Vision 2030

Central Institute for Research on Goats
Makhdoom, Farah-241 122, Mathura (UP) India

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Publication Committee:

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सत्यमेव जयते
डा. एस. अय्यप्पन
सचिव एवं महानिदेशक
Dr. S. Ayyappan
Secretary & Director-General

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद्
कृषि मंत्रालय, कृषि भवन, नई दिल्ली-110 014
GOVERNMENT OF INDIA
Department of Agricultural Research & Education
and
Indian Council of Agricultural Research
Ministry of Agriculture, Krishi Bhavan, New Delhi-110 114
Tel.: 23382629; 23386711; Fax: 91-11-23384773
E.mail: dg.icar@nic.in

Foreword

The diverse challenges and constraints as growing population, increasing food, feed and fodder needs, natural resource degradation, climate change, new parasites, slow growth in farm income and new global trade regulations demand a paradigm shift in formulating and implementing the agricultural research programmes. The emerging scenario necessitates the institutions of ICAR to have perspective vision which could be translated through proactive, novel and innovative research approach based on cutting edge science. In this endeavor, all of the institutions of ICAR, have revised and prepared respective Vision-2030 documents highlighting the issues and strategies relevant for next twenty years.

In global scenario, India ranks second in terms of goat population and meat production, and occupies top position in goat milk productions. The *chevon* is one of the most widely preferred and consumed meat in India, and goat milk is also gaining importance due to its health promoting traits. As such, demand for goat products is projected to rise considerably in coming decades. To meet the projected demand for goat meat, country has to almost double the existing goat population, which will be a challenging task considering the available resources including feed, fodder and grazing areas. Presently goat ensure livelihood for over five million households in India and this number would certainly increase as the goat provides future hope for better livelihood and income for more and more people living in agro-geo-climatic disadvantageous areas.

These emerging challenges and opportunities call for technology oriented innovative goat production system and prioritization of researchable issues for the coming future. The Central Institute for Research on Goats has come up with a comprehensive road map to address the upcoming challenges in goat research and production.

It is expected that the analytical approach and forward looking concepts presented in the 'CIRG Vision 2030' will prove useful for the researchers, policymakers, and stakeholders to address the future challenges for growth and development of the agricultural sector and ensure food and income security with a human touch.

Dated: the 22nd June, 2011
New Delhi

(S. Ayyappan)
Secretary, Department of Agricultural Research and Education
and
Director General, Indian Council of Agricultural Research

Preface

Traditionally goat has served as source of livelihood and financial security to large section of society, mainly comprising of resource-poor people. In the present scenario of changing agro-climatic conditions, this small ruminant farm animal has tremendous potential to be projected as the 'Future Animal' for rural and urban prosperity. The backyard goat rearing is steadily turning as the fast growing 'livestock industry' in the country. The 'goat meat' is one of the choicest edible commodities and carries premium value in the market. The goat milk is believed to possess many scientifically unexplored medicinal and health-promoting properties.

The Central Institute for Research on Goats (CIRG) is spearheading agricultural research, education and extension activities. The comprehensive initiatives taken by the institute have led to notable accomplishments in conservation of native goat breeds under natural resource management, efficiency in use of inputs, climate resilience, goat rearing as secondary agriculture and economic transformation of farmers though goat based technological advancements and interventions. The present document, CIRG Vision- 2030 articulates the strategies to overcome the challenges and tap the opportunities by harnessing the power of science and undertaking boundary less partnership with different stakeholders in food supply chain at national and international level.

Central Institute for Research on Goats is an apex organization spearheading agricultural research, education and extension activities for the enhancement of productivity and diversification of goat production in the country. Comprehensive initiatives taken by the institute have led to notable accomplishments in conservation of native goat breeds under natural resource management, efficiency in use of inputs, climate resilience, goat rearing as secondary agriculture and economic transformation of farmers though goat based technological advancements and interventions. The Vision – 2030 documents prioritizes the programmes and opportunities for the next two decades for better utilization the vast resource of goat production system for over-all socio-economic development and to address the increasing food demand in the country.

I express my sincere gratitude to Dr. S. Ayyappan, Secretary, Department of Agricultural Research and Education (DARE) and Director General,

Indian Council of Agricultural Research, and Dr. K.M.L. Pathak Deputy Director General (AS) for their constant guidance, inspiration and encouragement in developing this document. Chairman and members of the committee deserve appreciation for their hard work and dedicated efforts for on time release of this document.

Dated: 22nd June, 2011 **(Devendra Swarup)**

CIRG, Makhdoom Director

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Preamble

Among all species of farm animals, goats have the widest ecological range and have been poor people's most reliable livelihood resource since their domestication during Neolithic Revolution about 10 millennia ago. Goats possess distinct social, economical and biological advantages. They can be maintained on a limited area and can sustain on wide variety of vegetation in varied agro-climatic conditions. Goats are easy to manage and their small size makes them suitable for home slaughter. Goat meat (*chevon*) is one of most preferred meat type by the consumers in several countries including India. The goat milk is easily digestible due to smaller size of fat globules and serves as a ready source of family nutrition. In India, both demand and production of goat meat have shown steady increase during the last decade and despite the rising production trend, country would need to double the number of goats to meet the projected requirement of goat meat for growing human population in the coming decades. However, the increase in livestock number would definitely put more stress over limited natural resources.

Management of feed and fodder resources is crucial for the future development of goat production in the country. There is very little scope for increasing the area under fodder production, keeping in view the priority for food grains, pulses and oil seeds. Therefore, concerted efforts are required to develop technology for enhancing per animal productivity, besides increasing the productivity of fodder per unit area and utilization of the waste lands and newer non-conventional feed ingredients for goat production. Innovative research strategies need to be formulated to ameliorate impact of climate changes on health and productivity of animals. Research programmes for conservation and genetic improvement of indigenous goat resources and use of molecular genetics in understanding gene expression and gene variability and causes of genetic diversity need to be strengthen. Food management, food safety and value addition studies and green house gas mitigation technologies are important to address issues pertaining to eco-friendly sustainable goat production system. Disease occurrence leads to considerable economic losses and control of diseases is very relevant in present era of bio-security, safe food and 'one-health'. Control of helminthoses, JD, brucellosis, PPR, blue tongue and other emerging and re-emerging diseases is particularly important to augment goat production in the country without multiplying number of animals. Research directed towards newer generation vaccines, diagnostics and drugs can be an effective tool for disease control. The unorganized market system is a major hurdle for goat farmers to fetch remunerative price. There is an absolute necessity for market oriented livestock production system and vice versa. Considering the existing and emerging challenges, and opportunities, the CIRG has revisited its priority and envisaged future roadmap in the vision 2030.

Scenario: Goat an Animal for future

The poor man's cow- goat has tremendous potential to be projected as the 'Future Animal' for rural prosperity under the changing agro-geo-climatic conditions and depleting resources. There are over 880 million goats around the world, out of which India has over 126 million goats (14.31%) of 23 defined and non-descript breeds that are adapted efficiently in different agro-climatic conditions all over the country. Goat husbandry in India is essentially an endeavor of millions of small holders who rear animals on "Crop Residues" and "Common Property Resources". The small holders produce milk, meat, fiber, skin etc for the community with virtually no capital, resource and formal training. More often goats are reared for production of meat, but they also serve as ready source for milk to meet the family requirement. In India, considerable growth has been recorded in production of goat meat and milk during the last decade. The goat meat production has doubled (9.3% to 18.3%) and goat milk production has shown a growth rate of 31.53% during the last decade. The country stands first in goat milk production and is the second largest meat producer in the world sharing 26.31% goat milk and 10.41% goat meat production. Besides meat and milk, goats also produce good quality skin, valuable *Pashmina* fiber and manure. The goat sector contributes ` 14,453 crores to the agricultural economy of the country through meat (`6851 crores), milk (`4588 crores), skin (` 648 crores), etc. which accounts for around 8 per cent of the Gross Domestic Product (GDP) from livestock sector. In addition, the goat sector generates about 4% rural employment and about 20 million small and marginal farmers' and landless laborers' families depend on goats for their livelihood partially or completely.

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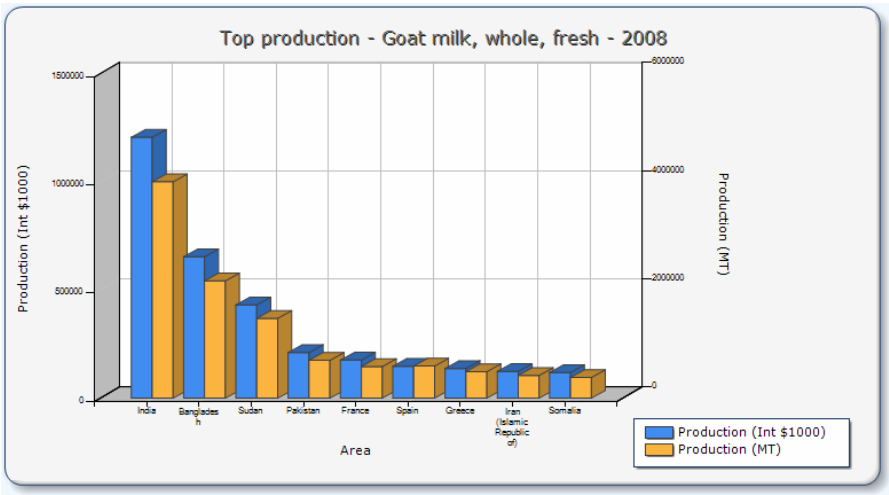
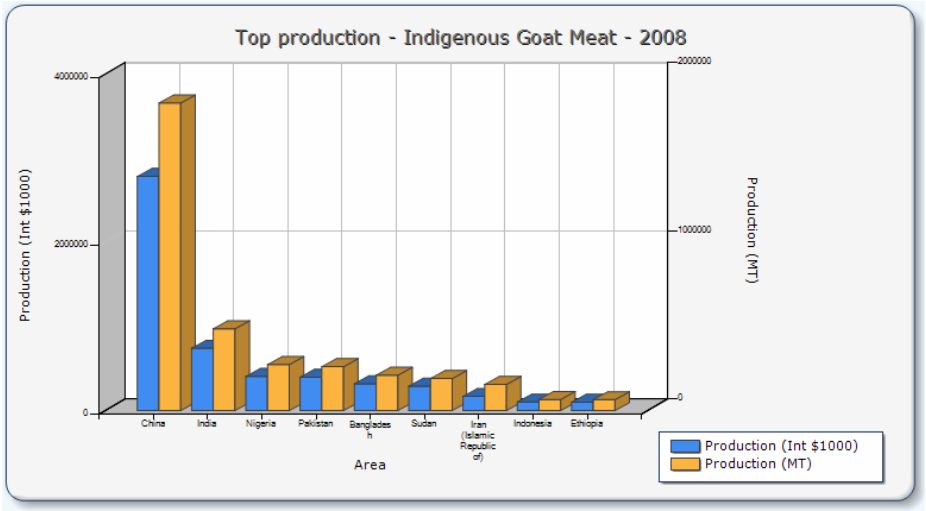


Source: FAOSTAT, 2008



Source: FAOSTAT, 2008

Goats significantly contribute to the agrarian economy and play a very vital role in the livelihood security of the small and marginal farmers and landless laborers especially in arid, semi-arid and mountainous regions of the country. They are hardy, disease resistant and widely adapted. They thrive well and reproduce well in tropical, cold, humid as well as dry regions. Their small size compared to cattle and buffaloes permit them to be maintained on a limited area. The breeding animals are inexpensive. Goats consume a wide variety of grasses, weeds, forbs, bushes, shrubs, tree leaves and crop residues that would otherwise go waste and cause pollution. Goat is an efficient converter of the sparse vegetation available in wastelands, community grazing lands of arid, semi-arid and mountainous regions into milk, meat, skin, fibre and manure while utilizing traditional and under employed manpower. They are gentle and easy to control. Their small size makes them suitable for backyard slaughter and the meat can be consumed by the family. The goats can be milked any time of the day and are therefore named as the moving refrigerators. Goat milk is prescribed for children, old and sick people as it is easily digestible and has possible medicinal value. Goat meat (chevon) is preferred over other meats because it is leaner and there are no religious taboos against its consumption. The vast population and large genetic resource are the strengths of the programme.

Constraints to livestock husbandry include the scarcity of good breeding stock, inadequate veterinary and extension services, lack of credit and access to markets. Focusing more assistance on small holder farmers would improve impact on the poor. Value-based holistic community development with self-help groups may create a foundation for increasing farmer incomes by providing a forum for education, mutual support and developing markets. Constraints faced in the

introduction and spread of goats and increasing their benefit to the small scale producers as well as success factors and best practices will be worked out and suitable frame work will be employed. The goat products are among the foods available with human health promoting characteristics.

Lack of awareness to adopt improved technologies due to poverty, illiteracy and little or no say in decision making process is the weakness of the goat owners. Lesser availability of elite breeding males, effective vaccines, grazing lands and feed resources are the other weaknesses. The goat farmers are exploited by the middlemen in marketing of surplus animals for meat markets. Sufficient modern abattoirs for hygienic slaughter are not available and a large number of goats are slaughtered in unauthorized places. There is great scope for rearing goats for meat production under semi-intensive and intensive systems of management. The reproduction rate, multiple births, growth, slaughter - weight, dressing percentage, bone: meat ratio and survivability can be significantly improved which in turn will provide higher returns to the goat owners. Scope for value addition in milk, meat, skin fibre and manure is tremendous. Opportunities for employment generation and foreign exchange earnings are very high. Increase in population, shrinkage in grazing lands, slaughter of elite breeding males, emerging diseases and shortage of trained manpower are posing threat to development of goat industry in the country.

Worldwide over 100 million people in arid areas, have only possible source of livelihood by grazing small ruminants. Grazing goats can improve soil and vegetation cover and plant and animal biodiversity, for example by removing biomass, which otherwise might provide the fuel for bush fires, by controlling shrub growth and by dispersing seeds through their hoofs and manure, which can improve plant species composition. Other major benefits are the improved productivity of small farms by the incorporation of manure and the use of other farming practices such as the planting of trees and forages controlling soil erosion. However, importance of this valuable genetic resource is often neglected due to many social and environmental biases and misconceptions.

Central Institute for Research on Goats (CIRG)

Central Institute for Research on Goats (CIRG) is a premier research Institute of Indian Council of Agricultural Research (ICAR). This Institute was established on 12th July, 1979 at Makhdoom village in Mathura district of Uttar Pradesh for undertaking research on all aspects of goat production and utilization. Research programmes at CIRG are flagged to provide cost effective scientific inputs that can easily be adopted by the weaker section of the society and to extend support to nutritional as well as the social security. The institute is contributing to high quality research in the areas of caprine physiology, genetics, nutrition, product technology, health and reproduction. The emphasis has been on the use of multidisciplinary and interdisciplinary approaches to improve eco-efficient rearing of goats and making goat farming a vibrant and viable enterprise, besides popularizing goat produce by value addition and making them attractive for industrial applications. The basic theme of research has been technological and institutional innovations to enhance the income of goat farmers. CIRG is trying to demonstrate the available improved technologies at the farmers' doorstep and a concerted approach has been adopted by the institute in this direction by creating goat-net and CIRG helpline to address the problems of goat farmers.

During the last 32 years of its glorious existence, CIRG has acquired and developed modern laboratory facilities to undertake research on Goat Genetics and Breeding, Feed Resource Development and Utilization, Nutrition, Physiology, Reproduction, Management, Diagnosis and Prevention of Diseases, Transfer of Improved Technologies and Milk and Meat Products Processing Technology. The institute maintains superior germ plasm of Jamunapari, Barbari and Jakhrana goats and Muzaffarnagari sheep. The Coordinating Unit of AICRP on Goat Improvement is also located at the Institute. The institute has developed many farmers' friendly and commercially viable technologies. So far, 18 patents have been filed; one green drug technology (*Alquit*) for control of ectoparasites has been released and value added goat meat and milk products , area specific mineral mixture, diagnostics for brucellosis and JD, etc are under active process of commercialization. The CIRG has successfully produced IVF kids twice.

Mandate

To undertake research, training and extension education programmes for improving milk, meat and fiber production of goats and to develop processing technology of goat products.

Vision 2030

The Central Institute for Research on Goats is moving forward with missionary zeal to tackle the constraints and challenges in goat development so as to ensure optimum returns to consumers and goat farmers. With a view to emerge as a vibrant institution and to achieve national and international goals, CIRG has felt the need for reorienting and recasting of the Vision 2025 and develop this Perspective Plan as VISION-2030. The efforts would be to assume a lead role in the goat sector in the world and build-up an organizational climate that is responsive to the needs of stakeholders in the goat production sector in India.

Vision

To develop Poor Man's Cow- the Goat as a source of livelihood security, poverty alleviation and employment generation for the smallholders

Mission

Goat-the future animal for rural prosperity by enhancing and then sustain goat productivity in respect of meat, milk and fiber through research, extension and HRD support.

OBJECTIVES

To accomplish the vision, mission and mandate, the following objectives have been decided:

1. To undertake basic and applied research in all disciplines relating to goat production and product technology.
2. To develop update and standardize area specific package of practices on breeding, feeding, management and prophylactic and curative health cover for goats.
3. To impart national and international trainings in specialized fields of goat research and development.
4. To transfer technologies for improving milk, meat and fiber production and value addition of goat products.
5. To provide referral and consultancy services on goat production and product technologies.

Harnessing Science

Goat husbandry in our country is recognized as an instrument for social and economic transformation of rural resource poor to a vibrant sustainable eco-friendly enterprise. Goat rearing supplements family income and generates employment particularly for small, marginal and landless farmers. Human population growth, progressive urbanization and larger purchasing power of people will increase the demand for goat products. The approach identified for the livestock and fisheries sectors in the XI Plan was to achieve an overall growth between 6 to 7 percent per annum. There has been a consistent growth in goat numbers and productivity over the past few decades. The National Policy on Agriculture also advises farmers to diversify their risks by avoiding mono-cropping and taking up animal husbandry, horticulture and other similar business. Most of goat farmers in the country maintain an average a herd of two-five goats of non-descript nature. Goat is an important source of animal derived proteins in the form of milk and meat products for millions of people from different strata of society. Goats fulfill their nutritional requirements by thriving on agricultural waste and byproducts, grazing on unutilized wasteland. Improved goat production could significantly enhance the economy and living standards of millions of goat farmers in India living in eco-fragile and vulnerable zones of country. There are 23 recognized goat breeds in Indian subcontinent alone. However, most of the goat population has not yet been characterized and are of the non-descript types which have low milk and meat productivity. The adaptation of goats to tropical climates ensures their place in the future livestock scenario. Unlike agriculture, goat husbandry has a distinct advantage as it provides a stable, year-round income – an important economic incentive for the small farmer to take to goat farming as a profession.

Resilience of goat production to harsher environmental conditions offers amicable solutions to alleviate the vulnerability of the small and marginal farmers at the time when crop production fails due to adverse climatic conditions and where the natural resources are limited. Prevailing goat production system is all set to be transformed in the coming years due to emerging market trends on account of strong consumer preferences towards quality animal foods. Goats provide a leaner meat in comparison to other domestic ruminants and their milk and milk products have several scientifically unexplored medicinal and health-promoting properties that need to be investigated, scientifically validated and promoted commercially. Responding to the market signals, the goat production system in India has been gradually moving from extensive to intensive system of management for commercial production. Goat enterprise will play a significant role in empowering rural women and will act as a triggering factor in transformation of socio-economic status of rural people. The Institute will therefore, strive with a single-minded

purpose to make goat rearing a profitable venture for the farmers. The goat scenario at present has to undergo a sea change for making this dream come true. CIRG is committed to bring about this transformation in major facets of goat development *viz.,* breeding, feeding, management, health cover, processing, marketing and extension.

Goat Production

It is strongly being realized that gradual stress induced by global warming and climate change is also influencing fertility and productivity of goat directly, and through reduction in fodder production indirectly. Climate change is likely to affect animal health and hence productivity directly, by altering the homeostasis and other thermo-regulatory responses to maintain the thermal balance and indirectly by affecting supply of feed and fodder, increasing vulnerability to diseases and pests. In the changing scenario of increasing global trade, food demand, manpower requirement, adverse impact of climate change on productivity of livestock and threat from emerging livestock and zoonotic diseases, livestock sector is going to face numerous challenges which need to be addressed for composite livestock development. Changes in productivity are also linked with changes in expression of different genes. Molecular characterization of candidate genes for growth, production, reproduction, health and adaptability traits in goats needs to be carried out.

Goat production is facing a feed scarcity due to shrinkage of grazing lands and increasing stocking rates which adversely affect the productivity of these animals. It has been well documented that proper feeding is by far the most important factor hampering the productivity of goats. There is a need to optimize the use of available feed resources and enhancing the bioavailability of nutrients from these feed resources. Strategic supplementation of limiting nutrients and area specific nutritional interventions are some of the approaches which are to be pursued for enhancing productivity. Biotechnological interventions, modeling of rumen fermentation and nutrient utilization for reducing enteric methane production to improve metabolizable energy utilization of feeds are to be harnessed for combating the adverse effects on climate. Nutri-genomic studies for understanding the impact of nutritional strategies and feed conversion efficiency at the genetic level needs to taken up. There is also a need to explore newer feed additives to improve the rumen fermentation, minimize wastage of nutrients and increase productivity from goat animals. Precision nutrition for maximizing efficient utilization of feeds needs to be established in goats. There is a need to development of nutritional strategies to combat impact of climate change on livestock productivity. The intensive goat rearing system should be standardized with locally available feed resources.

Majority of the goat population is nondescript that is capable of producing very less meat and milk. With shrinking resources and increasing demand of goat meat and milk, there is urgent need to genetically improve and manage these animals

through modern scientific tools to enhance their productivity. Although, there is a need to utilize between-breed genetic differences for higher yields, greater emphasis is required on improvement of adapted indigenous breeds/types because of valuable adaptive traits they have developed over long periods of time through natural selection. Breeding strategies for enhancing goat meat and milk production in the country is needed. A uniform goat breeding policy is an urgent need of the country and the Institute will play a key role in its drafting and implementation. The productivity of different goat breeds in different production systems is different and therefore, makes it necessary to characterize and evaluate the performance of the different breeds in different production systems. We also need to establish the genetic origin of different breeds as we have a valuable gene pool. It is necessary to identify the most diverse and distinctive population by analyzing genome and population diversity at various level in both descriptive and non-descriptive animals. Moreover adaptability to different stress, water requirement of different breeds with respect to environmental condition, endurance ability of goats in desert region and cold region should be analyzed at molecular level. Molecular characterization with respect to DNA marker, epigenetic analysis and the role of different RNA in expression of these traits in different environmental condition should be carried out. Evaluation of the economic value of goat genetic resource by analyzing economics and demographic data (performance, management) with respect to genetic distinctiveness should be carried out. Our indigenous goat population has not been characterized and evaluated for genetic –based disease resistance in natural population. Therefore we must evaluate our stocks for the disease resistance parameter with respect to geographic, climatic and production system. Genetic selection for resistance to diseases should be analysed in goat in specific ecological conditions. Advances in genomics and proteomics offer an opportunity to look at collective behavior of a large number of genes under a given situation. Discovering novel genes/ regulation mechanism of these genes, hitherto unknown, will remain another objective of the genomics research. The Institute therefore envisages undertaking studies to understand how changes in gene expression occur during different patho-physiological conditions and develop suitable remedies to overcome ill effects of stress. There is an urgent need to map the goat genome. Many of the annotated genes have been categorized as pseudo and hypothetical genes. Therefore there is a need to annotate the genes at the protein level by proteomic approaches.

Organic meat production will be also system of choice for future to fulfill the consumer demand. The improvement in village flock by providing support service such as breeding bucks and healthcare should be taken up for nutritional security, providing employment and to alleviate poverty.

Biotechnology as applied to agriculture implies increased productivity from animals. One of the main objectives will be to harness maximum from the animals, by not compromising with the health/fertility of the animal. This therefore demands

research in the frontline areas, so that superior germplasm can be multiplied at faster rate. Various reproductive biotechnologies have potential for this, like stem cell research, transgenesis and cloning etc. There is a need to takes up the challenge to solve the problems of artificial insemination in the goat by evolving cost effective simple technologies in physiology. Identification of fertility markers in goat needs to be established to increase the productive and reproductive ability of goats. Other aspects connected to animal productivity are assisted reproductive technologies, improved semen extenders, understanding of gene regulation. The knowledge of these aspects will help in harnessing science for sustained and profitable goat rearing. Transgenic research in goat needs to be strengthened for enhancing prolificacy, reproductive efficiency, increasing disease resistance through various approaches. Ultrasonography should be used for enhancing reproductive efficiency of small ruminants. Embryo technology should be explored for rapid multiplication of elite animals. Conservation of genetic material through cryo-preservation of semen is essential for maintaining and future use of indigenous goat breeds. It is necessary to establish a reference semen laboratory with all types of facilities and certification.

There is a need to integrate meat quality component in to breeding and genetic selection as well as nutrition and management studies. Developing a method to select animals for increased muscle mass is necessary for faster genetic progress on muscling attributes. It is necessary to analyze the effect of breed, diet, geographical region on palatability, flavor, tenderness attribute of meat and cheese quality and fatty acid composition of milk to understand better quality goat for meat and milk type. Developing a method to select live animals for increased muscle mass is necessary to form selection indices for faster genetic progress on muscling attributes.

Animal welfare measures should be delineated and ensured during transportation of animals, kept in confinement or used for show purpose. Most importantly painless slaughter/ humane slaughter should be done in the slaughter house and slaughter house standard should be improved and effort should be made to reduce unnecessary pain/suffering to animal (both physical and mental) should be minimum.

Goat health

Occurrence of diseases causes heavy economic losses in terms of livestock health and production. Advances in animal health are expected to play a major role in the progress of livestock industry. Control of animal diseases assumes prime importance in the crucial time of shifting of animal agriculture from extensive to intensive and commercial system of management. Presence and accumulation of infectious agents in the environment lead to reduction in quality and quantity of animal products. Strategic control and eradication of economically important diseases will result in enhancing goat production in the country. In present scenario, a uniform and clear policy for animal health at National level is necessary and Institute can play a key

role in its drafting and implementation of such a policy.

Development of new generation diagnostics and vaccines along with appropriate adjuvant and improved delivery system for the endemic, emerging and exotic diseases of goats will be the major thrust area in the coming decade. Research on developing technologies for early and accurate diagnosis of diseases and DIVA kits will be a priority programme. Health related research activities will be focused to assist programmes for control and eradication of important globally notifiable, zoonotically important and trans-boundary diseases. Application of microarray for detection and characterization of various goat pathogens will be employed for better disease diagnosis over large population of goats. Molecular tools for epidemiological studies on pathogens (Chronic, zoonotic and drug resistant pathogens and parasites) will be taken up. Efforts will be made for development of sensitive sero-diagnostic, molecular, chip- and biosensor-based diagnostics for important bacterial, viral, mycoplasmal, and fungal parasitic diseases. Host pathogen interactions, functional genomics and immuno-modulations of pathogens, mucosal and neoplastic immunity, molecular pathology, stem cell and cytokine therapy of different diseases will be given due emphasis. Risk analysis related to human health and biosafety of food and food animals need to be carried out in the context of endemic diseases. Another important thrust area would be development of formulations from herbal/synthetic sources against economically important goat diseases. Emphasis will be on surveillance, monitoring, control and forecasting of goat diseases at national scale. Role of siRNAs and gene silencers will be needed for the better control of certain congenital infections, deformities, genetic disorders, neoplastic conditions, serious injuries. Use of stem cells in the management of certain pathological conditions, injuries to vital organs and their use in expediting the recovery in certain chronic diseases will be used. Better utilization and application of traditional veterinary practices and ITK's in goat husbandry will be explored. In view of the increased resistance of pathogen due to continuous use and over use of certain antibiotics and anthelmintic and ecto-parasitic drug molecules, use of herbal (ethno-veterinary preparations) and alternative therapies like phage therapy, use of probiotic, prebiotics, cytokines, monoclonal antibodies etc., will be emphasized. Due to increase resistance of pathogens (bacteria and parasites) to drugs and pharmaceutical and rapid increase in cost of medicines, emphasis will be given to strengthen and increase and building up of 'herd or flock immunity' by selective breeding with respect to certain disease resistance genes in case of chronic and parasitic diseases. Nano-biotechnological approach will be used for development of efficient drug delivery system, development of nano-diagnostics and vaccines for better health care of animals.

Goat Meat and Milk Processing

In India most of the goats are slaughtered in backyard slaughter houses with little control on hygiene. Development of a protocol for small size modern slaughterhouse is the need of the hour and will be achieved during this vision

period. The vision of the Institute would be to develop a sustainable, scientific, environment friendly and animal welfare oriented goat management system based on principles of **clean, green and ethical animal production**. To accomplish the vision, the Institute will focus on strengthening the research base and human resource capacity, and infrastructure facilities including modernization of the existing amenities to become a front runner in the area of state-of-the-art goat animal production and management with the aim to evolve an efficient goat animal production and management system to produce quality milk that could compete in the global market.

Processing and value addition to goat meat and milk products and by-products is urgently required. Goat meat quality assurance needs to be ensured. Similarly Entrepreneurship program for processed meat sector development needs to be initiated and encouraged for goat meat. Foods with functional benefits such as hypo-cholesterolemic, anti-carcinogenic, anti-ageing effects are being preferred by consumers & it is possible to pass on these health benefits to the consumers through functional goat products. In this area of functional goat meat and milk products, research will be conducted towards production of functional foods to either enhance their bioavailability from their natural source or create novel foods via the addition and/or fortification of isolated or enriched fractions of bioactive peptides. Novel functional products such as antioxidant enriched, omega-3 fatty acids enriched, low cholesterol goat milk products, herbal products, low calorie indigenous goat foods and minerals and vitamins fortified functional products and low cholesterol foods will be evaluated. For commercial exploitation of the value added goat foods, development of shelf stable products assumes greater importance and work will be carried out in this direction.

Institute envisages contributing in the development of functional fermented goat foods and other nutraceuticals for better human health. The value addition of the goat foods through the development of newer biotechnological and nanotechnological approaches would bring in a new era of foods that would address the future needs of the society. There is an urgent need for developing rapid and reliable techniques for monitoring quality and safety management of goat-foods. Ready-to-eat convenient meat products processed from goat meat will be developed.

Shelf life enhancement employing novel processing and packaging options will be critical to address the issues of production of quality products for wider marketing network. Newer healthful and functional ingredients such as fruits, vitamins, bioactive peptides & natural antioxidants, and probiotics could be incorporated into product formulation to enhance value and offer consumers a wider range of choice.

Economics and Extension

The global economic and business environment is undergoing rapid changes that will have far reaching impact and implications for the goat sector in India. The

institute would endeavor to harness the emerging tools, techniques and research methods in econometrics and statistics, to provide direction for designing policies and programs, developing institutional mechanisms and facilitating decision-making process of the stake holders. CIRG will endeavor to develop and implement strategy of e-connectivity and cyber extension to drive full advantage of the available human and material resources for their best utilization.

Understanding the market and preparing itself to respond to emerging market trends would be the prime instrument for enhancing the domestic livelihood opportunities in the goat sector. Liaison is required between local agencies and institutions and donors for business and manpower training and development programmes.

Investors and financial institutions have to seek suitable local partnerships for survey of potential and investments in the areas of animal breeding, feed and fodder production, animal health cover, animal and plant insurance, transportation, processing, packaging, preservation and marketing of milk and value added products. CIRG can facilitate such a transformation.

The potentiality of science will also be harnessed by validating and transferring the technologies related to increasing the animal productivity, value addition of goat products and reducing cost of production. All efforts will be made to integrate various stakeholders to the extension mechanism to cover large number of rural mass which will help in the nutritional security of the nation. Strategic planning to extend benefit of research outcome to farmers will be undertaken in various areas of goat husbandry and health. For optimum communication with stakeholders 'Training on AIR' will be organized to reach a large number of beneficiaries in shortest possible time. Teaching- learning situation will be improved by incorporating advanced electronic gadgets. Development of liaison amongst research institutes for collaborative research is required.

Strategy and Framework

The following strategy would be adopted to accomplish the vision and the goals of Central Institute for Research on Goats, and to enhance efficiency and effectiveness of goat production in the country.

A. Research

Keeping in view the possibilities and constraints, the following thrust areas have been identified for future research, extension and human resource development:

- Genetic improvement and optimum utilization of goat genetic resources for sustainable production and conservation of indigenous breeds
- Refinement of frozen semen technology and popularizing Artificial Insemination in goats for better use of superior germplasm
- Nutritional strategies and feed processing technologies to facilitate sustainable goat production in different agro-climatic zones and reducing methane production
- Development of new generation diagnostics, vaccines and alternative therapies for important goat diseases.
- Human Resource and entrepreneurship development through training, consultancy and ICT Support

Genetic improvement programmes

- Genetic improvement and optimum utilization of goat genetic resources for sustainable production and conservation of indigenous breeds
- Identification of elite germplasm and establishment of seed stock production centers for important breeds of goats in their breeding tracts
- Multiplier flocks and breeding practices for low-input and high-input farming systems (registration of farmers, selection of elite animals, rearing and multiplication in nucleus as well as farmer's flock, semen conservation for future use)
- Molecular basis of adaptation and functional genomics for goat improvement
- Genetic epidemiological modeling for different goat diseases
- Developing National Goat Breeding and Conservation Policy
- Initiative on Goat genome sequencing

Nutritional and feed processing programmes

- Nutritional strategies and feed processing technologies to facilitate sustainable goat production in different agro-climatic zones and reducing methane production
- Developing cost-effective feeding regimes and formulations for improving goat production under different livestock production systems

- Development of economical balanced diets and supplement formulations specific for different regions and breed of goats
- Nutritional manipulation for higher quality meat production in goats.
- Rumen microbial and biotechnological studies for optimizing nutrient utilization and productivity in goats
- Feed processing technologies (Pellet, Complete feed block) for optimizing productivity in goats
- Development of feed and fodder production system for eco-friendly –viable goat production system
- Resilience of goat production under changing climatic conditions

Value addition/functional goat product technologies (secondary agriculture)

- Developing appropriate cost-effective processing technologies for production, popularization and commercialization of shelf- stable value added goat meat and milk products with health promoting characteristics
- Packaging and shelf life evaluation of goat meat and milk products under different storage condition
- Traceability, food safety standards and food chain evaluation (HACCP) pertaining to goat milk, meat and value added products
- Quality evaluation of different goat skin
- Evaluation of medicinal properties of goat milk and its promotion as nutraceutical

Physiology, reproduction and management programmes

- Refinement of frozen semen technology and popularizing AI in goats for better use of superior germplasm
- Multiplication of superior germplasm by using modern technologies viz. semen preservation, super-ovulation and embryo transfer, oocytes and embryo cryopreservation, IVF, Parthenogenesis, etc
- Biotechnological manipulation of reproductive ability of goats including embryonic stem cell production and cloning of goat embryos, gene expression pattern
- Analyzing impact of climate change on adaptability and productivity of goats and to evaluate and maintain production standards
- Automation in management systems for improving goat farm management practices
- To enhance the resilience of goat husbandry system to climatic variability and climate change through development and application of improved production and risk management technologies.
- Shelter management practices and behavioural interventions including animal welfare issues for efficient goat production systems under varied agro-climatic conditions

Health management programmes

- Strengthening adaptive capacities to the impact of climate change on diseases of goats in resource-poor small scale rural goat sector in the country.
- Development of new generation diagnostics, vaccines and alternative therapies for important goat diseases
- Establishing National Referral Centre on Goat Health at national level
- Establishment of Biological Product Division with P-III laboratory and animal house for various goat specific biologicals, vaccines, sera, diagnostics, antigens etc
- GIS and ICT based Surveillance, monitoring, forecasting, diagnosis and control of economically important goat diseases including caprine zoonoses.
- Molecular/Immunological marker studies for disease resistance and resilience with respect to parasitic, chronic and endemic diseases
- Development of alternative cost-effective therapies *viz*., ethno-veterinary medicines including herbal remedies, bacteriophage, stem-cell therapies, pre and pro-biotics, siRNAs, cytokine therapies, immunomodulators and growth enhancer for goats
- Control and eradication of economically important, globally significant diseases and zoonotic diseases and surveillance of Transboundary goat diseases (TGDs) and developing packages of practices for efficient management of goat diseases under different farming practices
- Developing healthcare strategies, preparedness and facilities for the disaster management

Farming system and extension programmes

- Human Resource and entrepreneurship development through training, consultancy and ICT Support
- Training and consultancy to trainers/KVK personnel, farmers and other stakeholders
- Facilitating Goat Market Federation involving farmers, microfinancers and commercial agencies for remunerative return to goat farmers
- Promoting Public Private Partnership (PPP) for entrepreneurship development in goat sector
- Popularizing scientific goat rearing using existing and modern technologies for maximum economic benefits at farmers' level
- Development of "Integrated Goat Farming Systems" for commercial goat production and "Backyard Goat Production System" for subsidiary income

Besides above mentioned specific strategies the following strategies in general form the part of vision 2030 for development of goat production in the country.

- Economic and social importance of goats for the rural poor demands large research and development investment.

- National governments and International agencies should support goat production.
- There is need for greater regional and international co-ordination in research and development programmes for goats to allow exchange of information, literature, germ plasm, diagnostics and immunization
- Surveys supported by gene marker studies on existing genetic resources of goats should be carried out in the breeding tracts of different breeds.
- Adaptation of the breeds to local environment should be the key element in the choice of the breed and in determining breeding strategy.
- Open nucleus breeding scheme using multiple ovulation embryo transfer and A.I. with frozen semen should be adopted.
- Techniques of buck semen freezing, artificial insemination and embryo transfer need perfection.
- Extensive system of goat rearing should be replaced with semi-intensive and intensive systems for commercial meat production.
- Suggested Packages of Practices should be adopted by the progressive farmers and the Entrepreneurs for commercial chevon production.
- Feed resources for goats should be developed through 3-tier system.
- Feeds and fodders available during rainy season should be harvested, conserved and utilized as bails, pellets and complete feed blocks under Animal feed security system.
- Suitable disease monitoring systems developed and strategic control and eradication measures are to be undertaken
- Continuation of breed improvement programmes under field conditions using elite germplasm.
- Molecular genetic evaluation of indigenous goats for traits like thermo tolerance, disease resistance and genetic disorders for improving the overall adaptability in view of the impending climatic change.
- Selection of goats for thermo tolerance, disease resistance and genetic disorders will be carried out.
- Identification and dissemination of superior germplasm under farm and field conditions will be intensified in cooperation with various Animal husbandry Departments under State Governments.
- State-of-art laboratory for certifying disease-free semen and cytogenetic screening of the bucks will be established.
- Data gaps will be filled covering vital aspects of goat production in India *viz*, milk, meat production, marketed surplus, procurement, processing and distribution across different agro-climatic regions.
- Information technology will be used for developing databases on a uniform platform which can be shared by the potential users including planners,

administrators, policy makers, economists and the scientific community at large.

- Institutional mechanisms will be studied for enhancing the competitiveness of the goat farmers and goat industry through integration in production, processing, value addition, and marketing of goat products in domestic as well as global markets.
- Studies will be undertaken to understand the shifts in consumer behaviour and product profile for goat producer's demand and supply projections.
- Impact and responsiveness of goat production on household nutrition, human health and environment will be examined.
- Effect of climate change on vulnerability and adaptive capacity of goat farmers will be investigated.
- Priorities and impact assessment of technologies and research investment in goat sector should be decided.
- Demonstration of leadership in the integration of goat production technologies in training the trainers, entrepreneurs and farmers.
- Facilitation of technologies dissemination through interactive video conferencing.
- Integration of goat production technology into the farmers learning experience will be developed.
- Provision will be made for shared learning goat production stakeholders through development and enhancement of the necessary physical infrastructure and the Online Learning Environment (OLE).
- Capacity building of goat farmer by providing suitable training and inculcating entrepreneurial characters will help in livelihood security and in turn, it will pave the road of holistic economic prosperity.
- Objective trainings for goat farmers, stake holders, development personnel will be implemented.
- GIS based data system will be developed for breed distribution, disease tracking and forecasting, commercial goat farming and goat resources.
- Strengthening market intelligence, entrepreneurship development, commercialization and transfer of technologies.

"Goat has a great future in changing livestock scenario."

Epilogue

CIRG is committed to meet the challenges of growth momentum in the goat production system sector through technology support for enhancing the livelihood security of the millions of goat farmers and ensuring sustainable development of. CIRG envisages that innovations and reinforcement of research on goat production, processing, policy and technology delivery mechanisms would lead to faster growth of the millions of poor and landless and marginal goat farmers in this country. Research at the Institute would augment farmers' income, generate employment opportunities, and besides being economically sustainable, will also be catalyst in social and environmental sustainability of goat production system in the country. To sustain the benefits of research and development, the Institute would create an enabling policy environment, favorable work culture and infrastructural support at different administrative levels.

Concerted efforts would be made to transform the Central Institute for Research on Goats to ensure the goals of a **National initiative on future resilient and progressive goat production system** in the country.

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Annexure: Strategy and Framework

Goal	Approach	Performance measure
Ensuring better disease control through application of newer biotechnological approaches.	▪ Development of new generation diagnostics and vaccines with appropriate adjuvant and improved delivery system for the endemic, emerging and exotic caprine diseases ▪ Establishing National Referral Centre on Goat Diseases with P-III laboratory ▪ Surveillance and diagnosis of important goat diseases including caprine zoonoses ▪ Molecular/Immunological marker studies for disease resistance and resilience with respect to parasitic, chronic and endemic diseases ▪ Development of alternative cost-effective therapies viz, ethno-veterinary medicines, herbal remedies, etc ▪ Developing packages of practices for the control and eradication of economically important, globally significant diseases and zoonotic diseases and surveillance and preparedness for the disaster management goat diseases ▪ Establishment of Modern Veterinary Clinics for healthcare of goat	▪ Reduction in the incidence of diseases hence reduced morbidity, mortality and improved animal health and production
To improve milk and	▪ Strengthening breed	▪ Sustainable and

meat production and fertility in goats	improvement programmes of goats for enhanced productivity ▪ Molecular genetic evaluation, genomic regulation, identification and characterization of fertility related genes and biomarkers and cytogenetic profiling of goats for improving the overall adaptability in view of the impending climatic change ▪ Application of modern endocrinological and biotechnological tools including gene regulation, gene manipulation and proteomics for elucidating the functional cellular processes, gamete competence, and embryonic development, for fertility enhancement of goats ▪ Therapeutic and immunomodulatory properties of indigenous herbs and application of modeling approach to optimize nutrient utilization, methane mitigation and animal productivity under different agro-climatic conditions ▪ Identification and modulation of phenotypic and environmentally regulated neural, endocrine and metabolic parameters for enhancing milk and meat production in goats	profitable goat production
Value additions to	▪ Value enhancement of goat	▪ Availability of

goat milk and meat products and availability of healthy and novel products in the market	products/ feed supplements for functional and nutraceutical attributes followed by validation using appropriate tools ▪ Isolation of bioactive molecules from goat milk using state of art technologies ▪ Value additions through modern technological approaches for design of novel functional foods ▪ Utilization of probiotics etc for preparation goat foods with medicinal properties. ▪ Enhancement of shelf life and marketability through modern packaging and technology interventions. ▪ Promotion of public-private partnership, management of intellectual property and effective transfer of technology of value added goat meat and milk products	functional goat milk and meat products with desired health claims ▪ Establishment of a national depository of goat microorganisms of public health significance and development of an interactive data base
Ensuring quality control through application of newer chemical and biotechnological concepts	▪ Rapid methods for detecting adulterants and contaminants using latest sensitive procedures ▪ Establishment of National Referral Laboratory and Quality Control Measures for food products	▪ Availability of ready to use technologies to detect adulterants and contaminants in goat meat and milk. ▪ Accreditation of Referral Lab
Transfer of technologies related to improved animal productivity, value added goat products and reducing cost of production	▪ Creating Information System (IS) and database on goat marketing and available practices for farmers ▪ ICT mediated extension approaches to strengthen linkages with large number of farmers to assist transfer of technologies and address	▪ Changes in the economic prosperity and livelihood security of goat farmers

	goat farmers' problems ▪ Databases on economic aspects of goat production and health ▪ Study on institutional mechanisms for enhancing the competitiveness of the goat farmers and goat sector through integration in production, processing, value addition, and marketing of goat products in domestic as well as global markets	