SHORT TERM TRAINING COURSE
ON
ADVANCES IN LIVESTOCK PRODUCTION MANAGEMENT TECHNOLOGIES

14 - 28 February, 2007

Indian Veterinary Research Institute
Eastern Regional Station
37, Belgachia Road
Kolkata - 700 037
SHORT TERM TRAINING COURSE
ON
ADVANCES IN LIVESTOCK PRODUCTION
MANAGEMENT TECHNOLOGIES.

14 - 28 February, 2007

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MESSAGE

The importance of livestock production as an integral part of the farming systems is increasingly felt, realizing the need for diversification of crop based agriculture to sustain the rural income and livelihood. This sector is among the few growth sectors that is directly linked with the livelihoods of more than 65 percent of rural households. This enterprise has unmatching contributions in terms of high value food products, nutritional security, draught power, manure for soil health and organic farming, income, employment generation and export earning. The livestock production management technologies are many covering a wide range of disciplines of animal health, genetic resources production management and livestock products technology. In a vast country like India with diverse agro-ecosystems, production systems of agriculture including livestock production have their unique features and opportunities for their optimal exploitation.

The Eastern Regional Station of Indian Veterinary Research Institute is committed to applied research on animal health problems of Eastern Regional States and plays important role in education and technology transfer activity for all round development of animal's resources in the region. I am glad to learn that the Regional Station is organizing a specialized training course in the area of “Advances in Livestock Production Management Technologies” from 14th to 28th February, 2007 for veterinarians and animal scientists working under Animal Husbandry and Veterinary Departments of various states.

I convey my best wishes to the participants and organizers for a successful training programme.

[S.P.S. AHLAWAT]
MESSAGE

In the ever-changing scenario of science, new knowledge is essentially required to refine the existing technology in all spheres including livestock sector. The rapid improvement in productivity of livestock is possible only if the human resources available are trained for updating their knowledge in different areas of Animal Health and Production. This must be one of the mandates of any research or academic Institutions in order to serve the society.

Animal resources of India, which is associated with the livelihood of 70 percent of rural people, is endowed with vast economic potentiality to improve the quality of masses. Management plays a crucial role to determine profitability or loss of any enterprise including animal resource sector. I am happy to learn that Eastern Regional Station of Indian Veterinary Research Institute is organizing a Short Term Training Course on “Advances in Livestock Production Management Technologies” at Kolkata from February 14-28, 2007 for the benefit of the scientists and Veterinarians of various states.

I convey my best wishes to all the participants and organizers of the training programme.

(Dharmeswar Das)
Joint Director (Acad.)
FOREWORD

With the solving problem of calorie hunger through green revolution, India is poised to solve the problem of protein hunger through development of animal resource. Animal resource is also recognized as an alternative source of income generation to millions and livelihood to under-privileged families. In India, 70-80% of the total livestock produce is contributed by the underprivileged families and livestock are central to their livelihood and culture. Eastern and North Eastern region have high proportion of underprivileged families and livestock is one of the important resources in this region to improve the socio-economic conditions of these families. Prevalence of many diseases in livestock and poultry due to the incliment climate, hamper the production and productivity. Further, this region is connected with five countries namely, Bangladesh, Nepal, China, Myanmar and Bhutan with land and faces the risk of transboundary diseases along with existing disease problems. This region also suffers a set back in improving indigenous species of livestock and poultry through cross breeding with exotic livestock because of hot and humid climate which is not congenial to exotic livestock for full expression of their genetic potentiality. As a result, the percentage of cross bred population is the lowest (11%) in eastern India in comparison to western (15%), southern (34%) and northern regions (40%).

The present training course on “Advances in livestock production management technologies” has been designed in such a way so that field veterinary officers can update their knowledge and adopt modern technologies to enhance the productivity of livestock in their respective areas.

Heartiest thanks to our respected Director and Joint Director (Acad.), IVRI for their whole hearted support and encouragement.

(S.K. Das)
Principal Scientist & Incharge
IVRI, Eastern Regional Station, Kolkata
Livestock rearing is a part and parcel of human civilization. The vast livestock resources of our country are considered national wealth. There is a tremendous potentiality of this sector to improve the national economy and particularly to uplift the socio-economical condition of millions of rural poor. This sector plays a significant role in supplementing family income and generating gainful employment in rural sector specially among the landless agricultural workers, marginal and small farmers and women flock. This sector also provides large self employment opportunities to unemployed youths.

Although the share of GDP contribution from agricultural sector as a whole has been declining over the years in recent times; but the contribution from livestock sector has been steadily increasing. The GDP contribution from livestock sector is about 5.40% at present which is very significant. There is a vast scope of improvement of this sector through adopting advance livestock production technologies which have been recently developed.

With this in view, the short term training course on “Advances in Livestock Production Management Technologies” has been developed by Indian Veterinary Research Institute, Eastern Research Station, Kolkata to update the knowledge of the veterinarians, animal scientists and officers engaged in this sector for adoption of modern technologies to enhance the livestock productivity.

In addition to various livestock management components, recent relevant issues like concept of organic farming, WTO regulations and IPR related matters have been included in the course.

This compendium of lectures from different experts in the field of Livestock Productions Management will be very much helpful to participants and other users.

Constant support and encouragement received from Director and Joint Director (Acad.), IVRI for organizing this course are gratefully acknowledged. Thanks are due to experts for providing manuscripts for this compendium. Help and cooperation received from Station in charge ERS of IVRI and other scientists of this station are also gratefully acknowledged.
The farmers’ economic returns largely depend upon the quality of livestock they raise. Increase in productivity of the animals and production as a whole are the primary concern for sustainable animal husbandry. Depending upon the capability, expertise and resources available with the farmers, they follow different farming systems for dairy production. Accordingly breeding strategies for cattle and buffaloes raised by them also vary considerably. Hence, appropriate breeding policies need to be formulated for production of genetically superior animals for sustainable production.

Cattle and Buffalo Resources of India:

India has a very rich reservoir of genetic diversity and possesses some of the best breeds of cattle and buffaloes in the world. There are 26 recognized breeds of cattle and 7 of buffaloes in India (Table 1). The country’s population of 185.2 million cattle accounts for about 17 percent of the total world population of cattle. The best indigenous germ plasm of milk, draught and dual purpose animals account for 22-25 percent of the Indian cattle population, while 7-10 percent of the cattle population is crossbred. The native livestock breeds exhibit a distinct superiority in utilizing poor quality feed and are adapted to withstand heat and show better resistance to tropical diseases.

There are 97.9 million buffaloes in India which is about 59 percent of the estimated 164 million buffalo population in the world. Of the total milk handled by the organized sector, about 95 percent is buffalo milk. This is because of the fact that the Indian buffaloes constitute the best germplasm of this species in the world and thus there is an export market for Indian buffaloes particularly in the Middle-East countries. Indian breeds of buffaloes known for their high production potential are Murrah, Nili-Ravi and Jaffrabadi and they are considered large sized. About 75 percent of the buffaloes are non-descript and low yielding and there is tremendous scope for their improvement through grading up, better feeding and management.

For developing strategic planning to enhance overall productivity under different agro-climatic regions of India, the country has been divided into 15 agro-climatic regions based on physiography and climate. These zones are further sub-divided into 126 agro-climatic sub-zones by taking into consideration rainfall, temperature, soil-type, topography, and existing cropping pattern and farm animal resources for developing policies on regional basis.
Table 1: Breeds and types of indigenous Cattle and Buffaloes of India

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<td>Dairy</td>
<td>Red Sindhi, Sahiwal, Karan Swiss, Karan Fries, Simandini</td>
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<td>Dairy and draft</td>
<td>Tharparkar, Gir</td>
</tr>
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<td>Draft and dairy</td>
<td>Deoni, Gaolao, Hariana, Kankrej, Krishna Valley, Ongole, Rath, Siri</td>
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<tr>
<td>Draft</td>
<td>Amritmahal, Bachaur, Bargur, Dangi, Hallikar, Kangayam, Kenkatha, Kherigarh, Khillari, Malvi, Mehwari, Nagori, Nimari, Ponwar</td>
</tr>
<tr>
<td>Dairy</td>
<td>Murrah, Nili-Ravi, Surti, Jafarabadi, Bhadawari, Godavari</td>
</tr>
<tr>
<td>Draft and Meat</td>
<td>Kalahandi, Manda/Parlakmed/Ganjam, Nagpuri/Pandharpuri, Sambalpur, Tarai, Jerangi, South Kanara, Toda, Swamp buffalo</td>
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The performance level of different breeds of cattle and buffaloes varies considerably so far the growth, reproduction and production traits are concerned. Besides that the indigenous nondescript cattle and buffaloes perform poorly so far the milk production is concerned but they are very good draft animal with disease resistance and are adaptable to harsh and poor environment and management to which they are exposed.

Breeding policies for cattle in India:

During the pre independent period, India did not have any specific approved breeding policy for development of dairy cattle and buffalo. After independence, as per recommendation of Goseva Sangha, Wardha, in 1949, Indian Council of Agricultural Research (ICAR) made the following recommendations:

1. In non-descript cattle, milch and draught qualities should be combined to produce an average kind of animal.
2. For specific types, selective breeding should be utilized to improve their draft and milch qualities.
3. In well-defined breeds; the milk production should be increased as far as possible without seriously impairing the draft capacity of these animals.
4. For well-defined milch breeds, selective breeding was recommended to develop their milch capacity to the maximum possible extent. This strategy of selective breeding and upgrading of indigenous breeds continued till 1952.

The above policy of ICAR led to creation of Key Village Schemes in 1951 during the first five year plan and to expand number of Govt. farms considerably to produce sufficient breeding bulls to upgrade the lower strata of cattle. These schemes envisaged controlled breeding, improved feeding, management and disease control measures. Then came the progeny testing of sires in Govt. farms during second five year plan (1959-64) and Intensive Cattle Development Projects (ICDP) in 1964-65 with a wider scope than key village schemes.

The Govt. of India maintained the policy of Key Village Scheme, ICDP and bull mother farms till 1962 when again the cattle breeding policy was reviewed. The efforts made directed attention away from the draft animals towards breeding for more milk eventually through crossbreeding besides progeny testing and selective breeding in well defined indigenous breeds in their breeding tracts. The rate of genetic progress through efforts made in retrospect to improve genetic potential for rapid growth and more milk has rather been slow because of low heritability of milk production, inaccuracy of pedigree selection and long generation interval in indigenous breeds. This slow rate of annual genetic gain could be greatly accelerated if bulls were progeny tested prior to their extensive use.
Breeding Policies and Programmes in the Planning Process:

First Five Year Plan: It was suggested that a programme for improvement of cattle should be launched, involving arrangements for production and use of adequate numbers of superior bulls of known parentage and productivity and elimination of inferior and unproven bulls.

Second Five Year Plan: The major guidelines of the all-India breeding policy, drawn up by the Indian Council of Agricultural Research and accepted by the Central and State Governments were:
- In the case of well-defined milch breeds the milking capacity should be developed to the maximum by selective breeding and the male progeny should be used for the development of the nondescript cattle.
- In the case of well-defined draught breeds, the objective is to put as much milk-producing capability in them as possible, without materially impairing their quality for work.

Third Five Year Plan: Weeding of inferior stock was a necessary complement to a programme of cattle improvement and systematic breeding. Having regard to the size of the problem of surplus cattle and its special features, with a view to elimination of scrub male stock, it was proposed to undertake a large-scale programme of castration during the period.

Fourth Five Year Plan: It was proposed that the schemes of the Third Plan including those relating to cattle breeding farms, bull rearing farms, Goshala development and organization of mass castration would continue and three central cattle breeding farms and eight bull rearing farms would be set up. It was also indicated that Sire-evaluation cells would be established in each State.

Fifth Five-Year Plan: It was envisaged that the emphasis would continue to be laid on crossbreeding of cattle through establishment of exotic cattle breeding farms and intensive artificial insemination measures.

Sixth Five Year Plan: Increase in productivity of cattle and buffalo received continued emphasis and progressive introduction of artificial insemination technique using superior breeding bulls was the main plank for cattle development under the Key Village Scheme and the Intensive Cattle Development programmes. It was envisaged to increase the productivity of cattle by making concerted efforts to contain the increase in the population of cows and she buffaloes and to change the structure of these populations by replacing non-descript local stock by high-producing cows of indigenous breeds, crossbred cows and improved buffaloes.

To achieve this, States were required to frame their breeding policies.

Seventh Five-Year Plan: Crossbreeding with exotic dairy breeds were accelerated through the establishment of frozen semen stations in different States. For increasing milk production and to improve draught power of bullocks, programmes for improvement of various breeds continued, with emphasis on inputs like high merited breeding bulls, adequate and scientific feeding, modern management practices, provision of health facilities with efforts to bring at least 25 million cows under the cross-breeding programme.

Eighth Five Year Plan: The need for paying special attention to technologies was sought to be given to research in frontier areas such as genetic engineering which would provide for rapid upgradation of cattle through the use of Embryo Transfer Technology, development of more effective vaccines to control livestock diseases etc.

Ninth Five-Year Plan: Intensified activities particularly, in improvement of genetic stocks, through crossbreeding, effective control of diseases and the Operation Flood Programmes. The specific areas identified for intervention and support included, scientific management of genetic stock resources and upgradation, breeding, producing quality feed and fodder etc. One of the key research areas identified under Animal Sciences discipline was Genetic resource enhancement of cattle and other animals, through selection / cross breeding / embryo biotechnology.
Tenth Five Year Plan: During the Tenth Five year Plan, a new programme focused exclusively on draught breeds of livestock. The National Project for Cattle and Buffalo breeding continued for its implementation to realize the envisaged targets as follows.

(1) Pure indigenous well-developed breeds should be improved through selection, while non-descript low producing populations should be improved by grading up with other superior indigenous breeds or crossbreeding with exotic males. It was observed that crossbreeding with exotic breeds in home tract of elite important indigenous breeds has been threatening the existence of these breeds in their home tracts. It was recommended for initiation of steps to create incentives for breeding indigenous elite breeds and improve them through selection.

(2) An aggressive strategy is to be adopted to remove the hurdles in sourcing and use of quality bulls for breeding.

(3) Monitoring cell for certification of sperm stations and A.I. bulls should be established in each state. Only certified semen should be used for A.I; where certification of semen is not possible, bulls may be used for breeding.

(4) Field A.I. network (A.I. outlets), sperm stations, breeding farms and breeding programmes (Performance Recording, Progeny Testing, ONBs etc.) should constitute focal points for monitoring efficiency and progress.

(5) Rapid computerization of the breeding network needs to be done in order to build up a reliable database and effective monitoring through a Management Information System (MIS) both at State and national level.

(6) Under the prevalent conditions in the country, the conventional method of producing progeny tested bulls could not achieve the desired results. Advance technologies like ETT and OPU-IVF should be used to support this programme.

BREED IMPROVEMENT AND PRESERVATION

The National Commission on Cattle Report (July, 2002) observed that the broad features of the national breeding policy have been laid down in the country and from sixties onwards there have been directions to State Governments to take measures to conserve the important national breeds. At the same time crossbreeding has been recommended as a major tool for increasing milk production. The following are the recommendations of the Committee on Breed Improvement and Preservation.

• The Government should review its breeding policy and provide more emphasis to conservation of indigenous breeds. If required, a separate policy for conservation of indigenous cattle breeds and their germplasm should be drawn up and translated into an implemental programme.

• Crossbreeding with exotic strains should be totally banned in the home tracts of the important cattle breeds and the ban should be strictly got implemented by the State Governments.

• A judicious mix of cross-breeding with exotic strains and preservation of indigenous germplasm should be maintained, while formulating the policy. Import of germplasm should be allowed only in very specific cases and after taking all the precautions to prevent the ingress of diseases into the country.

Implementation of the Breeding Programmes:

The broad outlines of the breeding policy are normally laid down by the central Government for the State Governments to follow. While there has been a clause prescribing conservation of the important native breeds, especially in their home breeding tracts, no follow up or monitoring is being done at the field level. While the Central Government has been recommending, since the sixties, that steps and measures should be taken to conserve Indian indigenous breeds, this has not been translated into programmes and activities on a sufficient scale. Some State Governments have prepared breeding strategies and regional plans, and have also identified the areas of breeding tracts for different breeds, on the ground these
strategies have not actually translated into proper programmes and plans of action, which could achieve the desired results. The Committee therefore recommended that:

• A proper institutionalized monitoring mechanism be established from the Centre downwards, so that the implementation of the Breeding Policy directives is monitored closely.

• Directions should be given to the State Governments to draw up region-specific and breed-specific breeding strategies, programmes and plans to implement the conservation programme.

• Targets should be allocated to the concerned State Governments, in terms of actual numbers of cattle heads of the particular breed, infrastructure facilities such as sperm stations, bull farms etc.

• The States should be directed to specifically delineate and identify, in their respective breeding policies, the geographical boundaries of the areas where non-descript cattle should be upgraded by crossing with bulls of indigenous breeds.

• Breeds, which no longer find favour with the farmers, whatever the reason may be identified and these breeds, should be preserved only in the institutional farms, with improved conservation technologies.

• Breeds, which are accepted by the common farmer, should be developed through region-specific and breed-specific programmes, aimed at selection in the breeding tracts and supply of improved quality of germplasm for breeding of cattle for supply to farmers on demand.

• Technologies such as artificial insemination, frozen semen production, progeny-testing, embryo transfer technology (ETT) should be used, after proper evaluation, wherever required, so that modern up-dated scientific methods can be used to give a fillip to the programme for conservation, preservation and up gradation of breeds.

• Monitoring cells for certification of sperm stations and bulls for frozen semen, should be established at the State levels and only certified semen should be used for AI, as suggested by the Working Group on Animal Husbandry set up for the Tenth Plan proposals.

Breeding policies for buffaloes of India:

A major step undertaken during the fourth five years plan by ICAR for improving genetic potential of buffaloes was to initiate an All India Co-coordinated Research Project on Buffaloes based on a multi-disciplinary approach. The objective of this project was to improve the production potentials of buffaloes through assessment of genetic merit of sires and increasing production by breeding, feeding and management. The Central Institute for research in buffaloes has been established at Hisar with a Net Work Project at Guwahati for research on swamp buffaloes. The current policy is to further improve the indigenous breeds like Murrah, Nili-Ravi, Mehsana, Jaffrabadi, Surti, Bhadawari and Nagpuri through selective breeding. The non-descript buffaloes are to be upgraded by repeatedly mating the females with the sires of improved breeds.

Breeding of recognized Buffalo breeds:

The relatively high yielding buffaloes of well-defined buffalo breeds are maintained under intensive production system in organized farms and mainly under semi intensive management system in farmers’ herds in the breeding tracts of different buffalo breeds. Selective breeding is practiced for bringing about genetic improvement in buffalo breeds. However, production of genetically superior buffalo bulls has become highly essential for the breeds of Murrah, Surti, Mehsana, Bhadawari and Jaffarabadi. Nili Ravi, Nagpuri etc. in the organized farms for future breeding.

Murrah is generally the breed of choice in the north Indian states of Haryana, Punjab and U.P. However, Nili Ravi also has sizable population in Punjab. In certain pockets of states like Gujarat, Rajasthan and Karnataka, Surti may be the breed of choice. Selective breeding for all these breeds of buffaloes will lead to higher milk production, reduction in age at maturity, reduction in service period, dry period and calving interval which in turn boost up economic returns to the farmers.
Through selective breeding and utilization of genetically superior bulls from different herds, it is expected that genetic improvement in milk production will be achieved ranging from 1 to 1.5 percent per annum in organized farms and 8-10 percent per annum in farmers' herds.

Local Non-Descript Buffaloes Under Low to Medium Input Production system:

The production potential of low producing non-descript buffaloes can be increased through mating with superior sires of improved breeds like Murrah, Surti, Mehsana etc. in Karnataka, Kerala, parts of Gujarat and Rajasthan, Nill Ravi in some pockets of Punjab, Murrah in Haryana, parts of western Uttar Pradesh and Punjab as the breed of choice for the purpose. Murrah can be used for grading up of nondescript buffaloes in other parts of the country where adequate feed and fodder resources are available.

This programme is expected to increase the milk production of village nondescript buffaloes by 2 to 3 times in early generations of grading up. The grading up of non-descript buffaloes yielding on an average 500 kg of milk with improved buffalo bulls having genetic potential of 2000 kg or more will yield on an average 1250 kg of milk in first generation. Through grading up of the low producing non-descript buffaloes with superior breeds for four to five generations using relatively high producing buffaloes, the production potentiality of the non-descript buffaloes can be gradually improved like that of some defined breeds.

In order to augment productivity and to improve performance of livestock particularly dairy cattle and buffalo, the breeding policies recommended are:

- Selective breeding of the pure Indian breeds of cattle and buffalo for milk production.
- Selective breeding of dual purpose breeds for improving their milk and work output.
- Upgrading of non-descript Indian cattle and buffaloes with selected Indian improved breeds for productivity of milk and work output.
- Crossbreeding of Indian breeds of cattle/ Buffalo.
- Crossbreeding of Indian breeds of cattle using exotic breeds.

National Project on Cattle and Buffalo Breeding:

Genetic improvement is a long-term activity and Government of India has initiated a major programme since October 2000, "National Project for Cattle and Buffalo Breeding" (NPCBB). This Project envisages genetic upgrading and development of indigenous breeds on priority basis.

The objectives of the scheme are (1) to arrange delivery of vastly improved artificial insemination service at the farmers' doorstep, (2) to progressively bring under-organized breeding through artificial insemination or natural service by high quality bulls, all breedable females among cattle and buffalo within a period of 10 years, (3) to undertake breed improvement programme for indigenous cattle and buffalo breeds so as to improve their genetic qualities as well as their availability. Twenty-six States of the country are participating in the project.

Technologies involved in Breeding of Cattle and Buffalo:

Selective breeding or Crossbreeding of cattle involves the following techniques and tools:

1. Genetic evaluation of sires and dams for selection.
2. Artificial insemination for maximum use of superior bulls with improved genes in identified populations.
3. Multiple ovulation and embryo transfer to improve the intensity and accuracy of selection and to reduce the period of evaluation.
4. For internal mating of half-breds, genetically evaluated half-bred bulls are a basic requirement. Bulls to be used for AI are evaluated for their ability to transmit economic traits advantageous to the breeders and the industry, i.e. milk yield, fat and protein percentage, fertility, and a number of allied factors. None of these factors can be measured on
the bull itself. The bulls are evaluated on the basis of actual measurement of the desired traits in their daughters (progeny tests) or siblings, both full and half (sibling tests in open nucleus breeding systems or ONBS).

Open Nucleus Breeding System (ONBS):

This system envisages formation of a nucleus population of breedable animals of exceptionally high genetic merit. The outstanding breedable males are to be let out from the nucleus herd to the farmers or breeders in the neighbouring areas to bring about genetic improvement of their animals. This system is useful for developing countries where field progeny testing and Artificial Insemination have not yielded much success for want of necessary infrastructure and lack of field performance recording.

The plan of work under ONBS with MOET is as follows:

1. Screening of the unrecorded base population for identifying some outstanding females.
2. Collection of the outstanding females to form a nucleus herd which would be used as test group of animals.
3. Super ovulation of the elite animals from the outstanding animals in vitro with semen of superior sires.
4. Transfer of the resulting embryos to the test group in the nucleus herd as well as to the females in the unrecorded base population.
5. The best males are selected on the basis of their own performances as well as on siblings' performance. They are then extensively used in the field.
6. The female offspring are next considered as potential elite females to donate embryos by MOET for the following cycle after their appraisal against elite cows already present in the nucleus herd and used upon for MOET.

The ONES can be used as an alternate way of testing young bulls at an early age of about 3-4 years instead of about 7 years in conventional breeding plans. The ONBS can be followed for genetic improvement of both purebred and crossbred populations. ONBS can be tried for genetic improvement of crossbred population for which some Nucleus herds of about 200 animals are required to be established in different regions / States considering the magnitude of the crossbred population. The animals collected from the field after their screening as outstanding animals can form these nucleus herds. In the Nucleus herds besides other, facilities for proper recording systems must be there so that the best males can be selected on the available records of their Dam, sibling and own records. Simultaneously, a system should also there for recording of at least these females' progenies, which would be collected and used as replacement stock in the field.

In most of the indigenous zebu cattle breed dominated areas of India, herd sizes are generally small. Therefore, the scope for selection among replacements within farms is small. Consequently, the potential of opening the nucleus for replacements from these herds may be limited, especially when an individual farm unit is considered. To circumvent this problem, use can be made of village herds each comprised of several individual farm units with a considerable number of cows from which replacements can be selected. Such a village-level programme would be particularly useful given the communal use of breeding bulls.

In a young bull scheme, untested bulls can be used to sire dams both in the nucleus and participating herds. Two types of young bull schemes need to be distinguished: one with semen storage or waiting bulls; and the other one without these possibilities. When AI is possible, the bulls can be disposed off and the semen can be stored until daughter records are available to select semen from the best bulls for planned mating. In the absence of AI, the bulls are to be maintained (waiting bulls) until daughter records are available and the inferior ones disposed thereafter. The rate of gain in such schemes would suffer because it takes a long time for the bull's daughters to be recorded. The use of young, untested bulls for AI or natural mating in the participating herds leads to a substantial reduction in the time-lag required for dissemination of the genetic superiority of the nucleus to this sector.

Field / Participating herds (farmers):

Animals in farmers herd in the field can contribute immensely in producing and selecting the best breeding males in cattle or buffalo development programmes in the
country. Farmers own the animals and they take on their own day-to-day decisions concerning the animals in their herds on feeding, health management etc. In an open nucleus system, this group may have the role of providing information on their best animals so that these animals can be introduced into the nucleus. These farmers are considered as the clients as well as the stakeholders of the breeding programme.

The foregoing discussion is made as to how a major thrust can be given on genetic upgrading of indigenous/native cattle and buffaloes for production of semen from high quality pedigreed bulls for expansion of artificial insemination network outreaching farmer's doorstep and to augment production.

Central Organizations in aid of Cattle and Buffalo Breeding programmes:

The Central Cattle Development Organizations include 7 Central Cattle Breeding Farms, the Central Frozen Semen Production and Training Institute, Hessarghatta and the 4 Central Herd Registration Units, which have been established in different regions of the country for production of genetically superior breed of bull calves, good quality frozen semen and identification of location of superior germplasms of cattle and buffaloes, to meet the requirement of bulls and frozen semen doses in different parts of the country.

The Central Cattle Breeding Farms located at Suratgarh (Rajasthan), Chipliana and Sunabeda (Orissa), Dhamrod (Gujarat), Hessarghatta (Karnataka), Alamadhi (Tamil Nadu) and Andeshnagar (U.P) are maintaining bull mothers of important cattle and buffalo breeds which include Tharparkar, Red Sindhi, Jersey, Holstein Friesian, Crossbred (HF x Tharparkar, Jersey x Red Sindhi), Surti and Murrah. The farms produce bull calves from these bull mothers and supply high pedigree bull calves and bulls to the State Governments and other breeding organisations for production of frozen semen. The farms located at Sunabeda, Suratgarh and Andeshnagar also have the facilities for production of frozen semen.

The Central Cattle Breeding Farm, Alamadhi has been associated with Associated Herd Progeny Testing Programme of the Central Institute for Research on Buffaloes, Hissar. The buffaloes available at the farm are used for test mating of Murrah bulls and semen of proven/ high pedigree bulls is used for further genetic improvement. The Central Cattle Breeding farms follow the fodder cropping programme as recommended by Indian Grassland and Fodder Research Institute, Jhansi and also produce fodder seeds for distribution under Central Minikit Testing Programme under which free fodder seed minikits are provided to farmers. The farms provide breeding facilities to the cows and buffaloes of the nearby villages free of cost and also conduct training of farmers in dairy farming under Animal Husbandry Extension Programme.

The Central Frozen Semen Production and Training Institute, Hessarghatta is producing frozen semen doses of indigenous exotic and crossbred cattle bulls and Murrah buffalo bulls for use in artificial insemination. The institute has acquired proficiency in Embryo Transfer Technology.

For genetic improvement of the country's cattle and buffaloes, the National Dairy Development Board (NDDB) has also developed appropriate selection programmes – the Dairy Herd Improvement Programme Actions (DIPA) and the Open Nucleus Breeding System (ONBS) integrated with artificial insemination. DNA fingerprinting and karyotyping are being undertaken to identify and select superior healthy milch animals. The NDDB has supported the Milk Unions to establish semen production, liquid nitrogen delivery and artificial insemination (AI) facilities.

The objectives of the Central Cattle, Buffalo Breeding Farms viz., Suratgarh (Rajasthan) for Tharparkar, Chipliana (Orissa) for Red Sindhi(RS) and RS x Jersey, Hessaraghatta (Karnataka) for Holstein Friesian, Sunabeda (Orissa) for Jersey, Andesh Nagar (U.P) for Holstein Friesian X Tharparkar cattle and Dhamrod (Gujarat) for Surti and Alamadhi (Tamil Nadu) for Murrah Buffaloes are progressive genetic improvement for milk production in important breed/type of cows and buffaloes by following scientific methods, production and distribution of superior pedigreed bulls for use in Cattle and Buffalo Breeding Programmes, preservation of indigenous germ plasm and production of upgraded crossbred animals suitable for specified breeding tracts.
Databases development for indigenous, non-descript, as well as crossbred cattle and buffaloes is a major prerequisite for success in any breeding policy. The problems of lack of timely and quality data are compounded by lack of perception of the data-collectors while categorizing the breeds and quantifying their performances, particularly in the Integrated Sample Survey for Estimation of Production of Major Livestock Products is conducted by the Department of Animal Husbandry of the Central Government, through their counterparts in the States. Clubbing of both non-descript and good indigenous cattle breeds into a single category of indigenous cattle often results in distortion while recording parameters such as average productivity etc. There is also a lack of perception about the maximum and average productivity of crossbred cattle in various production environments. Proper and scientific field data recording system has to be followed by all concerned in order to design and monitor the progress of implementation of the breeding policies.

A breeding network should be set up by computerizing and net-working all AI outlets, sperm stations, breeding farms, Goshalas etc. and other agencies involved in the production of breeding material and implementation of breeding programmes. Activities such as performance recording, progeny testing, herd registration and sperm certification should all be computerized and connected with each other through the network as suggested by the Govt. agencies and professionals.
Livestock rearing is an integral part of Indian rural life and culture. This sector is an important source of employment and income generation especially for rural poor. The per capita availability of arable land in India is gradually declining with the pressure of ever increasing pressure of human population and other non-agricultural activities. The availability of per capita arable land has declined from 0.24 hectares in 1979-81 to 0.10 hectares in 1997-99. However, there is a average increase of livestock population in the country. As livestock census 2003, India possesses 185 million cattle, 98 million buffaloes, 61 million sheeps, 124 million goats, 14 million pigs, 0.28 million mithunes, 0.07 million yak, and 489 million poultry. About 70 percent of this vast livestock population belong to poorer section of rural population. The livestock sector enables poor and landless agricultural workers to earn their livelihood using waste land, common property resources like forest, permanent pasture, riversides, grazing lander. Moreover, unlike agriculture which is seasonal, the livestock sector provides employment and income round the years. This is very much helpful for the poor who live from hand to mouth. It also provides self-employment to millions of rural households especially to unemployed youths and engages women flocks to utilize their spare time to earn supplementary income to run the family.

1. LIVELIHOOD OF RURAL POORS:

Although India achieved record food grains production of 208.08 million tonnes and maintained sizeable 60 million tonnes of buffer stock of food grains; but a large section of poor population has no economic access to their required food grains. It is reported by Family Health Survey (1991-99) that 42% boys and 40.8% of girls between 1-5 years of age are severely under nourished. About 30% new born babies have shown lower birth weight due to maternal and foetal under nourishment. About 74.3% children under 3 years of age and 51.8% of the married women between 15-45 years of age suffer from anaemia. The per capita availability of cereals and pulses per day is about 407.40 gm which is much below than standard requirement. All these showed that although we have a surplus stock of food grains in our reserve pool; everything is not well and people of below poverty line are not getting required quantity of dietary intake. It is also observed that there is an increase production of staple food grains but the consumption level of the economically under privileged section of the society has not gone up. The food consumption of the poor in the Country seems to have gone down in the last 10 years and is estimated to be at least 33% below as compared to per capita consumption of the top 10% of our population. This is a very serious matter. It is obviously because of low purchasing power of the poor peoples of the society. Due to low purchasing power they could not get the required quantity of food grains in spite of availability of food grains in the open market.

The remedy lies in enhancing the income of the poor through employment generation programmes and to set up their purchasing power. This can be done in diversification of agriculture into livestock farming, i.e. dairying, poultry farming, piggery and goatery etc. which will provide regular employment to the rural poor round the year for the generation of the income.

Various programmes e.g. Food for work, Employment guarantee scheme etc. which provide income to the poor to alleviate their poverty are all temporary in nature and not sustainable.
But if the productivity of their local livestock is improved through genetic up-gradation and improved husbandry practices; the employment and income of the poors will be enhanced and the benefits gained from the improved livestock will be regular and sustainable in nature over the years.

Majority of the livestock resources are under ownership of poorer section of rural population, whereas the distribution of the arable land is skewed in favour of rich and affluent farmers. That is why the benefits from “green revolution” had not been culculated among poor and landless. The maximum benefits from “green revolution” have gone to affluent farmers who possess more land and associated inputs required for cultivation. But the improvement of the livestock productivity will be directly helpful to the poors those who possess more livestock resources. The pattern of the land and livestock holdings among various categories of farmers are given below:

<table>
<thead>
<tr>
<th>Holding Size</th>
<th>% of total holdings</th>
<th>% of total area operated</th>
<th>% of total Livestock owned</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Cattle &amp;</td>
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<td></td>
<td></td>
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<td>Buffaloes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Goat &amp; Sheep</td>
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<td>15.0</td>
<td>35.9</td>
</tr>
<tr>
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<td>18.8</td>
<td>17.4</td>
<td>21.8</td>
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<tr>
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<td>13.1</td>
<td>23.2</td>
<td>20.7</td>
</tr>
<tr>
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<td>7.1</td>
<td>27.0</td>
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</tr>
<tr>
<td>Large</td>
<td>1.6</td>
<td>17.3</td>
<td>5.1</td>
</tr>
</tbody>
</table>

2. POTENTIALITIES OF LIVESTOCK SECTOR

The contribution of Livestock sector to agricultural GDP has gone up over the years and it is now 35.7% in 2004-05. This excludes the contribution of bullock power which in terms of electrical equivalent would be Rs. 31.50 billions. The contribution of milk alone (Rs. 82,624 crore) was higher than paddy (68,230 crores) and wheat ( Rs. 40,323 crores ). The milk production of the Country which was hovering about 17.0 million tonnes during 1950 to 1970 with lowest growth rate of about 1% p.a.; has now reached to 90.7 million tonnes in 2004-05 with growth-rate of 5.5% p.a. This is mainly due to successful “White revolution” and massive crossbreeding programmes of daily Cattle for enhancing milk production. The per capita availability of milk has increased from 112 gm per day in 1970-71 to about 231 gm per day in 2004-05. But it is still below the standard requirement of 280 gm/head/day. Out of total milk production more than 60% of it is produced by small, marginal farmers and agricultural workers. The average yield of the indigenous cow is about 500-600 lit/ lact/ per cow which is much below than average yield of 4000-5000 lit/ lact/ per cow in developed Country. Through crossbreeding of the indigenous cow with exotic breeds; the productivity of our cows can be enhanced to at least 2500 –3000 lit/ lact. So, there is good potentiality for improving the productivity of our indigenous cow.

The present meat production of the Country is estimated at 4.6 million tonnes which is far below the requirement. There is a wide gap between demand and production of meat in the Country. The productivity of the meat producing animals are very low in compare to the improved animals of the developed Country. Through genetic up-gradation and crossbreeding; the productivity of the indigenous meat producing animals can be improved. The meat group contributed Rs 21,900 crore and meat products Rs 828 crore while by-products comprising larger hide and skins contributed Rs.2,232 crore.

The poultry industry has shown tremendous growth in recent times. Today India ranks 4th in egg production and 19th in broiler production in the World. It is estimated that egg production in the Country is about 45 billion in number during 2004-05 and poultry meat production has also gone up to 1.9 million tonnes per annum with annual growth rate of 10%. As per
National Institute of Nutrition per capita requirement of eggs and meat per year are 180 eggs and 9 kg meat respectively which are yet to be achieved.

3. EMPLOYMENT GENERATION

The livestock sector is labour intensive especially in rural area. This sector provides employment round the year. Employment in this sector is estimated as 9.8 million in principal status and 8.6 million in subsidiary status. Apart from this; vast manpower is involved in livestock related activities viz. Livestock products producing and marketing, manufacturing of woollen & leather goods retail and wholesale trade of livestock products etc. There is a good scope of self-employment in this sector. Rural youths can easily start livestock farming and related occupation with minimum investment. There is also wide scope of utilization of family labour in this sector. Farmers can utilize their spare time in this occupation to earn supplementary income.

The rural women play a significant role in Livestock sector and are involved in various livestock operations effectively. It is estimated that women constitute about 71% of the labour force in Livestock farming.

4. DEMAND DRIVEN LIVESTOCK GROWTH

In spite of the significant increase of milk production in Country; the per capita availability of milk is 231 gm per day which is still away from the standard requirement of 280 gm per day per head. The meat production of the Country is estimated as 4.6 million tonnes which is also far behind the requirement. Similarly egg production is about 45 billion number per year. The per capita availability is only 35 eggs per year which is below than the annual requirement of 180 eggs per head. There is a massive development in all sectors of the Country, which has resulted increase demand of animal origin products i.e. milk, meat, eggs and their various products. This increase demand of animal products creates bright prospects of Livestock sector. This ever increasing demand of animal products can be fulfilled through technology supported and demand driven livestock growth. which will also ensure food and nutrition security and livelihood of the rural poors. This indicates that use of technological and marketing interventions in production, processing and distribution of livestock products should be theme of the future livestock growth.

5. GENERATION OF RURAL WEALTH THROUGH LIVESTOCK IMPROVEMENT

There are about 35 million poor families in the rural areas in the Country. These families mostly consist of landless agricultural workers, marginal and small farmers and most of this population is living below poverty line. In India land-man ratio is low and distribution of land is skewed in favour of rich and affluent farmers. So, diversification of crop based rural economy to animal based mixed farming system will be helpful for rapid economic development and generation of income especially for the rural poors.

To uplift the socio-economic condition of rural poors; asset / wealth creation in the hands of these poor families is necessary for earning their livelihood. As, the land asset of these population is very much limited and scarce; the livestock asset may be improved to generate better wealth to earn substantial income for their livelihood. The rural poor families may not have much cultivable land but they possess few animals. This may be either one or two cows / buffaloes or few sheep / goats / pigs; if not at least they will possess few poultry birds. But most of these livestock are indigenous type and low producers. So, the income from these animals is insufficient. But, if the productivity of these indigenous livestock is improved through genetic-up gradation, then the income and employment will be enhanced from these animals. This will be helpful to increase the purchasing power of poor rural population; so that they can purchase required food grains and other commodities for their livelihood. On the other hand, due to genetic improvement of their livestock; the poor rural livestock owners will now possess high producing improved livestock whose market price will be about Rs. 10,000 to Rs. 12,000 in case of cow in compared to his earlier local cows costing somewhere between Rs. 2,000 to Rs. 3000. Similar trend will be applicable in other species of livestock; if improvement programmes are undertaken.

As it is earlier mentioned that cultivable land asset of these group of poor families are very insignificant; so improved livestock assets could be very effective to raise the socio-
economic status of the poor families for generation of more employment and income to earn their livelihood.

6. ROLE OF LIVESTOCK SECTOR IN VARIOUS RURAL WELFARE PROGRAMMES

Various livelihood welfare programmes were launched from time to time by the Government to alleviate rural poverty. There are about 30% rural populations who are living below poverty level in the Country. Government is trying to help to this section of population through different welfare programmes i.e. Sampoorna Grameen Rozgar Yojana (SGRY), Swarnjayanti Gram Swarojgar Yojana (SGSY), National Food for Work Programme (NFFWP) and National employment guarantee programmes etc. in which employment and income for certain period are assured. Under these programmes various community work e.g. reconstruction of roads, renovation of ponds, irrigation of canals, flood control programmes, digging up community ponds, river boundaries etc. are undertaken through which rural poors are provided employment to earn their livelihood. But these programmes are seasonal and one time affairs. After the completion of the works / programmes the benefits received by the individuals will be exhausted and as no permanent assets are created to individuals from which they can earn their livelihood; so no sustainable benefits will be attainable by the rural poors from this welfare programmes.

But if livestock improvement/development activities are included in these rural welfare programmes; then the benefits gained through livestock improvement would be persistent and sustainable even after discontinuation of the particular welfare programme executed by the Government. Through livestock development programmes, employment and income can be provided to rural poors both on short term and long term basis along with enhancing the productivity of livestock by generating improved varieties of livestock from local indigenous animals. This improvement of livestock can be done through cross-breeding and grading up programmes. In case of poultry, ducks, quails, sheep & pigs etc. short term gain is possible within 6 months to 1st year. But in case of large animals i.e. cows & buffaloes long term programme is required to get the benefits which may take 4-5 years time. But once the gain is achievable, this can generate enhanced income year after year on permanent basis.

So the livestock component should be included with all sincerity in the welfare programmes like employment guarantee program etc. to spread the benefits from this sector to rural poors.

7. LOW PLAN PRIORITY FOR LIVESTOCK SECTOR

Inspite of significant contribution in the tune of Rs 1, 73,350 crore per anum from livestock sector, due plan priorities is not given to this sector. Livestock sector contributes more than 5.40% of total GDP of the Country. The contribution from livestock sector to agricultural GDP has gone up over the years and was 35.7% in 2004-05 excluding draught animal power equivalent to Rs 31.50 billion. Against this scenario; the plan investment of the Government of India including state share in Animal Husbandry and Dairying sector was extremely low and varied between 0.4% to 1.0% of the total plan investment. The investment in Animal Husbandry and Dairying as a percentage to the total investment of Government of India in 9th plan was only 0.4%. Such level of low priority does not encourage the desired growth of this sector. As there is a wide scope of improvement of this sector which can uplift the socio-economic condition of rural poors, plan priority should be given matching with its contribution and social commitments.

8. OWNERSHIP OF LIVESTOCK WEALTH

Unlike agricultural land; the ownership of livestock is more evenly distributed among landless agricultural workers, small and marginal farmers. Most of these poor farmers are living below poverty level. Seventy percent of our vast livestock population belongs to poorer section of our population. About 100 million milch cows and buffaloes are spread over in 5 lakh villages and distributed among 70 million farmers. Five million house holds are engaged in rearing small ruminants like sheep and goat for earning their livelihood. So, under this circumstances livestock sector deserves due attention from the planners and administrators to uplift the socio-economic status of rural poors.
productivity of the most of these indigenous livestock is very low. So, income generated from these low producing livestock is not enough for maintaining the livelihood of poor livestock owners. That is why, it is very essential to improve the productivity of these indigenous livestock to enhance the income of the poor families in rural area for their livelihood.

9. NEW DEAL FOR LIVESTOCK SECTOR

It is reported that 69% of our population is still dependent on agriculture but the share of agriculture sector in the GDP has gone down substantially from 52% to about 22% at present. This indicates that the share in income of rural population which is dependent on agriculture has come down. As a result, the purchasing power of rural poors has gone down and they do not have access to their required food grains. On the other hand, contribution from livestock sector to total GDP has gone up to 5.4%. This indicates that there is ample scope of further improvement of this sector, which can easily uplift the socio-economic status of rural poors. This sector provides large self-employment to millions of rural households and unemployed youths. The opportunities have to be created for the self-employment of rural youths by helping them to set up their own Livestock enterprises.

A strategy for the integrated sustainable livestock farming system as well as their diversification and value addition to primary livestock products commodities will have to be planned for economic feasibility of the enterprises. Government should give adequate plan priority for the development of this sector to uplift the socio-economic status of rural poors.
CONCEPT OF DAIRY CATTLE HOUSING IN VARIOUS AGRO-CLIMATIC ZONES OF INDIA

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DAIRY CATTLE HOUSING

Housing of animals is one of the important requirement for improving production. The basic justification of Livestock housing is that it should alter or modify the micro-environment for the benefit of the animals enclosed. In India, scientific housing of animals was practically ignored in the past, except in few organized Govt. farms where western type of dairy cattle housing was followed. This system of housing is mainly designed to suit the environment of temperate climate and not suitable for tropical climate.

In recent past loose housing system for dairy cattle is being advocated in Indian tropical climate. This system has proved quite suitable and economical for Indian condition. But some modification of loose housing is required to suite various climatic condition of different regions of the country.

In loose housing system, animals are usually kept in an open paddock in group of 40-50 throughout the day and night except during milking and some other specific purposes like treatment, breeding etc. hen the animals are required to be tied. This housing system (Fig.1) generally consists of continuous manger along with covered standing space, common water trough and open paddock which is surrounded by brick wall or railing fencing. A separate structure of calf pens, calving pens, milking byres, bull pens etc. are also required for housing of other categories of animal in this system. The loose housing of dairy cattle has following advantages:

1. The construction cost is less and thus economical.
2. This system of housing is more flexible and so it can easily be extended to accommodate more number of animals without much difficulty.
3. Animals move freely/comfortably and can eat or drink as and they desire.
4. Heat is easy and efficient.
5. Feeding, watering and cleaning operation can be done conveniently with the minimum labour requirement.

In planning and designing of suitable housing accommodation for dairy, consideration should be given to the comfort and health of the
The sheep and goat is particularly important animals in subsistence agriculture on account of unique ability to adapt and maintain itself in harsh environments. Although the origin of domestic goats remains to be clearly established, the available evidence indicates the Bezoar of southwest Asia is the main ancestor. It is also likely that the Makhor of northwest India, together with the Bezoar, has contributed to the genetic background of certain breeds in India and western Asia.

Sheep were domesticated at about the same time as goats and before crop agriculture had fully developed. The original center of domestication was the Aralo-Caspian steppe. From this center sheep breeding spread into what is now Iran, eastwards into the Indian subcontinent and Southeast Asia.

Goats are multipurpose animal, producing milk, meat, skins and hair. Although some breeds such as Jamunapari are capable of producing relatively large amounts of milk, the majority of goats owe their existence to the fact that they thrive as meat producers under conditions in which it is difficult for other species of domestic livestock to survive. Skins are a valuable by-product, especially in countries with a large goat population.

In the past sheep were maintained in the tropical region mainly for production of meat. Subsidiary functions were the production of wool, hair skins, milk and manure. This situation has since changed. A 'white revolution' is spreading throughout the tropics. Fine wool is being produced on an ever-increasing scale.

Sheep and Goat breeds:

According to World Watch List there are 59 breeds of sheep and 29 of goat in India. However, there are about 42 breeds of sheep and 20 of goats as documented in literature in India. Thus India is repository of a large segment of sheep and goat bio-diversity. It has been estimated that Indian sheep and goat breeds are approximately one-fifth and one-third respectively of the world breeds. Indian sheep breeds derive their names mainly from the respective localities where they are raised. The sheep raising tracts of India can be broadly divided in four regions each being represented by different types of sheep. Indian breeds are grouped into two types, viz., hairy and wooly. The former is priced more for its mutton and dairy products, whereas the latter is valued for its wool. All breeds of sheep found in Jammu and Kashmir are now highly threatened. These were the only indigenous germplasm producing fine wool. Population of other fine wool breeds, viz., Hissardale, Nilgiri, Changthangi is also dwindling. Muzaffarnagri is the tallest of Indian breed, showing sharp decline. The number of Pugal sheep, a good carpet wool breed, is not more than few hundreds. The Bonpala sheep of south Sikkim and north West Bengal is now a threatened breed. The Garole sheep of South 24 Pargana district of West Bengal is unique breed to survive in mangrove ecology as well as producing multiple births. Various strains of crossbred sheep have been developed by crossing Indian breeds with temperate breeds.

One can develop specialized dairy type goats or specialized meat type goat or dual purpose one; the dual purpose one being most desired in India. Hence, breeding techniques for goat have to be used for improving different economic traits in goat. There are several well-developed breed of goat in India. Some synthetic breeds have also been developed using different breeds in crossbreeding. One of the outstanding examples of the evolution of the synthetic breed is the Anglo-Nubian breed.
The Bengal breed of goat is renowned for the quality of their meat though they are very small in their body size. The breed is also very suitable for humid regions of the country. Jamunapari goat is under serious threat of extinction. Beetal, a very good milch breed is found in limited number. Changthangi, a pashmina goat is also endangered.

Selective breeding under 'Open Nucleus Breeding System' is the latest technology being used for improvement of different breeds of sheep and goat in India.

Systems of Management:

There are four major systems of sheep and goat production in the tropics: subsistence, extensive, intensive and semi-intensive. In subsistence production few animals are kept to meet domestic need. It is essentially a peasant enterprise, but nevertheless very useful one. The animals may range or be tethered. Extensive systems are generally practiced in regions where the land is not immediately suitable for agricultural improvement. It involves minimum amount of labour and expense. Intensive production involves continuous housing or 'zero grazing'. This is the costliest system of production and is uncommon in developing countries. Semi-intensive production covers all degrees of compromise between extensive management and 'zero grazing', but usually involves controlled grazing of fenced pastures with some supplementary concentrate feeding. Sheep are selective grazers, preferring short grasses, legumes and a wide variety of low-growing herbs. Goats have special feeding habits. On account of their prehensile tongues, they are able to graze very short grass and to browse foliage not normally eaten by other ruminants.

Reproductive Management:

Tropical breeds of small ruminants mature at 5 to 7 months of age. Although two kiddings/ lambings per animal per year is possible from prolific breeds, in practice this is seldom achieved. More commonly three parturitions are obtained in two years. Some breeds of sheep are seasonal breeders but not the goats. Ewes and does breed in all the seasons but rams are less fertile in some seasons than at others. The duration of oestrous cycle is 18 to 21 days and that of oestrus is about 24 to 36 hours, but considerable variation occurs. Gestation length varies from 140 to 150 days. Placing breeding females on a high plane of nutrition just before the breeding season commences is considered a desirable practice as it apparently 'triggers off the shedding of more eggs by the female and an increase in the probability of multiple births. This practice is known as 'flushing'. In practice, management and feeding are normally rather poor in tropics. Lambs/ kids from multiple births have less chance of survival than single births. Under these circumstances in most tropical countries no efforts has been made to achieve high birth rates.

Day-to-day Management:

It is essential that new born should consume colostrum for its multidimensional benefits. Weaning may be accomplished at 4 to 5 months of age. In meat animals the tendency is to delay weaning to allow the kid to obtain the maximum benefit from the dams milk. No elaborate housing is necessary, but what is provided should be well ventilated, well drained and easily cleaned. Castration, docking and shearing are needed to be performed scientifically.

Sheep and goat diseases and parasites unquestionably take a heavy toll in the tropics and they can best be combated with the aid of good management, proper feeding, strict sanitation and routine deworming, dipping and vaccination.
Advances in Yak Production Management
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Introduction

Yak is an unique bovine species of economical importance in high hill and snow bound areas, and had originated from the cold regions of Tibet and Siberia. Yak is the only large hairy multipurpose boid, earned several glorious names like- the Bison of Tibet, Ship of the plateau, Mountain machine, Beast of burden of Tibet, Coconut of animals or simply Gold to Tibetans. It provides milk, meat, hair/wool, transport, draught and fuel to the highlanders who almost depend upon this animal as the source of livelihood. The yaks are reared under free-range system in the high hills where the air, water, and pasture are free from any pollution, and their produce (milk, meat, hair) are organic.

The yak (Poephagus grunniens L.) belongs to the order Artiodactyla, family Bovidae, sub family Bovinae, genus Bos and subgenus Poephagus. The generic name Poephagus means grass eaters and grunniens stands for its grunt. The yak, an herbivore lives predominantly on the Qinghai-Tibetan Plateau which is often called as “roof of the world”. The home tract of yaks is characterized by a harsh climate of cool moist summer, severely cold winter having availability of grazing resources restricted by very short growing seasons.

Distribution

The yak-inhabited area extends from the southern slopes of the Himalayas in the south to the Altai in the north and from the Pamir in the west to the Minshan mountains in the east. The yaks are reared under free-range system and are found in alpine and sub-alpine regions usually between 3000 - 4500 m with a cold, semi-humid climate and even at 6000 m above msl in China, Mongolia, Bhutan, Nepal, Russia and India. The world population of domestic yak is about 14.7 million of which more than 90 percent (13.5 million) are in China. In India, there are around 71,000 yaks found in Ladakh of Jammu & Kashmir, Arunachal Pradesh, Sikkim and Himachal Pradesh.

Table 1 Yak population in the Indian states

<table>
<thead>
<tr>
<th>States</th>
<th>Distribution of yaks</th>
<th>Population</th>
<th>Sex Ratio Male: Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arunachal Pradesh</td>
<td>West Kameng &amp; Tawang</td>
<td>13,000</td>
<td>1: 1.54</td>
</tr>
<tr>
<td>Sikkim</td>
<td>North and West Sikkim</td>
<td>7,000</td>
<td>1: 2.45</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>Chamba, Kinaur, Lahul Spiti</td>
<td>4,000</td>
<td>1: 0.82</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>Leh &amp; Kargil districts, Ladakh division</td>
<td>47,000</td>
<td>1: 1.04</td>
</tr>
</tbody>
</table>
Adaptive features

Adaptation is a long term and complex phenomenon and needs alteration of complex biological processes that needs thousands of years. The capacity to survive must be one of the most important traits in the genetic make up of the yaks. The yaks are well adapted to harsh environment of highland with a thick coat of hair with outer coarse hair and inner dense fine hair, better lung capacity and ability to climb over rough terrains. They have good adaptation to the chronic hypoxic condition of the high altitude. Cup shaped hooves in yak help them to travel on hilly terrains making them sure footed animal, being better poised than even mule. The size and the body surface area relative to body weight of an animal show its special adaptive characteristics. In order to reduce the exposing surface, the body of the yak is short with a compact neck. The surface area of yak is relatively less per unit body weight, and this is quite useful anatomical adaptive characteristic of this mountain animal. The hair coat as well as the skin characteristics of yaks is special for the protection from severe cold and windy environment of high altitude. Yak has the ability to change hair growth and composition of the coat with the changes of season. As the winter approaches, the down fibers grow densely between coarse fibers that increase from 17.5% in summer to up to 30% in winter through by activation of dormant follicles. Yaks are efficient feed converters and economic user of feed during nutritional deficiency, which it experience in winter.

Management System

Management system followed in yak rearing tracts differs according to region, influenced by altitude, climate and topography, proximity to centres of population, marketing facilities etc. The yak production system that has been followed is different from other livestock production systems due to its special social, cultural, natural and economic characteristics and interrelated constraints. It is a low input - output system that is of low efficiency. However, for highlanders in remote terrain, yak is the only source of sustainable livelihood due to non-availability of arable land. In India, yaks are reared under semi migratory (transhumance) free-range system.

Seasonal migration and Grazing pattern

Traditional yak husbandry system involves migration in search of better pasture. In general, transhumance form of management predominates. In India and other neighbouring countries like Nepal and Bhutan, the farmers practise two-pasture utilization strategy. During summer, yaks are taken to high altitude alpine pasture (4,500 m and above). In winter, they return to pockets nearer to their villages located at mid altitude (3000m above msl). Grazing in summer pasture is from May to September while in December to February, winter pastures are utilized; the rest of the period is spent on transit from winter pasture to summer pasture.

Year round activities of herdsmen

Based on the climatic condition and availability of fodders, the year round activities of yak herdsmen differ from region to region on the basis of climate, topography, farmer's expertise etc. and generally classified as below.

Spring (March – April): moving the herds from winter pasture to summer pasture. Starting of calving period, milking of animals initiated, improvement in body condition of yaks due to availability of grass on the transit route.

Summer (May – September): Stay in alpine pasture, maximum calving in the first half of the season, milk yield reaches the peak, preparation of milk products like churpi, butter etc., combing of down fibres and preparation of hair products, compensatory body weight gain, breeding occurring in the later half of the season.

Autumn (October – November): Moving the herds from summer pasture to winter grazing ground. Productivity of animals increases due to availability of grasses, which remained
ungrazed during summer. Chances of picking up infections due to mixing with other animals are more.

Winter (December - February): Peak winter, grazing near the farmers land, very little grazing, maximum areas covered with snow; grazing area infested with weeds; milking of the animals stopped and calves allowed to suckle the dam and few pregnant animals given locally available maize floor as feed supplement, loss of body weight, decrease in productivity and death due to starvation etc. Providing of shelter to animals (especially calves and pregnant) in the form of small enclosures is practised.

**Herd Structure**

The structure of the yak herds, i.e., lactating females, dry animals, replacement animals, young ones, etc should be in best proportion in order to obtain maximum output from yak rearing. In majority of yak breeding areas in Tibetan plateau, India and other Himalayan countries, mainly Buddhists rear yaks. They consider that number of yaks maintained by them is the indicator of wealth and status symbol. The animals are often kept until they die rather than being culled, thereby raising the number of unproductive animals in the herd. This has led to increasing pressure on the pastures, particularly winter grazing land that is often utilized by other species of livestock also.

The opportunities for making changes in herd structure largely depends on the reproductive and survival rates and disposal of culled animals as well as change in the attitude of the herdsman so as to increase the proportion of the productive animals. Male - female ratio of pure yak population in India ranges from 1:0.82 in Himachal Pradesh to 1:2.45 in Sikkim. By raising female proportion in the yak herds along with concurrent culling of unproductive and older animals, there is scope of raising the production status of yak herds.

**Herd Management**

In Arunachal Pradesh, the herd size of each household varies from 5 to more than 100 animals. Herding of small number of yaks is not economical and the owners usually offer these animals to tenant herders called as ‘Brokpa’ who will collect together, from different owners, fifty or more animals to look after. Extensive survey carried out in yak tracts of West Kameng district has revealed that usually one brokpa controls around 60 yaks. These brokpa are paid one yak of 1-2 year age as their salary to take care of 60 yaks. The brokpa pays the yak owner usually in the form of 8 to 10 kg butter and 5 - 6 kg churpi per lactating female.

**Care of calves & Milking Practices**

Generally yak females are not milked for first one month after calving and entire milk is left to calf. Weaning of calves is not practiced in the field condition. Usually, during daytime, calves graze along with the dam and continue to suckle, in night, they are separated from dam and dams are milked in the early morning. At about 12 months of age, calves are separated from their mothers into different herds. Normally, the farmers do not practice proper health care management like periodical deworming, vaccination etc.

The neonatal survival rate is related to the maintenance of body temperature in the calf. The fall in temperature in the first hour after birth is related with birth weight i.e. greater the birth weight, lesser the temperature loss. Hence it is recommended to use simple housing made from plastic sheets to keep the young ones warm.

Yaks are milked once a day in the morning. Milking is done by stripping as the teats are small (2 - 4 cm) and funnel shaped. It was observed in yak farm of NRC on Yak at Nyukmadung that almost, one third more milk could be obtained by twice milking per day.
Shearing

Yaks produce two types of fibre: coarse outer hair and a fine down fibre. The down fibre of yak is like pashmina or mohair of goats. Shearing is done mostly once in a year in May or June, cutting and plucking are alternatives to shearing. An Indian yak yields 1.0 to 1.5 Kg of coarse hair and about 0.4 to 0.6 Kg wool annually.

Castration

Yaks are usually reared in small and isolated packets, which leads to inbreeding problem. Castration is a common practice only in some yak pockets of Arunachal Pradesh as an effective way to cull the yak bulls. Castration is usually done on a clear morning in early summer or late autumn, when the risk of infection to an open wound is less.

Breeding

In India, scientific breeding of yaks is not well conceived by the farmers. The age at first service is around 3-4 years and gestation period is about 258 days in yaks. Oestrus behavioural changes in yak are not usually as intense as in domestic cattle. The duration of oestrus is normally less than a day. The average length of the oestrous cycle is approximately 20 days. The gestation length is longer, by as much as 20 days on average, when the yak female carries an F1 hybrid calf. The pure breeding is the predominant practice with the yak. The Indian yak population is thought to suffer from inbreeding due to the non-availability of new yak germplasm from Tibet for the past five decades and because of the practice of prolonged use of the same bull within herd. Exchange of breeding bulls among herds and selection are not generally practiced.

In India, the constraints faced for improvement by genetic selection include lack of necessary performance and parentage records, long generation interval, low reproductive rate. Traditionally, the yak herders are breeding their animals in isolated geographical boundaries. Species hybridization between male hill cattle and female yak is common in Arunachal Pradesh and Ladakh but only on a limited scale in Sikkim and Himachal Pradesh. The F1 males are known as Dzo and the females as Dzomo. Yak herders in India practise inter species hybridization to raise a number of generations (F1 onwards to F5/F6). F1 hybrids are more productive than either of their parents. However, the subsequent generations (F2 onwards) are less productive and uneconomical. The F1 hybrids have better milk yield, higher beef production and better draftability. Yak hybrids adapt better to the intermediate zone between cattle and yak habitat and are therefore, able to utilize grazing areas too low in elevation for yak, but too high for cattle. First crosses between yak and common cattle adapt well to the conditions in which they are used, displaying good characteristics of both parental types, including resistance to a harsh environment and improved productivity. However the hybrids have reduced tolerance to cold, increased susceptibility to infection and parasitic diseases, need additional feed requirement during winter. The male off springs of all such crossbreeds are sterile which prevents interse breeding.

The productivity of Indian yaks is not only lower than the yaks of other countries but also the variability is high. Hence, there is scope for their genetic improvement. The major causes of low productivity in Indian yaks are (i) inbreeding and lack of selection of yaks for breeding (ii) unscientific husbandry system and (iii) inadequate nutrition coupled with lack of disease control measures.

Selective breeding of yaks is the tool to be used for the improvement of yak. Exchange of males amongst herders is the way to avoid inbreeding and its resulting adverse effects. The most practical way for yak improvement in India would be to concentrate on one or two most important traits. Superior females and males have to be identified from the yak population and to be used for producing bull calves extensively. Semen from selected superior yak bulls have been collected and cryopreserved at NRC on Yak for the first time in
India and is made available to the farmers for genetic improvement of their yaks and also to produce hybrids.

Feeding management

In India, the farmers practise two-pasture utilization strategy. The traditional way of maintaining the animals is to allow them to put on weight as much as possible in summer and utilize the fat as an energy reserve for survival in winter months, when there is scarcity of feed. The availability of the fodder, its growth stage and nutritive value largely influences the production performance of yaks. A scanty feed resource in the long winter period (November to March) is a major nutritional factor hampering the performance of the yaks in terms of production and reproduction.

At present, feeding of concentrate or commercial feed blocks is beyond the reach of poor yak herdsman considering their economic condition. NRC-Yak has taken initiative to prepare complete feed block for feeding yaks during peak winter by utilizing locally available alternative feed resources like tree fodder, agricultural by products, and coarse roughages. At yak farm in Nyukmadung (under NRC on Yak), a balanced concentrate mixture consisting of maize (35%), wheat bran (15%), rice polish (12%), Soya been meal (10%), groundnut cake (10%), mustard oil cake (15%), mineral mixture (1%) and salt (2%) is provided to the yaks.

Health management

Yaks suffer from diseases mainly when they are in winter pastures from October to April. During this period, they often share the grazing area with cattle as a result many of the diseases observed in cattle are also reported in yak. Ecto parasites and leach infestations are the major problems in the mid range and lower altitude pasture. Helminth infections are especially common in newborn calves causing heavy mortality. Among viral diseases, FMD is prevalent in Arunachal Pradesh and Jammu & Kashmir. Other major diseases encountered in yak tracts include hemorrhagic septicemia, Black Quarter (BQ) and Pyrrolizidine alkaloid poisoning. The major hurdle in taking preventive measure and timely treatment includes remoteness of the yak tracts, low cost effectiveness of treatment, traditional nature of yak keeping and lack of knowledge or recognition of disease by herdsman.

Yak Products

The yak products are in great demand amongst Monpas and other local tribes.

Yak Milk

The major source of income for the yak farmers comes from yak milk. The milk production of Yak is low, averaging only 100-300 Kg/lactation. The yak milk has a rich composition of protein, fat, lactose, mineral elements and essential amino acids. It is reported that the dry-matter is 17-18% during the main lactating period, whereas fat and protein are 6.9-8.9% (average 7.5%) and 4.5 % respectively. The total dry-matter is 1.2-1.4 times more than that of cattle milk; and may be concluded that yak milk is concentrated than cattle milk.

Traditional Yak Milk Products

The yak farmers do not consume milk as such, rather they convert, summer milk abundance into butter and churpi (a wet cheese) by traditional methods. A by-product of Churpi making process is whey. Besides Butter tea, traditional dairy products such as shosim and naturally fermented milk sho (yoghurt) are prepared from buttermilk after churning out butter and ther (yogurt, butter milk).
Yak Meat and Meat Products

The yak meat is fine textured and scarlet in colour. It is regarded, as very palatable but muscular, marbling is poor. It is rich in myoglobin and has a flavour akin to wild animals. Among local people, yak meat has been highly prized above that of ordinary cattle since ancient time. The herdsmen preserve yak meat using various types of traditional methods. Surplus meat is either smoked immediately on kitchen earth driers or kept deep frozen under snow. The meat is preserved by salting after slicing and drying it in open air and on open hearth.

Yak Wool and Wool Products

Yaks produce two types of fibres: coarse outer hair and a fine down fibre. For better economic returns from fibre, there is need to make value added products from yak fibre adopting modern technology, and organized sale. The coarse hair from upper coat is good for making carpets and other decorative hangings and upper covers. Traditionally, the hair is used for making ropes, caps, blankets, bags, and tents for daily use by the herdsmen. The quality of under coat fibre of yak is very fine and there is great scope to make value added products from yak wool such as shawl, caps, fabric and other woollen garments having great demand in the market.

Application of Reproductive Biotechnologies

For several years, there has been considerable interest in the application of reproductive technologies for yak improvement. As yak production has expanded, reproductive technologies that are used in domestic cattle (e.g. pregnancy diagnosis, artificial insemination, estrus synchronization, embryo transfer, and the collection and preservation of semen) have been attempted in yak. Although similarities between cattle and yak have facilitated the direct application of these technologies to the later, critical differences in biology and husbandry are responsible for limited application and success.

Estrus Synchronization, Superovulation and Embryo Transfer

Estrus synchronization in the yak has been effectively accomplished with products commonly used in cattle, including PGF2α and progesterone. Synchronization of estrus is most effective during the breeding season but estrus can be induced outside the breeding season.

Superovulation has been attempted in yak females using a variety of treatments and under varying conditions. Satisfactory responses have not been consistently achieved, thereby limiting the use of embryo transfer in this species. However, the first embryo transfer calf was born at NRC on Yak farm during 2005. The in vitro production of embryos and sexing of semen and embryos are yet to be used in yaks. Research progress has been made is several technologies but with limited success.

Preservation of yak ovaries and/or oocytes and cryopreservation of oocytes and embryos would be of considerable benefit for conservation of yaks. Many techniques developed and proven in cattle have been adapted in yaks with limited success.

Salient Achievements of NRC on Yak

- Cyto-genetic investigation on yaks and their hybrids were conducted, and the normal chromosomal profile of pure yaks of Arunachal Pradesh was studied.
- The molecular genetic work has been initiated and the random amplified polymorphic DNA (RAPD) assay was conducted to study the genetic similarities and divergence
among five types (Common, Bisonian, Bareback, White forehead and Hairy forehead) of Indian yaks using ten random decamer oligo nucleotide primers. The results indicated that phenotypically different types of Indian yaks are genetically similar.

- Studies indicated high genetic variability in production and reproductive traits.
- Studies were conducted to investigate the polymorphisms in the candidate genes viz Growth Hormone (GH) gene, Growth Hormone Receptor gene and Insulin Like Growth Factor-I (IGF-I) gene. The studies indicated that the polymorphism in IGF-I is associated with birth weight.
- Several haemato- biochemical parameters, serum concentration of different minerals and profile of different reproductive hormones were studied during different stages.
- Embryo Transfer Technology (ETT) in yaks has been standardized, and a calf named MISMO was born through ETT at the Centre for the first time in the world.
- Cryo-preservation of yak semen has been standardized, and AI is being successfully practised in the yak farm. First yak calf through Artificial Insemination of frozen yak semen was born at the centre for the first time in India.
- Timing of ovulation was determined during spontaneous estrus. Induction of estrus has been attempted in female yaks by ovsynch protocol and out of 8 animals, 7 animals were successfully induced into heat. This protocol will have tremendous utility for setting time of AI in yak.
- Feed blocks are being prepared from locally available materials including maize crop residue, and a digestibility trial in yak has been initiated.
- A suitable training schedule on yak for pack purpose has been evolved.
- Different milk products like Dahi, Lassi, paneer, whey drink, flavoured milk, cheese, Burfi etc. have been prepared from yak milk and processing technology demonstrated to the farmers.
- Proximate composition, physico- chemical properties, microbial quality and vitamin (Thiamine, Riboflavin, Vitamin A & E) contents of yak meat were studied.
- The sausage is prepared by incorporating 60% yak meat, 20% pork and 20% fat. Training on sausage preparation is being imparted to farmers.

Conclusion

Yak management system is varying from place to place and is influenced by altitude, climate and topography. There is ample scope for improving the productivity of yaks through improved management practices. The readjustment of herd structure by culling of unproductive and older animals is expected to increase the production performance of the herd and reduce the pressure on grazing land. The problems of feed scarcity in the winter can be solved through preservation of locally available fodder in the form of hay and silage, feed supplementation through complete feed block and by restoring the deteriorated rangeland using appropriate technologies. The inbreeding problem among yaks could be solved through bull exchange programme amongst yak rearing pockets. Timely vaccination and regular deworming will help to reduce the incidence of diseases thereby improving the overall performance.
Genetic improvement of farm animals is a prime concern over the years for researchers. Several reproductive technologies have been employed to achieve this. Artificial insemination (AI) is the most effective technique being used for the genetic improvement of animals. This technology enables the widespread use of outstanding sires with valuable genetic make up for breeding up gradation programme in livestock. But in this technology only the genetic quality of superior male is being used and takes a long time for genetic up gradation. In contrast, embryo transfer technology (ETT) offers the use of both male and female genetic quality to be propagated effectively to produce suitable offspring with important economic traits. In this technology the females of superior genetic merit are super ovulated, their eggs fertilized in vivo using semen from genetically outstanding male, then the resultant embryos are transferred to synchronized recipient mother's. The main limiting factor in application of embryo transfer technology is the unpredictable ovarian response and embryo recovery. Difficulty in synchronization of follicular wave emergence and superovulatory treatment limits the ovarian response and embryo yield. Thus the economical feasibility of the application for the technology in field condition becomes less viable due to less yield of transferable embryos.

In vitro embryo production can be made from the ovaries of slaughtered donors on large number. From a particular breed, oocytes may be collected from ovaries and matured, fertilized and cultured in vitro to propagate a particular breed following embryo transfer. By ovum pick up (OPU) or ultrasound guided follicular aspiration, oocytes can be collected from live donor without interfering the normal reproduction and production cycles of the donor. Following in vitro maturation and fertilization, the embryos are grown to transferable embryos and then transferred. OPU offers most flexible and repeatable technique to produce embryos from any given live donor. Drawback of OPU is higher cost compared to MOET. Lower number of oocyte availability and drastic fall of follicle number and the requirement of specialized laboratory equipments to perform all the steps of embryo production.

Cloning can be used to multiply animals of a high genetic merit, whether they are founder than of important families or progeny tested sires. Cloning of embryos involves the transfer of cell nucleus from a multicellular embryo, fetal or adult cell line into an enucleated metaphase-2 (M2) oocyte. This oocyte has the ability to incorporate the nucleus from the transferred cell and reprogrammed development of a new embryo. Various cell types such as embryonic cells, fibroblasts, mammary glands, cumulus cells, oviductal cells, leukocytes, granulose cells, germ cells and liver cells have been used as donor for production of cloned animals (Brem and Kuhholzer, 2002).

The major breakthrough in mammalian nuclear transfer occurred by a modified technique of Willadsen (1986) who produced full term lambs from the transplanted nuclei of blastomeres from 8-16 cell staged embryos. By the time electrofusion technique was developed (Prather et al., 1987) reported the production of two calves from the implantation of early cleaved bovine blastomere into enucleated oocyte. For cloning in cattle, initially embryonic blastomers were used as donor nuclei (Bondioli 1993) as these were thought to be relatively undifferentiated, readily programmed and likely to support full term development of the fetus. Several reports of production of offspring from blastomere cloning are available (Bondioli et al., 1990; Johnson et al., 1995; Willadsen and Polgen, 1981).

Development of nuclear transfer technology to produce clone animals after the birth of Dolly (Wilmut et al., 1997) opened a new era in the field of reproductive biology. Successful somatic cell cloning has now been achieved in several mammalian species as
reported by birth of offspring in sheep, cattle, goats, pigs and mice (Wilmut et al. 1997, Kato et al., 1998.) respectively.

Further expanding the potential of cloning was the development and use of embryonic stem cell as a source of donor nuclei. Embryonic stem cells are derived form the inner cell mass of an embryo at blastocyst stage and are thought to be relatively undifferentiated. Ramirez-soils et al (1993) reported that mouse embryonic stem cell divided indefinitely in culture without differentiation could be modified genetically.

The establishment of embryonic stem cell (ES) lines was achieved in mice from the late stage inert cell mass (ICM) of mouse blastocyst (Evans and Kaufman, 1981) or morula (Eistter, 1989) and it would be of great value for large scale cloning. Cherny et al (1994) developed strategies for isolation and characterization of bovine embryonic stem cells and concluded that primordial germ cells may provide an alternative avenue for the generations of pluripotent cell lines from domestic animals. Bovine embryonic cell cultures have been established from ICM cells, morulae and precompaction 16-20 cell stage embryo (First et al., 1994). Sims and First (1994) reported the birth of four calves from the use of 16-27 day loose suspension cultured bovine ICM cells in nuclear transfer.

Embryonic stem cells have been developed in bovine (Saito et al., 1992) and have been used as a source of donor nuclei. There are evidence of stem cells contributing to somatic tissues of chimeras in pigs (Wheeler et al., 1994; Shim et al., 1997) and cattle (Cibelli et al., 1997). A number of cloned animals have been produced from the blastomere cells, inner cell mass and stem cells after culture (Heyman and Renard, 1996; Campbell et al., 1996). It has been observed that stem cell as donor nuclei produce larger number of embryos as well as clones compared to somatic cells.

There is assumption that there is a role stem cell of particular tissue in the somatic cell cloning by the use of that particular type of cell. The somatic cell of fetal origin provides better result in nuclear transfer than adult somatic cell. Serum starved fibroblasts cells are more efficient as donor than serum unstarved fibroblasts cell. There is more chance of stem cell fusion in the serum starved group as stem cell number increase in this group (Majumdar and Bag 2006).

Stice et al. (1996) working with blastomeres from morula, or the ICM of blastocyst further cultured disaggregated blastomere in plate containing mitomycin -C blocked fibroblast cells, isolated embryonic cell lines and through nuclear transfer procedures produced embryos that develop through early organogenesis.

The possibility of generating genetically identical offspring in livestock increased considerably from the first embryo splitting experiment (Willadsen, 1979) up to the results obtained after the birth of dolly (Wilmut et al., 1997). Using nuclear transfer to multiply genetically superior livestock; however today in the field of biomedicine appears to be the first major commercial opportunity for cloning technology. Nuclear transfer technology can produce transgenic livestock faster and more efficiently than conventional microinjection technology.

For faster multiplication of superior germplasm, cloning is the best method. Successful somatic cell cloning has been achieved in several mammalian species. The overall efficiency of the technique however, remains low because only a very limited percentage (0.5-5%) of the reconstructed embryo results on full term development. This is due to high frequency of post implantation development arrest, which can occur after the transfer of blastocyst that appear to be morphologically normal in mice (Wakayama and Yanagimachi, 1999) and in cattle (Kato et al., 2000). These long lasting effects of cloning are associated with fibroid fetal membrane, excessive accumulation of allantoic fluid and increased fetal birth weight (-Hill et al., 1999). This syndrome is similar to large offspring syndrome (LOS), that causes dystocia which has been reported in sheep and cattle (Kurip and Dass, 1997). Frequency and occurrence of late gestation losses from cloned embryos of cattle were comparatively studied for adult somatic clone, fetal somatic clones, embryo cloning and in vitro fertilization (IVF) by Heyman et al. (2002). They reported incidence of loss between days 90 of gestation and calving was 43.7% for adult somatic clones and 33.3% for fetal somatic clones compared with 4.3% after embryo cloning and 0% in the control IVF group. Prior to these Heyman et al. (1997) observed that the incidence of late abortion was relatively low in (10%) after embryonic cloning and that LOS was limited to 3% of the calves born.
Somatic cell cloning has been proved to be less efficient till now. It is expected that early embryonic cells derived from early stage embryo are more efficient nuclear donor for production of cloned animals. Blastomeres isolated from embryo derived from best combination of sire and dam are the best source to be used as donor in cloning. Further there will be less loss due to abortion and having hardly any large offspring syndrome. But the blastomere cells are limited in number to be used as donor. Embryonic stem cell derived by the culture of blastomere cells from precompact morulae are of having similar characteristics as blastomere cells. Therefore there is a need to develop large number of blastomere derived from stem cell from 16-32 cell morulae that further to be used as nuclear donor.

India is having large population of low yielder cattle and buffalo that not only consume large quantity of feed and fodder but also release more methane that is contributing a lot in global warming. Interestingly, very few rare cattle and buffalo have developed in different corner of the country that produce very high quantity of milk per lactation. These milch animals have not only of high genetic merit but also have adapted very well in the specific region so they are in less stress. We need to multiply these animals very fast with the latest reproductive techniques viz. embryo cloning by nuclear transfer technique using the totipotent stem cells as nuclear donor.

Totipotent stem cell lines can be produced using techniques of hormonal stimulation of folliculogenesis, ultrasound guided oocyte collection, in vitro fertilization of these oocytes with adopted high milk mother bulls spermatozoa to form precompact morulae (8-16 cells) and then these blastomere would be cultured blocking genetic progression to stem cell lines from all the embryos produced from those few high milk producing cows and buffaloes. They could be sexed, cryopreserved while few embryos could be made out of these stem cells as nuclear donor by electro fusion or blastomere packing techniques and transferred to recipient to get few calves born in different region of the country. Their production potential can be checked using micro array techniques or on 1st calving and those showed high production potential can be multiplied in large scale to replace the low producing. The rest of the stem cell could be cryopreserved for further use in embryo cloning. A group of high yielding animals should be used for making stem cell lines and embryo cloning. Embryos from all the animals should be propagated by transferring them in a restricted area stopping AI to get animals of different genetic make up both in male and female to keep the genetic variability. This technique of totipotent stem cell development and cryopreservation may help in quick up-gradation of different indigenous breeds of animals of the country.

References


India exported organic agricultural products worth Rs 128 crore during 2005-06. All these products were sourced from many small scale producers spread all over India. The Ministry of Commerce, GOI is receiving increasing number of export orders and queries concerning availability of organic food products from EU and other developed countries. This necessitates that the various agencies under the GOI in particular gear up for the production of certified organic agricultural products. The annual global market of US $30 billion has India’s share almost negligible though India is recognized as one of the high potential countries to produce organic products due to natural advantage India has for organic agricultural production. The input use in Indian agriculture is still very low and the range of traditional methods available in India are effective substitute to chemical alternatives. This paper, thus, discusses some of the prospects and constraints of organic livestock farming in context of India.

Indian Livestock sector: Potential for growth

India has to feed its 1.03 billion people (16% of the world’s population) from 2.3% of the global landmass and 4.2% of world’s water resources. Most of the net sown area (65%) is rainfed, which contributes only 35% of the food production. Indian economy is increasingly looking forward to its livestock sector for growth, since India owns 11% of the world’s livestock. Indian livestock sector is vibrant with high potential for growth including for the development of organic animal husbandry due to certain favourable features (Table1). Livestock in India are raised largely under low input low output subsistence farming conditions, resulting in very low productivity.

India has the largest livestock population in the world, ranking number one in cattle and buffalo population. While it is number one in livestock numbers, the productivity per animal is dismally poor. Yet, the livestock and fisheries sectors together account for about 30 percent of value of output of agriculture and allied sectors and provide full time and part time employment to 5.5 percent of the total working population. Their contribution to total GDP in 2004 was 6.3 percent. The contribution of this sector to agricultural GDP increased from 18 percent in 1981 to 26 percent in 2005. The ownership of livestock is more egalitarian since resource poor farming families own a majority of cattle, buffalo sheep and goats. It is clear that livestock and livelihoods are very intimately related and that crop-livestock integrated farming is the pathway for farmers’ well being. The policy makers are now increasingly looking towards livestock sub-sector for growth in agricultural sector and Indian economy in general. To effectively harness the potential of livestock sector, it would be pertinent to pay attention to newer areas like organic farming and production of certified organic livestock products. In future, demand for organic livestock products may increase for export as well as local consumption. Considering the natural advantages India has in conversion to organic farming, organic livestock production may offer an opportunity? Thus, the prospects of organic milk and meat production in India are good. Therefore, it is essential that R&D establishments, policy makers, development officials, other extension staff get oriented to the emerging concepts like organic farming.

Organic Farming: The Definition

‘Organic’ is almost a buzzword now to signify something “natural” and inherently good, often used carelessly without knowing much about the very essence of organic farming per se. Organic farming has a very strict definition: it denotes farming systems that adhere to the standards of organic farming. As the word ‘organic’ is becoming popular by the day, it is important to spread correct awareness about it so that at least the stakeholders in particular
understand it in right perspectives. Organic agriculture has been defined and explained in many ways but all converge to state that it is a system that relies on ecosystem management rather than external agricultural inputs. It is a system that begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs, such as synthetic fertilizers and pesticides, veterinary drugs, genetically modified seeds and breeds, preservatives, additives and irradiation. These are replaced with site-specific management practices that maintain and increase long-term soil fertility and prevent pest and diseases.

FAO/WHO Codex Alimentarius Commission defines organic farming as “a holistic production management system which promotes and enhances agro-ecosystem health, including bio-diversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems”. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants and people... [where] systems are based on specific and precise standards of production which aim at achieving optimal agro ecosystems which are socially, ecologically and economically sustainable. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system.

Organic production systems, unlike traditional systems of production, are governed by a set of standards to be followed strictly by the producers of organic food. Compliance with these standards is verified by certification agencies authorized by the respective governments. A farm may be classified as organic if it meets the criteria stipulated in a set of guidelines known as organic standards. The quality of production under organic management is ensured through certification procedures using internationally acceptable standards for organic production. Organic certification guarantees not only the quality of the product but also the quality of production. This more than often appeals to the consumers. In case of conventional products, there is no way to guarantee the production procedure, but, in organic farming, production procedure is certified to be safe and sound as well as environment friendly.

'Organic' in organic agriculture is a labeling term that denotes products that have been produced in accordance with certain standards during food production, handling, processing and marketing stages, and certified by a duly constituted certification body or authority. The organic label is, therefore, a process claim rather than a product claim. It should not necessarily be interpreted to mean that the foods produced are healthier, safer or all natural. It simply means that the products follow the defined standard of production and handling, although surveys indicate that consumers consider the organic label as an indication of purity and careful handling. Organic standard will not exempt producers and processors from compliance with general regularity requirements such as food safety regulations, pesticide registrations, general food and nutrition labeling rules, etc.

The basic principles and standards for organic farming are formulated by the International Federation of Organic Agriculture Movements (IFOAM), which is an umbrella organization covering groups in more than 100 countries. The basic standards developed by the IFOAM state that one of the basic principles of organic agriculture is “to give all livestock conditions of life with due consideration for the basic aspects of their innate behaviour”. Animals have highly developed central nervous systems and behavioural needs, which place an added responsibility on the livestock producer. The production system is not sustainable, if animals show evidence of pain, disease, or distress as a result of an inadequate system or disharmony between the animals and the system. The need to prevent such situations forms the basis for the concepts of “positive health” and “positive welfare”, as introduced in the EU regulation 1804/99, incorporated in EU regulation 2092/91 on organic production. The step further is not only to prevent any pain, discomfort, or disease, but also to promote health and well being in each animal as well as on herd level and population level. This is a quality of animal products referring to mode of production, the so called process quality. The philosophy of organic farming emphasizes the need to produce food in
an "integrated, humane, environmentally and economically sustainable agricultural production system". Organic products have characteristics, which distinguish them from conventional farm products, viz. Integrated animal and crop production, safer products devoid of any chemical residues like pesticides, antibiotics, etc., more nutritious and natural products, higher quality, environment friendly and highest regard for human and animal welfare.

Under organic livestock production systems, it is expected that organic meat, poultry and egg products come from farms that have been inspected to verify that they meet rigorous standards which mandate the use of organic feed, prohibit the use of antibiotics, give animals access to outdoor, fresh air and sunlight. The production methods are selected based on criteria that meet all health regulations, work in harmony with the environment, build biological diversity and foster healthy soil and growing conditions. Market animals that were raised without use of toxic persistent pesticides, antibiotics and parasicides. Animal health, well being, better living conditions, welfare measures, feeding practices are to be ensured through a set of standards and maintenance of written records by the organic livestock farmers. Better managerial practices and prevention are emphasized over treatment. Thus, the primary characteristics of organic livestock production system are: a defined standard; greater attention to animal welfare; no routine use of growth promoters, animal offal or any other additives; at least 80% of feed grown according to organic standards, without the use of artificial fertilizers or pesticides on the crops or grass. To be precise, organic meat, milk and eggs means that are produced, harvested, preserved and processed as per organic standards.

Livestock plays an important role in relation to the general principles of organic agriculture, supporting biological cycles within the farming system and diversifying production. Consumers buy meat and milk products to experience direct qualities, such as taste, nutritive value, and food safety, but also to benefit from indirect qualities, which are linked to the production process. They expect animals to be treated with compassion and to a high level regarding their welfare, and that production has been carried out in an environmentally friendly manner.

The concept of organic livestock production gained momentum recently in developed countries because of concerns for animal welfare, chemical residues, incidence of Bovine Spongiform Encephalopathy (BSE), Foot and Mouth Disease (FMD), Genetically Modified Food (GMF) and some bacterial diseases. The affluent sections in developing countries too are influenced by these concerns and this stratum of society may increasingly look for organic livestock products fuelling the demand of organic food products in developing countries too. Moreover, the organic farming is considered to be more sustainable than the input intensive conventional systems of crop and livestock production. Therefore, whether one likes it or not, organic farming is rapidly expanding world over. There may be critics especially in developing countries where chronic food shortages are still common but organic is a growing reality, it's happening everywhere with the support of Non-Governmental Organizations (NGOs), private sector and also the government agencies.

Organic farming is not a production method to solve all problems in livestock production. It is primarily a production method for a specific premium market with high requirements for the quality of the production process, demanding high management qualification. For the development of organic livestock farming, it is important to ensure the confidence of the consumers in organic products by realizing the self created demands to a high degree. Therefore, organic farming is a challenge not only for the farmer but also for agricultural research and interdisciplinary work. The countries that have accepted this challenge have progressed even in developing country circumstances. The Latin American countries, like Argentina, Brazil and Uruguay produce substantial amounts of organic meat. In Argentina, more than one million hectares of land is dedicated to organic livestock production, the majority of which produce organic beef cattle and 80% of the produce is exported to the EU. In Brazil too organic beef, poultry, egg and milk production is increasing. The organic dairy and meat products are now increasingly available in markets in EU, USA, New Zealand, Australia, Japan, Argentina, Brazil and some other countries. This trend on livestock products may further expand in other Asian and African countries where
organic agro products have already entered into market. For instance, organic spices, pulses, rice etc is now available in market in Indian metros and several other Asian countries.

To remain relevant to the global economy, the developing countries too have to produce what the consumers are demanding globally. Therefore, it's a necessity to focus attention on this system of production. India certainly needs to move forward with its organic farming activities, if not in big way; certainly small steps are essentially needed. This is what is rightly happening in India currently in case of high value commercial crops. A beginning has to be made in the area of organic animal husbandry as well through systematic efforts made in a network mode drawing expertise from the different quarters. There is strong possibility that India will be able to produce organic livestock products for not only its domestic consumers but also the consumers elsewhere in the world, given the vast pool of resources including the technical and scientific manpower India has. Some South East Asian countries especially Malaysia and Thailand have already initiated research and development work in the area of organic animal husbandry, which deserve appreciation, and in fact may guide and show the path to other developing countries in the region.

Organic Certification Standards

The standards for organic production are basic requirement for organic production of crops, livestock, fisheries etc, since the production has to be in accordance to these standards. The certification bodies monitor the adherence to these standards by the organic producers. Therefore, most of the countries have national certifying body or agencies that certify the production management system as organic. Without their certification, products cannot reach the consumers as organic. A lot many organic standards exist at present. But, mainly 5 standards are important and have worldwide acceptance, viz. EU regulation (1804/1999), Organic Food Products Act (OFPA) of USA, Draft Guidelines of Codex/WHO/FAO, UKROFS of UK and the IFOAM Basic Standards. Considering the regional importance, the Government of India (GOI) too has developed Indian National Standards for Organic Production (NSOP). These standards are published under the National Programme for Organic Production by the Agricultural and Processed Food Products Export Development Authority (APEDA).

In India, in 2000, the National Programme for Organic Production (NPOP) was launched (formally unveiled in May 2002) and in May 2001, the National Accreditation programme was notified by the Ministry of Commerce. APEDA, Tea Board, Coffee Board and Spices Board have been designated as the accreditation agencies. In every sense, the National Standards for Organic Production (NSOP) in India are largely based on the IFOAM Basic Standards. These standards need to be discussed by the stakeholders at different levels for periodic changes and modifications as per the local situations. The Indian Standards for Organic Animal Husbandry, for instance, were discussed during the National Workshop on Organic Animal Husbandry Standards held at Indian Veterinary Research Institute (IVRI) on November 26-27, 2002. More such efforts are needed, as the awareness about the NSOP and NPOP is still very low especially in context of the organic animal husbandry. The academicians and researchers may play a vital role in raising the awareness among the farmers, who may have to venture into organic production sooner or later due to growing demand.

In case of organic food products, it is not only the product quality but also the process quality is important. The entire production, processing and marketing practices are subject to inspection. The traditional farming practices including animal husbandry practiced in India may be very close to the organic farming, not by the conscious choice of the farmers but by default yet the products from such production systems may not qualify to be considered as 'organic', for the want of adherence to the basic standards. Nevertheless, such traditional production systems with low to negligible use of chemical inputs are ideal for conversion to organic farming in comparison to the input intensive conventional production systems. This is where lies the opportunity for India to benefit from its traditional production systems, which are not yet much contaminated with the chemical fertilizers, pesticides, antibiotics and other hazardous chemicals. The fertilizer and pesticides consumption in India is well below the world averages. Manual weeding is a practice still followed in different parts of the
Advantages and limitations of organic livestock production

Organic food products are generally considered to be of better quality due to strict compliance of quality enhancing measures. Yet, the organic livestock products are not completely free from criticism in quality front. Some of the reported benefits as also the limitations of organic livestock production are - (a) It ensures strict animal welfare measures, (b) Recognize animal comfort and animal behaviour, (c) It is better for environment, (d) Better sustainability of production, (e) Continuation of traditions and culture, (f) Boost to traditional technologies, (g) It is ‘safer’ (antibiotic/chemical/drug/pesticide free), (h) It has better protein quality. Proteins of organic pork are less denatured than those of traditional pork during cooking, (i) It has lower content of carcinogenic nitrogen, thus, reduces carcinogenic problems, (j) Organic meat taste equal to or better than traditional meat, (k) Veterinary costs are generally significantly lower on organic farms than conventional farm, (l) Less importance on high live weight gains facilitate crossing breeds with higher intramuscular fat in meat for better relish when eaten, (m) Greater motion reduced abdominal fat and favoured muscle mass development in broilers, (n) Motor activity increased breast percentage in chicken, (o) Motor activity favours myogenesis against lipogenesis, (p) Lower pH in organic meat due to better welfare and reduced pre-slaughter stress and thus, reduced consumption of glycogen, (q) No drug or antibiotic residue in milk and meat.

Alongside the advantages, there are certain limiting implications associated with a shift to organic livestock production viz. (a) It is practically difficult to provide a large locomotion area as prescribed in EEC – Regulation on organic livestock farming eg 6.0m$^2$ indoors + 4.5m$^2$ outdoors for dairy cows; 1.5m$^2$ indoors+1.1 m$^2$ outdoors for calves; 1.3m$^2$ indoors+1.0m$^2$ outdoors for fattening pigs and 1600 cm$^2$ indoors+4m$^2$ outdoors for laying hens, (b) Prolonged withdrawal period required after any veterinary treatment with drugs, make farmers reluctant to call a veterinary surgeon, reaching to a delay in the treatment of sick animals and a deterioration in animal welfare, (c) Processing or preservation of meat and meat products is difficult without use of certain chemicals eg. trisodium polyphosphate, sodium nitrate, (d) Blanket rejection of preservatives may have serious effect on food supply and safety of foods, (e) Organic farming may interfere with optimum land use on farms, (f) Organic milk and meat production may further decrease the availability of milk and meat, (g) Cost of production of organic meat is very high. It has been reported that cost of production of organic pig is 85.2% higher compared to conventional production system. This increase in production cost was attributed mainly to increase in housing area. It is due to these limitations, organic farming is often criticized and questioned in developing country context, where there is already a shortage of foods.

Organic agriculture scenario in India: Some milestones

Organic agriculture is one of the fastest growing sectors of agricultural production in the world. The global market for organic food products is about US$ 30 billion and it is further expanding rapidly with annual increase of about 20-25%. In 2004, controlled organic farming took place in about 100 countries world wide on 26.3 million ha of land. With increasing concern for environment and rising consumer awareness about safe and quality foods, the organic foods are attracting ever increasing number of consumers. Its simple economic function of demand and supply i.e. more demand means pressure for increased supply of such foods, which has to be ensured either through domestic production or importing from countries producing such foods to cater to the needs of consumers.

Considering the potential environmental benefits of organic production and its compatibility with integrated agricultural approaches to rural development, organic agriculture may be considered as a development vehicle for developing countries like India, in particular. Therefore, the GOI has also taken initiatives to boost organic agricultural production in the country by taking appropriate steps (Table2). Most of these developments concern high value crops like tea, coffee, spices, cotton, Basmati rice etc.

The organic animal husbandry per se has not yet taken off in India though animals are central to organic farming. As such, the practical experiences of organic animal husbandry
per se are not yet available to quote though some Non-Governmental Organizations, religious and animal welfare trusts have attempted to set up dairy farms in India with emphasis on organic practices.

A review of the situation reveals that India may not be in position to export organic livestock products at the moment but the people from higher strata within the country may increasingly look for products from organically raised livestock. High consumption of meat and milk products in developed countries (where demand for organic food too is high), a large number of technical manpower available in India, availability of world class meat and milk products processing facilities, increasing support for organic farming through suitable interventions, rising consumer awareness, increasing concern for environment and animal welfare issues indicate opportunities for the growth of organic livestock production.

Problems in development of organic animal husbandry

While India is making concerted efforts to boost organic production especially of the high value commercial crops but the problems too are very serious restricting growth in organic farming. Some of the potential obstacles especially in context of the exports of livestock products are:

(i) Sanitary regulation: Only a few developing countries are able to export even the conventional livestock products due to strict sanitary requirements imposed by importing countries. These sanitary regulations are further strictly monitored in case of organic livestock products. The GOI is taking initiatives in this regard by emphasizing the Clean Milk Production (CMP), Good Manufacturing Practices (GMP), HACCP, ISO certification, best practices etc. These efforts would need to be further pursued strongly so as to improve access to international market for the Indian organic livestock products. This may be difficult but not impossible especially when some of the developing countries like Argentina and Brazil export organic livestock products to EU. The efforts are needed on massive scale to improve hygiene and sanitary conditions especially at production, processing and packaging stages.

(ii) Traceability: Importing countries emphasize farm-to-table traceability and there is an increasing attention on this in recent times. It may be comparatively easy to trace the origin of products in western countries, where farms are large with high volumes of production per farm. In Indian conditions, where, milk and meat is sourced from numerous small farmers, the traceability may be a difficult option. The cost effective traceability tools suitable to Indian farming conditions and acceptable to importing countries will have to be developed.

(iii) Existence of diseases: Prevalence of infectious/zoonotic diseases also adversely affects trade in livestock products. More controlled animal health environment is needed especially in case of organic livestock production. Thus, FMD control is number one priority for India. The Diseases Free Zones (DFZs) may be created, where; organic livestock production may be encouraged.

(iv) Small Farms: In India, livestock production is mainstay of landless and small scale farmers. However, the landless animal husbandry is not allowed under the organic systems of livestock production. Whereas, over 80% holdings are <2ha. The small farms are not suitable for the development of organic livestock production especially for the exports. The small farms means small volumes coupled with lack of processing infrastructure, results into poor quality. Milk production in India is largely under the domain of small producers producing small volumes, where, dilution, contamination and traceability are some common problems. Therefore, interventions, both technical and policy are critical including developing linkages to support value addition and marketing of products to ensure making small farm production system highly sustainable. Services and goods including credit and insurance and improved technologies need to be made available to improve efficiency of small farm producers. Contract farming may be a
potential solution where many small farmers may contract out their farms to companies, which may produce organic food products on consolidated holdings. The contract farming may be mutually beneficial and organic farming would be easier to pursue under such arrangements for the obvious reasons.

(v) Lack of knowledge: The awareness about the organic production practices, animal welfare issues and requirements of importing countries is inadequate especially at the level of trainers and farmers. Whereas, the organic production calls for an in-depth understanding of the principles, standards, production practices and requirements of the organic certification agencies. Most of the literature relating to organic farming is available in English through print medium and Internet, which are hardly accessible to small scale farmers.

(vi) Lack of training and certification facilities: Locally available training and certification facilities at an affordable cost to small farmers is yet not much available. Indian small farmers may find it difficult to pay for the mandatory inspection often done by the foreign certification agencies through their affiliates in India. This may deter many Indian farmers to switch over to organic production especially when there is weak domestic market and current poor prospects for exports in case of livestock products. Training for the trainers and farmers on organic production practices is essential to harness the potential of organic farming. The KVKs may be geared for this purpose. Already some KVKs in Orissa and other states have initiated some work in the area of organic crop production and marketing of organic agro-products including exports (turmeric).

Threats to development of organic animal husbandry

The prospect of exports is the major motivating factor for the development and growth of organic farming in most of the developing countries including India. These countries may have impressive livestock strength and other favourable factors to their advantage yet the international trade in livestock from the developing world is a risky business as far as organic livestock products are concerned. An exporter must have an assured certified supply chain in order to successfully enter international markets. For instance, the need to have a completely organic supply chain could present a problem for export of organic meat from India. Large-scale commercial farms usually undertake most organic livestock production for export; whereas, Indian livestock sector is largely dominated by the small scale producers with little risk bearing ability and resourcelessness. Moreover, the self-sufficiency of organic livestock products in EU may lead to reduced import demand, thus, constraining the growth of organic livestock sector in India. The EU is a net exporter of organic milk, milk products, pork, poultry and eggs. 85% of meat and >90% of the world’s milk trade is between developed countries. The developed countries are very restrictive about imports from the developing countries citing mainly the poor sanitary conditions, poor quality and traceability problems prevailing in these countries. Moreover, the developed countries particularly in Europe have huge food surpluses and farmer subsidy problems. Thus, only a handful of developing countries have export potential, including some in South America, Southern Africa (Namibia, Botswana and Zimbabwe) and South East Asia. India will have to make sustained efforts, more than what is being already done in case of other agro products to make its presence felt in organic livestock production. One way could be to develop organic livestock sector initially for domestic consumption so as to move gradually to organic livestock production for export.

Opportunities for India

The threats apart, there are strong reasons for India to focus attention on organic livestock production. Some of the encouraging factors are: (i) Demand for organic livestock products is growing in the USA, EU, Japan, Argentina and Brazil, (ii) Belgium, Luxembourg, Netherlands and UK import significant proportions of organic produce, (iii) The EU is a net importer of organic beef, sheep and goat meat, (iv) Consumers pay a large price premium for organic food in Austria, Belgium, Germany and UK, (v) Some developing
countries do trade livestock products to developed countries, (vi) In 2001, 16% of broiler meat and 40% of beef imported to the UK came from developing countries, India may follow the developing countries like Argentina and Brazil that export organic livestock products to EU, (vii) India exported 173 tons of certified organic honey in 2001-02, sourced mostly from small scale producers. Organic honey is good entry point along with small ruminants to focus, for organic livestock production in India, (vii) To begin with, non-food livestock products viz. organic textile/garments including the materials of animal origin like hides, leather, and wool offer hope for organic livestock production in India. There is a large import of textile raw materials and processed textiles into the UK; a significant proportion comes from developing countries. Current global market trends show a rapid increase in international trade in organic textiles. Therefore, organic leather has potential to be a valuable export commodity from India, (viii) Indigenous Technical Knowledge (ITK) available in India may provide effective substitute to veterinary care, (ix) The use of agro-chemicals is almost nil in some parts of India, ideal for the development of organic livestock production, (x) Indian native livestock are less susceptible to diseases and stress, need for allopathic medicines/antibiotics is very less, (xi) Grass based extensive production systems/forest based animal production prevalent in some parts of India have potential for conversion into organic animal husbandry, (xii) Literacy is on the rise, media is making the consumers aware and concerned about animal welfare issues and health foods- it may boost domestic consumption of organic foods, (xiii) Growing domestic market for organic products in India may help boost organic market at country, and regional level.

Issues for research

While research activities in organic crop production have begun, research relating to organic animal husbandry per se is yet to make a beginning in India. There is potential for on-station and on-farm research in all the dimensions of organic livestock production viz. breeding, feeding, disease control, management, processing, marketing, socio-economic and ethical aspects, it being a virgin area as far as India is concerned. The socio-economic investigations concerning the acceptance of organic livestock production and economics of organic livestock farming may also be taken up by the social scientists engaged in livestock sector. The availability of organic feed and fodder among others may be one big limiting factor in initiating any research programme on organic livestock production since the experimental animals need to be fed at least 80% of the feed and fodder grown organically. The comparative studies on conventional vs organic vs traditional animal husbandry along various dimensions needs to be carried out. Alternatives to conventional treatment methods viz. plant based products, homeopathy, and other traditional practices need proper documentation and validation for their efficacy to be worth using under organic production systems.

The agrochemical and veterinary drugs use in different agro-climatic zones may be determined so as to identify the potential areas and species of livestock for organic livestock farming promotion. The location specific organic livestock production demonstration farms need to be established to generate awareness on organic animal husbandry practices. The ICAR institutes, SAUs and KVKs may be best suited for this purpose. A coordinated interdisciplinary project on network mode is urgently needed to initiate research work in the area of organic livestock production. The ICAR has already launched this kind of project with an outlay of Rs. 28.30 million, but it is focused on crops (ICAR Reporter, July-September 2004). Therefore, a similar project is strongly recommended in the area of organic animal husbandry.

Conclusion

Market for organically produced foods is on the increase world over. The demand for organic products has created new export opportunities for the developing countries. Also, the domestic consumers are now increasingly looking for better quality in food products. The ‘organic’ is more or less a symbol of purity and quality of food products now, especially when it is certified by the recognized certification agencies. In India, currently 11 certification agencies are accredited by the APEDA for inspection and certification of the organic agricultural products. This means organic farming has to be paid attention to boost
organic production to meet the growing demand for such products. Organic farming as per
the prescribed standards was being practiced in India and the produce exported was valued at
about Rs.128 crores, which is less than 1% of the current global market and it did not have
any livestock component excepting honey. India can greatly benefit from the export of
organic foods, but needs to seriously devote attention to market intelligence.

The GOI has rightly considered organic farming as one of the priority areas for
attention during the X plan period with substantial outlay and likely to further increase
allocation for organic production during XI plan. The ICAR has also recognized it as a
system of agricultural production worth promotion in certain regions having potential for
organic farming. Animals are central to organic farming, and in fact, organic farming is not
even possible or sustainable without livestock maintained on the organic holdings. But very
little work has so far been done in the area of organic animal husbandry in India. This fact
makes it imperative that organic animal husbandry is paid due attention by the policy making
bodies, research institutions, the SAUs and other development agencies involved with the
R&D work on organic farming. Therefore, appropriate steps are required to be taken
urgently towards the development of organic animal husbandry in India. The courses
organized like this may a long way in promotion of innovative ways to harness the potential
of livestock sector for the growth in National economy.
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<th>S.No</th>
<th>Features favourable to animal husbandry development in India</th>
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<tr>
<td>1.</td>
<td>Crop- livestock integrated/mixed farming system. The requirements of fodder and feed are met on-farm. The dependence on market for external inputs is reduced to minimum. Under organic production management externally purchased inputs are discouraged. Indian traditional animal husbandry system has potential for conversion to organic animal husbandry system.</td>
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<td>2.</td>
<td>Largest livestock (450 million), poultry population (489 million) and number one milk producer in the world. Livestock sector produced 88 million tonnes of milk, 40.4 billion eggs, 48.5 million kgs of wool, and 6 million tonnes of meat in 2003-04. In 2003-04, India exported agro products of value US$ 3252.43 million, out of which US$377.66 million (12%) were earned through export of meat products. The total export earnings from livestock, poultry and related products was US$1080.82 million in 2003-04, out of which leather accounted for 54.24% and meat &amp; meat products accounted for 35.78%. Some proportion of this vast sector may be developed as organic in the areas, where, it is comparatively easy to convert to organic farming.</td>
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<td>3.</td>
<td>In India native breeds are well adapted to local situations. Being hardy, resistant to diseases, health and maintenance cost is very low.</td>
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<td>4.</td>
<td>The GOI is strongly committed to animal disease control and eradication. Rinderpest (RP) is not reported in India since 1995, OIE has declared it free from RP. Foot &amp; Mouth Disease (FMD) control programme is being implemented aggressively. India never had BSE, Bird Flu and many infectious diseases are not reported in India in last 10 years. The more controlled animal health environment is needed for the organic animal husbandry. The Indian native livestock breeds are less susceptible to diseases and stress, thus, ideally suited for the organic animal production.</td>
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<td>5.</td>
<td>Existing extensive livestock production systems are easier for conversion to organic production. The areas with low to negligible external input use like remote hilly terrains, tribal areas and certain north eastern states have favourable conditions for the development of organic farming.</td>
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<tr>
<td>6.</td>
<td>Small animals like goat, sheep, pigs, and rabbits may make good beginning in organic meat and leather production. Also, domestic market for organic milk and milk products viz. ghee can be developed with ease. Organic leather could be a valuable export commodity from India. Backyard poultry systems with indigenous breeds have potential for organic poultry production. Some consumers prefer milk, meat and eggs from native breeds for which they pay even premium prices readily.</td>
</tr>
<tr>
<td>7.</td>
<td>Unlike in western developed countries, where, specialized farming is common, farms in India are mostly diversified in term of crops grown, species and breeds of livestock raised. On-farm diversity is considered good for the organic farming.</td>
</tr>
</tbody>
</table>
Table 2. Organic agriculture scenario in India: Some milestones

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Development Indicators</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>National Programme of Organic Production (NPOP) launched</td>
<td>2000 (Formally unveiled in 2002)</td>
</tr>
<tr>
<td>2.</td>
<td>Indian National Standards for Organic Production (NSOP) developed and published</td>
<td>2001, revised edition available since 2002</td>
</tr>
<tr>
<td>3.</td>
<td>National Centre for Organic Farming established</td>
<td>2003</td>
</tr>
<tr>
<td>4.</td>
<td>Total area under certified organic cultivation</td>
<td>29,08,826 ha (This includes wild herbs collection from forest area of 24,32,500 ha)</td>
</tr>
<tr>
<td>5.</td>
<td>Total organic agricultural products produced</td>
<td>119656 Tons + 1657000 nos. of seedlings &amp; cuttings + 264000 litres of effective micro organisms</td>
</tr>
<tr>
<td>6.</td>
<td>Number of items exported</td>
<td>31</td>
</tr>
<tr>
<td>7.</td>
<td>Total quantity exported</td>
<td>6792 tons</td>
</tr>
<tr>
<td>8.</td>
<td>Value of the organic agricultural products exported</td>
<td>Rs.7123 Lakh (2004-05)</td>
</tr>
<tr>
<td>9.</td>
<td>X plan outlay for organic farming development</td>
<td>Rs 100 crore (US$ 22 million)</td>
</tr>
<tr>
<td>10.</td>
<td>Organic projects in India</td>
<td>Implemented by Government, NGOs, private sector</td>
</tr>
<tr>
<td>11.</td>
<td>Government policies</td>
<td>Favourable to organic farming</td>
</tr>
<tr>
<td>12.</td>
<td>NGOs &amp; Private sector</td>
<td>Playing proactive role in organic farming development</td>
</tr>
<tr>
<td>13.</td>
<td>Organic farming and ICAR</td>
<td>A Network project on organic farming sanctioned by ICAR (2004-07) involving 4 ICAR institutes &amp; 9 SAUs with a budgetary provision of Rs 28.30 million as an integrated part of ICAR’s on going project on ‘AICRP on cropping systems’. The North-eastern region and other dryland areas are particularly being targeted for the research and development activities relating to organic farming.</td>
</tr>
</tbody>
</table>

*National Programme for Organic Production (NPOP), APEDA, 2005*
The Concept of Tropical Climate and its effect on Livestock Production

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ERS of NRI, Kolkata

The geographical area between the tropical of cancer and tropic of Capricorn is designated on tropical area. The climate prevails in this region is termed as tropical climate, which is very much variable. It varies with unalterable factors such as latitude, altitude, distribution of land and water, soils and topography and variable factors such as ocean currents, winds, rainfall and vegetation. The interaction of all these factors results in specific micro-climates at specific localities.

Climate is a combination of elements that include temperature, humidity, rainfall, air movement, radiative conditions, barometric pressure and ionization. Among all these elements, environmental temperature and rainfall are the most important. The classification of tropical climate as suggested by USDA (1941) is generally followed which is categorized into five different classes, i.e.

1. Super humid
2. Humid
3. Sub-humid
4. Semi-arid
5. Arid

Characteristics of Various tropical climates:

I. Super humid climate:

This climate is characterized by constant heat, rainfall, and humidity. The mean annual temperature varies around 27°C and total rainfall is usually within 2,032 to 3048 mm. This climates are found 5° to 7° latitude north and south of the equator and specifically in the Congo basin and part of the Guinea Coast of Africa, in the Indian sub-continent, the Malaysian peninsula, Indonesia, Amazon basin. The typical vegetation of this climatic zone is tropical rainforest, characterized by a multiplicity of evergreen tree species. The climatic stress on domestic Livestock is considerable in this region. In general indigenous domestic breeds of Livestock are not numerous. The climate favours for better plant growth. Livestock are generally affected by internal and external parasites. Animal products rapidly deteriorate when stored. Good deal of research is needed for this region to improve the Livestock production.

II. Humid Climate:

This climate is characterized by high temperature, humidity, and rainfall. Temperature extremes are wider than in the equatorial region. There are generally three seasons; cool-dry, hot-dry, and hot-wet in this climate. The natural vegetation of this zone is rain forest but plant growth is not so vigorous as in the super-humid climate. Climate stress on domestic livestock is not quite so severe as in the super humid but forage supplies are more seasonal.

III. Sub- humid Climate:

The sub-humid areas are found north and south of the humid forest areas in the northern and southern hemisphere respectively. This is characterized by more seasonal climate than in humid zone. There is relatively short rainy season and long dry one. Temperature variations are much wider, with hotter summers due to a high intensity of radiation combined with...
longer day. The natural vegetation is usually open grassland. This region is favoured for nomadic livestock husbandry. Generally climatic stress on domestic livestock is less intense than in more humid areas but forage production is very seasonal and nutritional stress can be a problem. This is also the region where epizootic animal diseases are prevalent, though infection of internal and external parasites of domestic livestock are easier to control in this region than in more humid zones.

IV. Semi-Arid Climate:

This climatic zone is characterized by extremely seasonal conditions with less rainfall and very long dry seasons. Diurnal and seasonal temperature fluctuations are very wide, humidity is low for most of the year and there is high intensity of solar radiation due to dry atmosphere and clear sky. Total rainfall varies within 251 to 508 mm. This climate is more suited for livestock production than for any other form of Agriculture. Semi-arid climate is more suitable for the rearing of sheep, goats and camels than cattle.

V. Arid Climate:

This climate is characterized by temperature extremes of the order of 0° C to 52° C and by the fact that there is no seasonal rhythm in rainfall which is very less in total amount. Deserts may seasonally support very limited number of livestock. In addition to aforesaid reasons /climates; there is other major zone i.e. mountain region which also falls in tropical area.

A very considerable area is of land in the tropics is situated at an altitude varying between 305 and 1524 meter and appreciable area is above 1524 meter. Altitude influences climate in four ways i.e. decrease of temperature by 1.7°C for every 305 meter increase in altitude, higher the altitude the larger is the diurnal variation; rainfall is greater; and higher the altitude the lower atmospheric pressure which is halved at 5486 meter. As a whole mountain climate is to help in the improvement of livestock productivity.

The effect of the climate on the livestock:

Tropical climate affects the livestock production in 2 ways:
1. By direct influence on the animals.
2. By indirect effect on the animal’s environment.

Direct effect of the climate on the animals:

All the domestic livestock are homeotherms, i.e. these animals attempt to maintain their body temperature with in a narrow range (37°C-38°C / 40-40°C) suitable for biological activity in the wide range (-07°C to 52° C) of the environmental temperature in order to maintain their body temp. In wide range of environmental conditions, domestic livestock must preserve a thermal balance between heat production or gain from the environment and their heat loss to the environment.

Heat gain + heat loss.

Domestic animals may gain heat from environment, metabolic heat produced through feed consumption and heat production from various physical activities.

Domestic animals can lose heat through evaporation, conduction and convection.

Metabolic heat production of domestic animals depends on:

a) Basal heat production for maintaining essential body processes such as deep body temp., cardio-respiratory activities and muscle tone.
b) Digestive heat production that varies on quality and quantity of food animal ingests.
c) Muscular heat production that varies according to how much the animal moves about grazing etc.
d) Increased metabolism due to production processes such as growth, milk production and reproduction.

In general, various ways of heat production by the domestic animals is limited in comparison to the methods by which they can dispose of the heat. The methods available for the heat loss to the domestic livestock are many; out of this, evaporative heat loss is potentially important under normal circumstances. It depends on the ambient air temp., moisture, the area of evaporative surface, absolute humidity of the surroundings air and the air movement. The ability of livestock to lose heat through conduction is very limited. Convection heat loss is increased when cool breezes blow on the animals and increased air movement may also increase evaporative heat loss.

Livestock housing accommodation in the tropics should always be built in a way to ensure maximum air movement on and around the animals. Solar radiation may also can increase heat load, if suitable accommodation of the animals is not planned.

**Various factors for heat gain and heat loss by the domestic animals:**

1. **Grazing behaviour**

   The effect of climate on cattle is reflected in their grazing behavior. The length of day time grazing of the cattle varies to the degree of climatic stress, the breed and the type of cattle and the quality of the pasture land.

2. **Intake and utilization**

   The high temperature depresses the feed intake of the cattle. The effect of very high temperature is very pronounced on food consumption and rumination. High temperature and high humidity affects more than only high temp.

3. **Water intake**

   The direct effect of the climate on the water intake of the livestock is very complex, as water is required by the animal for at least two different purposes:
   i) As an essential nutrient and component of the body
   ii) To assist animals to lose heat by conductive and evaporative cooling.

   Humidity also affects water intake in the domestic animals.

4. **Growth**

   The climatic stress depresses the appetite, reducing feed intake and grazing time which is likely to affect the growth and productivity.

5. **Milk production**

   High temperature and high humidity are important climatic elements which affects milk production in dairy animals.

6. **Reproduction**

   The major climatic factors affecting reproduction are ambient temperature and humidity and length of day light. Duration of the day light affects in sheep and buffaloes in tropics. Egg production is affected by high temperature in poultry.
Indirect effect of the climate on the animals:--

The major indirect effect of the livestock is on the productivity and quality of feed available to the animals. Other indirect effects are on the incidence of the diseases and parasitic infections, storage and handling of animals and animal production.

Acclimatization:--

Acclimatization is a process by which an animal adapts itself to the environment in which it has to live. If an animal is introduced into a new environment; the stress on it are great and gradually the animal will acclimatize. Acclimatization to heat stress may be temporary or permanent depending on the situation. Permanent acclimatization to the stress may be due to changes in the behavior of the animal or due to changes in the physiological reactions that may or may not be inherited. Changes in the behavior of the domestic livestock are important in assisting acclimatization and it should be the aim of good management of livestock in the tropics to facilitate these changes.
Herd dynamics and herd structures is an important aspect of managing organized dairy herd. In any dairy herd, there are different categories of animals i.e. milch cows, heifers, dry cows, calves of different age groups, breeding bulls etc. There should be an optimum ratio of various categories of animals to maintain the herd performance. To maintain this herd structures; regular herd replacement and herd fertility should be kept optimum.

The average herd replacement in a dairy herd is about 20 heifers per 100 cows annually. Replacement rate varies between herd to herd between year to year depending upon level of fertility, culling and mortality etc. The age of first calving has also marked effect on herd replacement. The herd structure of female stock of the dairy farm is an important aspect for the maintenance of proper and regular replacement of the milch herd. The dynamic good dairy herd should have regular annual replacement of about 20 percent and the average herd life of reproductive cows should be restricted to 7-8 yrs. To maintain the status of the herd structure of female stock at any specific time should be so proportionate that annually 25-30 calving may take place from heifer stock for replacement.

Assuming 70% survivability of female stock in a crossbred dairy herd up to the age of 30-36 months and calving interval of 13-14 months the optimum herd structure of the female stock of 100 cows unit dairy herd is given in the table No.-I

Table-I:

<table>
<thead>
<tr>
<th>Categories of animals</th>
<th>Total no. Of animals</th>
<th>Percentage of total Female stock</th>
<th>Percentage of total Young female stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>100</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td>Heifers (18 months)</td>
<td>35</td>
<td>20</td>
<td>43</td>
</tr>
<tr>
<td>Heifers (12-18 months)</td>
<td>14</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Heifers (6-12 months)</td>
<td>15</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Young stock (3-6 months)</td>
<td>8</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Calves (0-3 months)</td>
<td>10</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>
Out of the heifers of more than 18 months age group at least 20-25 heifers will calve annually. Among this stock, twenty good first calvers will be selected for the replacement in the herd. The rest surplus heifers may be sold profitably. Other categories of male stock e.g. male calves, breeding bulls, bullocks etc. may be kept as per requirement of the herd.

To maintain the herd dynamics, each cow should calve in every 13-14 months interval. The realistic herd fertility level can be defined in terms of a) pregnancy rate of 65% on first service b) An average 1.5 to 1.7 service per conception on herd basis. C) a maximum 80-100 days interval from calving to subsequent conception i.e. service period. The reproductive status of the herd reflect the performance of the herd and maintenance of structure. The table no II shows the relationship of milch cow & dry cows ratio and other related traits of the herd.

Table-II:

RELATIONSHIP OF CALVING INTERVAL WITH OTHER RELATED TRAITS IN DAIRY HERD.

<table>
<thead>
<tr>
<th>CALVING INTERVAL (DAYS)</th>
<th>SERVICE PERIOD</th>
<th>PREGNANCY PERIOD</th>
<th>DAYS IN MILK</th>
<th>DAYS IN DRY</th>
<th>% OF COWS IN MILK</th>
<th>% OF COWS IN DRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>85</td>
<td>280</td>
<td>305</td>
<td>60</td>
<td>83</td>
<td>17</td>
</tr>
<tr>
<td>13</td>
<td>115</td>
<td>280</td>
<td>305</td>
<td>90</td>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>14</td>
<td>145</td>
<td>280</td>
<td>305</td>
<td>120</td>
<td>71</td>
<td>29</td>
</tr>
<tr>
<td>15</td>
<td>175</td>
<td>280</td>
<td>305</td>
<td>150</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>16</td>
<td>205</td>
<td>280</td>
<td>305</td>
<td>180</td>
<td>62</td>
<td>38</td>
</tr>
<tr>
<td>17</td>
<td>235</td>
<td>280</td>
<td>305</td>
<td>210</td>
<td>58</td>
<td>42</td>
</tr>
<tr>
<td>18</td>
<td>265</td>
<td>280</td>
<td>305</td>
<td>240</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>19</td>
<td>295</td>
<td>280</td>
<td>305</td>
<td>270</td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>20</td>
<td>325</td>
<td>280</td>
<td>305</td>
<td>300</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

In better maintained herd; 7-8% of cows should calve every month i.e. the pregnancy and non-pregnancy ratio among cows should be about 70:30. So, to maintain the optimum herd structure; the herd fertility should also be optimum.
Low Cost Livestock Housing using Locally Available Materials

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Kolkata-700 037

In India much attention has so far not been paid to this important aspect—animal housing. Poor to very poor economic background of majority of the animal farmers could be the cause behind this. It is needless to mention that sharing of same house by the animals and their owner is not very uncommon in India. So it is clear that though there is definite need for scientific livestock housing, financial constraints due to very low economic turnover of animal farming limits farmers from going for proper livestock housing. Thus there is definite need for low cost livestock housing. Housing cost is capital type expenditure. Minimization of this cost component will help to keep overhead expenditure low. This in turn, will improve the economic efficiency of livestock production.

Traditionally, livestock production system in this country is extensive type relying heavily on natural resources. This also reduces the need for livestock housing except the night shelter. However, in the past twenty years or so there has been a revolution of keeping farm livestock. Intensification of animal farming has taken place and large numbers of animals are confined to small lots. Reliance on natural resources is reducing and animals are managed indoor. Large conglomeration of animals in a small area is both a challenge and a risk. Environmental conditions must therefore be controlled by suitable housing so as to protect animals from inclement weather conditions, if good productivity is expected of them. Proper housing also helps day-to-day management in a better way.

Opportunities for cost lowering:

Animal growth, production and reproduction are the ultimate concern of the farmer. Animal production and reproduction are not generally influenced by slight and normal seasonal variations in environmental factors. But, when animals are exposed to extreme conditions for longer periods, the performance of animals is impaired resulting in death in extreme cases.

Thus animal houses should be so designed that they are less expensive and afford protection from extreme weather conditions. Expensive fittings and designs on a permanent basis should not be resorted to, to face only brief periods of climatic extremes. Often it will suffice to make some temporary additions and alterations (like provision of gunny bag or straw curtains as protection against bitter cold draughts on a very cold day) to protect animals against short period of inclement weather. By using suitable materials for construction of buildings and by landscaping around them, effect of solar radiation and high ambient temperature on animals can be minimized. The thermal properties of construction materials used for roof, floor etc. should be considered while selecting them, since the materials selected will have an important role in minimizing thermal stress on the animals. The thermal conductivity of materials varies from sample to sample depending on their density, moisture content etc.

Building materials:

Economics of cost of construction, equipment and operations versus production returns dictate the extent of environmental protection that can be attempted. Building materials accounts for the major share in the cost of construction. Thus cost of construction could be kept low by using locally available materials. To say locally available materials, it refers to those materials, which are naturally available in plenty or are the byproducts of some production system viz., straw costs thus involvement is less. Floor could be constructed using stone, kankar or sand. Raised platform of bamboo split or wood is cheap and hygienic at the northeastern states. Stone, mud, bamboo walls are durable and cheap. Many a time straw or dried leaves are used for construction of walls though durability is less yet with high
flexibility. These types of houses are cheap. In India, wide array of locally available materials are used for construction of roof. Straw (thatch), tree leaves, weeds, earthen tile, mud supported by bamboo are prominent. Decorative cages for fowl and duck, even in tiers are fabricated using bamboo. It may be noted these locally available materials are with low thermal conductivity are thus more efficient in thermal protection in comparison to those of galvanized iron, asbestos and aluminium sheets.

Mangers and Water Troughs:

Apart from providing sufficient floor space and thermal protection, care should be taken to see that the animals are provided with proper manger and water trough. In pucca houses manger and water troughs are constructed using bricks and cement concrete. Portable manger and water troughs are also constructed of iron bars and cement concrete but with high cost. Earthen manger and water trough are also very common in this country. Their durability could be long if properly placed (anchored) using mud and bamboo or wooden poles. Varieties of manger are fabricated using bamboo and wood. Bamboo made feeder and water for poultry are decorative item too.

Ancillary Structures:

Durable farm fences and gates are fabricated with bamboo protected by coal tar coating. Durability could be increased by wooden plunk supporting. Often jute stick and thatch are used for the purpose. Verities of animal and bird transportation cages egg transportation cages are fabricated with bamboo. Straw and dried leaves bedding are most comfortable to the animals. Bamboo or wooden pegs for tethering animals is widely used.

It is needless to mention that animal production is strong tool for poverty alleviation, employment generation and rural development besides providing much needed protein nutrition to the nation. Cost of animal production could be kept low by cheap housing which is only possible by using locally available materials.

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Use of non-conventional Feeds in livestock feeding

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India has attained the status of highest producer of milk producing 90 MT of the same. At the same time, it is in these years only India has attained the dubious status of world's most populous nation. The implication of the later fact is definitely pointing towards a regular shortage of food for Indians unless our farmers can produce more crops from less land and more amount of milk, meat and egg from less number of animals. The latter needs good quality feeds and fodder, but unfortunately there is a serious crunch in the nutritional resources. Availability of animal feeds indicate deficit of about 19% DM, 55% DCP and 28% TDN. It is not possible to bridge the gap between availability and requirement of nutrient by allocating more land for feed/fodder production due to over increasing demand of human population. As an alternative, it is necessitates efficient utilization of available feed stuffs along with continuous search for exploiting newer feed resources like non-conventional feeds and livestock wastes. Some of these non-conventional feeds were found to be very promising which are also available in different agro-climatic zones of West Bengal. These non-conventional feeds can replace the conventional feeds leads to the lower feed cost and may fulfill the increased demand.

DEFINITION: Generally Non-conventional feed refers to the feed ingredient which has so far been not used in for animal feeding. These are generally organic in nature and are the end product of a particular system (eg. By-products from agriculture or industry); these are either bulky (eg. Crop residues) or concentrate (Neem cake or sal seed meal) products and they do have a number of other uses rather than being utilized as animal feeds. Incidentally, almost all of these non-conventional feeds do carry one or more toxic factors.

CLASSIFICATION: Based on nutrient contents

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein rich products:</td>
<td></td>
</tr>
<tr>
<td>a) Vegetable origin:</td>
<td>Sunflower meal, Guar meal, Niger cake, Karanja cake, Neem seed cake, Rubber seed cake etc.</td>
</tr>
<tr>
<td>b) Animal origin:</td>
<td>Frog meal, Incubator waste or hatchery by-product meal, Liver residue meal, dried poultry manure, Crab meal, Shrimp shell powder, Poultry by-product meal, Hydrolysed poultry feather etc.</td>
</tr>
<tr>
<td>Energy rich products:</td>
<td>Sal seed meal, Tapioca products, Palm flour, Tamarind seed powder, Mango seed kernel, Triticale etc.</td>
</tr>
<tr>
<td>Other miscellaneous non-conventional feeds</td>
<td>Sea weed meal, babul pods, Sugarcane bagasse, Petro-protein etc.</td>
</tr>
</tbody>
</table>

At present large number of non-conventional/agro-industrial by-products which are tested for its nutritive value, are being used in compound feed industry upto 30-35% in cattle and 15-20% in poultry mash. Antinutritional factor present in these non-conventional products reduce nutritive value and may affects production and reproduction adversely if recommended levels are exceeded. Therefore suitable treatments are given for removal of antinutritional factors from these feedstuffs before its use in the feed.
Some important non-conventional materials tested for its inclusion in livestock feeds are listed below:

<table>
<thead>
<tr>
<th>Feed</th>
<th>Annual availability</th>
<th>ANF</th>
<th>Detoxification</th>
<th>Nutritive value</th>
<th>Feeding value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kapok seed meal</td>
<td>-</td>
<td>Cyclopropenoid acid fire (18%) &amp; tannins</td>
<td>Lysine &amp; Methionine supplementation</td>
<td>20% CP</td>
<td>1.30 Mcal ME/kg</td>
</tr>
<tr>
<td>Kokam cake</td>
<td>15,000 MT</td>
<td>-</td>
<td>-</td>
<td>9% DCP</td>
<td>80% TDN</td>
</tr>
<tr>
<td>Kusum cake</td>
<td>30,000 MT</td>
<td>HCN 2.4-6.12 mg/100g</td>
<td>Autoclaving, boiling, deoiling</td>
<td>15% DCP</td>
<td>79% TDN</td>
</tr>
<tr>
<td>Mango seed kernel</td>
<td>1 million MT</td>
<td>Tannins (5-6%)</td>
<td>-</td>
<td>6% DCP</td>
<td>50% TDN</td>
</tr>
<tr>
<td>Niger cake</td>
<td>0.1 m MT</td>
<td>-</td>
<td>-</td>
<td>32% CP</td>
<td>49% TDN</td>
</tr>
<tr>
<td>Palm kernel</td>
<td>1.97 m MT</td>
<td>High fibre, dry &amp; gritty</td>
<td>-</td>
<td>20% CP</td>
<td>1.90 Mcal ME/kg</td>
</tr>
<tr>
<td>Rubber seed cake</td>
<td>0.15 m. MT</td>
<td>HCN 9mg/100g</td>
<td>Roasting, toasting, water soaking</td>
<td>18% DCP</td>
<td>54% TDN</td>
</tr>
<tr>
<td>Safflower meal</td>
<td>0.45 m MT</td>
<td>Phenolic glucosides</td>
<td>-</td>
<td>40% CP</td>
<td>2 Mcal ME/kg</td>
</tr>
<tr>
<td>Sesame meal</td>
<td>1.49 m MT</td>
<td>Oxalates 35mg/100g;</td>
<td>-</td>
<td>40% CP</td>
<td>2 Mcal ME/kg</td>
</tr>
<tr>
<td></td>
<td>Phytate 5g/100g in hull fraction.</td>
<td></td>
<td>DCP</td>
<td>TDN</td>
<td>&amp; mineral supplementation</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------</td>
<td>-----</td>
<td>-----</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Spent annatto seeds</td>
<td>30,000 MT</td>
<td>Tannic acid</td>
<td>8%</td>
<td>67%</td>
<td>Crossbred calves-350g ADG (20% in conc. Mix.).</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>3.28 m MT</td>
<td>Chlorogenic acid (1.2% DM), Tannins</td>
<td>36%</td>
<td>2.1</td>
<td>5% in poultry diet with lysine supplementation.</td>
</tr>
<tr>
<td>Tamarind seed</td>
<td>8.7 million MT (in Asia)</td>
<td>Tannins (13-14%)</td>
<td>1.3%</td>
<td>67%</td>
<td>Calf starter-728ADG (25%) Bullocks were fed @ 1.5kg/d without any adverse affects.</td>
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<td>5.6 m MT</td>
<td>Tannins (8-12%)</td>
<td>0.1%</td>
<td>60%</td>
<td>Growing &amp; lactating ruminants 10-20%. In chicks should not be beyond 5%, in layer 10%.</td>
</tr>
<tr>
<td>Neem cake</td>
<td>0.4 m MT</td>
<td>Nimbin, Nimbidine</td>
<td>-</td>
<td>-</td>
<td>Can be fed upto 30% of conc. Mix. mixed with other palatable feed stuffs</td>
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<td>Saponin (Mowrin)-6-20%; Tannins (6.4%)</td>
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<td>Tea waste</td>
<td>0.1 MT</td>
<td>Tannic acid (2%)</td>
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<td>43%</td>
<td>Upto 20% level in the conc. mixture of crossbred calves (ADG 350g).</td>
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Large number of other agro-industrial by-products like banana leaves, pineapple waste, maize cobs, dhaincha seed cake, kidney bean chuni, corn gluten meal, triticle, apple waste, tea waste, petro-protein, palm flour, jackfruit waste, oak kernel etc. is used as non conventional feed resources in livestock feeding. Large quantity of sugarcane bagasse is becoming available from sugar industries. Stream treatment of sugarcane bagasse with or without addition of molasses and urea has been proved encouraging, increasing feed intake and digestibility.

COMPLETE FEEDS AS A TOOL FOR RECYCLING OF ANIMAL WASTES:

There is a good scope for increasing nutritive value of different agro-industrial by products, animal wastes by following new feeding system wherein these ingredients are blended into complete feeds. This helps developing low cost feed, ensures better roughage-concentrate ratio, avoids refusal of unpalatable portions of plant residue, improves utilization of NPN compounds enables use of locally available ingredients and by increasing bulk density facilitate economic transport. The vegetable wastes are available amply in and around big cities. Sawant et al. (1996) reported that good silage can be prepared out of market vegetables waste upto level of 70% mixed with paddy straw and added with molasses and urea upto 10 and 5.3% levels, respectively, under laboratory conditions.

Cattle and buffalo waste from animal production system is generally a mixture of dung, urine and feed refusal which vary in chemical composition. Slaughter of animal for human consumption leads to production of huge quantity of rumen content and blood. Rumen contents consist of nutrients present in the partially digested materials consumed by the animal before slaughter, digestive juices and enzymes as well as microbes. About 4000-5000 tones of CP could be obtained annually from rumen content from animals slaughtered in India (Rao and Fontenot, 1987). Deshmukh (1992) reported 12.57, 9.31, 1.76, 31.50, 42.83 and 14.50 percent DM; CP, EE, CF, NFE and ash content, respectively in rumen content. High moisture content of rumen content in combination with low moisture roughages in helpful in ensiling the feed which increases the palatability and destroys harmful pathogens. Addition of urea and molasses further improves the digestibility of the feed. Complete feed blocks prepared with 50% Paddy/Jowar straw, rumen contents upto 25%, along with 10% urea, 10% molasses, 3% mineral mixtures and 2% common salt can reduce the feed cost of growing calves without any adverse impact upon growth rate.

Patil et al., (1994) while reviewing the use of slaughter house waste in animal feeds concluded that digestive tract contents of slaughtered livestock can successfully be recycled as animal feed which will reduce the cost of production and also alleviate the environmental pollution problem.

The steady rise in poultry industries in last couple of years has increased the availability of different poultry wastes, which can be recycled to feed the livestock. Depending upon the raring system of the birds the following wastes can be available: Dried poultry manure is available under deep litter system of rearing; this contains litter materials, excreta. Broiler litter is usually high in protein. Poultry dropping contain 60-90% urinary nitrogen as uric acid and 9-13% as ammonium salts. The digestibility of nitrogen in pure droppings ranges from 70-85%.

Properly dried poultry manure can be used at 10-15% level in chick and broiler ration with good results. No effect on milk yield and composition was observed when diet containing poultry litter upto 30% was fed to cross-bred cows produced 20 litters of milk per day.

Other type of waste of caged birds collected under cages which contains mainly excreta of the birds, waste feeds and feathers. Hydrolyzed poultry feather is the product resulting from the treatment under pressure of clean, undecomposed feathers from slaughtered poultry. A minimum of 80% of its crude protein must consist of digestible...
protein”. It is rich in protein (80-86%). This product, therefore, should be used judiciously with other protein supplements to balance the amino acid deficiencies.

Results of the trial with ensiled broiler litter indicated that poultry excreta can be used as protein supplement for ruminants provided rich source of readily available carbohydrate is added to the diet to ensure effective utilization of NPN by rumen microbes (Daniel et al., 1983). Studies at NRC (1983) suggested that growth of growing chicks can be maintained with diet containing waste, but feed efficiency would be depressed due to lower ME value of waste. Harmful effect on health of sheep fed with ration containing broiler litter having high level of copper is copper toxicity. However, with withdrawal period of five days after feeding of ration containing poultry waste, such problem was not observed in cattle (Fontenot and Webb, 1975).

**FUTURE NEED, SCOPE AND TRENDS:**

Increasing production and productivity in marginal areas and under least favorable condition should be priority considering the limited resources of quality feeds. Use of waste from livestock and agro-industries in animal feeds involves three aspects viz, processing method, effect of processed waste on production performance and human animal health hazards. More than 60% of TDN requirements come from agricultural crop residues and agro-industrial products which are low in CP and energy and thus in palatability. Efforts should be made to enrich these feed by practicable pre-treatment in order to increase palatability, digestibility and nutrients availability. It requires effective management of antinutritional factors to improve use of non-conventional feed resources. Currently, animal wastes are not effectively utilized which causes environmental pollution problems. Some of the technologies have paved the way for its use in animal feeds.

**REFERENCES:**


Use of non-conventional Feeds in livestock feeding

T.K. Ghosh, S. Samanta and S. Haldar

Department of Animal Nutrition
West Bengal University of Animal and Fishery Sciences
Belgachia, Kolkata-700037

India has attained the status of highest producer of milk producing 90 MT of the same. At the same time, it is in these years only India has attained the dubious status of world’s most populous nation. The implication of the later fact is definitely pointing towards a regular shortage of food for Indians unless our farmers can produce more crops from less land and more amount of milk, meat and egg from less number of animals. The latter needs good quality feeds and fodder, but unfortunately there is a serious crunch in the nutritional resources. Availability of animal feeds indicate deficit of about 19% DM, 55% DCP and 28% TDN. It is not possible to bridge the gap between availability and requirement of nutrient by allocating more land for feed/fodder production due to over increasing demand of human population. As an alternative, it necessitates efficient utilization of available feed stuffs along with continuous search for exploiting newer feed resources like non-conventional feeds and livestock wastes. Some of these non-conventional feeds were found to be very promising which are also available in different agro-climatic zones of West Bengal. These non-conventional feeds can replace the conventional feeds leads to the lower feed cost and may fulfill the increased demand.

DEFINITION: Generally Non-conventional feed refers to the feed ingredient which has so far been not used in for animal feeding. These are generally organic in nature and are the end product of a particular system (eg. By-products from agriculture or industry); these are either bulky (eg. Crop residues) or concentrate (Neem cake or sal seed meal) products and they do have a number of other uses rather than being utilized as animal feeds. Incidentally, almost all of these non-conventional feeds do carry one or more toxic factors.

CLASSIFICATION: Based on nutrient contents

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein rich products</td>
<td></td>
</tr>
<tr>
<td>a) Vegetable origin:</td>
<td>Sunflower meal, Guar meal, Niger cake, Karanja cake, Neem seed cake, Rubber seed cake etc.</td>
</tr>
<tr>
<td>b) Animal origin:</td>
<td>Frog meal, Incubator waste or hatchery by-product meal, Liver residue meal, dried poultry manure, Crab meal, Shrimp shell powder, Poultry by-product meal, Hydrolysed poultry feather etc.</td>
</tr>
<tr>
<td>Energy rich products:</td>
<td>Sal seed meal, Tapioca products, Palm flour, Tamarind seed powder, Mango seed kernel, Triticale etc.</td>
</tr>
<tr>
<td>Other miscellaneous non-</td>
<td>Sea weed meal, babul pods, Sugarcane bagasse, Petro-protein etc.</td>
</tr>
<tr>
<td>conventional feeds</td>
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</tbody>
</table>

At present large number of non-conventional/agro-industrial by-products which are tested for its nutritive value, are being used in compound feed industry upto 30-35% in cattle and 5-20% in poultry mash. Antinutritional factor present in these non-conventional products reduce nutritive value and may affects production and reproduction adversely if recommended levels are exceeded. Therefore suitable treatments are given for removal of antinutritional factors from these feedstuffs before its use in the feed.
Some important non-conventional materials tested for its inclusion in livestock feeds are listed below:

<table>
<thead>
<tr>
<th>Feed</th>
<th>Annual availability</th>
<th>ANF</th>
<th>Detoxification</th>
<th>Nutritive value</th>
<th>Feeding value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protein</td>
<td>Energy</td>
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<td></td>
</tr>
<tr>
<td>Kapok seed meal</td>
<td></td>
<td>Cyclopropenoid acid fire, (18%) &amp; tannins</td>
<td>Lysine &amp; Methionine supplementation</td>
<td>20% CP</td>
<td>1.30 ME/kg</td>
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<td></td>
<td>Discolouration of egg yolk, beyond 10% depressed growth &amp; feed intake &amp; increased mortality in poultry, may be fed to ruminants.</td>
</tr>
<tr>
<td>Kokam cake</td>
<td>15,000 MT</td>
<td>-</td>
<td>-</td>
<td>9% DCP</td>
<td>80% TDN</td>
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<td></td>
<td></td>
<td></td>
<td>Crossbred calves-500g ADG (15% in conc. Mix.)</td>
</tr>
<tr>
<td>Kusum cake</td>
<td>30,000 MT</td>
<td>HCN 2.4-6.12 mg/100g</td>
<td>Autoclaving, boiling, deoiling</td>
<td>15% DCP</td>
<td>79% TDN</td>
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<td></td>
<td></td>
<td>Crossbred calves-418g ADG (35% in conc. Mix.), Broilers @ 17%</td>
</tr>
<tr>
<td>Mango seed kernel</td>
<td>1 million MT</td>
<td>Tannins (5-6%)</td>
<td>-</td>
<td>6% DCP</td>
<td>50% TDN</td>
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<td></td>
<td></td>
<td>Milch cows (10% in conc. Mix.)</td>
</tr>
<tr>
<td>Niger cake</td>
<td>0.1 m MT</td>
<td>-</td>
<td>-</td>
<td>32% CP</td>
<td>49% TDN</td>
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<td></td>
<td></td>
<td>Crossbred ADG (57% in conc. Mix.)</td>
</tr>
<tr>
<td>Palm kernel</td>
<td>1.97 m MT</td>
<td>High fibre, dry &amp; gritty</td>
<td>-</td>
<td>20% CP</td>
<td>1.90 ME/kg</td>
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<td></td>
<td></td>
<td>Incorporated at 30% level in poultry diets successfully, commonly fed to ruminants. Rich in sulphur containing amino acids.</td>
</tr>
<tr>
<td>Rubber seed cake</td>
<td>0.15 m MT</td>
<td>HCN 9mg/100g</td>
<td>Roasting, toasting, water soaking</td>
<td>18% DCP</td>
<td>54% TDN</td>
</tr>
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<td></td>
<td></td>
<td>Crossbred calves-500g ADG (30% in conc. Mix.), Milch cows-8 kg milk/d (25%).</td>
</tr>
<tr>
<td>Safflower meal</td>
<td>0.45 m MT</td>
<td>Phenolic glucosides</td>
<td>-</td>
<td>40% CP</td>
<td>2 ME/kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poor performance in poultry on unhulled meal. Limited usage in grower and layer diets due to high fibre without lysine supplementation</td>
</tr>
<tr>
<td>Sesame</td>
<td>1.49 m MT</td>
<td>Oxalates</td>
<td>-</td>
<td>40% CP</td>
<td>2 ME/kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15% in poultry</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Meal Type</th>
<th>MT</th>
<th>Extracted Compounds</th>
<th>ME/kg</th>
<th>TDN</th>
<th>Diets with Lysine &amp; Mineral Supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spent annatto seeds</td>
<td>30,000 MT</td>
<td>Tannic acid</td>
<td>8% DCP</td>
<td>67%</td>
<td>Crossbred calves-350g ADG (20% in conc. Mix.).</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>3.28 m MT</td>
<td>Chlorogenic acid (1.2% DM), Tannins</td>
<td>36% CP</td>
<td>2.1 Calorie &amp; ME/kg</td>
<td>5% in poultry diet with lysine supplementation.</td>
</tr>
<tr>
<td>Tamarind seed</td>
<td>8.7 million MT (in Asia)</td>
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<td>0.4 m MT</td>
<td>Nimbin, Nimbidine</td>
<td>11.4-25.4% CP</td>
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<td>Can be fed upto 30% of conc. Mix. mixed with other palatable feed stuffs.</td>
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In India, the contribution of livestock to the agrarian economy compared to crops though small but not insignificant. There has been significant achievement in livestock production specially in dairy and poultry sectors in the last fifteen years. Although many package of animal husbandry practices are available, still the transfer of animal husbandry technology is not encouraging due to traditional idea, belief, social bindings, social facilities and critical inputs etc. These bindings can only be solved by successful implementation of the animal husbandry development programmes containing various innovative technologies. For successful implementation of any developmental programme, we have to change the peoples’ attitude towards the adoption of improved technologies recommended under the programme by increasing their knowledge and skill. At the same time, they should be motivated to adopt the recommended technologies by providing facilities, inputs and training. Training is the best way for changing the people rather giving any incentives.

Programme: It is an overall long range schedule of work containing a broad outline of things that need to be done and the methods of doing them. This serves as a basis for specific extension plans and projects. Extension programmes are formulated and publicized in order to promote understanding and generate interest among the client groups and other concerns. Normally, this is a written statement, which describes the extension activities proposed the problems they address the premises on which they are based, the objectives they seek to attain and the resources they require. The following points should be considered for successful implementation of any animal husbandry programme.

A) PROGRAMME PLANNING: It is a decision making process involving critical analysis of existing situation and the problems, evaluation of the various alternatives to solve these problems and the selection of relevant ones, giving necessary priorities based on local needs and resources by the co-operative efforts of the people both official and non official with a view to facilitate the individual and community growth and development.

Principles underlying programme planning:

i) It should be based on an analysis of the past experiences, present situation and future needs.

ii) It should have clear and significant objectives that could satisfy the important needs of the people.

iii) It should fix up priority on the basis of available resources and time.

iv) It should clearly indicate the availability and utilization of resources.

v) It should have a general agreement at various level.

vi) It should involve people at local level.

vii) It should involve relevant institution and organizations.

viii) It should have a definite plan of work.

ix) It should provide for evaluation of results and reconsideration of the programme.
B) MOTIVATION OF THE LEARNER: Motives are a set of internal conditions which gives rise to action in an organization. Learning is governed not only by knowledge but also motivation in order to keep pace of development abreast with changing environments and time. Motivated behavior is directional and goal oriented, pass strength or valence, and have high variability between and within individual and vary on temporal and spatial dimension. Motivation aims at developing the personal effectiveness of individuals and groups, they are characterized by three dimensions-

a) Openness  

b) Perceptiveness  

c) Communication

Motivation interventions are commonly called as the AMT, (Achievement Motivation Techniques/ Training). They are as follows-

i) Personal Involvement: It is necessary in motivation for learning. It can be done by-

a) Involving the livestock owners in preparing the syllabus and choosing the training methods.

b) Appointing the trainees to help the instructor as much as possible.

ii) Intrinsic motivation: Trainees should be motivated for learning through their internal feeling of motivation. It can be done by-

a) Making the subject interesting to the learners.

b) Showing the relevance of what is being discussed.
iii) **Goal setting:** If the trainees set some goal, the action to achieve that goal become more motivative. It can be done by-

a) Setting some learning goal for the trainees. It should be realistic.
b) Test and evaluation should be announced in advance, in terms of time, materials to be covered and achieved.

iv) **Relevance:** Things that are relevant or related to the trainees will be more motivative for learning. It can be ensured by-

a) Theory and practical should be done simultaneously.
b) Explain theory by giving illustrations and examples.

v) **Interpersonal support:** Making participants feelings emotionally supported in their attempt at self-change.

vi) **Risk:** It is adversely proportional to motivation and opposite to rewards. So emphasis should be given to minimize the risk factor during the development of the programme.

C) **LEARNING:** It is the process by which a person becomes changed in their behaviour through self-activity.

**Conditions for effective learning:**

i) **Over learning:** If learning is repeated again and again, then learning will be more. We can arrange this by additional exposure like film show, field visit etc. Too much over learning also has to be guarded in order to check monotony.

ii) **Multiple sense learning:** Learning will be more effective, if multiple sense of the learner is used simultaneously. It can be done by using audio visual aids and by involving the livestock owners in action.

iii) **Feedback:** It can be done during the session by asking questions, giving assignments or by evaluation test.

iv) **Meaningful material:** If the learning material is meaningful (Beneficial) to the learner, then learning will be more. By hammering the benefit they will be more motivated for learning.

v) **Primacy and Recency:** Most important talk should be given at first and again it has to be repeated at last, then it will be retained more.

vi) **Reinforcement:** Rewarding of perceptions is more effective. Rewarding may be in terms of benefits, reducing risk, positive gain etc. It can be done by some incentives, promotions etc.

**Learning situation:** An effective learning situation consists of five essential elements.

Instructors ➔ Subject matter ➔ Learner ➔ Physical facilities ➔ Teaching material

The diagram shows learner as the control element in the learning situation. There is always a constant reaction by learners to each of the other four major elements in the learning situation.

**Learning environment:**

All physical facilities are considered as learning environment. i.e. temperature, light, ventilation etc. Environment has to be good for training in animal husbandry practices in terms of programme, venue, trainer and trainees. All these four elements together form a conducive situation for effective learning.

i) **Programme:** It consists of aids, methods, objectives, timetable, syllabus, tests, evaluation, management and administration.

ii) **Venue:** It should be decided considering different pre-occupations like facilities, distance from the home of the trainees etc. Training room should be properly enlightened with comfortable temperature. Sitting arrangement will be in such a way so that trainer will be visible by all trainees and use of aids will be easy and control will be minimum.

iii) **Trainer:** Learning is more effective when atmosphere is little bit democratic and trainees feel convenient but if trainers style is autocratic, the trainees reaction become conflicting and their involvement become restricted. Personality, attitude towards the trainees, organization, programme itself should be managed favorably in respect of all trainees.
iv) **Trainees**: Trainees differ in respect of their knowledge, skill, personality, attitude and expectation. Therefore, training programme must consider all such variation of the trainees.

It is our duty to create learning situation in rural area so that livestock owners can get effective learning regarding any new technology and apply in their daily life.

**METHODOLOGY TO BE ADOPTED FOR SUCCESSFUL IMPLEMENTATION OF ANY PROGRAMME**: To promote effective and efficient learning, programme delivery methods should include the following: Provide desired **EXPERIENTIAL** opportunities for the learner, **REINFORCE** the learner, Provide opportunities for the learner to **INTEGRATE** new information with existing knowledge and skills (Richardson, 2001).

**EXPERIENTIAL METHODS** are those that allow the learner to gain experience or a feel for the information presented. The experience may include physical activity, use of senses, emotions, social interaction, depending on the content of programme.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Audio/Video cassettes</th>
<th>Tour</th>
<th><strong>Audio/Video cassettes</strong></th>
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</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td></td>
<td>Route play</td>
<td></td>
</tr>
<tr>
<td>Teleconference</td>
<td></td>
<td>Case study</td>
<td></td>
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<tr>
<td>Office visit</td>
<td></td>
<td>Method demonstration</td>
<td>Result demonstration</td>
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<tr>
<td>Game</td>
<td></td>
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<tr>
<td>Symposium</td>
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</tbody>
</table>

**REINFORCEMENT METHODS** are those that provide informational, emotional, or social support for the learner to facilitate learning and enhance or maintain the motivation to continue in the learning process.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Fact sheet</th>
<th>Notebook</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Leaflet or flier</td>
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<td>Pamphlet</td>
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<tr>
<td>Magazine article</td>
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<td>Journal article</td>
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<td>Book</td>
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<td>Fax message</td>
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<td>Computer software</td>
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<td>Newsletter</td>
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<td>Home study kit</td>
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<td>Letter</td>
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<tr>
<td>Poster</td>
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</tbody>
</table>

**INTEGRATIVE METHODS** are those that provide opportunities for the learner to discuss, clarify, or otherwise gain better understanding of new information. Helps the learner to merge new information with their existing knowledge.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Conference</th>
<th>Convention</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
<td></td>
<td>Panel</td>
<td></td>
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<tr>
<td>Meeting</td>
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<td>Forum</td>
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<tr>
<td>Symposium</td>
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<td>Colloquium</td>
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<tr>
<td>Dialogue</td>
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<td>Buzz group</td>
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<tr>
<td>Discussion group</td>
<td></td>
<td>Interview</td>
<td></td>
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</tbody>
</table>

**OTHER METHODS** are those that are applicable in a wide variety of situations or that can be used for limited or special situations.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Broadcast television</th>
<th>Cable television</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td></td>
<td>Newspaper</td>
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<tr>
<td>Movie</td>
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<td>Photograph</td>
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<td>Bulletin board</td>
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<td>Show</td>
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<td>Exhibit</td>
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<td>Lecture</td>
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<td>Puppet</td>
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<td>Comics</td>
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<tr>
<td>Fair</td>
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</table>

**Factors to be considered in Selecting Programme Delivery Methods:**

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1. The target audience. Innovativeness of the farmers should be considered during selection.
2. The educational objective
3. The type and content of the message being provided
4. The characteristics of the delivery method
5. The method's utility for providing desired learning support

A) EXTENSION TEACHING METHODS:

Methods Classified by Nature of Contact

<table>
<thead>
<tr>
<th>Individual</th>
<th>Group</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm or home visit</td>
<td>Meetings</td>
<td>News stories</td>
</tr>
<tr>
<td>Office visit</td>
<td>Method demonstration</td>
<td>Radio</td>
</tr>
<tr>
<td>Telephone calls</td>
<td>Leader training</td>
<td>Television appearances</td>
</tr>
<tr>
<td>Personal</td>
<td>Tours &amp; field days</td>
<td>Newsletters Publications</td>
</tr>
<tr>
<td>Correspondence</td>
<td>Organized clubs</td>
<td>Interactive conferences</td>
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<tr>
<td>Result demonstration</td>
<td>Camps</td>
<td>Computer-aided Instructional learning</td>
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<td></td>
<td>Community forums</td>
<td>Satellite programmes</td>
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<td></td>
<td>Short courses</td>
<td>Exhibits</td>
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<td></td>
<td>Workshops</td>
<td>Answering machines</td>
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<tr>
<td></td>
<td>Teleconferencing</td>
<td>Internet</td>
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</tbody>
</table>

Methods Classified by Form of Communication

<table>
<thead>
<tr>
<th>Written</th>
<th>Spoken</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulletins</td>
<td>Meetings</td>
<td>Result demonstration</td>
</tr>
<tr>
<td>Leaflets</td>
<td>Farm/home visit</td>
<td>Exhibits</td>
</tr>
<tr>
<td>Fact sheets</td>
<td>Office call</td>
<td>Posters</td>
</tr>
<tr>
<td>News articles</td>
<td>Telephone call</td>
<td>Slides</td>
</tr>
<tr>
<td>Personal letters</td>
<td>Radio</td>
<td>Videos</td>
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<tr>
<td>Newsletters</td>
<td></td>
<td>Charts</td>
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<tr>
<td></td>
<td></td>
<td>Television</td>
</tr>
</tbody>
</table>

B) TRAINING: Training is an important mechanism for human resource development and transfer of technology, which are the main objectives of any Animal Husbandry Programmes. Training can be defined as reciprocal process of teaching and learning, a body of knowledge and the related methods of work. Training means to educate a person so as to be fitted, qualified, proficient in doing some job.

Training methods:

1) Learning on the job: It is self-learning. We can learn knowledge and skill. Trainer has no role.
2) Training in the field: Trainers' role is only to monitor and supervise. Here trainees are placed to certain organization for learning before actual posting.
3) Simulated real life training: In this method job situation is created in the training class. People are asked to do their job under the created situation. It can be done by two way- Role play and Business game.
4) Lecture: It is a method of verbal presentation on a topic by a speaker to a group of audience. Visual aids may be used during the talk and a question-answer session may follow it.
5) Group Discussion: This shall lead to a better understanding of the topic as the audience are allowed to discuss on the topic in presence of the speaker and the speaker elicit the latter's comments and clarification on the points raised.
6) Seminar: Topic will be one. Several experts may give their views on that particular topic from different angles.
7) **Symposium:** Topic is little bit broader and in the beginning it is divided into several subtopics. Sub-topics are different for different speakers to arrive into consensus or to decide something.

8) **Workshop:** Where the people learn by doing. Here all are experts.

9) **Syndicate:** The whole group will be sub-divided into sub-groups. In the same way major topic will be divided into sub-topic. Then each sub-topic will be assigned to each group to discuss, to work on it and also to have a final shape or resolution. It may be in the form of a recommendation. Syndicate’s reports are presented as a whole to an assembly of the training faculty for discussion and to give final conclusion.

10) **Panel discussion:** Sub-topics are assigned to panel of experts. Generally experts are sitting at a time in front of the participants. Participant may raise any question to the panel and the concerned panel has to answer it. Sometimes other persons also can reply. Experts are already nominated and they come prepared.

11) **Conference and Convention:** It is more or less similar. In scientific field it is called convention. Regular large gathering of members of some formal association or society is called conference or convention. It is mostly annual, sometimes once in two years.

12) **Assembly:** It is also large gathering where there is no personal specific goal. It decides policies. Some sort of political essence is here.

13) **Brainstorming:** It is not a group discussion, but it is technique of learning or technique of deciding something where all the participants are involved in contributing something free and frank on specific aspect which may be relevant, finally selecting and drawing conclusion.

14) **Buzz Session:** A large group is divided into smaller groups to which a topic is given to discuss and their opinions to solicit the solutions to the problem.
Recent advances in Frozen Semen Processing Technology

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Haringhata Farm, P.O.- Mohanpur, Dist.- Nadia, 741246.

Introduction

Frozen semen processing technology includes a series of laboratory procedures starting from collection of semen to freezing. Steward (1951) reported the birth of the first calf from insemination with frozen semen in this world. In India, National Dairy Research Institute was the first to experiment with frozen semen of cattle in 1961 (Bhosrekar, 1990). Thereafter number of organizations from different states came up for adoption of semen freezing and breeding with frozen semen accordingly, as “International Cross Breeding Project on Cattle - Haringhata” of West Bengal. Import of frozen semen ampoules to use in this project was initiated from 1968-69. After a long gap, production of frozen semen straw was started manually from the year 1989-1990 (Gupta, 1990). However, from 1996-1997 advancement referred different automation in the processing technology was being adopted. Gradually the processing unit is being standardized as ISO 9001:2000 organization since 2004-2005 (Annual Report, PBGSBS, 2005-2006). Other recent advancement in frozen semen processing technology is a continuous process of this organization with the advent of time.

Frozen semen processing technology includes collection, evaluation, quantification and dilution of semen including filling in straws, sealing, freezing and sterilization. Adoption of recent advancement in frozen semen processing technology induces qualitative and quantitative potentiality of frozen semen to use in breeding programme. These modem techniques to sperm collection and processing demonstrate how successful these procedures are to overcome even severe infertility. Recent advances have made fertility conditions once deemed hopeless “a thing of the past” (Jeyendran, 2003). It also increases the economic feasibility of the project as well as the end users. Recent advancement adopted in each and every processing step is given below in detail.

Recent advances in different steps of frozen semen processing technology

Semen collection

1. Tying of aprons (65x 62 cm. with semicircular cut at one end by leaving 12 cm. on either side and fixing slightly heavy 2 to 3 metal pieces on opposite side to keep it straight and to avoid folding of apron) to the bulls is very important to protect penis from hind quarter of dummy for proper and clean collection of semen.
2. Use of gloves by collectors makes hygienic semen collection.

Semen evaluation, quantification and dilution

1. Trinocular Phase contrast microscope with camera, monitor & heating stage increases the efficacy of primary gross evaluation process over the simple binocular one.
2. Quality control laboratory (QCL) focus on special quality measures related with qualitative and quantitative assay of semen by microscopic and chemical evaluation. Raw semen or frozen semen samples from each semen donor (bull) is taken for different quality control test depending on the test schedule following minimum standard protocol mandate of Government of India. These are live-dead count, acrosomal integrity test, morphology test, Hypo osmotic swelling test (HOST) and Post thaw viability test of spermatozoa before or after freezing including concentration in each straw. Validation of photometer test was also done by QCL. For microbial contamination study, scheduled aerial count, rinse and working solution test is done. Schedule pH measurement of all lab-equipments and working
solution is done. Action and corrective action in this perspective produce more hygienic and quality frozen semen that correlates positively with conception rate.

3. Differential Interference Contrast (DIC) trinocular microscope, digital pH meter and digital balance increase potency during quality control assay of frozen semen.

4. Millipore water purification system makes easy supply of pure water for the process.


6. Photometer with auto dilutor & printer (Microcell counter) bring more objectivity in frozen semen processing technology. It makes quick and more precision in concentration measurement and dilutor volume over the previous thumb rule or lengthy haemocytometer method. Maximum utilization of each semen batch through production of frozen semen doses (20 million sperm/dose in cattle) is possible by this recent advancement. Single step dilution takes less time after the incorporation of this instrument.

7. Evaluation of sperm chromatin status, assessment of capacitation like changes and the induction of the acrosome reaction, ability of spermatozoa to bind to the Zona Pellucida, zona free hamster egg penetration assay (Datta et al., 2004) etc. enrich quality control of semen to a great extend.

8. Sperm sexing, the sorting procedure reduces the amount of sperm (Feld, E. 2005) in each straw is important to have desirable offspring.

Filling in straws and sealing

1. Automatic ultrasonic semen filling and sealing (MRS3)&printing machine for mini/medium straw and Domino jet printer increases the speed of the whole process over previous comb filling, manual PVC sealing and putting identification marks.

2. Use of French mini straw decreases the total dilutor volume and dilution ratio. Dilution ratio inversely related with sperm quality. Mini straw is useful for equal thawing, less spacious and low freezing & packing cost. In both ways this recent advancement increases the economic potentiality of the frozen semen.

Freezing of semen

1. Cold handling cabinet and Biological Freezer (computerized semen freezing system, Digit cool) are the latest inclusion in frozen semen processing technology. It has got great impact on maintenance of exact temperature and time of freezing over previous liquid nitrogen vapour.

2. Quarantine measures for one month is followed to check transmission of dreadful diseases like FMD, IBR etc.

Sterilization

1. Air modular system, Laminar airflow unit, air shower or air sprayer or air cartoons, ultraviolet light and hatch window etc. decreases the chance of contamination in frozen semen during processing.

2. Use of ethylene oxide gas sterilizer and fumigator over the usual sterilization processes efficiently increase hygienic and clean frozen semen production.

New advancement in related matter of frozen semen processing technology

Screening of semen donors for better selection

Semen donors should undergo rigorous screening for genetic, sexually transmitted & other infectious diseases (Norris, 2006). Gross genetic abnormality can be assayed by karyotyping. Abnormalities in nucleotide level like BLAD, DUMPS & citrullinemia etc. in cattle can be detected by molecular screening. Adoption of ELISA and other microbiological tests check infectious and sexually transmitted diseases like FMD, IBR & brucella etc. in cattle. Increased productivity of dairy cows achieved through continued use of semen from intensively selected groups of progeny tested sires (Macmillan, 2002). Selecting bulls with
good semen for better productivity can also be search out through latest molecular markers as PCR, RFLP or micro-satellite (Feld, 2005) assays.

International Standards
International Standards as ISO 9001:2000 for production & processing of frozen semen maintain the quality management system. “Plan, do, check and act” theory in this context is a commitment for the production of quality end product.

Conclusion
Recent advances in frozen semen processing technology increased qualitative and quantitative potentiality of frozen semen. Quality enhances fertility. Conception rate has been increased from 36.63 %± 0.99 in 2001-02 to 44.14±1.09 in 2005-06 (Annual Report & Monthly report since 2001-2002) in bovine population of West Bengal. It decreases production cost of each straw from Rs. 30-35/- to RS. 8/- (Pal, 2007), which is very economical for the end users and feasible for the project. In addition this latest advancement increases total frozen semen straw production 8.08 lakh in 2001-02 to 17.22 lakh in 2005-06 of this state (Annual Report, 2005-2006) maintaining scheduled concentration in each straw. Thus recent advancement and continual improvement in frozen semen processing technology may direct in animal resources development in much better and faster manner.

References
1. Annual report (year wise since 2001-02) of Government Cattle Farm of West Bengal.
8. Monthly Report (year wise since 2001-02) of different districts of West Bengal.
Advances in control of haemoprotozoan diseases to enhance production in livestock

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Haemoprotozoan parasites are a serious constraints for the improvement of livestock production. Trypanosomosis, Theileriosis, Babesiosis and Anaplasmosis are the major haemoprotozoan diseases of livestock in our country which causes severe economic losses to the livestock owner. Here the discussion regarding control of haemoprotozoan diseases will be done under two broad headings – 1) control of tick borne haemoprotozoan diseases i.e. the haemoprotozoan diseases which are mainly transmitted by different species of ticks like theileriosis, babesiosis and anaplasmosis and 2) control of haemoprotozoan disease transmitted mainly by flies like trypanosomosis. The imported stock and cross bred animals are very much susceptible to various haemoprotozoan diseases and the up grading of local cattle through cross-breeding with high yielding imported stock is greatly hindered which leads us to think more about haemoprotozoan diseases. So, it is very much essential to control these haemoprotozoan diseases. But, before going to actual discussion on control measures against haemoprotozoan diseases, one should know how these diseases causes economic loss. Losses due to these haemoprotozoan diseases include high mortality, reduction in milk yield, loss of body weight, abortion, infertility, deterioration of meat quality of slaughtered animals and the cost of treatment of affected animals. Although the economic losses due to haemoprotozoan diseases depends on the number of animals affected in a particular area, mortality, morbidity, cost of treatments etc. which may vary from country to country, but to have some idea about economic losses due to haemoprotozoan diseases, some examples can be cited. In a recent study it has been observed that the total annual loss due to tick borne diseases (TBD) was estimated as 364 million USD, including an estimated mortality of 1.3 million cattle. Amongst these, theileriosis accounted for 68% of the total loss. Cost associated with mortality was estimated as 49%, cost associated with chemotherapy was 21% and cost associated with application of acaricide accounted for 14% of the total estimated annual losses due to TBD. Beside these losses 1%, 6% and 9% of the total annual loss were estimated due to infection and treatment method, loss of milk production and loss of body weight respectively (Kivaria, 2006). A recent field study to estimate the costs of tropical theileriosis revealed the total costs due to disease and infection were Euro 9388.20. The asymptomatic infection accounted a high proportion (50.8%) of these costs, which is important to note down. Sub-clinical infections with anaemia showed the highest losses in live weight, where as disease cases (prevalence 42.86%) were responsible for 23.64% of the losses with mortality as the most important element (Gharbi et al., 2006). Losses from morbidty and mortality due to anaplasmosis were assessed in beef and dairy cattle as $0.5 million (Morley and Hugh-Jones, 1989). The estimated total cost of T. evansi is about US $ 2.4 million and 6462 horses per year (Siedl et al., 1998).

Thus it has been observed that haemoprotozoan diseases of livestock causes considerable economic losses which should be controlled to improve the animal wealth. For control of haemoprotozoan diseases, it is very much important to know the transmission of such diseases. The tick borne haemoprotozoan diseases like bovine tropical theileriosis caused by Theileria annulata is transmitted by various spp. of ticks of the genus Hyalomma, Babesiosis caused by Babesia bovis and B. bigemina are transmitted mainly by the various spp. of the ticks of the genus Boophilus although ticks of the genus Hyalomma, Haemaphysalis etc. are also responsible for transmission of the infective agent, anaplasmosis caused by Anaplasma marginale and A. cetræ (some times) are transmitted by ticks of the genus Boophilus, Dermacentor, Rhipicephalus and Hyalomma and also mechanically transmitted by dipteran flies. There are also other mode of transmission of anaplasmosis like transplacental and through contaminated needle. The haemoprotozoan parasite Trypanosoma evansi which is responsible for causing ‘surra’ in animals is mainly mechanically transmitted by the dipteran flies like Tabanus, Stomoxys, Haematopota, Liperosia etc. although it can be
transmitted by other ways including oral transmission through eating of raw meat by carnivores, in addition to mechanical transmission by flies.

1. Control of tick borne haemoprotozoan diseases - The control of tick borne haemoprotozoan diseases consists of A) treatment of the affected animals with suitable chemotherapeutic agents. B) control by immunoprophylaxis and C) control of vectors to reduce the chances of spread of infections.

A) treatment of the affected animals with suitable chemotherapeutic agents.

a) Treatment of Theileriosis
   i) Buparvaquone @ 2.5 mg/kg b.wt. single i/m is an effectivr drug.
   ii) Berenil can be used
   iii) Oxytetracycline, chlortetracycline, tetracline can also be used

Chemoprophylaxis
   i) Rolytetracycline @ 4mg/kg b.wt, i/m for 3 days or
   ii) Chlortetracycline @ 16 mg/kg b.wt. orally for 8days have been found to immunize calves against theileriosis.

b) Treatment of Babesiosis
   Several medicines have been used for the treatment of babesiosis, but only diminazene acetate and imidocarb dipropionate are still in common use.
   i) Dimanazene is used @ 3-5 mg/kg b.wt. i/m.
   ii) Long acting tetracycline (20 mg/kg) may reduce the severity of babesiosis if treatment begins before or soon after infection

c) Treatment of Anaplasmosis
   i) Oxytetracycline / Tetracycline @ 10-15 mg/kg b.wt., i/m
   ii) Berenil @ 20mg/kg single i/m injection

B) Control by immunoprophylaxis

i) Immunoprophylaxis against Theileriosis
   a) Blood Vaccine - The basis of this vaccine is the inoculation of limited doses of blood from bovines infected with a strain of low virulence to the healthy animals. The complexity of preparation of inoculum, high mortality and risk of transmission of other diseases with the immunizing inoculum are the disadvantages for the routine use of this vaccine.
      i) Dimanazene is used @ 3-5 mg/kg b.wt. i/m.
      ii) Long acting tetracycline (20 mg/kg) may reduce the severity of babesiosis if treatment begins before or soon after infection

   c) Infection and treatment method of vaccination - The technique of infecting animals with measured doses of sporozoites and treating them simultaneously is called 'Infection and treatment' method of vaccination. The method consists of preparation of large amounts of an inoculum obtained by maceration of infected ticks, standardization its infectivity by assays in susceptible calves and storing of aliquots of the inoculum in liquid nitrogen. The animals to be vaccinated needs inoculation of a potentially lethal dose of this inoculum and a simultaneous dose of oxytetracycline (5mg/kg/day) for four or more days or of a long-acting oxytetracycline (20 mg/kg once or twice), buparvaquone (2.5 mg/kg i/m once) are used to limit the proliferation of the parasite and permit the development of immunity. But tetracyclines are not effective once the symptoms appear unlike other anti-theilerial drugs like parvaquone and halofuginone. 'Infection and treatment' method of vaccination using buparvaquone for treatment may be safely used for immunization of calves against T. annulata infection in endemic areas as there is no risk even if a calf remain in incubation stage of infection that can be immunized (Dhar and Rana, 1993).

   d) Cell culture vaccine - The main problem of vaccination by sporozoite / 'Infection and treatment' method of vaccination are the production of limited infections, to obtain the appropriate inoculum and to adjust the dose so that it cause strong resistance but will not produce severe disease. Both the problems could be solved by growing theileria in lymphocyte culture and to use attenuated infected cultured lymphocytes as vaccine. In India, attempt was made to develop cell culture vaccine by Gill et al.(1976).Biotechnology Laboratory of NDDB, Anand; HAU, Hissar and IVRI Izatnagar have developed culture attenuated vaccine against Theileria. NDDB vaccine comprises of tissue culture attenuated schizonts of T. annulata (ODE strain) in bovine lymphocytes grown in vitro and after 150 passages it is used as vaccine. The dose is 5X10^6 schizont infected cells per animal. In the trade name of 'Rakshavac-T' this vaccine is marketed since 1989, by the Indian Immunologicals. As per report (Singh, 2002), successfully immunization of more than two million cross bred as well as imported cattle have been done with this vaccine. The vaccine
should be stored in liquid nitrogen and to be reconstituted in buffer saline during vaccination and to be injected s/c @ 3 ml per animal, which give a maximum protection period of 36 months. It is safe to use in cows in the advanced stage of pregnancy and also effective in calves above two months of age (Singh, 1990).

The cell culture vaccine of *T. annulata* (Hisar) developed in the Department of Veterinary Medicine, CCS, HAU, Hisar, Haryana and when used @ 5X106 cells per animals, did not produce schizont in the vaccinated animals and only very rare piroplasms were detected in a few vaccinated animals (Gupta et al., 1998). In the experiment of IVRI, in cell culture vaccination, complete attenuation of virulence without loss of immunogenicity in macroschizonts obtained after 40 successive passages and this schizont vaccine gave complete protection against homologus, tick induced virulent infection in calves (Subramanian et al., 1986). Using this vaccine, animals challenged with the homologus strain developed no clinical symptoms and fully protected whereas animals challenged with heterologus strain developed severe clinical theileriosis and died 18-20 days post infection (Bansal and Ray, 1994). Duration of immunity of calves vaccinated with cell culture vaccine was observed upto 6 months although the immunity was found declined between 3 and 6 months (Beniwal et al., 2000).

With the use of biotechnology, production of many proteins in a pure form and in a large quantities can be obtained using recombinant DNA technology. A start in identification of immunogenic epitopes has already been made and the aim is to provide a one shot affordable subunit vaccine that is as effective as the existing live attenuated vaccine. Attempts to develop a subunit vaccine have focused upon a sporozoite antigen (SPAG-1) and a merozoite antigen (Tams 1-1, Tams 1-2). Both SPAG-1 and Tams have given partial protection using different delivery systems and adjuvants (Boulter and Hall, 1999). Sporozoite antigens SPAG-1 from *T. annulata* provide some protection and also provide some cross-species protection (Hall et al., 2000). It is possible that the use of sporozoites and merozoites based subunit vaccines could give rise to protective responses against both sporozoites and schizont stages of the parasite.

ii) Immunoprophylaxis against Babesiosis

a) Live attenuated vaccine- *Babesia bovis* and *B. bigemina* are the major species of Babesia affecting cattle. After a single infection with *B. bovis* or *B. bigemina*, animals developed a long-lasting immunity. This characteristic feature of *Babesia* spp.infection has been exploited to immunize cattle against babesiosis in some countries (De Vos and Jorgensen, 1992). The parasitized blood is inoculated into cattle which caused mild infection in the inoculated animals, but after recovery animal become resistant to homologus challenge. The blood is to be cryopreserved in straws and thawed before use and is to be injected by s/c, i/m or i/v route. It is essential to inject at least 1X10^6 parasites. The disadvantage of this vaccine is that this vaccine is associated with failure if the parasites are not viable. There might be severe reactions and may cause death in highly susceptible animals. However, such reactions could be controlled by suitable therapy. Some times donor animals may be carriers of other parasites such as anaplasmosis or other bacterial and viral diseases which the vaccine might spread. Now-a-days gamma irradiation on bovine serum and RBC allows proliferation and growth of in vitro cultured *Babesia* spp and has potential application to inactivate contaminating viruses and bacteria from the substrate (Rojas et al., 2006). Cattle vaccinated with a combined *B. bovis* and *B. bigemina* frozen immunogen has been reported to protect cattle during field challenge (Alvarez et al., 2004).

b) Molecular vaccine – It has been observed that immunization with crude extracts or selected fractions of *B. bovis* induced as much resistance as natural infections. Three antigens namely GST 12D3, GST-11C5 and GST -21B4 produced a resistance that reduced the parasitaemia of a challenge by more than 95% (Barriga, 1994). An Ag from merozoites of *B. bigemina* (p58) was identified and purified with a MAb that inhibited the penetration of parasites to the host cells (Mishra et al., 1991). Immunization of calves with this Ag and two other recombinant proteins of *B. bigemina* merozoites (go45 & gp 55) made a significant reduction of the challenge dose of parasitaemia (McElwain et al., 1991). Two Ags of *B. bovis* 12D3 and 11 C5 have been expressed and purified as recombinant proteins in Escherichia coli and used as vaccine in alone or combined which reduced parasitaemia by approximately fourfold and a number of animals appeared to control the parasite infection (Hope et al., 2005). It has been observed that Bacille Calmette-Guerin (BCG) has the capacity to deliver
infestations and transmission of babesiosis which resulted in savings of 23.4 dollars per animal per year (De La Fuente et al., 1999; 2000). Immunization with salivary gland antigens of ticks has been found to affect pathogen transmission and a good method for control of TBD of cattle as it has been reported a reduction in the incidence of clinical babesiosis among cattle immunized with salivary gland preparations compared to non-immunized control (Jittapalapong et al., 2004b). In case of 'surra', after treatment with quinapyramine prosalt, improvement in clinical signs and milk production has been recorded (Joshi and Singh, 2000). Thus, it has been recorded that proper control measure of haemoprotozoan diseases is an way to improve the production of livestock industry.

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Introduction

Throughout the world, internal parasites pose one of the major health limitations for grazing animals. Although there are numerous internal parasites, only a few of them account for the majority of problems for grazing livestock. Although there are numerous internal parasites of grazing livestock, nematodes (roundworms) are the principal internal parasites that plague grazing ruminants.

Common internal nematodes of ruminants:

Classification of nematode based on their site of predilection

**Abomasum**
- *Haemonchus* spp
  - *H. contortus* (sheep, goat, young calves)
  - *H. placei* (cattle)
- *Ostertagia* spp
- *O. ostertagi* (cattle)
- *O. circumcincta* (sheep, goat)
- *Trichostrongylus axei* (small intestine)
- *Trichostrongylus* spp
- *Cooperia* spp
- *Nematodirus* spp
- *Dictyocaulus* spp
- *D. viviparus* (cattle)
- *D. filarum* (sheep, goat)

**Control Strategies**

Strategies to prevent or delay the development of anthelmintic resistance fall into three groups: management strategies, grazing strategies and anthelmintic strategies.

**Management Strategies**

Controlling hypobiotic larvae

Nematodes overwinter either on pasture or in the host. Those that overwinter in the host stop their development (hypobiosis) when they are picked up from pasture in the fall. The most pathogenic nematodes of small ruminants, particularly *Haemonchus contortus*, overwinter principally in the host. Thus one of the most important times to worm animals is during the overwintering period. Most modern anthelmintics are effective against arrested (hypobiotic) larvae, but care should be taken to insure that the product of choice is both efficacious and that resistance has not developed to it. While the term overwintering implies freezing, nematodes in hot, dry climates also show hypobiosis to survive periods of heat stress. Similarly, control of arrested larvae in these climates would simply involve a different calendar.

An alternative or additional way to control hypobiotic larvae is to graze youngstock separately from their mothers. Since nematodes are not picked up in the barn, nursing animals will not be infected when they begin grazing.

Immunity to parasitic infections

There are some breeds of animals that are known for their ability to tolerate parasites. Alternatively, researchers (mostly in Australia and New Zealand) have been working to
select herds, within existing highly productive breeds, for comparable tolerance to parasites. Unfortunately, the progress has been slow and there is no commercially available seedstock selected for parasite tolerance. In spite of these limitations, systems are being developed to help producers take advantage of host immunity. One noted system would be a selective worming and culling system. Another side of immunity is that as animals mature, under conditions of some exposed to parasites, they develop some immunity to parasitic infections.

Grazing Strategies and Pasture Systems

New pasture systems
Animals pickup infective larvae by grazing pastures, so winter and spring born animals will not have nematodes at the beginning of the grazing season. Remember that their mothers are a potential source of larvae, which will develop to adulthood and contaminate the pasture. Studies have showed that if mature animals are effectively treated for hypobiotic larvae prior to being placed on clean (or safe) pastures that parasite loads will only develop slowly. In many cases strategic hypobiotic treatment, followed by a grazing season on clean or safe pasture, maybe the only treatment needed until the next winter hypobiotic treatment.

Pasture ‘rotation’ systems
In this system, animals would graze a pasture for a period of time (grazing period) then the pasture would rest for regrowth (rest period). The length of the grazing period depends on initial pasture condition, forage quantity and stocking density. The length of the rest period depends on the time needed to regrow specific forages, the weather and management. One major advantage of pasture rotation systems related to parasite control is that animals and pastures can be more readily managed, given producers the capability to have some control. One other comment on safe pastures would be related to browse utilization. Often it is noted that goats browsing in woodlands, or managing brush land don’t seem to have problems with parasites. Since infective larvae are generally associated with the moisture on the lower parts of the forage, animals consuming browse or woody plants would not pick up as many parasites. In some systems this may be viewed as a type of safe pasture.

Worm and move and clean/safe pasture
Grazing strategies, including rotation, can be combined with other management strategies to reduce the use of anthelmintics. One of these strategies is to combine rotation and haying, so that as animals are rotated, they move to regrowth following a hay crop. In such a system, any one field would have a sequence like:

1) Grazing period
2) Rest period
3) Hay harvest
4) Rest period

Alternate animal species
A small number of producers raise two or more different animals in enough quantity that they can alternate from year to year which animals graze which pastures. If horses or cattle graze a pasture one year, then the following year that pasture would be considered safe for small ruminants.

Organic Agriculture Systems
The biggest limitation in raising organic lamb or goat meat is the need to control internal parasites. In organic agriculture, crop rotation mandates that land not be used for the same crop year after year. Often the animal used in rotation is hogs, but small ruminants would also work in such a system. In an organic system the pastures will be fairly clean because they haven’t been grazed for several years. One option might be for organic producers to combine organic crops with natural lamb or goat meat production using very limited worming. Even if a farm isn’t organic the use of animals and crops in rotation systems increases the options for controlling internal parasites.
Anthelmintic Management Strategies

Reduction of use of anthelmintics

Studies in Australia have clearly shown that the more frequently an anthelmintic is used the faster resistance develops. If possible, anthelmintic use should be restricted to 2 or 3 times per year by combining anthelmintic use with the epidemiology of nematode infection. The emphasis on worming is shifting towards less frequent worming and treating only those animals that need to be wormed. There are a number of ways that producers could decide which animals are less parasite tolerant (need treatment). These would include fecal analysis of individuals, clinical evaluation of anemia (FAMACHA eyelid system) or general animal condition (large operations). Another is that tolerance is a genetic trait, so that animals identified as less tolerant should be culled. This will slowly improve the average herd tolerance to parasites.

Use the full dose of an anthelmintic

Use of a sub-therapeutic dose of anthelmintic may permit survival of some worms showing partial resistance to that drug. When these partially resistant worms interbreed they may produce offspring that are more resistant to the anthelmintic. All animals should be weighed prior to treatment and recommended dose (or higher) should be used.

Use of alternate type of anthelmintic:

It is generally accepted that anthelmintics should be alternated on an annual basis. Alternating anthelmintics at every worming is not recommended. This more frequent change may enhance the chances of developing resistance to both types of anthelmintics.

Anthelmintic Efficacy and Availability

Modern broad-spectrum anthelmintics are active in three classes of compounds. These are: the benzimidazoles, levamisole and related compounds the macrocyclic lactones of compounds is the macrocyclic lactones, of which ivermectin is the Macrocyclic lactones have dominated the anthelmintic market, since ivermectin was released. Resistance in this group is more complex. Currently, ivermectin is the most commonly used anthelmintic in small ruminants. So far resistance has not been reported to the newer macrocyclic lactones, moxidectin and doramectin.

For further reading:


The unnecessary catching, handling and shifting will not only hamper growth but increase injury and mortality. The requirements of space at floor (Cm²) feeder (cm) and waterer (cm) are 125, 2.5 and 1.5 in cages whereas 200, 3.00 and 2.0 in deep litter respectively up to 5 weeks of age for commercial purposes. The space for layer quails (6 week onwards) for floor (Cm²) feeder (cm) and waterer (cm) are 175, 3.0 and 2.0 in cage system while 250,35 and 2.5 in deep litter respectively. The breeder quails are housed either in colony cages (180cm x 60 cm x 25 cm) for mass mating or in individual cages (20 cm x 25 cm x 22 cm) for pair mating. In large farms, automation can be employed for time and labour saving as well as sanitation and convenience of management. Special attention is to be given regarding brooding temperature, lighting schedule, injury, overcrowding, power failure, nutritional and disease aspects during the first 2 weeks otherwise mortality and retarded growth may occur. The small chicks are very susceptible to environmental stress due to immature development of nervous and endocrine systems. After 2 weeks, they become harder and get well adapted to the environment.

Health cover

As per our experience, mortality may occur during the critical period of first 2-weeks due to chilling, overcrowding, heat stroke, cannibalism, power failure etc. which can easily be controlled through proper management and sanitation. The common diseases encountered include pullorum disease, ulcerative enteritis (quail disease), omphalitis, quail bronchitis, aspergillosis, avian cholera, avian pox etc.

Training and extension

As people are mostly unaware about quail, it's essential to popularize quail farming through mass campaign using various media and involving private and public sectors, financing agencies, non-government agencies and local panchayats. Emphasis should be given on training, particularly on practical aspects, to develop experience and confidence among the trainees to start and run their farms smoothly. It is suggested to contact Central Avian Research Institute, Izatnagar, Bareilly where training for quail production is organized.

Conclusion

The common disease preventive measures including sanitation are to be followed strictly to keep away from diseases and increase income and employment through quail farming.
Cleanliness is a way of life and is influenced by the level of social development and culture of a nation. In spite of producing the largest quantity of milk in the world (91 million tones during 2004-05), India lags behind most of the western countries in production of clean milk. In India, 70 million rural families are engaged in producing 15% of the world’s total milk from 277 and 77 million cattle and buffaloes respectively representing 20% of the world’s bovine population. Productivity per animal is, however, quite low and turns out to be only 987 kg against the world average of 2038 kg of milk per lactation. More than 40% of the total milk produced in India is utilized to cater to fluid milk consumption as against less than 10% in developed countries. There is a tremendous scope of enhancing the milk production in the country with the required Research & Development intervention and adoption of improved Animal Husbandry practices. The country is expected to produce 221 million tones of milk by the year 2020. Milk and milk products currently account for about two-thirds of the total value of livestock products in India. Dairying in India is now a multibillion rupees business involving a large number of farmers, processors, marketers and consumers. It is, therefore, needless to say that the country must devise ways and means to export milk products to earn foreign exchange taking the advantage of globalization process. But it would be a Herculean task to do so unless we improve the quality of raw milk in relation to presence of pathogens, violative drug residues, pesticides and insecticides residues, heavy metals etc. as most of the countries stipulate maximum permissible limits (MPL) for all these contaminants in the dairy products before allowing imports. Further it should be kept in mind that the maximum residue limits and safe tolerance levels for many residues of pesticides, insecticides, heavy metals, antimicrobials, chemotherapeutics etc. in milk as specified by Codex and/or EU and FDA are often more stringent than those stipulated by PFA authority in India. This makes the task of clean milk production more challenging in our country.

Risk of Chemical Hazards
Milk and milk products may contain the following residues which pose risks of health hazards to mankind:
- Pesticide and insecticide residues
- Heavy metals, other trace elements and radio nuclides
- Veterinary drugs and pharmacologically active compounds
- Nitrite, nitrate and nitrosamines
- Polychlorinated Biphenyls, polychlorinated dibenzodioxins and furans
- Mycotoxins
- Adulterants and preservatives
- Detergents and disinfectants
- Harmful products-generated during processing and storage of milk and milk products

What is clean milk?
Clean milk refers to “milk drawn from the udder of healthy milch animals, which is collected in clean, dry milking pails and free from extraneous matters like dust, dirt, flies, hay, manure etc. Clean milk has a normal composition, possesses a natural milk flavour with low bacterial count and is safe for human consumption”. Time has, however, come to modify this classical definition of clean milk in view of the Agreement on Sanitary and Phytosanitary measures (SPS) enforced by WTO which covers application of food safety, animal and plant life and health. According to SPS, milk must not contain residues of drugs particularly antibiotics, pesticides and insecticides, heavy metals etc. exceeding the MPL specified for these contaminants. Clean milk thus should ensure better stability, longer shelf life, higher...
commercial value, transportation over a longer distance and production of high quality products apart from containing lesser pathogenic microorganisms thereby proving to be safe for human consumption. Only healthy animals can produce good quality milk which primarily depends on the sanitary conditions maintained in animal shed.

Organic Milk

In recent times, a term ‘organic milk’ has been coined which is slightly different from clean milk in the sense that the former is totally free from antibiotics, growth hormones, heavy metals, radio nuclides, pesticides and insecticides etc. while the latter may contain these harmful residues at levels below the prescribed MPL. There are many other stipulations for organic dairy farming to produce organic milk such as controlling environmental pollution, conserving energy, maintenance of livestock health and nutritive value of foods etc. Cross-breeding and artificial insemination are not allowed while use of allopathic medicines is restricted in organic dairy farming. According to the Codex Alimentarius Commission Guidelines (CAC/GL 32-1999), the organic agriculture is defined as “a holistic production management system which promotes and enhances agroecosystem health including biodiversity, biological cycles and soil biological activity”. Organic milk contains higher Omega-3 essential fatty acids, conjugated linoleic acid, vitamin E, β-carotene, antioxidant lutein and zeaxanthine, calcium etc. than the ordinary milk available in the market.

Action Plan for Clean Milk Production

A well defined action plan needs to be formulated and implemented for CMP. The following points may be given due importance while planning such action plan:

1. Government of India must make it mandatory for the various State Level Dairy Cooperative Federations and the private dairy entrepreneurs to implement CMP policy in the area of their operation.
2. Region specific standards for clean milk need to be formulated.
3. Incentives to the producers for good quality milk should be given.
4. Modern food safety management systems are to be adopted for CMP.
   - Concepts of Quality Management Systems, ISO 9000 standards, various Food Safety Standards including Hazard Analysis and Critical Control Points (HACCP), Food Safety Management System (ISO 22000), Environmental Management System (ISO 14000), Total Quality Management and above all Good Manufacturing Practices should be made use of as far as possible. These systems/standards provide basis for exercising control right from the origin of raw materials through various stages of processing, storage, transportation till consumption of the products by the consumers.
5. Professionals are to be engaged to advise milk producers in CMP as well as to keep a vigil in the entire process of implementation.
6. Special emphasis needs to be given to the training of female members of the producers’ families as they are primarily involved in the management of milch animals while their counterparts remain busy in agricultural fields.

Preservation of Clean Milk

About 98% of the total milk is produced in the rural sector in India. But lack of proper preservation techniques leads to spoilage of a huge quantity of milk daily. The normal practices followed by the rural households for preservation are repeated boiling or simmering of milk to enhance its shelf life upto 6-8 hours or conversion of surplus milk into indigenous products such as dahi, khoa, makkhan, ghee etc. Farmers also resort to distress selling of surplus milk to middlemen/vendors at unfavourable prices and conditions to reduce monetary loss. More than 80% of surplus milk from rural area is being sold to urban population through the middlemen/vendors who resort to different kinds of malpractices such as addition of water, adulterants, neutralizers and preservatives to milk, separation of milk fat etc. Absence of electricity coupled with bad road conditions and transport systems in the rural
areas result in daily loss of a large quantity of milk due to souring. The following methods for preservation of raw clean milk have the potentiality to change the scenario in favour of the rural producers:

Chilling of Milk

Shelf life of milk extends considerably if it is chilled to below 4°C after production using direct or indirect mechanical refrigeration system. Milk collected from a cluster of villages may be chilled by immersion coolers (50-200 litres), bulk milk cooler (500-2000 litres) or plate heat exchangers (PHE) using chilled water (5000 – 20000 litres/hour). Use of PHE reduces cost per unit milk chilled and facilitates its despatch to the main dairy plant within reasonable time in good condition.

LP System

Chilling of milk using mechanical refrigeration system is not always practicable at village level due to various limitations like lack of electricity, difficulties in collection and transportation of milk, high operational cost, frequent breakdown of equipments, frequent load shedding etc. A more viable alternative particularly suitable for hot-humid developing countries is to preserve raw milk by Lactoperoxidase-thiocyanate-hydrogen peroxide (LP) system wherein a small quantity of SCN⁻ and H₂O₂ are added to raw milk to enhance its shelf life at ambient temperature. In this system, the native lactoperoxidase enzyme catalyzes the oxidation of SCN⁻ by H₂O₂, thereby producing short-lived antimicrobial intermediaries oxycis (OSCNS, O₂SCN⁻ etc.) which either kill or inhibit bacteria and prolong the shelf life of raw milk at ambient temperature. Enzyme lactoperoxidase is present in adequate quantity in cow or buffalo milk, but it is necessary to add calculated quantities of SCN⁻ and H₂O₂ to milk from external sources to activate LP system. Work carried out by NDDB indicated that an extension of 3 h in the shelf life of milk was achieved with 15:10 ppm dose of SCN⁻ and H₂O₂ at 37°C. The shelf life of milk was about 10 h at 37°C with the dose of 75:50 ppm, which could be enhanced to 18 hours by using a booster dose of H₂O₂ (35 ppm) on the 10th h after milking permitting overnight storage.

Addition of H₂O₂ and SCN⁻ from outside even in minute concentration to milk, however, interferes with existing food legislation in India. Excess of SCN⁻ in blood serum disturbs thyroid function and affects iodine nutritional status in human subjects. But in LP system, the concentration of SCN⁻ is too low to cause any thyroidostatic effect. Small amount of H₂O₂ added is utilized very quickly in the oxidation process and does not persist in milk. Clinical evidences also indicate that no potential risk is involved even if LP treated milk is consumed shortly after activation or if the residual levels of oxidation products of SCN⁻ are ingested via milk. However, Government of India is in favour of carrying out more researches of exhaustive nature for long duration on the safety aspects of LP system before approving it for field use.

Microfiltration

It is a membrane process used mainly for clarification of milk to remove macromolecules, suspended solids, milk fat globules, bacteria, spores, colloidal particles etc. The membranes have pore sizes of 0.1 to 10 microns and are operated with 1 to 25 psig pressure. Microfiltration removes bacteria and spores from fluid milk thereby extending its shelf life. The process has been effectively employed to reduce the bacterial load of raw milk by 99.5% and spore count by 98%. A nearly sterilized milk can be obtained if microfiltration is followed by pasteurization of milk as this would reduce the bacterial counts by 99.99% and spore count by 99%. Buffalo skim milk so processed kept well for more than 2 months during storage at refrigeration temperature.

High Hydrostatic Pressure Treatment

Application of high hydrostatic pressure (HHP) either in single or in combination with higher temperature can improve the shelf life of fluid milk due to partial or complete inactivation of microorganisms and/or enzymes. HHP causes a number of changes in microorganisms to their detriment. Fluidity of membrane and proteins play important roles in pressure inactivation of microorganisms. Though vegetative cells are destroyed, spores can survive pressure treatment. Denaturation of membrane bound ATPase or its dislocation in the
membrane due to HHP results in nonfunctioning of the enzyme. This method has met with limited commercial success mainly due to the high cost of the equipment.

Pulsed Electric Field

Use of pulsed electric field (PEF) is a non-thermal method of destroying microorganisms in milk. Exposure of cell membrane to an electric field of about 1-10 kV/cm for 20 ns to 10 μs causes membrane breakdown, degree of which depends upon the strength, duration and form of the electric pulse. The PEF method does not change the physical and chemical properties, but enhances shelf life of milk at ambient temperature. PEF operates below 50°C and proves useful for processing heat sensitive products.

Thermosonication

Reports of using heat and ultrasound under pressure to destroy microorganisms and inactivate enzymes present in milk are available. Cavitation produced by ultrasound mechanically disrupts bacterial cells. Thermosonication extends the shelf life of milk without adversely affecting its sensory and nutritional properties. The technology is, however, not yet ready for commercial application.

Irradiation

Irradiation is the process of subjecting foods to specific doses of electromagnetic radiation (upto 5 mev) or electron beams (upto 10 mev) to increase the shelf life of the products. Dose is decided depending upon the kind of food being processed and the desired effect. It is a cost effective process to reduce or eliminate bacterial and fungal load/contamination and inactivate insects, thereby arresting or delaying spoilage process in certain foods and reducing the hazard of food borne diseases. FAO/WHO stipulates that the food subjected to ionizing radiation under controlled conditions is safe for human consumption. Irradiation of milk has been found to increase its shelf life. However, development of an off-flavour in milk restricts its use.

Ultra High Temperature Process

Ultra high temperature (UHT) process is an aseptic processing technology and refers to heating of milk to 135-150°C for 2-10 sec using indirect or direct heating systems and subsequently packaging under aseptic conditions to produce commercially sterile milk with considerable shelf life at ambient temperature. The ratio of bactericidal effect/chemical effect in milk is much higher in an UHT process as compared to that obtained in conventional sterilization or pasteurization process. UHT process is now being widely because of its inherent advantages over other processes. The high cost of the equipments and packaging materials, however, proves to be a limiting factor for widespread adoption of UHT process in India.

Marketing of Clean Milk

Only about 20% of the total milk produced in India is handled through the organized dairy industry. India produces milk at competitive prices because of unique integration of animal husbandry practices with traditional agriculture and cheap labour. The dairy producers in most of the western countries receive large subsidy, but their counterparts in India do not get any subsidy. This makes the dairy products from India more competitive in the international market in long run. India is also surrounded by a number of milk deficit countries in Asia and Africa which provides a great scope for export of dairy products to these countries.

The population of Indian middle class with greater purchasing capacity is increasing at a faster pace. A clean shift is also visible in life style and food habits among people due to various reasons. All these factors would lead to increased consumption of value added convenient dairy products made from clean milk.

There is a bias against buffalo milk in western countries which needs to be tackled through effective advertisements emphasizing the quality aspects of such milk. We also need to print details of compositional and nutritional facts on the packages of milk which is not currently done. In view of the exportable surplus milk, free investment climate, availability of effective and efficient means of communication etc., India should attempt to build strong brand images in the global market for its dairy products. Development of low cost equipments, processing
technologies for value added dairy products, packaging materials and technologies for packaging of these products is vital for faster growth of Indian dairying.

Conclusion
Indian dairying has proved to be an effective tool for bringing about rural transformation and household nutrition security. Dairy industry in India is now a multidimensional and multibillion rupees business involving millions of rural families, and operates in buyers' market largely due to globalization process. The industry must, therefore, adjust itself to the new situation, consolidate the opportunities, innovate and operate to cater to the need and demand of the customers and take appropriate measures to upgrade the socio-economic status of rural people. Finally, formulation of a clear cut policy and action plan by the concerned parties, coupled with consumers' insistence for good quality milk and milk products would provide the real boost to production, preservation and marketing of clean milk in India.

References
RECENT DEVELOPMENTS FOR IMPROVING FERTILITY OF DAIRY CATTLE AND BUFFALOES IN TROPICAL CLIMATE

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FERTILITY:

Fertility is a complex expression of outcome of both male and female reproduction. Its objective is to maximize the profitability of animal production through effective management.

Advanced reproductive technologies have been applied in securing rapid rate of genetic improvement of dairy animals during the last decade. Biotechnology has given human beings unprecedented control over farm animals’ reproduction and it can play an important role in meeting this challenge. Reproductive biotechnologies such as artificial insemination, embryo transfer, in-vitro fertilization, cryopreservation of embryos, sexing, cloning, transgenics and stem cell technology either singly or in combination, can increase reproduction rates and play prominent role in the genetic improvement of livestock and their conservation. Although during the last two to three decades, several techniques have been developed for the effective control of reproduction in dairy animals, yet artificial insemination with frozen semen has almost become a routine practical breeding program. Because of economic pressure and over increasing emphasis on efficiency through production of high quality animals, it is certain that the farmer would search for newer technologies in animal reproduction which will be cost effective, easily available with better success rates.

-SEmen TECHNOLOGY:-

(A) ARTIFICIAL INSEMINATION:

It is the single most important reproductive biotechnology which has revolutionized the breeding of animals to produce and transfer superior germplasm for higher productivity, so also to minimize the transmissible reproductive diseases. Cryopreservation of semen now enables a single bull to be used simultaneously in several countries for up to 100,000 inseminations a year and very small number of top bulls can be used to serve a large cattle population. But in certain situations, a fairly large number of bulls produce azospermatic semen and poor quality semen which are very poor freezable in nature. This is a serious problem. But recently Sephadex Filtration Technique is being applied which improve the quality of such ejaculates as well as improve the freezability and storage capability of semen. Very high incidences of occurrence of static ejaculates in areas of extreme hot and cold climate are posing considerable difficulty in successful freezing of buffalo semen. However, direct collection in butter, slight warming and dilution help in revival of 80% of ejaculates.

(B) Crenellation Pattern Technique:

This is a simple inexpensive, rapid and reliable test for the semen and the versatility of the test lies in the fact that the slides could be prepared even by unskilled workers under field conditions and examined at a later date in the laboratory.

(C) CRYOPRESERVATION OF EPIDIDYMAL SEMEN:

The epididymal semen of buffalo was found to be an excellent source of germplasm for storage and cryopreservation. Even one time sperm collection from epididymis of
slaughtered bull could produce 400-500 doses of frozen semen. Sometimes surgical cannulation may be clinically necessary for males with poor libido. This has wider implications even for cryogenic preservation of animal biodiversity including wild life and endangered species.

(D) MARKER-ASSISTED SELECTION:

It is the process using the results of DNA-marker tests to assist in the selection of individuals to become the parents in the next generation of genetic improvement program. DNA tests are performed to assist the identification of those genes that are associated with a positive impact on the trait of interest and can result in an improvement in the observed phenotype for that trait.

(E) IN-VITRO SPERMATOGENESIS:

Testis derived cells transplanted into the testis of infertile males could populate the host testis, generate sperm and produce offspring. This is the recent technology to overcome the male infertility due to congenital or acquired defects.

---FEMALE FERTILITY---

(A) CONTROL OF ESTROUS CYCLE:

For achieving better reproductive performance, ovarian cycles of female animals must be controlled and ovulation is induced when needed. Estrogens, progesterone, prostaglandins and GnRH are judiciously used for estrous cycle synchronization and superovulation.

(B) SUPEROVULATION:

Ovulation rate can be increased moderately to improve natural prolificacy or it can also be stimulated significantly i.e. super ovulation to increase the number of high quality oocytes for embryo transfer program. Various treatments of FSH preparations containing a controlled level of LH, GnRH analogous or bovine follicular fluid have been tested for this purpose.

---EMBRYO TRANSFER TECHNOLOGY---

(A) IN-VITRO FERTILIZATION AND EMBRYO PRODUCTION:

Superovulation of elite donor animals, their breeding with top sires and subsequent embryo collection and their transfer to surrogate mothers has been used commercially to produce breeding stocks, especially bulls in many developed countries. The technique has been appropriately modified and adopted to suit our indigenous livestock to produce embryos.

(B) EMBRYO TRANSFER AND CONCEPTION:

Main benefit of improving reproductive rate of elite cows through ET is that, genetically outstanding cows can contribute more to the breeding program. MOET is a closed breeding system in which ET is used to increase average rates of genetic gain. It increases about 10% of the expected rate of genetic gain and these breeding schemes have more relevance to developing countries where due to lack of milk recording, conventional progeny testing is not possible.

In cattle pregnancy rate following transfer of fresh and frozen embryo is reported to be 68.3 to 77.1% and 56.1% respectively. In India pregnancy following ET was reported to be highly variable (20-50%). However, occasionally higher conception rates (72.72%) had
also been reported. In buffalo it is also like cattle varies from 20-50%. But a higher conception rate of 60% was also observed following transfer of only Grade-I embryos.

(C) EMBRYO CRYOPRESERVATION:

Cryopreservation of embryo is an important component in the commercial ET program as not only the surplus embryos can be frozen, but it also facilitates global movement of the complete animal as embryo. This technique can also be used for the conservation of endangered species and breeds. As unlike semen, complete genotype can be conserved as embryos. Freezing of embryos is an established commercial practice especially in cattle. It is important that the post thaw survival of such embryos is significantly higher when embryos are frozen at an early blastocyst stage than morula. Overall pregnancy rates from frozen cattle and buffalo embryos were 31% and 20% respectively which needs to be improved.

-:GENETIC ENGINEERING:-

The promising research areas, frequently referred to as genetic engineering procedures, include embryo sexing, embryo splitting, cloning by nuclear transfer, somatic cloning, transgenesis and gene transfer etc.

(A) EMBRYO SEXING:

Sex determination is possible by removing a few cells by micromanipulator and incubating for 4-6 hrs. The cells are then stained and examined under microscope for metaphase spread of chromosomes. There are many methods for the sexing of embryos i.e. sex chromatin or ‘Y’ body identification, ‘Y’ chromosome specific DNA probe, X chromosome linked enzymes, H-Y antigen, hormonal assay and sexing of embryo using a biopsied blastomere and subsequent amplification of DNA using polymerase chain reaction (PCR) and its characterization using a Y-chromosome specific probe. PCR technique has been standardized and is used commercially in cattle.

(B) EMBRYO SPLITTING:

Embryos can be successfully split into as many as parts through microsurgery. Each split fragment is placed in an empty zona pellucida and transferred to a recipient female. Thus 4 offsprings can be obtained from a single embryo through splitting. It is usually done during the morula stage. Blastomeres of 4 cell embryos are also separated and cultured to develop into 4 identical embryos. In cow 2 offsprings and in sheep 4 lambs are produced due to embryo splitting.

(C) CLONING:

A clone is genetically identical animal, which can be produced either by embryo splitting or transfer of embryonic blastomeres or somatic cells as donor nuclei. Initial attempts to commercialize this biotechnology did not succeed because of the poor efficiency of the cloning and the abnormality of the cloned calves. However the production of “Dolly” in 1997, the first mammal cloned from an adult cell, sparked a renewed wave of interest in Somatic Cell Nuclear Transfer (SCNT). In India cloned buffalo embryos have been produced using embryonic and fetal cells. Present success rates in SCNT in terms of pregnancy establishment varies from 25-52%, upto 3-19% pregnancies reach up to the term and 2-16% of SCNT embryos develop to healthy calves at weaning. A very serious limitation to successful cloning is the loss of majority of pregnancies/neonates due to developmental abnormalities that are commonly called “Large-calf-syndrome”, which was also observed in offspring derived from in-vitro produced embryos.
(D) TRANSGENESIS:

Transgenesis offers considerable opportunity for advances in medicine and agriculture. In livestock, the ability to insert new genes for such economically important characteristics as fecundity, resistance to tolerance of other environmental stresses would represent a major break through in the breeding of commercially superior stock. Gene transfer in animals has been used for modifying the fat or protein synthesis in the mammary glands. The principal methods used for the creation of transgenic animals are pronuclear microinjection, somatic cell cloning and embryonic stem cell mediated gene transfer. As a broad generalization, it can be said that in farm animal species about one in ten injected and transferred embryos survives and about one in ten of these carries the transgenic or transferred genetic construct.

(E) STEM CELL TECHNOLOGY:

The embryos from which embryonic stem cells are derived from the inner cell mass of the blastocyst. Under certain conditions of culture, these cells remain undifferentiated however, if these cells are allowed to clump together to form embryonic bodies, they begin to differentiate spontaneously. The stem cell lines can be generated in cattle from genetically superior female to allow an unlimited number of oocytes to be derived.

(F) OTHER ASSISTED REPRODUCTIVE TECHNIQUES:

Gamete-intra-fallopian tube transfer (GIFT) as assisted reproductive technology has been used to produce pregnancies in mares and cattle. Also intra-cytoplasmic sperm injection (ICSI) has been successfully used in cattle and other animals for augmenting fertility and better productivity.
The primary purpose of pig farming all over the world is the production of meat, including pork, bacon or fat. Secondary considerations are the production of pigskin, bristles, and manure.

In the tropics fresh pork has always been and continues to be the most important type of pig meat, but elsewhere processed meat is produced in large quantities, probably pig flesh can be more effectively preserved with salt than other types of meat. Processed pork is now finding a ready acceptance among many consumers.

Another advantage of pig farming that is now becoming apparent in some tropical countries that on account of the pig's high fecundity and high growth rate, pig production can yield a relatively rapid rate of return on the capital employed. Pig production also fits very well with mixed farming and can also be complementary to intensive crop production. In India, pig farming has special significance and can play an important role in improving socioeconomic status of a sizable section of the weaker community. Pig rearing is very popular amongst tribal population. Government has extended a great help to the weaker sections of the society by arranging subsidy and loan for pig farming through various schemes.

**Pig Breeds of Tropical Climate**

There are two conflicting theories as to the origin of domestic pigs. One is that they were independently domesticated at centers in several different regions. The other is that they were domesticated at one center in western Asia and that domestic pigs are gradually diffused from this center. Pig breeds may be classified into three types: pork, bacon and lard producers. The major British breeds, viz., Berkshire, Large Black, Large White or Yorkshire, Tamworth and American breeds, viz., Duroc Jerseys, Hampshire, Poland China etc. are very widely used in the tropics as pure breed and also for upgrading and crossbreeding purpose.

Domesticated or indigenous pigs of India have come to stay as a distinct group as a result of gradual domestication of wild pigs to their new surroundings. These pigs differ in their characteristics and colour from region to region within the country depending on the topography and climatic condition. Recently few indigenous breeds have been identified. They are Ankamali of peninsular region, Gholi and/ or Dome breeds of northeastern States and Ghoongroo of Duars' valley of north West Bengal. The Pigmy Hog of Brahmaputra valley is now a highly threatened bred.

**Tropical Pig Production Systems**

Several pig production systems could be identified. The peasant or village producers keep pigs as domestic livestock. Pigs are free to roam where they will. They are useful as scavengers. Quite simple arrangements could be made to improve the productivity of these scavenging village pigs:

(a) The feeding of supplementary feeds, either once or twice a day.

(b) Where land is plentiful, the pigs can be managed in simply fenced paddocks adjacent to the household in which some root crops are grown.

A further improvement would be to construct simple pens in which pigs could be confined. Productivity would, of course, only be improved if there were sufficient food available from village resources to feed the confined pigs.
The large-scale producers' managerial methods will depend upon what labour and feed supplies are available and at what cost and on the incidence of diseases and parasites. Pigs under intensive system are raised on concrete floors or on some other forms of flooring. Litters may or may not be used according to circumstances. There are many variations of the semi-intensive system. Usually breeding pigs are raised outside on grass and fattening pigs are raised intensively in buildings. The most common system is to allow the gilts and the in-pig sows to graze with or without boars. Under extensive systems, all pigs can be put out on grazing or in semi-covered yards. Rotation is essential on grazing and labour costs are high. It is doubtful whether it is a very suitable production system for the tropics.

Selection of Breeding Pigs:

Gilts should be selected for breeding herd at 4 to 5 months of age and body weight as per standard of the breed. Where it is possible they should be selected on the basis of records to ensure that they do not possess any inherited defects and they come from families noted for large litters and early sexual maturity. They should be healthy, possess sound feet, be well grown have at least fourteen prominent teats and a good carcass conformation ad they should have exhibited a rapid rate of live weight gain and good feed conversion efficiency up to the time of selection.

As on average only one or two boars have to be selected for every fifty gilts even more care should be taken in the selection of boar. Individual record, pedigree, family information and, if available, progeny testing information should all be used in the selection. However, progeny testing is not a general practice in tropical countries.

Reproduction Management:

The sexually mature female sow has regular oestrous cycles throughout the year. The length of cycle is 21 days (range 18-23 days) and the period of sexual receptivity lasts about 50 hours (range 24-72 hours). The oestrous cycle holds the key to reproduction because it synchronizes mating and ovulation and ensures that the uterus is ready to receive the fertilized ova.

In most tropical countries where the pig is an important domestic animal, the majority of producers only manage a small number of sows. It is obviously costly and wasteful of resources for each producer to keep a boar, as one boar can serve fifty gilts or sows per year. Even if a number of producers use one boar cooperatively there is a very real danger of disease transmission by the boar from farm to farm. Under these circumstances artificial insemination programme has considerable relevance.

Feeding Management:

The importance of proper feeding is very great as the cost of its food represents a very high proportion of the total cost of production of a pig – sometimes as much as 80 percent. The pig is omnivorous, i.e. it can eat all types of food, but although it likes to graze or chew forage in its pen it cannot digest too much fibre and unlike domestic ruminants it cannot live entirely on roughages. There are innumerable feeding stuffs that may be suitable for pig feeding. Therefore, it should be the pig farmers' aim to use the cheaper, lower grade feeding stuffs to the fullest extent and to supplement them by the more expensive nutritious feeds to the point that true economy dictates.

Health Management:

One of the major problems confronting pig producers in the tropics, particularly in the humid regions, is the high mortality experienced. Even where diseases and internal and external parasites are of no major importance large number of piglets are lost at birth due to 'overlying' by the sows.

The most effective control measure against disease is preventive action. As stressed pigs are likely to succumb to disease and parasites, the most effective preventive action is to reduce nutritional, climatic and other environmental stresses to a minimum by god management. Some measures that can be taken are:
• The use of vaccination in those cases where vaccine are available and effective.
• The control of external and internal parasites by spraying and/or drenching when necessary.
• Adequate feeding at all stages and amelioration of climatic stress by provision of suitable housing and fine water sprays.
• The segregation of individual diseased animals and premises when outbreaks of diseases occur.
• The proper disposal of diseased pigs, by slaughter if necessary, and of infective materials by burning or other suitable means.
• The cleaning and disinfection of all premises and equipment after an outbreak of disease and non-use of premises for 3 or 4 weeks.
Livestock Genetic Resources Conservation in India

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Faculty of Veterinary & Animal Sciences
W.B.U.A.F.S, Kolkata – 37

Introduction:

Animal genetic resources exist in the form of a vast array of breeds and livestock populations which have evolved and adapted over many centuries, to the range of environmental conditions encountered throughout the world. The pressure of selection imposed by climate, soil type, altitude, available food supply, endemic diseases and parasites, management techniques and market demands have resulted in thousands of breeds, types and strains, each with their own genetic make-up, and each adapted to its own specific niche.

The future improvement and development of livestock for agriculture is dependent upon the availability of this genetic variation, which is its principal resource. The requirements for genetically controlled variation are constantly changing over time and are unpredictable. They are influenced by environmental and climatic changes, by changes in market demands, and by the effects of new breeding technologies and DNA manipulation techniques.

The animal genetic resources available throughout the world are in a dramatic state of decline. The development of artificial insemination and other techniques that facilitate easy transfer of breeding material from one geographical region to another, have resulted in widespread cross breeding and the replacement of local stocks through prolonged dilution. In many cases this has been carried out without initial characterization or evaluation of indigenous breeds and with no effort to conserve local strains. It has resulted in the disappearance of a substantial number of local populations, with the consequent loss of their inherent genetic adaptation to their local environments. This increasing loss of identifiable diversity in animal genetic resources has been recognized for many years. Particular concern has been growing with respect to the speed at which uncharacterized breeds are disappearing in some rapidly developing regions of the world where climatic, parasitic or disease pressures could have produced important genetically adapted breeds.

The process of domestication began some ten thousand years ago, and both the process and the domesticated stock produced by it have been carried by migrating humans to all but the most remote regions of the earth. In each region and local area, domestic populations adapted and evolved in response to a great range of selection pressures. In each case the primary factors contributing to the final population were complex and included founder affects, migration, mutation, natural selection and selection by man.

Background

Phenotypic characteristics (appearance) are often used to divide animals into species, and there is great diversity across species. However there may be limited genetic variation within any given species. Domestication of animals has led to the development of specific breeds, in the process increasing the within species variation.

- Animals are kept in environments ranging from temperate to tropical, resulting in selection for different characteristics in different locations.
- We have selected animals for specific uses, e.g. cattle for draft purposes, meat and milk; poultry for eggs and meat, sheep for meat, wool and milk.
- Animals are often kept in large groups, leading to indirect selection for disease resistance and behaviour.
Why Conservation?

If we have the best stock, why are we concerned about preserving genetic diversity?

We need to keep potentially useful genes and gene combinations.
For example:

- Non-intensive agricultural production systems may not want genes for prolificacy, such as the Booroola gene in sheep which increases the number of lambs per mating. Hyper-prolific lines of sheep and swine are of value in modern production systems.

- Porcine stress syndrome in swine can lead to undesirable quality in the pork, but the condition has been associated with faster growth. DNA tests now allow us to select directly against the HAL allele linked with this condition.

- DNA tests have now been developed and commercialized to allow selecting beef cattle directly for meat tenderness, using the calpastatin gene. Frequency of this gene varies among breeds.

To take advantage of heterosis (hybrid vigour)
Heterosis is the increase above the average of the parent stocks obtained by crossing genetically diverse breeds. Crossbreeding is practiced widely in swine, sheep, and beef production. If only a few breeds are kept the opportunity to develop good crosses is lost.

To overcome selection plateaus
A selection plateau occurs when genetic variation is lost; no further change is possible because animals are genetically alike. If genetic variation exists in other breeds, crosses can be made to overcome this.

To provide an insurance policy against
- climate change
- spread of disease, especially in monocultures
- changing availability of feedstuffs
- social change, such as issues of animal welfare and environmental sustainability
- selection errors: a widely used sire may spread a genetic disease throughout a population before the problem is identified

Goals of conservation

To keep genetic variation as gene combinations, in a form that is easily recovered
Live animals may be appropriate for some situations. Cryopreservation of sperm, ova or embryos is possible in many species and new tissue culture technologies show promise.

To keep specific genes
As gene sequences linked to specific traits are identified and defined we will be able to save those DNA portions of interest

Whom to conserve?
Opinions have varied over the past forty years as to which animal genetic resources are candidates for conservation. Estimates have been influenced by the relative cost/benefit of conserving all genetic variation as compared to those that can be demonstrated to have predictable economic, scientific or cultural value. All ‘breeds’ or populations which are ‘unique and endangered’ are eligible for inclusion in some form of conservation programme.
Unique Populations

Uniqueness is difficult to define with respect to livestock populations. There are clearly some populations with obviously unique characteristics or traits. For example, naked neck chickens. No other population has the same ancestry, environmental adaptation, human selection, and appearance or production characteristics. The difference between two populations may only be a function of the relative frequencies of the same genes. From the point of view of conservation any population which is historically or geographically isolated or which has had little genetic influence from other breeds over a long period of time, or which exhibits unusual characteristics or traits should be considered to be a unique population.

Endangered Populations – Species

There is no simple numerical level at which a population is defined as being endangered or eligible for consideration as a candidate for conservation. It is dependent upon a number of factors.

The actual numbers of animals
The rate of decline in the population size
The closeness of relationship between individuals within the population
The geographical range and the rate of reduction of that range

Rapid changes in the environmental conditions including climate, predators, and parasites

As a rough guide, a population of less than 10,000 animals may be considered in need of some form of intervention with respect to species conservation.

Endangered Breeds

In common domestic species for which varieties, strains, or breeds are in danger of extinction, the population levels at which action needs to be taken are as follows:

<table>
<thead>
<tr>
<th>Categories for Domestic Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extinct</td>
</tr>
<tr>
<td>No possibility of restoring the population, no pure bred males or females can be found.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No of breeding females</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
</tr>
</tbody>
</table>

| Critical              |
| Close to extinction, genetic variability reduced to below that of the ancestral population, action to increase the population size is essential if it is to survive. |

<table>
<thead>
<tr>
<th>No of breeding females</th>
</tr>
</thead>
<tbody>
<tr>
<td>100–1,000</td>
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</table>

| Endangered            |
| In danger of extinction because the effective population size (Ne) is too small to prevent genetic loss through inbreeding which will result in a reduction in the viability of the breed. Preservation must be enacted. |

<table>
<thead>
<tr>
<th>No of breeding females</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–10,000</td>
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</table>

| Insecure              |
| Population numbers decreasing rapidly. |

<table>
<thead>
<tr>
<th>No of breeding females</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–10,000</td>
</tr>
</tbody>
</table>
Vulnerable: Some disadvantageous affects endanger the existence of the population and some precautionary measures should be taken to prevent further decline.

Normal: Population not in danger of extinction, can reproduce without genetic loss, no visible changes in population size.

<table>
<thead>
<tr>
<th>Vulnerable</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5,000</td>
<td>&gt;10,000</td>
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How to conserve?

**Ex situ preservation:**

Ex situ preservation involves the conservation of animals in a situation removed from their normal habitat. It is used to refer to the collection and freezing in liquid nitrogen of animal genetic resources in the form of living semen, ova or embryos. It may also be the preservation of DNA segments in frozen blood or other tissues.

**In situ conservation:**

In situ conservation is the maintenance of live populations of animals in their adaptive environment or as close to it as is practically possible. For domestic species the conservation of live animals is normally taken to be synonymous with in situ conservation.

Ex situ and in situ conservation are not mutually exclusive. Frozen animal genetic resources can play an important role in the support of in situ programmes. The relative advantages and disadvantages of the major systems are therefore reviewed here with a view to identifying the relative strengths and areas of mutual support.

**Advantages of Ex situ preservation:**

- Relative cost of collecting, freezing and storing frozen material, as compared to maintaining large scale live populations.
  - Once the material has been collected, the cost of maintaining a cryogenic store is minimal.
  - A very large number of frozen animals from a large number of populations can be stored in a single facility.
  - Cryogenically preserved populations suffer no genetic loss due to selection or drift.
  - Frozen animal genetic resources can be made available to livestock breeding and research programmes throughout the world.

**Disadvantages of Ex- situ preservation:**

- Require a guaranteed supply of liquid nitrogen which must be imported into many countries with expensive foreign currency.
  - They do not produce food or other agricultural commodities and might therefore be deemed to be expensive luxuries in periods of financial austerity.
Cryogenic method is less effective in the conservation of 'breeds' where the relative frequency of genes is important.

Cryogenic storage can result in an initial genetic drift. Thus there is a shift in gene frequencies between the original population and the cryogenically conserved sample population.

The technology necessary for semen collection and freezing, and for superovulation, ova and embryo flushing and freezing is not yet developed for all species.

**Advantages of in situ preservation:**

The in situ conservation of live populations requires no advanced technology.

The farmers of every region and nation know how to manage and maintain their local strains.

They do not require the importation of expensive materials, skills or equipment.

Live conservation projects involve animal utilization and are net producers of food, fibre and draught power.

In situ projects enable breeds to be properly characterized and evaluated in their own and related localities.

The maintenance of live herds allows for selection and improvement of populations within the sustainable constraints.

**Disadvantages of in situ preservation:**

In situ conservation projects require land and people which are limited resources in some regions of the world.

Genetic drift is an inevitable feature of all live animal conservation projects.

Selection and the resultant shift in the gene frequencies within a population are a real possibility.

In situ conservation incurs the possible threat of disease eliminating whole, or substantial parts.

Diseases may also act as a major selection pressure within a population, and may substantially change its characteristics.

Live animal conservation programmes do not assist in the easy international transfer of animal genetic resources as compared to the movement of frozen material.
SUMMARY OF RECOMMENDATIONS:

1. We have inherited a wealth of animal genetic variation in the form of a vast array of locally adapted and modified varieties, strains and breeds of livestock from our farming ancestors.

2. The rate of loss of this resource through dilution and extinction is very high. Immediate action is needed to ensure that it is not squandered, but is passed on to our descendants for whom this resource may be essential to develop new livestock populations in response to changing environmental conditions and unpredictable human requirements.

3. Conservation may be by the ex situ preservation of cryogenically frozen genetic material or the in situ conservation of live populations.

4. Immediate action should be taken to conserve any population in imminent danger of extinction. All livestock populations should be identified and action taken to describe and characterise them so that their genetic potential is known.

5. Populations should be conserved as separate breeds.

6. Minimum population sizes of an effective population (Ne) of 250 animals should form the basis of a conservation programme.

7. Very small populations should be increased in size as rapidly as possible.

8. Minimal conservation projects must be very carefully planned to minimize inbreeding and maximize the contribution of each individual to the next generation. In these programmes there should be no selection, other than against gross abnormalities.

9. Selection may be for those characteristics for which the breed was traditionally valued.
CONCEPT OF DAIRY CATTLE HOUSING IN VARIOUS AGRO-CLIMATIC ZONES OF INDIA

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DAIRY CATTLE HOUSING

Housing of animals is one of the important requirement for improving production. The basic justification of Livestock housing is that it should alter or modify the microenvironment for the benefit of the animals enclosed. In India, scientific housing of animals was practically ignored in the past, except in few organized Govt. farms where western type of dairy cattle housing was followed. This system of housing is mainly designed to suit the environment of temperate climate and not suitable for tropical climate.

In recent past loose housing system for dairy cattle is being advocated in Indian tropical climate. This system has proved quite suitable and economical for Indian condition. But some modification of loose housing is required to suite various climatic condition of different regions of the country.

In loose housing system, animals are usually kept in an open paddock in group of 40-50 throughout the day and night except during milking and some other specific purposes like treatment, breeding etc. when the animals are required to be tied. This housing system (Fig. 1)

Generally consists of continuous manger along with covered standing space, common water trough and open paddock which is surrounded by brick wall or railing fencing. A separate structure of calf pens, calving pens, milking byres, bull pens etc. are also required for housing of other categories of animal in this system. The loose housing of dairy cattle has following advantages:

1. The construction cost is less and thus economical.
2. This system of housing is more flexible and so it can easily be extended to accommodate more number of animals without much difficulty.
3. Animals move freely/comfortably and can eat or drink as and they desire.
4. Heat is easy and efficient.
5. Feeding, watering and cleaning operation can be done conveniently with the minimum labour requirement.

In planning and designing of suitable housing accommodation for dairy, consideration should be given to the comfort and health of the
BRUCELLOSIS IN CATTLE AND GOAT: A CONSTANT THREAT

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Brucellosis has been known for over a century although it has long been recognized as a global problem of man and a variety of livestock animals and wildlife with high economic impact and it still continues to be of great health significance and economic importance in many countries (Eaglesome and Garcia, 1992, Diana Sara et al., 1995). It is caused by Gram (-)ve bacteria of the genus Brucella that has six recognized species on the basis of host specificity. While all the species occur, at least sporadically, in almost all the countries. Nearly all of the cattle abortions that result from brucellosis elicited by B. abortus (Bricker and Halling, 1994); however, B. melitensis, though unlike B. abortus is not associated with stormy abortion in cattle, is recently highly placed in order of etiology for abortion in designed cattle herd.

Sheep are the preferred host of Brucella melitensis to goats causes abortion to latter but infected sheep will as well abort. The abortion usually occurs once in the event, in the last trimester of gestation (Elberg, 1981; OIE, 1996). Interestingly, B. melitensis is excreted in the milk of infected cows thus transmitting the disease to the suckling neonatals. Since the aborted placenta and fetus are massively contaminated with Brucella they lead to the dissemination of the organisms in the environment and to exposure of uninfected animals to the disease. Thus migrating flocks appears to be a major risk to dairy cattle herds and to intensively managed flocks that are fed on fodder harvested from such exposed fields. Another possible route of infection is by direct contact with infected flocks when common pasture is used. Thus canines and other carnivores present special risk to intensively managed livestock and their rearers as they scavenge and may carry the aborted material to new areas.

A portion of infected animals could be silent carriers of the disease as brucellosis can revert to latency. Possibility to transfer the disease in utero to the fetuses or post-natally to the offspring throughout lactation is remained. Therefore, it is wise to take away both the infected dams and their offspring when conducting eradication programs in infected flocks or herds.

B. melitensis causes epididymis and orchitis in the males. This can be the source of infection, or mode of transmission, in flocks where natural mating is practiced. The exchange of males amongst breeders of extensively managed flocks in endemic areas can similarly lead to dissemination of the disease by the infected males. Control programs need to address this issue mainly by restricting the animal movement.

In a recent brucella outbreak, however, cows infected with B. melitensis aborted at the onset of the infection in the herd and was confirmed the involvement of the brucellae in the abortion by direct isolation of the strain from the aborted placentas and fetuses. The dams had seroconverted either prior to, or immediately after the abortion. It was debatable, therefore, whether it was genetic susceptibility that led these cows to abort or whether it was due to evolutionary changes in B. melitensis that endowed the organisms with the abortive capacity in cows? Humans easily contract B. melitensis due to the extremely low inoculum dose required to establish infection.

Like B. abortus, eradication of B. melitensis from dairy cattle is a great concern as the bacteria are excreted in the milk and the requirement to remove the udder and internal organs from slaughtered cows would necessarily lead to exposure of the abattoir personnel. It is, therefore, recommended that the cows be dried off prior to sending them to slaughter to reduce the risks to this infection.
This method allowed vaccination of adult animals even during pregnancy without causing
appreciable harm. However, new formulations of vaccines were needed to
accomplish this objective. With this new, live vaccine, the attenuation recombinant
vaccines could be administered to the animals, thus providing better protection and
preventing the transmission of the disease to other animals.

The control of the disease, however, requires that both the infected and
susceptible animals be treated simultaneously with the attenuation vaccine. This
requires constant monitoring of the disease and the vaccination of all animals in
the affected area.

Proprietary

1. Senior Scientist, 2. Principal Scientist, 3. Intern

Impaired in such doubles.

Animals will have an immediate effect on prevention of this disease in humans.

Once proper hygiene precautions and diminished levels of milk production. One

This disease has been linked to the attenuation of the international as well as national and
state levels.

The method of control will vary, depending on the particular disease. In general,
the method of control will involve the removal of infected animals, the disinfection
of premises, and the culling of susceptible animals. This method of control
will be effective in the long term, but it is important to monitor the disease
and take appropriate action to prevent its spread.
abortion or persistent serological responses. It was therefore possible to repeat the vaccination in endemic populations without the need for slaughter compensation of the infected herds. The second approach applied a rough vaccine strain that would not elicit anti smooth O-chain antigen (the predominant antigen of the normal strain) thus allowing its use as a vaccine that can reduce its virulence by mutation. As a result vaccination with the rough strain could prevent adverse humoral responses that hamper routine surveillance programs.

Based on this concept the RB51 was developed according to these principles. This vaccine is inoculated subcutaneously, and can be applied in adult animals without causing abortion. Since anti smooth O-chain antibodies are not elicited, it is possible to repeat vaccination without hampering surveillance programs. It is therefore considered an improved alternative to the S19 vaccine (Palmer et al., 1997; Schurig et al., 1995). It has been suggested that production of the vaccine should conform to the methods described in the OIE manual of Standards for Diagnostic Tests and Vaccines (OIE, 1996). However, the implementation of use of this vaccine in practice has been limited. It has only recently been tested on a pilot scale and approved by the USDA for commercial use.

Surveillance, public health and control

A comprehensive consultation among the laboratory, the veterinary field services and the public health services is imperative towards implementation of a successful control of brucellosis. As brucellosis has been designated a notifiable disease; the veterinary services and the public health services shoulder the role for diagnosis of the disease among the animal and the human populations respectively which form the surveillance system. Veterinary field services may inform the public health services about the occurrence of the infection in the livestock that increases the physicians’ awareness of possible co-occurrence of the disease in the human population. The relay should be vice-versa. The success of the surveillance system depends on the harmonization of the steering committee activities where diagnostic services acts as a lingua franca between the coordination and standardization of the methods. The committee should consist of planners from the public health services, veterinary services and laboratory services who can dictate whether or not the veterinary services will instigate vaccination as well as decide upon the surveillance scheme and the criteria to assay the results and also for compensation of slaughtering the animals vis-à-vis replacement of stock. Additionally, an education campaign involving breeders and the rural & urban populations is highly beneficial to achieve the goal for brucellosis control.

References

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3. Bricker BJ and Halling SM. 1994. Differentiation of Brucella abortus bv. 1, 2, and 4, Brucella


Mastitis continues to be a major problem concerning dairy industry and rated as one of the costliest important diseases affecting the quality and quantity of milk in dairy animals. Its prevalence rolls to inflict the dairy herds throughout the world despite of continued research activity on the problem over the century. It has been estimated that mastitis reduces the milk production by 21% in affected animals (Chakraborty, 1996). The disease manifests in various forms depending upon severity and duration of infection and may be of sub-clinical or clinical form. Because of clear cut changes in milk quality and mammary tissues, acute clinical mastitis rarely poses problem in diagnosis. However, diagnosis of sub-clinical mastitis (SCM) calls for specific tests as clinical and visual changes in the udder and its secretion (milk) may rarely incite any beckon to the problem result in goes undetected and causes serious losses to dairy industry. The recent trend indicates higher incidence of sub-clinical cases (43.9% in cows and 24.4% in buffaloes) due to lack of timely detection in absence of visible signs of abnormal milk. The average incidence of clinical mastitis in India is calculated to be 1-10% (Prabhakar, 1986) whereas incidence of SCM is reported to vary from 10-50% in cows and 5-20% in buffaloes (Kumar, 1988; Singh, 1991).

Besides the persistence intra-mammary infection in non-lactating dry period or due to new infection getting access during colostrogenesis with dilatation of teat canal leads to such higher incidences. But the latent infection will be observed during peri-parturient period when the pathogenic microbes flare up in the immuno-compromised phase in population of dairy animals (cattle, buffalo, sheep and goat) causing palpable economic losses in term of production, therapeutic cost and rising morbidity.

Status of mastitis in India

Studies conducted in different states reflect high incidence of the disease all over India for the past seven decades since the first record of the disease was made by Land in 1926 (Sirohi and Sirohi, 1995). The incidence of clinical mastitis, in Punjab, was reported in 44% cows and 21% buffaloes (Dhanda and Sethi, 1961, 1963) and subsequently, Rahman et al., (1983) mentioned about the incidence of sub-clinical mastitis (SCM) to the extent of 59.2% in cow and 56.5% in buffalo. In the Malva region of M.P. 47.5% Gir cows and 50% Malvi cows were been with this disease (Shukla and Supeker, 1986). The on-field screening data, in West Bengal, generated by California Mastitis Test (CMT) with 292 Jersey x Haryana, 114 Brown Swiss x Haryana and 242 Holstein Friesian x Haryana crossbred cows showed prevalence of SCM in 62.8%, 44.73% and 1.85% cases, respectively (Roy et al., 1989).

Table 1: Milch animal population and production details

<table>
<thead>
<tr>
<th>Milch animal population¹ (1993)</th>
<th>Crossbred cows</th>
<th>Local cows</th>
<th>Buffaloes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(million)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average daily milk yield² (litres)</td>
<td>6.00</td>
<td>1.50</td>
<td>3.00</td>
</tr>
<tr>
<td>Average lactation length³ (days)</td>
<td>305</td>
<td>250</td>
<td>280</td>
</tr>
<tr>
<td>Average lactation yield (litres)</td>
<td>1830</td>
<td>375</td>
<td>840</td>
</tr>
<tr>
<td>Average milk price⁴ (Rs.)</td>
<td>5.00</td>
<td>5.00</td>
<td>6.50</td>
</tr>
</tbody>
</table>

(By courtesy to Sirohi and Sirohi, 2001)
Economic losses due to mastitis:

In one recent report it is estimated that annual economic losses incurred by the dairy industry in India on account of udder infections have been whopping to Rs.6053.21 crores; of which 4365.32 (72.12%) was attributable to sub-clinical phase of mastitis (Nauryal, 2001). The cost estimates accruing to other categories of loss viz. cost of increased labour, cost of veterinary services, replacement, cost of animals etc. would further jack up the magnitude of monetary loss from mastitis. The loss estimates are approximately three times the Eighth Plan allocation for dairy development. The average production losses estimated from 17.5% (in India) to 70% (in USA) (Dash, 2000). The financial loss worth Rs.381.01, Rs.761.82, Rs.986.89 and Rs.208.26, Rs.213.57, Rs.357.77 crores accrued to crossbred cattle, native cattle and buffaloes in sub-clinical and clinical mastitis, respectively. More so, SCM may cause up to 50% milk loss in herd (Karmanova et al., 1979). In addition to the costs outlined above, both clinical and SCM have been shown to adversely affect subsequent fertility (Schrick et al., 2001). The effective control of mastitis in India can result in increasing milk production by approximately 5.04 million tonnes per annum from the prevention or cure of one single disease-mastitis (Sirohi and Sirohi, 2001). More so, has also been estimated a profit of $ 396 per cow if sub-clinical mastitis was treated during early lactation (Yamagata et al., 1987). Furthermore, treatment of sub-clinical mastitis during lactation and that too in the case of non-availability of dry therapy preparations may have a positive effect on the control of mastitis. Logically, many cases of clinical mastitis can be prevented if sub-clinical mastitis is diagnosed and controlled timely and effectively (Bansal et al., 2000).

Monitoring of milk yield under Indian conditions has suggested that SCM causes a daily milk yield loss of 1.24 kg per cow and 2.65 kg per buffalo (Singh et al., 1991). A majority (70-80%) of losses suffered due to intra-mammary infection (IMI) are attributable to sub-clinical version of the disease. Clinical episodes, on the other hand, account for remaining 20-30% losses as these infections cause losses incurred on drug expenses and lost of revenue from discarded milk. Moreover, producer also loses the option of culling the affected cow until after the withdrawal period in the event of treatment failure. Furthermore, antibiotic treated cows in the herd increase the risk of contamination of milk with antibiotics. Analyses of data pertaining to clinical bouts indicate a proportional reduction of 5.9 to 6.4% in 305 day milk yield and a 5% loss in total milk yield.

Loss due to mastitis may be summarized by extrapolating the amount incurred as loss due to: 1) culling, 2) clinical mastitis and 3) sub-clinical mastitis.

1) Economic loss due to reduced productive life and early culling of milch cow: It embodied the accumulated amount towards outplaying / condemning the milch animal from dairy herd. Mastitis shorten the productive lifespan of a lactating animal and sometimes it partially or completely obliterate the teat canal leading to its early culling from the herd. A range of percentage to this kind of damage have been cited by workers from different countries with progress of time (Sirohi and Sirohi, 1995). Value of dairy cows lost by premature culling could be decided by the following formula (Hillerton et al., 1992):

\[
\text{Loss} = \text{No. of cows culled} \times (\text{Market value of animal} - \text{Cull value})
\]

2) Economic losses due to clinical mastitis: This could be derived by adopting the following parameters as described by Dobbins (1977) (Table 1).

a) Lower milk production- the major share of losses caused by mastitis is due to reduced milk production. Losses in total milk production may vary from 5 to 25% and sometime even upto 83.9% depending on the type of infection, its severity and duration and the loss could be estimated as:

\[
\text{Loss} = \text{No. of cows} \times \text{Milk yield per cow} \times \text{Duration of infection} \times \text{Loss rate}
\]

1. Senior Scientist, 2. Principal Scientist & In-charge.
Milk production loss = No. Quarter/ CMT Grade x Milk production loss/ CMT Grade x Milk price per litre.

b) Degrade in milk quality- Milk from infectious mastitis cases is poor in quality with increased somatic cell count, and associated with decline in the milk constituents and increase in lipase, sodium chloride, whey protein etc. which are undesirable and liable to unfit for human consumption. Value of milk discarded or down graded is calculated as:

\[
\text{Value of milk discarded per year (Rs.)} = \text{Av. Lit. of milk discarded/cow/milking} \times \text{No. of cows having mastitis/year} \times \text{Av. duration of disease} \times \text{Av. price of milk per lit.}
\]

c) Value of milk discard- when infected animals are under treatment with antibiotics, milk from such animals is supposed to discard till it becomes antibiotic free. Besides, clinical mastitis milk is also recommended to keep away from human use because of its altered composition (Sirohi and Sirohi, 1995).

d) Slump in market value and increased replacement cost- Mastitis usually produces gross damage of udder epithelial tissue resulting in the state of sinecure of one or more quarters. The market value of such animals goes down or may be completely lost if all the quarters get involved. It draws extra fund to replace such animals in the herd.

e) Therapeutic and veterinary service cost- No systematic and comprehensive study, in India, has been reported in this direction except a fragmentary study (Patel and Rao, 2001) where 12.29% and 8.59% economic losses attributed to treatment and veterinary service cost, respectively. No surveillance data, in India, is in record; however, the cost on this account presumed to be much more certainly than those reported from other countries. The incurred loss towards the treatment cost and veterinary expenses may be calculated as:

\[
\text{Treatment cost/year} = \text{No. of quarter of mastitis/Year} \times \text{Av. duration of disease} \times \text{Av. No. of intramammary therapy/cow} \times \text{value of intramammary therapy}
\]

\[
\text{Veterinary expenses (Rs.)} = \text{No. cases of mastitis/year} \times \text{Av. Vet. fees/case}
\]

f) Cost of extra manpower- Usually extra labour (beyond the schedule) is demanded for handling and managing the mastitis cases in a farm. Moreover, scepticism for the affected cases engage extra labour for washing of milking equipment, can etc. The associated cost may be summed up as:

\[
\text{Extra labour Cost (Rs.)} = \text{No. of cases of mastitis/year} \times \text{Av. hour of labour per day} \times \text{Av. labour cost per hour}
\]

3) Economic losses due to sub-clinical mastitis: It includes only the reduced milk yield in lactation and estimated by calculation as:

\[
\text{Milk production loss} = \text{No. Quarter/ CMT Grade} \times \text{Milk production loss/CMT Grade} \times \text{Milk price per litre}
\]

Fig. 2: Accounts of loss in mastitis

<table>
<thead>
<tr>
<th>% of Loss</th>
<th>Yield</th>
<th>Treatment</th>
<th>Culling</th>
<th>Clinician</th>
<th>Discard</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>74</td>
<td>13</td>
<td>12</td>
<td>9</td>
<td>4.5</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>40</td>
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<tr>
<td>20</td>
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<tr>
<td>10</td>
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<td></td>
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<tr>
<td>0</td>
<td></td>
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</tr>
</tbody>
</table>

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PREVENTION OF MASTITIS:

1. Daily washing of udder with effective antiseptic solution especially before and after milking including regular bath.
2. Proper disinfection of the floor routinely.
3. Routine screening of lactating herd by improved tests for detection of latent and sub-clinical mastitis following the International Dairy Federation Guidelines.
4. Use of antibiotics in detected cases along with the non-antibiotic approaches viz. biomothers, probiotics, antimicrobial peptides developed by selective recombinant of cytokines & defenses.
5. Use of specific bacteriophages.
6. Use of vaccine (preferably developed with the local strains) viz:
   i) *Staphylococcus aureus* (Fc Component)
   ii) *Streptococcus uberis* 0140I or C221 strain.
   iii) *E. coli O111:B4* ) J5 strain (bacterin)
   iv) *Salmonella typhimurium* Re-17 strain
   v) *Corynebacterium uberis* 22F strain.

REFERENCES


Role of animal husbandry in society:

Next to crop production, Animal Husbandry is still the most important activity in present day rural India. Production and productivity of main commodities of animal husbandry have increased significantly in overall manner. This has been mainly due to adoption of selective breeding, introduction of exotic high yielding germplasm and breeding stocks in varieties of animals, adoption of modern concept for nutrition and feeding and then, most important factor i.e. adoption of optimum coverage for health protection being aware on modern methods and products - diagnostics and vaccines and immunomodulators. Plane of knowledge among many farmers on rearing management of those animals in terms of proper nutrition, reproduction, production as well as health care coverage for high yielding animals is still poor. There is also need of further improvement on this aspect to cope up for future risks. They needs extra care for their overall management to sustain their life for a longer period of life and to remain in productivity. When those are sophisticated species of such high yielding large animals, metabolic and growth rates of those are high. In tropical like climate of this country, those exotic animals are also highly susceptible, to infections of different pathogens under continuous environmental stresses as annoyance from natural existing of high temperature-humid combinations in environments. Therefore, here, disease is a major factor for reducing the capability in production and life of those species in the region. There are various endemic diseases of virus, bacteria, mycoplasma, fungus and parasite origin. There are also uncertain threats for loosing their stock and production from transboundary diseases and on emergences of new strains from endemic pathogens. Most of such diseases are sometime in milder forms - not easily recognizable. Therefore, there should be national and state supports to provide safety guard program for raising awareness about need and manner in taking cares for animal health. Among those pathogens, many are having zoonotic importance which have a range of effects on human health from a mild action to tremendous health hazards to overall health of farmers, farmer’s community, consumers and also marketing persons. In Eastern area, cattle is the main commodity for rural sectors, then goat and sheep, and poultry & duck, and then, pigs. There are also chances of uncertainly sudden surge of pathogens from neighbouring international borders. Moreover, animal rearing in our country is in small units in numbers in backyard style existing in continuous spheres without giving well separation from each other units to prevent in easy spreading of pathogens. Moreover, livestock fares and trades cause inter-localities & intra-locality movement of animals which are sufficient for providing ample scopes of easy and quick transmission of pathogens from a population to another, even at a distance place in discrete manner.

Again, some endemic diseases are occurring in the multi-etiological forms and without showing franc clinical signs to have an easy diagnosis for those. In those cases, disease diagnosis become delayed for facilities, knowledgeable staffs and poor communications. The role of veterinarians who are contributing to save life of various animals and to protect natural environment should be properly stream lined to give better services and contributions to such works.

Thus, present key issues are:

Technology supported and demand driven livestock growth will be the future engine for growth.
A transition from subsistent livestock farming to sustainable and financially viable livestock farming, which will generate wealth and self-employment through entrepreneurship, is need of the day.

External markets, an extremely important source of demand should be tapped aggressively.
Abysmally low Public sector lending leads to poor capital formation

Infectious disease is the main hurdle in sustenance of high yielding livestock and poultry-

- Infectious diseases of livestock remain important constraints to productive and profitable livestock production in many developing regions. Diseases reduce farm incomes directly by causing considerable losses in both production and stock as well as forcing farmers to spend money and labour on their control and indirectly by necessitating health restrictions on exports.
- Continuous alertness requirement on control: Prevention of occurrences of diseases due to round the year presence of pathogens in environment which frequently compounds with enhanced susceptibilities to pathogens from stresses due to temperature and humidity factors in prevailing climate climates of the country is extra burden and risk for increasing investments for losses and enhancing cost in maintenance of farm activities.
- To keep low pathogen content to pathogen free conditions in products and live animals and load of pathogens in the environment are also important to enhance the quality of life for the people including farmers, marketing people, consumers and surrounding communities of animal rearing sides for supporting production of animal husbandry cum agriculture - for ensuring a safe, affordable nutrition, employment, income and accessible food.

Diseases causing heavy economic losses in India are

- Foot and Mouth Disease (FMD),
- Peste des petits ruminants (PPR),
- Sheep pox and Goat Pox,
- Classical Swine Fever.

Thus, Quick and effective Control, prevention and then eradication, if possible is urgently needed to reduce such loads and risks for Animal Husbandry in India.

Livestock markets and other congregations of animals are a very important potential source for the rapid spread of epidemic diseases. They should be a major focus for disease surveillance and should be carefully controlled during disease outbreaks.

There should wide published report/news on export/import on Livestock and their products from Countries where risks are involved to our livestock?

ROLE ASSOCIATED WITH THE HERD MANAGERS AND STATE DISEASE MONITORING UNITS FOR PREVENTION AND CONTROL DISEASES IN HERD COULD BE PLAYED FOR PROTECTION OF THEIR ANIMALS: Any farm management should be sophisticated, particularly in the eastern region where tropical climates prevalent in most of the period in the year with added environmental stresses. The picture of disease occurrence is more critical than other parts of the country. Here, disease frequently compounds with the temperature and humidity to cause stress on animals. Farming itself requires basic education and training. Time is required for farmers as well as the veterinarian assistants and veterinary practitioners to gain experience for this reason. With outbreak owner should be encouraged to submit all dead animals as soon as possible for a meaningful necroscopy examination and to identify the possible factors which may have contributed outbreak in the farms. When number of affected animals in the herd is more
in number, it is to be ensured that animal containment and quarantine measures have not been implemented. It may be based on either tentative diagnosis is suggestive for infectious diseases or obviously when laboratory confirmation has been received on the presence of infectious pathogens. Immediate steps must be further supplement. Increase biosecurity and inspection station must be established at the entrance of the contaminated premises. A well maintenance of data / histories on individual animals and simultaneously on the whole herd will provide important information / clues in achieving a quick diagnosis of the case. For getting clues towards tentative diagnosis and providing quick definitive diagnosis of enzootic infections, perhaps the most costly and time consuming activity performed by infection control personnel, systemic surveillance of common/ nosocomical infections is important for many reasons.

A well maintenance of data / histories on individual animals and simultaneously on the whole herd will provide important information / clues in achieving a quick diagnosis of the case. For this purpose, the farmer / herd manager will be the key person. The infectious nature of a disease incidence is primarily to be ensured by the attending clinicians / disease investing team considering the case history of diseases supplied by the farmer/ herd manager and observations made by them selves on spot disease investigation. In this regard, the following aspects are to be considered - incubation period, temperature, appearance of visible mucous membrane, clinical abnormality in general and then, system /organ wise involvement - respiratory, nervous system, reproductive, skin, abnormality in stool, urine and other secretions/ excretions, including history on abortion in female stock, etc. With those, new entry of animals, changes in feeds, drinking water, use of vaccine and common prophylactic drugs, etc. are also to be considered. Nature of the disease incidence, if any on changes of place, feed, drinking water, pasture etc is to be considered. Then, some definitive decision towards the infectious nature of the disease can be achieved.

Cattle disease:

Foot & Mouth Disease (FMD)

It is one of the most contagious animal diseases, with important economic losses in Indian crossbred animals but low mortality rate in adult animals, but often high mortality in young due to myocarditis. Disease in Zebu stocks of cattle are little or in milder form.

Etiology: It is a disease caused by a virus A virus of the family Picornaviridae, genus Aphthovirus. Seven immunologically distinct serotypes: A, O, C, SAT1, SAT2, SAT3, Asia1 of which only O, A, Asia -1 are common nowadays in India and the region.

Viability in Environment:

- Can persist in contaminated fodder and the environment for up to 1 month, depending on the temperature and pH conditions.
- Preserved by refrigeration and freezing and progressively inactivated by temperatures above 50°C.
- Inactivated by sodium hydroxide (2%), sodium carbonate (4%), and citric acid (0.2%).
- Resistant to iodophores, quaternary ammonium compounds, hypochlorite and phenol, especially in the presence of organic matter.

Hosts: Bovidae (cattle, zebus, domestic buffaloes, yaks), sheep, goats, swine, all wild ruminants and suidae. Camelidae (camels, dromedaries, llamas, vicunas) have low susceptibility.

Transmission -

- Direct or indirect contact (droplets)
- Animate vectors (humans, etc.)
Inanimate vectors (vehicles, implements)
- Airborne, especially temperate zones (up to 60 km overland and 300 km by sea)

Sources of virus:
- Incubating and clinically affected animals
- Breath, saliva, faeces, and urine; milk and semen (up to 4 days before clinical signs)
- Meat and by-products in which pH has remained above 6.0
- Carriers: particularly cattle and water buffalo; convalescent animals and exposed vaccinates (virus persists in the oropharynx for up to 30 months in cattle or longer in buffalo, 9 months in sheep). African Cape buffalo are the major maintenance host of SAT serotypes

Occurrence: FMD is endemic in this region of India along with other neighbouring parts of Asia, Africa, the Middle East and South America (sporadic outbreaks in free areas)

DIAGNOSIS: Incubation period is 2-14 days

Clinical diagnosis

Cattle
- Pyrexia, anorexia, shivering; reduction in milk production for 2-3 days, then
  - smacking of the lips, grinding of the teeth, drooling; lameness, stamping or kicking of the feet: caused by vesicles (aphthae) on buccoal and nasal mucous membranes and/or between the claws and coronary band
  - after 24 hours: rupture of vesicles leaving erosions
- Vesicles can also occur on the mammary glands
- Recovery generally occurs within 8-15 days
- Complications: tongue erosions, superinfection of lesions, hoof deformation, mastitis and permanent impairment of milk production, myocarditis, abortion, death of young animals, permanent loss of weight, loss of heat control ('panzers')

Sheep and goats: Lesions are less pronounced. Foot lesions may go unrecognised. Lesions in dental pad of sheep. Agalactia in milking sheep and goats is a feature. Death of young stock

Pigs: May develop severe foot lesions particularly when housed on concrete. High mortality in piglets a frequent occurrence

Lesions
- Vesicles or blisters on the tongue, dental pad, gums, cheek, hard and soft palate, lips, nostrils, muzzle, coronary bands, teats, udder, snout of pigs, corium of dewclaws and interdigital spaces
- Post-mortem lesions on rumen pillars, in the myocardium, particularly of young animals (tiger heart)
**Differential diagnosis**

**Other differential diagnosis:**

**Cattle:** Rinderpest, Mucosal disease, Infectious bovine rhinotraceitis, Bluetongue, Bovine papular stomatitis, Bovine viral diarrhea

In pig, it is **clinically indistinguishable to** Vesicular stomatitis, Swine vesicular disease, Vesicular exanthema of swine

**Laboratory diagnosis**

**Procedures:** Samples are to be send for quick diagnosis. Facilities are available with AICRP on FMD coordinating centre in the states (which are specified laboratory for the region). **Identification of the agent:** ELISA, Complement fixation test. **Virus isolation:** inoculation of primary bovine thyroid cells and primary pig, calf and lamb kidney cells; inoculation of BHK-21 and IB-RS-2 cell lines; inoculation of mice

Oesophageal-pharyngeal fluid collected by means of a probang cup. Probang samples should be frozen to below -40°C immediately after collection. Or in other cases scrapings with sterile gauge for foot lesions in case disease in recovery stage

- **Serological tests:** Pair Serum or clotted bloods collected at least 21 days interval immediately on set of the disease. - ELISA, Virus neutralisation test

RT-PCR for viral nucleic acid diagnosis is available in the Central FMD typing laboratory of AICRP on FMD at Mukteshwar. **Samples**

- 1 g of tissue from an unruptured or recently ruptured vesicle. Epithelial samples should be placed in a transport medium which maintains a pH of 7.2-7.4 and kept cool (see Manual)

**Needs to Control:**

- There will be need of active participation to prevent economic losses due to FMD and to develop herd immunity in cloven-footed animals. Foot and Mouth Disease Control Programme (FMD-CP) is being implemented in specified districts of the country in the first phase with 100% central funding as cost of vaccine, maintenance of cold chain and other logistic support to undertake vaccination (DAHD).
- Round the year, twice vaccination is necessary for the endemic zones that may be provided/done by the concerned State Governments having other infrastructure and manpower.

**Precautions:** Necessary cares are to be taken in the region during movement of suspected animals from affected zones i.e. neighbouring states and countries and also import of animal products.

**Medical prophylaxis:** Single or Multi-component Inactivated virus vaccine containing an adjuvant. Immunity: 6 months after two initial vaccinations, 1-month apart, depending on the antigenic relationship between vaccine and outbreak strains.

**In outbreak:** Ring vaccine covering areas of 8-10 kilometer radius from the centre of outbreak or more according to the affected zone size.

**Sanitary prophylaxis**

- Protection of free zones by border animal movement control and surveillance
- Slaughter of infected, recovered, and FMD-susceptible contact animals
- Disinfection of premises and all infected material (implements, cars, clothes, etc.)
• Destruction of cadavers, litter, and susceptible animal products in the infected area
• Quarantine measures (Code Chapter 2.1.1.)

Diseases of Sheep and Goats

PESTE DES PETITS RUMINANTS (PPR)

Occurrence and Importance of the Disease: It is a viral originated disease and no antibiotic or other curable treatment is available to veterinary doctors. It is endemic in West Bengal along with many other states of India but still Assam is virgin land for it. It is also reported in Bangladesh and Nepal. It has devastated many pockets of the country including West Bengal. It is highly contagious in close contact. To reduce secondary bacterial complication, antibiotic treatments are not very effective. Still it can tried for better efforts.

Etiology: Peste des petits ruminants is caused a virus - family Paramyxoviridae, genus Morbillivirus. Antigenically close to rinderpest virus

EPIDEMIOLOGY

Viability in environments:
• Stable between pH 4.0 and 10.0,
• Susceptible to most disinfectants, e.g. phenol, sodium hydroxide 2%/24 hours,
• Survives for long periods in chilled and frozen tissues

Mortality and Morbidity
• Morbidity rate 90% (susceptible population)
• Mortality rate 50-80% (susceptible population)

Hosts
• Sheep and especially goats. To date diagnosed only in captive wild ungulates from families of Gazellinae (dorcas gazelle), Caprinae (Nubian ibex and Laristan sheep) and Hippotraginae (gemsbok)
• Experimentally the American white-tailed deer (Odocoileus virginianus) is fully susceptible
• Cattle and pigs develop inapparent infections
• Breed-linked predisposition in goats

Transmission
• Direct contact between animals
• No carrier state
• Seasonal variations: more frequent outbreaks during the rainy season or the dry cold season
Sources of virus

- Tears, nasal discharge, coughed secretions, and all secretions and excretions of incubating and sick animals

Occurrence: It is endemic in West Bengal with many other states of India but still Assam is virgin land for it. It is also reported in Bangladesh and Nepal. It has devastated many pockets of the country including West Bengal. It is highly contagious in close contact.

PPR usually occurs in Africa, the Arabian Peninsula and the Middle East

Diagnosis -

Incubation period is 3-10 days.

Clinical diagnosis

Acute form

- Sudden rise in body temperature (40-41°C) with effects on the general state: restlessness, dull coat, dry muzzle, depression of appetite
- Serous nasal discharge becoming mucopurulent and resulting, at times, in a profuse catarrhal exudate which crusts over and occludes the nostrils. Respiratory distress
- Small areas of necrosis on the visible nasal mucous membrane
- Congestion of conjunctiva, crusting on the medial canthus and sometimes profuse catarrhal conjunctivitis
- Necrotic stomatitis with halitosis is common
- Severe non-haemorrhagic diarrhoea
- Bronchopneumonia evidenced by coughing is a common feature
- Abortion
- Dehydration, emaciation, dyspnoea, hypothermia and death within 5-10 days

Peracute form

- Frequent in goats

Subacute and chronic forms

- Frequent in some areas because of local breed susceptibility
- 10-15 days development with inconsistent symptoms
- Pneumopathy

Lesions

- Emaciation, conjunctivitis, erosive stomatitis involving the inside of the lower lips and adjacent gum near the commisures and the free portion of the tongue
- Lesions on the hard palate, pharynx and upper third of the oesophagus in severe cases
- Rumen, reticulum and omasum rarely have lesions
• Small streaks of haemorrhages and sometimes erosions: in the first portion of the duodenum and the terminal ileum
• Extensive necrosis and sometimes severe ulceration of Peyer's patches
• Congestion around the ileo-caecal valve, at the caeco-colic junction and in the rectum. 'Zebra stripes' of congestion in the posterior part of the colon
• Small erosions and petechiae on the nasal mucosa, turbinates, larynx and trachea
• Bronchopneumonia is a constant lesion
• Possibility of pleuritis and hydrothorax
• Congestion and enlargement of spleen
• Congestion, enlargement and oedema of most of the lymph nodes
• Erosive vulvovaginitis may exist

Laboratory diagnosis

Procedures

Identification of the agent

• Antigen detection
  o Agar gel immunodiffusion
  o Counter immunoelectrophoresis
  o Indirect fluorescent antibody test
  o ELISA
  o Immunohistopathology

• Virus isolation and identification
  o In primary lamb kidney cells or VERO cell line
  o Virus neutralisation
  o Electron microscopy

• Virus RNA detection
  o PPR-specific cDNA probes
  o Amplification by polymerase chain reaction (PCR)

Serological tests

• Virus neutralisation (prescribed test in the Manual)
• Competitive ELISA
• Counter immunoelectrophoresis
• Agar gel immunodiffusion
Immunodiffusion inhibition test

Samples

- Swabs of the conjunctival discharges and from the nasal, buccal and rectal mucosae
- Whole blood collected on heparin (blood and anticoagulant should be mixed gently)
- Lymph nodes, especially the mesenteric and bronchial nodes
- Spleen
- Large intestine and lungs

Samples should be transported under refrigeration

PREVENTION AND CONTROL

- No specific treatment
- Antibiotics may prevent secondary pulmonary infections (oxytetracycline, chlortetracycline)

Sanitary prophylaxis

- Recommended when the disease appears in previously PPR-free countries (see rinderpest)

Medical prophylaxis

- Rinderpest vaccine is commonly used
- A homologous PPR vaccine is also available and is preferable, to avoid confusion when retrospective serological surveys are done
- Both vaccines give strong immunity
- Genetically engineered recombinant vaccines are currently undergoing limited field trials

To ensure the Feasibility in doing Vaccination and Arrangement of Vaccines

- Vaccination is recommended
- Protection will be solid after 15-20 days post vaccination, only/Usually, it will work to start on 7 days onwards.

Sheep pox and goat pox

Occurrence and Importance of the Disease: The disease is endemic to some extent in West Bengal. It is a virus originated disease and no antibiotic or other curable treatment is available to veterinary doctors. It is endemic in many of pockets of West Bengal along with many other states of India but probably Assam is virgin land for it. It is also reported in Bangladesh and Nepal. It is highly contagious in close contact.

DETECTION OF THE DISEASE

ETIOLOGY: Classification of the causative agent - a Pox group of virus
Virus family Poxviridae, genus *Capripoxvirus*

**Epidemiology:**

**Resistance to physical and chemical action**
- Temperature: Susceptible to 56°C/2 hours; 65°C/30 min
- pH: Susceptible to highly alkaline or acid pH
- Chemicals: Sensitive to ether (20%), chloroform, and formalin (1%)
- Disinfectants: Inactivated by phenol (2%) in 15 min. Sensitive to detergents, e.g. sodium dodecyl sulphate
- Survival: Can survive for many years in dried scabs at ambient temperatures. Virus remains viable in wool for 2 months and in premises for as long as 6 months

**Morbidity & mortality:**
- Morbidity rate: Endemic areas 70-90%
- Mortality rate: Endemic areas 5-10%, although can approach 100% in imported animals

**Hosts:** Sheep and goats (breed-linked predisposition and dependent on strain of capripoxvirus)

**Transmission**
- Direct contact
- Indirect transmission by contaminated implements vehicles or products (litter, fodder)
- Indirect transmission by insects (mechanical vectors) has been established (minor role)
- Contamination by inhalation, intradermal or subcutaneous inoculation, or by respiratory, transcutaneous and transmucosal routes

**Sources of virus**
- Cutaneous lesions (crusts, nodules) resulting in aerosols
- Saliva
- Nasal secretions from sick animals for 1 or 2 months
- Faeces

**Occurrence**

Sheep pox and goat pox are endemic in most of Africa, the Middle East and Asia

For detailed information on occurrence, see recent issues of *World Animal Health* and the OIE Bulletin

**DIAGNOSIS**

Incubation period is up to 21 days. Following contact, incubation period is approximately 12 days, but is shorter than this following intradermal inoculation by insects

**Clinical diagnosis**
- Subclinical cases
Clinical cases vary from mild to severe:
- fever, depression, polypnoea
- conjunctivitis, lacrimation, rhinitis, oedema of eyelids, photophobia
- cutaneous eruption beginning with erythematous areas especially noticeable in hair or wool-free parts of the body, such as the perineum, inguinal area, scrotum, udder, muzzle, eyelids and axillae
- lesions evolve into papules

**Papulo-vesicular form**
- Papules become a white-grey colour, desiccate and form crusts that are easy to remove
- Rarely, papules may transform into vesicles. After rupture of vesicles, a thick crust covers the lesions

**Nodular form ('stone pox')**
- Papules give rise to nodules involving all the layers of the skin and the subcutaneous tissue
- Necrosis and sloughing of the nodules leaves a hairless scar

In both forms, nodules develop in the lungs causing bronchopneumonia with cough, abundant nasal discharge, depression, anorexia and emaciation
- Animals may recover within 20-30 days
- Death is frequent when complications occur (abortion, which is rare, secondary infections, fly strike, septicaemia, digestive localisation)

**Lesions**
- Skin lesions: congestion, haemorrhage, oedema, vasculitis and necrosis. All the layers of epidermis, dermis and sometimes musculature are involved
- Lymph nodes draining infected areas: enlargement (up to eight times normal size), lymphoid proliferation, oedema, congestion, haemorrhage
- Pox lesions: on mucous membranes of the eyes, mouth, nose, pharynx, epiglottis, trachea, on the rumenal and abomasal mucosae, and on the muzzle, nares, in the vulva, prepuce, testicles, udder, and teats. Lesions may coalesce in severe cases
- Lung lesions: severe and extensive pox lesions, focal and uniformly distributed throughout the lungs; congestion, oedema, focal areas of proliferation with necrosis, lobular atelectasis. Enlargement, congestion, oedema and haemorrhages of mediastinal lymph nodes

**Laboratory diagnosis**

**Procedures**

**Identification of the agent**
- Cell inoculation and identification by immunofluorescence staining of intracytoplasmic kidney Lamb testis and goat testis, and goat cells
inclusion bodies
- Inhibition of cytopathic effect using positive serum
- Antigen detection ELISA

**Serological tests**
- Virus neutralisation
- Indirect fluorescent antibody test
- Agar gel immunodiffusion
- ELISA

**NB!!** Differentiation from lumpy skin disease is not possible by serological methods

**Samples**
- Full skin thickness biopsies taken within 1 week of the first appearance of the lesions
- Lesions in the lungs
- Paired sera

**PREVENTION AND CONTROL**

No treatment

**Sanitary prophylaxis**
- Isolation of infected herds and sick animals for at least 45 days after recovery
- Slaughtering of infected herd (as far as possible)
- Proper disposal of cadavers and products
- Stringent disinfection
- Quarantine before introduction into herds
- Animal and vehicle movement controls within infected areas

**Medical prophylaxis**
- There are numerous attenuated virus vaccines delivered by subcutaneous or intradermal route
- The conferred immunity lasts up to 2 years

**Vaccines and feasibility:**

**Vaccines:**
- Live, attenuated virus vaccines available with states induce longer immunity than inactivated virus vaccines.
- Live, attenuated, lumpy skin disease virus also can be used as a vaccine against sheeppox and goatpox but it is risky in the region of crossbred animals. It may give disease in cattle.
- Infection results in solid and enduring immunity.
Protection from immediate vaccination will be solid after 15-20 days post vaccination, only. Usually, it will work to start on 7 days onwards.

Pig Disease
CLASSICAL SWINE FEVER (hog cholera)

- **Occurrence and Importance of the Disease:** It is a virus originated disease and no antibiotic or other curable treatment is available to veterinary doctors. It is endemic in West Bengal and Assam along with many other states of India. It is also reported in Bangladesh and Nepal. It is a regular feature in North-Eastern states of India including Assam. It is highly contagious in close contact.

**AETIOLOGY:** Virus - Classification of the causative agent: Virus Family Flaviviridae, genus Pestivirus

**Resistance to physical and chemical action**
- **Temperature:** Partially resistant to moderate heat (56°C)
- **pH:** Inactivated by pH < 3.0 or pH > 11.0
- **Chemicals:** Susceptible to ether, chloroform, β-propiolactone 0.4%
- **Disinfectants:** Inactivated by cresol, sodium hydroxide (2%), formalin (1%), sodium carbonate (4% anhydrous or 10% crystalline, with 0.1% detergent), ionic and non-ionic detergents, strong iodophors (1%) in phosphoric acid
- **Survival:** Survives well in cold conditions and can survive some forms of meat processing (curing and smoking).

**EPIDEMIOLOGY**

**Hosts:** Pigs and wild boar are the only natural reservoir of classical swine fever virus.

**Transmission**
- Direct contact between animals (secretions, excretions, semen, blood)
- Spread by farm visitors, veterinarians, pig traders
- Indirect contact through premises, implements, vehicles, clothes, instruments and needles
- Insufficiently cooked waste food fed to pigs
- Transplacental infection

**Sources of virus**
- Blood and all the tissues, secretions and excretions of sick and dead animals
- Congenitally infected piglets are persistently viraemic and may shed the virus for months
- Infection routes are: ingestion, contact with the conjunctiva, the mucous membranes, skin abrasions, insemination, percutaneous blood transfer

**Occurrence**

The disease occurs in much of Asia, Central and South America, and parts of Europe and Africa. Many countries are free of the disease.

For detailed information on occurrence, see recent issues of *World Animal Health* and the *OIE Bulletin*.
**DIAGNOSIS:** Incubation period is 2-14 days

**Clinical Diagnosis**

**Acute form**
- Fever (41°C), anorexia, lethargy
- Multifocal hyperaemia and haemorrhagic lesions of the skin, conjunctivitis
- Cyanosis of the skin especially of extremities (ears, limbs, tail, snout)
- Transient constipation followed by diarrhoea
- Vomiting (occasional)
- Dyspnoea, coughing
- Ataxia, paresis and convulsion
- Pigs huddle together
- Death occurs 5-15 days after onset of illness
- Mortality in young pigs can approach 100%

**Chronic form**
- Dullness, capricious appetite, pyrexia, diarrhoea for up to 1 month
- Apparent recovery with eventual relapse and death

**Congenital form**
- Congenital tremor, weakness
- Runting, poor growth over a period of weeks or months leading to death
- Clinically normal but persistently viraemic pigs, with no antibody response

**Mild form (sows)**
- Transient pyrexia and inappetence
- Fetal death, resorption, mummification, stillbirth
- Birth of live, congenitally affected piglets
- Abortion (rare)

**Lesions: Acute form**
- Leucopaenia and thrombocytopenia
- Widespread petechiae and ecchymoses, especially in the skin, lymph nodes, larynx, bladder, kidney, ileocaecal junction
- Multifocal infarction of the margin of the spleen is characteristic but not always present
- Enlarged haemorrhagic lymph nodes are common
• Encephalomyelitis with perivascular cuffing

**Chronic form**  
  i) Button ulcers in the caecum and large intestine, ii) Generalised depletion of lymphoid tissue, iii) Haemorrhagic and inflammatory lesions are often absent,

**Congenital form** -  
  i) Central dysmyelinogenesis, cerebellar hypoplasia, microencephaly, pulmonary hypoplasia, hydrops and other malformations

**Laboratory diagnosis**

**Procedures**

**Identification of the agent**

- Direct immunofluorescence test on cryostat sections of organs from affected pigs
- Virus isolation in cell culture, with virus detection by immunofluorescence or immunoperoxidase. Confirmatory identification with monoclonal antibodies

**Serological tests**

- Neutralisation peroxidase-linked assay
- Fluorescent antibody virus neutralisation
- ELISA

**Samples: Identification of the agent**

- Tonsil
- Lymph nodes (pharyngeal, mesenteric)
- Spleen kept under refrigeration and shipped to laboratory as quickly as possible
- Kidney
- Distal ileum
- Blood in EDTA (live cases)

**Serological tests**

- Serum samples from suspect recovered animals, from sows with suspected congenitally infected litters, or from pigs under surveillance

**PREVENTION AND CONTROL:** No treatment is possible. Affected pigs must be slaughtered and the carcases buried or incinerated

**Sanitary prophylaxis**

- Effective communication between veterinary authorities, veterinary practitioners and pig farmers
- Effective disease reporting system
- Strict import policy for live pigs, and fresh and cured pig meat
- Quarantine of pigs before admission into herd
- Efficient sterilisation (or prohibition) of waste food fed to pigs
• Efficient control of rendering plants
• Structured serological surveillance targeted to breeding sows and boars
• Effective pig identification and recording system

Medical prophylaxis: Vaccination with modified live virus strains is effective in preventing losses in countries where classical swine fever is enzootic, but is unlikely, on its own, to eliminate infection entirely. In countries which are free of disease, or where eradication is in progress, vaccination is normally prohibited.

Response to outbreaks

• Slaughter of all pigs on affected farms
• Disposal of carcasses, bedding, etc.
• Thorough disinfection
• Designation of infected zone, with control of pig movements
• Detailed epidemiological investigation, with tracing of possible sources (up-stream) and possible spread (down-stream) of infection
• Surveillance of infected zone, and surrounding area designed to prevent the spread of disease onto a farm. It is accomplished by maintaining the facility in such a way that there is minimal traffic of biological organisms (viruses, bacteria, rodents, etc.) across its borders.

Biosecurity is the cheapest, most effective means of disease control available. No disease prevention program will work without it.

Vaccines and feasibility: Vaccination is recommended in the field. There is vaccine and already certified by Govt. of India (available in State Institutes of Veterinary Biologicals). Protection will be solid after 15-20 days post vaccination, only/usually, it will work to start on 7 days onwards. Simultaneously Vaccination against HS may be needed to stop or overcome post complicacy of the disease with Pasteurellosis.
The integrated farming has emerged as an effective alternative to monofarming or monoculture of fish, raising of agri-crops or domestic animals. The integration of aquaculture with livestock, poultry, paddy as well as horticulture in a unified farming system has produced to be highly sustainable with reduced production cost. It is now quite prevalent in South East Asian countries including India. Out of these types of farming systems, modern trend now a day is integration of livestock with fish farming. It holds great promise and potential for augmenting production of animal protein, betterment of rural economy and generation of employment. The waste recycling and utilization is the key feature of the system, which provides for an environmentally sound and sustainable utilization of the land and water resources thus overcoming waste disposal problems and averting health related hazards. Since animal wastes make good feed and fertilizer for fish ponds, and about 60% of the total farming cost goes for feed; integrating livestock with fish farming makes sense. Through this type of integration, one can completely save cost on fertilizers and supplementary feed for fish production as the waste materials generated acts as a substitute for feed and pond fertilizer.

The basic necessity of such integration is not only to make the farm economically viable but also to fulfill the demands as inputs to other structural inputs. These inputs can, therefore, be recycled for food production through an integrated system of fish farming in combination with poultry, duck, goat, cattle and pig farming. As a sequel to this, in recent years, attempts have been made to standardize the number of animals required per unit area of water for supplying feed and fertilizer to get high fish yields from ponds besides obtaining meat, egg, milk, fibre from livestock sources.

Fish-cum-pig farming

The integrated pig cum fish culture system envisages raising of two crops of exotic pigs and single crop of fish during a culture period of one year. It has been estimated that each pig voides between 500-600 kg dung in one year time (250-300 kg/pig in six months) and about 30-40 pigs are adequate to fertilize one ha. of water area of pond under polyculture. Fish not only utilize the feed spilled by the pigs but also feed on the fresh pig dung which contains 70% of the digestible food. It is also reported that the excreta while passing through the alimentary canal of pig gets mixed up with certain enzymes and as such has high feed value for fish. The pig dung also acts as an excellent fertilizer and improves the biological productivity of the pond water. Due to high manurial value of pig dung, the fish grow very fast in the system. Thus, this type of integration can be termed as an effective means of waste utilization producing animal protein at low cost with total savings on inorganic fertilizers and supplementary fish feed.

The piglets are kept in sheds either sited hanging on the pond surface or kept near the pond on the embankment so that the wastes are directly drained in to the pond. In case of indoor system, pig house with thatched roof is preferred with cemented floor and good drainage facility. For healthy growth of pigs, house should be well ventilated and a living space of 1 to 1.5 sq. m per pig should be provided. The kind of pigs to be raised must be chosen with care since all the domesticated races are not productive although they are disease resistant. Among the exotic varieties, land race are most suitable because of their quick...
growth and prolific breeding ability. About two months old weaned piglets can be kept and fattened for six months when they reach maturity (60-70 kg). During this period, it is wise to sell them and fresh batch of two months old piglets should be introduced for further rearing. As pigs are single stomached animal, balanced diet @ 1.4 kg/pig/day is necessary to accelerate metabolic function and to maintain good health. Besides, grasses and green cattle fodder should be provided to them along with drinking water.

**Poultry-cum-fish farming**

Poultry farming is now well established in both rural and urban areas as it requires less space, low capital investment, quick returns and distributed turnover through out the year. Thus, the integration of poultry with fish farming can go a long way in animal protein production. Moreover, Poultry manure is a complete fertilizer with the characteristics of both organic as well as inorganic fertilizers, and is rich in highly soluble inorganic salts.

Poultry are kept either in extensive, semi-intensive and intensive system. In deep litter system of intensive type, up to 250 birds are kept in pens covered with 6” of dry organic matter (chopped straw, dry leaves, ground nut and broken maize, straw dust etc.). In about six month’s time, it becomes built-in-deep litter, and fully built-up litter in 10-12 months. About 25-30 birds produce one ton of deep litter in one year and as such 500-600 birds are adequate to provide manure for one ha. of water area under polyculture. Results show that one kg of fish can be produced by using about 17 kg of chicken manure. The deep litter contains 3% nitrogen, 2% phosphate and 2% potash. Selection of birds should be done depending upon the requirement i.e. meat type (broiler), egg type (layers), game purpose etc. Shed constructed for the purpose should be reasonably cool during summer, warm during winter with proper ventilation. For each bird, a living space of 0.3-0.5 sq. m should be provided. Poultry feeds are now available under different trade names in the market. Birds should be fed with balanced feed @ 50-70 gm/bird/day for 9-20 weeks age.

In case of layers, egg production starts at the age of 22 weeks and one bird normally lays between 210-250 eggs. Birds should be sold after 18 months of rearing as the egg laying capacity decreases after that period. In fish-cum poultry farming, a production of 4,500-5,000 kg of fish/ha/yr, more than 70,000 eggs per year and 1250 kg of live weight chicken meat can be obtained.

**Duck-cum-fish farming**

The raising of ducks in fish ponds fits very well as they are highly compatible with fish under farming. Experiences have shown that this combination increases the production of animal protein and decreases the input cost of fish farming as well. The ducks are given a free range over the pond surface from 9 A.M. to 5 P.M. The daily waste of duck feed and droppings collected can be utilized as fish feed and fertilizer thereby increasing the biomass of the natural food organisms in fish ponds. Further, the ducks feed on aquatic insects, tadpoles, mollusks, aquatic weeds that are not essential for stocked fish. The dabbling of ducks at the pond bottom in search of food releases nutrients from the soil making them available for plankton production. Ducks function as bio-aerator as they swim, play and chase each other in pond, thereby diffusing atmospheric oxygen in surface water. The ducks in turn get clean and healthy environment to live, and quality natural food from the pond for their growth.

The kind of duck to be raised must be chosen with care since all the domestic races are not productive and hardy enough to resist weather conditions. Although the local variety like Indian runner is suitable, exotic variety like khaki campbell, if available, should be preferred to be raised along with fish. Each duck voides between 125-150 gms of droppings per day that contains 0.9 % nitrogen and 0.38 % phosphate on dry matter basis. It has been found that 200-300 ducks are sufficient to produce manure adequate enough to fertilise one ha. of water area under polyculture. A low cost night shelter providing 0.3-0.5 sq. m floor space per duck can be constructed using split bamboos, cheap wood etc. Otherwise, a floating house can be constructed on the water surface using empty oil barrels and floats. Although duck feed is not available commercially, a mixture of any standard poultry feed
and good quality rice bran in the ratio of 1:2 by weight can be fed to ducks @ 75-100 gms feed / day / bird. The ducks are quite susceptible to aflatoxicosis. Therefore, mouldy feed or feed kept over long time should not be given to them. Ducks usually attain maturity at the age of 24 weeks when they start laying eggs, which continue for two years. The ducks lay egg only at night, so there is no possibility of eggs being laid when ducks are in the pond during daytime. The local variety of duck lays between 180 to 200 eggs per year whereas the exotic khaki campbell lay about 200 eggs during the same period. Ducks should, therefore, be sold after completion of two years of rearing as their egg laying capacity decreases after that. However, ducks do prey upon fry and small fingerlings. Therefore, only large fingerlings above 4"size should be stocked in polyculture. A total yield of 3,500 to 4,000 duck eggs and 500-750 kg duck meat (live weight) can be produced in this farming system.

Goat-cum-fish farming

Although goat farming is an age-old practice, its integration with fish farming has not been explored fully. India has one fourth of the world's total goat population. Goat droppings (around 4 mm pellet size) can be used as manure to fertilise pond water. As the pellets contain mucus and are in semi-dried state, deterioration of water quality is less as compared to other manures. The solid excreta of goat is also several times richer in nitrogen (2.7%) and phosphate (1.78%) content than almost all animal faeces. It has also been observed that 40-50 kg of goat manure produces one kg of fish.

There are about 13 well-known Indian breeds of goats scattered throughout the country. Breed should be chosen depending upon the requirement i.e. meat, milk and fibre types and local conditions. The house should preferably be kept in undulating lands. However, they thrive on marshy and swampy grounds and may contact parasitic infections mainly from such places. Goats love eating anything and everything of trees, shrub leaves, chaffed fodder etc. Some of the common green roughages preferred by goats are berseem (Trifolium alexandrium), alfalfa (Medicago sativa), napier grass (Pennisetum purpureum), green arhar (Cajanus cajan), leaves of trees of babool (Acacia arabica), neem (Azadirachta indica), ber (Ziziphus mauritiana), tamarind (Tamarindus indica) etc. They should be given concentrate mixture of gram, grain, wheat bran, maize grain, linseed cake along with Vitamin supplement of A, D and E. Besides, abundant clean water should be made available to them every morning and evening.

Cattle-cum-fish farming

Cattle farming is almost a way of life for people living in rural India. Cattle dung and urine can be collected and utilized in fish ponds to increase productivity of pond water. The output in terms of fish production from manured ponds is 2-4 times more than unmanured ponds. The quantity of dung voided by cattle (5 kg / day) ranks very high as compared to other livestock. As the dung is very fine due to repeated digestion in stomachs of cattle, it can remain suspended for a longer period in water enabling fish to get more feed. The Biological Oxygen Demand (BOD) of cattle manure is relatively lower because micro-organisms in the body of cattle decompose the forage of cattle. Cattle manure is nutritively rich and the levels of nitrogen (0.7%) and phosphorous (0.3%) are very congenial for plankton production. About 6-8 cattle are required to provide manure for one ha. water body under polyculture. Selection of cattle breed should be made depending upon the requirement and local conditions. Cattle shed should preferably be made adjacent to fish pond and a living space of 7 sq. m per cattle is stated to be sufficient. They should be fed with rice bran, oil cake, broken maize, fodder etc. in an appropriate combination. Disinfections of animal shed and vaccination should be done at regular intervals to keep the animals in good health. It has been seen that when cattle dung is applied @ 15,000 kg per year per ha. water area in fish ponds, an excellent yield of 5,000 kg fish can be obtained.
Conclusion

There is no denying of the fact that the integration of livestock with fish farming will go a long way in increasing the animal protein production, as research studies have shown that integration of these components is technically feasible and economically viable. In a country like India, where landholdings are small with surplus labour, this farming system could generate gainful employment for the rural poor. But maximum return from an integrated farming system can only be obtained by taking into consideration the natural and agro-climatic conditions, food preference, market demand, socio-economic conditions of people etc. For example, pig cum fish culture will not be beneficial where pig flesh is not accepted as food. A sizeable section of weaker rural community especially the tribes who traditionally raise pigs can take fish-cum-pig farming. A tri-commodity farming system involving poultry, pig and fish could be taken up utilizing waste materials to obtain animal protein. Likewise, duck cum-fish culture could be a preferable choice of integration in north-eastern part of India. Similarly, the slurry obtained after biogas production from cattle manure could be used effectively as manure giving more returns as compared to applying cow dung directly in ponds. Apart from these, appropriate training about scientific way of fish farm management and animal husbandry practices should be organized at regular intervals for rural unemployed youths and farmers interested to take up integrated farming. Along with this, if financial assistance in terms of short term loan is provided to them, they can earn livelihood producing protein rich nutritive human food utilizing wastes through integrated livestock-fish farming.

Further readings


Animal genetic resources exist in vast variety of breeds and livestock population, which have evolved and adapted over many centuries, to the range of environmental conditions encountered throughout the world. The pressure of selection imposed by soil climate, altitude, available food supply, endemic diseases and parasites, management techniques and market demands have resulted in thousands of breeds, types strains, each with their genetic make up and each adapted to its specific niche.

The future development and improvement of livestock through agriculture is dependant upon the availability of this genetic variation, which is its principal resource. The animal genetic resources available throughout the world are in a dramatic state of decline. Mithun (*Bos frontalis*), a unique animal of North eastern hills region of our country, is also under same state of condition.

Mithun (*Bos frontalis*), the pride animal of North-Eastern hills, is a rare species of livestock. This animal is confined to North Eastern Hill region of our country and also found in Myanmar, Bhutan, and Bangladesh as well as Yunan province of China. This animal has got great potential for Meat, Milk and hide.

This animal is well adapted in steep jungles at an elevation ranged from 300-3000 m MSL and has got important place in Economic, Social, cultural and religious life of tribal people of Arunachal Pradesh, Nagaland, Manipur and Mizoram. This is an underutilized animal and has got a great potential for quality meat, milk and leather production. The quality of meat, milk as well as leather of this animal is very good and there is a great scope to promote this animal as an organic meat and milk producer.

This animal prefers cold and mild climate. They are browsers like goats and can utilize coarse fodder, which are generally not consumed by other livestock. This is a very fertile animal, which can produce one calf in a year with age at puberty vary from 22-30 months. Their productive year ranges from 16-18 years.

Verma (1996) recognized 2 distinct types of Mithun and named them as Nagami and Arunachali and these two distinctive types have also been reported by Arora (1998). However, Bhusan et al (2000-2001) have identified four distinct strains and named them as Arunachalee, Mizoram, Nagami and Manipuri strain based on genetic studies using RAPD technique. The names indicate their home tract in NEH region. From the recent census it is seen that the population has been increased in all the states except in Mizoram where the population has gone down.
The important event related to Indian livestock trade and commerce is the India's signing of the Uruguay Round Agreement (URA) of the General Agreement on Tariffs and Trade (GATT) in April 1994, which was re-christened as the World Trade Organization (WTO). However as a part of commitment under WTO and domestic market reforms all quantitative restrictions and other non-tariff barriers on the import and export of livestock products were removed and most of livestock products were put under Open General License (OGL) by April 1, 2001 and the Indian markets have been opened up to the world markets. The above developments exposed Indian livestock sector to the highly distorted world markets.

The WTO’s Agriculture Agreement which was negotiated in the 1986–94 Uruguay Round, is a significant first step towards fair competition and a less distorted sector. Agreement on Agriculture (AOA) has following parts

I. The concessions and commitments Members are to undertake on market access,
II. Domestic support and export subsidies;
III. The Agreement on Sanitary and Phytosanitary Measures;
IV. The Ministerial Decision concerning Least-Developed and Net Food-Importing Developing countries.

The objectives of the Agreement On Agriculture (AOA) are

- To reform trade in the sector and to make policies more market-oriented.
- This would improve predictability and security for importing and exporting countries alike.
- To encourage the use of less trade-distorting domestic support policies to maintain the rural economy, that allow actions to be taken to ease any adjustment burden.
- Introduction of tightly prescribed provisions that allow some flexibility in the implementation of commitments.
- To address the concerns of developing countries and also the concerns of net-food importing countries and least-developed countries.

The agricultural package provides for commitments in the area of

- Market access — various trade restrictions confronting imports
- Domestic support — subsidies and other programmes, including those that raise or guarantee farmgate prices and farmers’ incomes.
- Export subsidies and other methods used to make exports artificially competitive.
Market access

Under market access commitments in the AoA, member countries were required to replace all types of non-tariff barriers with tariffs, and to reduce tariff levels under a time-bound programme. In addition to these commitments, this measure also called for maintaining current access opportunities and establishing minimum access tariff quotas. Tariffs resulting from this "tarification" process, as well as other tariffs on agricultural products, are to be reduced by an average 36 per cent in the case of developed countries and 24 per cent in the case of developing countries, with minimum reductions for each tariff line being required. Reductions are to be undertaken over six years in the case of developed countries and over ten years in the case of developing countries. Least-developed countries are not required to reduce their tariffs. For countries such as India, where all agricultural imports were covered by QRs for Balance of Payment (BOP) reasons, only ceiling bindings had to be submitted. For these ceiling bindings, there was no upper limit, provided the tariffs had not been bound in earlier rounds of negotiations. In addition, there was no obligation to reduce these ceiling bindings during the implementation period.

In the quota system, only certain countries can sell their product under the quota. Quotas are often allotted to specific countries because of past commitments under bilateral or regional trade agreements such as NAFTA. The world trade in dairy products was about 4.4 million tons ("World Dairy Situation 2000", IDF) and about 36 per cent of this (accounting for about 1.5 million tons) was through the quotas maintained by 27 countries. For example, EU's butter quota of about 75000 tons is allotted to New Zealand ("European Union: Dairy products annual 2000", USPA). Similarly in milk powder, 40,000 tons of Mexico's tariff quota of 120000 tons is reserved for the US ("Summary of the results of the Uruguay Round in the dairy Sector", GATT, 1994).

When the QRs were being removed (discussed in detail below), apprehensions were expressed about the likely impact of these liberalization measures on the domestic market, particularly in the case of those commodities for which the bound levels of tariffs were zero percent. These included commodities such as rice, coarse grains and dairy products, which were bound in the earlier rounds of negotiations. To raise bound rates for these products, India initiated negotiations with its trading partners under Article XXVIII of GATT and renegotiated new bound tariffs, which are shown in Table 1. In the case of dairy products, the new bound tariff rates were 60 percent, and in the case of cereals, the new bindings range between 70 and 80 percent.

Changes in quantitative restrictions on imports

As India had maintained QRs for BOP reasons, a few members of the WTO questioned the justification to continue these restrictions with the improvement in the BOP situation in the mid-1990s. Initially, India proposed a time schedule of nine years for the complete elimination of QRs that were maintained owing to BOP reasons. The developing member countries accepted this proposal, but the developed countries were uncomfortable with the time schedule that India had proposed. A group of six developed countries/regions (Australia, Canada, EU, New Zealand, Switzerland and United States) with Japan as a third party initiated dispute settlement proceedings against India. India negotiated a deal with five members with the exception of United States to phase out its QRs over a period of six years beginning in 1997. The United States, however, went ahead and filed a dispute against India. A Dispute Settlement Panel was constituted in November 1997, which ruled against India. India filed an appeal before the Appellate Body, which endorsed the findings of the panel.

As a consequence, an agreement was signed between India and United States under which India agreed to abolish all the remaining QRs that were being maintained because of BOP reasons by April 2001. While these negotiations were taking place with the members of the WTO, India started the process of removing QRs on imports unilaterally. After the agreement between India and the United States, dismantling of the remaining QRs on 2714
items was completed in April 2001. QRs are now maintained on imports of only about 5 percent of tariff lines (538 items) under Articles XX and XXI of GATT on grounds of health, safety and moral conduct.

**Implications of the removal of quantitative restrictions on imports**

It is premature to speculate on the exact impact of the removal of the QRs on imports of agricultural products, because the last instalment of QRs was removed only in April 2001. The early trends in imports, however, suggest that the surge in imports that was feared after the removal of the QRs has not occurred. This is indicated by the imports of a few selected items which are being treated as sensitive and whose imports are being monitored on a continuous basis (Table 1).

Table 1. Imports of selected agricultural commodities (US$ million)

<table>
<thead>
<tr>
<th>Section No.</th>
<th>Product</th>
<th>April-December 2000</th>
<th>April-December 2001</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk and milk products</td>
<td>8.9</td>
<td>1.9</td>
<td>-78.7</td>
</tr>
<tr>
<td>2</td>
<td>Fruits and vegetables</td>
<td>287.6</td>
<td>154.6</td>
<td>-46.2</td>
</tr>
<tr>
<td>3</td>
<td>Poultry</td>
<td>Negligible</td>
<td>0.1</td>
<td>n.a.</td>
</tr>
</tbody>
</table>


These somewhat early trends in imports establish that the protection provided to Indian agriculture through QRs was really redundant because, in most years, domestic agricultural prices of the major crops were lower than world prices (Gulati and Sharma, 1994; Gulati and Sharma, 1997). Consequently, the abolition of import controls did not lead to large imports of these commodities.

In addition, during the re-negotiations to raise zero bound rates, India had to grant a few concessions, which led to the establishment of tariff rate quotas (TRQ) for five commodities (Table 2). As the in-quota tariffs for these commodities are low, their imports certainly can go up to the agreed limits of tariff rate quotas.

Table 2. TRQs established for selected agricultural products during the renegotiations of tariffs

<table>
<thead>
<tr>
<th>Section No.</th>
<th>Product</th>
<th>TRQ (tonnes)</th>
<th>In-quota tariff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skimmed milk powder - in powder granular form of fat content not exceeding 1.5 percent</td>
<td>10 000</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Skimmed milk powder - not containing added sugar or other sweetening material</td>
<td>10 000</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Maize (other)</td>
<td>350 000 - 450 000</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Rape, colza or mustard oil, other</td>
<td>150 000</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>Sunflower seed or safflower oil and fractions thereof</td>
<td>150 000</td>
<td>50</td>
</tr>
</tbody>
</table>

Countries use a number of policy instruments such as support prices and input subsidies, which affect incentives that farmers receive in terms of prices and hence influence resource allocation. In the AoA, the impact of price support and related policies is captured through the AMS. India has a product price support system in the form of minimum support prices announced by the government for different commodities, based on the recommendations of the Commission for Agricultural Costs and Prices. However, for livestock products, no such direct support is provided by Government of India.

As a percentage of the value of agricultural output (crop sector), the product-specific AMS is (-)26 percent during this period. In 1995-1996, the estimated product specific AMS turned out to be (-)34.4 percent of the value of agricultural output, and by 2000-2001, the same stood at about (-)28.6 percent of the value of agricultural output during that year. The non-product-specific support, which includes subsidies on irrigation, fertilizers, electricity, credit and seeds, was about 1.3 percent of the value of agricultural output during the base period after allowing for exemptions which are granted for resource poor farmers in developing countries. In 1995-1996, the non-product-specific support was roughly 1.9 percent of the value of agricultural output, and by 2000-2001, the same worked out to be about 2.3 percent of the value of agricultural output. The negative product specific support to Indian agriculture basically shows that various controls on domestic as well external trade have kept domestic prices of major crops below world prices. In the case of domestic trade, these controls included restrictions on the movement of agricultural commodities, compulsory procurement levies, licensing and stocking requirements and credit controls. The controls on external trade comprised export prohibitions, quantitative restrictions, minimum export prices and canalization. The net result of these policies has been that negative product specific support outweighs the positive non-product specific support.

Export competition

The European Union is by far the largest user of export subsidies. Between 1995 and 2001, global export subsidies amounted to over $39 billion cumulatively, of which over 89% is from the EU. By comparison, the US, spent just over $US 556 million on export subsidies between 1995 and 2001, much of it for dairy exports under the Dairy Export Incentive Program (DEIP) and just over $US 10 million subsidizing poultry under the Export Enhancement Program (EEP). Other significant users of export subsidies include Switzerland, which subsidizes dairy products, fruits and vegetables, and other processed food, and Norway, which uses export subsidies for dairy and to lesser extent for nonbovine livestock. During 2002-03 the volume of subsidized quantity exports and expenditure in EU were 292 000 tons and Euro 545 million for respectively butter & butteroil; 220000 tons and Euro 163 million respectively for skim milk powder (SMP). In 2002/2003, the actual export subsidy expenditure was EUR 268 million.

Export subsidies are offered by major dairy countries to cover the difference between high local and low international prices, to dispose surplus stocks and thus to prevent any fall in local price. The average EU and US subsidy applied to SMP exports is more than 40 percent of average wholesale domestic price of the product. Consequently, it is difficult for countries that do not provide export subsidies to sell their products in the international market. The EU has been actively subsidizing the disposal of surpluses in many commodities to the world market, and thus, distorting trade flows. By using export subsidies, the EU has also been expanding its world market share in agricultural products. Under the Uruguay Round implementation period, the export subsidy expenditure was reduced by 36 percent and the volume of subsidised export was reduced by 21 percent over a period of six years from 1995 to 2001.
Indian Scenario

Indian tariffs for dairy products are low as compared to major countries. For SMP, the bound tariffs are 237 per cent in Canada and 176 per cent in Korea -- as against the renegotiated 15 per cent on the first 10,000 MT and 60 per cent thereafter for India. For Butter the bound tariff works out to a phenomenal 648 per cent in Japan, 351 per cent in Canada, 113 per cent in the EU and 100 per cent in the US -- as against 40 per cent in India. These computations are based on international prices, exchange rates and other relevant assumptions.

India does not have a system of direct export subsidies, so it made no commitments on export subsidies. There were a few benefits that were available to the exporters of agricultural commodities through income tax exemptions under section 80 - HHC of the Income Tax Act (1961) on profits from export sales. In 2000, the government decided to phase out these benefits over a period of five years starting from 2000-2001, making profits completely taxable by 2004-2005.

As the agreement allows developing member countries to subsidize costs of marketing agricultural products including handling, upgrading and other processing costs and the costs of domestic and international transport and freight, India is making use of these provisions. The schemes facilitate mainly the exports of horticultural items and are operated by the Agricultural and Processed Food Products Export Development Authority (APEDA). Because the exports of many agricultural items have been adversely hit owing to the fall in commodity prices and aggressive subsidization by those members which are allowed to subsidize their exports, the government is thinking of extending these subsidies, which are permissible under the agreement, to other agricultural products as well.

Although there is no commitment for India on export subsidies, there are restrictions on introducing direct export subsidies in the future that are not compatible with the agreement. This has become a binding constraint in the light of the huge surplus stocks of cereals, which are currently much above the stipulated norms for buffer stocks. Managing these surpluses, which are due to a combination of several factors such as domestic policy, good monsoons and low commodity prices in international markets, has become an important issue. The significance of this problem can be gauged from the fact that in the few years back the stocks of cereals had been swollen to about 63 million tonnes (May 2002). This level of stocks is about four times the minimum buffer stock norm prescribed for the month of April. Holding such a high level of stocks is expensive, but the options are limited. Releasing these stocks in the open market will lead to a significant fall in prices, which may benefit consumers in the short run, but will have significant implications for future output growth and food security in the long run. Similarly, exporting at such low prices is also not feasible without resorting to direct subsidies, which are not permissible.

As regards export controls, there were two broad groups of commodities which were treated differently. One group consisted of traditional and newer export products such as tea, coffee, spices, tobacco, oil meals, hides and skins, jute, fish and fruit and vegetables. In the 1960s and early 1970s, exports of these commodities were restricted by export taxes and other controls, but during the late 1970s and the 1980s, policies became more supportive of exports, for example, by removing most export taxes. At the time of the 1991 reforms, a number of complex export regulations to which these products were subject were abolished or simplified.

The other group, which is much larger in terms of production, employment and domestic consumption, includes the main cereals, skimmed milk, pulses, sugar, oilseeds and cotton. Exports of all these products have been controlled, in most cases directly by state agencies, and in others, through export prohibitions and minimum export prices. These prohibitions were widespread in the past and even now continue to be an important tool to ensure commodities in the domestic market in case of shortages. The recent example is the ban on export of skimmed milk declared in the month of January 2007.
For most of these commodities, these controls have now become meaningless in the light of excessive supplies and the removal of QRs on imports. The government constituted a panel of members of parliament, which recommended the abolition of such controls. This recent shift in policy has been notified in the new export-import policy, which was announced in April 2002.

**Sanitary and phytosanitary standards**

The provisions of the SPS Agreement state that "measures taken to protect human, animal or plant life or health, must be based on scientific principles and shall not be applied in a manner that would constitute a disguised trade restrictions." But world trade is distorted by entry barriers like arbitrarily higher standards for food quality and this make it difficult for any emerging country to acquire a major share in the world market. Higher standards for food safety and quality are imposed arbitrarily by many importing countries, encompassing animal health requirements, standards on microbiological quality, environmental contaminants etc. It could be difficult for India to meet these standards due to lack of infrastructure facilities.

Indian products which have been particularly affected by SPS measures include marine products, groundnut and egg powder. Some cases have also been reported for mango pulp and sugar. Regarding egg products, a Japanese importer reported the presence of BHC (beta isomer), a contaminant, far in excess of the permissible level, which affected exports of egg products. A study sponsored by the Department of Food Processing Industries in early 2001 revealed that 81 per cent of the samples of imported food products, including milk products, did not meet PFA Rule 32 (labeling requirement) and Packaged Commodities Rules 33. About 69 per cent of the samples did not have the importer's address, 64 per cent did not have the MRP printed on their pack, 22 per cent were found adulterated due to use of non-permitted colours/flavours and vegetable fats, 55 per cent were found not to carry a batch/lot number and 58 per cent of the products did not declare the month and year of manufacture. The Director General of Food Trade, Ministry of Commerce, Government of India should therefore issue directions to ensure that imported products meet domestic food regulations at the port of entry in terms of such laws and rules as the PFA, Packaged Commodities Rules, and M&MPO etc.

These cases brought into focus several issues including lack of awareness and the problem of consistency of domestic SPS standards with the standards of the importing countries. To handle the problems originating from these cases, the government has taken several steps. For marine products, the rules for quality control and inspection of exports under the "Export of Fresh, Frozen and Processed Fish and Fishery Products (Quality control, inspection and monitoring) Order and Rules, 1995" have been modelled on the basis of the directives given by the importing countries. These rules also comply with the HACCP quality control methodology. More units are being encouraged to comply with these standards.

The Government of India also set up a National Codex Committee under the Department of Health, Ministry of Health and Family Welfare. The Export Inspection Council and its agencies under the Ministry of Commerce, such as APEDA, have started framing standards for the products and packaging of meat, poultry, dairy and honey, grading and packing standards for spices, walnuts, vegetables, fruits and flowers. The State Departments of Animal Husbandry & Dairying under the respective State Governments have set standards for meat and meat products, poultry and milk and milk products.

There is no doubt that, ultimately, better SPS standards should lead to the lessening of health risks and should benefit consumers, but the manner in which these standards are being enforced gives an idea of the many problems that are being faced by the exporters of developing countries. Broadly, there are three types of problems.
I. There are institutional problems such as what should be the point of inspection and conformity (internal or the point of entry) and who should provide the scientific basis to settle disputes.

II. Costs of compliance are becoming highly prohibitive because SPS standards are being changed periodically, which makes it difficult to attain the prescribed norms since the norms are becoming more stringent and are moving targets. As opposed to these periodic changes in SPS measures, the technical assistance to help exporters to match these requirements is simply lacking.

III. Regardless of the fact that the agreement encourages multilateral agreements on mutual recognition of equivalence of specified SPS measures, member countries enter into bilateral mutual equivalence agreements. This practice favours imports from some countries over others, which results in discrimination against other members.
Sheep and Goat Breeding Policy in India

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Introduction

Sheep and goat are the most important species of livestock in the country. They are considered as one of the earliest discovery of mankind in prehistoric times for ready and easy source of meat. Beside meat they produce milk, skin and fibre / hair. The human race took little time to understand the value of its milk, hair and skin. Now sheep and goat play an important role in the country by contributing significantly to the economy of resource poor people besides meeting their nutritional requirement. They are of economic importance to the people living in arid, semi-arid, hot humid, hilly and heavy rainfall areas, where they can sustain themselves on meager forage and extreme climatic conditions. Sheep and goat have diverse ecological adaptability over a wide range of agro-climatic zones. Farmers particularly in drought prone and tribal areas prefer sheep and goat due to their small size, short generation intervals, higher rate of prolificacy, easy handling, easy marketing of their products and proportionately high returns.

Population dynamics

Goat: India ranks first among the countries in the world for possessing largest population of goats. The goat population in India was estimated as 120 million (Livestock Census, 2003) which is almost 17% of the total global goat population of 690 million. There are about 20 well defined goat breeds which contribute about 46% of the total goat population in the country. The remaining is non-descriptive having mixed features. Most of the breeds are evolved through geographical isolation and natural selection to suit the specific agro-ecological conditions based on their utility and production function. The region-wise distribution of goat breeds is given in Table-1.

Sheep: India has vast genetic resources of sheep. The total sheep population in the country is 61.78 million (Livestock Census, 2003) ranking 4th in the world and accounting for about 5% of total global population (125 million). In India, there are 40 defined breeds of sheep which contribute about 85% of the total sheep population in the country. The persistence of sheep breeds under different agro-climatic condition not only reflects its adaptability but confirms its utility under multifaceted economy of that area. Most of the breeds of sheep existing in India today evolved through natural selection for adaptation to different niches. To some extent there has been artificial selection based on social and economic requirements of the farmers/breeders. Most of the breeds are very well adapted to harsh climate, long migration, poor nutrition and scanty drinking water. The region-wise sheep breed distribution in India is given in Table-2.

Production status

Goats are the main meat animals in the country. Their meat is most-preferred and hence costliest of all meats. It is estimated that about 410 million kg of chevon, 1900 million kg of milk, 101 million kg of skin, 30 metric tones of pashmina and 85 metric tones of manure are produced annually from goat in the country. Goat meat represented 37% of total meat
produced in the country, although goat milk represented only 3% of the total milk produced. The average carcass weight of Indian goats is 9 kg which is 25% less than the world average. Indian goats produce an average of 58 kg milk per lactation whereas in case of exotic breeds of goat it exceeds 400 kg per lactation. On the other hand, 169 million kg of mutton, 42.7 million kg of wool and 40 million kg of skins are produced annually from sheep in the country. The production characteristics of Indian sheep with respect to quality and quantity of wool and mutton are very poor in comparison to exotic breeds. The average annual wool production is 700 kg per head as compared to 5-6 kg in European countries. On an average an Indian sheep produces 9.6 kg mutton while an exotic sheep yields 22 kg at a younger age. The annual per capita availability of meat in India is 5 kg against the recommendation of 11 kg per capita. Moreover, sheep and goat farming in the country provided gainful employment of women and children. Therefore, there is considerable scope for developing sheep and goat production not only for internal demand but also for export.

Development efforts

The sheep & goat development are extremely vital for the following reasons:

i) To improve socio-economic conditions of the weaker sections of the society.

ii) To produce more sheep & goat meat for supply of protein for the growing human population.

iii) To produce more superior quality wool to meet the needs of our growing woolen sector.

iv) To reduce dependence on import of raw-wool and thereby minimize the drain of foreign exchange.

v) To produce more milk and skin.

vi) To earn foreign exchange for the country by exporting live sheep & goat for meat and woolen goods.

To accomplish the above objective efforts were made since early sixties. As the performance of indigenous breeds is low in comparison to the exotic breeds, considerable emphasis has been given on crossbreeding of indigenous breeds with exotic germplasm as well as with indigenous improver breeds. The exotic breeds of sheep used for this purpose were Merino, Rambouillet, Karakul, Corriedale, Dorset, Suffolk etc. To improve the local goat breeds the exotic breeds of goat used were Saanen, Alpine, Toggenberg, Alglo-Nubian, Angora etc. The performance of some Indigenous sheep & goat and their crossbreeds has been given in Table-3, Table-4, Table-5 and Table-6. The resultant outcome was very inconsistent due to several reasons. Generally it has been found that exotic germplasm and crossbreds hardly perform better than indigenous animals under similar field conditions and same feeding regime. Although such efforts have resulted development of some new breeds / strains in sheep for wool quality and carcass traits (Table-7). However all the indigenous sheep & goat breeds are known for adaptability under varied climatic conditions from their long struggle against the natural forces and as a result they acquire some unique features (Table-8). These characteristics of indigenous breeds are found to lose when crossbreeding is undertaken. In case of goat, the indigenous breeds have high prolificacy, which is lost due to crossbreeding. The number of kids weaned per doe being an important economic trait and as the species is the preferred animal for meat, indiscriminate use of exotic blood is not desirable. In the field conditions as majority of the sheep & goat farmers belong to landless category they did not prefer crossbreds due to high cost involvement. Thus the development efforts that have been undertaken in the past have suffered due to reasons like i) Poor exploitation of the sheep & goat genetic resources, ii) Inadequate feed and fodder resources, iii) Poor health coverage, iv) Risk prone production systems, v) Economic and social backwardness of the farmers, vi) Inadequate marketing and financial infrastructure and vii) Low investment in research and
development. Hence, there is imperative need to take up sheep & goat development schemes in the country not only for supply of improved genetic material to the farmers but also for increase of per capita productivity. Recently there is a growing realization for conservation of indigenous breeds of different species of livestock because of their suitability and adaptation to diversified agro-climatic and socio-economic situations. With this in view, the breeding strategies and improvement programmes should, therefore devised considering the efficiency of production in relation to physical environment, feed and fodder resources availability, management and health aspects.

**Breeding policy recommended**

1. Adoption of “Selective Breeding” programme among indigenous breeds of sheep & goat for improvement of various economic traits like birth weight, weight at slaughter age (9 to 12 months), litter size, wool yield and quality, skin quality etc.

2. Implementation of “Open Nucleus Breeding System” in the breeding tract for production of bucks / rams. The purebred selected males should only be used in the tract. The best males should be primarily selected from the breeding tract of the breed for genetic improvement.

3. Creation of “Buck / Ram Mother Farms” in different areas of breeding tract where improved males would be produced for distribution in the field.

4. Creation of facility for exchange of breeding bucks / ram among the farmers to reduce inbreeding.

5. Characterisation of non-descript flocks through systemic survey of the home tracts.

6. Upgradation of low producing non-descript sheep and goat with elite males of the region for their genetic improvement.

**Table-1: Goat breeds of India**

<table>
<thead>
<tr>
<th>North-Temperate</th>
<th>North-Western</th>
<th>Southern</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaddi (MHS)</td>
<td>Jamnapari (MMS)</td>
<td>Sangameri (MHS)</td>
<td>Ganjam (MS)</td>
</tr>
<tr>
<td>Changthangi (MPS)</td>
<td>Marwari (MHS)</td>
<td>Osmanabadi (MMS)</td>
<td>Bengal (MS)</td>
</tr>
<tr>
<td>Chegu (MPS)</td>
<td>Zalawadi (MMS)</td>
<td>Kanai Adu (MS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beetal (MMS)</td>
<td>Malabari (MMS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kutchi (MHS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sirohi (MMS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barbri (MMS)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Mehsana (MMS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surti (MMS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jhakrana (MMS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gohilwadi (MHS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MS=Meat & Skin, MMS=Meat, Milk & Skin, MHS=Meat, Hair & Skin, MPS=Meat, Pashmina & Skin
### Table-2: Sheep breeds of India

<table>
<thead>
<tr>
<th>North-Temperate</th>
<th>North-Western</th>
<th>Southern</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhakarwal (CW)</td>
<td>Chokla (CW)</td>
<td>Bellary (MCW)</td>
<td>Balangir (MCW)</td>
</tr>
<tr>
<td>Changthangi (CW)</td>
<td>Hissardale (AW)</td>
<td>Coimbatore (MCW)</td>
<td>Bonpala (MCW)</td>
</tr>
<tr>
<td>Gaddi (CW)</td>
<td>Jaisalmeri (MCW)</td>
<td>Deccani (M)</td>
<td>Chottanagpuri (MCW)</td>
</tr>
<tr>
<td>Gurez CW)</td>
<td>Jalauni (MCW)</td>
<td>Hassan (M)</td>
<td>Ganjam (MCW)</td>
</tr>
<tr>
<td>Karnah AW)</td>
<td>Kheri (MCW)</td>
<td>Kanguri (M)</td>
<td>Garole (M)</td>
</tr>
<tr>
<td>Kashmir-Merino (AW)</td>
<td>Magra (CW)</td>
<td>Kilakarsal (M)</td>
<td>Tibetan (CW)</td>
</tr>
<tr>
<td>Poonchi (CW)</td>
<td>Malpura (MCW)</td>
<td>Madras Red (M)</td>
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<tr>
<td>Rampur Bushair (CW)</td>
<td>Marwari (MCW)</td>
<td>Mandya (M)</td>
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<tr>
<td></td>
<td>Muzaffarinagari (MCW)</td>
<td>Mecheri(M)</td>
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<tr>
<td></td>
<td>Nali (CW)</td>
<td>Nellore (M)</td>
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<tr>
<td></td>
<td>Pattanwadi (CW)</td>
<td>Nilgiri (AW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pugal (MCW)</td>
<td>Rammand White (M)</td>
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</tr>
<tr>
<td></td>
<td>Sonadi (MCW)</td>
<td>Tiruchy Black (M)</td>
<td></td>
</tr>
</tbody>
</table>

AW=Apparel wool, CW=Carpet wool, MCW=Meat and Carpet wool, M=Meat

### Table-3: Average body weight at different ages of some indigenous sheep and their crossbreds

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Birth weight (kg)</th>
<th>Weaning weight (kg)</th>
<th>Weight at 6 months (kg)</th>
<th>Weight at 12 months (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magra (Bekanari)</td>
<td>3.18</td>
<td>12.08</td>
<td>17.55</td>
<td>31.85</td>
</tr>
<tr>
<td>Corriedale X Magra</td>
<td>3.48</td>
<td>13.40</td>
<td>19.96</td>
<td>27.18</td>
</tr>
<tr>
<td>Malpura</td>
<td>3.12</td>
<td>11.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rambouillet X Malpura</td>
<td>3.79</td>
<td>17.59</td>
<td></td>
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</tr>
<tr>
<td>Nali</td>
<td>2.81</td>
<td>10.75</td>
<td>13.81</td>
<td>18.27</td>
</tr>
<tr>
<td>Russian Merino X Nali</td>
<td>2.87</td>
<td>10.57</td>
<td>12.60</td>
<td>20.91</td>
</tr>
<tr>
<td>Muzaffarnagari</td>
<td>2.70</td>
<td>10.20</td>
<td>15.99</td>
<td>27.85</td>
</tr>
<tr>
<td>Corriedale X Muzaffarnagari</td>
<td>3.10</td>
<td>10.20</td>
<td>17.48</td>
<td>28.32</td>
</tr>
<tr>
<td>Chokla</td>
<td>2.44</td>
<td>9.60</td>
<td>10.81</td>
<td>20.90</td>
</tr>
<tr>
<td>Russian Merino X Chokla</td>
<td>2.59</td>
<td>9.98</td>
<td>11.46</td>
<td>18.89</td>
</tr>
<tr>
<td>Deccani</td>
<td>2.80</td>
<td>11.08</td>
<td>14.80</td>
<td>19.90</td>
</tr>
<tr>
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<td>2.90</td>
<td>13.75</td>
<td>15.26</td>
<td>18.50</td>
</tr>
<tr>
<td>Madras Red</td>
<td>2.76</td>
<td>13.69</td>
<td>16.59</td>
<td>22.03</td>
</tr>
<tr>
<td>Mandya</td>
<td>2.35</td>
<td>11.17</td>
<td>13.81</td>
<td>21.02</td>
</tr>
<tr>
<td>Nellore</td>
<td>2.38</td>
<td>9.51</td>
<td>13.31</td>
<td>18.66</td>
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</table>
Table-4: Average wool yield and quality of some indigenous sheep and their crossbreds

<table>
<thead>
<tr>
<th>Breeds</th>
<th>6 monthly wool yield (kg)</th>
<th>Fibre diameter (μ)</th>
<th>Staple length (cm)</th>
<th>Medullation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magra</td>
<td>0.98</td>
<td>34.46</td>
<td>8.23</td>
<td>49.21</td>
</tr>
<tr>
<td>Chokla</td>
<td>1.23</td>
<td>29.88</td>
<td>4.99</td>
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<tr>
<td>Rambouillet X Chokla</td>
<td>1.22</td>
<td>19.44</td>
<td>4.46</td>
<td>23.79</td>
</tr>
<tr>
<td>Nali</td>
<td>1.95</td>
<td>33.53</td>
<td>8.98</td>
<td>32.24</td>
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<tr>
<td>Rambouillet X Nali</td>
<td>1.18</td>
<td>22.63</td>
<td>4.55</td>
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<tr>
<td>Malpura</td>
<td>0.62</td>
<td>38.28</td>
<td>4.15</td>
<td>45.21</td>
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<tr>
<td>Rambouillet X Malpura</td>
<td>1.05</td>
<td>28.49</td>
<td>4.03</td>
<td>43.62</td>
</tr>
<tr>
<td>Deccani</td>
<td>0.74</td>
<td>34.10</td>
<td>6.95</td>
<td>21.00</td>
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<tr>
<td>Rambouillet X Deccani</td>
<td>1.32</td>
<td>24.77</td>
<td>5.96</td>
<td>14.00</td>
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</table>

Table-5: Carcass traits of some indigenous breeds of goat

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Pre-slaughter weight (kg)</th>
<th>Dressed carcass weight (kg)</th>
<th>Dressing percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbari</td>
<td>19.6</td>
<td>9.7</td>
<td>49.7</td>
</tr>
<tr>
<td>Beetal</td>
<td>20.3</td>
<td>9.4</td>
<td>46.2</td>
</tr>
<tr>
<td>Black Bengal</td>
<td>15.8</td>
<td>7.0</td>
<td>44.5</td>
</tr>
<tr>
<td>Jamnapari</td>
<td>22.9</td>
<td>10.5</td>
<td>45.9</td>
</tr>
<tr>
<td>Maharasra Local</td>
<td>13.7</td>
<td>6.2</td>
<td>45.7</td>
</tr>
<tr>
<td>Sirohi</td>
<td>17.2</td>
<td>7.6</td>
<td>44.2</td>
</tr>
</tbody>
</table>

Table-6: Improvement of carcass traits (expressed in %) of some crossbreds of goat

<table>
<thead>
<tr>
<th>Crossbreds</th>
<th>Pre-slaughter wt.</th>
<th>Dressed carcass wt.</th>
<th>Dressing percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine X Beetal</td>
<td>18.7</td>
<td>23.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Saanen X Beetal</td>
<td>21.6</td>
<td>23.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Angora X Maharasra Local</td>
<td>35.5</td>
<td>36.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Black Bengal X Jamnapari</td>
<td>54.2</td>
<td>68.8</td>
<td>9.4</td>
</tr>
<tr>
<td>Black Bengal X Beetal</td>
<td>56.1</td>
<td>65.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Black Bengal X Barbari</td>
<td>23.3</td>
<td>25.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Table-7: New breeds/strains of sheep developed in India

<table>
<thead>
<tr>
<th>Breeds/Strains</th>
<th>Indigenous breeds used</th>
<th>Exotic breeds used</th>
<th>Level of exotic inheritance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bharat Merino</td>
<td>Chokla, Nali</td>
<td>Rambouillet, Merino</td>
<td>75</td>
</tr>
<tr>
<td>Avivastra</td>
<td>Chokla, Nali</td>
<td>Rambouillet, Merino</td>
<td>50</td>
</tr>
<tr>
<td>Sandyno/Sandynallah</td>
<td>Nilgiri</td>
<td>Merino</td>
<td>62.5 / 75</td>
</tr>
<tr>
<td>Patanwadi Synthetic</td>
<td>Patanwadi</td>
<td>Rambouillet, Merino</td>
<td>50</td>
</tr>
<tr>
<td>Avikalin</td>
<td>Malpura</td>
<td>Rambouillet</td>
<td>50</td>
</tr>
<tr>
<td>Avimanns</td>
<td>Malpura, Sonadi</td>
<td>Dorset, Suffolk</td>
<td>50</td>
</tr>
<tr>
<td>Indian Karakul</td>
<td>Marwari, Malpura</td>
<td>Karakul</td>
<td>75</td>
</tr>
<tr>
<td>Kashmir Merino</td>
<td>Sonadi, Gaddi, Bhakarwal</td>
<td>Delaine Merino, Soviet Merino, Rambouillet</td>
<td>50 / 75</td>
</tr>
</tbody>
</table>

Table-8: Sheep and goat breeds with unique features

<table>
<thead>
<tr>
<th>Name of breeds</th>
<th>Unique features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magra</td>
<td>Lustrous wool</td>
</tr>
<tr>
<td>Changthangi</td>
<td>Alpine sheep of high altitude for fine wool</td>
</tr>
<tr>
<td>Garole</td>
<td>High fecundity under mangrove ecology</td>
</tr>
<tr>
<td>Marwari, Jaisalmeri and Chokla</td>
<td>Hardy and capable of traveling long distances</td>
</tr>
<tr>
<td>Patanwadi and Chokla</td>
<td>Best carpet wool quality</td>
</tr>
<tr>
<td>Bengal / Black Bengal</td>
<td>High prolificacy and best quality of meat &amp; skin</td>
</tr>
<tr>
<td>Jamnapuri, Beetal, Barbari</td>
<td>Best dual purpose breed</td>
</tr>
</tbody>
</table>

References


Health Management for Enhancement of Production

AK Bera, Scientist
Indian Veterinary Research Institute
Eastern Regional Station
37-Belgachia Road, Kolkata-700 037

Introduction

**Industrialized animal agriculture**

The intensification of animal agriculture has created complex animal health and production problems. For which there are no simple and therapeutic and preventive procedures. This has made the task of the veterinarian much more challenging. For example, acute diarrhoea of calves under thirty days of age may be caused by several different enteric pathogens but knowledge of the risk factors and epidemiological determinants such as colostral immunity and population density is probably more important for effective clinical management and control of the disease. The solution to this type of complex problems are not always readily apparent, in part because of insufficient research on etiology and epidemiology and different control strategies in the herds where the problems are occurring. The veterinarians must be knowledgeable and skillful in the principle of epidemiology, applied nutrition and animal housing, the education and training of animal attendant, and the analysis of production indices including profit and loss, which includes the use of computers, in addition to being skilled in the traditional veterinary disciplines of medicine, reproduction, pharmacology and pathology. Thus the food producing animals practitioners must become more skilled in the simultaneous management of animal health and production; the modern livestock producer is cost conscious and anything veterinarians do or recommend must be cost effective.

**Disease as an economic process**

Livestock production is a specific example of a physical transformation process. Disease impairs this process (i.e. reduced output) and sometimes results in death. Thus, there is loss of efficiency, which possesses both technical and economic problems. The technical efficiency loss is the difference between the production functions of ‘healthy’ and ‘diseased’ animals. The disease acts as a ‘negative input’ and the relationship between input and output is shifted downwards, reflecting lower outputs for given inputs in diseased animals compared with disease free animals.

**Assessing the economic cost of the disease**

The total economic cost of the disease can be measured as the sum of output losses and control expenditures. A reduction in output is a loss because it is a benefit that is either taken away. Expenditures, in contrast, are increases in input and are usually associated with disease control. Example of control expenditures are veterinary interventions and increased use of agricultural labour, both of which may be used either therapeutically or prophylactically.

**Livestock and poultry health management**

Livestock and poultry health can be managed by means of various ways

a. **Management of animal’s environment and improvement in feeding, watering and animal husbandry practices.** Management of animal’s environment can prevent a number of bacterial and parasitic diseases. For example; mastitis in dairy herd and coccidiosis in young ruminants and poultry can be reduced by taking proper hygienic measurement.
b. Eradication, control or management of etiological factors

i. Doing nothing
   This is not strictly a technique of control but illustrates that the incidence of disease may be reduced by natural changes in host/parasite relationship without the intervention of man.

ii. Quarantine
   Quarantine is isolation of animals that are either infected or suspected of being so, or of non-infected animals that are at risk. It is used to isolate animals when they are imported from countries where exotic diseases are endemic. The period of quarantine depends on the incubation period of the agent, the time taken for the infection to be confirmed, and the time taken for an infected animal to become noninfectious (either with or without treatment).

iii. Slaughtering animals:
   Source of pathogens can be destroyed by this method. This is also sometimes required to make system economically and technically survivable. For example, FMD, clinical mastitis, bovine TB etc.

iv. Vaccination:
   Vaccine can confer immunity to many bacteria, virus and some helminths. Vaccines may be living and inactivated, antigens generated by genetic engineering techniques, genetically attenuated organisms, live recombinant organisms, naked DNA, synthetic peptides and anti-idiotypic vaccines.

v. Therapy and prophylactic chemotherapy:
   Antibiotic, anthelmintic, other drugs and Hyperimmune serum are used therapeutically to treat the disease and are administered prophylactically at the time of high risk to prevent disease and thus to increase productivity.

vi. Movement of hosts:
   Animals can be removed from high risk areas where infection are endemic.

vii. Mixed, alternate and sequential grazing
   The level of infection of some nematode can be reduced by using these types of grazing system.

viii. Control of biological and mechanical vectors
   Destruction snails and Tabanus fly may be essential tools to control fascioliosis and trypanosomiasis, respectively.

c. King Animal resistant to pathogen

GENETIC IMPROVEMENT SPECIALLY OF AVIANS
Understanding the Immune System:

The objective of any poultry management program should be disease prevention through effective biosecurity practices. If there is a breakdown in biosecurity, and a disease outbreak occurs, be sure the chickens are immunologically competent. This will limit the resulting losses. Poultry producers need to understand the function of the immune system to assure that its integrity is maintained and that full advantage of its protective capability is utilized. The avian immune system is divided into nonspecific and specific immune mechanisms.

Nonspecific Immune Mechanisms:
Nonspecific immune mechanisms include the innate or inherent ways in which the chicken resists disease. This protective system is often not considered when designing a poultry health program. Many programs tend to rely primarily on vaccinations and/or antibiotics to
maintain flock health. The importance of nonspecific immune mechanisms should be realized. Examples have been included.

**Examples**: Genetic factors - birds may not have complementary receptors to allow many disease organisms to infect them. For example, some strains of chickens are genetically resistant to the lymphoid leukemia virus.

Anatomic features - many disease organisms cannot penetrate intact body coverings (skin and mucous membranes) or are trapped in the mucus secretions. Some nutritional deficiencies (biotin deficiency) or infectious diseases compromise the integrity of the body coverings, allowing penetration of disease organisms.

Normal microflora - the skin and gut normally maintain a dense, stable microbial population. This stable microflora prevents invading disease organisms from gaining a foothold. Improper use of antibiotics or poor sanitation can disrupt the balance of the microflora.

Respiratory tract cilia - parts of the respiratory system are lined with cilia, which remove disease organisms and debris. If the air in the poultry house is of poor quality due to high levels of dust or ammonia, the ciliary system may be overwhelmed and become ineffective. Other factors involved in innate resistance include nutritional (avoid heat/cold stress), age (young/old animals are more susceptible to disease), inflammatory processes, metabolic factors, complement and interferon.

The reason that good management practices are important in maintaining poultry health is better understood when the nonspecific immune mechanisms are defined. For example, poor sanitation or the overuse of antibiotics may lead to a disruption of the normal microflora; poor nutrition may lead to deficiencies that allow disease organisms to penetrate the protective body coverings; selection of disease resistant strains of chickens may preclude or lessen the effects of certain diseases.

**Specific Immune Mechanisms**

In contrast, specific immune mechanisms (acquired system) are characterized by specificity, heterogeneity and memory. This system is divided into noncellular (humoral) and cellular components.

**Noncellular immune mechanisms**

The noncellular components include immunoglobulins (antibodies) and the cells that produce them. Antibodies are specific (specificity) for the foreign matter (antigen) to which they attach. For example, the antibody against Newcastle disease virus will attach only to the Newcastle virus, not to the infectious bronchitis virus (heterogeneity). There are three classes of antibodies that are produced in the chicken after exposure to a disease organism: Ig M, Ig G and Ig A.

Ig M appears 4 to 5 days following exposure to a disease organism and will disappear in 10 to 12 days. Ig G is detectable 5 days following exposure, peaks at 3 to 3 1/2 weeks and then slowly decreases. Ig G is the important protective antibody in the chicken, and is measured by most serologic test systems. Thus, if you are interested in determining antibody titer levels following vaccination, you should collect sera after 3 to 3 1/2 weeks. If sera is evaluated prior to this time, the antibody titer levels are still increasing, which makes interpretation of the vaccination program difficult. Ig A appears 5 days following exposure, peaks at 3 to 3 1/2 weeks, and then slowly decreases. This antibody is found primarily in the mucus secretions of the eyes, gut, and respiratory tract, and provides "local" protection to these tissues.
The cells that produce antibodies are called B-lymphocytes. These cells are produced in the embryonic liver, yolk sac and bone marrow. The cells move to the bursa of Fabricius (BF) at 15 days incubation and remain there through 10 weeks of age. The BF programs these cells, which then move to the blood, spleen, cecal tonsils, bone marrow, Harderian gland and thymus. Destruction of the BF at a young age by Gumboro disease virus or Marek's disease virus prevents the programming of B-cells. Thus, the chicken will not be able to respond as effectively to diseases or vaccinations by producing antibodies.

When a disease organism enters the body, it is engulfed by a phagocytic-type cell, the macrophage. The macrophage transports the disease organism and exposes it to the B-lymphocytes. The B-cells respond by producing antibodies 5 days following exposure. The lag period occurs because the B-cells must be programmed and undergo clonal expansion to increase their numbers. If the chicken is exposed a second time to the same disease, the response is quicker, and a much higher level of antibody production occurs (memory). This is the basis for vaccinating.

Antibodies do not have the capability to kill viruses or bacteria directly. Antibodies perform their function by attaching to disease organisms and blocking their receptors. The disease organisms are then prevented from attaching to their target cell receptors in the chicken. For example, an infectious bronchitis virus that has its receptors covered with antibodies will not be able to attach to and penetrate its target cells, the cells lining the trachea. The attached antibodies also immobilize the disease organism that facilitates their destruction by macrophages.

**Cellular Immune mechanisms**

The cellular component includes all the cells that react with specificity to antigens, except those associated with antibody production. The cells associated with this system, the T-lymphocytes, begin as the same stem cells as the B-cells. However, the T-lymphocytes are programmed in the thymus rather than the BF.

The T-lymphocytes include a more heterogeneous population than the B-cells. Some T-cells act by producing lymphokines (over 90 different ones have been identified); others directly destroy disease organisms. Some T-cells act to enhance the response of B-cells, macrophages, or other T-cells (helpers); others inhibit the activity of these cells (suppressors). The cellular system was identified when it was shown that chickens with damaged BF could still respond to and eliminate many disease organisms.

**Active Immunity**

A chicken may become immune to a disease organism by producing antibodies itself or by obtaining antibodies from another animal. When the chicken produces its own antibodies following exposure to a foreign material, the process is called active immunity. This occurs after the bird is exposed to a vaccine or a disease. Active immunity is harmed by anything that damages the cellular or humoral immune system.

**Passive immunity**

When the chick receives pre-made antibodies from the hen through the egg, this is termed passive immunity. These antibodies are not produced by the chick. Maternal antibodies are present in the yolk albumin, and fluids of the egg. If the hen has a high antibody titer level to a disease, the chick should also be immune for several weeks. However, since the immune system of the chick is not stimulated, there will be no antibodies produced by the chick and no memory cells.
The flock manager must be aware of the maternal antibody levels in the chicks to schedule vaccinations. If chickens are vaccinated when maternal antibody titer levels are elevated, the vaccine may be buffered excessively, resulting in a reduced response. Conversely, if vaccinations are delayed and maternal titer levels are low, a severe vaccine reaction may result. Chickens may also be susceptible to diseases as maternal titer levels will be low, and approximately 12 days is required following vaccination before minimal protective antibody levels are produced.

In summary, the immune system of the chicken is very helpful in preventing disease and helping to ensure that maximum productive potential is realized. We must learn how to take advantage of all parts of the system when designing health programs.

**Serology**

Routinely, serum samples are submitted to a poultry diagnostic laboratory to determine antibody titer levels as an aid in the diagnosis of disease or as part of a routine monitoring program. However, it is important to keep in mind that the ELISA serologic test system commonly used measures only Ig G levels in the blood. No determination is made of Ig A (local protection), Ig M (early protection), cell-mediated immunity, or the nonspecific immune system. Although serology can be very useful in a poultry health program it is important to understand its limitations.

ELISA serology, commonly used in the poultry industry, has limitations. Some of these include the following:

- Measures Ig G response only, not Ig A, Ig M, CMI or the nonspecific immune mechanisms.
- Must have paired sera to make determinations (diagnostic).
- Must have an organized bleeding schedule (monitoring).
- Antigenic specificity may lead to inaccurate results.
- Serum samples must be properly selected (randomly, sufficient number).
- Selection of birds is critical (representative of the disease problem - diagnostic; or of the flock-monitoring). Lack of consistency of results between laboratories.

**II. NON-SPECIFIC IMMUNOSTIMULATION**

Non-specific immunostimulation includes immunomodulation of the host system by using microbial herbal component or other neutraceuticals. These agents are in use for enhancing production performance both in livestock and poultry sector.

**Further Reading**


**Electronic Reference**

1. www.edis.ifas.ufl.edu
Basic human needs are food, clothing, shelter, fuel, transport etc. along with recreational requirements. Livestock and livestock products provide many of these needs and contribute to our standard of living. Since human civilization, cattle and other animals are domesticated to fulfill the human needs. With the advancement of science and technology, there are various developments in rearing of livestock to enhance the production. Specially in the era of globalization and WTO regime; most advance technologies available in the field are to be utilized to improve the productivity in competitive manner, so that livestock production system will be cost effective and sustainable. With this in view various components of Dairy Cattle Production Management are discussed. Dairy Cattle Production Management comprises different aspects of dairy herd operations which are as follows:

1. Care and Management during calving
3. Handling of heifers
4. Milking operations and clean milk production
5. Tips of lactation Management.
6. Reproductive Management.
8. Raising young bulls and Management of breeding bulls.
9. Herd structure and replacement.
11. Special management practices to ameliorate tropical heat stress.
12. Herd evaluation techniques.
13. Health control programmes and monitoring.

1.1 Care and Management During Calving:

Calving is the important process and consists of pre-calving, calving and post-calving stages. Necessary care should be taken in all the three stages for successful calving. Pre-calving care and management include following stages:

1. Proper feeding of advance pregnant cows is essential to ensure optimum growth of the foetus during last two months before calving. Each pregnant cow/heifer should be given pregnancy allowance @ one kg concentrate mixture/day in addition to her normal ration.
2. Minimum dry period of 50-60 days should be provided to all cows to ensure sufficient rest to the udder which will be helpful for next lactation.
3. Prior to calving (at least 7-10 days before calving) all advanced pregnant cows should be housed in calving pens for better management care and to ensure safe calving. The calving pens should be clean, dry, hygienic and spacious for safe and easy calving.
4. The udder and teats of the high yielding cows become large, discolored and tense just before calving in acute condition. It is necessary to milk the udder before calving to provide relief to the cows. In such cases colostrum should be preserved for new calves.

5. In case of pregnant heifers, udder massaging twice daily for a period of 5 min. prior to one month before calving is very helpful for obtaining better udder size and to increase 10-15 percent more milk production in 1st lactation. This practice is also helpful to train the heifers for milking.

Attention during calving process is very important as it is a critical period both for dam and its calf. Proper care and vigilance are necessary to ensure normal calving, which usually occurs within an hour after appearance of water bag. In case of delay, immediate veterinary assistance should be provided for safe calving. Generally, delay of calving more than one hour after appearance of water bag requires external assistance. The average time required for various stages of calving process i.e. time required for dilatation of cervix, time required for expulsion of foetus and time required for expulsion of placenta is 115, 25 and 318 min, respectively. Total average time taken for calving process is about 458 min.

Post-calving care and management directly and indirectly influence reproduction and production of the cow. It is generally observed that in 96 percent cases, placenta expelled naturally within 10-12 hours of normal calving. If the placenta does not expelled within 12-18 hours of calving, external help is generally required for removal of placenta. In case of external manipulation, sufficient antibiotic coverage should be given to check secondary infections. The laxative diet should be given to recent calvers for 3-4 days after calving and gradually normal feeding to be resumed. It is advisable to keep recent calvers separately for at least 15 days to ensure better post-calving management and feeding before they are mixed to general herd.

1.2 Management of New Born Calves:

Calves are the future herd stock. Successful dairy farming depends on efficient young stock raising in the herd. The maximum mortality occurred during the first 3 months of the life, specially within 1st 15 days of life. So, intensive care can reduce the mortality level to 5-8 percent which is usually considered better. It was found that the average mortality of female calves upto the age of first calving was about 30 percent in crossbred. Out of this
30 percent mortality, about 20% occurred within first 3 months of age. Therefore maximum attention should be given during the early part of the life to reduce mortality rate of the herd.

To minimise the calf mortality, feeding of colostrum is very important. The colostrum contains maternal anti-bodies essential to protect the calf from the infection it will face in early life before it has generated its own active system of immunity. It is absolutely essential for the newly born calves to drink an adequate quantity of colostrum i.e. cow's first milk preferably as soon as possible after birth (within 1/2 hour) and positively within 1 st 3-6 hours of life. Because it is only at this time the intestinal wall of the calf is sufficiently permeable to absorb the maternal anti-bodies from the colostrum unchanged. The permeability of the gut to these anti-bodies starts to decline very shortly after birth and has almost disappeared by about 18 hours after birth.

The following standard can be followed for successful calf rearing programme.

1. Immediately after birth all the mucus should be removed from the mouth and nostrils of the calf. If calf does not breath, immediately artificial respiration should be induced by alternately compressing and relaxing chest wall of the calf. The whole body of the calf should be cleaned and dried.

2. Remove the calf from the mother immediately after birth. If weaning is to be practiced at birth. In many cases calf is being kept for first 12 hours with dam and then it is seperated for weaning. But in case of indogenous cows, it is difficult to separate calf if it is not done just after birth. However, in crossbred cows there is not much problem of weaning either at birth or after few hours after birth.

3. Disinfect the naval chord after aseptically ligating and cutting at a distance of 1” from the base of the naval chord.

4. Birth weight of the calf should be recorded just after birth before feeding of colostrum.

5. Colostrum should be fed to calf as soon as possible after birth preferably within 5-6 hours of the birth and to be continued upto 3-4 days.

6. Feeding of anti-bodies to young calf for first 3-4 days gives better result to check the infections.

7. Calf should be identified as soon as possible by tattooing in the left ear. In case temporary identification is required, this can be done by hanging a paper lebel in the neck of the calf. Subsequently hot
8. The weaned calf should be individually fed lukewarm milk according to recommended feeding schedules (Table-1). It is desirable to keep calves in individual calf pens up to 3 months of age.

Table 1: Milk Feeding Schedule for Calves

<table>
<thead>
<tr>
<th>Age of the calf</th>
<th>Colostrum</th>
<th>Whole Milk</th>
<th>Calf starter</th>
<th>Legume Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 days</td>
<td>1/10 of the birth weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-56 days</td>
<td>Do</td>
<td>1/10th ad. lib</td>
<td>ad. lib</td>
<td>ad. lib</td>
</tr>
<tr>
<td>57-63 days</td>
<td>Do</td>
<td>1/20th ad. lib</td>
<td>ad. lib</td>
<td>ad. lib</td>
</tr>
<tr>
<td>64-70 days</td>
<td>Do</td>
<td>1/40th ad. lib</td>
<td>ad. lib</td>
<td>ad. lib</td>
</tr>
</tbody>
</table>

9. If young calves are kept in groups, they should be tied up during feeding time and at least up to half an hour after feeding to prevent them from licking and sucking each other’s body, ears, navel, scrotum or teats which causes problems.

10. All calves should be closely inspected at least twice a day for any signs of illness or distress. Sick calf should be separated from healthy stock.

11. Calves should be dehorned within 2 weeks of age by using caustic potash stick. The electric dehorner may be used within 4-6 weeks of age. Supramammary teat on the udder are always better to be removed at an early age.

12. Regular deworming, vaccination, spraying etc. should be practiced as per schedule of the farm.
1.3 Handling of Heifers:

Heifers are future replacement stock of the milch herd. Generally 15-20% of the cows are to be culled every year because of low production, poor breeding efficiency, disease and other reasons. A regular supply of good replacement stock from heifers is essential for maintaining the production level of the farm. It was observed that survival of crossbred female calves up to age at first calving was only 70%. Therefore, following care and management practices may be followed for successful rearing of the heifers.

1. Proper feeding of good quality feeds and fodder to the heifers to be ensured.
2. Providing sufficient housing space for comfortable accommodation according to the age group and body size of the heifers is essential.
3. Intensive heat detection should be practiced in heifers as soon as they attain the age of maturity which is generally achieved around 15-18 months of age.
4. Heifers should be bred only after they attain optimum age and body weight. This varies from breed to breed. However, approximately 200-225 Kg of body weight and 15-18 months of age can be considered as optimum for first breeding.
5. Udder massaging of pregnant heifers from 7-8 months of pregnancy onwards is helpful to develop udder size and also to increase 10-15% of milk yield in 1st lactation.
6. Advanced pregnant heifers are to be fed specially because they require nutrition both for their own growth and the growth of their foetus.

1.4 Milking Operation and Clean Milk Production:

The regular timely milking is the most important single factor for running successful dairy farm. The efficient milking is an actual harvesting of dairy farming. Milk let down is controlled by the hormonal action. This action is temporary and its influences continued for only 5-8 minutes, so milking should preferably be completed within this time. There are many steps in milking process. Whatever, the steps taken, these should not be changed frequently. Frequent changes affect milk production. For the better and efficient milking the experienced milkers should be selected and they
should be trained accordingly. There are two types of milking i.e. (1) Hand milking and (2) Machine milking.

In India, mostly hand milking is practised. In hand milking again there are two types of system i.e. (1) Full hand milking (ii) stripping. Full hand milking is generally followed for long and medium size teats and stripping is mostly followed in small size teats. Full hand milking is generally followed which considered better than stripping.

Regularity of milking is the most important factor. It is customary to milk twice a day in equal interval i.e. in the morning and evening. This is strictly to be followed. Three times milking is also practised which increased 10-15% of yield than two times milking. In case of high yield cows, i.e. producing more than 10-15 l/day of milk/day, three times milking may be economical. The frequency of three times milking may be fixed considering the equal intervals i.e. 4 A.M., 12 A.M. and 8 P.M. daily.

Special care and attention should be given to milk the 1st calvers. Generally milkers find difficulty to milk 1st calvers because of their small teats or giving some problem during initial milking. So, attention should be given to milk completely with care at least first one month and thereafter these animals will be habituated for milking.

Following standard may be adopted systematically for milking process.

1. Tying the cows in milking byre.
2. Wash the animals and shed before milking.
3. Offer concentrate mixture just before milking.
4. Tie the leg-knot, wash the udder and teats with anti-septic lotion and then dry-up the udder with soaked towel.
5. Few strips of milk from each teats should be drawn into strip-cup and examined for the presence of mastitis infection. In case of any infection that cow should be kept for milking in the last and necessary treatment may be given.
6. Milking should preferably be completed within 5-8 minutes as the hormonal action initiates at starting of milking lasts only for 5-8 min.
7. Complete milking should be ensured.
8. After milking, the leg knot of the cow to be opened and the milk to be recorded after weighing.
9. Before starting to milk next cow, the milker should dip their hand in anti-septic lotion kept in milking byre.
1.5. Tips of Lactation Management:

Lactation management is a complex phenomenon which requires perfect planning, clear understanding of certain terminologies along with their concept, for better harvesting of milk. Some of the common terms used in recording and managing in milch herd are discussed.

1. Lactation length is the duration from the date of calving to the end of a particular lactation. Total milk yield during one lactation is termed as lactational yield. Milk produced in 300 days of lactation period is generally used as a standard lactational yield for comparison and statistical analysis. Wet average or milking average of a cow is obtained by dividing her total lactational yield by its lactation length. The overall average is calculated by dividing total lactational yield, by its succeeding calving interval (lactation length plus dry period). Milk average of the herd is the average milk production per-day per milch cow in a herd while the herd average is the milk yield per-day per cow (both milch and dry cows) in a herd. Ratio of milch and dry cows indicates the performance status of a herd, where 80:20 ratio is considered as optimum. To maintain this ratio every cow should calve in every 12-13 months interval. This means about 7 to 8 percent of cows in a herd should calve in every month.

Milk production gradually increases from first lactation to 3rd/4th lactation and thereafter it started decline. Peak yield in a lactation is attained in cows within 40-45 days after calving which is maintained for a certain period and thereafter started decline. The persistency of lactation is the tendency of a cow to maintain its trend of day to day milk production in a lactation. Stage of lactation refers to a specific span in lactation period and is generally expressed in weeks. Proper care should be taken to achieve peak yield as early as possible and to maintain it for longer period to get more total yield from the cow.

2. Recently calved cows should be kept separately in one paddock upto 15 days from calving date for better feeding and management. The milch cows should be grouped and kept separately on the basis of their level of production, stages of lactation, body weight and sizes. This facilitates for their better feeding and management in each group. Monthly body weight should be recorded which is helpful as guidance for feeding and other cares to the cows.
First calvers should also be kept separately for special care and management. This is because first calvers animals require additional feeding care for both production, reproduction and growth. Special attention and care should be ensured for high yielding cows for their feeding, milking and management. In high producing cows (more than 15 Kg of milk per-day) three times milking should be practiced which will increase 10-15% of more milk production.

1.6 Reproductive Management of Dairy Cows:

Regular reproduction is the single most important factor for optimum production in diary cows. A cow must get in calf in every 12-13 months if she is to be efficient producer. Hence, the first priority of breeding programme is to get cows in calf quickly so that calving is not spread over for long time. To ensure a desirable reproduction, following should be considered.

i. Heifers should be bred only after she has attained optimum growth and age i.e. either a minimum body weight of about 200 kg or at least 15-18 months of age which ever comes earlier.

ii. The Involution of uterus in normal calvers is generally completed by 30-35 days after calving so, breeding can be resumed by 45 days post-partum in normal calvers to reduce the calving interval. In abnormal calvers, minimum 60 days rest should be given after calving for rebreeding. Because Involution of uterus requires more time (45-50 days) in abnormal calvers.

iii. If the cow does not show heat symptoms by 45-60 days after calving, she should be examined by veterinarians for necessary treatments.

iv. Careful and systematic heat detection is an important tool for better reproductive management. It has been reported that when heat symptoms were observed as frequent as 4.3,2 and 1 times a day. The accuracy of heat detection was 100, 91, 80 and 61% respectively. Generally, 25% of mounting occurs between 6 P.M. to 12 P.M. and 43% between 1.00 A.M. to 6.00 A.M. so heat detection in the early morning hours (i.e. in winter from 6.00 A.M. to 7.00 A.M. and in summer from 5.30 A.M. to 6.30 A.M. and in evening hour 4.30 P.M. to 5.30 P.M. In winter and 5.30 P.M. to 6.30 P.M. In summer) is considered suitable by breeder bull parading with experience stockman. For detection of heat, it is essential to provide optimum environmental conditions i.e. adequate paddock space, dry and antislippery floors, proper nutrition, loose housing paddocks etc.
The parameters for preparing a project for livestock farming are variable among species, breed, climatic condition, number of animal (herd size), availability (source) and nature of feed and fodder, scope of marketing, allied supportive industries etc. There are certain principles of assumptions to formulate such type of projects. The cost of project is varying against a fixed assumption depending upon the price of materials, equipments and other necessary requirement for a project. Hence, only the technical parameters with the principle are discussed in brief. Most of the livestock owners are related to cattle farming and more than fifty percent of the economies of animal husbandry are also depending upon the cattle rearing. Hence, the dairy project preparation can get more importance than the other livestock farming project preparation.

**Assumption**

1. **Purchase of Cow** – The cow will be purchased in two equal batches at 6 months interval. The cow should be purchased between 1st to 2nd lactating stages having calf (1 – 2 months of age) at heel. Their yield performance should be at least 8 – 10 liters per day.

2. **Lactation** – Lactation period 300 days and dry period 60 days will be considered in a year. The average lactation yield will be assumed as 6 liter per day, where about 75% of expected yield will be achieved at 1st lactation following 85% at 2nd & 3rd lactation, 90% (peak) at 4th lactation and more progressive decline from 5th lactation.

3. **Calving Interval** – The calving interval will be considered as 1 year.

4. **Breeding** – Proper breeding programme should to be maintaining in the farm so that at least 50% of the cow always remain in milked condition. Synchronization of heat may be followed (if required).

5. **Conception** – The conception rate should be considered as 50%.

6. **Male:Female** – The male –female ratio should be considered as 1:1.

7. **Mortality** – The calf mortality should be considered as 10% whereas in adult it could be considered as 5%. [In this project 1 calf may be considered as dead from the 2nd generation and 1 adult also may be exempted during calculation of income from the stage of 2nd generation. The rate of mortality should be considered for calculating income, but should not be calculating during calculation of expenditure.]

8. **Weaning** – Two to three months will be weaning age for a calf.

9. **Castration** – Best time for castration is to be considered as 2 – 2.5 months. The time may be extending upto 6 months during rainy season.
10. **Insurance** – The admissible age for calf is considered after 4 months. Premium should to be deposited at every month.

11. **Housing** – Shed should be considered as 50, 30 and 20 sq. ft. for adult, heifer and calf respectively. The run space should be considered as double space of shed area for each stage of animal. The long axis of the shed should be extended from east to west for proper ventilation. Head to head system should be preferred for further extension.

12. **Feed** –
   a) **Concentrate** – For milch cow – 2 Kg conc. for maintenance and additional 0.5 Kg per day should be provided for every liter of milk.
      For dry cow – 2 Kg conc. for maintenance
      For calf – 100 – 500 gm per day depending on age
   b) **Green** – 10 -15 Kg fodder should to be provided per day for each adult through out the year.
   c) **Straw** – 5 Kg straw per day for the adult.

13. **Fodder Plot** – About 0.8 acre land are to be required for 4 milch cow with followers using the plot on rotational basis producing one perennial non-leguminous(specially Hybrid Napier) and two leguminous fodder. The fellow land should be given first priority and mixed cropping with the main crop will be the target for fodder cultivation.

14. **Land Preparation** – Some financial parameters are to be considered for preparation of land. These are – (i) Land development, (ii) Seed and Planting materials, (iii) Irrigation, (iv) Manure and (v) Labor

15. **Health Care** – Proper deworming and scheduled vaccination should be followed. The schedule will be depending upon the epidemiological status of the farm area. Probable cost should be considered for each adult and for a calf:

16. **Manure** – The 10 Kg and 5Kg cow dung should be available from an adult and calf respectively.

17. **Bio-gas** – A bio-gas plant should be constructed around the farm area avoiding drinking water source to minimize the cost of electricity consumption. 4 – 5 numbers of cows are to be considered for production of 2 cubic meter gas. 2 cubic meter gas will be considered as an engine of 5 HP.

18. **Replacement of Stock** – The milch cow should be replaced to maintain sustainable farm economy after 5th lactation i.e. at the age of approximately 8 years considering the first AI at the age of 20 months.

19. **Depreciation** – An amount of 10% depreciation cost are to be considered on the cost of housing, machinery, equipments and farm implements from the 2nd year onwards.

20. **Flow Chart** – Some flow chart or table should be prepared for preparing a project for 5 years considering the assumptions. The chart / table will be of – (i) Number of calf and adult with their milch and dry state for each year, (ii) Cost of feed, health coverage and insurance on the basis of number of animal in the farm and (iii) Milk yield and manure availability in the farm.

21. **Fixed Capital** – The fixed capital will be comprised of – (i) Cost of construction of farm house, run, store house, manure pit, biogas plant, electricity, plumbing and fencing/wall of the farm, (ii) Cost of farm equipments and implements, (iii) Cost of purchased milch cow with transportation cost, (iv) Cost of 1st insurance premium and (v) Cost of fodder plot preparation with irrigation facilities.

22. **Recurrent Expenditure** – The recurrent expenditure will be considered for – (i) Cost of feed and fodder cultivation, (ii) Cost for health coverage including castration, (iii) cost of insurance premium (from 2nd year) (iv) Cost for electricity, (v) labour cost and (vi) Rate of premium of loan (if required).
23. **Income Component** – The income component should be considered with:
   (i) Price of milk,
   (ii) Price of manure/slurry and biogas,
   (iii) Sale of calf,
   (iv) Sale of gunny bag
   and (iv) insurance claim against rate of mortality as assumed.

24. **Unit Cost** – The unit cost of the project will be considered for the summation of:
   (i) Fixed capital and
   (ii) 2 months recurrent expenditure excluding loan premium.

25. **Future Projection** – The followings are to be considered for future projection –

   A. **Large unit size**

   B. **Integrated farming comprising of** –
      i) Feed Manufacturing
      ii) Goatary
      iii) Fishery
      iv) Silage Pit
      v) Vermicompost
      vi) Banana Plantation

   C. **House Dairy Product Processing** (viz. Ghee, Khoa etc.)
INTRODUCTION

Poultry husbandry is a powerful instrument for alleviation of poverty and improvement of socio-economic ambition of society especially of weaker section. Management is the foundation of animal husbandry as it provides optimum environment required to exploit maximum genetic potentiality. Management not only augments productivity of poultry but also has a crucial role to control and prevent diseases. Hence, the frontier technologies on various aspects of poultry production management need to be addressed properly to meet growing demand of poultry products in the country in the perspective of WTO regime.

MANAGEMENT SYSTEM

The broilers are generally reared in deep litter system in our country. Litter (often, paddy husk/straw/dust etc.) is provided to the birds in a house equipped with brooders, feeders and waterers and generally 0.8 to 1.0 ft² floor space is allotted per bird.

Layers may be reared by any or combination of two systems i.e. deep litter and cages. In litter system the required floor space/layer is about 1.5 to 2.0 ft² whereas 0.5 ft² in cage system. Considerable research has been carried out to evaluate the relative merits of the cage & deep litter systems for management of layers, though the evidence is not consistent in indicating the superiority of either the cage or deep litter systems. However, with the advancement of modernization in poultry production, cage system of management is gaining popularity in our country as it is the only answer to today’s acute problem of land scarcity. The cage stocking density involves the floor space bird in cage as well as the number of birds per cage. Although this subject has been the basis of more research than any other cage management factor but till date, a lot of controversy exists about the optimum number of birds in a given size and type of cage. The basis of the differences in opinion among the workers is due to the fact that the cage floor space per bird seems to depend upon so many factors like the body weight, age, sex, breed and temperament of the bird, feeder and waterer space, the degree of accessibility to feed and water, environmental factors like temperature, humidity, ventilation etc. Thus, the optimum cage density is an intricate one. The general principle is that when profits are high, increased stocking density will pay but during less profit, emphasis should be given to lighter stocking density.

The resistance of animal welfare lobbies may pose a problem regarding adoption of cage system for layers and broilers particularly in the West as some of the European countries have already made legislation in this direction. Considering the factor like lack of space available to the birds, poultry welfare researches have given birth the newer innovations in floor system, (e.g. all slat house, percheries, aviary, wire floor, Hans-Kier system, Elson tiered terrace system, Tiered wire floor, etc.) as well as in cage system (Shallow cage, Get away cage etc.)

Housing

The open-sided houses with varying levels of opening depending upon the agro-climatic conditions are generally used for rearing of broilers & layers. As the country experiences various climates from place to place, the design and construction of the poultry shed have to be carried out accordingly with due attention to certain factors like location, orientation, construction materials etc. Besides, appropriate measures have to be adopted during summer, winter and rainy weather to combat the seasonal influences as and when required. With rapid sophistication in poultry housing technology, the concept of environmental controlled house is gaining momentum particularly for large farms. A controlled environment house is one in which the inside conditions are maintained as near as possible.
to the bird's optimum requirement. The proposition is ideal but expensive and out of reach of the common farmers. Various problems those can arise from such type of houses include the failure of sophisticated instruments and cooling ventilation systems particularly in extreme climate, difficulty in managing the proper humidity inside the house etc. Thus, studies on such type of houses are essential keeping in view the micro and macro climates, as well as economic aspects in Indian conditions. Besides, the modern research in poultry housing has led to the development of newer concepts like High rise house and Flux house (Timmons & Benghman, 1983).

**Equipments**

Research is going on to modify the existing equipment or to invent new one. Automation has played a big role in modernization of equipment and more & more farmers are now insisting on automation because of high return on their investment.

The conventional type of open container/channel drinkers have been revolutionized to suit the modern management practices. The problems related to traditional drinkers like contamination and spillage of water, regular cleaning and filling of waterer, wetting of litter and labour intensive etc. are claimed to be largely avoided by the automatic drinkers. There are mainly two type of drinkers - the nipple and the cup to ensure supply of clean water. The nipple and cup drinkers are becoming increasingly popular and may be the drinking system in future.

The traditional trough/tube feeders have been modernized into mechanised ones. The conventional feeders are labour intensive and resulted wastage and contamination of feed. The automatic feeders not only reduced the duration and cost of labour but also minimized feed wastage and increased feed efficiency. There are two types of automatic feeders open channel, chain and pan. In chain type, manual feeding is possible in case of power failure as it's an open trough feeding system. Pan feeder has a winch system for adjusting the height and can be utilized to regulate the feeding of males and females separately. There has been a swing in several countries away from chain feeders in favour of well designed pan feeders.

The use of individual nest is common in our country, however, the community and roll-away nests are also being used in larger units.

**Lighting**

The use of CFL fluorescent light in poultry houses is being considered as innovation. Modern lighting system reduces lighting cost as well as it has got more illuminating power than the incandescent bulbs. The cost effectiveness of the lighting depends mainly on the type of house and lighting programme. The experiments with layers, broilers and turkeys have revealed that fluorescent system consumes 50-70% less electricity than incandescent system.

In windowless houses where artificial lights are used for 23 hours/day for broilers, the savings are significant. Presently, the most of the commercial broiler farmers use a schedule of 23 hours of dim light and 1 hour of darkness in open-sided houses after initially providing 48 hours of continuous light. Thyagarajan et al., (1987) opened that rearing broiler from 6 to 8 weeks of age, 18 hr. light is most efficient. In environment controlled light-tight houses, research results indicate that intermittent lighting programme of 1-2 hour light with 3-4 hours darkness period may improve feed efficiency and growth. It’s important to increase the feeder and waterer space when intermittent lighting systems are used so that most birds should be able to eat simultaneously. Red light may be used in controlled environment houses to reduce cannibalism.

**Feeding**

The broilers are generally full fed from start to market for faster growth and better feed conversion unlike the broiler breeders where restricted feeding is practised. For broilers, either an all-pelleted or crumbled ration (necessary during the first week after replacement) is preferred to mash ration. Research has shown 45g better feed conversion per 450g feeding pellets rather than mash. The layers are also generally full fed. Proper attention should be given to prevent wastage of feed by using efficient feeders, proper feeder management, debeaking and control of rats.
Biosecurity

Biosecurity, the new 'buzz word' in animal production is the collective term for all the management practices designed to minimize introduction of diseases. With regard to poultry, biosecurity simply means the protection of flock from all types of viral, bacterial, fungal or parasitic infectious agents. With the confinement of larger number of birds within a limited space due to advancement of sophistication in poultry farming, they have become very much susceptible to any disaster/epidemic. The reason for disease outbreaks often traces back to improper preventive measures taken at all levels of management. Infectious agents can be transmitted through all available agencies like wind, water, feeds, vehicles, workers etc. and the important function of biosecurity is to prohibit the entry of disease causing germs through these agencies (Limaye, 1992). According to Spackman (1991), 60% of all disease situations are the result of stockman's failure to appreciate the situation and to realize that disease, the environment and management and the birds are imperative in the expression of the subclinical or clinical and result. Some of the important functions of biosecurity concerning the prevention of diseases include proper selection of site, isolation measures, restricted entry of visitors and vehicles, proper storage of feed & feed ingredients, control of insects and pests, feedings, watering, equipments, disposal of dead birds, vaccination programme, personal hygiene of farm workers etc.

Conclusion

Management is one of the most important functions in human order and appears to be the most complex as well as subjected to constant change. Continuous gradual change is expected in poultry management in the coming years with due attention to stock welfare and environment. The use of computers to monitor temperature, humidity, air velocity, amount of feed and water consumptions, body weight gain, mortality etc are on the cards. Introduction of mechanization in harvesting management is inevitable to usher the fast food revolution. Automation will play a meaningful role in feeding, watering, collection of eggs and removal of manure etc. Thus, the advanced technologies on various aspects of poultry management should be adopted by the industry to meet huge demand of meat and egg in India.
Abraham Lincoln once said that if we could but know where we are, we are better judge where we ought to go. A study of the existing situation is the first step in extension programme planning (Leagans, 1961; Compton, 1984; Dahama and Bhatnagar, 1985). It is only from such a study that the needs, problems and interests of the members of a community can be ascertained or extracted. However, when it comes to practice, this step is usually ignored. Long ago, the Ford Foundation Team in its report (1961:234) commented as follows:

“There is an urgent need for Animal Husbandry Workers to observe and study practices and procedures used by the villagers in the management of farm animals. This should be done with a view to determining whether there are sound reasons for what is being done or whether traditional and ill-afforded beliefs are reducing efficiency and blocking progress. In the opinion of this team, such studies would reveal many opportunities for worthwhile research on simple but important problem.”

The general idea among veterinary scientists seems to be that the farmers are illiterate and therefore, they do not know anything worthwhile. Our scientists treat extension work as a one-way affair, where the farmers have to be educated about science. The fact is that the farmers have a rich heritage of maintaining and rearing animals. It is not possible for a farmer to remain in business if he does not learn animal management from his ciders. (Kaul, 1998)

Be that as it may, there have been studies in traditional wisdom in the Field of veterinary science. History was made when Khanna (1967) studied the indigenous systems of veterinary medicine. This study was conducted under the guidance of Dr. Y.P. Singh (now at IARI). It was conducted chiefly by the key-informant technique and contains many practices which are unknown to modern veterinary practice, yet these seem to be working well. It is one of the strengths of modern medicine that it is not prejudicial to anything which works, regardless of the logic or understandability of the practice. For example, quinine as a cure for malaria was discovered much before the causative agent for malaria became known.

Verma (1967) also conducted a similar study of animal husbandry practices among the Gujjars of Himachal Pradesh. However, after 1967. Such studies came to a temporary halt. After a gap of about twenty years) there was a renewed interest in such studies (e.g. Bharara, 1986; Hans, 1987; Bayer Waters and bayer, 1987; McCorkle, 1989 and several other studies well documented by Gupta et al, 1990.

Chittiraichelvan and Kaman (1991) have analyzed the importance of indigenous knowledge for rainfed agriculture, these authors also mention one or two such items in animal husbandry in Haryana

Singh (1990) has parted that besides the inherent academic interest, traditional wisdom is important to study because it gives us software as well as hardware of the knowledge, the innovations developed by the farmers reaction to new technology, and the farmers articulated and non-articulated needs. This thus provides the basis for any extension programme that may be envisaged.
The importance of studies of traditional wisdom in animal husbandry was pointed out by at least two committees in 1961, one Agriculture Development Committee and another Committee on Key village (see Singh, 1990). However, there seems to be difficulty in talking with action. I had submitted a proposal for studying Animal husbandry practices to a funding agency about four years ago; what to talk on approving it, the agency has not even acknowledged receipt of the proposal.

Studies of traditional wisdom can not only benefit social scientists, but can also not as eye openers for the biological scientist. In a study of goat rearing practices (Kaul, 1991), it was shown that most of the thrust areas in goat research are not directed at the goal farmer in rural areas. Much of the current research in animal sciences seems to be publication oriented rather than client-oriented (Dwivedi, 1991).

Historians believe that medicine and surgery data back to about 6000 B.C. (Tyagi and Singh, 1993). The Vedas contain abundant information on the treatment of man and animals. The Atharvavedas is a treatise on medicine. Kautilya Arthasastra also contains details account of a highly organized department of livestock. Apart from Indians, ancient Egyptians and Greeks have also contributed to the veterinary profession as back as 460 to 370 B.C.

There are at least two aspects in the study of indigenous knowledge in veterinary science. One is to study the practices as they exist; this can be done by direct persistent observation interspersed with scanty questioning, and by the key informant technique. The other aspect is the study of occult practices like 'Mantras', 'charms', 'Evil eye', 'amulets', etc. These occult practices require great patience and years of persistence to study. Normally, the practitioners of this art do not reveal its secrets to anybody except their disciples, so, one has to become their disciple if one wants to study this aspect. There are some examples to reveal the efficacy of occult practices. Once, as a young boy, I got burns from boiling water while performing Franklin's experiment; When I went to a charmer, I was crying bitterly due to the pain; however, within a few minutes of his treatment, my pain vanished before my eyes and I was calm and quiet. Verma (1993) narrated a case of a cow infested with ticks: the cow was treated by a charmer using 'Mantras' with a 'Chimta', and finally, all the licks on the body of the animal fell down in a heap on the floor.

So far, we have been collecting indigenous technologies at random and this effort has resulted in several good compilations. However, this method divests these technologies from their socio-economic context. Therefore re fore, it is appealed to future workers in this Field to study these technologies in their appropriate socio-cultural context so that the relationship between social structure and technology may emerge clearly. Just as all of modern medicine cannot be taken as a gospel of truth, indigenous technology can also not be taken as true per se without testing. The knowledge of traditional wisdom provides the biological scientists with a platform of new ideas which ought to be experimented upon and verified for their correctness, relative cost, efficacy and other parameters. (Kaul, 1998)
References


