

# VISION 2050



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## 1. CONTEXT

The world poultry meat production elevated from 91.9 to 104.0 million tonnes during the year 2009 and 2012. In poultry meat production, chicken meat contributes a major stake of about 87.4%. Nevertheless, the other species of poultry that contributes to the world poultry meat production are turkey (6.6%), duck (4.2%) and geese (2.7%) (Watt Executive Guide, 2012). Continent-wise statistics indicates that Asia produces about 36.5% of the world chicken meat, whereas, the other major producers are North America (21.1%), South America (21.7%), Europe (16.9%) and Africa (4.0%) (Watt Executive Guide 2011). Similarly, among the various countries, USA contributes 20.3% of global chicken meat production followed by China (14.3%), Brazil (12.4%), Mexico (3.2%) and India (2.3%). During 2009, worldwide hen eggs production was 62.8 million tonnes from a total of 6.4 billion laying flocks of hens. China occupies the largest stake (37.6%) to the world hen egg production followed by USA with 8.5% and India with 5.0% (FAO, 2009). Nevertheless, India stands 3<sup>rd</sup> position for hen egg and 5<sup>th</sup> position for chicken meat production in the world. The import of poultry meat during 2007-2009 was 9.63 million tonnes, while the export was 10.1 million tones of which Asia contributes 42.9% followed by Europe (24.7%). On the other hand, South America (37.5%) followed by North America (33.7%), Asia (18.7%) and Europe (9.0%) contributed to the majority of world exports during 2007-2009, whereas, Brazil (49.9%), America (41.7%) and Thailand (4.8%) were the largest exporter of broiler meet during 2007-2009 (Watt Executive Guide, 2010).

The world human population exceeded 7 billion in 2012 and expected to reach 8.0 billion in 2020, and further, it is expected to rise at 1.1% rate every year until 2050. It is predicted that 9.3 billion humans will be on the earth in 2050. Consequently, to feed the enormous population in 2050, the food production needs to be increased by 70% over and above the present quantity of food grain production (Watt Executive Guide, 2010).

During the year 2003, world poultry meat consumption was 11.6 kg/person/year, which increased to 12.62 kg/person/year in the year 2009. The poultry meat consumption in 2007 was highest in North America (49.4 kg/person/year) followed by South America (27.2 kg/person/year) and Europe (20.3 kg/person/year) while, Africa (4.5kg/person/year) and Asia (7.8 kg/person/year) reported to be at lower values for poultry meat consumption (FAO, 2007). The broiler meat consumption in the year 2015 is expected to reach 52 kg/person in USA and 13kg/person in China. Similarly, global average of egg consumption is currently around 8.57 kg/person/year. Highest egg consumption (13.9 kg) in 2003 was reported in North Central America followed by Europe (12.7 kg) and Asia (8.7 kg). The biggest rise in egg consumption was noted in Asia (60%). Globally, there has been increasing demand for organic poultry produce and the consumers pay premium price for such eggs and meat. Therefore, it is imperative to encourage the farmers in rural areas to undertake backyard poultry, which has immense potential for producing organic poultry produce to meet the demand of billions of health conscious people all over the globe.

In the context of Indian poultry production, during the past four decades, poultry industry has transformed itself from the age-old backyard farming into a dynamic agri-based industry. India is currently producing 2.75 million tones of chicken meat and 65.48 million (2.86 million tones) of hen eggs/year. The poultry industry with the strength of

227 million layers and 2224 million broilers employs 3.0 million persons and contributes over Rs.45,416 crores to the Gross National Product (Prabhakaran 2012).

The human population of India is about 1220 million in 2012 and it is predicted that another 877 million will be added to the existing human population in 2050 with the growth rate of 1.6% per year. The present per-capita availability of eggs is 54, while chicken meat consumption is 2.2 kg whereas the ICMR recommendation is the consumption of 180 eggs and 10.8 kg poultry meat per person per annum. Therefore, to bridge the gap between availability and requirement, the layer and broiler industry has to be upscaled by 5 and 10 folds, respectively. However, the projected growth of industry correspondingly depends on the availability of feed ingredients to meet the requirement. The total poultry feed requirement as on today is 28 million tonnes. More than 90% of the demand is being met through organized mills and about 10% from the unorganized sector. The estimated compound feed demand for the broiler and layer sectors in 2050 will be around 77 million tonnes. Maize, jowar, soyabean meal and other vegetables oilcakes may fetch higher demand for human consumption and may not be available to the poultry feed industry at the required quantity due to their enhanced export value and increased usage in human food industry. Therefore, it becomes necessary to evolve strategies for increasing the productivity of raw feed ingredients, search for newer feed resources and effectively regulate the supplies to feed industry to sustain the growth of poultry sector. Another operation that needs attention to sustain growth of poultry industry is the bio-security. Liberal importation of genetically improved stocks, clustering of commercial farms, and importation of vaccines, inadequate quarantine facilities etc., offset the balance of biosecurity and threaten the progress of poultry industry. Necessary counter measures have to be standardized to achieve and sustain the projected growth of the industry. Genetic selection has played a significant role in historical improvement in the production efficiency of layers and broilers, which brought about 85 to 90% of the change that has occurred in broiler growth rate over the past 50 years. However, as growth rate, feed efficiency, and meat yield have been improved, livability, skeletal integrity, cardiovascular health and immune responsiveness have declined as correlated genetic responses.

Acceptance of processed chicken is on the rise, particularly in the urban markets. With the rise in consumer awareness and requirement for hygienic and safe food, processing will have a bright future in the poultry industry in the years to come. A few plants for processing eggs have been installed using state of art machinery in some states with an average daily turnover capacity of 0.7 to 0.8 million eggs. Whole egg powder, yolk powder, egg white powder, lysozyme etc. are being produced under high standards of operation. The raw material production for these plants needs to be managed under strict supervision and monitoring for ensuring acceptability of final product under international food safety regulations.

Commercial farms are mostly concentrated in and around the urban and peri-urban areas. Currently, native chickens in rural and tribal areas constitute about 38% of country's chicken population. However, due to their low productivity (50-60 eggs/year), they contribute only 21% to the total egg production. The eggs and meat are sold at higher price in rural areas than urban areas. Therefore, there is absolute necessity and adequate scope for development of backyard poultry in rural and tribal areas, which in turn can contribute substantially to raise the overall per capita availability of eggs/meat.

Further, Indian eggs in the International market are facing severe competition from those of other countries forcing the farmer to lose 15-20% on exported poultry products for reasons of trade subsidy. Similarly, chicken meat exports are mostly confined to only Middle East.

Poverty alleviation is one of the prime priorities of the Indian government. Among the several popular schemes in livestock sector, poultry rearing in villages have topped the importance. Project Directorate on Poultry, a constituent of ICAR was established in 1988 with a mandate to co-ordinate and monitor ICAR sponsored network programme, to undertake applied research on genetics and breeding, and conservation of improved chicken germplasm with supportive research on nutrition, disease control and management, and to lay emphasis on development of chicken varieties for meeting the needs of rural/tribal and other under privileged section of the society.

Since the initiation of the AICRPs during early 1970s and subsequent inception of the Project Directorate on Poultry at Hyderabad in 1988, various layer crosses (ILI-80, ILM-90 and ILR-90), broiler crosses (B-77, IBL-80, IBB-83 and IBI-91) and germplasm for rural backyard poultry (*Vanaraja* and *Gramapriya*) have been evolved for rearing under intensive commercial/backyard poultry farming. Further, 4 lines (PD-1, PD-2, PD-3, and PD-4) were evolved through selective breeding at Project Directorate on Poultry. These lines are being used for generation of germplasm for rural poultry. The crosses evolved at Project Directorate on Poultry are being extensively popularized for rearing under adverse climatic condition of our country.

Further, under the poultry seed project of this institute, throughout India, 6 centers are operational of which 3 centres are in NEH region and 3 are in main land with an objective to produce around 0.75 to 1.0 lakh improved poultry seeds for distribution to the villagers for production enhancement of eggs and meat in rural areas. Therefore, Project Directorate on Poultry can be one of the pivotal institutes to play a major role in expanding the appendages in various sectors of poultry industry that are essential for up scaling the poultry production in India, which will lead to bridge the gap between availability and requirement for rising human population by the year 2050.

## **2. CHALLENGES**

India is predicted to become world's most populous country with a population of 1.6 billion in 2050. This scenario throws two major challenges, firstly, the chicken egg and meat production has to be increased manifold to meet the high demand. This assumes significance in light of not being able to match the present recommended egg and meat consumption, more so in rural parts of the country. Secondly, there will be competition between poultry industry and human population for cereals, which is the main ingredient in chicken feed. Apart from the availability of these cereals, the price of this and other ingredients are rising at regular intervals. Since the feed cost constitutes about 70 per cent of the cost of chicken production the availability and price of the feed assumes importance, which necessitates search for alternative sources of energy and other feed ingredients. Further, the feed resources available are not uniform throughout the country. Therefore, region specific feed formulation by incorporating the locally available feed ingredients is required. Under disaster management plan, feed alternatives or methods of feeding during emergencies like flood or severe drought is needed. The alternatives may

be in the form of highly concentrated feed capsules/blocks containing essential nutrients for survival.

Global warming and climate change process is predicted to alter many geographical events like change in rainfall pattern and more frequent incidence of drought, which will impact the agricultural output and consequently the feed availability and price of the feed ingredients. Ambient temperature projections for this century indicate an increase between 3°C and 6°C. This increase will lead to heat stress in chicken causing high morbidity and mortality. The productivity of the heat stressed birds will be declined and the birds will be more prone to diseases. Under these circumstances, the feeding strategy, housing and other management practices followed presently have to be modified to overcome the adverse conditions. The selection strategy for both layer and broilers has to be oriented to produce heat tolerant lines or varieties. Genes responsible for conferring better adaptability may be introgressed into the high performing low adaptive lines through traditional as well as molecular breeding tools.

The consumer awareness about the welfare of chicken raised for human consumption is high in recent times both in our country and abroad. This welfare awareness has led to the elimination of cage rearing of birds in some western nations. These welfare concerns are to be addressed by adopting housing systems that are less stressful and high in animal welfare. This will also become a necessity for exporting poultry products to overseas markets. Different housing types have to be evaluated for the maintenance or improvement of productivity, behavioural responses and stress levels. Handling of chicken for administration of vaccines and medicine causes stress to the birds. Technologies like *in ovo* administration of vaccine and nutrients have to be developed so that stress due to handling of live birds is minimized. Chicken are moulted after a laying cycle by way of feed withdrawal so that they once again come into laying cycle. But, this practice raises welfare issues. Exploring the natural moulting process in the birds and finding an effective method to make birds to moult will be of immense use to poultry farmers in maximising their return on investment.

The increase in disposable income with people as well as specific health requirements have led to demand for specific nutrient enriched poultry products. Therefore, germplasm for production of designer egg and meat has to be developed. For the comparative assessment of nutritional qualities of different poultry produces, in particular egg and meat of different chicken lines has to be documented which then can be manipulated. Intra population enhancement of egg and/or meat quality performed through traditional selection and genetic engineering tools. Therapeutically important proteins in poultry products can be produced through transgenic technology. Nutritional manipulation for enhancing the egg and meat quality is another approach for production of designer poultry products.

The chicken should be in good health for maximizing productivity and net profit. Occurrence of infectious diseases or production disorders will bring reduced remuneration to the farmers. Therefore, research focus on minimisation or preventive strategies of the diseases is of paramount importance. In case of viral diseases effective vaccines and vaccination schedule for emerging and re-emerging diseases are required. Use of antibiotic in treatment of diseases or as growth promoters should be minimised or eliminated. By this way, organic poultry farming, which is having a niche clientele, may be promoted. Herbal derivative application in disease prevention and management might

be an answer to this problem. The occurrence of avian influenza in chicken leads to culling of huge number of birds in the affected area. This causes huge loss to the poultry farmers and a negative impact to the poultry industry. Further, there is the possibility of zoonotic occurrence of diseases. Deeper insight has to be developed on the mechanism of incidence and transmission of this disease and prevention of its occurrence. By selection for higher production level in both layer and broiler, the stress on the bird's physiological mechanisms have been increased leading to many metabolic disorders like ascites, sudden death syndrome etc. These problems have to be overcome by the way of newer solutions. Application of nanotechnology in the form of nanoparticles for delivery of drugs, vaccines etc., for better utilization efficiency and activity against the diseases is a promising area of research. Even for gene therapy applications, nanoparticles can be developed for delivery of DNA/RNA molecules. Further nanoparticles developed can be utilised for modulating different physiological mechanisms regulating growth and production. Nutraceuticals in form of nanoparticles may be explored for better feed utilization and counteracting some production disorders.

PDP is engaged in developing newer varieties of chicken in response to the diverse need of the farmers and consumers. In this process, different indigenous chicken germplasm is being used for which the indigenous germplasm need to be identified and characterised both at phenomic and genomic level. Estimation of genetic divergence among populations and introgression of novel gene(s) of economic importance are very much essential for obtaining sustainable performances of genetically improved varieties of chicken. The specialised crosses and location specific varieties developed for intensive and backyard farming need to be assessed. Conservation by *in-situ* and/or *ex-situ* of the existing and newly developed varieties is a must to prevent loss due to epidemics like avian influenza etc. For *in-situ* conservation, the varieties may be maintained at multiple locations of the country. In case of *ex-situ* conservation, cryopreservation of germ cells or embryonic stem cells should be attempted.

Poultry rearing process produces wastes which have to be disposed properly without posing health problems to human and animals and creating environmental degradation. Hatchery operations produce wastes in form of infertile eggs and dead chicks. The poultry litter, hatchery wastes, slaughter house wastes etc. can be converted to animal feed resources and disposed off effectively. Poultry wastes have been the breeding ground for multiplication of house flies, insects, rodents etc. Methods have to be devised to minimise or prevent growth and multiplication of flies. The wastes can be converted to organic manure for using it in agricultural operations. Different methods of treatment such as physical, chemical or biological methods can be efficiently applied for converting the litter and other wastes to biodegradable manure. Alternative uses of poultry litter and wastes for production of bio-gas and electricity needs to be explored which can be used for the farm itself leading to sustainable utilisation of resources.

There is steady growth in poultry sector and making available sufficient quality of manpower both technical and scientific with latest knowledge will support this growth. Involvement of private sector in the functioning of public organisation will augment the benefits reaped. The technologies developed have to be IP protected and have to be disseminated quickly and effectively. Licensing of products and services to private or cooperatives helps in faster and deeper spread.

### **3. OPERATING ENVIRONMENT**

Poultry rearing in our country is practised by two extremes; high input commercial rearing of chicken and low input backyard or rural poultry. The commercial rearing of broilers and layers are dominated by private players employing latest technologies whereas low input system of rearing is carried out with less resource by rural people. The growth of commercial poultry rearing has grown immensely in the last four decades and today, it is in the form of agri-industry. But, the growth is concentrated in and around urban areas catering to the high income groups living in that area. The major population in the country sustains on low productive native chicken. The price of eggs and meat is higher in the rural areas than urban areas. With this skewed distribution and availability of poultry products, it is not surprising to observe lower level of availability and consumption than the recommended standards of 180 eggs and 10.8 kg poultry meat/person/annum. The above scenario provided the necessity and scope for further strengthening of backyard poultry in rural and tribal areas. More improved germplasm with higher productivity need to be developed and supplied apart from the present rural varieties. Besides, government institutions, in recent times, private agencies are also propagating improved varieties for backyard conditions.

The consumer preference in the urban areas lately is changing towards value added products. The awareness and acceptance of processed meat and egg is also increasing in the urban areas. This can be observed in the number of private companies offering different processed cut up parts of chicken in big commercial establishments. The processed products are of high standard and quality meeting international standards. Therefore, it can also be exported to other countries. Presently, in the global trade in poultry India accounts for less than 0.4% and exports are concentrated to only Middle East countries. Thus, there is a huge scope in expanding the export market.

The future growth of poultry industry requires adequate availability of feed ingredients at reasonable price. Due to various factors, the price of the ingredients is soaring high leading to higher cost of production of chicken. Therefore, information on alternative and newer feed resources is sought after by the poultry producers.

The occurrence of disease epidemics like avian influenza and other infectious diseases are frequent and cause huge losses in financial terms and loss of genetic stock. For constant monitoring of some important disease causing agents, diagnostic services from standard laboratories is being sourced by the poultry farmers. There is also demand for simple and quick disease screening tests that can be done at the farm to take quick corrective measures. Disease prevention in poultry is carried out by proper scheduled vaccination programme. The vaccines available are of large doses that can be utilised fully by big commercial farms only. For use in backyard or rural poultry, where less number of birds is reared, smaller dose and cost effective vaccines that can be stored and transferred at room temperature is preferred but still unavailable.

In the private sector, poultry research and development in our country is reasonably progressing but it responds to the issues concerning their operations or clients or stock. The knowledge is also confined to their business clientele. The public sector organisations like Project Directorate on Poultry only cater to general public and information and knowledge are available in public domain. The dissemination of information is done at physical locations of these organisations and is easily accessible



from anywhere in the country. For this purpose latest ICT has to be harnessed effectively to disseminate knowledge to the stakeholders.

#### **4. NEW OPPORTUNITIES**

The science is progressing at high pace with many breakthroughs in different fields like biotechnology, nano technology, genomics and phenomics to name a few, giving ample opportunities for developing and propagating new products and technologies. India as a rich biodiversity based country with availability of more than 18 chicken breeds has immense potential to exploit native genetic resources to further augment productivity, adaptability and disease resistance. With the application of biotechnology and genomics, productivity may be markedly increased to mitigate the demand of ever increasing human population for poultry meat and eggs. High through-put genome sequencing, molecular breeding, functional genomics, gene microarray, transgenesis and gene silencing technologies may be judiciously applied to pave the way for extremely fast genetic improvement of poultry and also to maintain for sustainability of Indian Animal Agriculture. For production of designer eggs and meat, Molecular Biology and nutritional modulation has huge potential as the consumers have better preference for value added poultry products. Low cholesterol eggs and meat, enriched protein in eggs and meat, presence of high value protein in egg/meat having therapeutic importance are the desire today for health conscious people and by 2050, these products will be the most preferential ones.

Biotechnology to disease resistant lines against economically important diseases such as Avian Influenza, Marek's disease, Avian leukosis, Salmonellosis and Coccidiosis etc. can be developed. Gene chip consisting of markers for high through-put screening of elite germplasm can be developed and molecular breeding techniques like gene silencing used to improve overall health status and resistance to number of diseases. New inroads in proteomics opens opportunities for development of simple, easy and cost-effective field level immunodiagnosics. Nanomaterials with different properties are good materials for development of diagnostics and vaccine/medicine delivery systems. In the process of development of vaccines, growth promoters and immunomodulators by rDNA and RNAi technology provide ample scope for making user defined products. Vaccine delivery to the farmers is a great problem in the field for constantly maintaining cold chain. Sometimes in the village, electricity is not available or storage facility is not available. Under these circumstances, thermostable vaccine may be very much useful and maintain required prophylaxis. Due importance and consideration should be enforced to develop technology for preparation of thermostable vaccine.

Propagation of information to different stakeholders at right time is essential for timely action. In this regard the information and advisories can be disseminated to large number of farmers spread across the country in real time at negligible cost by using newer ICTs like Short Messaging Services (SMS) and Multimedia Messaging Service (MMS) to name a few. This is possible since there is wide use of mobile phones among the population of the country. There is also the possibility of live interaction between researcher and stakeholder, offering videos on different package of practices and online free courses in different languages with improvement in IT infrastructure and availability of cheaper tablets or mobile phones with connectivity facility. The different information provided to farmers may include the weather information and any adverse climate



forecasted for the particular region, availability of feed ingredients with their market rates, availability of alternative feed resources, market rates of different poultry products etc. The same ICT tools can be used for information gathering from stakeholders about their requirements and changing preferences for incorporation in the R&D process and refining the products and technologies developed by the institute. Occurrence of any epidemics can be controlled by quick information (clinical signs, photos/videos) passage from the farmers to the researchers at main station so that corrective measures can be suggested on real time basis.

## **5. GOALS/TARGETS**

The organised sector of poultry industry is contributing nearly 70% of the total output and the remaining 30% is by the unorganized sector. The poultry industry is well dominated in southern states in the country particularly Andhra Pradesh and Tamil Nadu with nearly 60-70% of the total output. India's 75% of egg produce is consumed by the 25% population living in urban and semi-urban areas. In India, 20% population is vegetarian. The per-capita availability of poultry egg and meat is 54 and 2.36 kg per annum, respectively while per capita requirement as recommended by ICMR were 180 eggs and 10.8 kg meat per annum. In fact, 33% of the country's total population lives in urban and peri-urban areas while rest of the population live in rural areas. In urban areas, per-capita consumption is around 100 eggs per annum while in village the consumption is around 20 eggs per annum. In addition, poultry activities create job opportunities for more than 3 million farmers while 15 million agrarian farmers are employed in the poultry industry that grow poultry ingredients for feed as well as in avian health industries.

India has emerged as one of the self reliant country in the developing world having technology driven industry, with capability to produce every essential input for successful poultry farming, vaccines and medicines, specific pathogen free eggs (SPF), farms and hatchery automation systems, pelleted feed, egg processing, poultry processing and nationwide network of disease diagnostic laboratories through both private and public sectors. Rural poultry production constitutes important component of agricultural economy in India. Small poultry keepers are capable of more significant contribution to alleviate malnutrition, poverty and unemployment. A spectacular progress has been made from subsistence to sustainable production system. Indian backyard population has increased by 16% in the last 30 years from 60 to 70 million. It is a fact that China's 76% of total egg comes from rural backyard production. Hence, India requires both mass production as well as production by masses.

India produces 5.0% of global egg production. The annual growth rate of egg is 5 to 8%. India has the lowest cost of egg production in the world with a premium of 2.55 US cents per egg. The introduction of new poultry products and perceptible shift in eating habits are moving people to branded food such as chicken yummiiez, cold cuts, breaded and coated snacks, marinated snacks, chicken nuggets, canned chicken curry, freeze dried chicken pulao, meat soup, powder omlette and scrambled egg mixtures, sandwich, pizza, burger and dial-a-chicken and fast food joints, Kentucky Fried Chicken (KFC), McDonald's, Wimpy, Pizza Hut all these are going to change the palatability preferences of the consumer. Under the WTO regime, multinationals are being involved in poultry sector to carry forward the industry at a very fast space. They are not only providing the

food items but also creating millions of job opportunities. Poultry rearing is labour intensive and has a potential to create 25,000 more jobs on the consumption of one more egg per capita and similarly 25,000 additional jobs on the consumption of 100 gm more chicken meat.

Diet eggs or designer eggs are getting gradual preferences by the health conscious consumers in the country. They are going to boost special eggs for vitamin E substitution, Omega fatty acids and antioxidant requirements. Poultry eggs and meat have got sensorial, curative, nutritive and therapeutic potential. Chicken eggs are used to synthesize high value molecules for further use in therapeutics and immunoprophylaxis. Duck embryos are used in manufacturing anti-rabies vaccine. Poultry is the only industry where modern technology co-exists with the traditional poultry keeping because poultry technology is appropriate, adaptable, accessible, available and affordable both by the rich and the poor.

Keeping these facts and findings in mind, the goals/targets has been stated below:

- To make available about 180 eggs per head per annum by augmenting productivity
- To make available about 10 kg poultry meat per head per annum by augmenting productivity
- To produce vaccines, therapeutics and neutraceuticals in poultry meat and egg as bioreactors
- To eradicate or minimize the incidence of deadly emerging diseases in poultry
- To efficiently utilize poultry wastes for renewable energy or other purposes to get rid off pollution

## **6. WAY FORWARD**

Presently, India ranks third for egg production and fifth for meat production in the world. In 2050, the demand of meat and egg would be extremely high on account of stiff population growth rate. The expected population at that time would be 1.5 to 1.6 billion. The present growth rate of layer and broiler industry is about 6-7% and 8-10%, respectively. However, to keep this growth rate intact, the poultry feed ingredients are to be provided to the poultry industry at reasonable price. At this rate, the availability of egg and meat per head per annum will reach upto 110 eggs and 8.4 kg by 2050. Hence, there will be a huge gap between requirement/demand and production of egg and meat. It is established that poultry meat is superior to other edible meats as it is a white meat and most suitable for persons having/prone to cardiac ailments. To meet the demand of poultry produce, enormous improvement for the performance of poultry birds is required for which systematic, long term strategies are to be formulated and implemented thoroughly. Cutting edge technologies should be adopted to assist conventional practices followed for genetic improvement of birds. To obtain faster growth of genetic potential, newer advanced technologies are to be implemented judiciously. Keeping the demand of farmers and consumers in view, the strategies are to be prepared and to be adopted as and when required. The genetic potential, feed efficiency and utilization and health status of the birds need to be improved upon to obtain high performing birds so that farming enterprise would be lucrative and highly profitable. PDP vision 2050 will cater all these requirements to not only augment productive performance of the birds but also take care

several emerging issues like environmental concern, natural resource degradation, WTO regime and climate change impact.

The following strategies and approaches would be adopted to accomplish the mandate and goals of Project Directorate on Poultry keeping in view important issues including natural resource degradation, climate change and associated stresses, world trade and markets, IP regime and human resource needs.

### **1. Up-gradation of genetic potential through conventional breeding, genomics and biotechnological tools**

- Characterization of chicken germplasm with phenomic, structural and functional genomics tools
- Establishment of molecular markers for growth, production and disease resistance traits in different chicken lines
- Utilization of gene chip for high through-put screening of elite germplasm and use in molecular breeding to improve a number of traits at a time
- Improvement of pure lines through conventional breeding tools
- Paradigm shift for development of lines for specialized purpose by using molecular markers
- Epigenetic analysis and gene silencing technology and its implication in poultry production

### **2. Development of chicken variety as per consumer preferences in different regions of the country**

- Identification and characterization of indigenous chicken germplasm both at phenomic and genomic level and genetic divergence study among populations with respective economic traits
- Exploration of nutrigenomic pattern (Metabolonomics) for feed utilization in different chicken lines
- Introgression of unique characteristics of economic importance into different chicken lines for sustainable performances
- Development and relative assessment of various specialized crosses and location specific varieties for both intensive and backyard farming

### **3. Development of package of practices for pure line and commercial poultry**

- Standardization of managerial procedures for chicks, growers and adult birds in pure lines and commercial crosses
- Studies on housing and welfare practices with respect to intensive and semi-intensive farming
- Metagenomic analysis of gut microflora for better feed efficiency
- Development of nutritional package of practices for germplasm developed by PDP
- Standardization of nutritional requirements with reference to essential and expensive nutrients
- Identification of novel/alternate feed ingredients to meet the growing demand of the poultry industry

- Identification of suitable, easily adoptable and economically viable methodologies to inactivate anti-nutritional and toxic factors and enhance the nutrient availability
- Improving efficiency of nutrient and feed utilization by using newer/frontier areas of bio-technology/ natural agents/ molecular tools (feed enzymes, acidification, extracts from plant & microbes, probiotics, prebiotics etc.)
- Optimizing the productivity through early chick nutrition
- Nutritional manipulations for lean meat production, optimizing immunity and gut health
- Nutritional and management approaches to minimize residues of extraneous toxic/ deleterious compounds (pesticides, antibiotics, mycotoxins, etc.) in poultry products
- Dietary manipulations to reduce the fat and cholesterol content and enhance the content of omega-3 fatty acids, antioxidants etc. in eggs and meat
- Development of nutraceuticals and their effective use in poultry production

#### **4. Development of germplasm for production of designer egg and meat**

- Comparative assessment of nutritional qualities of different poultry produces particularly, egg and meat in different chicken lines
- Intra population enhancement of egg and/or meat quality through traditional selection and genetic engineering tools
- Production of therapeutically important proteins through transgenic technology
- Nutritional manipulation for enhancing egg and/or meat quality
- Development of marketing channels and IP protection for production of nutritionally enriched poultry produces

#### **5. Nanotechnology and its application in poultry production and health**

- Development of nano particles for delivery of drugs, vaccines etc. for better utilization efficiency and activity against the diseases
- Research on nano particles for delivery of DNA/RNA molecules for gene therapy
- Understanding and development of nano particles for inducing different physiological mechanisms regulating growth and production
- Development of nano particles for efficient utilization of nutraceuticals in poultry

#### **6. Development of health management practices for production of hygienic poultry products**

- Active monitoring of the chicken lines for mortality pattern and causes of mortality by high through-put and accurate disease mapping techniques
- High through-put screening of the chicken lines for vertically transmitted diseases
- Development of disease resistant birds through molecular breeding technique

- Development of effective vaccines (recombinant/DNA etc.), peptides and newer drugs against emerging and re-emerging diseases through biotechnological tools
- Eradication of economically important diseases through well planned, judicious prophylactic measures in the country

#### **7. Development of modules for package of practices to ameliorate impact of climate change and global warming**

- Assessment of climate change impacts on poultry production and health using controlled climatic conditions
- Exploring profiles of adaptability characters in indigenous and exotic chicken germplasm and establishment of molecular markers for adaptability traits by genomic tools
- Development of managerial strategies to ameliorate heat stress in chicken lines
- Introgression of genes responsible conferring better adaptability to the high performing low adaptive lines through traditional as well as molecular breeding tools

#### **8. Planning and preparation of modules for effective use of poultry litter and wastes to prevent environmental pollution and human health hazards**

- Physico-chemical assessment of poultry litter and wastes
- Use of poultry litter as organic manure for crop production under plant animal interactions and as a food for fish production
- Alternative use of poultry litter and wastes for production of bio-gas and electricity
- Organic farming with poultry litter and its impact on consumers preference and human health

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