Strategy Paper

Livestock Development in India

Prof A.K. Srivastava

Member, ASRB & Trustee, TAAS

taas

Progress Through Science

Trust for Advancement of Agricultural Sciences (TAAS)

Avenue-II, IARI, Pusa Campus, New Delhi-110012

E-mail: taasiari@gmail.com; Tel.: +91-11-65437870

Website: www.taas.in

Progress Through Science

Trust for Advancement of Agricultural Sciences (TAAS)

GOAL

An accelerated movement for harnessing agricultural science for the welfare of people.

MISSION

To promote growth and advancement of agriculture through scientific interactions and partnerships with stakeholders.

OBJECTIVES

- To act as think tank on key policy issues relating to agricultural research for development (AR4D).
- Organizing seminars and special lectures on emerging issues and new developments in agriculture.
- To institute national awards for the outstanding contributions to Indian agriculture by the scientists of Indian and other origin abroad.
- Facilitating partnerships with non-resident agricultural scientists visiting India for short period.

Livestock Development in India

Prof A.K. Srivastava
Member, ASRB & Trustee, TAAS

Preamble

India is blessed with huge livestock population reared under diverse production systems and agroclimatic conditions. The country has 15 per cent of world's cattle population, 58 per cent of buffalo population, 18 per cent of goat population, 7 per cent of sheep and 5 per cent of chicken population and ranks first in buffalo and goat population, second in cattle and sheep population and fifth in chicken population in the world. As such, livestock have an immense contribution for sustainable rural development and provides a stable, year-round income, which is an important economic incentive for the small farmers. This sector plays a multi-faceted role in providing livelihood support to more than 60 per cent of the rural population. As per the report of the working group on Animal Husbandry and Dairying - 11th Five Year Plan: 2007-12, the livestock sector employs eight per cent of the country's labour force, including several small and marginal farmers, women and landless agricultural workers. Besides their monitory benefit and providing a steady stream of food and revenues for households, livestock provide employment to the family, act as insurance during crop failures, contribute to gender equality by generating opportunities for women, generate *in situ* fertilizers for enhancing the soil fertility, contributes to day-to-day expenses of the farm family, recycle waste products and residues from cropping or agro-industries, supplies energy source for cooking and at places, the number of livestock owned by a farmer determines the social status among the community.

The role of livestock in nutritional security is also immense. Animals in the country provide huge amount of proteins and essential nutrients to the human population. They are an important source of food, particularly of high quality protein, minerals, vitamins and micronutrients. The importance of dietary animal protein can be well recognized because it contains essential amino acids that are deficient in cereals. Eating even a small amount of animal products corrects amino acid deficiencies in cereal-based human diets, besides permitting more of the total protein to be utilized because animal proteins are more digestible and metabolized more efficiently than plant proteins. Meat, milk and eggs provide proteins with a wide range of amino acids that match human needs as well as bio-available micro-nutrients such as iron, zinc, vitamin A, vitamin B12 and calcium in which many malnourished people are deficient.

Driven by the structural changes in agriculture and food consumption patterns in the past few decades, the utility of livestock has undergone a transformation since their importance as a source of quality food has significantly increased. With the increasing income levels and growing awareness among the population, there has been a shift in taste and preferences of consumers towards animal proteins. On the other hand, meeting out the requirement becomes more onerous in the coming years set against climate change, shrinking natural resources including soil, water and cultivable land in the wake of massive unplanned urbanization. To fulfil the market demand, the livestock production system needs to be relooked and re-oriented towards obtaining more productivity per unit resource. In addition, the interventions for enhancing the livestock production potential will have a large impact on pace of poverty reduction due to relatively egalitarian distribution of livestock assets. In this paper, performance appraisal of current livestock production system and its futuristic requirements and policy interventions are detailed.

Current Status of Livestock Production

Milk is the second largest agricultural commodity produced in India, next only to rice. India ranks first in milk production, accounting for 18.5 per cent of world milk production. The growth rate in milk production during 2013-14 was 6.3 per cent while the growth rate during 2014-15 was 9.6 per cent. The milk production in the country increased from 137.69 million tonnes (mt) in 2013-14 to 146.31 m t in 2014-15 and to 155.5 m t in 2015-16 (Fig. 1). The per capita milk availability during 2015-16 was around 337 g, which is well above the ICMR recommended level. Buffalo contributed to 49 per cent of the total milk produced in the country, while cattle contributed to 48 per cent. Indigenous buffaloes (13 recognized breeds of the buffalo) produced about 73 per cent of the milk produced by the buffaloes, while the remaining was from non-descript buffaloes. Among cattle, exotic and crossbred cattle contributed to 56.3 per cent of the total cow milk produced in the country. The contribution of indigenous breeds was to the extent of 25 per cent while

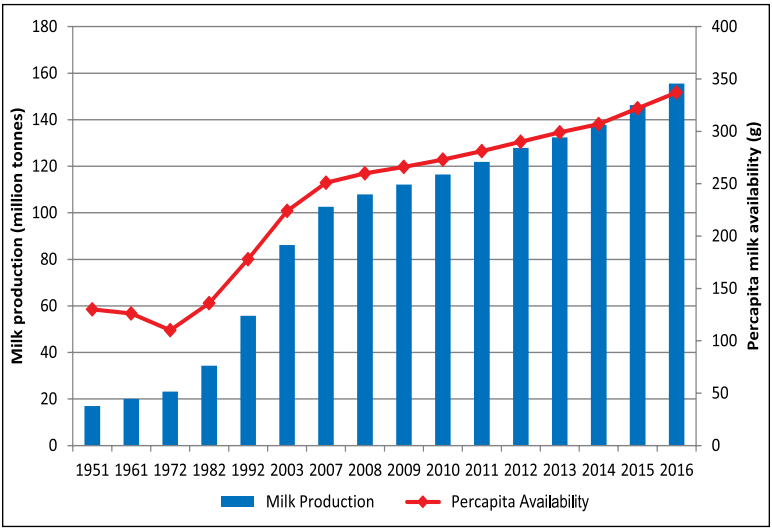

Fig. 1. *Milk production in India during 1951-2016*

non-descript cows contributed to 19 per cent of the total milk produced by the cattle.

India is the largest exporter of buffalo meat and third largest exporter of meat after Brazil and Australia. India started exporting meat since 1969 and exports both fresh and frozen meat to several countries, of which the major buyers of Indian bovine meat and other meat are Vietnam, Malaysia, Thailand, Australia, UAE, Saudi Arabia and Egypt. Among Indian states, Uttar Pradesh has emerged as the major exporter of buffalo meat, followed by Punjab and Maharashtra. The meat production showed a good growth rate during the last decade. According to the Department of Animal Husbandry, Dairying and Fisheries, the total meat production was only 2.1 million during 2003-04, which increased to 7 m t during 2015-16 (Fig. 2). Bovines are the second largest source of

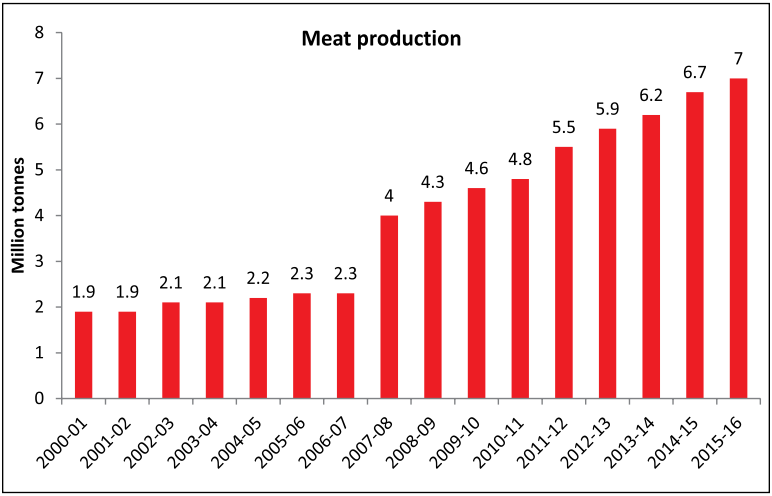

Fig. 2. *Meat production in India during 2000-01 to 2015-16*

meat in India after poultry, and ahead of goat and sheep. Poultry contributed 3.26 mt, followed by beef (1.61 m t from buffalo and 0.33 m t from cattle), chevon (0.94 mt) and mutton (0.49 mt). Pork accounted for 0.39 mt.

Poultry is one of the fastest growing segments among the components of agricultural sector in India. The highest growth of the Indian poultry industry placed India at third position in world's egg production with a production of 82.93 billion eggs and sixth position in broiler meat production with a production of 3.26 m t of broiler meat during 2015-16. Egg production showed an impressive growth during the past few decades. During 1980-81, the country produced only 10 billion eggs; during 2000-01 the egg production increased to about 39 billion numbers. In the year 2015-16, the egg production reached to about 83 billion numbers (Fig. 3).

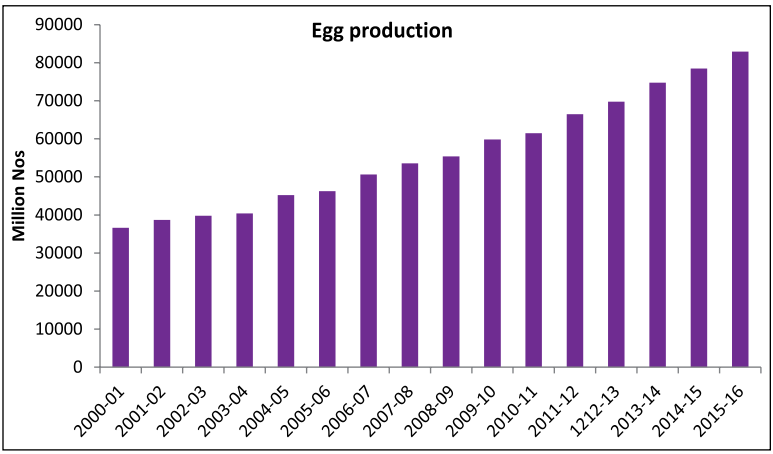

Fig. 3. *Egg production in India during 2000-01 to 2015-16*

SWOT Analysis of the Indian Livestock Sector

Strengths

- Vast livestock population, with adaptability to wide range of agroclimatic conditions, is a vital asset for the country and offers scope for diversified animal agriculture.
- Good number of high quality buffalo germplasm offers a unique strength to produce high market value products like mozzarella cheese.

- Abundant crop residues and common property resources ensure adequate availability of roughages for animals.
- Low cost of production compared to the most other parts of the world, strengthens the possibility of reaping the benefits of comparative advantage.
- Animal protein, especially milk, consumption is regular part of the diet of the people and hence there is presence of large market.
- Rapidly increasing number of processing plants, especially in dairy sector is expected to boost value addition on the livestock sector.
- Considerable number of educated youths/non-livestock based companies and organizations venture into livestock, especially dairying, which is a strength to improve the quality of the produce.

Weaknesses

- Though cross breeding programs have improved animal productivity, at least in cattle, generally the country is still largely dominated by low yielding non-descript animals.
- Lack of cold-chain and poor support infrastructure, e.g. roads and erratic power supply remain a major challenge for procurement and supply of good quality raw animal products.
- Inadequate knowledge and low adoption of scientific livestock farming and clean milk/meat production practices.
- Non maintenance of records by the farmers constrains the availability of comprehensive and reliable production data for proper planning.
- Investments in livestock research is not commensurate with returns and potential.

Opportunities

- Purchasing power of the consumers is on the upswing with growing economy and continually increasing population of middle class.
- Expanding market will see creation of enormous job and self-employment opportunities.
- Demand for livestock products is income elastic. Continued rise in middle class population will see shift in the consumption pattern in favour of value added products.
- Untapped potential of improved technologies in certain areas leaves ample scope for improving productivity.

Threats

- Excessive grazing pressure on marginal and small community lands has resulted in degradation of land.
- Indiscriminate crossbreeding for raising productivity could lead to disappearance of valuable indigenous breeds and germplasm.
- Entry of multinationals could result in a large portion of milk being diverted towards value added products which, though it argues well for the producers, is likely to affect the availability of liquid milk supply for mass consumption especially for the poor urban class.
- Export of quality feed ingredients, viz., cakes, molasses, etc. is making the domestic producers rely on low energy fodders.
- With intensive industrialization of livestock sector in response to market forces, the small producers will find it increasingly difficult to compete with the industrial sub-sector and thus risk losing a significant means of livelihood.

Critical Gaps in Improving Livestock Productivity

- Livestock production is mostly resource driven than demand driven
- Mind set of people to manage animals under low/ negligible input system
- Huge non-descript livestock population
- Low genetic improvement in organized and unorganized rural herds
- Poor productivity of native animals
- Inadequate availability of superior germplasm
- Inadequate feed and fodder supply
- Indiscriminate breeding of animals in field conditions
- Inadequate availability of vaccines, cold-chain and other health measures
- Unorganized marketing of animal products
- Problems in diffusion of new technologies - weak forward and backward linkage

Major Issues in the Livestock Sector

The Indian livestock sector is constantly looking ahead and promises to take greater strides in making livestock production more remunerative to the farmer. However, there are serious bottlenecks in our quest for making livestock sector a profitable venture. These issues are flagged here.

Low individual animal productivity

Despite holding the number one position in milk production in the world, our milk productivity remains one of the lowest as compared to the many leading countries of the

world. The milk production/cow/year in countries like USA, Denmark, Sweden, Finland, Netherlands, etc. are above 7,500 kg whereas in India the average milk production/cow/year is around 1,200 kg, indicating enough scope to improve the productivity. The average milk productivity of crossbred cows, indigenous cows and indigenous buffaloes is only 7.3, 3.4 and 5.8 kg/day, respectively. Empirical evidence based on the large sample surveys indicate that level of milk production for 36 per cent households is only ≤500 litres/annum and for another 27 per cent between 500-1,000 litres/annum. Such a tiny scale can provide some nutritional benefits to the family, but not enough surpluses for the market. Only 15 per cent households produce >2,000 litres/annum and contribute to 50 per cent of the total milk production.

Dilution of indigenous germplasm

For the genetic improvement of dairy animals, exotic germ plasm was imported and crossbreeding has been practiced, which led to increased crossbred cow population. No doubt the crossbreeding increased the milk production, however, it also led to dilution of Indian local breeds. For instance, the population of crossbred cows increased at the rate of 7.5 per cent during 1982-92, compared to 0.1 per cent for indigenous cows. The annual growth rate of crossbred cattle during 2003-07 was 7.58 per cent, while the corresponding growth rate of indigenous cattle was only 0.85 per cent. If the same trend continues, we may lose our valuable indigenous cattle breeds. The first report on State of World's Animal Genetic Resources, published by the FAO in 2007, indicated that 9 per cent of breeds were extinct, 20 per cent were under risk and 36 per cent of the breeds were classified under "Unknown status". This indicates that only 35 per cent of world's breed are enjoying "not at risk" status, which is an alarming situation to the entire world. Among the indigenous cattle breeds in India, three breeds (Punganur, Kasargod Dwarf and Kumauni) are reported to be endangered, two

breeds (Krishna Valley and Tarai) are vulnerable and one breed (Vechur) is reported to be critical. In buffaloes, two breeds (Chilika and Manda) are endangered and Kujang breed is classified as vulnerable.

Shortage of feed and fodder

One of the major constraints in livestock farming is inadequacy of feed (quantity and quality) to sustain production, particularly during the dry season. The area under fodder crops in India has stagnated at about 8.5-9.0 million hectares (m ha) during the past decade and accounts for only about 4.6 per cent of the total cultivated area. The projected dry fodder, green fodder and concentrate demand for 2020 is 468, 213 and 81 m t on dry matter basis whereas the availability is estimated to stand at 417, 138 and 44 m t leaving a short fall of 11, 35 and 45 per cent, respectively. Although significant quantities of crop residues are produced, their quality cannot meet the nutritional requirements of dairy cows.

Inadequate breeding inputs

Although we started using artificial insemination for breeding purpose in 1940s, its coverage and the conception rate through artificial insemination is very less. India has one of the largest breeding infrastructures in the world (51 frozen semen stations, 3,321 bulls and 94,688 artificial insemination centres) with total production of about 90 million frozen semen straws per year, however we could cover hardly 25-30 per cent of the breedable population. To achieve national target of 50 per cent AI coverage by 2021-22, we require high number of superior bulls. The quality semen production must reach to 140 million doses. The major limiting factor in achieving the required numbers of frozen semen straws production is the availability of quality bulls. As such, the availability of quality bulls is very limited and the situation is further amplified by the poor quality semen produced by the breeding bulls.

Reduced reproductive efficiency

The total female population of crossbred, indigenous/non-descript cattle and buffaloes, as per 2012 livestock census, was 33.76, 89.22 and 92.59 million, while the breedable population was 21.27, 55.42 and 56.58 million, respectively. Among this breedable population, 1.6 million crossbred cattle, 6.03 million indigenous/non-descript cattle and 4.6 million buffaloes have not yet calved even once. This "calvable" but "not-calved" population accounts to nearly 10 per cent of the total breedable population. If this population can be made to calve once, at least, we could add substantial quantities of milk to the nation's milk pail without any additional expenditure. Conception rate through artificial insemination in buffaloes is very less when compared with cattle. Delayed age at sexual maturity (31-33 months in Murrah against 18-19 months in Mediterranean buffaloes), poor expression of heat symptoms and uterine infection still remains as major issues in achieving high reproductive efficiency in buffaloes. Summer infertility characterized by high incidence of silent heat (even up to 70 per cent) is more common in buffaloes.

Anestrous and repeat breeding in buffaloes and bovines are two of the most serious reproductive problems affecting 30-40 per cent of the total cattle and buffalo population followed by uterine infection. On a conservative estimate, the country is losing 20-30 m t of milk annually on account of anestrus and repeat breeding in cattle and buffaloes which translates to a loss of nearly INR 40-50 thousand crores annually. At a micro-level, each missed heat is a missed opportunity. For each heat missed, the farmer incurs a loss of milk production of 21 days, in addition to bearing the feeding cost for animal maintenance, which tantamount to about INR 4,000-5,000 for a even very moderate milk producing animal.

Reduced outreach of veterinary health services

The outreach of veterinary health care services to the livestock farmers is also low. Lack of awareness and timely

non-availability of inputs for preventive measures leads to high incidence of diseases and epidemics in the country. It has been estimated that losses due to brucellosis cost India at least INR 350 million every year on account of food animals and loss of man-days. In India, annual economic losses incurred by dairy industry on account of udder infections have been estimated about INR 6,053.21 crores. Out of this, loss of INR 4,365.32 crores (70-80%) has been attributed to sub-clinical version of udder infections. The direct economic loss due to foot and mouth disease (FMD) in India is estimated at INR 20,000 crores a year. Small, marginal and unorganized dairy sector of the poor farmers are most sufferers by this disease. It also affects the export potential of the livestock industry. Milk and milk products, meats and hides are not accepted by the disease-free importing countries. If FMD is controlled, the milk production can be increased by at least 5 per cent annually and the export of meat could be enhanced by 3-5 times of the present level.

Inadequate human resource

The decisive factor in effective animal health services is the availability of veterinary personnel in terms of quantity and quality. Thus, it is imperative to develop man power in desired numbers with desired skills. A shortage of qualified veterinarians and support staff can be a serious obstacle to the control of animal diseases, as well as to husbandry and trade in animals and animal products. Veterinary human resources are of primary importance for the successful application of strategies, measures and methods to promote, protect and restore animal health. They are the driving force behind the effective transfer of modern technology and accumulated experience into general practice. One veterinarian is recommended for every 5,000 animals. In 1985, our country had 9,451 livestock units per veterinary institution and as on date the number of livestock units per veterinary institution remains not less than 7,000. Similarly in the last decade, on an average one Veterinarian looked

after 9,000 livestock units, which was very high compared to the global average. Though animal health sector has expanded in terms of infrastructure and technical expertise, many of the veterinary institutions still do not have adequate man power.

Indian Livestock Sector: Futuristic Needs

Unlike earlier days, wherein smallholder livestock production has been universal in the country, recent days witness a gradual transformation to semi-commercial or commercial mode. The requirements for age old traditional production system and the current as well as future production system are not similar and the country need to equip for effective technological backstopping and efficient input delivery system besides facilitating favourable market and marketing network. Availability of superior germ plasm in required numbers, quality inputs including frozen semen, feed and fodder, vaccines and other health measures, machineries for organized and large scale livestock farms and ensuring the quality of the produce are some of the areas wherein we need to have concerted efforts in terms of research and development.

Animal identification and performance recording

Till date we do not have an effective mechanism to identify the animals and performance recording, although small scale level progeny testing programs are existing at some places. The elite germplasm of all breeds needs to be identified, subjected to performance recording and systematic breeding program so that more numbers of elite germplasm are obtained and male offspring from these elite females can be used for future artificial breeding purpose.

Conservation and improvement of indigenous animals

Currently, 40 cattle breeds, 13 buffalo breeds, 26 goat breeds, 42 sheep breeds, 17 chicken breeds and 6 pig

breeds are recognized by the Indian Council of Agricultural Research - National Bureau of Animal Genetic Resources (ICAR-NBAGR); however considerable livestock population exist in the country deserving a breed status but yet to be recognized. Indigenous animals have the advantage of sustaining productivity under low inputs and are also known for their drought tolerance and disease resistance. However, there has been a change in the utility pattern of these genetic resources, which has created a stiffer competition to the local breeds for their survival, which warrants immediate measures to be taken for their conservation. Some indigenous breeds are having good potential of milk production (Gir, Sahiwal, Rathi, Red Sindhi, Thaprparkar, etc.); the lactation milk yield of these breeds varies between 1,200-3,000 litres or even more. Such breeds need to be promoted and may also be used for grading-up of non-descript cattle in different parts of the country for improving their milk productivity. Besides the regular programs for conservation and improvement of indigenous cattle, the strength of having several *gaushalas* can be converted into opportunity by involving them as focal points for development and conservation of indigenous breeds in their respective regions.

In India, as on 2014, a total of 4,187 *gaushalas* are existing, of which 1,413 are registered by the Animal Husbandry Department. Some of the *gaushalas* have good infra-structure and capable of acting as conservation-cum-genetic improvement units. There is a need to develop a strong linkage between research institutions working on conservation aspects with these *gaushalas*. *Gaushalas* can play four important roles in development and conservation of indigenous breeds; they can be utilized as (i) genetic improvement centres, (ii) technology demonstration schools, (iii) livestock training schools, and (iv) integrated livestock production and demonstration units. For greater benefit, *gaushalas* in a particular region can be linked with Krishi Vigyan Kendras (KVKs) in the region. Because most of the KVKs do not have a big animal farm, it will be

an immense help to the KVK personnel for demonstrating the proven technologies to the farmers in association with the *gaushalas*.

Climate resilient livestock production

In India, the anticipated rise in temperature between 2.3 and 4.8°C over the entire country together with increased precipitation in future resulting from climate change is likely to aggravate the heat stress. This is expected to result in reduced productive and reproductive performance of livestock. Therefore, it is essential to develop a portfolio of strategies that includes adaptation, mitigation, technological development and research (climate science, impacts, adaptation and mitigation) to combat climate change. Increased focus on sustainable livestock production involving indigenously adapted livestock for optimizing production is, therefore, critical in sustaining the resource base. Since livestock are both contributor to and victim of climate change, the livestock development strategy in the changing climate scenario should essentially focus on minimization of potential production losses resulting from climate change, on one hand, while intensive efforts are required for methane abatement from this sector on the other.

Improving feed and fodder availability

An exercise has to be conducted to develop an effective plan for improving the availability of feed resources of the country, as there is shortage of feeds, resulting in inadequate supply of nutrients especially protein, energy and minerals. The regional and seasonal deficits of fodder and feed are more important than the national deficit as it is not economical to transport them over long distances. In order to meet the nutritional requirements of animals, there is a need to increase the bioavailability of the feeds and fodders using chemical, biological and biotechnological approaches. We also need to have enriched feed/fodder banks like food/seed banks as technologies for compaction, enrichment

and fortification are now available. Also, it is necessary to improve the productivity of the land for meeting out the feed and fodder requirements from the limited area available for this purpose. We also need to explore new feed resources and evaluate them for livestock feeding and find out how much these can be useful in bridging the gap between supply and demand of the nutrients. For updating the information about feed resources, there is also a need to generate information on the level of anti-nutritional factors in the feeds.

Animal health improvement and control of diseases

An exact diagnosis of diseases is not possible under field conditions due to insufficient availability of veterinary laboratories/ health centres. Most of the diagnosis is made based on the symptoms only. There is a need to keep pace with the contemporary developments in the technology improvements of the conventional vaccines to make them more useful and also continue the R&D effort for development and application of newer generation vaccines in the long-term. Launching of systematic disease control and eradication programs for Office of International Education (OIE) listed diseases along with effective disease surveillance on the lines of rinderpest eradication program, and strict enforcement of sanitary and phytosanitary conditions in processing the livestock products are critical in promoting the export as per international acceptance.

Prevention and control of animal diseases is an issue that requires commitment of many stakeholders in the chain. Especially at farm level, better prevention and control of diseases could contribute to a much higher output. We need to develop a strong and reliable epidemiological status of economically and zoonotically important disease in different regions of the country to identify high, moderate and low prevalence area and to formulate the control or eradication strategies. Although vaccination is the most promising way to control several diseases, it is not 100 per cent effective in preventing some of the diseases

like brucellosis. Thus, vaccination coupled with good husbandry practices is essentially required to control the disease. Surveillance to find infected animals, investigation of affected herds and vaccination of replacement calves in high-risk areas are important features in disease control program.

Special animal product economic zones

Zone-specific planning is an essential pre-requisite for any livestock development program. Intensive livestock development programs envisaging germplasm improvement through selection and upgrading shall be put in place along with region specific production packages. In order to promote the export of livestock products, it is the need of the hour to set-up the "Special Animal Product Zones (SAPZ)" on the lines of "Special Economic Zones". The areas for setting up SAPZ may be identified keeping in view the basic infrastructure and other requirements including availability of land and irrigation facilities for the production of fodders, healthcare and marketing facilities in the region. These SAPZ may be linked with an export based processing plants, compound feed industry, regulated animal market, veterinary polyclinics, semen bank, etc. in cooperative or private sector. The farmers in SAPZ may be offered incentives to set-up medium scale (20 - 100 animals) or large scale (more than 100 animals) commercial livestock farms depending upon the purpose (milk, meat, etc.). The farmers in this SAPZ may be offered assurance on the minimum price for animal products with an added premium for quality. A strong network of extension services may be established in each of these SAPZ and each state Govt. may set-up at least one such SAPZ depending on the agroclimatic conditions.

Policy measures

The population of non-descript livestock need to be described and the homogenous populations deserving the status of

breeds are to be recognized as new breeds in the livestock breed list of India. Once the animals deserving breed status are recognized properly, suitable policies need to be evolved to improve their productivity while restricting the growth of low producing population.

Only by facilitating the large scale commercial livestock production, it may not be possible to obtain inclusive growth, however boosting the smallholder farmers as a whole and commercial livestock production at identified areas would keep livestock as an instrument of inclusive economic development. To achieve this, we need to have a stringent mechanism/legislation in place that protects the interests of large smallholder population while facilitating scaling up commercial livestock production.

Livestock producers need to be brought under an organized umbrella by establishing livestock cooperatives/groups/breed societies, etc. to promote the concept of "quality assured production" and incentivising in the form of better price for the quality producers. Quality test centres need to be established at various levels for this purpose.

Quality standards need to be revised for livestock products and a check system to be applied for tracing "from table to farm" for the prevention of sale of substandard livestock products as it adversely affects the consumer health.

Developing competent man power in desired number is the need of the hour to look after huge population of livestock. Developing designer courses and programs in the frontier areas of biotechnology and applied areas of disease diagnosis, surveillance, vaccine production, nutritional management, etc. would help in producing man power with desired skill. We also need to re-orient or evolve veterinary education system that is harmonized with job markets and also meets the changing needs of livestock sector.

Recommendations

- Establishment of a strong and reliable national and regional data base on different aspects of livestock production needs to be taken up on priority to evolve suitable policy measures for improving livestock production and productivity.
- There is an urgent need for updating knowledge of stakeholders on the importance and recent developments in indigenous breed conservation and improvement for wider dissemination and application of frontier technologies to conserve the valuable germplasm in the modern era of intellectual property right (IPR) and climate change.
- Promising reproductive biotechnologies like multiple ovulation and embryo transfer (MOET), ovum pick-up and *in vitro* fertilization, and cloning need to be utilized to the maximum extent at least for breeding bull production. Further MOET and sexed semen can be used for faster multiplication of superior germplasm of elite female animals.
- Presently, data on the levels of aflatoxins, pesticide residues, heavy metals in feeds and fodders is inadequate. It is, therefore, imperative to generate objective information on this vital aspect so that we are able to produce livestock feed of internationally acceptable quality.
- Veterinarians may be slowly weaned away from routine artificial insemination activities, which can very well be taken up by trained inseminators, to utilize their expertise in specialized needs like precision livestock production and health cover management advisory service in view of increasing demand of veterinary consultant for large herds and increasing problems that needs special attention and expertise (for instance increasing infertility and emerging and re-emerging diseases).

- A well-planned and operational livestock disease control program involving public-private-participation (PPP) mode could be an option to ward-off huge economic losses due to changing climatic conditions.
- A comprehensive package about disease awareness, management and control measures needs to be developed for education at farmers' level to control the disease incidence.
- For effective transfer of technologies and implementation at end user level, it is important that adequate number of trained manpower and training facilities are ensured. Networking of institutions with KVKs and other local bodies may be an option in this direction.

Recent TAAS Publications

- Managing Our Water Resource for Increased Efficiency - Strategy Paper by Dr. R.S. Paroda, May 28, 2013.
- A Brief Report on Seventh Dr. M.S. Swaminathan Award presented to Dr. William D. Dar, DG, ICRISAT, Hyderabad, June 24, 2013.
- Brainstorming on Achieving Inclusive Growth by Linking Farmers to Markets - Proceedings and Recommendations, June 24, 2013.
- The Indian Oilseed Scenario : Challenges and Opportunities - Strategy Paper by Dr. R.S. Paroda, August 24, 2013.
- National Workshop on Outscaling Farm Innovation - Proceedings and Recommendations, September 3-5, 2013.
- Brainstorming Workshop on Soybean for Household Food and Nutritional Security - Proceedings and Recommendations, March 21-22, 2014.
- The Eight Foundation Day Lecture on "Sustainable Agricultural Development - IFAD's Experiences" by Dr. Kanayo F. Nwanze, President, IFAD, August 5, 2014.
- Need for Linking Research with Extension for Accelerated Agricultural Growth in Asia - Strategy Paper by Dr. R.S. Paroda, September 25, 2014.
- Global Conference on Women in Agriculture - Proceedings and Recommendations, March 13-15, 2015.
- Brainstorming Workshop on Upscaling Quality Protein Maize for Nutritional Security - Recommendations, May 21-22, 2015.
- The Ninth Foundation Day Lecture on "21st Century Challenges and Research Opportunity for Sustainable Maize and Wheat Production" by Dr. Thomas A. Lumpkin, Former DG, CIMMYT, September 28, 2015.
- National Dialogue on Efficient Management for Improving Soil Health - New Delhi Soil Health Declaration - 2015, September 28-29, 2015.
- Regional Consultation on Agroforestry: The Way Forward - New Delhi Action Plan on Agroforestry 2015, October 8-10, 2015.
- National Dialogue on Innovative Extension Systems for Farmers' Empowerment and Welfare - Road Map for an Innovative Agricultural Extension System, December 17-19, 2015.
- Round Table Discussion on Promoting Biotech Innovations in Agriculture and Related Issues - Proceedings & Recommendations, August 4, 2016.
- Awareness cum Brainstorming Meeting on Access and Benefit Sharing – Striking the Right Balance – Proceedings, October 22, 2016.
- Delhi Declaration on Agrobiodiversity Management – Outcome of International Agrobiodiversity Congress 2016, November 6-9, 2016.
- National Conference on Sustainable Development Goals: India's Preparedness and Role of Agriculture, May 11-12, 2017.
- Regional Policy Dialogue on Scaling Conservation Agriculture for Sustainable Intensification, September 8-9, 2017.
- Policy Brief on Scaling Conservation Agriculture in South Asia, September, 2017.
- Retrospect and Prospect of Doubling Maize Production and Farmers' Income – Strategy Paper by Dr. N.N. Singh, September 10, 2017.
- Indian Agriculture for Achieving Sustainable Development Goals – Strategy Paper by Dr. R.S. Paroda, October, 2017.
- Strategy for Doubling Farmers' Income - Strategy Paper by Dr. R.S. Paroda, February, 2018.

Copies of all TAAS publications are avialable at : www.taas.in

Brief Resume

Prof A.K. Srivastava, Member, Agricultural Scientists Recruitment Board, New Delhi was earlier Director and Vice-Chancellor, National Dairy Research Institute, Karnal. He was also Dean Faculty of Veterinary Science & Animal Husbandry, followed by Director Resident Instructions and Dean Postgraduate Studies at Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu (J&K). Presently, Prof. Srivastava is Vice President of National Academy of Agricultural Science. He is also President of National Academy of Dairy Science, President of Probiotic Association of India and President of Indian Society of Veterinary Pharmacology & Toxicology. He is Chairman of DBT Task Force on "Animal Biotechnology" and Chairman, R&D Executive Committee, Ministry of Food Processing and Industries, Govt. of India. He was also Authority Member of FSSAI, Govt. of India; Chairman, Indian Dairy Association (NZ); Chairman of Sub-group of Planning Commission Advisory Committee on processing and value addition of milk and milk products. Earlier, Professor Srivastava was also Secretary of National Academy of Agricultural Sciences, Secretary, Vice President and President of Indian Agricultural Universities Association of Vice Chancellors, He was Founder Chief Editor, Indian Journal of Veterinary Pharmacology & Toxicology; Councilor, Punjab Academy of Sciences and Member, J&K Council of Science and Technology. Prof. A.K. Srivastava is distinguished fellow of National Academy of Agricultural Sciences, National Academy of Veterinary Sciences, National Academy of Dairy Sciences, Punjab Academy of Sciences, Society of Sciences, Indian society of Veterinary Pharmacology & Toxicology, Indian Association for Advancement of Veterinary Research, Society of Toxicology, Society of Environmental Sciences, International Society for Ecological Communications and member of National Academy of Science. He is Member, Board of Governing Council of "Agriculture Skill Council of India", Governing Board Member of Punjab Livestock Development Board and Rajasthan Livestock Mission. He is also Member Governing Board of National Institute of Animal Biotechnology, DBT, Govt. of India. Prof. Srivastava is Patron of Indian Dairy Association, New Delhi. Prof A.K. Srivastava has been decorated with numerous prestigious awards and honors including ICAR Jawaharlal Nehru Award; International NOCIL Award; "National Alarsin Award"; Rashtriya Vidya Saraswati Puraskar, Bhoomi Nirman Award; German Academic Exchange Fellowship, Gold Medals of Indian Science Congress Association, Indian Association of Science and Technology and Indian Society of Pharmacology & Toxicology. He has been conferred the "Life Time Achievement Award" of Indian Society for Buffalo Development, Indian Society for Study of Reproduction and Fertility, the Society for Community Mobilization for Sustainable Development and also CLFMA India. He has also received the Chellappa Memorial Oration Award, Dr. Rao Memorial Oration Award and Prof M. Sabir Oration Award. Prof A.K. Srivastava has published more than 200 research papers in journals of International repute, written/edited more than 15 books and authored 12 Policy Papers/Status Paper on different aspects of Dairying, Animal Husbandry and Veterinary Sciences. He has guided more than 20 Ph.D. & M.V.Sc. students in the field of Veterinary Science and Animal Husbandry.