department Kashmir have jointly organized an eleven-day multiple venue event Colloquia on "Small Ruminant Production and Disease Control: Kashmir Perspective" followed by a National

level seminar on the related theme wherein subject matter experts of national and international repute participated in a meaningful discussion.

We live in an age where the latest is always the greatest. I believe, this latest information and recommendations on Kashmir-specific sheep husbandry will help all stakeholders to redefine their priorities, and rethink their approach to contribute to national and international initiatives of Doubling farmers' income by 2022, and Zero hunger by 2030.

Foreword

Prof. Mushtaq Ahmad
Ex. Vice-Chancellor
SKUAST-Kashmir

Sheep and goat farming is the lifeline for majority of the farming community in hill agricultural system of Jammu and Kashmir, and is critical to the very progress and survival of such people. Rich natural resources (alpine, subalpine pastures and meadows) together with fair percentage of land under orchards coupled with preferential food habits of the people offer a great promise for development of this sector as an industry. However, to make the industry economically viable, bottlenecks in livestock management need to be identified and addressed through a holistic approach.

SKUAST-Kashmir has undertaken numerous husbandry specific research and development initiatives viz conservation of germplasm, breed upgradation, feeding, housing, disease diagnosis and therapeutics. University is also providing all possible technological backstopping to the development department. Capacity building of field vets, need-based trainings to

farmers and skill oriented courses for educated youth constitute an important component of the varsity's outreach program.

Together, in a convergent mode, we can contribute to sustainable development and make a difference. It is heartening to note this collaborative activity on "Small Ruminant Production and Disease Control: Kashmir Perspective", bringing experts of national and international repute on a single platform to deliberate and discuss issues pertaining to sheep husbandry will help identify critical points for immediate redressal by the concerned departments for a prosperous future for sheep husbandry in Jammu & Kashmir. I hope the recommendations made will help reorient the small ruminant sector and constitute a new chapter in our development story.

Foreword

Mr. Bashir Ahmad Khan
Director
Sheep Husbandry
Department Kashmir

Sheep and goat contribute immensely to the agrarian economy, and in particular, supports the livelihood of small, marginal and landless farmers. In Union territory of Jammu and Kashmir, sheep is perceived as the "finance elevator" of economically weaker sections of the society like gujjars, bakerwals, chopans etc. J&K is a home for 3.2 million sheep but still imports sheep worth Rs1000 crores per annum from the neighbouring states to meet the huge demands for mutton, indicating a definite opportunity and potential for measured growth of the sector.

Department of Sheep Husbandry Kashmir, on a mission mode, has initiated several farmer-centric schemes for expanding the producer base, recently imported quality germplasm from Australia for upgradation of the existing stock, established state-of-the-art disease diagnostic centres, germplasm units, and other facility centresenroute livestock migratory routes as important support measures for making this sector viable and sustainable.

Lot done, but lot more needs to be done vis-à-vis curtailing the expenditure on imports, conservation of indigenous germplasm, pasture rejuvenation, disease-diagnosis, prevention and therapeutics, capacity building of the sheep breeders, broiler-type sheep farming, upscaling of sector-specific research and extension, addressing public health concerns for safe and nutritious food, promotion of environmental health etc.

It gives me an immense pleasure to learn that Directorate of Sheep Husbandry Kashmir in collaboration with SKUAST-K has organized such a wonderful event and presented science-based husbandry related recommendations for the greater good of all stakeholders. I believe, with the novel and newer ideas and directions, we together can make the sector producer-friendly and consumer-acceptable, and that is contributory to local, regional, national and international responsibilities of food and nutritional security.

Foreword

Dr. Abdul Salam Mir
Ex. Director
Sheep Husbandry
Department Kashmir

Small ruminants play an important role in Indian economy, and provide livelihood to two-third of rural community. In areas where crop and dairy farming aren't profitable, sheep and goat farming can be a viable and sustainable alternative. The productivity of sheep and goats in our conditions is lower than those of agriculturally more advanced countries, and multiple factors (breeding, feeding, housing, health care etc.) can be the reason.

Sheep Husbandry Department Kashmir through various farmer-friendly schemes is doing a lot in transforming the sector *viz.* shifting from dependency to self sufficiency and traditional farming to industry, imparting skill-oriented trainings to educated youth and grooming them into potential entrepreneurs and lot more. Genetic improvement of the livestock, conservation of indigenous germplasm, feed/fodder fortification, disease monitoring and surveillance, farmer and animal welfare, marketing etc are some priority areas for the Department considering the sectoral challenges and obligations towards One Health concept.

It gives me joy to mention that I successfully got initiated the project of Artificial Insemination in goats for the

first time in the history of the Department and established state of the art Embryo Transfer Technology laboratory for futuristic goals and accordingly many sessions in the seminars have been dedicated to further improve these newer ideas and services for farmers. Besides, I undertook major upgradation of Biological Products unit and other sections including pathology at Disease Investigation Laboratory, Nowshera that has resulted in substantial improvement in delivery of services in terms of readiness to provide confirmatory diagnosis of major prevalent diseases, and undertaking cell culture based work on vaccines.

It is pleasing that research wing of the Department has strengthened collaboration with SKUAST-Kashmir, and organized jointly this important event focussing on sheep and goat production and disease scenario. This unique document will help understand better the challenges and opportunities in Sheep Husbandry in our conditions. I believe the recommendations made are worth implementation and will help realize our potential in small ruminant sector.

From the Editors

This publication was made possible through generous contributions of time and efforts by domain specific experts and many other individuals. We offer our sincere thanks to all. Knowledge and experience shared by the experts, and participation in panel discussions enriched the participants. Few contributors deserve special mention and recognition. The patronage and support received from Dr Mushtaq Ahmad and Dr Abdul Salam Mir in execution of the event is noteworthy and unforgettable. Dr Abdul Hai made the event comfortable and colourful, and we sincerely thank him for his generous efforts. Dr Farooz A Lone endured a lot from us in checking plagiarism of manuscripts in shortest possible time. Dr Shabeer A Hamdani deserves a special recognition for providing technical inputs and photographs of event specific activities. Valuable comments and guidance from Dr M S Mir, Dr A A Khan, Dr Rahika Razvi, Dr Umar Amin and Dr Amani Ishtifaq merit a special mention and we thank all of them for making this event meaningful. We thank panelists, participants, progressive

farmers for their valuable suggestions, and to media personnel for ensuring wider audience and readership. We offer our sincere thanks to all, Dr M R Fazli in particular, who contributed in drafting and critical review of the recommendations.

We offer our sincere gratitude to Department of Sheep Husbandry Kashmir for providing monetary assistance and to SKUAST-Kashmir for technical and logistic support.

We apologize in case we have failed to acknowledge individuals who have assisted in making this event a success, and publication of this book.

We believe through this event the inter-sectoral linkage has been strengthened and through this compilation the awareness about breeding, feeding, housing and health-care of small ruminants vis-à-vis Kashmir perspective has been promoted.

Editors

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Ideas for Development of Livestock Sector in Jammu & Kashmir with Special Reference to Sheep and Goat

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Prefatory Remarks

We have sizeable work force but little has been done so far to really think or rethink the key policies that if continue will mean status quo and little progress. I wish the Department organizes seminars/discussions on important issues and constitutes a high powered committee who reports about the need to review the basic structure, vision and policies and then debates newer ones. Despite Herculean efforts to make the difference, one can't expect basic change though some improvements may surely come. It became clear decades after we started wool-centric breed development program that it was not our choice or best choice. No wonder our animals don't have competitive dressing percentage and are second choice in slaughter/qurbani market. Our production cost too is on higher side. Similarly key policies we have undertaken have not been timely reviewed. There has been space for everything but little for organized thinking/rethinking key issues. One of our central problems has been unorganized/semi-organized/badly organized livestock farming in private sector and failure of various stakeholders to optimally tap huge potential investment for livestock sector - almost every family would love to get milk, mutton, eggs etc and invest in any enterprise that

supplies them or reduces their cost and we haven't been able to invest their money into any kind of milk/mutton/egg/chicken bank. Just advertise shares in such a bank and we will get huge money for supplying all these products through professionally managed farms and create thousands of jobs in the process and reduce budget on such items by half at least in a short time. People can't rear animals for reasons of modernization/class mobilization but can contribute money/kind to these banks. The farmers and investors elsewhere do have a mechanism to share on 50% basis profits but here farmers are entirely relying on their own and investors have not link or mechanism to contribute money so that farmers rear on their behalf. We need aedij with interested people able to contribute.

- The challenge before us is how we cull over 70% of livestock that is neither optimally performing nor is going to perform optimally. We can get greater production with only 30% of current population. In Denmark cows yielding less than 35 liters are culled for slaughter. Here we should have some scale at least, say 15 liters and then have a mechanism to enforce it so that farmers not serious in efficient production and drain our limited resources by rearing animals quite inefficiently. Similarly, sheep that don't attain certain minimum body weight in stipulated time should be culled as they dilute selection pressure for general improvement.
- Here I present some facts and suggested measures that might interest the Department, or at least some authorities there for consideration. May be these ideas have limitations but better can be sought to be developed by professionals. I wish every Veterinary Assistant Surgeon/Officer could facilitated/ encouraged to design a small project of his/her own that s/he could implement in her/his jurisdiction and we might select the best in a year or two to be propagated elsewhere. What I want is a mechanism in place in the Department that seriously reviews and periodically debates new ideas and suggests changes and comes up with new thinking. It has been since decades that any genuine path breaking new thinking has been done either in the University or the Department. To begin with we

may invite from anyone who is interested (vets/paravets/scientists in SKUAST/entrepreneurs/economists) to submit their ideas/projects for meeting various challenges in the livestock sector and then one day you convene a meeting by technical committee to review them and then sponsor/seek Detailed Projects Reports for better ideas).

- We suffer primarily for want of thinking not doing. Unorganized action, mechanical action, chalta hae (as is) syndrome are our bane. We have planned wings but not enough to plan them in a way that challenges status quo radically. No wonder we have no answer to most important questions like where are quality animals to begin farming, why it was wool and not mutton that officially colors our development policy despite seven decades post independence, why we have little reliable records on most parameters that could guide policy etc.
- Given mostly unorganized or badly organized sector with abnormally huge percentage of people associated with farming despite the State's drive for modernization and failure to carry out modernization of the sector (3% people in America do farming and they are exporters as against over 60% people here and we are still importers of every livestock product. The difference is consciously planned big mechanized farms and not allowing small holdings in livestock sector as they are not sustainable or efficient. Either we plan modernization or we believe we continue with traditional ways. However, urbanization, class mobilization and historical forces driving economy and social lives can't be defied. We are so far an economy that is hesitant and unsure of its direction or aspiration and is more driven than driving and exploits women and old people and is terribly inefficient. Most farmers are cheated and they are unaware that they have missed the bus of modernization or upward mobility and failed to efficiently run their enterprises. Currently followed individual farming or semi cooperative mode in some seasons necessitates great individual effort, both physical and mental, much more labour cost, more risk and uncertainty, difficulties in supervision and many other costs all of which may lead to their abandoning farming enterprise

and this is precisely what has happened with greater urbanization and education in our State. We need to advise the State how to go about the sector and how far traditional ways may continue without affecting larger goals of all stake holders.

- We don't have good economists/social scientists reviewing the sector to help guide how we plan for the farmers whose life standard has, generally speaking, failed to increase correspondingly. Few farmers/workers are unalienated and that means on human plane, a huge crisis that we often even fail to cognize.
- Total number of jobs lost on account of lost opportunities in sheep/dairy farming is in thousands.
- We have lost wool board, many farms including Sheep Breeding Farm Dachigam and Duck Farm and much space in Manasbal farm and some in Wussan Farm.
- Number of jobs lost on account of inefficient individualisí management is in thousands.
- Generally speaking, schemes operative for popularizing animal/sheep husbandry and improving economic status of farmers associated with it have not as satisfactorily clicked - and can't click in a big way - as expected in the beginning.
- To the basic question where are the good farms or professional suppliers of good cows/ewes? Neither department nor the university has any answer presently. Neither easy finance for starting enterprise, nor insurance for most of animals nor marketing support nor expert accessibility at times nor readily available examples of professionally run model farms whose economics we know nor awareness regarding even the comparative profitability and alternative options available are there for farmers/entrepreneurs. Entrepreneurs are not often interested in investing in it on large scale and there are very few big livestock/sheep farms in Kashmir. Though some are interested but are unable to cope up with certain real and imaginary apprehensions or hurdles.
- Most of the districts receive a paltry sum around Rs 4-5 lac from

District plan and that has remained static from more than a decade. This must be increased ten-fold to make extension centres livable and develop preliminary facilities. The current state in most centres is shabby small hired tottering room or two and no facilities for the staff with even good chairs absent.

- It seems bahaks (highland pastures) have been left entirely at the mercy of Nature or wild animals. Virtually no infrastructure has been built in bahaks or en route bahaks and consequently huge flocks are defenseless against predators and Chopans/staff can't sleep properly for months.
- There is no policy to grade Chopans in terms of honesty and professional ethic with the result that a good number of good prospective entrepreneurs don't invest or drop out as Chopan mistrust is a great deterrent and every third farmer has a tale to narrate. We haven't been able to help farmers choose Chopans and punish miscreants. So little is control over Chopans due to inability of department to give them good incentive (Rs 500 is given to them that is simply insulting) and this affects ultimately breeding and we find our efforts to plan breeding and get good rams come to naught as virtually no control over indiscriminate breeding at High Land Pastures (HLPs). We lose millions of dollars annually to failure in controlling breeding as thousands of substandard lambs are born following September breeding in HLPs that fail to properly grow competitively.

The current state of affairs is depressing, to say the least. Is it possible to bring a radical transformation in the scenario? I propose various measures below besides the key measure of Cooperative farming/sheep banking/Qurbani banking, outline summarized below, as a possible working model to be considered for review by any technical committee.

Some Measures

Livestock Banking and Cooperative Farming:

These are two approaches that can revolutionize livestock sector. The

idea in some form has been practiced throughout history in almost all traditional societies and today in certain socialist states like China. I think the idea worth exploring and experimenting for any welfarist or development planner or NGO working for mass upliftment. The Department needs to think how to discourage those farmers who are only half committed to livestock enterprise rearing small units that drain resources and in turn contribute little. So wasteful is the current process that we could well produce all the milk and mutton separately produced by say 30 households in two sheds employing three or four persons from the locality. Anyone can contribute animals or cash to be shareholder and the Department may facilitate one such venture that call sheep bank. Huge investment could be attracted if the department in collaboration with relevant agencies succeeds in investing people's money directly into local farms so that shareholders get either free milk/mutton or at half rate or even less. A farm of 10 cows and 150 sheep will supply almost all requirements and generate three or more jobs in average village where thirty households' rear 30 cows and 200 sheep in small inefficient units whose management, health cover, breeding and other parameters can't compare with properly managed & supervised two farms by local sheep/dairy bankers/mohalla committee. Thus, we could generate thousands of jobs, reduce stress on environment, curtail exploitation of old and women who run farms while facilitate those who really mean business and honour farming vas a way of life. About 80% of farmers do farming in a way that stresses environment, makes little contribution to economy when we factor all costs including labour and missed opportunities for choosing farming due to animals that don't perform or can't perform optimally - most animals currently used should have been culled in the first instance if profit/economy is an issue - and inefficiently utilized/problematic linkages with Chopans/scientists. The argument that farming is a way of life applies to very small percentage now and what is mostly the case is small units of sheep/goat or a cow or two which are, in 80% cases, underperforming and even source of strife in family including sas-bahu (Mother-daughter in law) conflicts that explains why life standard of farming community has generally been static and not transformed. Hardly any farmer is willing his son to continue the job. Why

should he be willing anyway if other sectors seem more promising?) I propose, in Sheep Husbandry Department (that may, however, with some modification, be applied to Animal Husbandry Department as well), the following.

1) The Problem and Solution of Dosing/Vaccination Issue

The Problem in Current Scenario

Current Scenario of Ðosing and Vaccination Program in Sheep and Goat in Kashmir Division

- Most breeders fail to follow/are not aware/don't have access or necessary facilitation for abiding by standard dosing and vaccination calendar.
- No or little record keeping in the field specifying when and which drugs have been administered to specific flocks.
- Lot of hassle to many breeders in procuring proper drug (to mitigate resistance problem and consider local epidemiological data for prevalence of particular diseases).
- Flurry of complaints against staff or even department on the assumption that drugs/vaccines have not been properly/timely procured/made accessible.

Proposed Solution

One solution is to divert subsidy/budget spent for medicine/vaccine in accounts of farmers/select farmers according to strict criteria that helps us grade them according to how efficiently they carry the enterprise. Another is to privatize the service. It is proposed that Rs 50 may be charged/annum/sheep from any sheep breeder interested in registering for the services to be offered by our Sheep Extension Centers (SECs). Incharge SECs shall collect, issue receipts and then periodically intimate higher authorities regarding implementation of the program. The following services shall be provided to the breeders who register by advance payment in one/two installments:

- Provision and execution of routine recommended dosings
- Provision and execution of vaccinations at proper/recommended

time

- Record keeping through entries in particular cards issued to breeders for the purpose against cash payment of Rs. 10.

Impact of Program

Envisaged impact includes the following, among other points:

- Making delivery of services more professional.
- Reduce wastage of drugs.
- Curb development of anthelmintic resistance.
- Avoid a lot of hassle to some breeders in procuring their own recommended drugs/vaccines.
- Take care of long standing issue of pending payments from some breeders that hinders better service delivery on the part of our staff.
- Better accessibility for drugs with huge market demand procured from departmental supplies or privately purchased by incharge staff.
- Help control morbidity, mortality and production losses to a significant extent.
- It would virtually translate itself into a sort of "insurance" program against most of the prevalent and economically important parasitic, viral and bacterial diseases. This in turn would control morbidity, mortality, production losses and other adverse effects from different diseases. If we are able to save, by virtue of these multiple positive impacts of disease/death/drug resistance prevention and not insignificant production increase, only Rs 5000/breeder against Rs 500 investment by an average breeder having 10 or more number of animals, it amounts to millions of dollars annual saving/prevention of loss in the small ruminant sector and this is a stupendous achievement.

Notes:

a) In case the breeder is unable to administer drugs/vaccines himself/herself, he/she shall be charged Rs 10 extra. The idea is to empower breeders and work towards motivating them to learn key routine operations in rearing/first aid etc. on their own.

b) Calculating current market costs of routinely used anthelmintics and vaccines available either through govt. supplies or in open market, one arrives at a figure for three dosings and three vaccines at around 35-40/sheep of average body weight. Rs 15-25 shall be incurred in executing delivery of services taking note of distance from SEC and other incidental costs and even generate slight profit to be spent for supporting a percentage of farmers who can't pay even Rs 50/ sheep/ annnum. It is envisaged as approximating to no profit no loss deal in terms of economics as it is fundamentally aimed at better reaching out to masses and more efficient and professional delivery of services.

c) The Department shall incur no additional cost to facilitate the program. What is, however, needed, is continuous monitoring, guidance to fine tune it for better results and endorsement at either formal or informal level whatever deemed fit to encourage the staff and accountability.

Extension of the Program to Treatment Insurance

A perusal of treatment registers in the field shows an average cost incurred on medicines other than dosing and vaccination for routine health problems by owners/animal/annum is in double digits. Rarely it exceeds three digits or reaches four digit figure. As such, charging Rs 50/animal as a premium for insurance against any disease subject to the condition that the animal has already been registered for dosing/vaccination program. Since morbidity hardly exceeds 20% and thus most animals don't require any treatment in the year, providing insurance makes sense as we generate enough resources by charging Rs 50/sheep or goat to take care of occasional cases that require, ordinarily treatment costing money in two digit figures only.

2) Long term Solutions to Disposal of Govt. Rams Problem

Given huge problems in existing set up whereby many breeders are reluctant to take up govt. rams or part with them at the time of migration or rear them properly in winters or prevent certain percentage of easily avoidable deaths in them, the proposal of transferring rams to breeders has been under consideration. But the same has been stalled due to

various legitimate concerns. However, it seems possible to devise a mechanism that will make it possible without associated costs. The following proposal envisages one such mechanism.

- Get a joint application with an affidavit from interested breeders along with remarks of concerned Incharge and VAS regarding his overall character, experience and trust worthiness. The breeders shall be allotted rams as per the following schedule: Ram A with first breeder goes to Second breeder after two years which in turn is returned back to first breeder and he becomes their full fledged owner. However, additional requirement for transferring ownership shall be returning one male animal, of at least 30 kg live weight, from the progeny of the transferred ram to the Department by or before fourth year.
- For these four years breeders shall be accountable to the Department and any mortality on account of negligence is payable by the breeder.
- Breeders have to provide guarantee of each other besides providing one guarantor who should be local employee/local imam/any pensioner or mortgage of one of the animals of equivalent body weight and the same shall be mentioned in the affidavit. Local Panchayat may also be co-opted while making the agreement.
- The process may be started phase wise, in certain selected areas and following good feedback, extended to whole region.

Impact of Program

It will control inbreeding, ensure better care of govt rams, restore faith of farmers, make available hundreds of animals for breeding/qurbani or be a step towards making supply of rams self sustaining in the long run.

3) Outsourcing a part of Production of Breeding Rams

Each govt. farm shall outsource 50 ewes to selected entrÉpreneur on the condition that females will be property of the latter and males of the Department and breeding shall be wholly under the control of the parent farm. The entrepreneur will be given Rs. 300/ kg for male animals the Department takes back for supplying to field. The contract with the

entrepreneur would last for 5 years till 100 animals have been extracted back. If the Department requires any ewe as well, it shall be entitled to get it on market rate from the entrepreneur. The cost of producing one govt. ram through this method is ten times less than it is presently in govt. farms. And the Department will get every year a new farm (around 300-400 animals from currently existing govt. farms) from out of nothing through this scheme.

4) Reviewing Revenue Generation Policy

Since the Department is currently suffering for want of funds for optimal running of many schemes or even routine operations and facilities in centres/offices - we don't have arrangements for feeding most of quality rams in field, gas bukharis/money for fuel wood and furniture in most centres, no money for facilitating transport of animals in emergencies or for surgical interventions which may be available centrally/in FVSc & A.H (e.g., surgery for Gid etc), little support by way of quality foldable tents for Chopans and staff during migration season, little support for hiring horses during migration at field level, no support for brucellosis infected cases that require compensation etc., help average farmer only marginally by way of supply of certain drugs though need is for much more quantity and more number of important drugs currently we fail to purchase - Why not explore legal and technical avenues for possible diversion of revenue generated by the Department for its own developmental objectives? The department is generating enough revenue annually through sale of animal manure, shearing services and auctioned animals that could help in meeting all these challenges at our own level. If we could divert even 20% of revenue locally generated for local uses by the respective officers, a significant improvement would occur. The same has the precedence in other departments such as education where revenue generated by way of fees etc is partly diverted to local developmental goals as deemed fit by headmasters/principals. Since we fail to optimally fulfill our cherished objectives (more mortality in winters in govt. rams because of lack of proper feeding/supervision in feeding centres) for want of funding and do we have funds that are best used for the development of departments/breeders/Chopans, it should not, in

principle or theory, be a huge problem to meet without any financial burden to State exchequer. Since we are already creating new RKVY units from retrieval of animals the Department has the claim to ownership of the same for appropriating for developmental objectives.

5) Investment Wing of the Department

The Department should propose to facilitate private sector build a corporation/company that would procure quality ewes - to begin with, from our own farms unless sufficient shareholders come forward to be part of the venture - and distribute them to prospective entrepreneurs on certain conditions. One way is to retain female progeny for itself and allow the entrepreneur to own male progeny only. The female progeny thus collected would be in turn distributed to other prospective breeders/entrepreneurs. Aedij and associated concepts that involve around 50% shareholding by business partners are already a legacy in Kashmir and it wouldn't be difficult to institutionalize the same. Or this corporation/company supplies 20 ewe units to interested entrepreneurs on the condition that 22 animals attaining certain minimum body weight/age are be returned within 6 years. Any failure to clear the installment will incur penalty for breeder.

I propose around 10% "interest" on loaned animals which amçunts to one animal/10 animals/annum. The same shall be invested in other units and this will be self sustaining in the long run. Since, on an average Rs 3000-4000/ewe/annum is the profit (according to surveys conducted, for instance, in Hajin amongst breeders), the Investment Wing might demand Rs400/animal/year as its share of profit besides the installment in the form of at least one animal (ram/ewe) from the progeny till the Principle amount is liquidated through kind. Or the Investment wing shall be entitled to one kg meet/annum from every male progeny of beneficiaries. If the Wing owns 1000 animals, it shall get 1000/13 = 77 Qurbani animals from beneficiaries for sale at the time of Eid annually. Or we shall get one kg/week meat for half of market rate for 1000/48= 21 beneficiaries who propose to invest with our wing in this venture. The scheme would entitle beneficiaries to get half price mutton for 10 years for contributing Rs 12,000 as one time investment. The

premise is that the Investment wing shall purchase and rear animals from this money from beneficiaries and slaughter a percentage of animals thus obtained.

If each farm invests only 20 animals/annum in such schemes, a new farm will be created in ten years for no cost. Farm's own budget would be, at least partly, covered by opening up new branches from its own produce and retaining ownership through these ventures. Imagine 50 such units are established in which Department is a partner on 50% basis and annually each of these units yields only Rs 1 lac as share of profit for the Wing with which the Department signs MoU . It means Rs 50 lac is added to the revenue and it is a regular addition every year. If the Department facilitated corporation owns, every year, only 1000 animals by virtue of various ventures, within a decade its estate shall grow, as that of a big corporation or company, and it could be self sustaining to an extent. Selling off a few thousand animals annually would cover much of its budgetary requirements and maintain a lot of schemes without any financial support from outside by the State or Centre. The department could well grow the way Banks grow - opening newer branches every year if necessary legal support is provided to this corporation.

We do have precedent for the same in existing structure of our ownership of govt. rams and RKVY produce. So it is only a small step towards opening an Investment Wing.

6) Charity/Zakat Unit Scheme

Since empirical surveys have established that a sizeable percentage of breeders do give zakat/charity on annual basis but all in unorganized way and mostly by way of slaughter rather than for creating new units in poor deserving farming community, there is a need for organizing this zakat collection and then rationalization of its distribution. If the Department facilitates this, annually hundreds, if not thousands of animals could be collected and based on proper survey be distributed to enterprising deserving farmers. Another simultaneous "contract" may be made with such beneficiaries whereby they are motivated/required (so that religious motivation for zakat is not violated) to create a new unit within 5 years by dispensing with one animal from progeny for helping other needy ones.

As a gift from the Department, breeders contributing Zakat to the Departmental Pool shall be entitled to certain privileges in future programs of the Department to disseminate awareness and motivation for contributing in other breeders. If the Department writes letters to all breeders (or personally meets some of them through District Sheep Husbandry Officers) to whom zakat from their sheep pool is due and prepares a motivational lecture series along with Ulema/religious scholars on the topic and disseminates awareness and zakat forms, it is hoped that at least a percentage of breeders will respond and start giving zakat if they have hitherto skipped or shift from unorganized individual to collective mode of collecting and spending of zakat in the form of sheep. This is sufficient for starting scores of new sheep units annually for beneficiaries.
Note: Breeders or progressive farmers contributing animals in this zakat stock shall be entitled to better grades and certain preference in distribution of different incentives/services from the Department besides free vaccination for the year as a token of gratitude and encouraging others to come forward.

7) Orchard Sheep Unit Scheme

Every orchard owner with 10 or more kanals of orchard land will be entitled to get benefit from this scheme according to the formula of I sheep for every kanal in addition to ten kanals. Thus for an owner of 20 kanals, ten sheep unit could be sanctioned. And here the Department shall retain some percentage of share in the venture @ Rs 500/animal supplied/year until the equivalent numbers of animals are returned. The orchardists shall be required to return the animals @ 1 animal/year from progeny and the same shall be pooled and distributed to other orchardists who shall be nominated by original beneficiary orchardists but fulfilling requirements. Small profits to which the Department is entitled shall help running the scheme. And the whole scheme shall, in time, be fully self sustaining.

8) Accelerated Lambing

Given tremendous gains made by the Department in terms of quality of animals, twining, increased lambing percentage with a good percentage of ewes that lamb twice in a year/15 months and many more

three in two years, it is, urgent requirement that we apply certain selection pressure to increase these gains significantly. One idea could be the following.

Ewes with proven credentials of lambing twice in a year shall be motivated to contribute/spare for four years on lease such ewes to the Department and a farm of around 100 such ewes shall be created in each district in the already existing space in farms. The original owners shall be given an option to retain ownership or given cash payment according to market rate besides some additional money to motivate them. With time, following rigorous selection, we will be having significantly increased percentage of ewes with more than 100% lambing percentage calculated on annual basis and excluding twinners. Proper genetic studies for exploring increasing lambing percentage shall be in addition to this managemental intervention.

9) Dairy Sheep Farm

Given the significant percentage of milk production from sheep in developed world and given field experience of presence of certain number of animals with promising milk production traits and given some presence of Gurezi breed that has better dairy traits, it seems possible to tap the potential by mere increase in selection pressure and choosing one of the departmental farms to house, breed and further study the selected animals with better milk production promise based on local field data further corroborated by verification through filed technical staff. If we get only 100 ewes with more than 1kg milk yield/day in a farm and subject the same to intense selection pressure and then complement the same by genetic studies, it is hoped that in a span of few years we will have dairy use for significant number of ewes currently not used for the same purpose. It is assumed that milk traits have significant heritability and progeny would have better milk production.

10) Sale Outlets for Mutton

(The idea has been jointly elaborated by Dr Showkat Ahanger and myself)

On the pattern of sale of dressed poultry and fish, a sale outlet selling, on weekly basis, some quantity of mutton will be able to attract larger

consumer market with time. Since it is recommended to annually cull about 15-20% of animals on routine basis for farms, SHD auctions (that mostly go for slaughter) around 500 animals in a year for less than competitive sum and loses both revenue and control over market. If we provide a small outlet that slaughters them for consumers (may be registered ones only if we have lesser quantity) on say less than Rs 400 and certify it as wholesome mutton as it would be slaughtered with proper ante-mortem and post-mortem examination from staff near sale outlet, say somewhere in Lalmandi/Lalchowk, we save some money and provide to at least a fraction of customers better meat. A rough outline of costs and benefits follows:

Existing Scenario Money realized from sale of 500 animals@ Rs 140kg live weight = 500x140x30= 21,00,000

Proposed Sale Depot Economics

Given 40% dressing percentage and assuming average weight of animal 35kg that are to be slaughtered

We propose to sell mutton at say 370, (Rs 50 less from market rate)

So money realized from sale of mutton=500x370x14= 25, 90,000

Additional money realized from pelts = 500x50=25,000

Hoofs/heads and select viscera @Rs 200/animal= 500x200=1, 00,000

However we need to minus transport/ slaughter costs to be paid = Rs 20,000 So net savings = 2590000+25000+100000 - 2100000+20,000= 5695000.

This would provide one kg wholesome meat on weekly basis for (500x14/48) 146 customers which is a small but significant intervention that would display some sense of public concern by the Department.

If we increase number of animals to be slaughtered on weekly basis to 50 by inviting entrepreneurs/farmers to supply animals to us (by some incentive, say Rs20/kg of live weight) we need to give around 14 lac as subsidy for guaranteed wholesome supply of meat round the year once a

week for 1460 customers which is some presence. We could register these 1460 people by requiring them to submit Rs 1500 as registration fees (that totals as 21.9 lac) which we invest in sheep banks by inviting interested breeders to rear around 250 average quality female hoggets/ewes and supply us male progeny for slaughter for three years for free (on 50% sharing basis as he retains/sells females). We get total of 120x3=360 animals for free and meet out with half of them money required for subsidy and use other half to create more such units and supply chains to make the endeavour sustainable.

In the next step we can make available some rabbit meat, some ewe/goat milk and some other products locally made in these sale centers we would be able to generate market for these things with the objective of ultimately increasing entrepreneurship in rabbit, dairy sheep/goat. Impact of the program will be

- Achieving better control on mortality as timely culling will be possible.
- A part of valuable resources for feeding livestock to be culled would be saved.
- It will prevent exploitation of farmers in local market as they will not be forced to sell animals with only local butcher/middle men.
- It will generate healthy competition amongst entrepreneurs to supply animals to Department for sale.

11) Supply of Qurbani animals at district level

If we wish to keep available around 500 animals in each district headquarter for qurbani at equivalent to or less than market rates, say Rs 210/kg live weight, the Department can consider giving subsidy of Rs 20 on every kg of live weight to entrepreneurs who supply the same for 500 animals that amounts to (assuming average body weight of 35 kg) 700x 500=3.5lac which is not huge and could even be met out by investing money in new units on the pattern suggested above (50% progeny is taken by the Department for three years) registering names beforehand and taking Rs 1500 as registration fees for 3 years. Carrying this forward would make the enterprise of supplying 500 animals every

year in every district sustainable. Hopefully we would be able to generate good interest amongst new prospective customers and one day significantly control market rates and ensure timely supply of desired animals and reserve more funds for more number of animals.

We have enough resources at district levels such as revenue from manure, fodder, auctions, shearing etc. that could well be diverted into such activities instead of govt. treasuries on the pattern of education department which uses revenues from school resources for its own development instead of depositing in govt. treasury.

12) Best Ram Award

It is proposed that Rs 20,000, 15,000, 10,000 be reserved in each district for every district so that best breeders are encouraged and we get elite animals. Besides special price of 400/kg live weight should be reserved for 220 elite animals, (10 from each district) at festival time so that they could be procured for breeding. DSHOs select these animals locally. Every year we would get an elite ram farm for distribution/experimental studies/further selection for a few lacs. Awards for best animals at district level in local mandis be instituted on yearly basis and can be extended to dairy animals as well.

Economics of Sheep Rearing: Lessons from Success Stories of Sheep Farmers and Entrepreneurs

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Sheep sector in Kashmir region presents more than 7 folds improvement in production since 1950 (2.33 lac to 17.64 lac). This reflects in productivity also wherein both meat production (7.4 lac kgs vs 112.1 lac kgs) and wool production (0.89 lac kgs vs 32.75 lac kgs) has improved. Despite of these improvements, the sector is not able to meet the requirement of ever-growing human needs and most of the animals are imported from other states. This attributes largely to the reason that sheep rearing is in the hands of traditional rearers (lower strata) mostly practicing low input low output production system wherein expected progress is slow. Only a few breeders who readily accept modern technologies owing to better incentives/ profitability in this sector are involved. These breeders need immediate attention for meeting the requirement of elite male germplasm for augmenting production and productivity of sheep with traditional breeders. Keeping in view the available resources (tapped and untapped) and the value chain involved in this sector, it holds promise for transforming the weaknesses into opportunities for primary, secondary or tertiary occupation. Further, commercial farming can help in meeting the ever increasing demand in the near future wherein entrepreneurs need to be acquainted about the sustainability of this sector. Value chain is important to enable improved understanding of the various elements and stages from production to

consumption systems. This chain of processes shall generate employment opportunities and entrepreneurship development wherein a part from conventional rearing of sheep, the opportunities will be provided by production and processing of feed and fodder, value addition of products and byproducts, product diversification, reviving of cottage industry etc.

Economic analysis of the sheep farming apprises about cost-benefit ratio, minimum flock size for optimal production, availability of resources and value addition of products besides marketing strategies so as to encourage and boost the sector on commercial lines. Economics determines all the aspects involved from purchase of farm animals to sale of products and byproducts. It can be a helpful tool for policy makers besides other stakeholders to frame policies in this regard. Flock size economics provides an insight view regarding the minimum strength needed for meeting the nutritional/ economic security of farmers.

^ study, under field conditions, was conducted on economics of sheep farming in Bandipora district (northern Himalayan region of India). Results are presented in Table 1 and 2. Assumptions were as under:

a. System of rearing: Varies with the locality. The calculations in the table have been done assuming the following system of rearing which is prevalent in the northern Himalayan region of the country.

Months	Duration (Months)	System of rearing	Feeding options
Dec.-Feb.	3	Intensive	Commercial feed and Fodder(Hay)
March-May	3	Semi-intensive	Grazing in community pastures
June-Nov.	6	Extensive	Grazing in highland pastures

a. Breedable animals purchased at 2 year age @ Rs 10,000/animal and culled at 7 year age @ Rs 8,000/animal

b. Annual depreciation on animals calculated on the basis of decrease in the sale price of the animal from purchase till culling divided by the number of years reared (i.e 10000-8000/5= Rs 400/animal/yr.)

c. Cost of the construction calculated in the field conditions on the actual inputs wherein the kacha type ordinary shelters predominate. Annual depreciation on buildings calculated based on the average life span of different types of buildings.

d. Feeding of concentrates @ 500kg/adult animal/day and dry fodder @ 1kg/day/adult animal during winter months.

e. The cost of commercial concentrate was Rs 2000/quintal and dry fodder Rs 1600/quintal. However, the rates are subject to market variation.

f. Conception rate = 90%

g. Manure not sold but utilized as manure

h. Labour: Family type

i. Land: owned

j. Sale of lambs @ Rs 200/kg live weight at 6-8 months age

k. Sale price of wool Rs 100/kg with an average production of 3.0 kg per animal/year and 1kg/animal/yearling/yr.

Table-6: Tentative estimate of expenditure and income components in sheep rearing (Mutton as main product)

Category	Variant	A*	B	C
Housing costs (Rs)	Construction costs	13792	15959	20588.08
	Depreciation (A)	689.61 (0.92)	797.97 (0.52)	1029.40 (0.35)
Cost of animals (Rs)	Cost of animals	146742	274366.86	521944.44
	Depreciation (B)	11012.5 (14.67)	20605.92 (13.47)	39238.89 (13.46)
Recurring cost (Rs)	Concentrate (c)	20599 (27.43)	49925.68 (32.62)	87983.33 (30.18)

	Dry fodder (D)	34327 (45.72)	68406.81 (44.70)	135260 (46.40)
	Labour (E)	6213.24 (8.28)	9117.16 (5.96)	21775 (7.47)
	Miscellaneous (F)	2242.28 (2.99)	4178.70 (2.73)	6193.88 (2.12))
Total cost (Rs)	(X=A+B+C+D+E+F)	75083.63	153032.24	291480.5
Income (Rs)	Sale of lambs (G)	83111.36 (76.22)	166052.66 (75.40)	361419.17 (77.91)
	Sale of culled stock (H)	15919.12 (14.60)	17130.18 (7.78)	32500 (7.01)
	Sale of wool (I)	3708.65 (3.40)	6656.19 (3.02)	13876.24 (2.99)
	Value of additional lambs retained (J)	6297.81 (5.78)	30396.07 (13.80)	56110.14 (12.10)
Gross income (Rs)	(Y=G+H+I+J)	109036.94	220235.10	463905.55
Net income (Y-X)/year		33953.31	67202.86	172425.05
Net income/Year/animal		1787.01	1920.08	2652.69
Net income/month		2829.44	5600.23	14368.75
Benefit: cost ratio		0.45	0.44	0.59

*A=sheep units with a flock size of 0-30 (average 19 ewes+0 rams), B= sheep units with a flock size of 30-60 (average 34 ewes+1 rams, C= sheep units with a flock size of > 60 (average 63 ewes+2 rams). Figures in parenthesis under costs and income are percentages w.r.t gross expenditure & gross income, respectively.

Entrepreneurship as a function involves the exploitation of opportunities which exist within a market. Entrepreneurs risk and invest their own capital into the business and industrial-ventures. One such entrepreneur (Agripreneur- Entrepreneur in Agriculture activities) is highly successful in Sheep farming. His name is **Hilal Ahmad Yattoo** R/o Chandehama, Pattan and his success story is as:

Flock strength Previous year	70	
Present flock strength	80	
Birth wt		
Wool yield/adult	4-5 kg	
Sale price of 3 to 4 m weaners	35000 – 40000	Avg. wt 35 kg
Wt. of 9 m male weaner	80 kg	
Wt. of 2 yr old male	130-140 kg	
Adult females wt.	70-80 kg	
Income	**Total cost (Rs)**	**Av. sale price of sheep (Rs)**
Total sheep sold (48)	**11 lac (approx.)**	Approx. 23000
Expenditure		
Feed cost (maize, wheat bran	1.5 lac	
Fodder self grown	0.5 lac	
Medicine & Miscelleneous cost etc	0.5 lac	
Labour	1 lac	
Total Expenditure	**3.5 lac**	
Net returns (per annum)	7.5 lac	
Net returns (per month)	62,500	

Feed and fodder cost accounts for more than 70% of the cost of expenditure on raising small ruminants. On an average, the cost of feeding during winter for adult ewe is approximately Rs 1600 to 1800 for dry fodder and Rs 1000-1200 for concentrate. Fodder cost can be reduced if there are chances of growing fodder by the farmer himself/herself.

Sheep units *average* 34 ewes+1 ram; *and average* 63 ewes+2 rams seems viable for startups for providing livelihood and food security.

Sheep units *average* 19 ewes+0 rams may be viable as subsidiary occupation

Similar study in Anantnag and Pulwama districts revealed viable startup units of **28 ewes + 1 Ram** and **29 ewes +1 Ram** with net return per month Rs 5261 and Rs 6021, respectively.

There is immediate need to replicate such farmers/breeders for meeting the demands of the region. Such model farmers need to be identified and projected in the region for developing competitiveness among stakeholders and for start-up new business units on commercial lines.

Need of the hour for economising and development of sheep sector in Kashmir:

1. Wide variability (adult weight 30 to 120 kgs) existing in sheep flocks needs to be exploited for breed improvement. Identification of the farmers/breeders with elite germplasm and its dissemination among traditional farmers can be taken on priority. Registration of farmers and performance evaluation of germplasm needs to be undertaken at district levels and subsequently this elite germplasm needs evaluation under farm conditions and its improvement through Open Nucleus Breeding System (ONBS). This can help in regular supply of elite germplasm for breed improvement under field conditions. There is immediate need to conserve and preserve the indigenous germplasm which should be the baseline for breed development. Further, to augment production and productivity of sheep, government farms need better infrastructure and optimum human resource. Each Government sheep farm should have its own unique identity and importance for which following plausible changes if possible may be considered.

    a. One/Two farms may be exclusively kept for Kashmir merino sheep (Dachigam/Khimber and Daksum)

    b. Zawoora farm for Corriedale sheep

    c. Goabal for Fec B sheep

    d. One farm may be allocated for elite germplasm procured from the field and maintained through ONBS

    e. One farm for local germplasm (Gurezi and Karnah breed)

    f. One for Research and Development for breed development

    g. One farm exclusively for Rams of different breeds; Rams from this farm shall be supplied to different farms and sheep rearers at the time

of breeding only

2. Winter remains the most limiting factor in economizing sheep rearing in this region when compared to other parts of the country. Out of total cost of production around 70% is the share of stall feeding undertaken during winter months. This is another reason for low performance at farmers level with less resources (landless and marginal farmers). Farmers with better resources meet this requirement from home grown feeds and fodders and are thus more successful as the cost of production is reduced in such instances. A comprehensive study regarding availability of CPRs (Common Pasture Resources) and nutrient bio-availability from these CPRs needs to be taken for strategic development of this sector. Concept of fodder banks and different nutritional technologies need to be adopted to meet the challenge.
3. Kashmir produces around 32.75 lakh kgs of wool which normally goes unnoticed as the demand of wool is decreasing. There is varying level of sickness in woolen sector which further impedes development of this sectçr. Wool board and Handloom sector of the valley need to revamp their activities and diversify their product range depending upon the quality of wool and market demand. They should offer competitive price to the producers so that they are not forced to sell the same at throwaway prices. Otherwise every district should have its own collection centre and wool processing unit for making this business more lucrative. There is also need for developing/revival of cottage industries for product development/ diversification at the producer's level through NGOs, SHGs, FPO and government initiatives.
4. Economic activities of this sector can go beyond production of meat/wool for the consumer market. In order to boost this sector every step involved in its value chain needs to be strengthened and investors should be acquainted about such economical activities to generate employment and entrepreneurship opportunities with active involvement of Government agencies. Some of the areas wherein there is scope for entrepreneurship development are as under:

a. Sheep farming as an enterprise
b. Establishment of shearing units
c. Wool processing units
    i. Felting unit
    ii. Scouring unit
    iii. Product diversification/development units
d. Revival of cottage sector
e. Meat and meat products
f. Slaughter Houses
g. Composting/ vermicomposting units
h. Establishment of feed mills
i. UMMB, Fodder block units

5. Marketing is mainly informal in Kashmir region wherein farmers are exploited by the middlemen/ commission agents; the reason for less returns to the farmer. Need of the hour is development of proper marketing channels for better remuneration to the farmer as per his cost of production. NGOs, SHGs, FPO and government initiatives can help in price fixing so that farmer gets the best share in demand driven market.

Addressing Shrinking Fodder Resources

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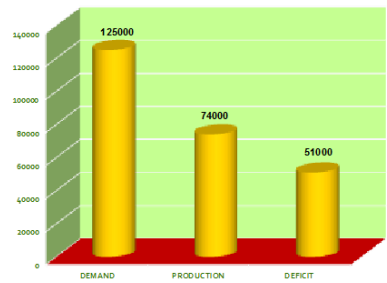
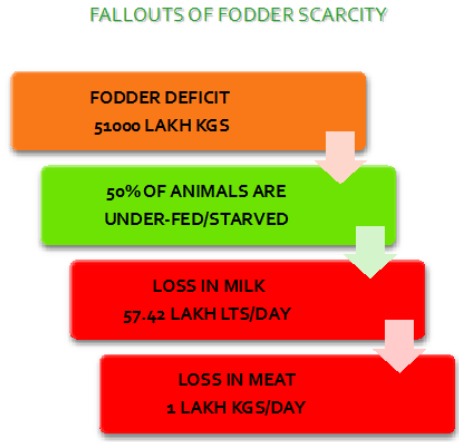
Feed and fodder resources and their quality determine productivity and profitability in any livestock sector. Fodder is the single largest recurring expenditure accounting for 60% to 75% of the cost of production. Over the last three decades livestock development programs have been directed mainly towards satisfying the rapidly increasing demand for milk, meat and fiber with special thrust on breed up-gradation. Meager efforts have focused on addressing grazing and fodder shortages. Appropriate technologies to improve locally available fodder resources did not receive desired attention. Crop residues, dry grasses and tree fodders that form bulk of fodder resources are deficient in critical nutrients. Average land holdings in the state are small. Therefore, crop residues are no longer proving sufficient to feed the existing animal population. This conclusion reaffirms the significance of what has long been an acute problem. In seeking to optimize the productivity of animals, it will be necessary to make full use of available fodder and feed resources.

PRESENT STATUS OF FEED AND FODDER ANNUALLY



The average annual requirement of fodder for all the three regions (Jammu, Kashmir and Ladakh) for livestock population of 92 lac on dry matter basis is 12,5000 lac kgs whereas the availability is 74,000 lakh kgs. This means there is deficiency of 51,000 lakh kgs. The UT has been bereft of policy for the development of this sector. This directly impacts growth. Due to fodder scarcity, the genetic potential of animals both large/small is not exploited fully, resulting in losses of 57.42 lac litres of milk per day and1.5 lac kgs of mutton per day from the existing livestock population. In order to make the UT self-sufficient in fodder the area under cultivation has to increase from present 2 to 8% by bringing cultivable wastelands, fallow lands and orchard lands into cultivable farm.



Land Use Pattern

The total land as per the revenue documents (year 2012-13) is 2416 thousand hectares, which is divided into the following categories (as per the concepts and definitions prescribed by the Union Ministry of Agriculture):

- **Area Not Available For Cultivation**

As per the figures for 2012-13, area not available for cultivation accounts for 564 thousands hectares constituting 23.34% of the reporting area. The category consists of 252 thousand hectares (10.43%)

falling under land put to non agricultural uses and 307 thousand hectares (12.71%) under barren and uncultivable land. 5 thousand hectares (0.21%) is land under still water, marshy and waterlogged category.

- **Other Uncultivable Lands (Excluding Fallow Lands)**

This constitutes 13.41% of reporting area with 324 thousand hectares. Out of which land under miscellaneous tree crops constitutes 66 thousand hectares (2.73%), permanent pastures and other grazing lands with 114 thousand hectares (4.71%). 134 thousand hectares (5.55%) is culturally wasteland.

POTENTIAL FODDER RESERVES

CATEGORIES OF LAND	UNITS IN THOUSAND HECTARES
• PERMANENT PASTURES (Alpine, Subalpine)	300
• FOREST	658
• CULTIVABLE WASTE LANDS	134
• LAND UNDER TREE GROUPS	66
• FALLOW LANDS	126
• ORCHARDS	344
• LAND UNDER RESIDUES FROM (LEGUMINOUS, COARSE AND FINE GRAIN)	1039
• TOTAL AREA SOWN	1162
• AREA SOWN MORE THAN ONCE	417
• NET SOWN AREA	745
• AREA UNDER FODDER CROPS	30

- **Fallow Land**

The State has 126 thousand hectares (5.21%) of fallow lands.

- **Forest Land**

The Forest land constitutes 27.24% with 658 thousand hectares.

- **Net Area Sown**

The State has 745 thousand hectares net area sown. This indicates that proportion of area under agriculture in the State was 30.84% for the year 2012-13. Area sown more than once constitutes 56.11% of the net

area sown for the year 2012-13.

- **Area According To Village Paper**

Area according to village paper comprises the reported area or the cadastral surveyed area i.e. the area for which data on land use classification are available. The estimates of reported area are prepared by the village patwari. It does not correspond to the total geographical area of the state as the revenue department does not maintain the records which are not fit for habitation. The area maintained by the forest department also does not form part of the reported area.

- **Forests**

They cover the barren-line forests viz. the forests falling outside the forest area demarcated by the forest department for maintenance.

- **Land Put To Non Agricultural Uses**

It consists of entire land occupied by buildings, river, canals and other lands put to use other than agriculture.

- **Barren And Uncultivable Land**

It includes all barren and uncultivable land like mountains, deserts etc. Land which can not be brought under cultivation is also included under this category.

- **Permanent Pastures And Other Grazing Lands**

All grazing lands whether they are permanent pasture and meadows or not are categorized as permanent pasture and other grazing lands. It also includes the common grazing land in the village.

- **Land under Miscellaneous Tree Crop, Groves Etc.**

This constitutes the cultivable land which is not included in net area sown but is put to some agriculture uses. For example the land under thatching grasses, bamboo bushes and other groves for fuel etc. are not included under orchards, fall under this category.

- **Cultural Waste Land**

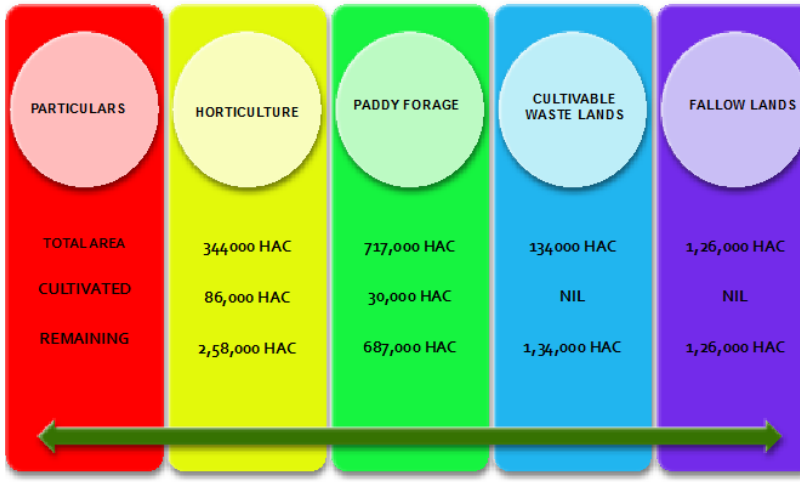
This includes land available for cultivation irrespective of the fact whether they have been taken up for cultivation or not or taken up for cultivation at once but not cultivated during the current year and the last

five years or more in succession for one reason or the other. Such lands may either be fallow or covered with shrubs are jungles which are not put to any use. These may be assessed or un-assessed and may be in isolated blocks or within cultivated holdings. Land once cultivated but not cultivated for five years in succession is also included in this category at the end of five years.

- **Fallow Lands Other Than Current Fallows**

This includes all lands which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years.

EXISTING LAND USE PATTERN FOR FODDER DEVELOPMENT



Jammu & Kashmir has an area of 344 thousand hectares under horticulture (both fresh/ dry fruits) in which 86 thousand hectares are already under grass cover, while as 258 thousand hectares of land are presently available for cultivation of temperate perennial legumes/ grasses as an intercrop in the orchards. If only 50% of the uncovered

horticulture land is being brought under the grass cultivation (Horti-pastoral Scheme), then 206.4 crore kgs of quality fodder will be available which can support 7.0 lakh animals annually. Similarly it has been seen that only 30 thousand hectares of land are under cultivation of Rabi Fodder (oats) out of the available area of 717 thousand hectares, which means that 687 hectares of land are available during rabi season. If only 50% of area is brought under cultivation of rabi oats, it can produce 274 crore kgs fodder, which can be fed to 9.4 lacs animals annually.

The UT of J&K has 134 thousand hectares of land under cultivable wastelands and if only 50% of the land is brought back in cultivable form by way of land development measures it can produce 107 crore kgs of fodder, which can grow fodder for 3.7 lac animals. The state also has 126 thousand hectares of land under fallow and it has been calculated that 50% of such land if brought under cultivation of fodder can support 1.7 lac animals.

In J&K UT cultivated fodder is grown in 30,000 Ha. Under proper management practices it can be increased to 1.0 lac Ha of the current fallow land available in rabi season from all districts of Jammu Division and Kashmir Division. In cultivated area seasonal annual fodder crop are grown in sequence to other crops, while perennial grasses/ legumes are sown under horti-pastoral system on field boundaries/ mends, terrace riser, contour ridges. Field of dry fodder (residues) in terms of paddy straws, wheat straws and maize stovers is less and green fodder production finds very little place in cropping sequence which is about 2.5% of grass cropped area of the state.

Pasture-Wealth

The alpine and sub alpine pastures of the North Western Himalayas are entirely used for grazing under migratory; semi migratory and sedentary system of animal rearing and these areas fall under demarcated forest area. The pastures of Jammu and Kashmir, which lie in sub-tropical zone of Jammu temperate, sub-alpine and alpine areas of Kashmir Division and Ladakh are also extensively used for grazing. The vegetation of tender pasture forage consists mainly grasses with an interspersing of legumes and other forbes. The sub-alpine pastures are

located at comparative lower altitudes and are available for a longer time of grazing. Forests surround these pastures and the grazing is a continuous process in both of these simultaneously or sequentially. During winter, the migratory livestock is stationed in lower-hills or plains while the semi migratory livestock is stationed on foothills. The long stretches having a dominant grass cover are found from tree line up to the snow line at an altitude of 3500 to 5400m. These are spread throughout the Kashmir Himalayas and well connected to the lower altitude by well-established bridal paths. The alpine pastures are located at higher altitudes. Hence availability for grazing is limited to about 4-6 months in a year. During rest of the period these are covered with snow. These pastures are available for grazing during the summer only.

JK has large geographical area under forest and has widespread pastures which support large population of domestic animals. Area under permanent pasture in the state as per the village paper is around 114 lac Ha. The sub-alpine and alpine pastures of Himalayas are unique biological entities. These are long, flat undulating or sloppy stretches of land covered predominantly with grasses, legumes and bushes. These pastures are variously known in different regions. In Pakistan and Kashmir these are called Margs or Behaks. Due to continuous and heavy grazing pressure, the pastures and forest area have deteriorated to critical levels. Overgrazing has resulted in a depleted vegetational cover.

Strategic Interventions In Fodder Development

At present there is a fodder deficit in JK and much dependence on grazing. However there is considerable potential available to meet part of forage requirement by continuing grazing and by cutting and lopping of green fodder (stall feeding) from plantation and grasses legumes and fodder trees from the land presently lying waste.

A scientific land use pattern suggests that the land resources be used on the system of land capability classification. On this pattern our waste lands (whether these are under croplands forestlands or grassland village common lands and road side lands etc.) have a serious limitation of slope stoniness and soil depth etc and are presently in the process of denudation and degradation due to over grazing and deforestation as part

of natural process of erosion. Major part of waste lands fall in these categories and hence recommended use is for permanent vegetative cover such as plantation of fuel, fodder, timber species of trees grasses and legumes, fodder bushes under three tier system with suitable combination. Such land use improves infiltration rate in soil helps in adding large quantity of organic matter and plant nutrients to soil, reduces peak rate of runoff etc. This system would besides conserving soil and moisture meet the requirement of forage for livestock and plant based occupation to the people living around.

Technology Interventions

For developmení of grassland to increase the productive potential we need to take following steps:

- Continuous contour ditch of 20 cm x 20 cm size to be formed 2 meters apart.
- Planting tall grasses with rooted slips like Napier (*Pennisetum purpureum*) or Guinea grass (*Panicum maximum*) or Pigeon grass (*Setaria sphacelata*).
- Dina nath grass with seed on the side of the ridge and sowing of perennial legumes on top of ridge.
- In the inter-space between two trenches dwarf grasses may be planted at 50 cmx50 cm spacing with rooted slips or sowing of seed of these dwarf grasses may be done @ 5 kg/ha. This will also help in mixed feeding of grasses along with legumes to animal as feeding with pure tall grasses is not advisable, since these are rich in oxalates.
- Cutting schedule of this flora may be done in May/June August and October. In case of hay making, only one cutting may be taken in October when legumes also shed the seed for successive germination. This technology yields in the range of 400 to 800 qtl/ha.

Development Of Waste Land Through Silvi-Pastoral System

- Continuous contour ditch of 30 cm to 30 cm x 20 cm may be formed at 4m apart for planting trees like *Grewia optiva*, *Albezzia lebbeck* at 2 meter apart in the trenches having pit of 1.1/2 x 1.1/2.

- Tall grasses may be planted on the side of ridge and legumes on top of ridge.
- Fodder trees will be cut at a height of 0.75 m every year during winter (November - December), since these plants have enough copping.
- Grasses and legumes be cut in October for hay. However, to further increase the tonnage of forage tall grasses can be planted in trenches of 20 cm x 20 cm at 2 meter apart in between tree line and sowing dwarf grass in intra space of 2 meter.

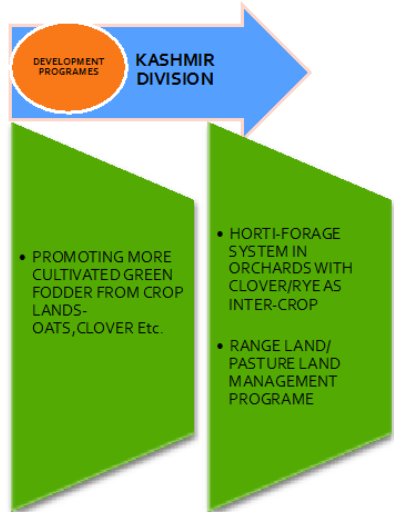
In areas where snow is experienced, same model may be adopted having fodder trees like *Salix*, mulberry and grasses like cox-foot, lolium, timothy or tall fescue, legumes and red clover, white clover or vetches. Under three tier system, fodder bushes suited for different altitudes can also be introduced. It may include garna for kandi, wood forbia for intermediate belt and the barberries and rubus for temperate and sub-temperate belt.

Strategic Intervention: Kashmir Division

Since the sub-division Kashmir falls in the tropical-zone, the following interventions are proposed to achieve the vision of self-sufficiency and surplus in fodder development in this division:

- To support crop livestock systems and promote small herd of cows/cattle to the valley farmers; projects promoting quality fodder production as alternative crop in winter months has good potential. It requires supply of good seed supply of fodder. Thus, projects promoting more cultivated green fodder from crop lands - oats, clover, etc. are recommended.
- Projects on using orchard lands for developing pastures/meadows underneath are recommended. These can be used as grazing area for cattle, for haymaking or for silage making.

FODDER DEVELOPMENT PROGRAM IN KASHMIR DIVISION



- Project on improving income of small farmers fourfold through small dairy. It is possible by promoting two products, milk and manure-compost for cash income (example - small dairy farming for milk and manure by Shiwalik farmers of Himachal Pradesh).
- Rangelands/ Pasturelands program. Nomads make use of highland pastures in summers and moving to scrub lands of Jammu in winters. Addressing their problems would require, participatory *Research Projects* on technological innovations for summer pasture improvement and winter grazing area- rangeland improvement program.

Fodder Policy

For a comprehensive policy for the fodder development in JK and Ladakh, the following initiatives need to be taken on sustainable basis.

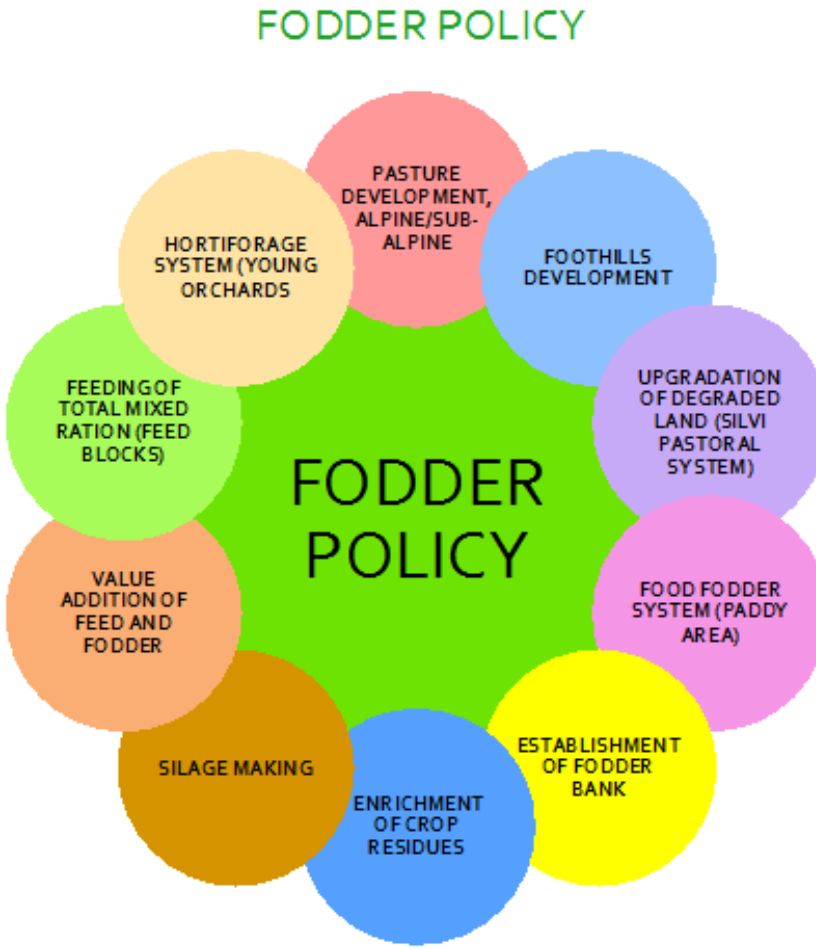
A detailed study on native pasture has to be carried out at various sites and altitude with the following objectives:

- Study needs to be conducted in selected pasture in Jammu, Kashmir valley and Ladakh based on micro agro-climatic zone. Survey studies for bench mark status of pastures, grazing lands and other fodder

resources.

- Studies on distribution of pasture flora and their ecological status through the study of plant succession under natural habitat.
- Ecological life history of major grasses and legumes and preparation of phonological charts and germination calendar of the species.
- Studies on various improvement parameters like weeding, seeding and fertilization so as to serve as demonstration plots for actual users who will be associated with the programme.
- Mapping of forest cover in the terms of intensity and vegetation using remote sensing technology.
- Studies on soil status of pasture.
- Studies on vegetative cover, plant density, biomass production of various pastures in selected areas.
- Studies on carrying capacity of alpine and sub-alpine, low land and other grazing areas for this purpose 20 hectare of pasture land in each micro climatic zone needs to be taken for the study, enclosed and divided into 6 plots of equal size for animal studies.
- Studies on stocking density, livestock composition and animal health under all system of grazing.
- Studies on pasture growth patterns and seasonal changes in herbage availability.
- Studies on migratory pattern of livestock.
- Introduction of cut and carry system for low land pastures.
- Soil nutrients improvement.
- Reseeding.
- Grassland management along nomadic routes.
- Weed control.
- Propagation and introduction of high yielding verities.
- Development of strong linkage between stakeholders.
- Integration of forage and livestock resources.

- Awareness programme.
- Regeneration of degraded range and forest land.
- Learning and capacity building of field functionaries



Crop Residue Processing

Large quantities of crop residues, tree leaves and jungle hay are available and most of these resources are fed to livestock without processing as a result large quantities of this valuable material is wasted. In a pilot study it was observed that 30% of straw, 15 % of hay, 50% of maize stover and 30% of top fodders are lost as farmyard waste. Secondly, these resources are poor in their nutritive value and serve as bulk rather than energy feeds. Available processing technologies have the potential to ease out the shortage to a substantial extent.

Silage Making

Farmers in general, especially in the valley, conserve forages through sun-drying. Oats is one major forage crop grown in the valley and is harvested in the month of May, which mostly remains wet. The season also coincides with the paddy transplantation, which leaves no choice for the farmers but to remove the crop from the field on emergent basis. As a result huge quantities of the biomass are lost due to spoilage through putrefaction. Silage making is an all weather process of forage conservation with added advantages of nutrient conservation and reduced losses.

Development of Degraded Lands Including Foothills

Under this program, degraded foot foothills will be upgraded by the introduction of indigenous and exotic varieties of grasses and legumes without disturbing the fauna and flora. The land available after development shall be taken up for further use by the departments.

Horti- Pastoral System

UT of Jammu and Kashmir has an area of 2.15 lac Ha under fresh fruits. The area can be utilized for sowing of temperate perennial legumes/grasses (red clover/rye) as inter-crop which helps in the production of huge fodder and will help as production of fruit due to more pollination. This horti-pastoral system will also solve the problem of creating grass cover for spring/autumn grazing.

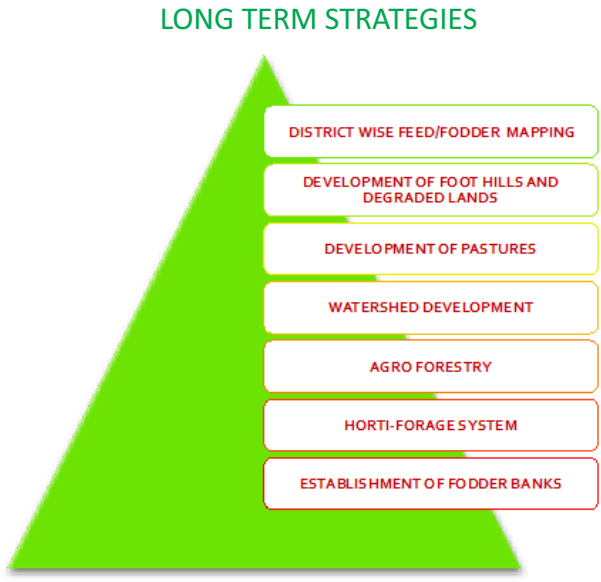
Strengthening of Forage Seed Production Chain (Forage Seed Availability)

Adequate quantity of quality forage seed production and or supply at farmers, door is the key to increase fodder production in the stipulated farm land for the livestock owners. Establishment of seed villages and cooperatives for procurement and distribution of fodder seeds is an essential step to bridge the gap.

Establishment of Fodder Banks

As a general state of affairs in the hills and mountains there are peak seasons of green biomass availability during summer followed by severe shortages during winter. Establishment of fodder banks is aimed at supporting the livestock with feed and nutrients during scarcity of winter at higher altitude areas, when pastures are covered with snow. At such places fodder banks store surplus forages and serve during periodic scarcity.

Long Term Strategies



Nutritional Status of Locally available Feed Ingredients and Feeding Practices for Small Ruminants in Kashmir Valley

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Livestock play a vital role in the lives of hundreds of millions of people in India. The vast livestock population has a large number of breeds of all species of farm animals with amazing genetic diversity. Small ruminants provide much needed livelihood support to the landless and weaker sections and hold considerable potential for commercialization. A stable sheep population in the last two decades produced around 40 million kg wool annually, of which only 4 million kg is of fine quality. Inspite of such an outstanding livestock wealth bearing superior germplasm, it is tragic to note that Indian livestock has low growth rate and production than those of the developed countries. The fall in production potential is probably due to poor nourishment or deficient supply of nutritious feeds and fodders and gene-environment interaction for many generations and management in unscientific way or conventional manner.

Chemical composition and nutritional status of feed resources

To meet the nutritional requirements of livestock, a precise knowledge of feedstuff composition is necessary. Such information is particularly vital when trying to achieve the high levels of production through the preparation of balanced diets for the animals. Knowledge is also essential in order to blend/mix the right proportions of various available ingredients for a balanced diet. Ultimately, knowledge of chemical characteristics and the nutritional profile of feed and fodder

used for livestock feeding pave way for enhancement in productivity and on-farm returns. Fodder tree leaves alone contribute 76.8% to state fodder resources, followed by paddy straw (11.5%), cultivated fodders (oats, maize, natural pastures, aquatic vegetations, other straws and stovers) altogether contribute 11.7% to state resources.

The composition of tree and shrub foliage reveals wide variation in the CP content, which ranges from 10.3% (*Malus sylvestrus*) to 21.3% (*Morus multicaulis*). The CP content of *Morus*, *Ailanthus*, *Robinia*, *Salix*, *Populus*, *Ulmus* and *Elaeganus* species is higher than 17% and comparable to common legume fodders like lucerene, berseem and cowpea. The CF varies widely among the foilages, lowest content in *Morus multicaulis* (12.6%) and highest in *A. indica* (23.06%). The CF content of less than l8% indicate that these foliages are potentially more digestible and better source of feed for livestock. Ether extract content varies from 2.5% (*Elaeagnus angustifulic*) to 7.6% (*Morus multicaulis*). NFE content varied from 40.1 (*Morus multicaulis*) to 55.2% (*Salix viminalis*). In general, all the tree leaves recorded more than 40% NFE, which indicated a high level of soluble carbohydrate. Hence, all the tree leaves besides proteins sources, can also be considered as a good source of energy. In a series of experiments carried at the Division of Animal Nutrition, FVSc & AH, Shuhama, it was revealed that the tree foliage cannot only fulfill maintenance requirements of small ruminants but also can support a reasonable growth besides being rich source of macro minerals (Table 1).

Table 1: Chemical composition and nutritive value of common fodder tree foliages of Kashmir

Top foliage	CP	EE	NFE	TA	NDF	ADF	Cellu-	ADL	%DCP	%TDN
Salix	17.44	2.85	50.25	10.44	55.30	35.89	26.23	9.66	6.28	56.48
Poplus	13.56	3.21	48.84	15.48	52.11	39.36	29.03	10.33	7.84	59.61
Kiker	19.78	5.81	47.77	11.20	44.70	26.80	17.79	9.01	15.43	66.74
Mulberry	21.25	7.60	40.09	18.46	33.10	23.04	13.94	9.10	10.16	66.10
Ulmus	20.44	4.02	46.37	12.00	55.30	44.00	32.34	11.66	12.35	65.75
Ailanthus	20.05	5.43	45.82	12.00	28.40	17.22	9.22	8.00	14.01	61.60
Celtis	13.18	4.44	44.93	21.22	46.78	35.10	23.70	11.40	-	-
Elaeganus	18.50	2.49	51.67	9.13	36.50	20.44	12.22	8.22	-	-
Asculus	16.11	2.95	44.55	13.33	35.60	20.50	12.10	8.40	-	-

The chemical composition of aquatic weeds including *Phragmites* and *Nymphoides* differ widely. DM contents are higher (20.5-40.0%) during August-September than May-June harvests (11.1-41.8%). The DM of *Phragmites elephantoides*; however, do not vary (40.0-41.8%). Aquatic vegetation of *Nymphaea* spp. seems highly nutritious as revealed by proximate analysis (CP 19.4, NFE 55.4 and total ash 11.7%). Although the nutritive values of *Carex* spp. and *Phragmites* spp. are no comparable with *Nymphaea* spp., yet these are far better than traditional feeds and fodder offered to livestock in Kashmir. In spite of high ash, lignin and low cellulose, hemicellulose, ADF and NDF contents, higher IVOMD have been observed in *Nymphoides* spp., probably due to the high CP and NDF soluble contents. Possibly the high NDF-soluble content gave better nutritive value in *Nymphoides* and hence is preferred for feeding the livestock. Among the aquatic fodders, small ruminants usually prefer only *Phragmites* spp. and *Echinocolla* spp. which are good source of protein and energy.

All the feed ingredients (roughages as well as concentrates) are good sources of Ca. Roughages contain P content below the critical concentrations whereas concentrates contain P in adequate amount. Almost all the feeds and fodders contain adequate Mg. Roughages and rice bran are poor sources of Zn whereas other concentrates contain

adequate Zn. Except paddy straw and rice bran, the available feeds contain adequate concentrations of Cu. All the feed ingredients contain high content of Fe. P and Zn supplementation of livestock feeding on such feeds is important as these two mineral elements are not found in adequate quantity to support animal requirements. Lactating, dry and pregnant sheep are deficient in Ca. Only dry sheep are deficient in Zn. Therefore sheep generally contain adequate levels of different mineral in blood and need only Ca and Zn supplementation for normal growth, health and productivity, while as wool breeds require supplementation of Cu as well.

Feeding practices of small ruminants

Feeding of tree leaves (dry), paddy straw, sun cured dry wild hay/paddy field herbage (*lowe* grass) is the common traditional feeding practice of sheep farmers (marginal farmers and landless labourers) during late autumn, winter and early spring season (November to March). Maize stover as source of roughage is secondary choice of feeding to small ruminants; however, wild sorghum hay is well relished by small ruminants during these lean periods. A small proportion of progressive farmers offer cultivated fodders and crop residues/horticultural waste besides small quantity of concentrates to their small ruminants. Acceptability of *Iris kashmeriana* in sheep improves only after sun-drying as winter fodder. From April to May animals are left to graze on natural hill slope and pastures around the villages (CPR's) while during summer season and early autumn (June-October) sheep are migrated to high alpine pastures. Pastures of the valley in general supply ample amount of macro and micro-nutrients in late summer and early autumn, but become deficient in proteins and energy and high in fibre and lignin that lowers their digestibility. Therefore sheep particularly weaners and hoggets need supplemental diets to be essentially fortified with mico-nutrients.

Grazing by small ruminants is usually practiced from late spring, summer and early winter season. Grazing and stall feeding in combination represents the choicest method of feeding. Since the region experiences severe winters and grazing is not possible during this period,

supplementation with concentrate feeds is resorted to sheep. Concentrate feeds offered to sheep are partly home-made and predominantly purchased from the market by the sheep farmers. Concentrate feed is prepared from crushed grain, oilcakes and agro-industrial by-products available with the farmers. However, certain sheep farmers are feeding only maize grains and/ or wheat bran. In addition, pregnant and lactating animals receive a separate ration of grain (200-250 g/day) when considered necessary. Commonly group feeding is practiced in the valley and the animals in general are not segregated and fed according to production status, growth rate, age or class of animal, although weaning was practiced by very few farmers. However, at lambing/kidding, the animals are given an additional supplement consisting of Jagari or warm soaked wheat bran/legumes. Feeding of silage and root crops (turnips/carrot) is not as common as practiced in dairy farming in some parts of the valley. In rural areas, animals are offered salt before the onset of severe winter (20th December) or after 15th February in a single dose. Mineral supplementation to sheep is very uncommon

Tree fodders form a major part of the diet to small ruminants during lean season and derive their nutrient intake from a variety of tree foliage (loppings of leaves, small branches and pods) including *Robinia pseudacacia* (kikar), *Salix viminalsi* (Veer), *Ulmus wallichinia* (Bren), *Populous deltoids* (Phres), *Morus multicaulis* (Tul), *Ailiantus altissima* (Alumthus/Alther) depending on the locality. The farmers collect leaves from their fruit orchards also and store for winter feeding. During the autumn season, the animal owners lops branches from desired trees, which is an additional duty attached to flocking. For large flocks, two or more people are required for herding and lopping. Flocks temporaêily migrate to other regions where ample feed resources are available. This reduces the demand for feed during the periods when shortages are most acute. Sheep flocks migrate for long distances (60-300 km) towards high alpine pastures during summer. The migratory system is adopted by nomads viz., Gujjars and Bakarwals/ village shepherds. Soon after melting of snow, migratory flocks reach there and graze the pioneer species which have not yet attained height of few centimeters. The downward movement of migratory flock starts in September and during this period

the edible pasture grasses do not get time to thrive, set seeds and dispose. Besides above major tree foliage some important shrub foliage viz., *Zizyphus jujube, Indigofera heterantha, Rosa webbiana Rosa brunonii, Berberis lyceum, Rubus sp.,etc.,* are some common shrubs available for browsing of small ruminants in the pastures of Kashmir valley, while as *Thymus linearis, Gnaphalium affine, Carpesium cernuum Cynadon dactylon, Lolium temulentum, Sisymbriuim officinale, Lespedeza cuneata, Trifolium pretense* and *Trifolium repens* are important grass species of pastures of Kashmir valley from which small ruminants derive their nutrient needs during grazing.

During lean season (December to March), the small ruminants (especially sheep) are confined to basements of houses, invariably stall-fed, and during which severe shortage of fodder are faced by the livestock owners both in quantity and quality. Paddy straw meets the bulk of the fodder requirements of the animals during the season followed by maize stovers. Further to overcome this shortage, they store "*lowe grass*" and "dried tree leaves" during autumn to meet bulk fodder requirements in winter. This is a unique traditional practice popular in Kashmir. Lowe (mixed grass hay), a sun-cured grass and rolled into ropes/bales, harvested from paddy fields bunds/orchards/forests, used for feeding in winter to all species of ruminants and is highly palatable for sheep. These roughage feed resources are supplemented with tree leaves for sheep and aquatic vegetation for cattle. Feeding of aquatic weeds at flowering stage especially to cattle during summer to autumn season is a unique and popular animal feeding practice in Kashmir. These vegetations belong to genus *Nymphaea*, *Carex* and *Phragmites* and are obtained from fresh water bodies (lakes) located in the suburban areas of Srinagar city and some plain towns of Kashmir.

Applicable Feed Technologies for Small Ruminant Production

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Livestock is one of the fastest growing agricultural sub-sectors, since the demand for livestock products is rapidly increasing with the rise of human economic status. Rising pressure of ever growing human population on one side and limited scope of increase in agricultural production on the other side advocates livestock husbandry component as the best possible way-out for rapid rural economic development. In Jammu and Kashmir, livestock sector alone contributes about 11% to the GDP.

Among livestock reared in the J&K state, sheep and goat are well suited as this region has a tremendous scope for its development since majority of the people are fond of mutton. Majority of local population (85%) are non-vegetarian. In this state, annual consumption of mutton is around 51,000 tonnes of which 21,000 tonnes are imported from outside. There is always great demand of meat and therefore sheep/goat farming in this region is always considered as promising. Besides, sheep and goat have excellent adaptation for utilization of wasteland and pastures, converting the same to high quality proteins in the form of meat and wool. Sheep are gregarious in nature and less prone to extreme environmental conditions prevailing in the valley during winters.

In Kashmir valley, sheep and goats are reared under semi-migratory management system. The tribal people (Bhakerwal, Changpa, Chopan) as well as the weaker section of the region are involved in traditional rearing

of sheep and goat for a subsidiary source of income. During lean period (October - March) when greenery perishes from the scenario of valley, animals are completely stall fed and are mainly offered poor quality hays (oats or jungle hay) /straws (paddy)/ stovers (sorghum or maize) as basal roughage diet with little (only 50-75g/day/animal) or no concentrate/compound feed leading to deterioration of their health and poor body score condition. During summer season when abundant lush pastures are available, animals are migrated to high land pastures (Margs or Behaks). The shortage of feed/fodder is more severe during winter season when most of the animals in this region are underfed. The price of transport and marketing add to the cost of production and the livestock produce face the stiffest challenge resulting in narrow inputs-output ratio and economic un-sustainability.

Need for technological intervention:

The alarming multi-dimensional nutritional crisis possess severe problem in meeting the nutritional needs of livestock and have made sheep/goat farming in the state very expensive due to drastic rise in cost of conventional quality roughages and concentrates. Hence, to overcome this scarcity of feed and fodder, the situation needs multi-fold approach *i.e.,* Identification and exploring the possibility of utilization of potentially available local animal feed resources.

- Improving utilization of available feed/fodder resources through technological intervention. Efficient utilization of locally available feed resources is the need of the hour to obtain the maximum profit from livestock industry. To economize the small ruminant feeding, many promising technologies have been developed so far, but for several reasons, some of these have not been adopted by end-users, especially those having limited finance and poorly skilled. The latest developments in this direction to exploit the potential of locally available animal feed resources in a better way are discussed here. These can make sheep farming an economically viable enterprise to fulfill the increasing demands of growing human population.

Complete Feed Block (CFB) technology:

Despite the availability of huge edible biomass during surplus

season, the transportation, handling and storage of these low bulk density roughages are un-economical. Under these circumstances, augmentation of feed and fodder utilization through complete feed system and feed technology like densification appears to be appropriate to provide adequate balanced nutrition to the animals for sustainable production. A complete feed block is defined as an intimate mixture of processed ingredients including roughage and concentrate parts designed to be the sole source of feed in compressed form. Complete feed block is a solid product containing roughage and concentrates in desired proportion capable to fulfill nutrient requirement for targeted production purpose. It may be square, circular or quadrangular depending on the type of dye used in the feed block making machine.

Advantages of feeding CCFB:

- Higher voluntary feed intake: complete feed block feeding improves dry matter intake in all species compared to feeding complete feed in mash form or conventional feeding by about 10-20%, thus reduces loss of valuable dry matter, thereby preventing environmental pollution too. Better nutrient utilization and growth performance: complete feed block feeding ensures intake of intended proportion of roughages and concentrates by animals, thus not permitting faster or selective eating of any individual feed ingredient thereby protecting rapid degradation of valuable dietary protein sources, besides providing better rumen fermentation environment with minimum fermentative losses.
- Economical aspect: in small ruminants, about 65-70% of dry matter intake is through roughages alone. Improved utilization of these low quality roughages is important because of the physical and chemical constraints that limit their uptake by animals. Also, they are available seasonally; hence their storage becomes necessary for use of these roughages during lean periods. Due to low bulk density (65-70 kg/cu mm), these roughage sources require large storage space and poses problems in handling, storage and transportation which becomes among major constraints in their feeding to livestock.
- Scope for incorporation of non-conventional feeds: livestock

productivity need to be economized by reducing the cost of feeding, which can be achieved by minimizing the use of costly conventional feeds due to incorporation of nutritious non-conventional but safe feed resources in concentrate or roughage component during preparation of complete feed blocks, thus does not facilitate selective eating by animals. Roughage: concentrate ratio can also be manipulated as per the targeted production purpose.

- Establishment of feed banks: storing feed in complete feed block form is highly useful in establishing feed banks for the benefit of farmers and solving the problem of feeding livestock during natural disasters like snow storms in the valley.
- Improved keeping quality of feeds: crop residues, fallen tree leaves, shrubs or grasses and other forest wastes after harvesting are stored conventionally either on tree tops or ground where these precious nutritional resources are exposed to vagaries of weather. There is shattering of lighter leafy nutritious matter, leaching by rains, mould growth, decomposition of biomass and fire hazards that drastically reduces their nutritive value. Feed block making prevents disintegration of valuable nutrients and thus is a simple and efficient technique for long term conservation of animal feed resources.
- Balanced feeding: feeding of complete feed blocks reduces problems of nutrient deficiencies in livestock fed on poor quality feed resources by allowing a synchronous and fractionated supply of all essential nutrients for attaining maximum production potential.
- Pasture management: complete feed block feeding under stall feeding system serves as an alternative to grazing and supplementation feeding strategy for sheep production, especially where pastures are highly eroded and need resting for regeneration or curing.

Urea molasses multi-nutrient block (UMMB) technology

In developing countries, ruminant diets principally comprise of poor quality crop residues, which are not only deficient in nitrogen, minerals and vitamins, but also have poor digestibility due to presence of anti-nutritional factors like lignin, silica etc. in them. UMMB are lick blocks

containing urea, molasses, vitamins, minerals and other multi-nutrients. The feeding of the blocks is a convenient and inexpensive method of providing a range of nutrients required by both the rumen microbes and the animal, which may be deficient in the diet.

Advantages of feeding UMMB:

- Higher total dry matter intake: DM intake significantly increases due to UMMB feeding on straw based ration. Conventional feeding system practiced in the rural areas where growing animals (calves/lambs/kids) are fed solely on poor quality crop residues as roughages and a small amount of poor grade concentrate is not satisfactory. Feeding value of these poor quality roughages can be improved through supplementation with UMMB that also leads to better nutrient digestibility and utilization by the animals.
- Better animal performance: The positive effect of UMMB intake on overall performance of an animal will be more pronounced on a low plane of nutrition, i.e., a crop-residue or straw-based diet. There occurs improvement in growth and production of animals due to UMMB supplementation. Animals attain maturity at an early age and cost per kg gain is reduced by feeding UMMB to the animals. UMMB supplementation leads to significant improvement in body condition and reproductive performance as well as an overall increase in milk yield thereby generate better returns at the village level on farm produce.
- Longer storage of feeds: UMMB has longer self-life on storage at dry place, thus is meant for long term conservation of animal feed resources
- Simple and efficient technique: Ingredients used for UMMB formulation are easily and cheaply available, besides the methodology for its preparation is very easy.
- **Cheaper:** Density of UMMB is much higher than the ingredients used in its formulation, which facilitates long distance transportation, storage and handling at a cheaper rate. Also, UMMB is much cheaper than the conventional source of intact proteins (oil cakes)

- **Safer:** Licks are hard enough to control gradual intake limited to about 700 g/day in adult bovines and 100-150 g/day in adult ovines/caprines. It releases the urea nitrogen more slowly and frequently so as to minimize the chance of ammonia toxicity.

Area-Specific Mineral Mixture (ASMM) supplementation

Providing ASMM, based on the deficiency of minerals in soil, plant and animals in different agro-climatic zones is most appropriate and cost effective method of mineral supplementation. The approach of free choice mineral supplementation could sometimes lead to deleterious effect, as some of the minerals may be available in excess than requirements affecting utilization of other minerals, like excess of selenium affecting sulphur utilization, excess of molybdenum and sulphur reducing copper absorption and excess of iron disturbing copper metabolism. The method of supplementing only the most deficient minerals through ASMM by assessing the mineral content in soil, feeds and fodders and in animals in different agro-climatic zones appears to be the best approach. This approach has been found to improve the reproductive efficiency and health in crossbred cattle under field conditions and this technology has been successfully replicated.

Feeding of bypass nutrients

In ruminant animals, most of the feed nutrients ingested are degraded by microorganisms present in the rumen at varying degrees /proportions. Bypass nutrients mean the nutrient fractions, which get fermented at a lower degree in the rumen, becomes available at the lower part of the gastrointestinal tract for the subsequent digestion and absorption. In addition to this, the bypass nutrients provide a steady supply of nutrients instead of providing all nutrients immediately with sudden bursts from easily soluble nutrients. Initially the concept of bypass nutrients was used for proteins to describe the protein quality of ruminants, but subsequently this term has been extended to other nutrients like carbohydrates and fats that could also escape rumen fermentation partially and digested and absorbed in the small intestine. These concepts are useful not only

for better utilization of nutrients but also minimize the ruminal fermentation losses thereby reducing the wastage of nutrients into the environment.

In ruminants, protein digestion is dominated by microbial transformation in the fore stomach. A varying portion of feed protein is degraded into peptides, amino acids and ammonia, all of which can be used for synthesis of microbial protein. Microbial proteins and non-degraded feed proteins are digested in the lower tract. Dietary proteins that resist degradation in the rumen and pass to lower tract are called bypass proteins. Inclusion of higher level of bypass protein in the ration of ruminant animals improves their performance in terms of milk production and growth under the Indian conditions of feeding and management. It is observed that the feeding of bypass protein is even beneficial for medium production animals, although the benefits could be more pronounced on high producing animals.

Under traditional feeding practices on grazing resources alone, lambs achieve only 40 to 50 g average daily gain during active phase of growth and attain market weight of 20 to 22 kg at 9 to 12 months of age. Besides proteins, lambs require high energy to support faster growth. Feeding higher level of concentrate to lambs increased feed intake and live weight gain. It is presumed that fortification of concentrate with fat supplementation would increase energy content and improve growth at similar intake levels. Inclusion of fat in ruminant diets improves energy efficiency due to direct use of long chain fatty acids in the metabolic pathways of fat synthesis without the need for acetate and glucose.

Dietary inclusion of novel feed additives

These are the compounds that are added in the diet of livestock in order to ensure additional benefits either from production point of view or towards improvement of quality of livestock products. Due to public concerns regarding accumulation of various residues of different feed additives like antibiotics, arsenicals, hormones etc. in animal derived food products and in the environment has led to the ban on use of such additives in animal feeding since January, 2006 by European Union. This has forced to search for the alternative feed additives as discussed below:

Enzymes

Application of exogenous enzymes is used in animal production to promote growth, efficiency of nutrition utilization and reduce nutrient excretion. Phytase improves growth and enhance P utilization. Non-starch polysaccharide hydrolyzing enzymes are less consistent in their effects on growth and nutrient utilization although they show promise and it is imperative to closely match both types and amounts of non-starch polysaccharides with appropriate enzyme for beneficial effects. Exogenous fibrolytic enzymes act synergistically with the endogenous microbial enzymes promoting the overall fibrolysis and ruminant performance.

Probiotics

These are "live microorganisms, that when included in foods can influence the composition and activity of the gut microbiota, modulate the inflammatory response, improve the nonspecific intestinal barrier, and reinforce or modulate the mucosal and the systemic immune responses. Bacteria frequently utilized as probiotics are *Bacillus, Bifidobacterium, Enterococcus, Lactobacillus*, *Lactococcus*, *Streptococcus* etc. In addition to bacteria, yeast such as *Saccharomyces cerevisiae, Aspergillus oryzae* are also used as probiotics in the diet of animals.

Prebiotics

Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and or activity of one or a limited number of bacteria in the colon. The prebiotics are characterized by their non-digestibility at gastric levels, selective stimulation to the beneficial gut microflora, biological origin and obviously without any residue problems. Presently frugal information is available on the effects of prebiotic in ruminant animals. All the rumen hemicellulose degrading bacteria are capable to utilize xylooligosaccharides as growth substrate. These are *Butyrovibrio fibrisolvens*, *Eubacterium ruminantium*, *Ruminococcus albus* etc. Lower rumen ammonia nitrogen concentration in sheep was observed as a result of prebiotic administration, which may be due to the suppression of ammonia producing bacteria. Dry matter intake, nutrient

digestibility is as such not affected by prebiotic supplementation but showed higher nitrogen retention owing to increased microbial protein synthesis in rumen.

Essential oils

Essentials oils from various medicinal plants (herbs) are emerging as an effective feed additive to improve the quality of meats as it preserve the colour and protects from meat spoiling bacteria without altering the sensory features. Essential oils are effective towards improvement of meat quality when administered along with feed or sprayed while processing. It exhibits synergistic effects on inhibition of lipid oxidation in raw and cooked meat in case applied in conjunction with alpha tocopherol. The essential oils namely eugenol, clove, oregano are capable of increasing shelf life of meat by virtue of inhibiting the growth of *Listeria monocytogens, Aeromonas hydrophila* and several autochthonous spoilage microflora.

Recommendations for Promoting Sheep Rearing in Kashmir

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In view oÑshrinking agrarian economy (subsistence crop sector) wherein 91 percent of farm holdings (marginal and sub-marginal) with average size of holding declining from 1.61 hectare in 1953-54 to 0.65 hectare in 2010-11, the agriculture crop production sector emerges a losing proposition and focus need to be shifted to agricultural ancillary activities, like sheep, dairying, etc. In order to encourage sheep rearing, propagation and development, it is recommended that:

1. All government schemes and centrally sponsored schemes for sheep development and rearing be are put on government website updated every day.
2. The facilitation by the government need to be promoters-friendly with least minimum hassles. The requisite formalities by prospective promoters/entrepreneurs, to avail of scheme or facility, to be completed on-line.
3. The per capita red meat availability per day in Kashmir stands 6 grams or 2.18 kgs per annum. The government needs to establish cross-breed breeding farms at block level to facilitate prospective

promoters/entrepreneurs to establish rearing farms in the private sector.

4. There is an urgent need for effective connectivity between prospective promoters and government veterinary/animal healthcare centers with regular periodic visits by veterinary doctors to on-site farms.
5. The sheep rearing/development farms need to be given support system for automation for communication augmentation and marketing.
6. The delivery of sheep on festive occasions from farm-site to consume-site by effective and reliable transportation system need to be created.
7. Feed production and procurement centers need to be created in the private sector with adequate, effective and hassle-free support.
8. The networking of sheep-farms, with automation in place, is required for advertisement, pricing, transportation and marketing and to that effect the Sheep Husbandry Department has to play a lead role.
9. A special scheme needs to be put in place for centralized procurement and marketing of wool from the private farms with remunerative prices.
10. A coordination mechanism needs to be established between Government Woolen Mills and other wool processing enterprises in private and government sector.
11. The traditional woolen blankets, wool-textile with Research and Development need to be encourage and disseminated.

Economics of Sheep byproducts Industry in Kashmir

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Kashmir is a state full of pastures and meadows, very conducive for sheep rearing. Sheep are reared mainly for meat and wool purposes. The population of Kashmir is mostly non-vegetarian and chief source of meat is mutton. Every year roughly 30-40 lakh sheep and goat are slaughtered for meat purposes. Since total sheep and goat population of Jammu and Kashmir including Ladakh is 5.4 million 3.2 million sheep and 2.2 million goats, and therefore, cannot meet the requirements of meat thus, sheep are imported from other states of the country. Lot of by-products are generated during the process of slaughtering and dressing of sheep carcasses. These byproducts are both edible and inedible. Edible are processed into human food generating employment while as inedible except skin are not properly harvested and go waste.

In addition to those obtained after slaughter sheep yields wool, a valuable by product and sheep dung, an organic manure of choice for agriculture and horticulture crops and some breeds may yield surplus milk during their early lactation period. The byproducts are classified as edible and inedible upon their suitability or use as human food or otherwise. The meat and organs of condemned carcasses are inedible byproducts so are skin, horns and hooves and stomach and intestinal contents of carcasses which have been passed for human consumption. Basically, the term

byproducts and offal are used to denote very part and particles which is not included in a dressed carcass. Byproducts are obtained while the main product is processed or harvested. In meat industry main objective is to harvest meat from the animal but during this process lot of other things are obtained from the animal from slaughter to dressing of carcass.

These byproducts constitute a significant component of animal body (50-55%) and if used properly can give large economic benefits to the processor.

Byproducts: Heart, liver, lungs, intestinal tract, head, feet, ear, lips, trimmings, fleshings, horns, hoofs, feet, stomach and intestinal contents, urogenital tract, testes and mammary glands. Social customs and purchasing power of consumers may render an edible byproduct inedible and vice versa. People of lower income may eat intestinal tract, lungs testes etc while with the increase in the income people prefer meat and thus the organ meats may be sent for stock feed making.

Sheep by Products may be broadly classified as:

S. No.	During lifetime	Post slaughter
1	Wool	Skin and Wool
2	Milk	Head (Brain ,cheek meat and tongue)
3	Dung	Feet
4		Horns and Hoof
5		Liver
6		Lungs
7		Heart
8		Stomach (Tripe) and Intestines
9		Reproductive organs
10		Trimmings and Fleshings
11		Fat

Benefits of byproducts: Byproduct proÅessing has the following main benefits:

1. **Economic purpose:** The byproducts after sale will give good enough returns to the processor so that he recover same profits from the sale of items and which will reduce the pressure on recovery of costs and profits solely from meat. This will also benefit the consumer as the price of meat will be relatively cheaper now.
2. **Animal welfare:** Large quantities of condemned material such as parts of carcass or whole carcass can be converted into protein and mineral rich carcass meal, blood meal, meat meal and bone meal. This will help to provide better nutrition for livestock especially poultry and pigs and thus increase productivity and animal health.
3. **Human health:** The condemned material including surplus offal after proper treatment into meals will prevent pests, harmful insects, mice and bacterial growth in the premises and thus prevent spread of diseases to humans. Also, by converting condemned material into animal feed we prevent condemned meat being exchanged for meat passed as fit for human use.
4. **Prevention of Environmental pollution:** While collecting and storing byproducts and condemned meat hygienically and using them for preparation of various meals prevention of environmental pollution is achieved as no blood is allowed to flow in drains and offal is not scattered here and there to be used otherwise by dogs, jackals, rodents and insects and birds which can create a lot of pollution of water bodies, air and land surfaces. The off odours due to rotting of blood and meat are prevented by proper processing of byproducts.
5. **Employment generation:** Employment is generated as for processing of byproducts we need people and small industries will develop. For human consumption of some byproducts such as head and cheek meat and scalded feet, some butchers are exclusively doing this job. Further, women also earn while they do scalding of head and

feet. A trained workforce is required for running a byproduct plant.

6. **Better crops**: Waste material rich in Ca, P and N along with manure can be used to improve crop yield.

Percent yield of byproducts:

Item	Percent yield (%)	Item	Percent yield (%)
Dressed carcass	34-52	Blood	4-9(7)
Paunch contents	22	Feet	2
Skin	9.2(4-11)	Tongue	0.28
Stomach and intestines	8	Fatty tissue	2
Head	5.6	Lungs	1
Liver	1.2	Spleen	0.2
Hooves	0.8	Kidney	0.6%
Heart	0.4	Skirt	0.5%

Dressing percentage of lambs ranges from 40 to 55% depending on and whether shorn or unshorn and grade. Percentage of byproducts will be 46 to 60%.

Wool

Wool is obtained from the live animals in a significant amount after shearing which in the state is carried out twice a year. Yield depends on breed, age, size and nutrition of the animal. The state produces annually 70-75 lac kgs of wool with average 2.28 kg/sheep. Wool industry is well developed in our state. From shearing to spinning and weaving, lot of people get job. Wool was being purchased from doorstep of farmer by the Sheep and Sheep Products Board and other private agencies but now the government has disbanded the board. There are lot of artisans connected with the wool industry in the state who prepare woolen blankets, shawls and other woolen products and earn their livelihood. Women folk are engaged in spinning of wool. Although, changing professions and competition with the synthetic fiber, the wool industry has received a

setback. It is reported that due to lack of processing facilities the state is now exporting 70% of wool as raw wool.

Sheep Yard manure

The other byproduct of sheep rearing which is now gaining significant economic importance is the sheep yard manure. Sheep yard manure is rich in Na, k and P. It helps to provide important nutrients to plants and also helps in soil texture and water retention. There is a great demand for this product. On an average sheep produces 1-2.5 kg of dung in the form of pellets per day. Presuming that only half of it can be retrieved by the farmer because of loss of half of it during open grazing of sheep it can work out to be 6030MT per day. The cost of sheep yard manure is around Rs 17/cft.

Ewe Milk

Ewe milk is rich in nutrients and in early periods of lactation people have been using the ewe milk. Ewe milk produces quality cheese. A farmer with enough lactating ewes with single lambs may be able to collect and market a significant amount of milk which may fetch him additional income.

Edible byproducts sold in Srinagar

Many people are involved with processing and sale of edible sheep byproducts. The common edible byproducts sold by the street vendors in the state are head and cheek meat, tongue scalded and cleaned feet which constitute a delicacy and as well as provide a cheap source of palatable and nutritious food to the people of lower income groups. The head constitutes 5.6% of live animal weight while feet constitute 2% of live animal weight.

The cost of mutton in Srinagar is Rs. 600/kg whereas head meat is sold @ 300/Kg. The other viscera like liver and lungs are sold separately at reduced rates. The stomach and intestines are also sold at lower rates @ 120/kg. The sale of these byproducts helps to reduce the sale price of meat as it helps the butcher to spread the recovery of cost and profits both from meat and byproducts. The benefits get transferred to consumer as well.

Cost of meat and byproducts in Srinagar

S. No	Item	Cost Rs/kg
1	Mutton	600
2	Head meat	250-300
3	Scaled feet	150-170
4	Stomach (tripe)	120
5	Liver	200
6	Lungs	30/piece
7	Skin	50/piece

Edible Fat:

The trimmable fat which is obtained from the fit carcass is sold as such for use in comminuted meat products. The fat can also be used as a frying agent for meat and other foods.

Edible Bone:

Edible bones are good source of collagen which can be converted to gelatin. Small intestine.Catgut, tennis rackets, strings for musical instruments and suture material can be prepared from small intestines.

Sheep pellets:

Being rich in cellulose have been mixed with traditional pulp material to make paper.

Byproducts which can be prepared at cottage scale level:

These are sheep casings madefrom intestine and dried ruminal contents for poultry feed.

Casings

The small intestines of sheep and goat are converted to other byproducts such as casings for sausages, strings for musical instruments and catgut as suturing thread for surgical operations. Normally a sheep yields 90 feet small intestine while goats yield 75 feet.

Slime:

During the processing of casings, mucus and muscular layers of intestine after removal form a highly rich proteinaceous mass which is used as feed additive in poultry and pigs.

Collagen casings: are made from extracted collagen of Ram skin and extruded into casings which are used for bigger sausages and need to be peeled.

Ruminal Contents

Ruminal contents of slaughtered animals consist of digested feed materials which include broken down cellulose and large quantity of vitamins especially vitamin B complex and large ruminal microbes which are a source of protein. This material is a very rich dietary source and can be used as calf feed to help establish ruminal flora in 6 to 8 weeks old calf. In case of poultry feed, the dried contents can be used @ 10% to replace bran.

Composition of Dried Ruminal Contents

S. No	Item	Quantity (%)
1	Moisture	9.5
2	Ash	8.4
3	Crude protein	13.0
4	Fiber	27.5
5	Carbohydrate	36.5

Pharmaceutical byproducts:

Various biochemical compounds such as hormones or enzymes are extracted from various glands like pituitary, parathyroid, adrenal, adrenal, ovary, testes, lungs, liver, and intestinal mucosa. But most of these compounds are now synthesized. Blood is also used for these purposes. These materials must be collected from healthy animals and frozen immediately

Type of gland	Number of animals	Active ingredient
Pancreas	14-16	Insulin
Ovaries	500-700	Estrogen, Progesterone
Thyroid	80-120	Thyroxin, calcitonin
Parathyroid	1600	Parathormone
Pituitary	1500	GH, TSH, Prolactin, ACTH, Vasopressin, Oxytocin
Suprarenal (Adrinal)	150	Corticosteroids, epinephrine and nor-epinephrine
Bile (concentrated)	200-250	For preparation of corticosteroids
Bile (liquid)	20-30	For preparation of corticosteroids
Testes		Hyaluronidase
Lungs/ Intestinal Mucosa		Heparin

Sheep Skin:

Skin is the most important byproduct obtained after slaughter its use is in manufacture of clothes, footwear, rugs, material for sofas, bags, wallets, purses etc. and other products. The sheep slaughter in our state is estimated to be between 36-40 lac heads per annum. This gives us equal number of pelts. Pelts from fallen animals are in addition to this. Butchers were getting Rs 250/pelt which was far less than it was sold for. But from the past year butchers are complaining that they get only Rs 50/pelt now which is too low a price. The reason is some situation created by some

groups in the garb of ethics. This situation shall be reversed if the tannery is developed in the valley so that we can export processed leather at much higher price.

Secondary byproducts:

There are secondary byproducts which are obtained from primary byproducts they include casings, catgut and strings for musical instruments and tennis rackets from intestines and pharmaceuticals from the glands and tissues and organs. Lanolin from wool, composting of manure and production of methane gas for energy.

Byproducts as animal feed

The condemned meat and bones are converted to valuable animal meal such as meat meal, carcass meal and bone meal. Meat meal is rich in protein and vitamin B particularly thymine. Carcass has around 20% bones, so bone meal is obtained after rendering of bones and crushing them into powder to provide Ca and P. Quality of bone meal is determined by its P content. Bones contain organic and inorganic matter in the ratio of 1:2. Collagen or ossein is 33-36% of organic matter. Ossein or bone collagen is used for gelatin preparation. Desert bones are those bones which are collected from field where organic matter is lost due microbial action except collagen is dried and mineral matter remains there. Composition of bone meal is 15.1% P, 32.5% Ca and 7% protein.

The inedible fat:

The inedible fat rendered from the condemned carcasses is obtained anÇ used for soap manufacíure and lubrication of some machinery. The fats obtained after rendering of inedible meat and bones can be used for industrial purposes in candle and soap manufacture.

Blood meal:

Blood can be preserved by adding 1% Na pyrosulphite. Blood will remain fit for eating to pigs and poultry for 21 days at 20 C or 10 days at 30^{o}C. Blood (6-7% of body weight) is not collected and is wasted causing lot of environmental pollution and clogging of drains. This valuable byproduct can be used for human consumption, converted to blood meal

for stock feed or used for various industrial purposes. For pharmaceutical use and as human food blood is hygienically collected with special knives and equipment. Blood meal is prepared by rendering. It contains nearly 85% protein and should be free from fat, fiber and phosphorous. Blood meal yield can be up to 200gm/kg of blood as blood has 20% solids. The moisture level should not be more than 10-12%. A crude way of making blood meal is mixing blood with 1% by weight of unslaked lime (calcium oxide) and then drying. This will not spoil and attract no flies.

Meat meal:

This is obtained after rendering meat of condemned carcasses and parts. It should contain no more than 10% phosphoric acid equal to 4.4% P and not less than 55% protein.

Carcass meal:

When carcass is rendered and bones and meat are together dried and converted to powder form it is called carcass meal. It contains less than 55% protein and phosphorus content more than 4.5%

Bone meal:

Inedible bones from condemned carcasses are converted into bone meal for a mineral source for animal feed. Bones are also used for carved items, buttons and also used for glue and gelatin.

Liver meal:

It is prepared from condemned livers and should contain 27mg riboflavin per pound.

Composting of sheep fecal matter:

Sheep manure can be composted also for production of fertilizer. This has got very excellent water binding properties.

Production of methane gas:

Instead of composting methane gas can be obtained in a gobar gas plant by utilizing sheep manure for clean energy.

Lanolin (wool grease or wool fat):

Wool yoke wool wax is secreted by sebaceous glands. It protects

wool and skin from rain. It is used for human skin care and protection and beautification. It lacks glycerides (glycerol esters) so it is not a true fat. It contains sterol esters. It must not contain pesticides more than 40 ppm. Very pure lanolin is used for treatment of eczema and open wounds.

Neats foot oil:

A pale yellow golden oil can be obtained from feet (shin bones). It requires large quantity of feet. Generally cattle feet are used.

Constraints in the process of byproducts utilization on industrial bases:

1. The biggest problem is unavailability of byproducts and carcass utilization plants.
2. No semi modern or modern slaughter house is at present available in any part of the state which would provide regular and sufficient raw material for conversion to industrial level byproducts.

Conclusion:

The state is slaughtering large number of sheep and goats in unorganized way causing wastage of large amounts of byproducts especially blood and other inedible and condemned materials. The skin and pelts are also going waste and sold on throwaway prices. To protect the costly resource and generate employment and prevent environmental pollution, the state needs to establish semi modern slaughter houses at each town and modern slaughter houses at two big cities of Jammu and Kashmir with facilities for rendering byproducts. For preventing the huge loss on account of sheep skin, a tannery needs to be established each at Srinagar and Jammu. Further two carcass utilization plants for processing dead animals be established away from slaughter houses one each at Srinagar and at Jammu.

FecB Introgression: Status Report and Action Plan

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India is an agriculture based country and animal husbandry is an important component of agricultural sector. It plays a vital role in rural economy by providing employment and subsidiary income to a larger number of people. The production potential of Indian sheep is low and average wool production is around 1 kg per annum against world average of 2.7 kg and the average carcass yield is about 12 kg as compared to world average of 15 kg. The reasons for low productivity of sheep in India are poor genetic potential, inadequate feed resources, nutritional deficiency, heat stress, poor health management etc. Increasing production of meat from sheep, goat and other livestock to meet the growing demand both for domestic and export market is a priority area. Kashmir division has 17.684 lacs of sheep and 3.830 lacs of goats and off-take number is not sufficient to meet local demands. Therefore, around 15 lacs of small ruminants are imported to Kashmir valley annually from the neighbouring states. The augmentation of meat production in our state requires increase in all meat producing animals in general and sheep in particular because of preference for mutton in this region. The policies that are required to be adopted for augmentation of meat production are to have higher growth rates in all animals and increasing productivity of females in terms of number of lambs born.

The efforts for enhancing growth rates have been practiced in the state of Jammu and Kashmir since early sixties and substantial improvement has been made in the carcass weights by adopting crossbreeding in sheep. But efforts till date have not been seriously directed to enhance the prolificacy of sheep. Hence, it is imperative to increase the number of sheep available for slaughtÉr in the shortest possible time by enhancing fertility and prolificacy of the existing sheep population. Reproduction being a fitness trait has low heritability and, therefore, selection response for enhancing the reproductive efficiency by traditional animal breeding and genetic approaches are generally considered to be very low.

In sheep, a large litter size has been observed among different breeds and within breeds. In some cases, genetic studies have established that the litter size and ovulation rate can be genetically determined by the action of single gene(s) called *Fec* genes with a major effect. Identification and exploitation of these genes by fixation in the sheep population can bridge the gap in the existing demand of meat in our state to some extent. Three of these *Fec* genes have been identified in sheep. These *Fec* genes belong to the transforming growth factor β (TGF-β) super-family. Most of the Indian sheep breeds have litter size of one lamb per lambing except in Garole Sheep which is renowned for high reproductive efficiency and prolificacy due to presence of Booroola fecundity (*FecB*) Gene. The identification of Booroola gene has created a unique and exciting opportunity to introgress a high level of prolificacy to sheep that fit the Indian environment well. Therefore, to explore the polymorphism at gene level is of immense importance since it would be advantageous to use molecular markers to identify whether an animal has genetic potential to produce certain economically desirable characteristics even at younger age. Division of Animal Genetics and Breeding FVSc & AH Shuhama SKUAST-Kashmir Srinagar has developed animals with high fecundity under a project entitled "Screening and Introgression of *FecB* Gene for Augmenting Productivity in Kashmir Sheep" funded by Department of Biotechnology (DBT) Govt. of India during 2007-2012. The performance of these animals was as per the expectation and the litter size of the animals developed under the project was 145% against 90% in

animals without this mutation at University farm level. Some of the rams developed under the project were also utilised for breeding of the ewes of Kashmir Merino at Government Sheep breeding Farm Goabal District Ganderbal for dissemination of the *Fec B* gene in the local population.

Sheep breeding policy in manner in J&K is one of the recommended by National Commission on Agriculture (1976) for Northern Temperate Region wherein the Northern Temperate areas of the state were earmarked for fine/apparel wool production. However, with globalzation, the wool from international market is offered at cheaper rates and hence wool business is in loss. However, the requirement for mutton is escalating day by day with period. Therefore, there is a prerequisite of policy modification from apparel wool sheep rearing to mutton sheep rearing. Because of the policy shift and availability, good performing crossbred from the progressive farmers of Kashmir Division for meat production from sheep shall be the policy of the UT of Jammu & Kashmir. Crossbred sheep have relatively low dressing percentage than mutton breeds (40-45% v/s 50-55%). This need to be improved while safeguarding the gains made in the wool production and quality in the local crosses are maintained. Therefore, dual purpose breeds like Corriedale, Sufflock, Dorper and Texel shall be introduced for carcass traits, high prolificacy and high growth. Germplasm of the nucleus sheep breeding farms may correspondingly be developed to meet the elevated requirement of mutton production. The exotic inheritance in stock should be about 75%. Crossbreeding of the local sheep with breeds cited above shall be started in the uncovered areas followed by selective breeding to stabilise the stress on mutton traits. Stabilization of the inheritance level (75% Merino & 25% Local) by selective breeding with stress on growth, fecundity and dressing percentage attributes. The gains obtained in fine wool shall be maintained. The developed Kashmir Merino shall be completely acknowledged and registered as a separate breed. Also, the breeding of dual purpose corriedale sheep (with exotic inheritance maximum upto 75%) in orchard areas of the Kashmir Division shall be continued. Efforts shall be also made for the introduction of high prolificacy genes in sheep for production of twins and triplets, for the vertical/horizontal growth.

Prospects of Artificial Insemination and Embryo Transfer in Small Ruminant Production

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Goats are maintained for meat, milk, fiber, skin and manure, but whatever be the production goal, reproduction is the most important character. The length of breeding season varies in goats. Near the equator, breeding can occur all year round, though there are seasonal differences in ovulation rate. In higher latitudes, the breeding season is more restricted. In India, breeding bucks are kept in the flock throughout the year and that 80-90% of does exhibit estrus throughout the year, breeding is restricted to nutritionally better times of the year i.e. July to August or immediately after the onset of monsoon. A small percentage of goats are also bred during March to April when they are stubble grazed on harvested fields and supplemented with *Acacia* / *Prosopis* pods. Thus, high levels of reproductive efficiency can only be achieved under optimal management and nutrition.

Similarly, production and reproduction goes in hand and hand. Our indigenous caprine population is ill reputed for low production. Therefore, it is great challenge for animal reproductive scientist to improve the reproductive efficiency of caprine species. Reproductive efficiency can be improved by using Recent Reproductive Technologies *i.e.*, **Induction of oestrus, Synchronization of oestrus, Artificial Insemination (AI), Multiple Ovulation and Embryo Transfer (ET), In-vitro fertilization (IVF) etc.**

Prospects of Artificial Insemination:

Artificial insemination has a range of benefits over natural insemination. The prevention of venereal diseases was historically the most significant cause. The most widely promoted explanation nowadays is to improve one's genetics. The use of AI for genetic improvement stems from the fact that each ejaculate in most food-producing animals can be divided into multiple inseminations.

Direct genetic selection of sires is only one of the ways in which AI can be used for achieving genetic improvement, inasmuch as AI allows rapid dissemination and/or substitution of new breeds. AI can be used to change the gene pool of a national flock rapidly; a technique that is also used for upgrading unimproved goat and sheep in remote areas. In this process, AI has the advantage of being both cheap and simple, inasmuch as local distribution of extended and cooled semen from a small number of imported sires are within reach of even the poorest countries' economic capabilities. International trade in livestock is also facilitated by AI and embryo transfer. Improved stock can be imported in the form of semen for AI and embryos for embryo transfer rather than having to move animals themselves. By this means, many of the problems of acclimatization, such as a lack of resistance to local diseases, can be eliminated. Importing semen and embryo also allows the importing country to exert a far greater level of effective control over the health status of the donor sires than if the livestock itself were imported.The reduction in the number of sires that individual farmers must maintain is the third major benefit of AI.

Artificial insemination in Sheep and Goat: Challenges and way forward

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Artificial insemination (AI) is the oldest technique within assisted reproductive techniques (ART) which involves the introduction of sperm into the female reproductive tract by means of an instrument. The use of AI in animal reproduction was originally introduced for sanitary reasons (to prevent the spread of sexually and non-sexually transmitted diseases). However, farmers soon recognised that AI was the method of choice for tÜe rapid introduction of valuable genes into a population in order to improve its production traits. Artificial insemination (AI) of sheep and goats is an advantageous management practice aimed at the genetic improvement at farm level and a programme of genetic selection. AI of sheep been practised for over 50 years, originally in the Soviet Union and many other countries for several decades. AI has the potential for a significant impact on the Sheep/Goat breeding industry. The main role of AI in small ruminant production is to increase the rate of genetic improvement and AI also contributes to achieving other goals, e.g. allowing extensive use of the best available rams/bucks, therefore increasing selection pressure and the rate of response to selection. With AI, superior rams/bucks can be identified more easily through progeny testing. The sires under test may be too old or even dead by the time their progenies have proven valuable through progeny testing as it involves large numbers of animals over long periods. Therefore AI, by speeding up the identification of superior rams/bucks at a younger age, results in faster genetic progress.

Genetic progress can be increased by the use of frozen semen for AI after semen collection from young rams before progeny testing, thereby allowing the use of genetically superior semen more widely to confirm their superiority. AI takes advantage of oestrous synchronization with its precise control of ovulation and parturition and furthermore allows the advantage of out of season breeding. In addition to the importance of AI with frozen semen for genetic improvement, AI is also associated with other animal health benefits. This technique helps avoid disease transmission and reduces the risk of spreading sexually transmitted genital infections which are associated with natural mating. There are some limitations with the widespread use of AI when used extensively with a limited number of sires, mainly from a reduced genetic variation in the population. Moreover, some hereditary defects and undesirable traits can possibly be rapidly disseminated with AI.

Small ruminant industry has been revolutionised with artificial insemination as it lead to genetic improvement, dissemination of valuable genetics, better control of reproduction and/or sexually transmitted diseases and preservation of the genetics of endangered breeds. The results of the artificial insemination are better in goats compared to sheep, the difference being the complex anatomy of the sheep cervix which acts as the major hindrance in the success of Ovine Artificial Insemination Programmes. The ewe cervix is long and fibrous tubular with tortuous canal having 3-7 misaligned cervical rings. In Goat, the cervix is relatively less tortuous with 3-4 aligned concentric rings. Since the optimal conditions for the application of Ovine AI are through the vaginal application of frozen-thawed semen, two very important limitations of this procedure arise. The first is the inability of the frozen-thawed ram spermatozoa to traverse the tortuous cervical canal of ewe and reach the site of fertilization. The second problem is the inability to vaginally deposit semen directly into the uterus because of the complex anatomy of the cervix.

Advantages of Artificial Insemination (AI) in Sheep/Goat:

(a) Unlimited breeding selection:

(i) Primary advantages of AI is that a Ram/Buck from around the world can be used for breeding.

(ii) Make use of semen from deceased sires.

(b) Cost effectiveness:

(i) A farmer can have access to a wide variety of ram and buck at relative low cost.

(ii) A farmer can make use of superior genetics that cannot be found at local animal sale.

(c) Disease:

Many diseases in small ruminants are spread through sexual contact. The risk of these diseases is minimized with AI because the semen of donating animal is tested.

(d) More mating per Ram/Buck:

Through the use of AI, a male can be bred far more often than with natural breeding.

Limitations of AI in Sheep & Goat:

(a) Fertility rate, clean-up male (Only 40-60% conception rate with AI especially in sheep).

(b) Knowledge of physiology of reproduction. TÜe behavioural patterns of estrus including ram-ewe seeking activity, ewe tail fanning, movement of the head towards the male and active immobilization followed by mating.

(c) Trained technician.

(d) Cost of keeping semen frozen.

(e) Equipment.

(f) Handling facilities for breeding.

There are several factors that could modify the effectiveness of artificial insemination some of which are breed and age of the ewe, season of insemination, type of semen and extender used, dose of

inseminated semen, dose of PMSG used, time of insemination after oestrus synchronisation and method of insemination used.

Methods of Artificial Insemination:

Several methods for AI in sheep have been developed and involve deposition of semen into the vagina, cervix or into the uterus. The most widely used insemination technique for sheep is deposition of semen into the cervix, usually with the aid of a speculum using the 'over the rail' technique. The cervix acts not only as a reservoir but as a barrier for spermatozoa and, in general, the deeper into the cervix is the deposition of semen, the higher the conception rate. The barrier is particularly effective for frozen thawed spermatozoa which apparently have reduced viability in the female reproductive tract. Best results have been obtained with intrauterine insemination, either via the cervix or by direct injection into the uterine lumen by laparotomy or laparoscopy. The various methods differ in their complexity, cost and effectiveness.

I. Vaginal (Peri-cervical) Insemination:

This technique was originally developed in the U.S.S.R. as a more simple approach to artificial insemination than other methods. The technique, often termed in Australia the 'shot in the dark' or S.I.D method is simple and practicable because it simply means depositing fresh semen into the anterior vagina without speculum or attempting to locate the cervix, and therefore this technique is more applicable to maiden ewes. Although there have been some favourable reports on the effectiveness of the technique, there is evidence to suggest that conception rates are lower than for cervical insemination, even with relatively large doses of semen. The method is ineffective for frozen-thawed spermatozoa. This is caused by reduction in a high proportion of the spermatozoa in inseminate or semen.

II. Cervical Insemination:

Cervical insemination of fresh semen provides the most economical use of semen. This technique is commonly used in sheep which involves placement of semen into the first fold of cervix. Acceptable

lambing rates between 55% and 84% have been obtained following cervical insemination with fresh semen. However, with frozen-thawed semen low conception rates occur and part of the problem is impaired transport through the cervix and reduced viability of frozen-thawed spermatozoa.

III. Intrauterine Insemination:

Intrauterine AI has found favour for use with frozen semen, since the cervical barrier is effectively circumvented, and conception rates are comparable with those of natural service or other forms of insemination with fresh semen. The technique of intrauterine insemination with the aid of a laparoscope has made the use of frozen-thawed semen effective and practicable. Since its inception, there has been considerable research effort put into development and refinement of laparoscopic AI with particular regard to the appropriate time of insemination and dose of inseminate. These two factors are inextricably linked as there is evidence to suggest that relatively low doses of semen are effective if they are inseminated at a precise time in relation to ovulation whereas larger doses are required at other times. This, in turn, is probably related to the viability of the spermatozoa.

IV. Trans-cervical Insemination:

Lack of non-surgical procedure for sheep severely limits use of insemination technology. Using laparoscopic technique for direct transfer of semen in the lumen of the uterus has resulted in an acceptable pregnancy rate, but it has several disadvantages. Alternatively, trans-cervical intrauterine insemination techniques (e.g., Guelph system) has been developed and improved by which allows the deposition of semen atraumatically deeply into the uterine horns. It this technique, the cervix is grasped with forceps and retracting partly into the vagina to introduce the inseminating probe. The studies have reported that penetration of the cervix ranged between 76% - 98% and resulted in a lambing rate of 51%. The success of this technique is influenced by several factors including

the skill to locate, retract and stabilise the cervix prior to depositing the semen. The technique also brings about certain disadvantages to the animals.

Conclusion:

Artificial insemination in sheep has been limited appliÅation because of the problems related to semen application techniques, leading to variability in results. Currently, AI in ovine commercial programmes use superficial cervical insemination, CAI (vaginal) with chilled semen (15°C) and intrauterine insemination, LAI (laparoscopic) with frozÉn-thawed semen. It is necessary to develop strategies to improve the OAI procedures to increase the performance of these techniques and to develop protocols that enable the use of vaginally applied frozen-thawed semen. Thus, studies need to be conducted which will be focussed to overcome/cross the cervical barrier or to optimize the sperm quality of the AI dose by improving the freezing and thawing methods.

Embryo Transfer Technology in Small Ruminants: Action Plan and Timeline

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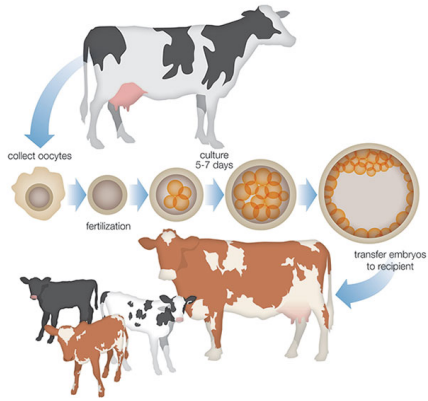
Embryo transfer technology has come a long way in Sheep and Goats since its introduction by Warwick and colleagues in 1934. Though the technique is the most common in cattle but it has a lot of potential in multiplying the animals of superior genetic merit especially females in other species as well. The technique basically relies on hormonal stimulation of females of superior genetic merit to make them super ovulate and subsequent fertilization and recovery of multiple embryos. These embryos of superior genetic merit are then transferred to synchronised recipient animals. In this way we can multiply the genetic potential of animals by several folds over short period of time. The natural reproductive potential such as low prolificacy, seasonal breeding etc which are limiting factors in diffusion of genetic improvements especially the sex limited traits (lactation traits, prolificacy) in females can be overcome by this technique. Some of the examples are introduction of Angora Goats in Australia and Newzealand, Lacaune Sheep in France whose milk is being used in making of Roquefort cheese. Besides Embryo transfer technology is an important component in reproductive cloning, conservation biology and animals Gene Pharming (transgenic biorecators) and disease modelling.



In context to our conditions the laboratory for Embryo Transfer was set up at Zakura Campus a wing of Deputy Director Research, Disease Investigation Laboratory, SHD Kashmir. The main aim of this institution will be to standardise the procedure for embryo transfer in Sheep and Goats. Since the inception of department, the main goal was improvement in wool production which has led to evolution of Kashmir Merino sheep. The breed is dual purpose known for fine wool. However in recent times due to massive urbanisation, increased standard of living has led to demand for mutton production as the state is deficit in mutton production. There is the need to introduce exotic mutton breeds for cross breeding programme. But importation of exotic animals is a costly affair with possibility of exotic disease transmission. The only way out is importation of frozen embryos of exotic breeds which could pave way for crossbreeding programmes. Besides, the same facilities could be used for biobanking of somatic cells, semen, oocytes from animals of superior genetic merit and indigenous breeds such as Gurezi etc.

PROPOSED TIME LINE OF ACTIVITIES FOR EMBRYO TRANSFER TECHNOLOGY LABORATORY

(Sheep Husbandry Department, Kashmir)

0-6 Months

- Standardization of procedures for retrieval of oocytes and semen from slaughter house waste.
- Standardization of *in-vitro* maturation of oocytes and processing of semen for IVF.
- Construction of embryos from slaughter house waste by IVF procedures.
- Studying *in-vitro* development of embryos from slaughter house waste.

6-12 Months

1. Standardization of procedures for Super ovulation of ewes and oocyte retrieval by laparoscopic assisted ovum pick up (LOPU).
2. Semen collection from live animals and assessment of semen quality.
3. *In-vitro* maturation of oocytes and semen processing for IVF.
4. Standardization of IVF procedures for embryo production.
5. Assessment of embryo development (from zygote to blastocyst).
6. Standardization of procedures for embryo transfer to synchronised recipient animals through laparoscopic procedures.
7. Establishment of pregnancies and studying foetal development.

12-24 Months

1. Standardization of procedures for cryopreservation of semen, oocytes and *in-vitro* produced embryos.
2. Revival of cryopreserved semen, oocytes and embryos to study their viability.
3. Transfer of revived cryopreserved embryos to synchronised recipient animal and study their *in-vivo* development.

4. Biobanking of semen and somatic cells of exotic animals and elite animals for future use.

24-36 Months

5. Standardization of procedures for super ovulation, mating and retrieval of multiple embryos from single animals by flushing (MOET).
6. Cryopreservation of *in-vivo* produced embryos.
7. Subsequent transfer of *in-vivo* produced embryos (fresh & cryopreserved) to synchronised recipient animals and to study their development.
8. Importation of elite embryos of superior genetic merit from foreign countries, their revival and transfer to synchronised recipient animals, establishment of pregnancies and study their development.

Establishing Mini Diagnostic Laboratory in Farms

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All producers face the loss due to unusual or unexplained sickness and death of farm animals. Most producers are interested to know the cause, have the best and effective treatment and want to prevent reoccurrence. The local veterinarian is the immediate rescue. The earlier the doctor is contacted, the better are the chances of instituting an effective treatment. However, if the animal is found suddenly dead or the disease is spreading or the treatment is not effective, veterinarians often turn to a vet diagnostic laboratory for confirming a diagnosis and for treatment and control planning based on test results. Lot of information about an individual animal death or the herd health issues can be gathered by performing a necropsy. In necropsy, the pathologist will first look for gross abnormalities called "gross necropsy" and often gives an initial indication of the cause of death. Then the blood and other bodily fluids and samples taken from all the organ systems are submitted to different laboratory sections for specific testing. Then the pieces of organs like liver, lung, heart, kidney, brain, etc. are cut into thin slices, processed for microscopic examination. This process is termed as histopathology..

TYPES OF VETERINARY MEDICAL TESTS

There are several categories of diagnostic tests that may be performed to help the veterinarian determine the cause of illness.

Clinical Chemistry

Here we usually study the chemical composition of samples like serum or plasma, although other body fluids may also be studied. These tests are important for determining the wellbeing of different organs like kidneys, liver, etc. These tests are also used to monitor the response of animal to treatment.

Cytology

The study of individual cells, their structure and origin, function(s), and death is known as cytology. Pathologists can come to rescue to know about the functioning of cells in the animal's body. Samples are collected by fine-needle biopsy or fluid aspiration, then examined under microscopic to determine the kinds of cells and any abnormalities therein. This is primarily used to diagnose the presence of cancerous cells and to ascertain if the tumor is benign or cancerous. We can also identify the presence of infectious agents.

Hematology

The study of cellular elements of blood like red blood cells, white blood cells, and platelets, in health and disease is called haematology. We usually do complete blood count (CBC) which determines the number and types of cells circulating in the blood stream. This will give some clue about anaemia, inflammation, and clotting. The different types of white blood cell counts gives information about inflammation due to an infection or other cause.

Histology

The study of the microscopic structure of animal tissues is called histology. Pathologists determine whether the examined tissue samples are normal or diseased and can also determine the cause and effect of diseases.

Microbiology

The study of microscopic organisms such as bacteria, viruses, fungi, and other single-celled life forms is called microbiology. In a veterinary laboratory, microbiologist can perform many tests like first growing (culturing) and then identifying bacteria, viruses, and fungi.

Antimicrobial sensitivity testing can be done to see which antibiotics should be effective in eliminating them from the body. At times, microorganisms are difficult to grow in the laboratory, then we use antibodies or other chemicals to detect their presence. In blood, urine, faeces, secretions from the nose or lungs. In addition swabs are taken from an abscess or wound.

Serology

In ëerology we determine the level of antibodies which is often termed as the titer. We check the presence of antibodies reactive to a particular infectious microorganism. Either high titre or increase in the titre from one sample to another taken a few weeks later, indicates that the animal is exposed to the microorganism. Several test kits are available for a number of serologic tests.

Toxicology

Toxicology is the branch of science that studies poisons and how they affect animals. If your veterinarian suspects that your animal has been poisoned, samples will be collected for toxicologic tests to identify the poison and the amount of damage it may have caused. Some common poisons can be quickly identified. Rapid identification of a poison can be critical for your animal's survival. In other cases, samples may be sent to an outside laboratory that can accurately test for a much wider range of poisons. If your animal has eaten something toxic, your veterinarian may ask you to bring a sample of it with you for testing.

DIAGNOSTIC LAB EQUIPMENT

Biochemistry Analyzer

An automated biochemistry analyser is a medical diagnostic lab equipment which is designed to measure different chemicals and other characteristics in a number of biological samples with minimal human assistance.

Brands available are Biosystem, Elitech, Robonik, Abbott, Horiba, Thermo Scientific, Diasys, Hycel, Rayro, Biobase and others.

Centrifuge

A laboratory centrifuge is a motor driven equipment which spins

liquid samples at high speed. A centrifuge is used for the separation of fluids, gas or liquid, based on density.

Brands available are Remi, Thermo fisher, Lab-tech and others.

Electrolyte analyser

Electrolyte analysers are used to measure electrolyte levels in the animal body and to detect metabolic imbalances and measure renal and cardiac function as also for blood plasma, serum, or urine samples.

Brands available are Diamond, J.S. Medicina, Hycel, Diestro, Sensa Core, Erba, i-sens I-smart 30 Pro and others.

Hematology Analyser / Cell counter

A cell-counter and bio-chemistry analyser are the most basic diagnostic lab equipment required as blood cell count and blood profile are most commonly used tests.

Hematology analysers are automated systems that count leucocytes, red cells and platelets in the blood, and also check the level of hemoglobin and hematocrit in the blood. A complete blood count is usually the preliminary test requested by veterinarian to assess animal health.

Brands available are Abbott, Horiba Yumizen H 500, Pentra MSCRP, Biosystems, Hycel, Rayto, Maccura, Mindray and others.

Incubator

An incubator is an equipment in a laboratory which is used to grow and maintain microbiological cultures or cell cultures. The incubator maintains optimal temperature, humidity and other conditions such as the carbon dioxide (CO_2) and content of oxygen in the atmosphere inside.

The simplest incubators are the boxes which are insulated with a heater which is adjustable which temperature goes up to 140 to 150°F. Laboratory incubators gives controlled, contamination-free environment for safe and reliable work with cell and tissue cultures by specific conditions such as temperature, humidity, and CO_2. Laboratory incubators are used for storage and growth of bacterial cultures.

Brands available are Apollo, Avilab, Rotek and others.

Elisa Reader/Microplate reader

Also known as microplate readers or microplate photometers, ELISA readers are equipment which are used to detect biological, chemical or physical events of samples in microtiter plates. ELISA stands for enzyme linked immunosorbent assay. In short, it is an antibody test or a test for immune response to things attacking the body such as virus, bacteria and allergens. The test is done in an ELISA plate, also known as a 96-well plate or microplate. The ELISA reader reads the plate.

Brands available are Thermofisher scientific Wellwash 1 * 8 and 1* 12, Biotek instruments TS washer, Titertek Berthold Zoom HT, iD 3090, Edutek ETA-34 and others

Hot air oven

Hot air ovens are electrical equipment which sterilize using dry heat. Generally, they can be operated from 50 to 300 °C, to control the temperature using a thermostat. Hot air oven have double walled insulation that keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic. There is also an air filled space in between to aid insulation. It has an air circulating fan which uniformly distribute the heat. These are fitted with the adjustable wire mesh plated trays and it has switch for on and off and indicators as well for temperature and holding time.

Brands available are Bionic Scientific, Remi, Innolab India, Labline, Oracle and others.

Bio Safety Cabinet

Autoclave

Autoclave is the nucleus of a microbiology laboratory. It is used not only to sterilize liquid substances such as prepared media and saline (diluents) solutions, but also to sterilize glassware's, when required.

Fridge (Refrigerator)

It serves as a repository for thermo labile chemicals, solutions, antibiotics, serums and biochemical reagents at cooler temperatures and even at sub-zero temperatures (at less than 0°C). Stock cultures of bacteria are also stored in it between sub-culturing periods. It is also used

for the storage of sterilized media, so as to prevent their dehydration.

Freezer

It is used to store chemicals and preserve samples at very low sub-zero temperatures.

Electronic Top-pan Balance

It is used for weighing large quantities of media and other chemicals, where precise weighing is not of much importance.

Distilled Water Plant

Water is used in the preparation of media and reagents. If the media is prepared using tap water, the chemical impurities present in it may interfere with the growth of the microorganisms in the media.

pH Meter

A pH meter is an instrument for determining the pH of liquid media, liquid samples and buffers. It has a glass pH electrode. When not in use, it should be kept half immersed in water contained in a small beaker and preferably be covered by a bell jar to avoid dust accumulation in the water and loss of water through evaporation.

Hot Plate

Hot plate is used to heat chemicals and reagents. The hot plate is made of an iron plate, which gets heated by an electric heating element from below. The required degree of heating is obtained by a regulator.

Shaking Water Bath

Sometimes, heating at very precise temperatures is required. Such precise temperatures cannot be obtained in an incubator or oven, in which temperature fluctuates, though slightly. However, precise temperatures can be maintained in a water bath, which provides a stable temperature.

Magnetic Stirrer

In the preparation of solutions, certain chemicals require stirring for long time, to be dissolved in certain solvents. Magnetic stirrer is used to dissolve such substances easily and quickly. A small teflon-coated magnet, called 'stirring bar', is put into a container containing the solvent and the solute.

Laminar Flow Chamber

It is a chamber used for aseptic transfer of sterilized materials, as well as for inoculation of microbes. Dust particles floating in the air harbour microbes. These microbe-laden dust particles may enter into the sterilized media and contaminate them, when they are opened for short periods of time during inoculation of microbe or transfer from one container to another.

Microscopes

Different types of microscopes are used for visual observation of morphology, motility, staining and fluorescent reactions of bacteria.

Spectrophotometer

It is an instrument for measuring the differences in color intensities of solutions. A beam of light of a particular wavelength is passed through the test solution and the amount of light absorbed (or transmitted) is measured electronically.

Trends in Zoonoses and Tackling Zoonoses in Livestock Farms and Slaughter Houses

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Rudolf Virchow, father of zoonoses defined the zoonoses as "primary infections of animals which are by any route transmitted to man". However, World Health Organization (WHO) and Food & Agricultural Organization (FAO) defined Zoonoses as diseases and infections which are naturally transmitted between vertebrate animals and man.

Schwab in 1969 defined Zoonoses as infections and infestations which are shared in nature by man and other vertebrate animals.

Lysenko, (1980) a Russian Scientist, defined Zoonoses as those diseases and infections which are shared in nature by xeno-organisms that include insects as well.

Sixty (60%) of 1415 pathogens are zoonotic and more than 75% of all emerging diseases, 80% of bioweapon and every three of five new pathogens are zoonotic. The Indian subcontinent has been identified as one of the four global hot-spot at increased risk for emergence of new infectious diseases. In addition to being more vulnerable to emerging zoonoses, India has also contributed a major share of the global burden of other endemic zoonoses.

The concept of "zoonoses" is anthropocentric, the epidemiological study and their control is however different. Zoonoses cover a broad range of diseases with very different clinical and epidemiological features and control measures. The fundamental reason for grouping these diseases together is that successful control requires joint veterinary and medical efforts. The final objective of Veterinary Services lies very

definitely in man and above all humanity.

History of Zoonotic Diseases

Clinical features for a few of the zoonoses have been recognized since early history. For example, the signs of encephalitis in dogs with rabies, ringworm in people and animals, *Mycobacterium bovis* - associated scrofula in children, glanders and tetanus in horses and humans and epidermic urban plague (*Yersinia pestis*) have been described for many centuries. Confirmation of the specific etiology for all zoonoses was possible after Leeuwenhoek's invention of the microscope in the late 1600s and the scientific discoveries that have followed to date.

All major microbial and parasitic categories from viruses to helminths are associated with zoonoses. It is not surprising therefore that the larger parasite were the first to be examined with the primitive microscope. In 1758, Linnaeus (the father of scientific classification) included description of two cestodes (*Dipylidium caninum* and *Diphyllobothrium latum*), a trematode (*Fasciola hepatica*) and two nematodes (*Ascaris lumbricoides*, essentially to *A. suum* and *Dracunculus medinensis*) in *Systema Naturae,* 10th edition. The zoonotic species of most genera of protozoa (*Babesia, Entamoeba, Giardia, Pneumocystis, Toxoplasma, Trypanosoma*) were first described between 1885 and 1915.

Arthropod vectors are involved in the transmission of several zoonotic protozoan parasites, bacteria, rickettsiae and viruses. In 1893, Smith and Kilborne first demonstrated vector borne transmission of an infectious agent with tick transmission of *Babesia bigemina*, the agent of bovine babesiosis. By the beginning of the 1900s, the concept of vector borne spread had been established for zoonotic members of all the major groups of infectious agents except fungi.

Trends in zoonoses

The close association of people with animals in large areas of the world and often in unsatisfactory sanitary conditions, continue to promote the opportunity for zoonotic infections. Animals continue to provide a substantial contribution to the energy requirements of agriculture in terms of converting poor-quality cellulose to first class

protein, in the provision of draught power by cultivation of crops and transport and the provision of fuel. The need to care for these valuable animals, which represent a major capital investment to the farmer, exposes millions of people to contract a zoonotic disease. The tropical parts of the world are high-risk areas, especially where the zoonotic infection is arthropod-borne.

The situation may become acutely worse when political or social instability occurs and normal sanitary arrangements are disrupted, disease control programmes discontinued and medical and veterinary services are unavailable.

Certain occupational groups may be at greater risk such as veterinarians, slaughter-house inspectors/workers, rural agriculturists or pastoralists, forest workers, hunters and wild-life workers. Such groups may accentuate the problems through the expansion of rural and even urban settlement.

It is usually presumed that zoonoses are essentially a rural problem but the urban dimension is indeed worthy of consideration. Wild-life can become established in suburban and recreation areas, in some cases encouraged by householders, which may enhance these as a source of zoonotic infection (e.g. foxes and *Echinococcus multilocularis*). However, the companion animal in the urban scene is an important source of zoonotic diseases, especially of parasitic infection. The population of dogs and cats as companion animals continue to grow enhancing the dangers of zoonotic diseases associated with these companion animals and require national and local laws and regulations to control them by preventing fouling of the environment. In India the problem is greater because of high stray dog and cat population.

A new dimension of zoonotic diseases has been manifested by the growing number of immuno-suppressed people, either through the use of immunosuppression in therapy as in transplantation, cancers or through immunosuppressive diseases particularly in the acquired immunodeficiency syndrome (AIDS). There are many newly emerging or re-emerging infections which are causing concerå and for which global surveillance systems are being developed. Important recent examples

include Ebola virus in Africa, Hantavirus in United States of America, *Escherichia coli* O157 in Japan, the new equine morbillivirus in Australia and brucellosis in Middle East.

Therefore, Zoonoses are now amongst most frequent dreaded risks to which mankind is exposed. It is now well known fact that the animal world is a reservoir of numerous diseases of human beings which is true in tropic and sub-tropic areas where arthropods play important role in transmission of disease. There are several reasons to believe that most of present infections and parasitic diseases of human beings have originated from animals and pathogenic organisms have become adopted themselves to the environmental conditions of human body either as parasite or as commensal and therefore their association being eventually important for transmission of diseases in man and animals.

Interaction of factors in Zoonoses

Zoonoses is the result of interaction of the causative agent, host (degree of susceptibility) and the environment they share that determines whether or not transmission of the agent will be successful, leading to infection and ultimately occurrence of disease. Carrier hosts, individuals infected without overt signs of disease, are important in the persistence of many zoonotic agents. Vertebrate animals are the reservoirs (where the agent persists in nature) of zoonoses. The agents may be transmitted either directly or indirectly by fomites or vectors. Many diseases are shared by other animals and people, but the reservoir is in the inanimate environment (soil, water).

Factors influencing prevalence of Zoonoses

1. **Ecological consideration** e.g. Water resources development e.g. dam construction and irrigation schemes increases the danger of water rĤated zoçnçses. e.g. Schástosomosis, Trypanomosis, Paragonimiosis, Typhoid bacilli, *Escherichia coli, Clostridium perfringens* etc.

   Under the influence of seasonally defined climatic conditions, eco-system is subjected to repeated changes which affect host-vector and pathogen as regards to their habitat. Man's infringement of natural

conditions brought about by practices like reclamation of waste land, artificial irrigation or changing crops, contribute to alteration of environmental condition, therefore leads to changes in propagation of zoonotic diseases. The example reported so far is by Egyptian workers leading to propagation of schistosomiasis in human in Egypt.

2. **Effect of human settlements -** Synanthropic animals which live in and around human settlements such as rats, mice, other rodents, bats, lizards influence parasitic and other microbial infection.
   a) Companion animals such as pets, riding horses etc.
   b) Food producing animals.
   c) Wild and semi-wild animals.
3. **Fluctuation in animal population -**The density of animal population may have a bearing on zoonotic infections. From the general ecological point of view, one may consider the livestock in large breeding units as an unstable artificial population of domestic animals which is maintained through human care and application of zoo technological and prophylactic veterinary methods e.g. an outbreak of cysticercosis among cattle in a large unit in USA was transmitted by a single human carrier of *Taenia saginata*. Sarcoptic mange was transmitted in a large scale milk cattle unit in central Europe by a sole farm worker caused by *S. scabiei*.
4. **Human behavior and food habits -**Human behavioural patterns are often significantly related to man's risk of acquiring zoonoses e.g. hydatidosis. Food and water play an important role in transmission to man of zoonotic diseases and some food habits increase the risk of infection. Same is the case of viral and other microbial diseases. HIV infection is a classical example for abnormal human behavioural habits.
5. **Environmental pollution -**Faecal pollution of water, soil and vegetation, irrigation of pastures with sewage effluent, animal wastes from animal breeding establishment, dairies, abattoirs and carcass disposal plants constitute another health hazard.

In the last two decades we are witness of an increasing importance of certain zoonoses induced by the acquired immunodeficiency syndrome (AIDS) of man. Therefore the zoononses can be subdivided into "AIDS-related zoonoses" and "other zoonoses", although strict differentiation between two groups is difficult.

The Disease Reference Group on Zoonoses and Marginalized Infectious Disease of Poverty (DRG6) was part of an independent think tank of international experts, established by the Special Programme for Research and Training in Tropical Disease (TDR) to identify key research priorities through the review of research evidence and input from stakeholder consultation.

Thus zoonoses largely occur amongst individuals in population which are:

- Occasionally engaged in handling the animals, their carcasses and animal products so veterinarians, slaughter house workers, farmers, milkers and employees in processing byproducts which are at high risk.
- Those who repeatedly come in contact with soil, mud, water readily contaminated with animal excreta, agricultural workers, sewage workers, fisherman, hunters in jungles.
- Gêoup of people /masses which may be affected by elementary zoonoses that is due to consumption of Livestock products like Meat & Meat products, Milk & Milk products etc.

The zoonoses are classified as:

A. According to transmission
B. According to Russian method of classification
C. As per Etiological agents
D. According to reservoir pattern
E. According to Animal-Man relationship.

A. According to transmission, zoonoses is further classified as:

I. Direct zoonoses

a) Direct anthropozoonoses

b) Direct zooanthroponoses

c) Amphizoonoses

(e.g. Leptospirosis) (e.g. Human TB)

e.g. Staphylococcal infection)

II. Cyclozoonoses.

a) Obligatory Cyclozoonoses

e.g. *Taenia solium* / *Taenia saginata*

b) Non-obligatory Cyclozoonoses

e.g. Echinococcosis / Hydatidosis

III. Metazoonoses

a) Metazoonoses type-I

b) Metazoonoses type-II

(e.g. Q-fever caused by *Coxiella burneti*)

(e.g. *Paragonimous westermanii*)

c) Metazoonoses type-III

d) Metazoonoses type-IV

(e.g. *Diphyllobothrium latum*)

(e.g. KFD)

IV. **Saprozoonoses**

a) Sapro-anthropozoonoses

b) Sapro-amphizoonoses

c) Sapro-meta-anthropozoonoses

(e.g. Ancylostomiasis)

(e.g. Histoplasmosis)

(e.g. Fasciolosis)

Combating Zoonoses

Controlláng zoonotic diseases at the animal source is most effective and economical. Despite the huge burden of endemic zoonoses and increased risk of emergence of novel zoonotic diseases, there is little awareness about zoonoses, even among health professionals in the country like India. While there is no single intervention that can address all zoonoses, it is now increasingly recognized that establishment of intersectoral collaborative mechanism is the most efficient strategy to address existing and emerging zoonoses.

However, the coordination mechanism in place is more administrative in nature and not always effective in promoting diffusion of knowledge from across sectors. In the aftermath of H5N1 and SARS outbreaks of 2008, there has been a felt need for a flexible space outside formal structures that promote technical dialogue between human, veterinary and wild life health sectors and inform policy discussion in the formal sector.

The Roadmap to Combat Zoonoses Initiative (RCZI) in India was launched in March, 2009 following a brainstorming meeting in New Delhi in June, 2008. It modeled itself around the 'One World One Health' concept which is worldwide strategy for expanding interdisciplinary collaboration and communication in all aspects of health care for human, animals and the environment. The RCZI has been set up under the aegis of the Public Health Foundation of India (PHFI) and is the only standalone initiative on zoonoses in the country that mobilizes a range of intersectoral partners working in the human, veterinary and wildlife health sectors.

By fostering academic collaboration around these functional areas, RCZI aims to build confidence, demonstrate value, stimulate need and influence policy makers and programme implementers to allow joint action for the prevention and control of zoonoses and other emerging infectious diseases as also bringing zoonoses into the realm of a wider public discourse.

Zoonoses like brucellosis, leptospirosis, tuberculosis, anthrax, rabies, Q fever, cysticercosis, trichinellosis affect mostly poor, rural people and

neglected group but others can be affected as well. Most of the zoonotic diseases are endemic and have no pandemic potential and are controllable. For decades these were classified Neglected Zoonotic Diseases (WHO-NZD) because of the 'mixed human veterinary nature'. These were less important for health sector.

Strategies Adopted by RCZI

The very nature of zoonoses necessitates collaboration between sectors and disciplines for their effective prevention and control. RCZI, since its inception, has strived to promote coordination between human-animal-wildlife sectors through adaptation of the following strategic approach:

Multidisciplinary collaboration is most easily brought about in a research setting. Ensuing networks and research outputs then feed into national discourse, acting as change agents advocating for increased collaboration. Build workforce capacity across sectors. By undertaking capacity building and offering technical support, RCZI is ensuring joint capacity building for strengthening a consolidated and collaborative response to zoonoses.

Advocate for increased awareness of zoonoses. Recognizing the limitation of generating knowledge for its own sake, RCZI works on policy relevant research. It communicates latest state-of-the-art research advances to policy planners, programme managers and lay audience. The initiative has increased its networks among veterinary and public health communities at the national and international levels, using them to implement knowledge translation strategies.

"Zoonoses necessitate collaboration between sectors and disciplines for their effective prevention and control" creating champions to advocate the need for an integrated approach to zoonoses prevention and control because:

Wildlife and wild animal meat has been source of emerging zoonoses. 71.8% of zoonoses originated in wildlife. Nipah, Ebola, Sars have pandemic potential:

SARS CoV: most rapidly spreading disease was identified in palm civet (*Paguma lavarta*) and other species in wet markets in mainland China. Palm civet was consumed in winter as substitute of fresh fruit often unavailable in winters. Mass vaccination of small ruminants with *B. melitensis* Rev.1 (eye drop) for 2 years followed by biannual of all young and non-vaccinated, ear-notched for identification and 'Stepwise method' reduced prevalence by 83% down to 1.9% in 6 years in Tajiskistan (FAO, 2014).

Veterinary services (VS) is defined as the governmental and non-governmental organizations that implement animal health and welfare measures and other standards and recommendations contained in the *Terrestrial Code* and the OIE *Aquatic Animal Health Code (OIE-2012)*. VS is expected to function as per the OIE standards- as stated in the first element of strategic frame work of One Health. VS impacts food system and food security through six fields of activities- (i) Organization (ii) Surveillance (iii) disease prevention and control (iv) sanitary inspection (v) traceability and (vi) food hygiene.

Veterinary Surveillance Strategy has its core "protection of PH in relation to food and animal disease transmissible to people". Functional Units are Disease Intelligence, Monitoring and Surveillance, Scanners, Risk assessment.

"Positive Disease Surveillance at Livestock Farms and Construction of Scientific Slaughter houses is must for prevention of Zoonotic diseases"

Food Safety Issues with Respect to Diseases of Sheep and Goat

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"Food safety" refers to routines in the preparation, handling and storage of food meant to prevent foodborne illness. As a scientific discipline, food safety draws from a wide range of academic fields, including chemistry, nutrition, microbiology and engineering etc. Food products may encounter any number of health hazards during their journey through the supply chain and therefore safe food handling practices and procedures are necessary to curb these risks and prevent harm to consumer. In modern context, the concept of food safety is described by the *'Farm to Fork'* model.This concept captures the essence of food safety. For food from animal sources, this concept can be explained as *'Stable to Table'*.

According to the WHO (2020-21) report an estimated 600 million, almost 1 in 10 people fall ill after eating contaminated food each year, resulting in 4,20,000 deaths around the world. So, there is need to take utmost care in every step such as proper storage, transportation, processing, heating and cooling properly to adequate temperatures, and avoiding contact with other uncooked foods to reduce food contaminant and making it safe for consumption.

Sheep meat (mutton) is having high demand in Kashmir region as majority of the population are nonvegetarian and *'Kashmiri Wazwan'* (meat

products) forms the basis for every feast and marriage ceremonies. The annual production of mutton in Kashmir region during 2016-17 was 108.80 lakh Kgs unable to fulfil the demand requiring import of sheep and goat from other parts of the country. Several diseases such as anthrax, brucellosis, listeriosis, Q-fever, contagious ecthyma, toxoplasmosis and many more may be associated with handling of food animal or consumption of contaminated meat/meat products. However, meat borne disease can be prevented by using safe meat which can be obtained from disease free animal. An important step in safe meat production is ante and postmortem inspection. Ante mortem examination should be done within 24 hours of slaughter and repeated if slaughter has been delayed over a day. Routine post-mortem examination of a carcass should be carried out as soon as possible after the completion of dressing. Personal hygiene like washing hands with soap and water for at least 20 seconds before and after handling meat helps in reducing microbial load. Uncured raw meat generally lasts safely for around three days in refrigerator, however can be stored upto 3 to 4 months in freezer. Proper cooking is essential at 165°F (73.9°C) or higher from safety perspective.

In relation to milk production, contribution of sheep and goat milk in Kashmir region is little as cow's milk remains prime source (around 1401.184 metric tons in 2016-17). Nowadays, milk from sheep and goats are popular in some populations that preferred to consume by the people with allergies to cow milk. Consumption of sheep and goat milk is mostly confined among the nomadic and rural people in this region and so data is scanty on milk borne diseases of sheep & goat.

Several research studies on various meat products such as rista, kebab, tikkas, meat balls and ready to eat meat confirmed contamination at a level of 75-90% by various micro-organisms. Similarly, most of the raw milk and milk products sold in Srinagar city were found contaminated by coliform, staphylococcus and other organisms. These studies indicate the needs of broader investigation of foods of animal origins in Kashmir.

Government has also a key role in setting and providing legislation that lays down minimum food safety standards at all levels. Governments must ensure that these are implemented through training, inspections and

enforcement. In 1963, the WHO and FAO published the Codex Alimentarius which serves as a guideline to food safety. ISO 22000 is a standard developed by the International Organization for Standardization (ISO) dealing with food safety. The promulgation of the new Food Safety and Standards Act (FSSA) 2006 by Food Safety and Standards Authority of India (FSSAI) is an attempt by the government to achieve food safety in India. Around the world, the majority of laws about food safety are based on two concepts i.e. *Hazard Analysis Critical Control Point* (HACCP) and Good Manufacturing Practices (GMP). The HACCP concept is designed to counter health hazards by identifying potential food safety problems. HACCP concept entails controlling for contaminants at a number of key junctures in the food production process and strict adherence to hygiene practices throughout. GMP is internationally recognised quality assurance guidelines for the production of food. These guidelines lay out the protocols which manufacturers must implement to assure that their products are consistently high-quality.

The Five Key Principles of Food Hygiene, according to WHO are:

i. Prevent contaminating food with pathogens from various sources
ii. Separate raw and cooked foods to prevent cross contamination
iii. Cook foods at appropriate temperature to kill pathogens
iv. Store food at the proper temperature
v. Use safe water and safe raw materials

Common Pathogens Associated with Sheep & Goat milk:

Micro-organisms that may be present in sheep and goat milk are *Brucella* spp. *Coxiella burnetii*, *Listeria* spp. *Salmonella* spp. Shiga-toxin producing *Escherichia coli, Staphylococcus aureus, Coxiella burnetii*, *Listeria* spp., tick borne encephalitis virus (Toga virus), Orf virus and *Toxoplasma gondii*. Lesser important organisms with minor risk of transmission are *Bacillus anthracis, Bacillus cereus*, *Clostridium* spp. *Corynebacterium* spp. *Erysipelothrix rhusiopathiae, Mycobacterium spp., Streptococcus* spp., *Yersinia* spp. and *Cryptosporidium* spp.

Prevention and control: The risk of milk borne disease can be reduced by proper flock health management, prevention of contamination during milking, adequate milk processing, transport and refrigerated storage. Most of the milk borne disease can be prevented by using pasteurised milk or boiling the milk at proper temperatures up to specific times and preventing recontamination.

Important Disease of Sheep & Goat and Carcass Judgement:

1. **Required Total Condemnation**: Anthrax (carcass should be buried at least 6 feet below ground covered by quicklime & disinfection with *10 % NaOH* or *5 % formaldehyde)*, Black quarter (prohibited to slaughter), Enterotoxaemia (Pulpy kidney), Listeriosis, Salmonellosis, Infectious necrotic hepatitis (Black disease), Bluetongue (reactor animals are *approved*), FMD *(prohibited to admit in abattoir)*, Rinderpest, Q fever and Scrapie.
2. **Carcass conditionally approved without systemic involvement**: Brucellosis (after removal of affected parts; in acute abortive form carcass are *condemned*); Johne's disease (carcass with emaciation is *condemned*); Tuberculosis (reactor animal without lesions *may be approved);* Contagious Ecthyma (Carcass is *condemned* if disease is accompanied with inflammation of stomachs and intestines); Ovine progressive interstitial pneumonia/maedi; Rabies (*approved* if the animal was bitten within 48 hours of slaughterafter removing bitten parts, however advised not to be handle or slaughter); Sheep and Goat Pox (*condemned* in acute febrile or pustular stage); Babesiosis (if icterus is not present; carcass with haemoglobinuria is condemned); *Cysticercus ovis* infestation (*passed* after *cysts are removed and* heäd for 10 days at -10°C); Hydatid disease (heavily infested carcass is *condemned);* Fascioliasis (heavily infested parasitic liver is *condemned);* Gid/Sturdy (*approved,*affected brain along with other organs *condemned);* Toxoplasmosis (Carcass with acute diseased condemned, recovered and reactor animals approved); CCPP (septicemic form carcass is *condemned, otherwise approved*).

Recommendations

1. Risk of meat borne disease can be minimised by maintaining proper flock health including recent vaccination records against important diseases prevalent in the region. The source of food animals should be known and in record.
2. Risk of milk borne disease can be reduced/prevented by "clean milk production" which can be achieved by scientific management of "milch animals". Further, processing of milk which can be achieved by proper boiling or pasteurization/ similar heat treatment of milk and avoiding recontamination is the finest tool for safe consumption.
3. Inspection of slaughter house, meat shop/ butcher's shop, dairy units and plants, retail milk outlet, milk vendors, restaurant's and street food vendors by Food Inspectors of Municipal Corporation or Food Inspectors of Drug & Food Control Organization under supervision of Commissioner of Food Safety falls within the jurisdiction of the state.
4. Establishment of slaughter house as per scientific guidelines at tehsil/district level.
5. Quality control of animal food products by testing its qualities in referral/accredited laboratories.
6. Comprehensive educational programme among farmers, butcher's, meat shop owners, and milkman/ milk vendors about the potential hazards of disease transmitted through meat and milk by conducting awareness program at tehsil/district/state level or via digital media and newspaper.
7. Veterinarian with specialization in public health, food hygiene or livestock products technology need to be engaged as designated Food Safety Officer at municipal, district or state level.
8. Application of *Hazard Analysis Critical Control Point* (HACCP) system in food production system to reduce the risk of meat and milk borne diseases.
9. Implementation of FSSAI regulations (FSSA Act, 2006) in full spirit.

APPENDIX

Recommended Bacteriological Standard (Count/g) for Meat and Meat Products (BIS & FSSAI)

Type of organism	Count/ g	Judgement
TVC	Less than 0.5 million/g	Satisfactory
	Moe than 0.5 million but less than 2 million/g	Accepted but need Investigation
	2 million/g or more	Condemned
Coliforms	less than 500/g	Satisfactory
	500-5000/g	Accepted but need Investigation
	More than 5000/g	Condemned
Salmonella/ Shigella	Absent in 25g	Satisfactory
	Present in 25g	Condemned
Staphylococcus	Less than 100/g	Satisfactory
	100-1000/g	Accepted but need Investigation
	More than 1000/g	Condemned

Bacteriological Standard of Raw Milk (BIS- IS-1479, Part-III- 1997)

Grades	DMC/ml (Lakhs)	SPC/ml (Lakhs)	MBRT	1hr.Resazurin disc test (Disc No.)	Presumptive Coliform Test in 0.01 ml
Very Good	NS	<2	>5	NS	Absent
Good	<5	2-10	3-4	4 or higher	Absent
Fair	5-40	10-50	1-2	3.5-1	Absent
Poor	40-200	>50		0.5-0	Present
Very poor	>200	NS	NS	NS	NS

***NS: Not Specified**

Bacteriological Standard of Pasteurised Milk
(BIS- IS- 6397-1971)

Test	Requirement
Standard Plate Count(SPC)	30000 CFU/ml maximum
Coliform Count	Absent in 1: 10 dilution
E. coli	Absent
MBRT	More than 4 hour
Alkaline Phosphatase	Negative

Recommendations to Control Brucellosis in Small Ruminants

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Brucellosis in small ruminants is caused by *Brucella melitensis* which is characterized by abortion in third trimester of gestation period, retention of placenta, reduced milk and orchitis and/or epididymitis in breeding animals. *Brucella melitensis* is highly pathogenic and infectious organism and communicable to humans, besides great economic losses to the sheep and goat farming community/entrepreneurs and impacting as a whole, the economy of the country. Particularly Jammu and Kashmir is the main land in India where sheep and goats are traditionally raised and reared intensively and extensively both in Govt. and private sector, on small and large organized farms, besides nomads. Though brucellosis in sheep and goats is endemic and prevalent throughout the country, unfortunately, there is no effective and adaptable policy in place anywhere in the country including Jammu and Kashmir to control this disease. I will deliberate in my address on the issues why brucellosis in small ruminants has not been paid attention. Briefly the basic principles to control brucellosis in small ruminants are as under:

1. Testing of sheep and goats
2. Stamping out or culling/segregation of positive animals
3. Vaccination of animals
4. Practice proper sanitary and hygienic measures on farms

5. Careful management of flock/farm/herd
6. Restriction of movement of animals from endemic areas

In view of above guiding principles I would recommend following strategy to control brucellosis in sheep and goats in Jammu and Kashmir:

1. Two test *i.e.* RBPT and indirect ELISA should be used for the diagnosis of brucellosis and to establish the presence or absence of the disease in the flock/farm/herd.
2. For screening the flock/farm/herd use Rose Bengal Plate Agglutination Test (RBPT).
3. If the flock/farm/herd turns out to be positive in RBPT then test/examine all the animals by indirect ELISA to identify all positive animals (being RBPT is not a sensitive test).
4. Now remove the positive animals from the flock/farm/herd by culling or segregation.
5. Vaccinate the reaming negative animals (Mass vaccination) on flock/farm/herd as soon as possible using *Brucella melitensis* Rev-1 vaccine.
6. Since *Brucella melitensis* Rev-1 provokes life-long immunity to animals there is no need to vaccinate them again next year.
7. In subsequent years vaccinate the young animals (lamb/kids) between the age of 3 to 5 months.
8. If the flock/farm/herd turns out to be negative in screening even then vaccinate all the animals to prevent entry of the disease in future.
9. Vaccination should be continued in the area to bring down the sero-prevalence less than 2%.
10. Once the sero-prevalence reaches below 2% then further steps to eradicate the disease may be taken into consideration.
11. Give proper attention during the lambing/kidding season. If any abnormal parturition noticed on the farm then proper disposal of

abortion materials etc is necessary and disinfection of the area reduced chances of transmission to in-contact animals.

12. The policy which is mainly based on test and culling without vaccination of animals is a truncated policy and is not successful, particularly in the endemic area.
13. Extensive information, available literature and experience gained clearly suggest that any strategy without vaccination does not yield fruitful results.

In conclusion, any control program in order to be effective must have support and cooperation of the animal owners/farmers, must be well planned so that all the resources needed to be available on time; the veterinary service that is responsible must be well organized and has ability and patience for implementing long-term control program.

Status of Brucellosis in India and Food Safety Issues

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Brucellosis is an important zoonotic disease which causes huge economic losses to the livestock owners and is of great public health significance. Brucellosis is a chronic infectious disease of livestock, marine animals and human beings and is caused by facultative intracellular bacteria called *Brucella*. It is one of the important causes of reproductive losses in animals. Abortions, placentitis, epididymitis and orchitis in the affected animal are the most common consequences of the infection.

Brucellosis has an important public health significance. Humans are usually infected due to direct animal contact or ingestion of contaminated milk/dairy products, causing acute febrile illness (undulant fever) which may progress to a more chronic form and can produce serious complications in humans. It is an occupational disease in shepherds, slaughter house workers, veterinarians, dairy industry workers and laboratory personnel.

The predominant symptoms in infected sheep and goats are abortions, stillbirths birth of premature and weak offspring. Aborted animals may retain the placenta. Abortion in sheep and goats occur only once but the organism can reinvade organs like uterus during subsequent pregnancies and shedding of organisms can occur. Some infected animals can carry the pregnancy to term, but can shed the organism.

Acute orchitis and epididymitis resulting in infertility can occur in

males. Arthritis is seen occasionally in both sexes. Non-pregnant sheep and goats can be asymptomatic also.

Etiology of brucellosis in small ruminants:

The genus *Brucella* is currently known to contain nine species: *B. abortus* affects cattle, *B. melitensis* affects sheep and goats and *B. ovis* infects sheep. *B. melitensis*, *B. suis*, and *B. abortus* are regarded as the most pathogenic/virulent and cause human disease in the majority of cases. Brucellosis is mainly caused by *Brucella melitensis* in sheep and goats.

Epidemiology of ruminant brucellosis

Brucellosis is present worldwide but is more prevalent in countries which are having poor animal and public health programs. Brucellosis has been eradicated from many developed countries like Australia, Canada, Israel, Japan, New Zealand and Europe. However, it remains an uncontrolled problem in regions/areas of high endemicity such as Africa, the Mediterranean, Middle East, and parts of Asia and Latin America.

Brucellosis is endemic in India and prevalence of the disease ranging from 6.5% to 16.4% in different species of livestock.

All India Coordinated Research Project on Animal Disease Monitoring and Surveillance (AICRP on ADMAS) NIVEDI in its annual report 2015-16, reported the overall prevalence of bovine brucellosis in the country as 2.3% with higher prevalence in the states of Nagaland (25%), Punjab (7.4%), Rajasthan (6%), Telangana (4.4%).

In Punjab, the overall prevalence of Brucellosis in the year 2000 was reported to be 11.80% in cattle, 10.67% in buffaloes and 3.60% in goats.

As per National Institute of Veterinary Epidemiology & Disease Bioinformatics (NIVEDI) annual report 2013-14, among 5 livestock species screened from different states/UTs of India, highest seropositivity was recorded in sheep (11.04 %), followed by swine (5.01%), goats (3.93%) and lowest prevalence was observed in cattle (3.48%).

Prevalence of brucellosis in sheep and goats in India

B. melitensis is the major cause of sheep and goat brucellosis in many

countries including India. Brucellosis is endemic in India and is prevalent in all parts of the country. The brucellosis infection is spread widely in India. In a national survey of sheep and goat brucellosis, cumulative incidence of 7.9% in sheep and 2.2% in goats was reported.

Serological surveys of small ruminant brucellosis in India indicated varying levels of infection in different states/UT's - 4.9% of sheep and 7.6% of goats in Karnataka, 11% sheep and 18% of goats in northern state of Delhi, 50% sheep and 16% goats in Punjab and 33% sheep and 30% goats in the weëtern state of Rajasthan, 55% of goats in Andhra Pradesh.

All India Coordinated Research Project on Animal Disease Monitoring and Surveillance (AICRP on ADMAS) NIVEDI in its annual report 2015-16, reported overall prevalence of brucellosis in small ruminants (sheep and goats) in the country as 5.1% with higher prevalence in the states of Telangana (16.8%), Karnataka (16.2%), Jammu and Kashmir (15.5%), Gujarat (8.6%), Andhra Pradesh (7.2%). The study observed that brucellosis is more prevalent in small ruminants than in large ruminants and stresses the need for mass vaccination of small ruminants (sheep and goat) to control brucellosis in India. also be a source of infection.

Milk and milk products

Milk from infected animals can contain large number of *Brucella* organisms. Milk products, such as cream or cheese, butter, yogurt, ice cream etc if prepared from raw/unpasteurized milk presents a particularly serious hazard. Whey formed from cheese making if not pasteurized could also transmit infection. It is always recommended to pasteurize milk before consumption particularly in areas in which brucellosis is prevalent. If pasteurization is not possible, the milk should be heated to a minimum temperature of 8085°C for at least several minutes, or boiled.

Meat

Muscle tissue usually contains low concentration of *Brucella* organisms. However, few organs like kidney, liver, spleen, udder and

testes may contain more number of organisms, hence these organs should be discarded. The handling of infected meat and offal without proper hygienic measures/precautions can also lead to the contamination of other foods. Few processing methods like drying, salting and smoking don't kill *Brucella*. Similarly, the oêganisms survive well under refrigeration. It is highly recommended that all meat products should be thoroughly cooked before consumption. (Brucellosis in Humans and Animals., WHO/CDS/EPR/2006.7)

Paratuberculosis in small ruminants: Methodology and timeline of work plan (Kashmir perspective)

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This paper summarizes indigenous and global vaccines and vaccination approaches currently used in order to control JD with respect to improvements in the body condition, health, productivity. At 530 million India possesses 13% of the global livestock population and is among 12 mega-biodiversity centres in livestock resources (Cattle-50, Sheep-44, Goat-34, Buffaloes-17, Camel-9, Yak-1, Mithun and wild life species. North Himalayan states (J & K, Ladakh and HP) are endowed with some outstanding breeds of sheep (Gaddi or Bhadarwah, Rampur Bushair, Bhakarwa, Poonchi, Karnah, Gurez, Kashmir Merino, Changthang); Himalayan goat breeds (Gaddi or White Himalayan, Changthangi, Chigu, Pashmina); Himalayan cattle (Badri or Pahadi, Uttarakha Belahi, Morni, Desi), Ladakhi (Jammu & Kashmir). This genetic bio-diversity is threatened by silent killer like Johne's disease (paratuberculosis), a major production disease, wherein high producing animals are being lost slowly. Temperate climate is additional stress on animals besides other stress factors (depleting nutritional resources, poor hygiene & housing, concurrent disease conditions-external & internal parasites), etc., leading to the loss of genetic diversity and low productivity.

Johne's disease (JD) is caused by *Mycobacterium avium* subspecies

paratuberculosis (MAP) in domestic and wild ruminants. Extensive studies from US, UK, Europe, New Zealand, Australia, India, Iran, Brazil, Africa, etc., reported high rates of JD in domestic ruminants. In India, data on incidence in precious animal genetic resources, especially in the high reaches of Himalayas (J & K, Ladakh and Lahul & Spiti (HP) is not well studied. Johne's disease (JD) caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) affects domestic livestock population world-wide. Disease is characterized by chronic enteritis and major symptoms are vague (diarrhoea -continuous, intermittent or no-diarrhoea), with progressive weight loss. Bio-load of MAP in our domestic livestock has shown increasing trend in last 28 years. Bio-load of MAP is highest (16.0–54.7%) in sheep, followed by buffaloes (28.3–48.0%), cattle (6.0–39.3%) and goats (9.4–20.1%). Once it enters any herd / flock, it becomes endemic.

Economic losses: These are mainly production losses and are due to, shorter life expectancy, reduced fertility, longer calving interval, heavy and premature culling, reduced salvage value, increased veterinary costs, higher susceptibility to other diseases, etc. In severely affected herds, losses are difficult to estimate since animals get culled early on health and production grounds from the elite germ-plasm developed through many years of genetic selection and breed improvement programs. Despite very high slaughter rate of domestic livestock (goats, sheep and buffaloes) to meet the ever-growing demand of meat and milk for domestic consumption and export, incidence of JD continues to increase and has become endemic in herds and flocks in India. Estimated 70.0% of US dairy herds are infected with JD, costing $200 million to $1.5 billion per year to dairy industry (NAHMS, 1997). In India, estimated economic loss due to JD is estimated @ Rs. 2000/ infected sheep/ year and @ Rs. 54,442.5/cow/lactation.

Disease Transmission: It occurs both vertically (one generation to another) through semen, during pregnancy, feeding of milk and colostrum and horizontally by oral-fecal route from contaminated environment. Since bacilli (MAP) is not killed or inactivated by

pasteurization therefore entering human food chain continuously through milk and milk products leading to potential public health issues. Human infection leads to development of auto-immune disorders, (Inflammatory Bowel Disease, Ulcerative colitis or Crohn's disease, rheumatoid arthritis, diabetes, etc. With increased use of pasteurized milkand milk products, incidence of auto-immune disorders has emerged as major health problems to human population.

In view of the chronic and insidious nature of the disease, control programs can be time consuming and may take a minimum of 5 years or longer to be successful in controlling JD. Countries without paratuberculosis control practices of any kind are likely to suffer with greatest impact to human welfare through reduced production of animal protein and potential zoonotic impact. The practices and tools for the control of JD are well known and predominantly limited to breaking the transmission cycle.

Test and cull method: Culling of infected animals has been used globally to control JD has failed miserably since bacilli is transmitted to next generation vertically, so transmission cannot be stopped. It is not economically viable in India and other poor countries. Culling of cows is not feasible due to ban on cow slaughter in India.

Regular removal of shedder goats ('Test and cull') at ICAR_CIRG, Makhdoom since establishment of goat farms in 1979 has not reduce disease burden. Similar findings in goats have been reported in other parts of the world buffaloes and cattle where 'test and cull' methodology was ineffective, therefore switched to vaccination for the control of the disease.

In developing and poor countries where disease is highly endemic, it is not possible to indiscriminately cull large number of infected animals with high to very high level of infection (super shedders), primarily due to economic reasons. Therefore, it will be prudent to first focus on culling or segregation of super-shedders and then focus should be on resistant/resilient animals known to have received an infectious dose of MAP bacilli at an age when they were susceptible but not infected or

remain in a dormant state so that when the animal is examined at necropsy, the infection cannot be detected by culture of tissues and there is no evidence of disease in the histopathological examination also.

Improved management practices: JD may be controlled by preventing newer cases of infections in kids and lambs or by eliminating source of infection, which can be achieved by identifying infected sub-clinical and clinical shedder animals and then either culling or segregating them from healthy stock.

Culling (forced removal) of clinical cases, 'test and cull' approach for sub-clinical cases, hygienic rearing of young animals, bio-security measures and management of shed environment and pasture were leading approaches for control of JD. Shed complexes and calving pens should be cleaned to reduce fecal contamination on the coats of animals. Weaning of the kids / lambs after colostrum feeding from JD-negative dams helps in reducing the risk of infection to new animals from infected parents. In already infected herds, manure management associated with feeding of colostrum or milk from JD-negative dams should get priority. Water should be piped and ponds and streams should be fenced to minimize fecal contamination of drinking troughs and grazing area may help to reduce losses due to JD.

These precautions are not practiced and grossly over-looked in livestock farming in India, since majority of the livestock population of the country is in the hands of poor and marginal farmers. As a consequence, livestock frequently graze on public properties and is categorized as 'zero-input agriculture', with little or no attention on health care and lack of additional inputs in the form of green fodder and concentrates. MAP infection is predominantly prevented by closing new animal additions or securing additions or replacements from JD-free/negative herds. Off-springs of positive goats and sheep are at risk for infection and should be either segregated or tested biannually. For elimination of JD, culling of daughters of sero-positive or culture-positive animals has been practiced in some of the developed countries. Annual testing of adult animals in herds is essential to identify and cull

asymptomatic, sub-clinical and clinical shedders.

Application of the diagnostic tests in the control programs has been critical for the chronic, insidious and spectral disease like JD, with focus on the presence and absence of bacilli and/or antibodies. Though culture is more sensitive and considered 'Gold standard' test, ELISA has been found to be quick and cost effective as screening test Microscopy using Ziehl Neelsen staining (cheap, quick, screening test, specificity is low) and IS900 PCR (confirmatory, laboratory intensive and costly) are other methods for determining infection status. Problem with this approach is the long- and variable-time interval between the infection and time when the animals will either test positive or exhibit clinical symptoms (incubation), which in turn is dependent mainly on factors like management, nutrition, health care and other in-puts.

Vaccination strategy: Vaccination is the most efficient and cost-effective strategy for the prevention of appearance of the clinical cases in herds. Only seven countries have a control program in place that include vaccination. Major reason for not using vaccine is likely due to the interference of JD vaccines with serological tests for bovine tuberculosis. Control of JD using vaccination, 'test and cull' or combined approaches waeconomical and has been used as a tool to aid the control programs for JD in Australia, New Zealand, Spain, the Netherlands, Canada, Iceland and India. However, vaccination has been prohibited in Denmark, Norway and Sweden and stamping out have been used as control practices instead. As an example, Australia used vaccine approach (5–35 years) to reduce infection from >35% to eradication of infection. Immunity frequently breaks down when vaccinated animals are sold to other herds, negating the value of vaccination for herds selling breeding animals for replacements. As a result of this and because of vaccination with a live organism that may be capable of potentially infecting humans, therefore live vaccines are not favored by several countries. Killed vaccines are preferably used and positive cost benefits have been reported with their use. Currently there are limited number of killed vaccines licensed internationally against JD. Research into development of

improved vaccines is being undertaken in many countries in the world. The main drawback to vaccination is that, since vaccines used in the field are not DIVA and can interfere with serological diagnosis of paratuberculosis and tuberculosis infections. There is also potential for interference with the skin test for tuberculosis. Tests capable of DIVA has been successfully developed and validated using field samples. Over the period of few years, economic advantages of vaccination might be much higher than 'test and cull' strategy and combined approaches may be most effective in clinical shedders. Furthermore, it has been suggested that vaccination might be the beginning of the end of this devastating problem of domestic livestock world-wide known as 'paratuberculosis' and might mark the difference between doing nothing and advancing towards global control.

Conclusions: Reducing burden of JD will have a huge impact by turning loss making livestock farming into viable enterprise and prevent loss of bio-diversity. For the effective control of this incurable disease effective vaccine is the most potent option. At present, JD control program are severely hampered due to lack commercial vaccine in India. An 'indigenous vaccine' for JD developed by author has been approved for use in India by Drug Controller General of India (DCGI), New Delhi, has proved to be both preventive and 'therapeutic' in sheep, goats, cows and buffaloes. Combined approach using vaccination with 'test and cull' and better management of animals and animal waste was far more economical and more effective strategy to control persistent losses and increased incidence in herds of goats, buffaloes and cattle and sheep flocks.

Vaccination in Small Ruminants and Policy Considerations

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Introduction

Vaccination has long been an effective way to reduce disease burden in small ruminants and is a key tool in maintaining their health and welfare. The main types of vaccines available can be categorized as modified-live (attenuated), inactivated, recombinant and toxoid.

- **Modified-live (attenuated)**: a vaccine that contains an intact but weakened pathogenic microbe that stimulates an immune system but does not cause the clinical disease.
- **Inactivated (killed)**: a vaccine that contains a killed pathogenic microbe, which is no longer infectious. The killed pathogen is often applied together with an adjuvant, which is a chemical compound added to help improve the immune response.
- **Recombinant**: a vaccine that is produced using DNA recombinant technology and using a specific antigenic gene from a pathogen to produce protein antigen which will stimulate an immune response when the animal is vaccinated.
- **Toxoid**: a vaccine that is based on inactivated toxins produced by a pathogenic microbe. Like a killed vaccine, they are applied along with adjuvant to stimulate immunity and protect the animal against the toxin.

SMALL RUMINANT VACCINATION

Core (recommended) vaccines are those vaccines that protect

animals from severe, life-threatening diseases that have global distribution. They should be received by all animals, regardless of circumstances or geographical location. Core vaccines for sheep and goat are those that protect against clostridial disease - Enterotoxemia caused by *Clostridium perfringens* type C & D and Tetanus caused by *Clostridium tetani*.

Non-core (optional) vaccines as those that are required by only those animals whose geographical location, local environment, or farming practices place them at risk of contracting specific infections. These include a vaccine against *Brucella*, Footrot, Sheep pox, PPR, Blue Tongue, FMD, and Orf.

VACCINATION POLICY

Vaccination policy is the health policy an organization adopts about vaccination. Vaccination policies can be developed to eradicate the disease or create herd immunity for the animal population the organization aims to protect. Within the organization, vaccine advisory committees are usually responsible for providing evidence-based decisions regarding vaccines and immunization policy.

FORMULATING VACCINE POLICY

Assessment phase:

The first area concerns the disease that the vaccine in question targets whether it is a animal health priority, the magnitude of the disease burden in the animal population and the existence and effectiveness of other strategies for preventing and controlling the disease.

The second area relates to the vaccine its safety, performance and other characteristics; its economic and financial attributes (cost, affordability, and cost-effectiveness); and whether the organisation can expect a reliable supply of the vaccine.

The third area concerns the capacity of the immunization programme and underlying health system to successfully introduce the vaccine and to be able to continue to deliver it over the long term.

As a result of this assessment of the issues, the decision might be to

introduce the vaccine or not to introduce it at this time. Policy-makers may have to make further decisions about the scope of vaccination, target ages and schedule, and the specific vaccine product, since these have policy and financial implications.

Planning phase:

It involves

- Choosing the immunization strategy i.e. phased or simultaneous introduction
- Selecting the vaccine, presentation and formulation, safety, ease of use
- Cold chain, transport and storage requirements
- Assuring quality and procuring the vaccine and injection supplies
- Planning procuremeå t options, Forecasting supply needs.
- Staff training

Implementation phase:

It involves

- Vaccine procurement, transport cold chain, storagerequirement and logistics needed
- Vaccination of the animals
- Recording the vaccinated
- Recording adverse reaction to vaccine
- Ensuring injection safety and safe waste disposal of vaccine
- Supervision of the field staff

Monitoring and evaluation phase:

Coverage monitoring this is routinely done using administrative data from immunization registries, vaccination cards and tally sheets. Comparison of coverage and dropout rates with that of other vaccines can identify problems with the vaccine introduction.

Disease surveillance the ability to monitor the impact of a vaccine on disease will depend on the nature of the disease being

prevented and the existing surveillance system. Baseline data on disease incidence, mortality and epidemiological patterns (e.g., prevailing serotypes, age distribution) are recorded.

Vaccine safety monitoring (vaccine pharmacovigilance) It involves adequate monitors of vaccine safety, including detecting and investigating possible reactions or adverse events following immunization.

Vaccine potency monitoring this involve analysing seroconversion and deterring persistence of immunity/antibody (duration of immunity)

CHARACTERISTICS OF VACCINE FOR CONSIDERATION

The characters of vaccine that need to be taken into consideration are:

Vaccine quality

- Potency/ immunogenicity/ protection power
- Antigenic mass
- Safety
- Sterility for killed vaccine & freedom from any extraneous organism in live vaccine
- Innocuity (harmlessness)
- Freedom from any non-inactivated virus or bacteria in inactivated or live vaccine

Other characteristics:

- Number of doses required The greater the number of doses, the more difficult it is to achieve high levels of coverage
- Formì lation: Combination versus monovalent products Combination vaccines require fewer delivery devices (e.g., syringes) and less cold storage space, but they can be less flexible
- Live versus killed
- Lyophilized vs. liquid products Lyophilized products require diluents and reconstitution devices. They also require extra cold storage space at the peripheral level, since the diluents need

refrigeration before reconstitution. Some lyophilized vaccines also result in higher wastage rates due to the need to discard the vaccine within six hours after being reconstituted. In addition, they create the risk that an incorrect diluent is used, possibly causing adverse events. On the other hand, lyophilized vaccines are often more heat stable than comparable liquid vaccines

- Heat and freeze sensitivitya more heat-stable product would facilitate the delivery of the vaccine and improve immunization coverage. Another important consideration is the sensitivity of the vaccine to freezing, which is relevant for severaä of the newer î accánes
- Presentation and packaging--the number of doses per vial for the vaccine will affect wastage rates and cold chain capacity requirements
- Emulsion stability for oil-adjuvanted vaccine
- Shelf-life
- Availability of vaccine supply There are many factors that affect the available supply and prices of vaccines. New vaccines are often produced by one or two manufacturers for the first several years after initial licensure.
- Cost-Economic and financial issues the cost of adding a vaccine to the schedule and how it will be financed are important considerations when making a decision about new vaccine introductions. (Cost-effectiveness analyses)

POLICY CONSIDERATIONS LIVE VERSUS KILLED VACCINE FOR SMALL RUMINANTS

Bacterial vaccines for small ruminants:

Clostridial Disease**:**

- The preferred vaccine is 3-way CD-T toxoid
- *Clostridium perfringens* have seven toxinotypes (AE)
- Type C causes a hemorrhagic enteritis ("bloody scours") in suckling lambs during the first few weeks of life. It may be triggered by changes in feed or receiving too much feed
- Type D causes enterotoxemia (overeating disease) and pulpy kidney disease. It usually affects lambs over one month of age and is often precipitated by a change of feed.
- Tetanus is a potential risk at docking and castration time. If their ewes were vaccinated when pregnant, then revaccination of lambs is unnecessary.
- Vaccination of the ewe in late pregnancy, four weeks before lambing, offers protection for first few months.
- Primary vaccination at the age of 4 month for kid or lamb (If dam is vaccinated). At the age of 1st week for kid or lamb (If dam is not vaccinated). Booster 3 to 4 weeks after primary vaccination.
- The 7and 8-way vaccines are combination vaccines used to protect against other clostridial diseases such as malignant edema, "big head", and black leg caused by wound infections. These should only be used if these other clostridia are knownto be present in a flock.

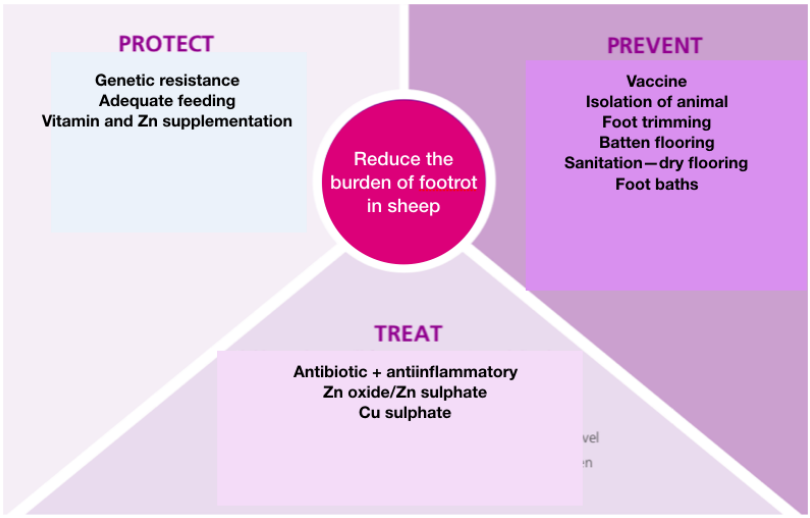
Foot rot:

- Footrot is primarily caused by *Dichelobacter nodosus*. Infection by *D. nodosus* is preceded and accompanied by maceration and

colonization of the interdigital skin by *Fusobacterium necrophorum*.

- Based on the antigenicity of their fimbriae, there are 10 major serogroups of *D. nodosus* (A-I and M), and within these serogroups there are additional serotypes (other classification systems have identified as many as 21 serotypes).
- Immunity is serogroup specific and multiple different serogroups may be found within a single sheep flock.
- **Whole cell vaccines** are rarely protective against heterologous subgroups. The vaccine is not ideal and rate of abcession is very high.
- The **fimbriae** provide the major antigenic determinants (also called epitopes) and as such are the major protective antigens.
- Denatured fimbriae are not protective either. However, fimbriae containing pilin polymers are as effective as whole cell vaccines. These fimbrial antigens may be derived by physicochemical methods or produced in recombinant organisms.
- A **multivalent recombinant fimbrial vaccine** containing ten serogroups (A, B1, B2, and C to M) is currently used in Australia and other countries. It is not ideal, and protection lasts for less than 10 weeks.
- A coordinated approach should be adopeted for the control of footrot in Kashmir as shown in the figure:

Framework for coordinated approaches to footrot control



Brucella:

- Brucella melitensis Rev.1 is the most widely used vaccine for the prevention of brucellosis in sheep and goats,
- Rev.1 vaccine is known to often cause abortion and excretion in milk when animals are vaccinated during pregnancy, either with a full or reduced dose.
- No matter the inoculation route, the standard dose must be between $0.5 \times 10\text{^}9$ and 2.0×10^9 viable organisms.
- The standard dose of Rev.1 administered by the conjunctival route when the animals are not pregnant or during the late lambing/kidding and pre-breeding season.
- It should be given to lambs and kids aged between 3 and 5 months as a single subcutaneous or conjunctival inoculation, 5 months being the upper time limit to minimise the antibody response to make this vaccination compatible with further serological testing.
- Field evidence shows that the immunity conferred declines with time,

and revaccination within 6 12 months could be advisable in endemic areas.

- The subcutaneous vaccination induces long lasting serological responses, causing strong interferences in serological tests and should not be recommended for use in combined eradication programmes.
- B. abortus RB51 vaccine is not effective against B. melitensis infection in sheep.

Viral vaccine for small ruminants

Peste des petits ruminants:

- PPR is caused by a virus of the family Paramyxoviridae, genus Morbillivirus.
  Several homologous PPR vaccines are available, being cell culture-attenuated strains of natural PPRV.
- Vaccine gives strong immunity and shown to be effective in providing protection iå animals for atleast 3 years when administered at the recommended dose.

Sheep pox:

- Both live atíenuated and killed vaccine are available.
- Sufficiently attenuated and tested vaccines are safe and can be used in pregnant animals providing three months of immunity to lambs.
- Some attenuated strains may have unacceptably high levels of residual pathogenicity and may cause skin lesions and generalised disease in some animals.
- Local reaction at the inoculation site and transient raise in body temperature are typical of live attenuated poxvirus vaccines and should be accepted as an indicator of virus replication, which is required for the production of strong cell-mediated immunity in vaccinated animals.
- Immunity provided by inactivated vaccines is not long-lasting (up to six months) and is considerably shorter than that afforded by live attenuated vaccines. Therefore, vaccination with an inactivated

vaccine should be repeated at six-month intervals.

Blue tongue:

- Vaccination, preferably using an inactivated virus, is recommended as a first line of defence but within a set of measures including mainly animal movement control and Culicoides control.
- Live attenuated vaccines should not be used during Culicoides vector seasons because these insects may transmit the vaccine virus(es) from vaccinated to non-vaccinated animals (including other ruminant species). This may result in reassortment of genetic material and give rise to new and potentially more pathogenic viral strain.
- Potential adverse consequences of live attenuated vaccines are depressed milk production in lactating sheep and abortion/embryonic death and teratogenesis in offspring if used in pregnant animals. The risk is increased when live attenuated vaccine are injected during the first third of pregnancy.
- Inability to distinguish serologically naturally infected and vaccinated animals with live attenuated vaccines.

Foot-and-mouth disease:

- Due to the often inapparent nature of the disease in sheep and goat, FMD is not clinically important in sheep and goat. However to control the FMD, the vaccination of all susceptible species is important.
- Inactivated virus vaccines for FMD are only recommended vaccine for control
- Live FMD vaccines are not acceptable due to the danger of reversion to virulence and as their use would prevent the detection of infection in vaccinated animals.
- The vaccines used should meet OIE standards of potency and safety, and the strain or strains in the vaccine must antigenically match those circulating in the field.

Orf:

- Orf vaccine is unique because it contains virulent virus obtained from the scabs of affected animals.
- Lambs should be vaccinated when around one month of age. A booster may be administered two to three months later.
- The vaccine is brushed on to scarified, woolless skin. It is commonly administered by a scratch to the inner thigh or foreleg of a lamb.
- Ewes are vaccinated inside the ear or under the tail. The site should be checked 7 to 10 days after vaccination to ensure vaccine "take." If positive, the scratch will be raised and inflamed. It produces an uncomfortable lesion, but after 12 to 14 days the scab falls off, the lesions heal, and the young animal is immune.
- Soremouth is a zoonosis and will cause disease in humans. Vaccinators must therefore wear appropriate protection, including gloves and goggles.

CONCLUSION

- Kashmir's small ruminant industry has the potential to improve the living standards of farmers and households, as well as to increase animal protein available to the public. The microbial disease has a major significance in small ruminant production and many of them are endemic to the state. Also, by virtue of Jammu and Kashmir's geographical location and its borders with Pakistan and China, the small ruminant population in the state is specifically vulnerable to several transboundary microbial diseases, including PPR, BT, FMD, sheep pox/goat pox, brucellosis, and other diseases. Prevention of these microbial diseases employing vaccination should form an integral part of the health plan for small ruminants. Vaccination should help in terms of improving animal health, increased production efficiency, less veterinary costs, less use of medication, and keeping safer food chains by decreasing the incidence of foodborne illness.

Revisiting the Existing Vaccination Schedule of Department of Sheep Husbandry, Kashmir

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The Edward Jenner a British-French physician and scientist pioneered the concept of vaccines including creating the smallpox vaccine in 1796 and laid foundation stone of the world vaccines. The method involved taking material from a blister of someone infected with cowpox and inoculating it into another person's skin; this was called arm-to-arm inoculation. However, by the late 1940s, scientific knowledge had developed enough, so that large-scale vaccine production was possible and disease control efforts could begin in earnest. The next routinely recommended vaccines were developed early in the 20th century. These included vaccines that protect against Pertussis (1914), Diphtheria (1926) and Tetanus (1938). These three vaccines were combined in 1948 and administered in the name of DPT vaccine.

Vaccines for animal diseases were the first to result from laboratory-based scientific investigation. French chemist Louis Pasteur developed a vaccine for chicken cholera in 1879, and one for anthrax of sheep and cattle in 1881.

There is a huge list of animal and poultry vaccines used for prevention and control of bacterial, viral and protozoan diseases. Vaccines have played important role in the prevention, control or eradication of infectious diseases in man, animals and poultry. Thus serve an essential warfare in the battle against infectious diseases. Glaring

examples are the eradication of diseases like small pox (of human) and Rinderpest (cattle plague) through vaccination. Both diseases used to play havoc before vaccination. On May 8, 1980, the33rd World Health Assembly officially declared the world free of smallpox disease. Eradication of smallpox is considered the biggest achievement in international public health. Similarly rinderpest was declared eradicated in 2011, making it the first animal disease to be eliminated in the history of humankind. For centuries, rinderpest caused the death of millions of cattle, buffalo, yak and wild animals, leading to famine and starvation.

There are five main types of vaccines: Live-attenuated vaccines, Inactivated vaccines, Subunit vaccines, Toxoid vaccines and Conjugate Vaccines. Lately two other types i.e, DNA vaccines and Vector vaccines were added in the list. Success of the vaccines may vary with the type of vaccine.

Usage of veterinary vaccines vary from country to country or region to region depending upon the absence or presence of disease as well as type or strain of the infectious agent involved in a location. This further depends upon the vector or intermediate host involved in a particular disease. Multi-component vaccines have been also introduced for ease of administration.

Other criteria for selection or introduction of a vaccine depend upon the epidemiological trends of the disease. In case of veterinary vaccines, the nature of the infectious disease also plays an important role. For example, a disease though serious but may be sporadic or have very low incidence may not hold good for vaccination. Economic impact and zoonotic potential of a livestock disease do play tremendous role in vaccine decision policy. Socio economic conditions of country or location which may not allow stamping out policy also compels for mass vaccination or compulsory vaccination as is the case with Foot and Mouth disease (FMD) in India. Thus keeping in view the nature, economic impact and socio economic conditions of the disease each state or a country may have its own vaccination schedule for large, small ruminant animals and poultry. Accordingly, Departments of Animal Husbandry and Sheep Husbandry of Jammu and Kashmir union territory do have its

vaccination schedule for safeguarding the livestock health, enhancing animal production and products of the state, besides to minimize the zoonotic threats to the public health and to prevent the economic losses to the farmers. This becomes essential also to boost or realize one health campaign across the globe

Vaccination in animals often occurs in high risk areas or when an outbreak is occurring or is predicted. Vaccination is seldom continuous or covering all species and there are seldom enough animals protected by the next outbreak to provide the herd immunity. When the next outbreak starts there might be a mix of naturally infected, vaccinated and still naive animals in the herds. This complicates sero-surveillance and early detection. To overcome this difficulty introduction of Differentiating infected and Vaccinated Animals (DIVA) vaccines are in progress.

Maintenance of cold chain and storage are also important in successful vaccination. To overcome some of the storage difficulties lyophilization has been also used for storage and efficacy of vaccines. Further in case of multivalent etiological agents like FMD virus and *Dichelobacter nodosus* the regular updation of the vaccine is mandatory based on field surveillance.

The Sheep and goat farming is a very vibrant sector of the Jammu and Kashmir Union territory (JK UT) for its food security and economic upliftment. The erstwhile state and now UT is unique in the country to have separate and full-fledged department for the sheep and goat production. The commitment of pioneer leaders of the Department can be well judged by receiving Padma Shri. The Department has made tremendous progress and achievement in its cross breeding programme and has been successful in introducing foreign germplasm for its mutton and wool production. However, the department is encountered with numerous inherent problems like lack of pastures and fodder besides facing many diseases of infectious and non-infectious nature. Right from the inception, the Department has been facing the various viral and bacterial diseases taking heavy toll of the sheep and goat population. The economic or zoonotic ones being Sheep pox, enterotoxaemia, contagious ecthyma (Orf), Goatpox, Foot and mouth disease (FMD), Black disease,

Braxy, Brucellosis, Contagious Caprine Pleuro Pneumonia (CCPP) and Pneumoenteritis/ abortions of bacterial and viral nature. Over the period some other infectious or contagious diseases have emerged which include Jhone's disease (JD), Peste des Petits Ruminants (PPR) and the rampant foot rot. Thus, the Department has been continuously fighting against these challenges by adopting latest therapeutic, prophylaxis and control measures. This includes the vaccination against Sheep pox, enterotoxaemia, FMD, PPR etc. on regular basis while for against rabies and anthrax on need basis. However, any scientific policy matter is always to be updated or improved to keep pace with modern trends and better performance. So is true for vaccination schedule of the JK UT.

Keeping in view the present scenario, Department of Sheep Husbandry, Kashmir need to update its vaccination schedule for better production and to prevent losses to the farmers. Thus it is strongly recommended that vaccination against foot rot be added as a regular feature and same against CCPP and JD may also be used as and where required.

Pathological Evidence of Paratuberculosis in Sheep and Goat

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Veterinary pathology is the scientific study of disease processes that affect normal anatomy and physiology of animals. Anatomical and physiological changes are the result of an underlying disease process or abnormality. Various injurious agents like bacteria, viruses, fungi, parasites etc., which are the main sanitary problems in livestock production, are responsible for bringing about these changes in the organs, tissues and cells of the body. These changes have been studied and a tremendous advancement has been made in linking these changes for identification of the injurious agent. The abnormalities that occur in normal anatomy (including histology) are reflected in the physiology (normal functioning) of the body and also in the alterations in the hematological and biochemical constitution of the body which correspond to the pathopysiology, haematology and clinical biochemistry disciplines.

The anatomical abnormalities in the organs or tissue are called as lesion which may be visualized either grossly or with the help of microscope (histopathology). The changes are brought about with the progression of the disease. The genesis of the disease from its initiation to its development is called as pathogenesis and is=usually characteristically observed in a disease. An experience with visualization of these changes at the necropsy table and under microscope helps the pathologists to give diagnosis of the disease. An

experienced pathologist is able to give a fair amount of diagnosis as he visualizes the various body organs at the necropsy table itself. Occasionally, the characteristic gross and/or microscopic lesions (pathognomic lesion) give a conclusive diagnosis of a particular disease. Therefore, the knowledge and understanding of pathology is essential for all would-be doctors as it helps to know the causes, mechanisms, nature and type of disease. For example, clinically weak and emaciated goat revealing gelatinization of subcutaneous and visceral fat along with corrugated appearance of intestine, resembling the surface of brain, is characteristic of paratuberculosis in goats. The diagnosis is further supplemented by histological demonstration of fusion of intestinal villi having broadening club shaped appearance. Ziehl Neelsen's staining method helps to demonstrate the acid fast organisms *in situ* in the tissue sections (Figs 1-4).

Fig 1. Extreme cachexia and dehydration in an adult goat affected with paratuberculosis

Fig 2. Intestines of Paratuberculosis affected goat showing thickening and corrugations.

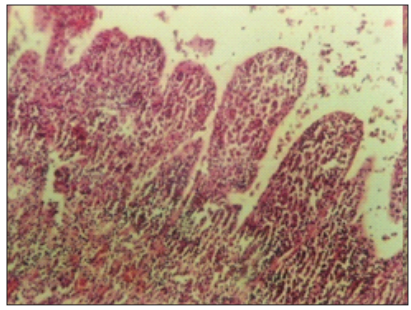

Fig. 3. Section of jejunum from paratuberculosis (multibacillary) affected goat revealing fusion of villi and broadening giving a club shaped appearance. HE x 10.

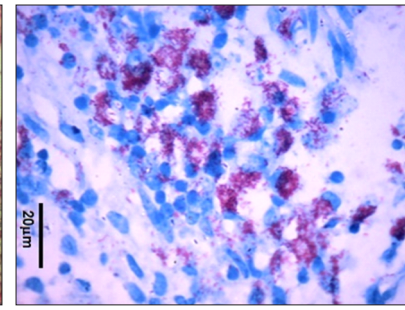

Fig 4. Mucosa of goat intestine showing acid fast *M. Avium paratuberculosis*. Ziehl Neelsen's stain

The tissue sections, frozen and/ or fixed, are further subjected to various histo-chemical, histo-enzymic, immune-histochemical and *in situ* hybridization techniques to arrive at the causation of diseases. Light microscopy supplemented with electron microscopy has further enhanced the knowledge of sub-cellular pathology. Half the battle of making an accurate assessment of health and disease is to understand the range of normal gross and histological anatomy.

Surgical pathology, another field of pathology, is the study of tissue samples removed during surgery. These are used to help diagnose a disease and decide on a treatment plan. Often a surgical pathologist provides consultation services in a wide variety of organ systems and medical/veterinary subspecialties. Surgical pathologists give diagnostic information or second opinions. For example, a surgical pathologist may

examine tissues removed during mammary gland cancer surgery. The examination is usually performed by a combination of macroscopic and microscopic examination of the tissue, and may involve evaluations of molecular properties of the tissue by immunohistochemistry or other laboratory tests. This can help the surgeon decide if he or she should remove lymph nodes associated with the gland. The pathologist may give the diagnosis whether the tumor is benign or malignant, along with the grade of the cancer, on the basis of histological evidences.

Mastitis in Sheep and Goat: Prevalence and Control Strategy

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Mastitis

Mastitis refers to inflammation of the mammary gland regardless of cause and is most commonly caused by infection with an infectious pathogen (intramammary infection [IMI]), sometimes it may also be caused by injury and, less commonly, by allergy and neoplasm. The various types of mastitis are characterized by either physical, chemical, and usually bacteriological changes in the milk, pathological changes in the udder or both. The early recognition of mastitis and timely treatment are vital for preventing tissue damage and production losses.

Classification of mastitis

1. Clinical mastitis

Clinical mastitis is externally evident visually or by palpation of the udder or by systemic effects such as pyrexia or altered behaviour of the affected animal. The main signs of clinical mastitis include swelling, redness or necrosis of one or more udder halves and abnormal discharge of milk (clots/flakes/serum), as well as other systemic symptoms such as anorexia, fever or agalactia. The clinical syndrome can follow a variable course, ranging from per-acute to chronic. The occurrence of chronic disease may produce clinical pictures, which become gradually less clinically evident.

2. Subclinical mastitis

Subclinical mastitis is infection of the mammary gland with no outward clinical signs of inflammation. It has been defined as the simultaneous bacterial isolation and presence of an inflammatory reaction in the mammary gland such that functional changes occur in the absence of abnormal gross findings in the mammary gland or systemically. Despite a lack of overt clinical signs a reduced milk yield is frequently observed in dairy cows, dairy goats and dairy sheep with subclinical mastitis. In contrast, in suckler ewes, subclinical mastitis will often pass unnoticed, although a decreased lamb weaning weight has been recorded.

Etiology

Globally, staphylococci are the most common mastitis-causing agents in cows, buffaloes, ewes, does and even woman. It is followed by Streptococci and *Escherichia coli* which in some species may have a similar or higher prevalence than that of staphylococcal mastitis, while less commonly, other Gram-positive bacteria (*Actinomyces* spp., *Corynebacterium* spp., *Bacillus* spp., *Mycobacterium* spp., *Enterococcus* spp., *Clostridium* spp.) and Gram-negative bacteria (*Klebsiella* spp., *Citrobacter* spp., *Serratia* spp., *Proteus* spp., and *Pasteurella* spp.) have also been reported. Mycoplasma may be involved in the aetiology of mastitis while cases due to moulds or yeasts are rare).

Incidence

a) Clinical mastitis

Most cases of clinical mastitis in ewes occur up to 4 to 8 weeks after parturition or immediately after weaning. Compared with housed ewes, those grazing pasture have a lower prevalence. The incidence is usually lower than 5% per year but mastitis can be responsible for up to 10% of all ewe deaths. In a low percentage of herds and flocks with management problems, the incidence is higher and may exceed 30 -50% of the animals, causing mortality or culling of up to 70% of the herd.

b) Subclinical mastitis

The incidence and prevalence are defined by the bulk SCC of the herd. In French does, SCC values of 750,000, 1,000,000 and 1,500,000 cells/ml correspond to 30%, 39%, and 51% prevalence of subclinical mastitis. Similarly, Spanish flocks with SCC values of 250 000 or 1,000,000 cells/Ml corresponded to subclinical mastitis prevalence of 16 and 35% respectively. It is reported that the prevalence of subclinical mastitis (SCM) is between 5% and 30% per lactation. Murphy and co workers observed that the average incidence of clinical mastitis (CM) is relatively low (1.2% to 3%) across flocks sampled around the world; however the morbidity rate of SCM in sheep is much greater than CM (12-50%). In dairy sheep flocks, mastitis prevalence of 22-48% and up to 40% has been reported by various authors.

Diagnosis

1. Physical examination

a. Visual examination and udder palpation

The visual examination of the udder should be undertaken to observe colour changes, injuries, nodules as well as changes in the general shape of the udder (increase in size and atrophy) followed by palpation of both udder halve in order to palpate fibrotic changes in udder or teat canal.

b. Visual Examination of Mammary glands Secretion

The first few streams of milk are to be drawn from the teat onto a paddle or on the palm of the gloved hand of the investigator to observe the abnormal features in mammary secretion e.g., clots, flakes and tints.

2. Chemical Examination

a. Milk tests

Various tests are used and include California Mastitis Test (CMT) and Somatic Cell Count (SCC) are regarded as the best indirect tests to diagnose IMIs in both sheep and goats, when they are interpreted correctly.

b. Indication Paper tests

- pH indicatioå papers
- Mastitis Card Test

3. Ultrasonographic Examination

Ultrasonographic is a non-invasive, rapid and painless tool useful for monitoring the changes in the mastitis affected udder and providing significant information about the udder status.

4. Endoscopic Examination

Teat endoscopy is a non-invasive method for the diagnosis of teat lesion in farm animals and helps in evaluating the abnormalities of the teat duct and teat cistern.

5. Bacteriological Examination of Milk Samples

Bacteriological examination of milk samples remains the 'gold standard' for aetiological diagnosis of the clinical mastitis in small ruminants.

Economic Impact

Mastitis has a significant effect on economy as well as welfare in small ruminant production particularly in dairy-type flocks. The financial loses occur predominantly due to the reduction in milk yield, reduced milk quality, rejection of milk after antibiotic administration and also due to lamb loses. In meat type flocks also mammary infections are an important cause of financial loses as reduced milk yield of ewes leads to suboptimal growth of their lambs and kids and also caused increased lamb and kid mortality from starvation. According to Moulk, (1954) poor mothering of lambs, either because of a reduced mothering instinct or because of udder problems, including those caused by intra-mammary infection, blind teats or poor nutrition, has been implicated as the most significant contributor to the high mortality rate in lambs.

Control and Prevention

According to Domingues and Langoni 2001, a broad mastitis control program based on prevention will provide reduction in losses associated with mastitis, improve milk quality and increase yield. The

mastitis control programme mainly revolves around management and includes:

1) Hygiene

- **Environment**: The risk of mastitis increases greatly in dirty environments. When dairy goats or ewes lie down, their udders are in direct contact with the floor, thus, bedding, living and birthing areas should be clean and dry at all times.
- **Milking hygiene**: Hygiene during milking is the basis for the success of a program to control mastitis in small ruminants. It involves hygiene of milkers, facilities, equipments and even animals.

2) Cull all ewes and does chronically affected by mastitis

- The udders of all ewes/does in the herd should always be examined after weaning and before breeding to detect the animals with chronic mastitis. The examination should be carried carefully, and not only the udder tissue but the teat canals should also be felt to detect any fibrosis (a thickened cord) which is a sure sign of chronic mastitis. It is recommended that the ewes and does that have hard lumps in the udder or have severe damage of one or both the teats should be culled as they are uneconomical owing to decreased milk production. Additionally, producers should consider culling ewes/does with severe mastitis that do not show an immediate response to treatment.

3) Ewe nutrition

- In the prevention of all types of mastitis, correct nutrition is vital to achieve adequate body condition of ewes at lambing and during early lactation in order to ensure that sufficient milk is provided for their lambs.

4) Prevent teat damage

- Ewes which have inadequate milk for the number of lambs they are rearing are particularly prone to teat lesions. Teat lesions have been reported to be a risk factor for development of mastitis.

5) Biosecurity for Herd Replacements

- Biosecurity measures must be used to ensure that herd replacements

are not infected with contagious mastitis pathogens (specifically *S. aureus*, *S. agalactiae*, and *M. bovis*). An optimal biosecurity program includes knowing the herd of origin, knowing the ewes/does, and protecting the home herd.

6) Weaning management

- Ewes with more than one lamb should have their lambs weaned together and feed inputs should be reduced to rapidly discourage milk production (e.g, by bare grazing or housing on straw for a few days). The lambs or kids form ewes or does whose milk production has not sufficiently decreased should not be weaned abruptly as it puts severe stress on the udder thereby predisposes animal to mastitis.

7) Dry therapy

- Dry therapy is not a routine practice in small ruminants. However, wherever practised it is recommended to be used after the last milking when the animals are dried-off. The effective use of dry therapy helps in reducing the prevalence of both clinical and subclinical mastitis in sheep and goats leading to improvement in herd production. There are at least two preparations licensed for ewes-Orbenin LA (Pfizer) and Streptopen Dry Cow (Schering-Plough Animal Health).

8) Health management of lambs and kids

- *Pasteurella hemolytica*, the organism which is one of the important causes of pneumonia in lambs or kids has also been reported to contribute to mastitis in ewes. It is thought to be transmitted from lambs to ewes during milking and therefore preventing these in lambs and kids can also help in preventing mastitis.
- Sore mouth is another contributing factor, as lambs/kids with mouth lesions can infect their dams and any other ewe/does that they may nurse.

9) Proper milking procedures should be followed

- Milking procedures should be followed properly and consistently. Milking clean, dry and properly stimulated teats allows the most

efficient harvesting of milk and reduces the risk of udder infections. Also milking the healthy animals first and then the suspected animals is also important to prevents cross infection.

10) Prompt treatment and constant vigil

- Using good management practices and acting quickly if mastitis is discovered will help keep this particular health issue to a minimum. The ewes and does showing signs of the disease should be separated from the flock and treated.
- Performing monthly CMT test, aiming to monitor cases of subclinical mastitis;

11) Pre and post-milking teat dipping

- In dairy animal's pre and post-milking teat dipping greatly prevents the mastitis prevalence in the flock.

12) Vaccines

- The use of vaccines is an economic decision for veterinarians and breeders since it reduces costs and has positive effects on milk quality and public health, reducing the need for antibiotics. Vaccines are available for gangrenous mastitis for small ruminants in some countries and are recommended when high prevalence of infection is present.

Genetic selection

- Genetic selection of dairy ewes with a reduced SCC is an indirect way of reducing susceptibility to mastitis infections and may offer a longer term option for the control of subclinical mastitis. However, to have the most chance of success this needs reliable pedigree information, performance recording, and estimates of breeding values.

Summary

Mastitis in small ruminants is a significant disease causing not only huge economic losses due to decrease in meat and milk production but also affecting the wellbeing of animals as well. It is the most common disease in livestock species, and it is one of the major diseases in the

veterinary field. As treatment of the ewe or doe for mastitis is often unsuccessful, prevention of disease needs to be the priority for small ruminant farmers. As research in small ruminant mastitis progresses, hopefully, in the near future, there are likely to be many more strategies based on sound scientific evidence for farmers to use. However, at the moment, some of the advice is based on "common sense" and experience. Important measures for controlling and minimizing the negative effect of mastitis is by improving hygiene of animal sheds and using proper milking procedures. Proper diagnosis, treatment and replacement of chronically infected animals contribute for the reduction of the detrimental effects of mastitis in small ruminants.

Scientific Evidence for Existing Deworming & Dipping calendar for Small Ruminants of Kashmir valley

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Parasitic diseases which occur in clinical or sub clinical form impose a severe economic burden on livestock industry in the form of morbidity, mortality, inefficiency of feed conversion ratio and by way of costs incurred on treatment and control. Despite the availability of some good and effective anti parasitic drugs for treatment and control of important parasitic diseases of livestock, there is pressing need for adaptation of alternative control measures including the development of successful anti parasitic vaccines. The most important reasons for this are development of resistance by parasites against many of the previously as well as newly developed drugs; associated problem of drug residues in milk, meat and increased concern for environmental pollution especially that caused by use of ectoparasiticides. Despite these associated problems chemotherapy and chemoprophylaxis are still the most effective weapon for fighting the menace of parasites and the situation will remain similar in the near future. Since the occurrence of parasitic diseases is greatly influenced by varying climatological and ecology factors, it therefore implies that the parasitic fauna of different species of livestock mapped out accurately in different seasons of the year forms fundamental information on which further prophylactic measures can be based up on. This necessity has been adequately recognized by parasitologists all over the world and extensive epidemiological surveys have been carried out on parasitic fauna of different species of livestock in different seasons of the year not only in many parts of the world but also in India including Jammu and Kashmir. The epidemiology of various important parasitic diseases of small ruminants in Kashmir valley is briefly described as under:

Epidemiology of fasciolosis in small ruminants of Kashmir: Lyã naeid snails especially *Lymnea auricularia* act as intermediate hosts of these parasites and the definitive hosts become infected by ingestion of metacercariae along with herbage in swamp areas. This snail is highly prevalent in autumn followed by spring and summer. Most of these snails undergo hibernation during the winter season. Snails which do not undergo hibernation do not release cercariae during winter, which indicates that no development of larval stages of trematodes occurs in snails during winter because the temperature above 10^0C is necessary before the snails will breed or before the *Fasciola* spp. can develop within the snails. Metacercariae also do not survive under extreme/severe winter conditions. In spring, the eggs that have accumulated over winter hatch, the miracidia infect snails and the cercariae emerge some 5-8 weeks later depending on the temperature. The infection passes on to the herbage in late spring (May) and early summer (June). Ingestion of these metacercariae by animals on herbage gives rise to fasciolosis in early summer (June) and mid-summer (July). This is known as spring cycle of infection. Miracidia hatching from eggs deposited in grazing areas during summer and autumn infect the snails and the infection passes on to the herbage in late summer and autumn. Ingestion of these metacercariae by definitive hosts results in fasciolosis from mid autumn (October) onwards. This is known as summer cycle and is the most important source of infection. In general the availability of metacercariae is greatest in late summer and autumn. Animals housed during winter may become infected if fed insufficiently dried hay prepared form infected grasses because metacercariae can survive in moist hay for up to eight months. Some infections may also occur in early spring from overwintering metacercarie. Therefore, prophylactic dosing of the sheep in late winter/early spring (15 February to 14 March) is especiaily useful to reduce the contamination of the grazing areas. Similarly the prophylactic dosing in early summer/mid-summer (15 June to 14 July) is useful in preventing losses from spring cycle of infection and the prophylactic dosing in mid autumn/late autumn is useful to prevent losses from summer cycle of infection.

Epidemiology of paramphistomosis in small ruminants of Kashmir: Planorbid snails especially *Indoplanorbis exustus* act as intermediate hosts of these parasites and the definitive host become

infected by ingestion of metacercariae encysted on herbage as in case of fasciolosis. In Kashmir valley this snail has been found highly prevalent in spring and summer seasons. Most of the outbreaks occur during late summer and autumn when the grazing areas become heavily contaminated with metacercarie.

Epidemiology of cestode infections in small ruminants of Kashmir: The important species of tapeworms found in ruminants especially lambs and kids include *Moniezia* spp., *Avitellina* spp. and *Stilesia* spp. Oribatid mites and psocids (bark lice, dust lice and book lice) act as intermediate hosts of these parasites. In sheep of Kashmir valley the infection has been found to be highest in late autumn and winter months which indicates that animals mainly pick up the infection by ingestion of these mites along with herbage in mid and late autumn and reach to maturity after prepatent period of 37-40 days, therefore, deworming against tape worms is recommended in late autumn.

Epidemiology of gastrointestinal nematode infections in small ruminants of Kashmir: Development of larval stages of most of the gastrointestinal nematodes like *Haemonchus, Ostertagia, Mecistocirrus, Marshallagia, Trichostrongylus, Cooperia, Nematodirus,* etc. ingested by the ruminants in late autumn is delayed until spring in a process called hypobiosis. Thus, fewer eggs are shed into the environment at a time when the chances of their survival are reduced. Resumption of development of arrested larvae occurs at a time when environmental conditions are suitable for the survival of the free-living stages and is associated with a seasonal stimulus. Larvae resume development usually in the month of March/April resulting in the spring rise in faecal egg counts because of which grazing places become contaminated with infective larvae in about two weeks, if the temperature is between 10-15^{0}C. However, in the summer infective larvae are produced in only one week under optimum conditions at 27^{0}C. The most rapid development occurs in summer with peak larval burdens in grazing places being reached in 6-8 weeks resulting in heavy infection in young animals from September onwards. The eggs passed in the faeces of the infected animals in late autumn/early winter when the temperature is below 9^{0}C undergo little or no development. However, the eggs which have reached the 'pre hatch' stage are most resistant to adverse climatic conditions and can survive freezing and desiccation more readily than other stages, therefore,

prophylactic dosing of the animals in late spring (1-31st May) is recommended to prevent contamination of the grazing areas and keep the parasitic burden at minimum level during summer. Similarly prophylactic dosing in late autumn is meant to remove the maximum parasites acquired during summer and autumn. However, target selective treatment of heavily infected animals assessed after quantitative faecal examination is also recommended during summer months.

Prophylactic measure against ecto parasites like ticks and mange: In Kashmir valley it has been found that tick infestation starts appearing in mid spring (April) and remains prevalent up to October. The developmental cycle of ticks is greatly influenced by prevailing temperature. The low temperature causes marked prolongation of different developmental stages especially hatching of the eggs and pre-oviposition of the engorged females. Therefore, prophylactic medication of the sheep against ticks in late spring will result in death of most of the engorged females which shall keep the tick population under control during summer and early autumn. Optimum conditions for the development of sheep scab include moistness and cool temperature that is why the disease is most common in autumn and winter months. During adverse conditions (summer) mites survive in the protected parts in the perineum, inguinal and inter digital regions, the infra orbital fossae, inside the ear and on the scrotum. Therefore, prophylactic medication against the sheep scab in late autumn shall be very useful in preventing outbreaks of the disease during winter months, however, target selective treatment of sheep showing the signs of itching and scratching during winter should also be undertaken to prevent spread of the disease due to close confinement of animals in winter.

Disease Prediction Based on Snail Ecology in Kashmir

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The digenean trematodes (flukes) have complicated lifecycle in which molluscs play the key role as their intermediate hosts. Their typical life cycle involves two free living short lived stages, the miracidium and cercariae (emerging from the first intermediate host) and parasitic stages, the sporocyst, redia and adult parasite in the definitive host. Therefore, the presence of susceptible snail host is a primary requirement for the perpetuation of snail borne parasitic infections. Their distribution accounts for the occurrence of different trematodes in a particular region and thus monitoring the infection rate of snails with the trematode parasites forms an important component of epidemiological studies. This is also the key stone for identifying the trematode fauna in the area of interest. Approximately 5000 species of snails are found to inhabit different habitats worldwide. The fresh water snails are involved in the transmission of trematode species belonging to superfamilies Schistosomatoidea, Fascioloidea, Clindostomoidea, Paramphistomoidea, Echinostomatoidea, Diplostomatoidea and Pronocephaloidea. Among the snails, *Indoplanorbis exustus* and *Lymnaea luteola* are responsible for transmitting almost 90% trematode infections related to man or domestic animals. Snails of the family

Lymnaeidae are recognized as potential transmitters of fasciolid trematodes. Lymnaeid snails mainly *L. auricularia* and *L. luteola* act as intermediate hosts of *Fasciola hepatica*, *Fasciola gigantica*, *Schistosoma incognitum*, *Fischoederius elongatus* and *Orientobilharzia dattai*. *Indoplanorbis exustus* is respoå sible for the transmission of *Schistosoma indicum* group as well as other trematodes such as *Echinostoma* spp., some spirochids, *Paramphistomum epicilitum* whereas *Gyraulus convexiusculus* plays an important role in transmission of *Explanatum explanatum* and *Gastrothylax crumenifer* in India.

Freshwater molluscs inhabit all types of aquatic bodies like ponds, lakes, ditches, irrigation canals, streams and rivers with or without vegetation, with or without boulders etc. Broadly these habits can be grouped into two categories such as ponds, ditches, paddy field etc. with more or less stagnant water (lentic type) and streams, rivers and canals with flowing waters (lotic type). In general, the snails belonging to the families Neritidae, Littorinidae, Ancylidae, Thiaridae are found in streams and small rivers, whereas the members belonging to the families Viviparidae, Ampillariidae, Planorbidae and Lymnaeidae thrive in stagnant water.

The composition of the fauna of stagnant water differs from that of the fauna of flowing water. The streams of hills with higher elevation have different fauna than that of streams of plains. In these habitats, molluscs are found attached to the submerged vegetation, rocks or the substratum of the water bodies, crawling on the mud, or found buried partly or wholly in the muddy or sandy bottom of the aquatic bodies. In the tropical countries, the freshwater molluscs usually face an annual dry season and show varying capacity to survive during this period and usually overcome this situation by aestivation under dead vegetation or debris or by actively burrowing at least the aperture of their shell in the mud. During the unfavourable conditions, the molluscs remain inactive and resume the normal life again as soon as the condition becomes favourable. The transient and discontinuous nature of freshwater bodies leads to

the isolation of molluscs into small local population leading to concentration of snails and animals at these places resulting in maximum transfer of infection to both sides. Conditions influencing the proliferation of snail population will inevitably enhance the existence of different trematode parasites in their intermediate host. Some fresh water habitats provide physiochemical conditions that favour the proliferation of particular snail fauna. For this reason, environmental conditions in different habitats, in different climatic zones may support the trematode lifecycle differently. Most of the molluscs are sufficiently large conspicuous and can easily be picked up. A hand net or water net fitted with a wooden handle is useful to drag over the aquatic vegetation, and when filled with aquatic weeds the contents are poured out on a spread out cloth piece.

In Kashmir Valley, trematode parasites like *Fasciola gigantica*, *F. hepatica*, *Dicrocoelium dendriticum*, *Paramphistomum cervi*, *Cotylophoron cotylophorum*, *Gastrothylax crumenifer* and *Carmyerius spatiosus* have been reported by various workers from different zones of Kashmir. Their presence indicates the availability of snail intermediate host for propagation of their lifecycle. Different snail species like *Physa acuta, Lymnaea lagotis*, *L. stagnalis*, *L. brevicauda*, *L. auricularia var obliquata*, *L. auricularia sensu stricto*, *L. luteola*, *Gyraulus ladacensis*, *G. pankogensis*, *G. compressus*, *Bithynia troscheli*, *B. tentaculata*, *Valvata* and *Indoplanorbis exustus* have been reported from Kashmir Valley. The availability of snails is due to presence of favourable environmental conditions like warm summer, long rainy season which facilitate stagnation of water in various pools. There are many canals, ponds, drains, paddy fields with irrigation channels as well as marshy lands along with the river Jhelum that flows adjacent to these areas. All these factors contribute to the growth and multiplication of different snails species. These snail species have been reported from ponds, lakes, rivers, streams, paddy fields and marshy areas. So, animals grazing in and around these areas leads to transmission of infection to snails as well as domestic animals which graze these lands or are fed grass brought

from these places. Among these, *Physa* and *Lymnaea* snails are known to be highly prevalent because of shorter generation time which facilitates colonization and expansion at a higher rate in *P. acuta* and explosive growth due to high reproductive rates under favorable conditions in *Lymnaea* snails. Local environmental and biotic factors determine the occurrence and abundance of freshwater snails in each habitat due to environmental heterogeneity among ecological zones. Temperature and depth of water are considered as the two important factors for determining the availability and density of snail species.The temperature plays an important role in the physiology of molluscan fauna. Temperature above 20°C is favourable for most of the snails. Lower temperature below 10°C is lethal for development of snail eggs and survival of snails. Most of these snails have been reported to be highest prevalent in summer followed by spring, autumn and lowest in winter season in Kashmir Valley.

Fasciolosis

Fascioliosis is a common disease of cattle and other ruminants caused by *F. hepatica* and *F. gigantica*, which have been found to occur in ruminants of Kashmir Valley. Among the various types of fresh water snails that are prevalent in Kashmir Valley, *Lymnaea auricularia* is known to act as its intermediate host. This snail is commonly seen in poorly drained land, drainage ditches, areas of seepage of springs or broken drains, ponds, lakes, canals, irrigation fields, etc. So grazing of animals near these water bodies, and drinking water from snail infested reservoirs will result in *Fasciola* infection in animals. Stall fed animals supplied with paddy straw carrying encysted metacercariae of the parasite is also an important source of transmission. This snail has been found to be highly prevalent in Kashmir, with highest seasonal prevalence in autumn followed by spring and summer seasons. Most of these snails undergo hibernation during the winter season. Snails which do not undergo hibernation do not release cercariae during winter, which indicates that no development of larval stages of trematodes occurs in snails during winter because the

temperature above 10°C is necessary before the snails will breed or before the *Fasciola* spp. can develop within the snails. Usually little development of the parasite occurs in snail below a mean day/night temperature of 10°C. This ability of the snail to undergo hibernation plays an important role in the epidemiology of the parasite. Even these snails have the ability to undergo aestivation under drought conditions. On the return of moist conditions, the snail grows to maturity very rapidly and similarly the developmental stages of *Fasciola* undergo rapid development, leading to release of large number of cercariae on the herbage within a short time, and ultimately predisposing the animal to heavy infection. Higher prevalence of snails in autumn reflects that metacercariae occur on herbage in greatest numbers in late autumn and ingestion of these metacercariae by definitive hosts results in fasciolosis from October onwards. Availability of snails in spring indicaíes that large number of cercariae are released and metacercariae are passed on to the herbage in late spring and early summer and development of fasciolosis in animals occurs in early summer and mid-summer, which is known as spring cycle of infection. Similarly occurrence of snails during summer means that cercariae are released and metacercariae passes on to the herbage in late summer and autumn. Ingestion of these metacercariae by definitive hosts results in fasciolosis from mid-autumn (October) onwards. This is known as summer cycle and is the most important source of infection. So, deworming of animals in late winter/early spring, early

summer/mid-summer and mid autumn/late autumn should be recommended.

Amphistomosis

Amphistomosis, a disease of domestic and wild ruminants is caused by digenetic trematodes belonging to superfamily Paramphistomoidea. Various species of the different paramphistomoid families, especially members of Paramphistomidae and Gastrothylacidae, cause amphistomosis in ruminants. The prevalence of amphistomosis is influenced by both the abundance of infected definitive hosts and the abundance and efficiency of the snail intermediate hosts. Hence, the epidemiology and seasonal patterns of infection with amphistomes is determined to a large extent by the availability of the snail intermediate hosts and the grazing habits of the definitive hosts. Various species of snails have been incriminated as intermediate hosts, but *Indoplanorbis exustus* is thought to be the major one followed by *Lymnaea* and *Gyraulus* snails. This species is found attached to aquatic plants in small ponds, pools, tanks, lakes as well as stagnant pools of water in rivers, and reservoirs, less commonly in man-made habitats such as paddy fields, ditches, etc. The snail may also occur in semi-permanent pools formed in flooded areas of fields, where it can survive the dry season buried in mud. The desiccation tolerance of adults snails is high, while the resistance of juvenile snails is very low. Consequently, dispersal may occur in clumps of mud adhered to the bodies of cattle or across water in flotsam (vegetation mats), and possibly also attached to migratory birds. *Indoplanorbis exustus* requires a water temperature in excess of 15°C for maturation and at the optimum temperature of 30°C each snail can lay up to 800 eggs. Besides this, it has a shelf life of only 4 months. Prevalence of *I. exustus* has been reported lower as compared to *Lymnaea* snails and has been found to be prevalent in spring and summer seasons only. This rare occurrence of *I. exustus* during autumn and winter clearly indicates that these undergo hibernation from early autumn to early-spring. Therefore, animals

pick up heavy infection during summer and thus most of the outbreaks of paramphistomes occur during late summer and autumn when the grazing areas become heavily contaminated with metacercariae.

Dicrocoeliosis

Dicrocoeliosis is a widespread disease caused by *Dicrocoelium dendriticum*, which resides in the bile ducts and gall bladder of domestic and wild ruminants. Species of land molluscs and ants act as its primary and secondary intermediate hosts, respectively. Dicrocoeliosis is present worldwide particularly in lowland or mountain pastures, which provide adequate conditions for the survival and development of terrestrial snails and ants. Land snails like *Zebrina detrita*, *Cionella lubrica*, *Theba* spp., *Helicella* spp., *Arion* spp., and *Macrochlamys* spp. Among these *Macrochlamys* and *Helicella* species are known to occur in Kashmir Valley. Terrestrial snails are mostly nocturnal, but following rain they come out of their hiding places even during the day time, where they pickup as well as release infection. Moisture and temperature are the main factors that account for their nocturnal habits. They are found everywhere, but prefer habitats offering adequate moisture, shelter, an abundant food supply and an available source of lime etc. Snails can remain in the dormant state (aestivation) for years and break dormancy when climatic conditions are favourable again.These species usually occur from spring to late autumn, which indicates animals acquire higher infection during this phase. So, deworming of animals in late winter/early spring, early summer/mid-ëummer and mid autumn/late autumn should be recommended.

Early Recognition of Epidemic Diseases, its Prevention and Mitigating Measures

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India being subtropical country has vast resources of livestock and poultry, which play a significant role in improving the socio-economic conditions of rural masses. Animals produce nutritionally rich food in addition to employment and income generation. The livestock species are facing threat due to disease outbreaks in addition to climate change related issues like droughts and floods. Animal disease emergencies are often caused by transboundary animal diseases, which are of significant economic and food security importance by affecting the production, productivity, trade and human health and consequently on the overall processes of economic development. Considering the effective transmission of these diseases to naïve areas, their control requires planning in advance. Without proper contingency in place, the disease might spread to wider geographical areas leading to losses not only to famers but also to the exchequers. Hence, the preparation of national livestock disease contingency plan should be an essential part of disease control preparedness in the country. There are two parts of emergency preparedness planning: The first one being the early warning, which comprises of rapid detection of the disease of livestock before outbreak or in the event of outbreak. It is based mainly on disease surveillance, disease reporting and epidemiological analysis. The second part of emergency preparedness is early reaction, which comprises of disease control measures to stop thÉoutbreak and further spread of the disease

and thereby eliminating the source of infecíion. To achieve this goal, there is need for training of professionals involved in the preparation of national emergency contingency plans at state and national level as country is off late facing emergence of new diseases like lumpy skin disease and African swine fever in addition to avian influenza.

Forewarning System Powered by Artificial Intelligence for Livestock Disease Management in India with Special Reference to National Animal Disease Referral Expert System v_2 (NADRES v_2)

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Forewarning of outbreak of disease and the prediction of spread of diseases to new vulnerable areas serves as a pre-requisite for the effective containment and control of epidemic livestock diseases including zoonosis. The weakness of disease surveillance system and the inability to control major diseases at their source have contributed to the spread across geographical borders. Forewarning of livestock diseases is based on the concept that dealing with disease epidemic in its early stages is easier and more economical than having to deal with it once it is occurred and widespread.

Disease forewarning systems are an important component of livestock disease risk management strategies comprising of four elements *viz.*, knowledge of disease risk, technical monitoring and warning services, dissemination of meaningful warnings to at-risk region and awareness and preparedness to act. India endowed with vast livestock resources of 535.78 million heads includes 192.49 million cattle population of which 50.42 million are exotic/crossbreed, 109.85 million buffaloes, 74.26 million sheep, 148.88 million goats, 9.06 million pigs, 4.4 lakhs of mithun & yaks etc. (20th Livestock Census of India, Department of Animal Husbandry & Dairying (DAHD) under the ministry of Fisheries, Animal husbandry & Dairying, Govt of India) with increased production of milk at 187.75 million tonnes by increase of 6.5% over

previous year and per capita availability of milk stood at 394.gms/day (2018-19) compared to previous year 375 grams/day. Forewarning system is type of multifunctional system improves the community preparedness & awareness for risk of livestock disease occurrence, in terms of both warnings and increased understanding of risks associated and response of policy makers, veterinarians and farmers. This minimizes the morbidity and mortality of animals and subsequently helps in building efficient production system. Global Early Warning system for Major Animal Diseases including Zoonosis (GLEWS) and alert system developed by Food and Agriculture Organisations of the United Nations.

FAO), the World organisation for animal health (OIE), and WHO regularly provides the disease alerts (GLEWS, 2020). In this, the networks from the international community and stakeholders are linked to assist an early warning, prevention and control of animal disease threats including zoonosis. Similar application in India with weather-based forewarning enabled with artificial intelligence system to predict the occurrence of livestock disease in two months advance is implemented through NADRESv_2 at National Inëtitute of Veterinary Epidemiology & Disease Informatics (ICAR), Bengaluru, Karnataka state, India. The system captures data from four dimensional settings (i) Disease outbreak data from the database of NADRES v2, ICAR-NIVEDI web application, Bengaluru, (ii) GES DISC GLDAS_NOAH025_M.2.1 for weather parameters (iii) Remote Sensing MODIS products MOD13Q1 and MOD11A2 for Normalised Difference Vegetative Index (NDVI) and Land Surface Temperature (LST) to forecast potential threats from pathogens and (iv) Livestock population data from the database of Livestock Census, DAHD, Govt of India.

Weather and climate affect the different diseases in different ways, simple logic suggest that, climate can affect the disease patterns because of disease agents (viruses, bacteria and parasites) and their vectors, are clearly sensitive to temperature, moisture and other environmental conditions. This motivates to understand linkages between temporal and spatial variations of climate and transmission of infectious disease agents. The characteristic of geographic distributions and seasonal variations of many infectious livestock diseases are prima facie evidence of linkages

with weather and climate. Studies have shown that factors such as temperature, precipitation and humidity affect the lifecycle of many disease pathogens and vectors, both directly and indirectly through ecological changes, and thus potentially affect the timing and intensity of disease outbreaks. The current strategies for controlling infectious disease epidemics depend largely on surveillance of new outbreaks, in some contexts, climate forecasts and environmental observations could potentially be used to identify regions of high risk for disease outbreaks, and thus aid efforts to limit the extent of epidemics or even prevent them from occurring. The operational disease forewarning systems are more feasible and economical to mitigate the risk of epidemics, when the predictions are more precise and accurate. Development livestock disease forewarning system should include the vulnerability and risk analysis, feasible response plans, and strategies for effective risk communications.

Livestock disease occurrence cause major damages such as morbidity and mortality. The methods and techniques of disease risk prediction &evaluation, risk communication and response have been widely studied, but the few studies combine both disease risk prediction& communication with response. Presently, the application of disease risk prediction &evaluation, communication and response system is a very demanding task. In this connection, National Animal Disease Referral Expert System (NADRES version2: https://nivedi.res.in/Nadres_v2/) is built using PHP, JS, AJAX, HTML, CSS, SQL and R tools. This application is state of the art analytics systems automated with artificial intelligence algorithms for data capturing, cleaning, annotations, modelling, risk analysis and communications. Disease outbreak or incidence data is captured from 31 All India coordinated centres (AICRP), these centres regularly collect and supply epidemiological data (lab confirmed) from their respective jurisdictionson monthly interval. Artificial Intelligence system of models were enabled to predict the livestock disease risk in advanceof two months using metrological, remote sensing variables and host parameters like population density. The predicted results on incidence of risk of 13 economically important livestock diseases were disseminated regularly through forewarning bulletin, webcast, mobile app and auto-messaging. Scientific and

technological advances have driven marked improvements in the quality, timeliness and the lead time of warnings and in the operation of observation network. Based on above facts, the objectives of forewarning system (NADRES v_2) are designed as (i) Forecast and forewarning of livestock infectious diseases in advance of two months for better management and prevention, (ii) To issues alerts on predicted disease risk to various state animal departments and veterinarians for taking appropriate preventive measures well in advance and (iii) To generate effective feedback system on disease forewarning from the different stakeholders for improving the efficiency in disease forecasting system.

Meteorological & remote sensing parameters were extracted and forecasted using Auto Regressive Integrated Moving Average (ARIMA) models. Forecasted data of weather parameters including remote sensing variables along with host density were further modelled using Artificial Intelligence and Machine learning models of system of algorithms to predict the risk of disease at reasonable accuracy with lead time of 2 months to enable the stakeholdes to better preparedness and response and the predicted risks were classified into 6 levels namely; No risk, very low risk, Low risk, Moderate risk, High risk, and Very high risk. Predicted risk maps of the livestock disease are generated using R software and were regularly communicated to all State departments of animal husbandry, department of animal husbandry & dairying, Govt. of India and AICRP centers so as to enable them to respond when there is probable risk of infectious disease. Forewarning of livestock diseases is based on the concept that dealing witÜdisease epidemic in its early stages is easier and more economical than having to deal with it once it is occurred and widespread.

COLLOQUIA

On

Small Ruminant Production and Disease Control:

Kashmir Perspective

ORGANIZED BY

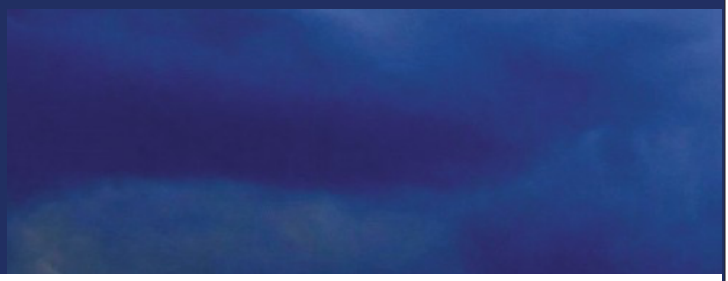
Directorate of Extension
SKUAST - Kashmir
& Department of Sheep Husbandry, Kashmir

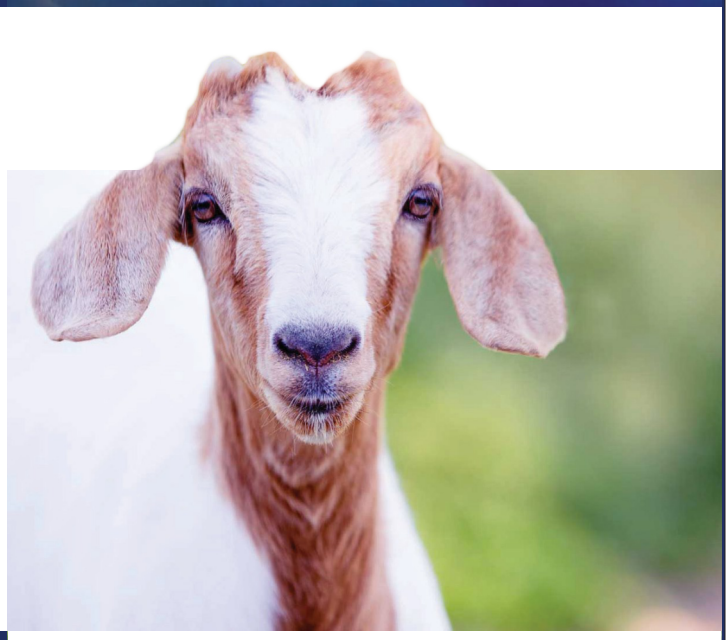
DATE

9th February - 20th March, 2021

VENUE

Faculty Outreach Centre
FVSc & AH Shuhama Alusteng
&
Disease Investigation Laboratory Nowshera, Srinagar





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Vety Assistant Surgeon
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PROGRAM SCHEDULE

Colloquia

On

Small Ruminant Production and Disease Control: Kashmir Perspective

(February 09 - March 20, 2021)

Event – I (Feb 09, 2021)

(Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng)

Talk 1 **Field Report on Entrepreneurship in Sheep Husbandry**	**Dr Rafiq A Shah** (DSHO, Kulgam)	11:00 am - 11:45 am
Talk 2 **Economics of Sheep Rearing: Lessons from Success Stories of Sheep Farmers & Entrepreneurs**	**Prof Hilal Musadiq Khan** (Professor, Division of LPM, FVSc & AH, Shuhama Alusteng)	11:30 am - 12:30 pm
Inaugural Function		02:30 pm - 03:30 pm

Event – II (Feb 13, 2021)

(Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng)

Talk 1 **Pattern of Growth in Lambs & Weaners in Organized Farms**	**Dr Basharat A Kuthu** (Joint Director Farms, DSHK)	11:00 am - 11:45 am
Talk 2 **Challenges in Vaccine Production & Revisiting the Existing Vaccination Schedule**	**Prof Shakil A Wani** (Ex Director Education, SKUAST Kashmir)	12:00 pm - 01:30 pm
Talk 3 **Establishing Mini-Diagnostic Lab in Farms**	**Prof M Altaf Bhat** (Head, Division of Microbiology & Immunology, FVSc & AH, Shuhama Alusteng)	02:30 pm - 03:30 pm
PANEL DISCUSSION		03:30 pm - 04:00 pm
EXPERTS	• Prof H M Khan, Professor, Division of LPM, FVSc & AH, Shuhama • Dr Showkat-ul-Nabi, Assistant Professor, Division of Vety Clinical Medicine, FVSc & AH, Shuhama • Dr Shaheen Farooq, Assistant Professor, Division of Vety Microbiology & Immunology, FVSc & AH	

Event – III (Feb 17, 2021)

(**Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng)**

Talk 1 **Macro-economics of Sheep Rearing & Byproduct Industry**	**Prof Nisar Ali** (Ex Professor Economics, Kashmir University & Ex Advisor Education, JK Government)	11:00 am - 12:30 pm
Talk 2 **Wool & Fiber as an Industry: Potential & Challenges**	**Prof Sarfaraz A Wani** (Head, Division of LPT, FVSc & AH,Shuhama Alusteng)	12.30 pm – 1:30 pm
PANEL DISCUSSION		02:30 pm - 04:00 pm
EXPERTS	• Dr Javaid A Khan, Ex Director, SHD Kashmir • Prof H M Khan, Professor, Division of LPM, FVSc & AH, Shuhama • Dr Asif Hassan Sofi, Assistant Professor, Division of LPT, FVSc & AH, Shuhama • Er Younis Farooq, Manager Executive, Pashmina Testing and Quality Certification Centre, Srinagar	

Event - IV (Feb 20, 2021)

(**Venue: Disease Investigation Laboratory, Nowshera Srinagar)**

Talk 1 **Pathological Evidence of Diseases in Sheep & Goat**	**Prof M M Darzi** (Ex-Head, Division of Vety Pathology, FVSc& AH, Shuhama)	11:00 am - 12:00 noon
Talk 2 **Policy Considerations wrt Killed vs Live Vaccines in Small Ruminant Vaccination**	**Dr Pervaiz A Dar** (Scientist, Animal Sciences, KVK Ganderbal)	12:00 noon - 01:00 pm
Talk 3 **Tackling Zoonoses in Livestock Farms & Slaughter Houses**	**Prof Ziaul Hassan Munshi** (Ex- Head, Division of Vety Public Health,FVSc & AH, Shuhama)	02:00 pm - 03:00 pm
Talk 4 **Food Safety Issues wrt Diseases of Sheep & Goat**	**Prof Syed Akram Hussain** (Head, Division of Vety Public Health, FVSc& AH, Shuhama)	03:00 pm - 04:00 pm

Event - V (Feb 23, 2021)

(**Venue: Disease Investigation Laboratory, Nowshera Srinagar**)

Talk 1 **Mastitis in Sheep & Goat: Prevalence & Control Strategy**	**Dr Abdul Qayoom Mir** (Assistant Professor, Vety Medicine, MRCSG, FVSc & AH, Shuhama)	11:00 am - 11:45 am
Talk 2 **Monitoring Health Status in Farm Animals with Special Reference to Sheep & Goats**	**Prof H U Malik** (Head, Division of Vety Clinical Medicine, FVSc &AH, Shuhama)	11:45 am - 12:45 pm
Talk 3 **Scientific Evidence for Existing Deworming Calendar**	**Prof R A Shahardar** (Head, Division of Vety Parasitology, FVSc& AH, Shuhama)	02:00 pm - 03:00 pm
Talk 4 **Disease Prediction based on Snail Ecology in Kashmir**	**Dr Zahoor Ahmad Wani** (Assistant Professor, Division of Vety Parasitology, FVSc & AH, Shuhama)	03:00 pm - 03:45 pm

Event - VI (Mar 04, 2021)

(**Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng**)

Talk 1 **Innovative Extension Methods in Sheep Husbandry**	**Dr Ajay Sudan** (Joint Director Extension, DSHK)	11:00 am - 12:00 pm
Talk2 **Early Recognition of Epidemic Diseases, Prevention and Mitigating Measures**	**Dr G B Manjunatha Reddy** (Scientist, ICAR-NIVEDI, Bengaluru)	12:00 pm - 01:00 pm
Talk 3 **Performance Evaluation of Fecund Swarna Merino under Farm Conditions**	**Dr Riyaz Ahmad Khan** (Assistant Research Officer, DIL Nowshera - DSHK)	02:00 pm - 02:30 pm
Talk 4 **Narrowing the Gap: Mutton Production vs Mutton Consumption**	**Prof Nazir A Ganai** (Director Planning & Monitoring, SKUAST - Kashmir)	02:30 pm - 04:00pm

Event - VII (Mar 06, 2021)

(**Venue: Disease Investigation Laboratory, Nowshera Srinagar)**

Talk 1 **Artificial Insemination in Sheep & Goat: Work Plan & Way Forward**	**Dr Asloob A Malik** (Assistant Professor, Division of Animal Reproduction Gynecology & Obstetrics, FVSc & AH, Shuhama)	11:00 am - 11:45 am
Talk 2 **ETT in Small Ruminants: Action Plan with Timeline**	**Dr Suhail Nabi Magray** (Vety Assistant Surgeon, DSHK)	11:45 am - 12:30 pm
Talk 3 **FecB Introgression: Status Report & Action Plan**	**Dr Mir Shabir** (Assistant Professor, Division of Animal Genetics & Breeding, FVSc & AH, Shuhama)	12:30 pm - 01:15 pm
PANEL DISCUSSION		02:00 pm - 04:00 pm
EXPERTS	• Prof M R Fazili, I/C MLRI, Mansbal (SKUAST – K) • Prof R A Shah, Head, Animal Biotechnology, FVSc &AH • Prof H M Khan, Professor, Division of LPM, FVSc & AH • Dr Mohd Ashraf Baba, Deputy Director, SBF Khimber • Dr Showkat A Ahanger, DSHO Bandipora • Dr Javid A Baba, DSHO Ganderbal • Dr Arjuma Khatun, I/C Head, ARGO, FVSc & AH • Dr Farooz A Lone, Assistant Prof, ARGO, FVSc & AH • Dr Bushra Mushtaq, VAS, DSHK	

Event - VIII (Mar 10, 2021)

(**Venue: District Sheep Husbandry Office, Baramulla)**

Talk 1 **Opportunities & Challenges in Dairy Goat Sector**	**Dr Qayser Gani Wani** (Sheep Development Officer, Karnah, DSHK)	11:00 am - 11:30 am
Talk 2 **Nutritive Value of Available Feed/Fodder, and Review of Region Specific Feeding Practices**	**Prof Abdul Majeed Ganai** (Head, Division of Animal Nutrition,FVSc & AH, Shuhama)	11:30 am - 12:30 pm
Talk 3 **Addressing Shrinking Fodder Resources**	**Dr Mirza Iqbal Hussain** (Consultant, Khyber Agrofarms Pvt Ltd)	12:30 pm - 01:30 pm
PANEL DISCUSSION		02:30 pm - 04:00 pm

EXPERTS	• Prof H M Khan, Professor, Division of LPM, FVSc & AH • Dr Manzoor A Yatoo, Assistant Professor, Animal Nutrition, Faculty of Agriculture, Wadura • Dr Altaf H Peerzada, TO to DSHO Kupwara • Dr Tanveer A Rather, TO to DSHO Baramulla

Event - IX (Mar 13, 2021)

(Venue: District Sheep Husbandry Office, Pulwama)

Talk 1 **Status of Brucellosis in India & Food Safety Issues**	**Dr Mir Nadeem hassan** (Scientist - AS, KVK Budgam)	11:00 am - 11:45 am
Talk 2 **Efficient Utilization of Small Ruminant Byproducts**	**Dr Asif Hassan Sofi** (Assistant Professor, Division of Livestock Products & Technology, FVSc & AH, Shuhama)	11:45 am - 12:30 pm
Talk 3 **Applicable Feed Technologies for Small Ruminant Production**	**Dr Yasir Afzal Beigh** (Assistant Professor, Division of Animal Nutrition, FVSc & AH, Shuhama)	12:30 pm - 01:15 pm
PANEL DISCUSSION		02:00 pm - 04:00 pm
EXPERTS	• Dr M Amin Dar, DSHO Shopian • Dr Zubair Ahsan Kabli, DSHO Anantnag • Dr M Raies Ul Islam, Scientist (AS), KVK Pulwama • Dr Hayat ur Rafiq, VAS, DSHK	

Event - X (Mar 16, 2021)

(Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng)

PANEL DISCUSSION **On** **Recommendations given by Experts during Event 1-9**	11:30 am - 03:30 pm (Lunch 01:00 pm to 02:00 pm)
EXPERTS	
• **Dr Sarfaraz A Wani** • **Dr H U Malik** • **Dr R A Shah** • **Dr Azmat Alam Khan** • **Dr Hilal M Khan**	• **Dr Rafiq A Shahardar** • **Dr Ziaul Hassan Munshi** • **Dr M Maroof Shah** • **Dr Mohammad Ashraf Baba** • **Dr Zahoor Ul Haq**
Moderators	• **Dr Aijaz A Dar** • **Dr S A Hamdani** • **Dr Aabeen Sakina**
Rapporteurs	• **Dr Syed Shakeebah Kubra** • **Dr Umer Amin** • **Dr Amani Ishtifaq**

Event - XI* (Mar 20, 2021)

(Venue: Faculty Outreach Centre, FVSc & AH, Shuhama Alusteng)

*** Merged with Event X & Event XII**

Submission of Recommendations	• **Dr Aijaz A Dar** • **Dr Aabeen Sakina** • **Dr Riyaz A Khan**	11:00 am - 11:45 am
Release of Compendium	• **Prof M S Mir** • **Prof Abdul Hai** • **Dr H A Ahmad** • **Dr Afzal Akand** • **Dr M Maroof Shah**	11:45 am - 12:30 pm
VALEDICTORY FUNCTION		02:00 pm – 3:30 pm

NATIONAL SEMINAR ON

Advances in Small Ruminant Production and Disease Control: Kashmir Perspective

23rd March, 2021

ORGANIZED BY:

Disease Investigation Laboratory
(Nowshera, Srinagar)
Department of Sheep Husbandry
Kashmir

IN COLLABORATION WITH:

Sher - e - Kashmir University of
Agricultural Sciences
& Technology - Kashmir

VENUE:

Faculty Outreach Centre
Faculty of Veterinary Sciences &
Animal Husbandry
Shuhama Alusteng, Srinagar
(J&K) - 190 006

INVITED SPEAKERS

TALK 1:
Contribution of SKUAST - Kashmir vis-à-vis small ruminant production and disease control

SPEAKER: PROF M ASHRAF PAL
Dean, Faculty of Veterinary Sciences & Animal Husbandry
SKUAST - Kashmir

TALK 2:
Status of brucellosis in small ruminants and control strategy

SPEAKER: PROF PURAN CHAND
Expert Committee Member on Brucellosis, Govt of India
Sheep Husbandry Department Kashmir

TALK 3:
Para tuberculosis in small ruminants: Methodology and timeline of work plan (Kashmir perspective)

SPEAKER: PROF SHOOR VIR SINGH
Ex - Principal Scientist
ICAR - CIRG, Makhdoom

TALK 4:
Early warning system for disease management in small ruminants

SPEAKER: DR K P SURESH
Principal Scientist
ICAR - NIVEDI, Bangaluru

TALK 5:
Prospects of artificial insemination and embryo transfer technology in small ruminant production

SPEAKER: DR S D KHARCHE
Principal Scientist
ICAR - CIRG, Makhdoom

INTRODUCTION

Small ruminants are an important component of livestock production, and contribute significantly to national economy and livelihoods. Sheep and goats have high adaptability and thrive in difficult environmental conditions. They are central to the task of meeting food security and sustainability of number of allied and by-product industries. This sector has the potential to transform distressed agrarian communities provided technological advances made are embraced and practiced. Considering the present scenario of Sheep Husbandry in Kashmir, there is an urgent need to review and introduce advanced technologies for conservation of indigenous germplasm, improving productivity and prolificacy and better disease control. Given emphasis on one health concept and significance of zoonoses and emerging diseases, and need to review preparedness regarding any future pandemics, it has been decided, as sequel to recently held Colloquia, to host a national level seminar on "Advances in Small Ruminant Production and Disease Control: Kashmir Perspective". The seminar shall be hosted by Department of Sheep Husbandry Kashmir in collaboration with SKUAST- Kashmir on 23rd March, 2021 at Faculty Outreach Centre, Faculty of Veterinary Sciences and Animal Husbandry, Shuhama Alusteng, Srinagar (J&K). The event is aimed to provide local veterinarians, scientists and policy makers an opportunity to interact with subject matter experts of national and international repute, and evolve a joint scientific strategy for addressing select issues in small ruminant production and disease control.

ORGANIZING COMMITTEE

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RECOMMENDATIONS FOR STAKEHOLDERS FOR MAKING SHEEP FARMING IN KASHMIR VALLEY A SUSTAINABLE ENTERPRISE

Compiled by:

Syed Shakeebah Kubra
Aijaz Ahmad Dar
M Maroof Shah
Aabeen Sakina

RECOMMENDATIONS

1. Establishment of breed-specific farms (e.g. one for Corriedale in Shopian & one for Kashmir Merino in Kupwara) by the Sheep Husbandry Department for "Unique Identity" and better performance plus reservation of one farm for indigenous/elite germplasm procured from sheep breeders and/or Government farms and maintained through Open Nucleus Breeding System (ram stud farm).

(This will ensure conservation of local/indigenous (Gurezi, Karnahi etc) and elite germplasm, timely supply of adequate number of proven rams to sheep breeders and sustainable and profitable sheep farming in the valley).

2. Development of mutton villages (one each in North, South and Central Kashmir) by the Government in line with the concept of model villages by Rural Development Department. In addition, Department of Sheep Husbandry Kashmir and SKUAST Kashmir must establish technology/research guided model mutton farms/germplasm centers as a demo unit for interested and unemployed educated youth.

(This will help narrow the gap of mutton consumption versus production; formation of sheep husbandry related farmer produce organizations; establishment of slaughter houses on scientific lines in or near designated mutton villages; conversion of waste into wealth by effective rendering of farm waste; efficient by- product utilization; prevention of zoonoses/occupational health hazards; promote entrepreneurial opportunities in small ruminant sector, and development of proper marketing channels for better remuneration to the farmers).

3. Establishment of medium to large scale slaughter houses on scientific lines one in each district in or nearer to designated mutton villages *(with slaughtering and byproduct utilization capacity as per the need)* in addition to already identified urban local bodies for establishment of slaughter houses by the Government, and

posting/recruitment of adequate number of qualified Veterinarians (with specialization in the concerned field) within these establishments for supervision. In addition, Tanneries (at least one each in Kashmir and Jammu) be established by the Government or though Private – Public partnership strictly under environment/pollution control norms.

4. Ten-fold increase in budgetary allocations to Veterinary Extension Services from the existing 1% (purely as additional budget due to hilly and mountainous terrain of the valley) for effective technology transfer and shift from existing extension to extension plus.

(This will help strengthen liaison with all stakeholders and effective community outreach, and prioritize Departmental/University activities vis-à-vis small ruminant production and disease control).

5. Providing hard-duty allowance to officers/officials of Department of Sheep Husbandry /Agricultural University posted in livestock farms. Gender should not be an overriding consideration for farm/laboratory posting, and livestock at highland pastures (HLP) should be manned by teams instead of individuals with pre-fixed targets and on roaster basis to overcome the problem of HLP posting for females/specially-abled.

(This will improve service deliverance in farms; ensure effective farm operations, improved structural and functional activity of farms).

6. Introduction of special scheme for centralized procurement and marketing of wool from the private farms with remunerative prices (MSP for wool be introduced). Initiating research by Livestock Products Division of FVSc & AH, SKUAST Kashmir for processing of wool and product development. Also, mandatory once a year purchase of locally made woolen products (coat, muffler etc.) for employees of SHD, AHD, and Agriculture University through purchases from local cottage industrial units.

(This will help in development of industry-specific skilled man-power; employment generation through establishment of small to

medium scale units, and enhancement of farmers' income).

7. Establishing (through available schemes of Central Wool Development Board/related agencies) common facility centers like scouring units in areas having high wool production, carding and felting centers particularly in far flung areas like Gurez, Karnah, Machill etc for improved processing of wool/woolen products and product diversification.

8. Prioritizing field-oriented research and teaching in academic institutions; and inclusion (desired by officers of Sheep Husbandry Department) of highly qualified field veterinarians (possessing MVSc/PhD) in student advisory committee on need basis and regular capacity building of the field vets for knowledge updation and skill enhancement.

9. Strengthening departmental disease monitoring and surveillance cell through collaboration with relevant institutions/research centers at local and national level for better disease control with special focus on revisiting existing vaccination schedule and sustainable livestock production. Besides infectious diseases,government/registered private farms be monitored/screened for metabolic/deficiency diseases through regular metabolic profile testing; for mastitis in advanced pregnancy/early lactating ewes, and fecal egg counts for strategizing livestock deworming.

10. Diagnosis of brucellosis and establishing the disease occurrence in farm/flock by tests like RBPT and indirect ELISA followed by immediate culling/segregation of the positive animals and vaccination of the remaining negative animals with *Brucella melitensis* Rev-1 vaccine.

(Existing clause of clinical correlation be dropped while recommending disposal of Brucella positive animals; carcass conditionally approved without affected parts but condemned in acute abortive form and disposal by deep burial or incineration).

11. Providing monetary assistance/insurance cover (through relevant boards/agencies) to registered units (flock strength ≥ 10)

particularly those established by the Department of Sheep Husbandry through various schemes, against important zoonotic/livestock threatening diseases (like Brucellosis, JD, TB, Prion diseases, sudden deaths due to outbreaks, natural calamities like floods, lightening strike, accidental fires, fire-arm caused deaths, wild animal attacks etc) as is provided in states like Karnataka for sustainable livestock production, better disease control and preparedness against epidemics/pandemics.

12. Duty assignment/delegation of powers to officers of Sheep Husbandry Department for checking indiscriminate breeding in the field, especially and more strictly in Units established by the Sheep Husbandry Department and linking progressive sheep farmers/sheep breeders to departmental website.

(This will prevent loss of local germplasm and/or introduction of exotic germplasm beyond the permissible level of inheritance; single window for information dissemination and feedback; data bank and real-time data analysis).

13. Inspection of livestock mandis/markets, livestock product outlets be entrusted to registered Veterinarians only.

14. Establishment of common facility centres at/near highland pastures and along the migratory routes like portable dipping tanks, feeding and watering points, and mobile health care units with adequate facility for screening of the migratory livestock for diseases of economic importance (Brucellosis, Para tuberculosis, FMD, Sheep Pox, and PPR etc) for better livestock management, disease controland capacity building of the personnel involved. Setting up of check posts at identified/entry points for preventing the movement of affected and/or sick animals.

(This will prevent spread of such diseases to healthy susceptible hosts (animal/human) during the transit and/or at highland pastures, and improve standard of living of all involved).

15. Artificial insemination in sheep be done at farm level (Department/University) on more number of animals (increased

sample size) in collaboration with Division of Animal Reproduction Gynecology and Obstetrics, FVSc & AH, Shuhama for further evaluation of the already done research by SKUAST scientists and standardization of insemination technique in small ruminants and cryopreservation of ram/buck semen before attempting it on the farmers' field/flock. However, AI in goats can be done at farm/field level with liquid semen or freshly collected semen from bucks of proven potential (Beetal) with due preference to areas/regions like Karnah, Machil, Uri and Gurez. In addition, Goat rearing be promoted in such areas with introduction of 2 Goat/5 Goat unit schemes similar to that of sheep, and periodical reviewing of the targets.

16. Strengthening of existing facilities for Embryo Transfer Technology by the Department of Sheep Husbandry Kashmir; and setting up of affordable/low cost laboratories at farms supported by better facilities and technical expertise (Subject Matter Specialists) at district levels.

17. Distribution of FecB gene carrying ewes to progressive sheep breeders only instead to all sheep farmers, mandatory change of breeding rams every two years to avoid inbreeding depression, and exploring the possibility of establishing Broiler Mutton farms by the Department of Sheep Husbandry involving progressive sheep breeders as well for narrowing the gap of mutton consumption versus production.

18. Identification and purchase of ewes with proven credentials of lambing twice a year (excluding twinners) by the Department of Sheep Husbandry from progressive sheep breeders, and stocking a sizeable number of such ewes in a separate farm for further propagation and subsequent popularisation in the field. The departmental expert committee including two SKUAST Kashmir scientists (one each from Animal Genetics & Breeding and Livestock Production & Management) be empowered to purchase such elite germplasm with cap/ceiling on cost per animal depending on the

breeding/stud/phenotypic value as determined by the subject matter experts and reviewed from time to time.

19. Establishment of fodder banks in fodder rich areas/designated mutton villages through promotion of good varieties of fodder crops and supply of quality seeds; development of community wastelands and pastures through involvement of all stakeholders.

(This will ensure timely supply of good quality fodder in fodder scarce/deficient areas and/or during lean periods to sheep breeders/farmers; development of wasteland through silvi-pastoral system and rejuvenation of highland pastures).

20. Preparation of ingredient based livestock feed, silage, urea molasses mineral blocks, complete feed blocks by the Department of Sheep Husbandry at each farm or at some central feed and fodder unit, at least catering to the needs of departmental farms till establishment of mega feed unit/mill by the department.

21. Holding of Technology Exhibition *cum* livestock sale mela in each district preferably in the month of October; exhibition of best rams by the sheep breeders in the mela and awarding of the best animals for evoking interest in scientific livestock rearing.

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