Livestock Infertility and Its Management

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Preface

Livestock sector is an important subsector of Indian agricultural economy providing livelihood support to the rural population. The share of livestock to Agricultural GDP has increased from 14% to nearly 30% in the last decade or so, and its ownership has remained egalitarian. Sustaining an annual growth rate of nearly 4%, this sector also provides asset creation, employment opportunities and financial security to the livestock owners.

With an annual production of about 130 million tons, India is the highest milk producer in the world contributing 15% of the total world milk production. However, infertility in Indian livestock is a matter of serious concern. Apart from being non-productive, these animals also share the meager feed, fodder and water resources and contribute to a colossal burden to the animal owner. Such limitations substantially reduce the farmer's financial returns due to overall reduced number of pregnancies and hence lactations.

A Brainstorming Session on fertility improvement and fertility management for finding solutions to bridge the gap between available knowledge and its application at the farmers' doorsteps was thus convened by the National Academy of Agricultural Sciences on October, 15, 2011. In addition to the valuable presentations by experts in their relevant areas related to various aspects of infertility *viz*. endocrinology, nutrition, infection, biotechnology, etc. there was active participation from 36 experts from the industry and Centre and State Animal Husbandry Departments. I trust, the carefully structured recommendations in this Policy Paper will be acted upon by all the stakeholders and help utilize the full potential of the dairy animals for enhanced and sustained milk productivity and economic growth of the farmers.

On behalf of the Academy I would like to compliment the Convener Dr. B.S. Prakash, the then Head, Division of Dairy Cattle Physiology, NDRI, Karnal & presently Assistant Director General (AN&P), ICAR, New Delhi and Dr. A.K. Srivastava, Director & VC, NDRI, Karnal, Co-convener for their contributions. My thanks are also due to all distinguished participants of the Brainstorming Session and the Editors of the Policy Paper.

(R.B. Singh)
President, NAAS

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PREAMBLE

Livestock serves as one of the main pillars of India's agrarian economy, food and nutritional security and livelihood. Its ownership is predominantly egalitarian with highly pro-poor growth potential. India possesses the highest 15% cattle population of around 199 million in the world. Buffaloes with 105 million population form a third of the total such cattle and contribute more than 55% of the milk. Farmers prefer buffaloes over cattle, being a triple purpose animal contributing milk, draught and meat. The buffalo milk also fetches higher price due to higher fat content. It can utilize poor quality roughages and is capable of adjusting to wet conditions better than cattle.

Sheep and goat are also important livestock species in India, especially in the arid/ semi-arid and mountainous areas. While sheep are mostly reared for wool and meat, goat provide both milk and meat. Backyard pig farming systems is also practiced as part of the mainstream farming in Kerala, Goa, North-Eastern States and by socially weaker sections and tribals in Jharkhand solely for meat. The domestic demand for livestock products is going to increase substantially in the years to come. There is also a good export potential for livestock products.

Good reproductive performance is essential for efficient livestock production, therefore, livestock improvement programs should aim to increase reproductive efficiency. The females must grow rapidly to attain sexual maturity, initiate estrous cycles, ovulate and be mated by fertile males or artificially inseminated at the proper time. Improved buffalo and zebu cattle production in particular, could significantly enhance the economy and living standards of farmers in India. There are at least 30 different zebu breeds in India. Sahiwal, Red Sindhi, Gir, Kankrej and Tharparkar are predominant dairy breeds. The average lactation yield of these breeds is around 1800 litres in a 305 days lactation period. However, most of the cattle in India are of the nondescript types which yield very little milk. In an effort to increase milk production, cross breeding of zebu with exotic breeds has been carried out. The average milk production over a 305 days lactation period of milch buffaloes ranges from 1500 – 2500 litres. Better adaptation of buffalo and zebu to tropical climates and disease resistance ensures their place in the future of world agriculture facing the challenge of global warming due to climate change.

Perusal of Livestock Census reveals that there has been a significant decline in cattle population from 204.58 million in 1992 to 198.88 million in 1997 and 185.13 million in 2003. Interestingly, there has been a consistent increase in buffalo population from 84.21 million in 1992 to 105.34 million in 2007 indicating preference for buffalo rearing among farmers. The Indian Dairy scenario is constantly looking ahead and promises to take greater strides in making dairying more remunerative to the farmer. However, there are serious bottlenecks in our quest for making livestock rearing a profitable venture. These issues are flagged here.

Issue 1. Poor fertility among Indian Livestock

Anestrous and repeat breeding in buffaloes and bovines are two of the most serious reproductive problems affecting 30-40% of the total cattle and buffalo population. This results in a loss of 20-30 million tonnes of milk annually which translates to a loss of nearly Rs. 50000 crores annually. At a micro level, each missed heat is a missed opportunity incurring a loss of milk production for 21 days, with additional cost of feeding and maintenance. Artificial insemination (AI), which is a normal practice in cattle, is not as successful in buffalo, especially in hot summer months, because of the weakness of oestrus symptoms and the variability of oestrus length, which make oestrus detection very difficult. The usual weak symptoms of oestrus in the normal breeding season (September to February) become even weaker during hot months of summer. Failure to detect oestrus and time of onset of oestrus in buffalo considerable percentage of oestrus cycles are left uncovered resulting in increase of unproductive period which adversely affect economics of livestock production.

Several studies have attempted to understand the reproductive physiology of buffalo and the factors affecting its behaviour. These have been adequately reviewed (Madan and Prakash, 2007). During the last two decades, considerable attention has been focussed on reproductive endocrinology, with the aim of developing models to improve reproductive efficiency, particularly when using controlled breeding techniques. The techniques of ovsynch and heatsynch protocols for estrous synchronization for enhancing fertility in cattle are well documented (Pursley *et al.*, 1995; Pancarci *et al.*, 2002). The approaches to ameliorate infertility in buffaloes includes the application of ovsynch and heatsynch estrus synchronization protocols followed by fixed time AI both at farm (Paul and Prakash, 2005; Mohan *et al.*, 2010) and field levels (Prakash, 2011); the average success rate for conception being around 50% at fixed time AI and AI at subsequent estrus (both inclusive). Additionally, 30-40% of anestrus buffaloes become cyclic using these protocols giving a hope to the farmers for getting them

pregnant at some stage later. The challenge is to apply these techniques in the small holder livestock system under Indian conditions.

Issue 2. Delayed puberty in buffalo and cattle

In organized farms of defined breeds of buffaloes the first signs of estrus occur at 24– 36 months of age and nearly 280 kg body weight. In non-descript buffaloes the first estrus appears at a comparatively higher age. Once estrous cycles are initiated, subsequent estrus appears with normal regularity. The first calving of buffaloes occurs at a body weight of around 480 kg generally between 33 to 45 months of age although many do not calve until much later. Zebu heifers attain puberty earlier-around two years of age at about 250 kg body weight. Puberty occurs much earlier in crossbred cows at around 15 – 18 months of age. As such, age of puberty/ sexual maturity within the breed is more a function of growth than of age. Hence breeding, feeding and management should be directed towards attaining faster growth.

Issue 3. Deficiency of availability of genetically superior bulls and proper artificial insemination.

Although India possesses the largest breeding infrastructure in the world with 60 frozen semen stations and more than 77000 AI centres, the average productivity of cows and buffaloes is still very low (Mishra, 2010). This is mainly because the bulls used for breeding do not possess high genetic superiority and there is rampant use of bulls with poor pedigree. More than 80% of our bovine population is still non-descript and the breed improvement programs have hardly taken off. Artificial Insemination though in existence for over 60 years in our country has only covered 20% of our breedable livestock so far. The conception rate for A.I. is very poor. A.I. facilities are not available at the farmers' doorsteps. Semen available for A.I. is generally not of required quality. There is shortage of qualified para-veterinarians. We have learnt a lot from our past failures. Farmers must be provided incentives to use A.I. program. An A.I. program should always be an essential part of an integrated livestock development programme for obtaining high yielding livestock, and hence, should never be implemented on its own.

Issue 4. Infertility among crossbred male cattle

In order to augment the milk production in India the crossbreeding of our indigenous breeds (*Bos indicus*) with European breeds *(Bos taurus)* was adopted in the seventh decade of the last century. Application of artificial insemination has made

crossbreeding between *Bos taurus* and *Bos indicus* populations very widely possible for substantial increase in milk yield. However, the male crossbred offsprings are often inferior to purebreds in semen production. The proportion of males reserved for breeding and reaching successful freezing stage was lowest (29%) in Karan Fries (cross between Sahiwal or Tharparkar with Holstein Freisian cattle) and highest (45%) in Sahiwal cattle and poor semen quality was an important reason of disposal in Karan Fries bulls (Chauhan, 2007). Poor semen quality was found to be the main reason of disposal in adult Karan Fries crossbred bulls above three years of age (Chauhan, 2007). A large number of Frieswal bulls (63.41%) produced non freezable quality of semen with a very high occurrence of abnormal spermatozoa in the semen ejaculates.

The reason for infertility in crossbred males appears to be genetic in nature and requires investigation at chromosomal, endocrine and molecular levels which are indicated separately.

Issue 5. Nutritional deficiency and imbalance

Insufficient feed and fodder resources to fulfil the nutritional requirements of dairy animals is a very important cause for poor reproductive efficiency. In conditions when sufficient nutrients, particularly energy are not available to the lactating cows and buffaloes a loss in body condition results causing decrease in milk production and reproductive activity is compromised. In pregnant cows the end result is under weight calves and open period postpartum is prolonged. Fertility of the cows decline when their body condition score (BCS) drops to below 4; especially at calving and when they go into breeding season in poor condition. Energy deficient diet during advanced stage of pregnancy followed by the additional requirement of energy for high milk production in early stages of lactation results into negative energy balance. This condition delays onset of estrous cyclicity. The transition period of cows and buffaloes from 3 weeks before to three weeks after calving is very important. It is characterized by marked changes in metabolism as the cow prepares for parturition and lactogenesis. Energy requirements for maintenance and pregnancy of dairy cattle increase 23% during the last month pre-partum. Dry matter intake of late gestation cows can decrease approximately 30% prior to calving (Bell, 1995; Grummer 1995). Depending on the severity and duration of the decrease in intake, cows can experience negative energy balance prior to parturition. Inadequate energy intake causes mobilization of body lipids, which increases the concentration of NEFA in serum, and in turn can cause hepatic lipidosis if mobilization is excessive (Grummer 1995). Hepatic lipidosis decreases the glycogenic capacity of hepatocytes (Cadorniga *et al.*, 1987) and predisposes cows to postpartum metabolic diseases. Moreover,

elevated NEFA pre-partum is a risk factor for dystocia, retained placenta, ketosis, displaced abomasum, and mastitis in the peri-partum period (Dyk *et al.*, 1995).

Researchers (Grummer, 1995) have suggested that increasing the energy intake during the transition period may have positive effects on the health, lactation, and reproductive performance of high producing lactating cows. However, feeding a more energy-dense diet does not guarantee that cows will consume more calories, because energy-dense diets decrease feed intake in some situations (NRC, 1985). Therefore the approach may be to increase the energy and protein density of diets for cows in the last 3 weeks of gestation that would increase energy intake and decrease in the loss of body tissue and concentration of NEFA in plasma pre-partum, decrease liver fat content at parturition, and increase in subsequent milk production.

The overall consequences of inadequate intakes of energy, protein, vitamins and minerals have been presented in Table 1 showing that reproduction is impacted most by these deficiencies.

Table 1. Influence of inadequate dietary nutrient intake on reproduction in cattle (Corah 1988).

Nutrient consumption	Reproductive consequence
Inadequate energy intake	Delayed puberty, suppressed oestrus and ovulation, suppressed libido and spermatozoa production
Inadequate protein intake	Suppressed oestrus, low conception, foetal resorption, premature parturition, weak offspring
Vitamin A deficiency	Impaired spermatogenesis, anoestrus, low conception, abortion, weak offspring, retained placentae
Phosphorus deficiency	Anoestrus, irregular oestrus
Selenium deficiency	Retained placenta
Copper deficiency	Depressed reproduction, impaired immune system, impaired ovarian function
Zinc deficiency	Reduced spermatogenesis

Imbalance in the ratio of energy and protein in the diet adversely affect the reproductive efficiency. However, protein overfeeding can adversely influence reproductive efficiency. High protein feeding in cattle led to elevated ammonia concentration in the rumen and ultimately decreased the conception rates and increased the calving to conception period (Ferguson and Chalupa, 1989). Excess crude protein is degraded to ammonia by ruminal microbes, absorbed into the

portal blood and rapidly converted into urea by the liver. Concentrations of plasma urea nitrogen above 19 mg/dl have been associated with lowered pregnancy rates in dairy cows (Dunlap *et al.*, 1997). *The problem of high protein diet feeding is, however, not the cause of low reproductive efficiency in India as it is not practiced here.*

Another major cause of low reproductive efficiency in cattle and buffalo is micro-nutrient deficiency and imbalance. The deficiency and imbalance of micronutrients in the soil results in deficiency in feed and fodder and hence also in animals consuming the fodder. The micronutrient status of soil, water, feed and fodder and animals have been mapped for almost all parts of the country. The area specific mineral salts for different zones have been developed. Feeding of area specific mineral mixture to animals has been seen to be beneficial in ameliorating infertility conditions.

Issue 6: Livestock infertility due to infectious diseases

Some infectious agents, such as bacteria, viruses, fungi and mycoplasma are also known to interfere with reproduction. Bacterial infections of the uterus, vagina and vestibulae can lead to anestrus, repeat breeding, delayed return to oestrus after mating, early embryonic death and, sometimes, abortion. However, nearly half of the cows are still capable of breeding, indicating that pathological conditions do not necessarily render cows permanently sterile. Their seriousness depends on the location of the infection. Many diseases can be substantially reduced by vaccinations. Infected animals may require to be eliminated to prevent spread of infection. Pathological causes due to infectious diseases are responsible for about 25% of cases.

The important diseases which are responsible for infertility and abortion in livestock are brucellosis, infectious bovine rhinotracheitis, leptospirosis, listeriosis, salmonellosis, chlamydiosis, campylobacteriosis, trichomoniasis, epizootic bovine abortion, mycotic abortion, corynebacteriosis, neosporosis, foot and mouth disease, etc. *Brucella abortus*- the pathogen which causes brucellosis has an affinity for uterus resulting in abortion. In trichomoniasis, abortion occurs in the early pregnancy. *Leptospira pomona* leads to abortion in 6 months to full term of pregnancy. In listeriosis, abortion takes place at approximately 7 months of pregnancy. Infectious bovine rhinotracheitis virus affects reproductive system as well as respiratory system. Abortion has been reported in lambs due to foot and mouth disease virus. The foundation of an accurate diagnosis of reproductive loss due to infectious pathogens facilitates prudent use of immunization and biosecurity to minimize reproductive losses.

Issue 7. Lack of strategies for implementation and transfer of modern biotechnologies to endusers

Serious inroads have been made in embryo biotechnology research with tremendous progress in basic embryo transfer (ET) techniques, *In-vitro* maturation of oocytes and invitro fertilization and production of buffalo calves by IVF technology. India became the first country to produce the first IVF buffalo calf as early as in 1991. Embryo biotechnologists at NDRI also made history by producing 3 buffalo calves by hand guided cloning techniques during 2009-11. Scientists in India are also at the forefront of stem cell and ET technology research.

It is now more than 20 years since the advent of ET technology in our country. This is a time for introspection. While we need to encourage our scientists to develop new potential biotechniques our Government agencies must not forget that the technologies our scientists have so painstakingly developed are confined only to publications and laboratories.

Transfer of technologies developed by scientists to the livestock owners is very weak. Small holding livestock farming system is the backbone of our milk production in India. Almost 80% of the milk is produced in the unorganized sector scattered throughout the country. The technologies developed in breeding, feeding, management and health cover do not reach out to the livestock rearers as the majority of them are small, marginal and landless farmers. There are three main reasons for this problem:

i. Extension and agriculture are state subjects and states are not bound to adopt policies of central government. Breeding policy for cattle and buffaloes is neither very clear nor adopted by states.

ii. Many technologies developed by our scientists are not targeted to the needs of small holding livestock owners. The adoption of such technologies in feeding management and health cover is therefore low.

iii. Majority of our livestock owners are resource poor and cannot afford to divert finances for improvement of animal husbandry practices adopting new technologies.

The cost of fertility enhancing drugs and hormones is prohibitively high and beyond the reach of the common farmer for treating his livestock as these drugs and hormones are imported and hence costly. Various therapeutic methods to correct the problem of infertility are based on ayurvedic, small molecule, recombinant protein based or peptide-based drugs. Pharmaceutical industry has grown enormously in

recent years in human healthcare in our country. Similar drivers for growth in the veterinary pharmaceutical industry is essential. Our country is very rich in terms of expertise in recombinant technology and peptide synthesis. Yet we continue to be dependent on imports. Until the country produces these drugs indigenously, it is unreasonable to expect a significant improvement in increasing fertility at national. Herbal remedies need to be explored to overcome some of the problems adversely influencing reproductive performance of livestock.

SCOPE FOR SCIENTIST-INDUSTRY INTERACTION FOR IMPROVING PRODUCTIVITY

The brainstorming on fertility improvement and management assumes great significance for finding solutions to bridge the gap between available knowledge and its application at the farmers' doorsteps. Several techniques have been developed for enhancing production and reproduction in livestock. Unfortunately, most of these have not yet been adopted at large scale which is imperative if they are to make an impact on increasing productivity and thereby enhancing farmers' incomes. Perhaps the main reason for research efforts not reaching the farmers doorsteps is the lack of knowledge interaction between farmers, scientists and the industry. It is therefore essential for a collective thinking on the issues raised here and involve interaction between the state animal husbandry officers, scientists and even (if possible) the industry. This policy paper presents a consensus evolved at this important meeting.

STRATEGIES FOR IMPROVEMENT OF REPRODUCTIVE EFFICIENCY

It is essential that for increasing animal productivity, the reproductive efficiency of the animal is required to be optimum. Over the past two decades, a number of reproductive techniques have been developed at ICAR research Institutes as well as state Universities, in addition to the biotechniques including artificial insemination and embryo transfer technique. These include biotechniques of estrus induction and synchronization, endocrine analysis of body fluids for fertility improvement, multiple ovulation and embryo transfer, IVF and simple hormone assay procedures (by radioimmunoassay and non radioactive assays such as enzyme-immuno-assays) etc. Expensive hormone antiserum (progesterone) has also been produced indigenously, which has reduced the cost of the test. However, these techniques are still restricted to research institutes. The knowledge however, need to be propagated nationwide by providing necessary training. One can not comprehend any success in adopting specific breeding policies if proper infrastructural facilities are not developed at

grassroot levels. In this context, it is pertinent to suggest certain improvements, which can considerably bring about a quantitative change in enhancing reproduction leading to higher milk production.

1. Feeding strategies to meet optimum nutrient requirements.

- Developing feeding strategies for faster growth is essential for the onset of puberty at an early age. Since majority of small and marginal farmers and landless farmers are resource poor, they cannot afford feeding of concentrates to their animals. Crop residues used as the main source of feed are supplemented with green fodder and/concentrate ingredients. It has been demonstrated that feeding nutritive fodder as well as silage or hay of can meet the nutrient requirements of majority of medium milk producing animals. Availability of quality seeds of these crops is highly inadequate and farmers are unaware of some of the latest varieties of these crops and grasses.

- Strategic feeding of deficient macro- and micronutrients together with fodder can improve fertility to a large extent. Based on the mapping of micronutrient status in soil, water, feed and fodder animals in different agro-climatic zones in each State of the country, area specific mineral mixture salts have been developed which need to be included in the animal's feeding regimen.

- Proper feeding of cows and buffaloes to maintain good body condition score (above 4) during breeding period and to maintain optimum energy and protein balance during the transition phase will help in early commencement of cyclicity of estrus and conception rates.

- Incorporation of low cost non cereal based rations like urea and molasses along with cheaper byproducts from cereals like deoiled rice bran in the ration can cut down the cost of feeding.

- There are limited protein supplements available in the form of cakes/meals, which are not sufficient to meet the requirement of dairy animals. However, if these resources are treated suitably, their digestion in the rumen can be controlled and their efficiency of utilization for growth and milk production can be substantially increased. The advantages of feeding bypass protein for increasing efficiency of utilization of proteins, as well as supply of growth limiting amino acids like lysine and methionine to the small intestine are evident which can improve the rate of growth in high yielding animals.

2. Appropriate management practices to improve fertility among cattle and buffaloes

- Efficient reproductive management is very essential for improving reproductive efficiency. An essential requirement for reproductive management is to have all records for every cow/buffalo indicating (a) date of birth (b) initiation of cyclicity (c) dates of insemination (d) number of calvings (e) abortion rate (f) parturition related problems etc. This will form an excellent database for suitable interventions for improving reproductive efficiency in cattle and buffaloes.

- Efficient heat detection protects against extended periods of non-productivity. Cows and buffaloes should be observed visually or parading a teaser for 30 min intervals 2-3 times daily. Detection should be done during the quiet times of the day. Around sunrise and sunset are appropriate for heat detection since a higher percentage of animals exhibit estrus during the late evenings early morning hours especially in summers.

- The heat stress during summer months should be ameliorated by provisioning appropriate animal housing and management practices which will reduce the incidence of silent heat.

- Timing of insemination is important. Ovulation occurs about 30 and 42 h after commencement of heat in cows and Murrah buffaloes, respectively. Hence, it is advisable to follow the AM-PM rule i.e if the cows are reported in heat in the afternoon they are inseminated the next day morning followed by a second insemination 10-12 h later.

- Buffaloes exhibit very high incidence of silent heat in summers. Application of effective ameliorative hormonal therapies viz. ovsynch and heatsynch protocols for estrus synchronization and fixed time AI which have been successfully demonstrated even in farmers' herds on a limited scale for improving fertility in repeat breeding and anestrus animals should be undertaken on a large scale by State Animal Husbandry Departments. The technologies can be very effective even in cycling buffaloes during summer months when heat expression is poor.

- There is a need for developing enduser friendly technologies for monitoring the reproductive status of the animals. Hormonal monitoring is routinely used in organized cattle farming abroad. Modern endocrine technique of using progesterone estimation in body fluids (milk or blood) by radioimmunoassay or enzymeimmunoassay are routinely practiced in western countries for monitoring

reproductive status of herds. The technique is very useful in detection of functional ovarian abnormalities especially in buffaloes where palpation of ovaries for detection of ovarian structures (follicle/corpus luteum) is difficult. The information obtained using progesterone analysis in body fluids will help the field veterinarians to decide the correct line of therapeutic treatment of cows and buffaloes after obtaining the progesterone values in 6 samples collected twice weekly for 3 weeks. The mechanism for using this technology for small holder livestock systems scattered in villages prevalent in India needs to be evolved. Since hormone assay labs are limited to a few centres in a State, the samples (only 1-2 ml blood plasma/skim milk is required) can be sent to the centre by post and results declared telephonically.

3. Improvement in availability of genetically superior females and bulls, good quality semen and artificial insemination services.

Selection of genetically superior males and females should based on fertility status which can be known from reproductive records. Until such time when suitable molecular diagnostics are developed the important parameters for selection should include age at first calving and the calving intervals for females. This will also take care of the seasonal pattern as well as fertility at estrus, since regularly calving livestock will be those which maintain reproductive function with good fertility even during summer months. Selection should be for larger ovarian and testicular size in the two sexes. More intense requirement is in selection of males, where the genetic potential gets transmitted to a much larger population in the progeny.

- There is a need for a large number of genetically superior breeding buffalo and cattle bulls of high milch breeds viz. Murrah, Surti, Nili Ravi, Jaffrabadi, Mehsana and Bunny (buffaloes) and Sahiwal, Tharparkar, Red Sindhi, Gir and Kankrej (zebu cattle) and Karan Fries and Frieswal (crossbred cattle). It is estimated that for breeding even 30% of the breedable population of our livestock there is a minimum requirement of at least 1300 proven crossbred bulls, 7000 indigenous bulls of cattle and at least 13000 buffalo bulls. Hence, for accomplishing the task of genetic improvement of cattle and buffalo resources in the country it is strongly recommended to

  (a) Identify and establish breeding service organizations – either government controlled at Centre and State levels or encouraging private entrepreneurship

  (b) Identify specific operational areas/regions for the breed/genetic group/animal population to be improved upon

(c) Establish and strengthen breed nucleus herds/bull mother farms, young bull rearing centers, semen collection and cryo-storage banks

(d) Establish data bank to carry out activities on animal identification and performance recording linked with progeny testing programme for selection of large number of high genetic merit bulls

(e) Networking of breed-specific organized government/private cattle and buffalo farms and large progressive farmers' herds for testing of large number of breeding bulls and linking with performance recording and progeny testing of bulls under farmers' herds in rural setting.

(f) For faster multiplication of superior germplasm and large-scale dissemination, selected organized nucleus breeding herds should adopt open nucleus breeding system with or without MOET and other emerging reproductive and genetic techniques

(g) Form milk producers' co-operative unions/breed societies/NGOs for participation of farmers/breeders in the activities on breed development and improvement as their own programme.

- Field veterinarians at AI centres should receive training on latest developments in breeding and reproduction management from time to time.

- State Animal Husbandry Departments should undertake development of well equipped AI centres in all districts with one AI centre for about 1000 breedable cows and buffaloes.

- Application of modern biotechniques of semen sexing, in-vitro fertilization and embryo transfer should be implemented for long term improvement of livestock germplasm. It is imperative that adequate trainings are imparted to field veterinarians on a regular basis by trained manpower available at research institutions viz. NDRI, IVRI, CIRB and SAUs on these techniques. Simultaneously, State Animal Husbandry Departments should undertake programs for setting up facilities for sexed semen storage, embryo transfer and IVF to utilize the trainings of the field veterinarians.

4. Control of infectious diseases and improvement in health cover

The important diseases which cause infertility and abortion in cows and buffaloes like brucellosis, leptospirosis, listeriosis, FMD etc. should be controlled. The vaccination and other preventive measures should be strictly followed to control these diseases.

5. Strategic implementation of modern biotechnologies

There is an urgent need for implementation of multiple ovulation and embryo transfer (MOET) selectively for faster multiplication of superior germplasm. Expertise for MOET is available in various SAUs and ICAR institutes. Besides, development of infrastructure for undertaking MOET, the State Veterinary and Animal husbandry Departments should encourage linkages with the Universities and ICAR Institutes by sending their veterinarians for training in MOET. These trained personnel will be provided the back-up support for further training from time to time to keep them updated with the latest developments in this technique. Bull mother farms to produce genetically superior bulls need to be established in different States. Public –Private partnerships may be more successful in this endeavor.

The hormonal preparations required for adoption of modern reproductive biotechnologies are not indigenously available. While the technology is available to produce these, effective mechanisms need to be set in motion to ensure an effective dialogue between the scientists and industry to produce them indigenously. Extremely potent hormonal preparations such as GnRH and prostaglandins etc. if produced indigenously, will considerably bring down the costs of treatment and make them affordable to farmers. Another important research objective wherein scientists and industry can work together is to produce recombinant buffalo gonadotrophins which may improve the consistency of the responses to superovulatory treatment, an extremely important requirement for greater success and practical application of embryo transfer in buffaloes.

RECOMMENDATIONS

Policy matters for consideration of State and Central Government

- Small and marginal farmers and landless livestock owners should be supported financially to ensure supplementation of area specific mineral mixture to their animals. It should be made available either free of cost or at highly subsidized rates. The area specific mineral mixture has been developed by ICAR for almost all agro-climatic zones of country and is commercially available.
- Fodder banks should be established to meet the feed requirement of animals during period of scarcity.
- Bull mother farms should be established for important breeds of cattle and buffaloes to meet the demand for genetically superior bulls. These farms should be established in the home tracts of the important breeds of cattle and buffaloes.

- Artificial insemination system including production of good quality semen should be strengthened in public – private partnership to improve its efficiency.
- Extension services should be strengthened for transfer of technologies and knowledge to the endusers. Cyber café may be established in each village which should have complete database of animals and their owners. These cyber cafes should be connected to taluka and district centres and utilized for livestock related issues including transfer of latest technologies using audio-visual aids.
- Setting up of a National Livestock Mission by Government of India.
- Financial and technical assistance should be provided to livestock owners for constructing good animal houses for heat stress amelioration.

Researchable issues

- Area specific strategic feeding to meet the energy and protein requirement of livestock should be worked out for all agro-climatic zones.
- Finding out markers to identify good semen producing bulls- particularly crossbred male cattle- at an early age using molecular, endocrine and chromosomal approaches.
- Development of end user friendly technologies for estrous synchronization protocols, augmentation of ovarian follicular development and responsiveness to gonadotrophins, improvement of conception rate and enhancement of immunity in livestock.
- Understanding the cellular and molecular dynamics and mechanisms underlying buffalo oocyte maturation including hormonal effects using homologous hormones.
- Development and application of appropriate diagnostics for estrus detection and pregnancy diagnosis. These need to be developed and applied as per the diverse existing and rapidly developing buffalo husbandry practices. In females, the use of ultrasound scanning is of utmost diagnostic importance, and should be applied in diagnosing the ovarian and uterine contents and their dynamics, apart from helping in assessing the outcome of therapeutic regimen.
- Creation of functional livestock – agriculture models (integrated) at certain organizational levels whose success inspires the farming community.

- ✦ Research should be conducted for development of an improved, preferably live modified IBR vaccine for use in cows and buffaloes.
- ✦ Indigenous production of fertility enhancing drugs and hormones (GnRH, prostaglandin F2α to reduce cost of importation and making the drugs affordable to farmers.
- ✦ Development of technologies for climate change resilient livestock production.

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