



Vision 2030



Project Directorate on Poultry
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Rajendranagar, Hyderabad 500 030

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Foreword

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

Indian poultry sector has recorded the phenomenal growth of 10-12% every year and emerging as the world's second largest market for poultry products. India is currently at 3rd and 5th rank in the world in hen egg and chicken meat production, respectively. The per capita availability of eggs has increased from 10 to 49 eggs, while that of chicken meat increased from mere 147 g to 1.9 kg per annum in the last four decades. Recurrent outbreak of epidemics and likely climate changes are going to be major challenges before the poultry sector.

The Project Directorate on Poultry, nearing 25 years of its existence has been playing pivotal role in augmenting poultry production in the country, particularly in the disadvantaged rural and tribal areas. The crosses developed, viz. Vanaraja, Gramapriya, and Krishibro have been showing good adaptability and satisfactory performance under diverse agro-climatic regions of the country. PD on Poultry needs to intensify its efforts in developing appropriate poultry production technologies suitable for both rural and intensive poultry farming in view of emerging challenges.

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

20 June, 2011
New Delhi



(S. AYYAPPAN)

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Preface

Project Directorate on Poultry is a constituent Institute of Indian Council of Agricultural Research spearheading poultry research and extension activities for productivity enhancement of intensive and extensive system of poultry production in urban, rural and tribal areas of the country.

PD on Poultry has been striving hard in fulfilling the mandated responsibilities of evolving high yielding varieties with special reference to the disadvantaged sections of the society. White leghorn layer with the capacity to lay more than 305 eggs in a laying cycle has been developed under AICRP under intensive system of rearing. Besides propagating parents and progenies of popular and established crosses of Vanaraja and Gramapriya, new promising crosses of chicken were developed and being tested for their performance at farm and field level for low input backyard farming. Besides, development of location specific rural poultry germplasm, conservation of lesser known breeds of chicken and their molecular characterization will get focus in the near future under AICRP on Poultry breeding.

Although India is currently at 3rd and 5th rank in hen egg and chicken meat production with percapita availability of 49 eggs and 1.9kg poultry meat per year, which is way behind the recommended consumption of 180 eggs and 10.8kg poultry meat per person per year despite the stupendous growth of poultry sector in last four decades. This mismatch in production and consumption is more at rural areas of the country.

Soaring food prices have direct impact on availability of cheaper feed ingredients for feeding poultry hence there is a need to continuously search for alternate and location specific feed raw materials. Incidence of emerging and reemerging diseases of poultry poses threat to the poultry industry. Climate change is another challenge that needs to be addressed with suitable varieties and package of practices. In view of this the PDP vision-2030 document is being prepared by harnessing the power of science and need based researchable issues.

I am highly obliged to Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR), Dr. K. M. L. Pathak, Deputy Director General (AS) ICAR for all the guidance extended in revising the PDP Vision document and making it more pertinent to changed scenario. I also record my deep sense of gratitude to Dr. S. C. Gupta, Assistant Director General (AP & B), Dr. Gaya Prasad, Assistant Director General (AH) and scientific staff of animal science division, ICAR for all their support and encouragement. I specially appreciate the cooperation and help of the committee and scientific staff of the Directorate in bringing out this document in appreciable form.

6 July, 2011
Hyderabad



(R. N. Chatterjee)
Project Director

Preamble

In just over 4 decades, poultry farming in India has transformed itself from backyard venture into a dynamic agri-based industry at an incredible pace. During late sixties, the demand for commercial layers and broilers in the country was answered through importation of grand parent stock from abroad. It is in this context that ICAR undertook a methodical approach in initiating pure line breeding programmes to achieve self-reliance and produce superior genetic stocks of layers and broilers. A network programme was started by the Council involving SAUs in the year 1971. The Government of India subsequently permitted importation of pure/grand parent stocks from 1993 and also reduced import duty substantially.

With the sophistication in poultry industry, the number of breeds, varieties and strains have declined to just a few now. The genetic composition of industrial stocks held by a few giant multinational corporations is a closely guarded secret. The number of such corporations is reduced further through merger of smaller units. This trend however, opened the scope for monotype and vulnerability in the industrial stocks. As a safeguard, it is desirable to conserve populations that are likely to be genetically apart so as to achieve better heterosis, and meet the newer requirements of the market. In order to avoid the possibility of monotype and vulnerability in stocks, it is essential to maintain and improve the pure line populations available in the ICAR system. The mating between ICAR/GOI lines and those available in industry will yield higher heterosis in the terminal cross.

The modern commercial stocks need optimum environmental conditions of nutrition, housing, climate and management to maximise their performance. Currently the poultry industry has 227 million laying hens and 2224 million broilers consuming around 28 million tons of feed annually. While there is need to look for unconventional feed ingredients to reduce input costs on feed, it is also important to identify specific strains of birds that need less nutrient inputs and yet sustain good growth and egg production through efficient nutrient utilisation.

In broiler breeding programmes, major emphasis is placed on realizing efficiency on economic chick production, fast growth, efficient feed conversion and low mortality under a wide range of environments. However, selection for body weight has increased the appetite in broilers resulting in fat deposition, which is considered as an unwanted component by the meat industry. Increase in growth rate through selection has also a negative influence on reproductive traits of broiler dams. To minimize this effect, specialized sire and dam lines have been developed for broiler production.

The free range poultry farming that is less organized, yet contributes 21% of eggs to the national egg basket. It is a low cost input practice and substantially enhance the total productivity and availability of protein rich food at the doorstep in the village scenario. It can be independent in its growth and does not compete or hinder the commercial poultry farming. As the productivity of native chicken is very poor, special lines have to be evolved to suit to the village scenario and free-range rearing system. Native birds have a list of major genes like naked neck, dwarf, frizzle, Fm, etc., which can resist the adverse environmental factors in backyard farming. The rural population can advantageously use the backyard bird with less input cost and encourage consumption of egg and meat at the source of production and to improve their nutritional status.

To consolidate the gains already made in broiler and layer industry, it is appropriate to introduce molecular methodologies to further improve their production potential. Through genomics, it is now feasible to measure the underlying genetic variation within the breeding populations without affecting the existing genepool. Then it is possible to identify desirable genotypes by using DNA analysis and molecular genetic markers to aid in evaluating and testing the breeding stocks for various important quantitative and tropically important traits.

'*PDP Vision 2030*' document describes key challenges and opportunities in the poultry sector in the next 20 years for developing an appropriate strategy and a roadmap to articulate the role of Project Directorate on Poultry in shaping the future of the poultry research for sustainable growth, development and food security.

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Poultry Scenario

Global

THE world poultry meat production grew from 90.2 million tonnes in 2008 to 91.9 million tonnes in 2009 and the estimate for 2010 is 94.2 million tonnes. Chicken meat (80.3 million tonnes) is major contributor of poultry meat production accounting to 87.4%. Among the regions of the world, Asia produced about 31.9% of the world chicken meat and the other major producers were North America (21.6%), South America (19.2%), Europe (16.7%) and Africa (4.5%) (FAO 2009). The other species of poultry that contributed to the remaining portion of world poultry meat production were turkeys (6.6%), ducks (4.2%) and geese (2.7%)(Watt Executive Guide, 2010). Among the countries, USA (20.3%) followed by China (14.3%), Brazil (12.4%), Mexico (3.2%) and India (2.3%) lead in that order with regard to chicken meat production.

In 2009 an estimated 62.8 million tonnes of hen eggs were produced world wide from a total laying flock of approximately 6.4 billion hens of which Asia accounted for 59.1% followed by Europe (16.4%) and North Central America (13.4%). China is the largest contributor (37.6%) to the world hen egg production and was followed by USA (8.5%) and India (5.0%) (FAO, 2009). Accordingly, India is currently at 3rd and 5th position in the world in hen egg and chicken meat production, respectively.

The import of average poultry meat during 2007-09 in the world was 9.63 million tonnes while the exports were 10.1 million tonnes. Asia (42.9%) followed by Europe (24.7%) accounted for a major share of imports. 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 2007-09. Brazil (49.9%), America (41.7%) and Thailand (4.8%) were the largest exporter of broiler meet during 2007-09 (Watt Executive Guide, 2010).

The world human population was estimated was at 6.12 billion in 2000, rising to 6.83 billion in 2009 and expected to reach 6.91 billion in 2010. From now until 2019 it is expected to rise at an average of 1.1% per year compared to 1.2% average annual growth rate in the previous decade. But the biggest forecast is that 9.2 billion humans will be on the earth in the year 2050. To feed these many

number of mouths the food production need to be increased by 70% over and above the current level of food production (Watt Executive Guide, 2010).

The world poultry meat consumption showed a steady increase during 2003 (11.6 kg/person/year) to 2009 (12.62 kg/person/year). The growth in consumption during the decade was noted among all the regions of the world. However, the poultry meat consumption in 2007 was the 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 (4.5 kg/person/year) and Asia (7.8 kg/person/year) had low consumption (FAO, 2007). The recent outbreaks of Avian Influenza had significant negative impact on chicken meat consumption in most of the countries. The broiler meat consumption by 2015 is expected to reach 52 kg/person in USA and 13 kg/person in China, while a marginal increase may be noted in India, which is mostly due to simultaneous increase in human population.

Similar to chicken meat, hen egg consumption per person is increasing at the rate of 0.1 to 0.2 kg/year with the world average currently around 8.57 kg. Highest egg consumption (13.9 kg) in 2003 was noted 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 for such eggs and meat.

National

During the past four decades, poultry industry in India has transformed itself from the age-old backyard farming into a dynamic agri-based industry. Several breakthroughs in poultry science and technology have led to the development of genetically superior breeds capable of higher production, even under adverse climatic conditions that offer opportunities for overseas entrepreneurs to expand export and import of poultry products. India is currently producing 2.2 million tonnes of chicken meat and 2.67 million tonnes of hen eggs/year. The poultry industry with the strength of 227 million layers and 2224 million broilers employs 2.0 million persons and contributes over Rs. 35,000 crores to GNP.

India's population is about 1096.9 million in 2005 and with the growth rate of 1.6% per year another 450 million people will be added to the existing

population by 2025. The current per-capita consumption (availability) of eggs is 49 while chicken meat consumption is 1.9 kg. It is far below the recommended consumption of 180 eggs and 10.8 kg poultry meat per person per annum. Thus to meet the nutritional requirement, the layer and broiler industry has to grow 5 and 10 folds, respectively. India is also showing a relatively strong growth for the egg and poultry meat industry, in both the urban and rural areas. It has been found that egg consumption has grown at a much faster pace than the consumption of poultry meat.

In India, commercial farms are concentrated more in urban and semi-urban areas although nearly 65% of the population of the country lives in rural 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.

The projected growth of industry depends to a great extent on the availability of feed ingredients to meet the requirement. The total poultry feed requirement as on today is 28 million metric tonnes. More than 90% of the demand is being serviced by organized mills and only about 10% from the unorganized sector. The estimated compound feed demand for the broiler and layer sectors by 2025 will be around 44 million tonnes. Maize, jowar, soybean meal and other vegetable oil cakes may not be available to the feed industry at the required quantity due to their export value or 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 growth of poultry sector.

Another major operation that needs attention to sustain the 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. The poultry produce is primarily available as fresh eggs and broiler meat for consumption. Value

addition to eggs and meat is at a very low key. This can be taken up in a big way for export and domestic purpose.

Genetic selection has played a significant role in the historical improvement in the production efficiency of layers and broilers and brought about 85 to 90 percent 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, liveability, skeletal integrity, cardiovascular health and immune responsiveness have declined as correlated genetic responses.

Trading of live chicken is primarily done in number and not by weight at the wholesale level. However, 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 the art machinery in some states with an average daily turnover capacity of 0.7-0.8 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 is managed under strict supervision and monitoring for ensuring acceptability of final product under international food safety regulations.

At present, India accounts for less than 0.4% of the global trade in poultry, even though the cost of inputs is low. The major identified markets for India are Japan, Hong Kong, Poland, Belgium, Singapore, Bangladesh, Sri Lanka, Maldives, Saudi Arabia, Oman, Bahrain, Kuwait, Yemen Arab Republic, UAE, Thailand and in recent times Germany, USA and Australia. The poultry products presently exported include table eggs, hatching eggs, frozen eggs, egg powder, day-old chicks, poultry meat and equipment. Substantial quantities of specific pathogen free eggs are being exported to Iran, Saudi Arabia and Indonesia for manufacture of vaccine. 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. It is expected that the current constraints could be overcome and India will play a dominant role in the near future in the international poultry market. Similarly, chicken meat exports that are mostly confined to Middle East may expand to other parts of the world.



Project Directorate on Poultry

THE initiation of All-India Coordinated Research Project on Poultry Breeding in IV five year plan is a land mark in the history of poultry research in India. This project provided a base to conduct target-based and mission-oriented research programmes at national level. Later, in order to give more focus, the AICRP on poultry breeding was upgraded as Project Directorate on Poultry which started functioning from March 1, 1988. During the last two and half decades the budgetary provision for developing infrastructure and manpower in the Directorate has also improved significantly.

The Project Directorate on Poultry has been mandated to coordinate, monitor and evaluate the AICRP network on poultry breeding. In addition to this, the Directorate has been conducting research at its own research farms in breeding supported by nutrition and health cover. A review of the progress made in AICRP through IV to X Plan showed that the layer lines crossed the production targets set from time to time. The initial targets of 220 eggs in a laying cycle were revised periodically to 235, 250, 260, 270, 290 and 300. Similarly in broilers, the initial target of 1500 g body weight at 10 weeks of age was revised to 1200 g at 8 weeks, 1200 g at 6 weeks and 1500 g at 6 weeks of age with feed efficiency of around 2.0. The revised target set for layers in 11th plan was 305 eggs with 52 g egg weight and for broilers was 1700g at 6 weeks of age or 2000 g at 7 weeks of age with feed efficiency of 2.0. The layer crosses have already achieved 305 eggs and the coloured broiler cross has achieved the body weight of more than 2000 g at 7 weeks of age.

The crosses identified have been evaluated periodically in the Random Sample Poultry Performance Tests conducted by Government of India. Breeding programmes carried out at different research



IWH Female Parent



PB 1 female parent

centres (SVU/SAU) and IVRI/CARI resulted in developing and releasing three layer strain crosses (ILI-80, ILM-90 and ILR-90) and four broiler crosses (B-77, IBL-80, IBB-83 and IBI-91) for commercial exploitation. Pureline parents and commercial crosses were supplied by the centres and the Directorate to different research institutes, State Government organisations and private industry for catering to the needs of the farmers.

Transfer of technologies developed at PD on Poultry was given much importance through propagation of parent lines and commercial stocks of popular varieties viz., Vanaraja and Gramapriya across the length and breadth of the country for backyard or free range farming especially in rural and tribal areas. PD on Poultry acknowledges the importance of partnerships and synergies of different stakeholders in providing technological solutions for poultry farming. The concept of 'public private partnership' is given due importance by undertaking contract research projects, consultancy projects and providing technical services to poultry industry, animal husbandry departments and farmers in nutritional and health related aspects.



Flock of Vanaraja

Considering the importance of improved rural poultry germplasm in improving the productivity of backyard poultry farming, ICAR has set up four more centers of All India Coordinated Research Project under the XI five year plan to develop location specific rural poultry germplasm in addition to two already established centres. Recently, six 'Poultry Seed Project' centers were established during the XI five year plan to increase the availability of the improved chicken germplasm at affordable cost and convenience by establishing parent farms in these locations.

Mandate

- To coordinate and monitor ICAR-sponsored network research programmes.
- To undertake applied research on genetics and breeding, and conservation of improved chicken germplasm with supportive research on nutrition, disease control and management.
- To lay emphasis on development of chicken varieties for meeting the needs of rural/tribal and other under-privileged sections of the society.



THE demand for poultry products, eggs and meat is constantly increasing because of their nutritive value, wide acceptability and cost effectiveness compared to other sources of animal protein. India ranks third in egg production and fifth in broiler production in the world. The layer industry is growing at 5 to 7% and the broiler industry at 10 to 12% per annum. However, the per capita availability of eggs is 49 and that of broiler meat is 1.9kg per annum, which is far below the ICMR recommended levels of 180 eggs and 10.8 kg meat per head per annum. Further, it is important to note that just 25% of the country's population living in urban or semi-urban areas consume 75-80% of the total eggs and broiler meat produced. In urban areas, the per capita consumption is 100 eggs and 1.2 kg meat per person per annum, while in contrast the consumption is 15 eggs and 0.15 kg meat in villages. The availability of eggs and chicken meat at affordable prices in rural areas is possible by developing efficient rural poultry production system. This system will result in progressive improvement in poultry production with low input costs and bring about improvement in the rural scenario. As the production potential of native birds is very poor, it is necessary to develop new improved varieties, which can perform under low plane of nutrition and harsh environmental conditions.

The poultry industry will now need to adopt changed breeding programme with more emphasis on the needs of the consumer (e.g. product quality, health and animal welfare etc.), as well as the needs of the breeders/producers (e.g. lower feed costs, better survivability and higher fertility etc.). The consequences of climate change phenomena are now evident and considered as the serious long-term threat to poultry production.

The issue of greatest concern to poultry industry is the increasing feed cost, which is the major input (70-75%) in the cost of production. Acute shortage has been experienced in the availability of conventional feed ingredients like maize, soybean meal, groundnut cake, sunflower cake etc. whose annual production remained almost static over a long period of time.

Vision

Enhance productivity of chicken for household nutritional security, income and employment generation.

Mission

Develop and propagate improved varieties of chicken for sustainable production under intensive and extensive systems.

Focus

To accomplish its vision and mission, Project Directorate on Poultry gives highest priority for multidisciplinary research for sustainability of poultry production, which in turn can improve its competitiveness. It would concentrate on the following key areas.

- Special emphasis to develop new varieties of chicken for sustainable rural poultry production
- Development of layer and broiler strains for intensive poultry production through conventional breeding
- Up-gradation of genetic potential through molecular biology and biotechnological tools and development of lines for specific commercial needs
- Identifying new animal-feed ingredients that reduce cereal use and dependence on imports
- Integrated disease control in pureline and terminal crosses developed by the Directorate
- Assessment of climate change impacts on poultry performance and health and development of adaptation strategies through multidisciplinary approaches
- Promote technology management, commercialization and technology transfer
- Establishment of linkages through technology transfer, consultation and collaborative research with private and public institutions



Harnessing Science

Potential of genetic resource enhancement

PROGRESS in the selection of growth and production traits in the poultry breeding has been dramatic over the past few decades. The genetic potential of layer and broiler needs further improvement so as to meet the growing requirement for human consumption and reduce feed required for production of unit produce. The layer and broiler purelines currently available hold promise for further improvement. Besides, these improved exotic lines may also provide ample opportunity for use in the breeding programme for development of improved varieties for rural poultry production. The promising strains of layers and broilers that are available in public and private sectors may be brought under focus for further improvement and conservation. Larger populations with revised selection criteria to reflect the specific objectives and higher intensity of selection should be used. While private sector has attempted and achieved the desired growth, using higher intensity of selection, the public sector need to concentrate on this issue. The pure lines so developed should be tested for the nicking ability and be used for development of terminal crosses. Selection for early immune competence will be superimposed on the other selection criteria. Some pure lines of layers and broilers may be developed for high immune competence.

Rural poultry production

The fruits of impressive growth achieved in commercial poultry production have been limited to the urban and semi-urban areas and the rural poultry sector remained unchanged. Chicken population in rural areas increased marginally from 63 million to 73 million in the past 35 years. Backyard poultry contributes around 21% to total egg production of the country. Nearly 60-65% of human population still lives in villages and they are getting access only to a negligible share of total poultry products. In rural areas, the poultry products are sold at 10-40% higher price than the prices at urban and semi urban areas. Further, the incidence of protein deficiency is prevalent among the susceptible groups like children, pregnant women, nourishing mothers and aged people in rural areas, which can be alleviated by adopting small scale



A pair of Vanaraja Male line



A pair of Vanaraja Female line

poultry farming in backyards of rural house holds. Besides, the backyard poultry production relies on minimal cost inputs in the form of kitchen waste, locally available grains, tender leaves, worms, insects and other material available for scavenging. Therefore, it is necessary to promote free range and backyard poultry farming in rural, tribal and underdeveloped areas of the country. Realizing the importance of backyard poultry farming in India, research efforts were initiated in the recent past at ICAR Institutes and SAUs for developing high yielding strains suitable for rural farming. Nevertheless, there is a need to continue the activity with renewed emphasis on coloured plumage, long shanks, moderate body weight, high immune competence, low feed input and good egg production.



Vanaraja Male

Power of biotechnology

Conventional breeding adopted over the years attained a significant progress in genetic enhancement of productivity in poultry. But, the rate of genetic gain has been limited on account of attaining selection plateau, low to medium heritability of the traits and sex limited nature of some economic traits. To intensify faster growth rate, molecular tools, in particular SNP based marker may add higher selection intensity in the breeding programme irrespective of the nature of traits. Structural and functional genomics and epigenetic approach will aid in exploration of genomic markers for economic traits including growth, production and disease resilience traits while genome-wide MAS will enable screening elite birds for use in regeneration programme. Molecular characterization and DNA bar-coding analysis will not only unravel the genetic relatedness among birds/lines/varieties but also protect variety adulteration in commercial/rural poultry production. Genetic engineering or transgenic approach has been the frontier science today to prepare designer poultry products and to produce high value proteins of commercial importance. In addition, gene silencing technology has become another advanced tool to improve the productivity and disease resilience of chicken. The fertilizing ability of spermatozoa is affected by different factors. The molecular mechanisms underlying the fertilizing capacity of spermatozoa need to be studied. Analyzing the gene expression patterns of some important genes, which are known to influence fertility of males, will be of immense help in identifying males with superior semen quality.

Impact of climate change

The global atmospheric concentrations of greenhouse gases (GHGs), have increased markedly as a result of human activities. The global average surface temperature is now about 0.8°C above its level in 1750. It is projected that by the end of the 21st century rainfall over India will increase by 15 to 40% and the mean annual temperature will increase between 3°C and 6°C. Such changes would culminate in a situation of intolerable impacts on both human and animals, despite feasible attempts at adaptation to the climate change. Climatic changes will adversely affect the poultry production and poultry health, because birds can only tolerate narrow temperature ranges. Climate change affects the occurrence, distribution and prevalence of poultry diseases. The increasing proportion of poultry production in tropic and subtropical region makes it necessary to reconsider the selection strategy and potential use of naked neck and frizzle genes for improving heat tolerance in chicken. Although some of the impacts may happen to greater or lesser extent in short, medium or longer term, it is important to think ahead for future, especially in relation to issues such as building design, environment control, nutritional management and disease control to cope with new climatic extremes.

Nutrition for optimizing productivity

The issue of greatest concern to poultry industry is the increasing feed cost, which is the major input (70-75%) in the cost of production. It is therefore, imperative to conduct research on the utilization of novel feed resources as possible alternatives to the primary feed ingredients. Nutritional requirements may be standardized to avoid excess feeding of birds with particular reference to limiting amino acids and minerals. Nutrient standards are also needed for specific criteria of production like feed efficiency, immunity, egg size, export quality of poultry products, etc. Efficiency of nutrient and feed utilization may be enhanced using newer/frontier areas of bio-technology / natural agents / molecular tools (feed enzymes, acidification, extracts from plant & microbes, probiotics etc.), so that feed cost per unit production is decreased. Development of comprehensive nutritional package coupled with good bio-security will help in enhancing immune competence and minimizing routine use of antibiotics or chemotherapeutic agents in poultry diets. With the rise in economy and consumers' awareness about health, the demand for eggs and meat that are health friendly has been steadily increasing. Attempts should be made through dietary manipulations to reduce the fat and cholesterol contents in egg and chicken meat and enhance the concentration of specific nutrient in poultry products. Due attention is required on strategic screening of feed raw materials and nutritional and management approaches to minimize residues of these extraneous toxic/deleterious compounds (pesticides, antibiotics, mycotoxins etc.) in poultry products.

Post-harvest and value addition

Marketing of commercial broilers need to be organized as per the production output. Some losses may occur in the food supply chain from production to consumption. Low cost improved technologies are required to improve market efficiency and to be competitive. Cold storage facilities need to be improved. Processing and further processing technology of broiler meat need to be improved to explore the export potential.

Poultry welfare

The future of poultry husbandry is aimed at enhanced animal welfare, with minimal use of preventive medical treatments. These husbandry conditions will resemble more natural or ecological conditions. Under such farming systems, birds will be subjected to physical and climatic stresses (cold, heat and wind), infectious diseases and social stress. Poultry maintained under such future conditions must be able to cope with or adapt to much more dynamic environments than nowadays, preferably without an increase in production costs and risk of diseases. Because environmental stressors can alter the susceptibility of animals to infective agents, it is important to learn how stressors affect the immune system of poultry, the adaptive capacity of birds to respond and the time it takes for birds to return to homeostasis.

Poultry health and production problems

With the increasing density of production, both on the farm and in specific geographic areas, coupled with a highly mobile, often global workforce and global marketplace, the chance for introduction of known diseases will continue to increase. It is apparent that new diseases affecting poultry are constantly emerging or re-emerging at a rate of approximately one per year. This trend will continue and new threats to poultry health will be identified between now and 2030. Some will have minimal impact and may be somewhat ephemeral, while others will challenge the ability of the industry to remain competitive. Introduction of infectious agents into new areas and diseases that jump from another species will impact poultry production as well as domestic and export marketing of eggs and meat. Avian influenza is the best example. The virus is introduced for the first time in many countries, which were free from Avian Influenza, and also it crossed the species borders by infecting humans. Although, human death was not reported in India, the AI outbreak caused panic in general public resulting in enormous loss to the poultry industry. Further, with continuous emphasis for enhancement of production performance, incidences of new infectious diseases and metabolic disorders are bound to occur. Alterations in husbandry, management and genetics of the stocks appear to encourage previously harmless agents or combinations of agents to cause disease. The increase of pressure placed on the physiology of the bird by selection for greater

productivity is likely to aggravate the metabolic problems like skeletal deformities, ascites, sudden death syndrome etc. Research efforts are needed to correct the problems caused by these diseases.

Management of poultry waste

Environmental pollution due to poultry litter and hatchery wastes is of great concern directly or indirectly to human health and environment. With the poultry industry growing at 10-15% per annum, the disposal of poultry wastes will continue to remain as an unanswered problem. Research work on minimization of environmental pollution from poultry wastes using recycling methodologies need to be explored. Bio-balancing management of nutrients may be pursued to minimize the excretion levels of uric acid and other ammonical and mineral wastes. The poultry house wastes (litter) and hatchery discards can be treated using physical, chemical or biological applications and transformed into products of utility.

Human resource development

Rapid changes and newer developments have been experienced particularly in the recent past in research methodologies and tools. It is expected that the trend will continue and many more new areas and tools of research will emerge in future. The scientific and technical manpower need regular updating of their knowledge and skills so as to carry out research efficiently and meaningfully. The areas like gene transfer, genetic engineering, DNA marker studies, transgenic applications, enzyme and fermentation technology, biosecurity, development of immunodiagnostics, cryopreservation of semen etc., need attention in this regard.

Technology management and transfer

The varieties developed PDP are quite popular throughout the country. There is vast realizable yield reservoir available with the existing technologies. Hence, effective transfer of technology through on farm and field evaluation/ demonstrations, adoption of villages, further strengthening of seed project, training the extension personnel, subject matter specialists, state animal husbandry officers and farmers is the need of the hour. The crosses developed for commercial exploitation need to be popularized through print and electronic media. Linking of the research accomplishments with the stake holders is very important.



Tribal woman with Vanaraja birds



Strategy and Framework

THE following 6-point strategy would be adopted to accomplish the vision and the goals of Project Directorate on Poultry and to enhance the genetic potential of chicken (see Annexure 1).

- **Development of germplasm for backyard/free range farming for rural and tribal areas**
 - Development of new varieties for backyard/free range poultry and regular monitoring and evaluation of the newly developed varieties under field conditions
 - Refinement and adaptation of parents under simulated free range conditions
 - Introgression of native germplasm in the new varieties for better survivability under free-range system
 - Development of package of practices for existing and newly developed varieties for backyard and free range farming
 - Development and adaptation of pure lines to low plane of nutrition
 - Biodiversity, characterization and improvement of native germplasm
 - Study of welfare and behavioural characters in purelines and crosses
 - Understanding the genetics of disease resistance
 - Development of cryopreservation technology for chicken semen
- **Pure line improvement of broiler and layer populations for specific objectives**
 - Conservation of elite layer germplasm developed under AICRP network
 - Improvement of broiler populations employing conventional method of selection and breeding
 - Application of advanced breeding tools such as BLUP, Animal Model etc., to augment productivity in layer and broiler populations
 - Development of specialized lines for heat tolerance and disease resistance
 - Development of coloured heavy broiler male line

- Incorporation of major genes such as *Na* (Naked neck), *dw* (dwarf) etc., to enhance sustainable production in tropical environment
 - Intensity of selection to maximize genetic response of promising White Leghorn strains under various AICRP centres will be increased
 - Selection for 64 weeks egg production with emphasis on better pullet egg size, better persistency will be continued so as to achieve 315-325 eggs in 72 weeks period
 - Multi trait index selection will be carried out to improve all desirable economic traits
- **Genetic up-gradation of chicken gene pool through biotechnology and genetic engineering tools**
 - Molecular characterization and DNA bar-coding of chicken breeds/lines/varieties
 - SNPs discovery and allele mining for its use in molecular breeding
 - Development of divergent lines for QTL studies
 - Structural and functional genomics, and epigenetic study for genetic marker identification
 - Cytogenetic analysis for exploring genetic disorders in the purelines
 - Genome-wide MAS for identification of elite birds and their use in molecular breeding
 - Designer eggs and meat production through transgenic approach
 - Production of high value proteins through transgenic approach
 - Gene silencing and its application in poultry
- **Nutritional intervention for sustainable production of chicken meat and eggs**
 - 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 methodology 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
- **Disease monitoring and control in chicken lines and strains developed by the Directorate**
 - Active monitoring of the chicken lines for mortality pattern and causes of mortality
 - Screening of the pure lines for vertically transmitted diseases (ALVs, mycoplasma, salmonella, infectious chicken anaemia etc.,)
 - Development of package of best health management and disease control practices for rural poultry
 - Assessment of immune competence and disease resistance in purelines and crosses of chicken developed at the Directorate
- **Impact assessment of climate change on poultry and development of adaptation strategies**
 - Assessment of climate change impacts on poultry production and health using controlled climatic conditions
 - Impact of climate change on reproductive functions of meat, egg and dual type chicken
 - Epigenetic adaptation of embryos and chicks to high ambient temperature related to climate change
 - Development and evaluation of heat tolerant chicken varieties for adaptation to high ambient temperatures
 - Development of adaptation strategies through nutritional manipulation and management approaches



Epilogue

THE Project Directorate on Poultry is committed to bring a demand driven and technology-led revolution in the country to meet challenges of the rising demand for eggs and chicken meat, improving the nutritional security and livelihood opportunities of farmers in rural and tribal areas, and for ensuring sustainable farming and growth of poultry sector. Through this vision document, an attempt has been made to put researchable issues and activities in perspective for next twenty years so as to transform the low input low output system of backyard poultry farming into low input medium output system of farming and to further enhance the growth of poultry sector as a whole.

The PD on Poultry firmly believes that research and development in the field of poultry sector would augment farmers' income, generate employment opportunities, conserve natural resources and increase value addition for higher and inclusive growth of poultry industry. To sustain the benefits of research and development, the PD on Poultry would provide consultancy and technical advice to the farming community. Concerted efforts would be made to transform the PD on poultry to be more sensitive to the needs of the farming community, especially the small holders and of the poor living in the backward, fragile and disadvantage areas. The PD on Poultry will give thrust to the development of backyard or free range system of poultry farming in rural and tribal areas.



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Annexure 1: Strategic framework

Goal	Approach	Performance measure
Development of germplasm for backyard/free range farming	<p>Development of location specific varieties for rural poultry</p> <p>Development of new varieties for backyard poultry and evaluate them under field conditions</p> <p>Development of package of practices for existing and newly developed varieties for backyard and free range farming.</p> <p>Development of pure lines for adaptation to low plane of nutrition and simulated free range system of rearing</p> <p>Characterization, improvement and utilization of native chicken germplasm</p> <p>Study of welfare and behavioural characters in purelines and crosses</p> <p>Study of genetics of disease resistance in native germplasm</p>	Growth, egg production and livability under field conditions
Conservation of pureline layer populations	<p>Maintenance and evaluation of layer germplasm available at PDP and AICRP centres for desirable traits</p> <p>High intensity multi trait selection to maximize the genetic response.</p> <p>Production and evaluation of different cross combinations</p> <p>Development of a sex linked layer line</p>	Egg production, egg number, egg size, age at sexual maturity

Goal	Approach	Performance measure
Genetic improvement of coloured broiler population	<p>Maintenance and evaluation of synthetic broiler lines developed at PDP and under AICRP network</p> <p>Genetic selection of male and female lines for various economic traits</p> <p>Development of specialized lines for feed efficiency, heat tolerance, immune competence and disease resistance</p> <p>Maintenance and utilization of resource populations of major gene lines such as Naked Neck, dwarf, frizzle, Fm, etc., for tropical use</p> <p>Identification of promising crosses for commercial exploitation</p>	<p>High body weight in male line and high egg production in female line</p> <p>Commercial broiler with high body weight and feed efficiency at market age</p> <p>Heat tolerant and feed efficient broilers</p>
Genetic up-gradation of chicken lines using biotechnological tools	<p>Molecular characterization of chicken lines/varieties</p> <p>DNA Barcodes for various lines</p> <p>Development of divergent lines for QTL studies</p> <p>SNPs discovery and allele mining for its use in molecular breeding</p> <p>Genetic marker identification through structural and functional genomic studies</p> <p>Genome-wide MAS for identification of elite birds</p> <p>Cytogenetic analysis of chicken lines</p> <p>Development of transgenic chicken for specific needs</p> <p>Development of cryopreservation protocols of chicken semen</p>	<p>Mitochondrial DNA specific marker for specific lines</p> <p>Genetic markers or candidate genes for QTL</p> <p>Chromosomal abnormality patterns of pure lines</p> <p>Cryopreservation of elite chicken germplasm</p>

Goal	Approach	Performance measure
Sustainable production of chicken meat and egg through nutritional intervention	<p>Standardization of package of practices for supporting the improved germplasm developed and being developed by the Directorate vis-à-vis commercials through nutritional trials</p> <p>Identification of novel/alternate feed ingredients to meet the growing demand of the poultry industry</p> <p>Enhancing nutrient and feed utilization efficiency by using newer/frontier areas of bio - technology / natural agents / molecular tools (feed enzymes, acidification, extracts from plant & microbes, probiotics, etc.)</p> <p>Dietary manipulations to reduce the fat and cholesterol contents in egg and chicken meat and enhance the concentration of specific nutrient in poultry products</p> <p>Minimizing residues toxic/deleterious compounds (pesticides, antibiotics, mycotoxins, etc.) in poultry products through nutrition and management</p>	<p>Enhanced performance</p> <p>Identified newer feed resources and processing methods</p> <p>Value added and safe products</p> <p>Superior health status of poultry</p> <p>Technology and management practices developed for managing environmental pollution</p>
Control of infectious and non-infectious diseases in chicken germplasm developed and maintained at PDP	<p>Monitoring of mortality pattern and causes of mortality in chicken lines developed and maintained at PDP</p> <p>Screening of purelines for vertically transmitted diseases</p> <p>Development of package of best practices for disease control and health management</p>	<p>Mortality rates, susceptibility of different lines to infectious/ non - infectious diseases</p> <p>Reduction/eradication of vertically transmitted diseases such as ALVs and Salmonella</p>

Goal	Approach	Performance measure
	Evaluation of lines for immune competence and disease resistance Assessment of impact of climate change and development of adaptation technologies	Adaptation to climate change and alleviation of heat stress



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