PREFACE

The Central Avian Research Institute, Izatnagar has played a pivotal role as a technology leader in metamorphosis of Indian poultry sector (IPS) from the yesteryears’ subsistence backyard systems into vibrant agro-industry worth Rs 400 billion. Growing annually at about 6% in egg and 10% in broiler production, contributing nearly 0.7% to the national GDP, the IPS is bustling with commercial activities, high employability and income generation potential.

The contributions of the institute in developing superior genetic stocks of diversified poultry species, packages of management practices, processes and technologies to improve productivity and reduce cost along with product quality assurance have been widely acclaimed by the industry. The institute has also been supporting HRD and capacity building in tune with the growing demands of IPS for trained manpower. However, despite spectacular performance of the IPS, nutritional gaps at the grass root levels, trade liberalization under WTO, growing demand coupled with rising incomes, depleting feed resources, threats of global warming and growing consciousness for quality foods pose newer challenges.

Vision 2030 document presents perspective planning of the institute to overcome the challenges by developing technologies to augment productivity of the poultry production systems as also to focus on qualitative aspects in poultry value chain. It proposes to undertake basic, applied and strategic research and to serve as national repository in all aspects of Poultry Science to solve the existing and foreseen problems in a planned and timely manner.

I am highly thankful to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR for guiding in shaping up Institute’s Vision 2030. I express my gratitude to Dr. K.M.L. Pathak, DDG (AS) and his team at the HQ for the valuable support. I record my sincere appreciation and thanks to Dr. Sandeep Saran, Head, PME and his team for their efforts in preparation of the document. Last but not the least, I acknowledge valuable inputs from all the scientists of the institute and am thankful for extending their full cooperation in preparation of this document.

June 26, 2011
Izatnagar

(R.P.Singh)
Director
Preamble

The poultry farming in India occupies an important position due to its enormous potential to bring about rapid economic growth, particularly benefiting the weaker sections due to its low investment requirement and short gestation period. The poultry, which was considered as a backyard proposition in the early 60’s has now been transformed into a strong agro-based commercial activity having tremendous employability and income generation potential contributing nearly 0.7% of the national GDP and about 10% of the Livestock GDP.

The poultry sector in the Country during the last ten years has witnessed cyclic boom and burst phenomena due to accelerating factors such as high demand for poultry products as a result of overall economic growth and consequent rise in incomes, investments from multinational food giants, disintegrating joint family system leaving limited scope for home cooking etc. on one hand and decelerating factors such as high feed cost due to instable supplies of agro-feed ingredients, emergence of deadly poultry diseases and resultant distortions in domestic as well as global poultry trade, limited investments in poultry infrastructure etc. Despite such ups and downs, the growth of poultry sector has been over 6% in egg and 10% in poultry meat production. However, the growth has been highly skewed in favour of some well defined geographical areas termed as ‘poultry belts’ whereas most of the remaining parts of the Country suffer from inadequate supplies and high prices of poultry products. Ironically over 75% of poultry produce is consumed by about 30% population living in urban areas. Nearly one third of Country’s population living below poverty line is suffering from malnutrition wherein poultry can serve as an important tool to provide household nutritional security and supplementary incomes especially to the vulnerable sections of society. Therefore, technological support is crucial for the development and consistent growth of the poultry sector to protect and safeguard the interests of all stakeholders in the poultry value chain particularly the more vulnerable small poultry holders throughout the Country.

Realizing the significance of poultry research in the Country, the Central Avian Research Institute was established at Izatnagar, Bareilly,
Uttar Pradesh in 1979 under the aegis of the Indian Council of Agricultural Research (ICAR) to provide all-round support to the progress of poultry sector. The mission of this premier Institute is to provide the necessary research, education, training and technology transfer support in all areas of Poultry Science for promoting productivity and profitability of the Indian poultry sector. The Institute remains responsive and vigilant to the ever evolving needs of the poultry sector through development of cutting edge technologies targeting specific problems faced by the industry. The R&D efforts of the Institute have been widely acclaimed and acknowledged as is evident from a long list of prestigious national and international awards and laurels; the Institute has been adorned with. Moreover, the Institute has been continuously updating and reorienting its R&D focus abreast with the latest developments taking place globally and in accordance with the changing needs of the domestic poultry sector. The first Vision 2020 document was chalked out by the Institute during late nineties consisting of perspective planning for 20 years down the time line; the next attempt was made 5 years later and CARI Perspective Plan Vision-2025 was brought out to tune up with the new challenges and opportunities that had cropped up by then.

The CARI has once again reviewed its R&D focus and has re-tailored its programme and strategies to address the present problems and future demands / expectations of the poultry sector as a whole so as to face several challenges and opportunities emanating from demand and supply perspective as also to most optimally employ scarce and depleting resources. Emphasis on target oriented research efforts leading to development of technologies and innovations along with capacity building and efficient delivery systems to the end users have been the corner stone of the whole exercise.

CARI Vision 2030 document briefly presents the current scenario of global as well as domestic poultry sector, prospects for its further growth along with issues, concerns and perceived future threats and challenges in the next two decades for developing appropriate strategies and a road map to elucidate the role of Central Avian Research Institute in solving these issues by providing consistent technological support to the poultry sector for its sustained development and growth for ensuring nutritional security for all.
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Poultry Sector: An Overview

The world population in 2010 stood at 6.9 billion, which is expected to rise further to 8.30 billion by 2030. World’s total production of poultry meat during 2010 was approximately 95 mmt comprising of 85.6% chicken, 6.8% turkey, 4.6% duck and 2.6% goose and Guinea fowl meat. The share of Asian and South American continents has been steadily rising, presently contributing over 52% of global poultry meat production whereas the share of North and Central America and the Europe has been consistently shrinking. The world wide per capita poultry meat availability in 2010 stood at 13.8 kg per year. Global poultry meat production is expected to reach 140 mmt by 2030.

Global growth in egg uptake has been remarkable, from less than 20 mmt per year in the 1960s and 1970s to around 40 mmt by the 1990s, and reaching about 63 mmt in 2010 of which over 60% is contributed by Asia alone. The global average per capita availability of eggs is about 9.1 kg per year. By 2030, the world’s egg production is likely to reach about 90 mmt of which about 55% is likely to be contributed by Asian countries only.

The number of undernourished people in the world remained unacceptably high at 0.93 billion in 2010 although slightly lower than 1.023 billion during 2009. At present more than half of the world’s protein-energy malnutrition problem is in South Asia; and a larger number are estimated to remain malnourished even by 2030. Poultry production has been the most dynamic sector of animal production worldwide. Diets are expected to change in favour of products of animal origin particularly the poultry products due to cost competitiveness and high nutritional value.

Feed International has estimated that out of a total of some 708 mmt compound feed produced by commercial mills for all species in 2009, 290 mmt (41%) was utilized for feeding the poultry alone worldwide making it the largest single segment of compound feed production on a global basis.

Brazil, USA, and Netherlands are the major chicken meat exporting countries together accounting for over 72% of world’s chicken exports.
whereas Russian Federation, Hong Kong, China, Saudi Arabia and Japan are the major chicken meat importers together accounting for about 40% world’s chicken imports. Similarly, Netherlands, Spain, Germany and China are the important exporters of hen eggs together accounting for about 50% world’s hen eggs exports whereas Netherlands, USA, Germany and Spain are the major egg importers with a total share of over 51% of the world’s egg imports.

**Indian Poultry Scenario**

Among the Indian livestock based vocations, poultry farming occupies a pivotal position due to its enormous potential to bring about rapid economic growth with low investment. Poultry industry contributes about Rs. 400 billion accounting for about 0.7 per cent of the national GDP and provides employment to over five million people in the Country. Poultry sector is dubbed as the one having highest employability per unit of investment. The Indian poultry sector with 7.3% growth in poultry population, has witnessed one of the fastest annual growth of about 6% in eggs and 10% in meat production over the last decade amongst all animal based sectors. The high growth has placed India at 3rd position after China and USA with a production of 59.8 billion eggs and 5th after USA, China, Brazil, and Mexico with a production of 2.6 mmt of chicken meat during 2009-10. Despite such progress, the average per capital availability is still merely 52 eggs and 2.3kg of poultry meat against the recommended levels of 180 eggs and 11kg meat per annum. Ironically, India’s 75% of poultry produce is consumed by the 25% population living in urban and semi-urban areas. It has been estimated that under moderate growth scenario of 6% per annum in the Country’s GDP, by 2030, the demand for meat and eggs is likely to shoot up to 5.9 and 9.5 mmt, respectively.

The organised sector of Indian poultry industry contributes nearly 70% of the total output whereas the rest emanates from the unorganized sector. The broiler industry is well dominated in the Southern states accounting for nearly 60-70% of total output. Similar is the case with the layer industry which is well developed in the states of Andhra Pradesh, Tamil Nadu and Maharashtra contributing nearly 70% of the Country’s egg production.
Regional Imbalances in Poultry Production:

Regional imbalances in poultry production are inevitable since both large commercial egg and broiler production farms are mainly confined to the Southern states, apart from Maharashtra, Punjab, Uttarakhand and Haryana in the North. More than 60% of eggs are produced in AP, Haryana, Maharashtra, Punjab and TN States, whereas more than 60% of poultry meat is produced in 5 states namely, AP, Karnataka, Maharashtra, Punjab and WB. However, poultry production, particularly broiler farming is gradually catching up in some deficit Northern, Central and Eastern regions of the Country in the recent years. The commercial poultry farming is yet to make a dent in some of the most populous states like Bihar, MP, Orissa, Rajasthan and UP.

Diversity in Poultry:

Among poultry species, chicken production has already acquired large scale commercial dimensions in India due to its better efficiency than other domesticated poultry species to convert poultry feed into highly nutritious egg and meat. Chicken (including desi fowl) accounts for about 90% of the total poultry population, followed by 7% ducks. The remaining 3% is comprised of other domesticated poultry species such as quails, turkey, Guinea fowls and geese etc. Ducks are mostly reared in coastal states, Jammu and Kashmir and NE region of our country. Although, commercial quail farming for meat and egg production is becoming increasingly popular and this Institute has emerged as the focal point for evolving high yielding quail germplasm and its spread in the Country, sincere efforts in terms of financial resources, trained scientific manpower and R&D infrastructure are required to place the diversified poultry species against chicken in the market as its commercially viable alternatives. While commercial turkey, Guinea fowl farming is still in their infancy, emu and ostrich rearing is a more recent and nascent development in the Country.

Rising Feed Cost:

Poultry feed accounts for about 60-70% of the total cost of production which is one of the most serious challenges for the industry.
Therefore, improving feed conversion efficiency would be crucial to profitability apart from the feed cost itself. Over the past two decades, feed conversion rates for poultry have improved by about 40 percent, partly due to improved productivity and partly due to efficient feeding strategies. However, still only 25-35 percent of the nutrients consumed are utilized. Hence, further understanding of digestive physiology and biochemistry can be expected to improve nutrient utilization.

Growing human population along with that of livestock has strained the feed resources of the Country. Cereal by-products and oilseed residues usually constitute about 50% of poultry diet. Coarse cereals such as pearl millet, grain sorghum, corn, minor millets and ragi etc. also form the staple diet of millions of marginal farmers and landless labourers. These coarse cereals are the most important and most widely used poultry feed ingredients all over the world. However, their domestic supply is marred by the vagaries of nature as they are grown on rainfed/drought prone marginal lands with wide fluctuations in the yields and hence their total production. Coarse cereals constitute about 22% of total food grain production and occupy about 38% of total acreage under cereals in India. The demand for coarse cereals is continuously increasing at 4% per year due to ever increasing population and their use in livestock rations.

The yield of maize, the most important ingredient of poultry feed in India is just about 40% of the world’s average which is attributed to limited availability of quality seeds, pesticides and fertilizers etc. The consumption of maize growing at 6% per annum has clearly outstripped production growth due to stagnant productivity and acreage at about 6.6 million ha. Thus, the consumption and production gap will keep rising due to growth of poultry sector as also due to its increasing industrial use (for production of ethanol, maize starch and high fructose corn syrup etc.)

Soybean is yet another important poultry feed ingredient used as protein source in poultry rations. Instability in its production and indiscriminate exports result in its shortage for the poultry industry leading to its high prices. The soybean production in the country is about 12.5 mmt which is likely to reach 18.9 mmt by 2030.
Declining Share of Backyard/Small Scale Poultry:

Rural poultry production constitutes important component of agricultural economy in India, small poultry holders are practically capable of contributing more significantly to alleviate malnutrition, poverty and unemployment. Although the population of small scale/backyard rural poultry characterised by sub-optimal use of inputs has registered a growth of over 7.8% per year during the last decade, its share in total poultry production has been consistently declining due to faster growth in organized commercial poultry sector characterised by professional management and highly efficient input use. India requires both mass production as well as production by the masses to cater both its rural and urban population.

Onslaught of Poultry Diseases:

In the recent past, Indian poultry sector has faced frequent onslaught of newer poultry diseases like bird flu (Avian Influenza) leading to enormous losses to the poultry sector not only in India but globally. The total losses to the Indian poultry sector till 2009 have been estimated to the tune of over Rs. 2200 crore. Every reported case of outbreak of AI leads to distortions not only in the domestic demand and consequently in prices but also in global trade. Therefore, scientific interventions are urgently needed to curb the menace of such emerging poultry diseases in the Country.

Poultry Waste Disposal and Environmental Concerns:

The magnitude of poultry wastes is constantly on increase due to growth of the poultry industry. The problem of waste disposal is all the more grave due to concentration of poultry in some well defined pockets or geographical boundaries. The poultry waste generation has been estimated to the tune of about 22 mt at present which is like to increase manifold in conjunction with the fast growing poultry population. There is a need, therefore, to devise cost effective ways and means for proper disposal of wastes arising from dressing plants, hatchery and poultry manure etc. to minimize environmental pollution and for putting them to alternative efficient use. Some of the alternatives uses of poultry waste are production of pet foods, manure or bio-fertilizers (vermi-compost), biogas and
electricity etc. Although technologies are available for utilization of poultry waste, there is much to be done on proper disposal of wastes including dead birds by refining and up-scaling these technologies. Promotion of cost effective methods of waste disposal has to be taken up to entice the commercial sector for putting the same into practice.

Global warming projected to increase the earth’s temperature by 1.8°C to 4.0°C by the end of this century, is likely to result in frequent extreme climates, floods, droughts, cyclones and recession in glaciers with threatened coastal lines. Such massive changes are likely to alter the entire food chain, ecological balance and consequent dynamics of pests and diseases in the entire eco-system leading to instability in food production. Therefore, technology driven systems need to be evolved to counter such environmental and climate associated threats.

Frail Poultry Marketing Infrastructure:

Marketing of poultry products is the major issue faced by the industry. In the absence of orderly marketing network, sufficient regulated markets, lack of adequate cold-chain and warehousing facilities etc, the wholesale prices of poultry products suffer violent fluctuations and often become unremunerative, due to cyclic boom-and-bust phenomena. The poultry marketing is largely in the hands of commission agents and private traders. Procurement in remote places receives low priority. Despite growing non-vegetarianism and demand potential for poultry products, consumption growth has not been able to keep pace with the production growth due to low purchasing power of people especially in rural areas. Fragmented and remote rural markets also restrict reach of commercial poultry products to the far flung rural areas. Strong marketing network covering the entire country is needed to set the industry free from the clutches of middlemen.

Limited acceptance of processed poultry products in the domestic markets is yet another constraint restricting capacity utilization of already established processing units and further investments in this area. Only about 4-5% of table eggs produced in the country are presently processed. Wet marketing of broilers is still preferred and is widely prevalent in the
Country in the absence of general awareness about food safety and quality, and statutory provisions to restrict the same. The product quality and safety issues are now of paramount importance in the wake of WTO not only to promote poultry exports but also to save the domestic markets from the onslaught of imported poultry products owing to open market access and trade liberalization policies.

**Institutional and Capital Constraints:**

The support in the form of public funded institutional support is not adequate for the Indian poultry sector worth Rs. 4000 crores. Support for Poultry Science education and R&D is meager in the National Agricultural Research System. Similarly, there is an urgent need to establish Poultry Development Board on the lines of NDDB in the country, though National Meat and Poultry Processing Board has recently been set up for addressing key issues related to development of meat and poultry processing sector.

Financial barriers prevent small farmers from intensifying their production. The investment required often exceeds their net worth. It has been observed that the financial institutions exhibit reluctance in supporting the projects aimed at establishing small/medium poultry production units. Some of the institutions even put the poultry activity in their negative list as far as financial support in the form of credit is concerned. The facilities of micro credit must be extended to poultry sector as well in order to promote poultry production by the masses.

Having drawn an sketch of Indian poultry sector appreciating various challenges and opportunities thrown open in a transforming poultry economy, there is a need to prioritize various issues and to draw a road map to address the same through technological interventions. In the process, it is imperative to review the R&D support already available to the Indian poultry sector and the status of technologies already developed.
The remarkable growth achieved in the Indian poultry sector is due to several factors like initiation of pure line breeding within the country in both public and private sectors leading to availability of elite commercial layer and broiler chicks and parallel development of other input sub-sectors like feed mill, hatchery and farm appliances, poultry biologicals, feed analytical and disease diagnostic labs., modern mechanized poultry and egg processing plants, vertical and horizontal integration in poultry farming, availability of soft credit, and above all ever-increasing demand of poultry products, etc. In addition, Central Avian Research Institute, Izatnagar, Project Directorate on Poultry, Hyderabad and some State Agricultural or Veterinary universities having sound Poultry Science education and research base in conjunction with the Central Poultry Development Organization have played a key role in providing highly qualified man-power, training support to poultry farmers/entrepreneurs and R&D support to the growth of poultry sector.

Having established on November 2, 1979, the Central Avian Research Institute (upgraded from the erstwhile Poultry Research Division, Indian Veterinary Research Institute, Izatnagar) has been the major driving force steering the Indian poultry sector through various phases of development during the past four decades providing much needed technological support to the poultry industry especially the rural poor. The Institute with its main campus at Izatnagar, Bareilly, Uttar Pradesh and a Regional Centre at Bhubaneswar, Orissa is the only one of its kind wholly dedicated to Poultry Science research, education and extension in the Country with the following mandate.

**Mandate**

- To undertake basic, applied and adaptive research in all disciplines relating to production of diversified poultry.
**Vision 2030**

- To develop post harvest technologies for value addition, quality assurance, efficient processing and marketing of poultry products and by-products.
- To impart specialized training and post graduate education in Poultry Science and allied fields.
- To transfer the proven technologies to the end users employing efficient and cost effective methods.
- To provide referral and consultancy services in all aspects of production, processing and marketing (value chain) of diversified poultry.

The institute has addressed a wide range of challenges faced by the poultry industry in the years bygone, some of which are outlined as follows.

**Germplasm Development:** Doing away with the dependence of Indian poultry sector on imported poultry stock, the institute made significant strides in developing germplasm of diversified poultry species in the country and developed, improved and released the following germplasm. These are immensely popular in the poultry farming community across the country. Their production technologies have been disseminated not only to the private sector but also to CPDOs, SAUs/SVUs, KVKs, State AH departments and NGOs etc. which in turn have been providing the germplasm to the poultry farming community in their respective command areas.

The Institute has been serving as the nerve centre for popularizing quails, Guinea fowls and turkey and for spread of their germplasm throughout the country. The high performing improved indigenous fowls have very high demand in the market as they are highly suitable for the concept of ‘production by masses’ under sub-optimal input regime. The pure lines of various important breeds of diversified poultry species including chicken layers, broilers and desi fowls are available with the institute, apart from the parent lines of the above mentioned commercial seed material.
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<tr>
<th>Species</th>
<th>Commercial Crosses/ Strains/Varities</th>
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<td>Quails</td>
<td>CARI-Pearl, CARI-Sweta, CARI-Ujjwal,</td>
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<td>CARI-Uttam</td>
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<td>Turkeys</td>
<td>CARI-Virat</td>
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<td>Guinea Fowls</td>
<td>Chitambari, Kadambari, Swetambari</td>
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<td>Ducks</td>
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<td>Dual Purpose</td>
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<td>Layers</td>
<td>CARI-Priya, CARI-Sonali</td>
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**Poultry Biotechnology:** The challenges poultry industry is facing can be addressed by advance biotechnological tools which may be efficiently used for enhancement of productivity, disease resistance, tropical adaptability, as well as genetic resource characterization and for specified goals. In these frontier areas of research, the institute has made significant advancements with the following achievements.

- **Molecular markers based characterization and breeding:** The germplasm of duck, quail, Guinea fowl, turkey, layer and broiler have been characterized using RAPD, AFLP and microsatellite markers. QTLs and candidate genes analysis for identifying molecular markers related with economic traits, disease resistance and tropical adaptability has been carried out for their use through MAS.

- **Modification of genome:** The work on gene driven technologies like transgenesis, RNA interference (RNAi), *in vivo* embryo-culture system using single and double window approaches etc. has been
Carried out for augmenting productivity and disease resistance. Developing transgenic sperm and *in-vitro* silencing of myostatin gene in cultured chicken embryo fibroblast up to the tune of ~25% have been important milestones.

- **Production and utilization of recombinant proteins**: Utilization of rDNA technology for production of poultry cytokines for their use as vaccine adjuvant, immune modulator and growth promoter.

- **Comparative & Functional genomics**: Identification of nucleotide variations, SNPs among species/strains. Candidate genes analysis for indentifying their role and further exploitation. Identification of critical genes involved in forced moulting procedures. An effective procedure as alternative to feed withdrawal i.e. by using organic zinc in feed has been developed.

- **Poultry Disease Resistance**: Immuno-divergent lines for humoral and cell mediated immune response have been developed and analyzed using genomics and functional genomics approaches. Identification of an SNP associated with ND vaccine response and development of new MHC genotyping procedure and selection criteria for enhanced immunocompetence have been achieved. Analysis of Tvb locus to find ALV resistant/susceptible alleles among WLH, Kadaknath and Aseel highlighted the scope of molecular breeding for ALV resistance.

- **In-ovo interventions for better growth and immunity**: Techniques of *in-ovo* nutrient supplementation package based on gene expression analysis has been standardized to improve early chick growth and development of vital organs. The *in-ovo* procedures for multiple vaccine delivery has been standardized for better post-hatch immunity.

- **Parthenogenesis in turkey and chicken**: Key factor influencing parthenogenetic development in unfertilized turkey and chicken eggs has been identified through microarray, real time PCR and chromosomal analysis.
Quality Poultry Nutrition and Feed Resources: Faced with the challenges of ever growing feed cost, the Institute has devised ways and means to ensure precise nutrient supply in tune with the requirements of different nutrients (amino acids, energy, minerals, protein, vitamins etc.) for different classes and age groups of various poultry species under different rearing conditions, in a bid to minimise the same. Efforts have also been made to identify, evaluate and efficiently utilize the newer feed stuffs in poultry rations in a bid to resolve growing competition for the same feed resources for the human population and the poultry. Some of such feed stuffs are millets, cereal by-products, fruit processing waste, oilcakes and oilseed residues and many other stuffs not consumed by human beings. Treatments like acid/alkali, autoclaving, fermentation, fungal treatment, enzyme supplementation, pre and probiotics supplementation, roasting and water washing of the feed ingredients have been used to augment the nutritive value of feedstuffs. The Institute has made significant achievements in developing technologies to deal with the anti-nutritional factors, adulterants and toxicants in various feeds compromising their quality. MakeFeed Poultry, the Windows(R) based software developed to design cost-effective feed-formulae for different classes and age groups of various poultry species, has been immensely popular in the poultry industry and over 250 copies have already been sold.

Housing Systems and Package of Practices: The Institute has pioneered the rearing and management practices of different poultry species under diverse systems of rearing. Entire range of rearing appliances such as battery brooders, feeders, incubation trays, laying and rearing cages, waterers, etc. for different avian species have been designed and fabricated. The Institute has also designed low cost poultry houses utilizing locally available materials for semi-intensive or small scale poultry farming.

Stress Management & Reproduction Technology: Deviation in normal physiology disturbs the homeostasis process, which ultimately causes reduction in poultry production. Under stress conditions, there is redistribution of body resources including energy and protein resulting in
Central Avian Research Institute

decreased growth, reproduction and health. Several technological interventions have been developed in the form of additives/supplements to mitigate various types of stress in poultry.

The techniques of artificial insemination in various poultry species have been developed and standardized. The problem of internal laying of eggs has been addressed. Further, the emerging issues concerning welfare aspects of poultry have also been tackled by devising alternate techniques of moulting, thus doing away the age old practice through prolonged starvation of birds. Development of semen storage techniques and semen dilutor for AI in poultry species have been important landmark achievements. Moreover, several physiological mechanisms have been resolved in bid to accommodate suitable interventions aimed at enhancing productivity of the poultry species.

**Processing, Value Addition and Product Quality:** The Institute has developed a number of value added products utilizing poultry eggs, meat, culled birds and slaughter waste including leaking eggs and hatchery waste etc. The effective and economical techniques of preservation/shelf life extension including suitable packaging of poultry products have also been standardized. The efficacy of natural preservatives for shelf life extension of poultry products has been evaluated. The techniques of meat tenderization have been standardized to pave the way for effectively utilizing tough meat of culled birds. The Institute has also developed some information base on product quality parameters such as occurrence of pesticides’ residues, presence of aflatoxin and heavy metal in poultry products as well as surveillance of the microbial quality including food pathogens in poultry products.

**Market Watch:** The institute also keeps a close tab on the market trends and developments taking place in the poultry sector in India as well as globally. The prices trends of poultry products and various inputs such as feed, its ingredients and chicks are closely monitored and appropriate projections are made. Institute also provides consultancy services for establishing poultry units and for raising institutional finance. The cost and
returns from quails, turkeys, Guinea fowls, ducks, broilers and layers under different systems of rearing are continuously updated. Economics of parent lines rearing integrating with production of commercial broilers and layers has also been worked out and updated.

**Technology Transfer and HRD:** The institute has made significant strides in disseminating the proven technologies developed by the institute. The species like quails, turkey and ducks have been widely disseminated across the length and breadth of the country. Quails and turkey have already gained substantial popularity in the country. But for the restrictions of the Wild Life Act 1972, the quails are likely to grow exponentially in the Country as a viable alternative to chicken being an elite delicacy. Similarly, the Institute has also made significant contributions towards revamping the backyard or small scale rural poultry farming in India. The native type dual purpose improved chicken varieties have been developed and propagated throughout the Country. These varieties are being further propagated by the NGOs, social organizations, CPDOs, private hatcheries, SAUs/SVUs and the State AH departments to provide equity base along with household nutritional security and supplementary incomes to the poorest of poor.

The availability of technical manpower for the industry is less than adequate at present. The human resource development and capacity building exercise is taken up by this institute in the form of short term and specialized trainings on various aspects of poultry production and management. Besides, the Institute, in collaboration with the deemed university IVRI, Izatnagar also imparts post graduate education in various faculties of Poultry Science. Other modes of capacity building such as summer/winter schools, farmers fair, conferences, seminars and symposia are also organized by the Institute from time to time. In private domain, the Central Poultry Training Institute, Hessarghatta, Bangalore (Karnataka) and Dr. B.V. Rao Institute of Poultry Management and Training, Pune (Maharashtra) have developed facilities for training of technical manpower in all disciplines of Poultry Science.
Central Avian Research Institute
CARI 2030

Needless to say that the poultry production systems are changing very fast both at national and international level. The changing scenario has posed new challenges to the Institute not only for reorienting its research programme both in quality and direction to develop technologies which are competitive, cost effective, eco- and farmers-friendly, commercially viable, sustainable and acceptable internationally but also to redefine its clients and to develop technologies as per their requirements. Keeping with the traditions of high standards of research and need based problem solving approach coupled with most efficient and optimal utilization of scarce resources, the Institute would make all out efforts to play a lead role in the field of Poultry Science research and education in the National Agricultural Research System. The Institute will strive to be responsive, sensitive and responsible to all the stakeholders of the Indian Poultry Sector.

Vision

Revolutionizing the diversified poultry production for household nutritional security, income and employment generation as a viable alternative to chicken.

Mission

Developing and popularizing appropriate poultry production and processing technologies in respect of diversified avian species for enhanced profitability.

Focus

In order to realize its vision and mission, the institute accords highest priority to the needs of the farming community at the grass root levels especially the women folk. The institute is committed to the requirements of the small poultry entrepreneurs on one hand and is also responsive to the problems and challenges faced by the commercial poultry industry on the other hand. The institute intends to focus on the key areas of immediate importance:
Promote and propagate farming of diversified poultry species through technological development for their sustainable and profitable production.

Search for alternate poultry feed resources to minimize the feed cost in the face of stiff competition amongst the human beings and poultry for the common feed resources.

Developing cost effective and efficient processing technologies for production of value added poultry products with extended shelf life and utilization of poultry by-products and wastes etc.

Promoting feed and product safety and development of technological interventions for their quality assurance.

Contingency planning for facing the challenges of climate change for sustainable poultry production by evolving technologies for mitigating the adverse effects.

Promote innovations and infuse capacity building for meeting the requirements of all stakeholders in the poultry value chain.

Establishment of an information clearing mechanism for efficient dissemination of technologies and technical know-how.

Strengthening and modernization of R&D infrastructure, improvement in the quality of human resources.

Foster linkages and collaborations with the stakeholders in both private and public sectors as also with international agencies.

The R&D efforts of the Institute are targeted on the following poultry species.

- Quail
- Guinea Fowl
- Desi Fowls
- Ostrich
- Turkey
- Ducks *(at Regional Centre, Bhubaneswar)*
- Emu *(soon to be introduced)*
R&D Perspective

The insatiable human quest and consequent advancements in scientific knowledge has led to development of advanced tools, techniques, methods and approaches capable of technological breakthroughs to accomplish the envisioned goals of enhancing production of poultry species to meet its ever growing demand. The Institute would make all out efforts to reap the benefits of synergies of modern scientific tools and techniques, viz., bio-informatics, geographical information system, nano-science, information and communication technologies in conjunction with the conventional and core scientific techniques to enhance productivity, input use efficiency, reducing cost and post-harvest losses, minimizing risks and improving quality of poultry products as also to address and shield diverse interests of various stakeholders in the poultry supply chain. Some of the ardent aspects requiring focus in the next two decades are outlined hereunder.

Augmenting Genetic Potential of Diversified Avian Species:

Keeping in view the developments in the private sector, the institute would reorient its pure line breeding programmes, laying renewed emphasis on alternate and promising avian species to establish them in the chicken dominated Indian poultry industry for commercial exploitation. The issues like impact of climate change, disease resistance and improvement in productivity along with feed conversion efficiency etc. would receive focused attention harnessing the power of latest biotechnological tools. To address the future needs, research would focus on sustainable use of available genetic resources through their characterization and genetic improvement, functional genomics, epigenetics, proteomics, gene mining, molecular breeding tools like marker assisted selection and gene staking and customized genetic engineering aimed at production of trait specific transgenics etc.

Efficient Feeding Systems: Nutritional requirements of diversified poultry species vary with climatic conditions, genetic potential and production
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status. The same would be regularly fine tuned for ensuring precise nutrient supply so as to improve feed utilization efficiency, productivity aimed at reducing stress to the birds and finally the feed cost. The research output would be utilized for developing and updating poultry nutritional standards of various poultry species by the Bureau of Indian Standards (BIS).

Highly diverse landscape and agro climatic conditions in India and newer food processing techniques provide wider options for choosing alternate feed stuffs aimed at lowering the cost of production. The database preparation on nutrient contents, their digestibility/bioavailability and effective/ safe level of inclusion of such feed stuffs in poultry rations is of prime importance for practical feed formulation. Such database is also important in the face of instability in food chain due to threats of climatic extremes. Efforts would be made to improve the feed conversion rates further by ensuring efficient digestibility/bioavailability and utilization of nutrients from diverse high fiber feed resources through application of biotechnological tools and strengthening of feed processing technology.

Waste Management: The poultry wastes from poultry farming mainly comprise of hatchery wastes, litter material, poultry droppings and slaughter house wastes which pose a serious threat to ecology if left untreated. Problem of dumping and accumulation of poultry waste continues to haunt poultry farmers especially in the major poultry producing belts. Development of eco-friendly technologies for cost effective and efficient utilization of poultry waste will not only solve the problem of waste disposal but also will protect the environment from harmful gases and toxic residues in soil. Similarly, processing technologies for hatchery and slaughter wastes will also open up new business opportunities for the entrepreneurs. Efforts will also be made to develop suitable self propelling and efficient integrated composite farming systems wherein production of overall waste itself is minimized.

Food Safety and Product Quality Assurance: In view of the growing health consciousness, there is an ardent need to develop convenient and affordable functional poultry products with adequate food safety and longer
shelf life not only for the domestic markets but also to tap international markets and to realize full export potential by conforming to the international food safety norms. Hence, research efforts would be directed towards microbial risk assessment as well as use of predictive microbiology approaches to produce safe poultry products. Further, surveillance/assessment of level of potent food pathogens for predicting their growth in poultry products along with simple and quick laboratory methods for detection and quantitative estimation of incriminating factors such as pesticide, heavy metals, veterinary drugs and other toxic residues in poultry feed and products would be developed apart from their amelioration techniques for safer food production.

**Efficient Management Systems for Poultry Farming:** Strategies for physiological balancing and improving core organ functioning would be evolved in order to overcome the stress associated with higher productivity of poultry species as also to cope up with threats of unfavorable weather conditions. Housing systems and farm management practices would be developed to address the growing animal welfare concerns, WTO obligations and climatic extremes. Reproductive efficiency of diversified poultry species would be enhanced by evolving technologies for prolongation of reproductive phase, artificial insemination and development of semen extenders etc.

**Contingency Planning for Disaster Management:** The impending threats of global warming are likely to jeopardize the food chain and overall ecological balance. Therefore, technology driven systems such as integrated risk-and-disaster management production systems would be developed to mitigate the adverse affects of climatic extremes like floods, droughts, cyclones and erratic rainfall patterns etc. on poultry production. Alternative poultry feeding systems need to be evolved to counter the environmental and climate associated eventualities. Similarly, the diseases patterns and pathogenesis of the agents causing such diseases are likely to alter warranting newer strategies to manage them.
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Capacity Building and Technology Transfer:

Growth of poultry sector demands matching growth in efficient and well trained human resources not only for the organizational needs of the sector but also to meet the requirements of R&D institutions for developing newer technologies. Therefore, the Institute would strive to strengthen its HRD programme by revising and developing need based course curricula. Tailor made training programmes with emphasis on hands on training would be developed. Technology delivery systems involving latest mass communication tools would be developed and strengthened by forging linkages with various public and private sector entities and international agencies. Participatory approaches would be employed for refining and re-delivery of technologies to the stake holders. For quicker dissemination of information/feedback and providing a common platform for information sharing, a cyber based information exchange system would be developed. Such system may also be helpful in alerting the poultry sector about the impending threats and upcoming opportunities.

Institutional and Policy Support:

Augmentation and modernization of infrastructure and establishment of hi-tech laboratories in the area of Avian Biotechnology, Disease Diagnostics & Forecasting, Feed/Food Microbiology, Feed and Poultry Processing and Quality Assurance on International Standard Organization norms etc. are essential to face the R&D challenges emanating from rising demands, instabilities in production-consumption systems and growing globalization etc. Furthermore, to popularize and disseminate the diversified poultry species, research centres would be established. Institutional arrangements would also be strengthened to tackle the issues concerning IPRs.
**Strategy and Framework**

In order to resolve the challenges of poultry sector which is expected to maintain the past annual growth trends in egg and meat production at 6% and 10%, respectively, utilizing the existing resources in an efficient and planned manner and building on the new state-of-the-art R&D infrastructure would be the main stay. The following strategies would be adopted to realize the cherished vision and goals of the Central Avian Research Institute.

- Vying for increased budgetary provisions for R&D support for genetic improvement and evolving package of feeding, management and health care practices as well as enhancing productive and reproductive efficiency of diversified poultry species.

- Need-based import of superior genetic stocks of diversified poultry species with strict enforcement of bio-security measures as and when required to improve the efficiency of the breeding programmes for developing elite poultry stocks with higher productivity, immunity competence/disease resistance and adaptability to diverse climates employing molecular and bio-technological approaches in conjunction with the conventional techniques.

- Promotion of rural/small scale rearing of diversified poultry species as an alternative to chicken through development of suitable germplasm by conserving, improving and utilization of native (indigenous) breeds in view of their hardy character and tropical adaptability for developing egg type, meat type or dual purpose desi varieties in difference agro-ecological zones, particularly in hilly regions.

- Survey of unexplored alternate feed resources as an alternative or supplement to conventional poultry feed ingredients and developing precise nutrient supply regimes for diversified poultry species ensuring enhanced nutrient utilization for reducing feed cost.
• Assessment and monitoring of potent pathogens and residues of heavy
metals/pesticides/veterinary drugs etc in compounded feed/feed
additives, raw and processed poultry products for improving food
safety and product quality.

• Developing proactive strategies for mitigation of adverse affects of
epidemics/natural disasters and impending climate change by enhancing
resilience of the poultry farming and its support systems.

• Evolving cost-effective and efficient technologies for the production
of market-oriented, value-added, convenient poultry products including
designer eggs/organic egg/poultry meat to boost domestic consumption
of poultry products and promote export trade.

• Developing national database on occurrence of bio- and phyto-
contaminants to address safety concerns of poultry products and
promote their export trade under the WTO regime.

• Technology development for cost effective utilization of poultry by-
products arising from hatchery, poultry slaughter and poultry droppings
as feed, fuel and fertilizer to address environmental concerns and reduce
cost of poultry production.

• Strengthening the HRD support by introducing vocational poultry
diploma courses (poultry polytechnics) for matriculates/10+2 students
to meet the shortage of mid-level technicians in private sectors in
addition to the training programmes for the poultry farmers and
entrepreneurs.

• Forging public-private partnerships and effective dynamic linkages
between R&D institutions and the stakeholders and transfer of proven
technologies, for getting feedback.

• Appropriate technologies for prevention/control of emerging and re-
emerging poultry diseases through effective bio-security measures and
evolving effective control systems.
• Development of market intelligence mechanisms for assessment of demand and supply of poultry products and inputs (especially feed and chicks) for research priority setting, forecasting and entrepreneurial development.

• Recommending formation of a suitable institutional support mechanism in the form of Poultry Development Board for coordinating and supporting poultry sector on the lines of National Dairy Development Board.

• Inter-institutional collaboration wherever necessary to speed up the progress of R & D efforts and to reduce burden on exchequer and establishment of effective linkages among Government, private institutions and Non Government Organizations (NGOs).

• Capacity building through international training and faculty improvement/exchange programmes for the scientists and periodic revision of the poultry science course curricula.
Fuelled by the need based import of grand-parent stocks and proactive pure line breeding programme coupled with simultaneous development of other allied sectors, the Indian poultry industry has already been on the spiralling growth path. However, in the process of intensification in commercial poultry production, small holder rural poultry sector remained neglected. Besides, the growth in the Indian poultry sector has been chicken centred ignoring at large, the potentials available in the form of diversified poultry species. The CARI, will therefore, strive to lead a technology driven revolution in the Indian poultry sector to meet the challenges of nutritional security, improving livelihood opportunities and ensuring sustainable and consistent growth of the sector by evolving technologies for production of alternate poultry species such as quails, ducks, turkey, Guinea fowls and emus etc. apart from the improved varieties of desi chicken.

The Indian poultry sector characterised by its frequent upheavals due to uncertainties in feed supply and onslaught of poultry diseases, further compounded owing to several missing links in the poultry supply chain would be transformed into vibrant and globally competitive sector through innovations and technology development in the near future. Sincere efforts will be made to transform the Institute to be more responsive and sensitive to the needs of all the players of the poultry sector right from vulnerable small/marginal poultry farmers to large scale commercial integrators including the allied stake holders. The Institute will focus in the areas wherein private sector has shown reluctance. The Institute will remain ever vigilant to the changes taking place at the national and international levels, responding strategically in a timely manner to protect and further the interests of all the stake holders following participatory approaches and by shaping up a tradition of scientific conscientiousness, reliability and veracity at all levels.
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### Annexure 1: Strategic Framework

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<th>Goal</th>
<th>Approach</th>
<th>Performance Measure</th>
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<tr>
<td>Improving productivity, protection and adaptability of diversified poultry species</td>
<td>Integration of conventional and molecular approaches for characterization and breeding. Application of biotechnological tools like transgenesis, RNAi, proteomics, nanotechnology epigenetics, aptamers, in-ovo approaches, etc. Production and utilization of recombinant proteins, e.g., cytokines and pharmaceutical/nutraceutical, etc. Sequencing/re-sequencing of genome of poultry species; comparative and functional genomic applications Induction of new poultry species/breeds viz. Emu, ostrich, geese, Red jungle fowl etc. and their utilization/improvement</td>
<td>Increase in productivity/ adaptability/ disease resistance No. of stocks characterized/ developed -Development of designer/ enriched poultry products</td>
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<tr>
<td>Standardization of package of practices for diversified poultry production</td>
<td>Improving FCR and growth by identification of symbionts using metagenomic approaches and their utilization. Identification of newer feed resources, by-products and wastes their evaluation and utilization through processing, improving gut-health,</td>
<td>Improvement in FCR &amp; No. of symbionts identified and evaluated. Improvement in productivity, immune-responsiveness, FCR, stress</td>
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biotechnological tools, supplements and management of anti-nutritional factors.

- Determination and fine-tuning of nutrient requirements of diversified poultry under different systems of rearing and climates.

- Stress management through physiological balancing and improving core organ functioning, use of phyto-hormones and neuro-endocrine tools, etc.

- Surveillance, monitoring and control of poultry diseases, developing bio safety procedures and diagnostic kits.

- Prolongation of reproductive phase of birds through conventional and molecular techniques.

- Developing climate resilient low cost housing and feeding systems

<table>
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<tr>
<th>Designer eggs and meat production</th>
<th>Modulation of poultry diets</th>
<th>Cholesterol reduction and targeted nutrients enrichment in eggs and meat</th>
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<tr>
<td></td>
<td>Application of biotechnological tools like transgenesis and RNAi</td>
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<th>Management of poultry waste and by-products</th>
<th>Processing and recycling techniques employing conventional and biotechnological methods.</th>
<th>Reduction in levels of pollutants due to poultry waste</th>
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<th>Improving food safety,</th>
<th>Developing technologies for production of demand driven</th>
<th>Number of products,</th>
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- Reduction in feed cost

- Improvement in productivity, reduction in morbidity and mortality.

- Improvement in productivity.
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<th>Area</th>
<th>Details</th>
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<tr>
<td>Value addition and quality assurance</td>
<td>Convenient value-added poultry products, their shelf life extension and quality assurance.</td>
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<tr>
<td>Development of user friendly soft tools to</td>
<td>- Development and updating software for formulating cost-effective feed-recipes (MakeFeed), disease diagnosis including genetic selection and bioinformatics for diversified poultry species.</td>
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<tr>
<td>support poultry production</td>
<td>Number of soft tools developed and their demand by the target groups/ clienteles.</td>
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<tr>
<td>Improving risk management in production</td>
<td>Application of market intelligence approaches for risk assessment in poultry production and marketing and its mitigation strategies. Priority setting through ex-ante analysis and simulation techniques for optimum utilization of resources and investment opportunities.</td>
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<tr>
<td>and marketing of diversified poultry</td>
<td>Entrepreneurial development in poultry sector.</td>
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<tr>
<td>HRD, Capacity building and technology</td>
<td>- Improvising course curricula for imparting post graduate education in Poultry Science, organizing need based training programmes, trainers’ training programmes, interactive meets, conferences/ symposia, seminars, etc.</td>
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<tr>
<td>transfer</td>
<td>- Students’ throughput.</td>
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<td>- Number of trainings organized.</td>
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<td>- Level of participation</td>
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<td>- Dissemination of proven technologies through mass media approaches, exhibitions etc.</td>
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<td>- Demand for technologies and revenue earned.</td>
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