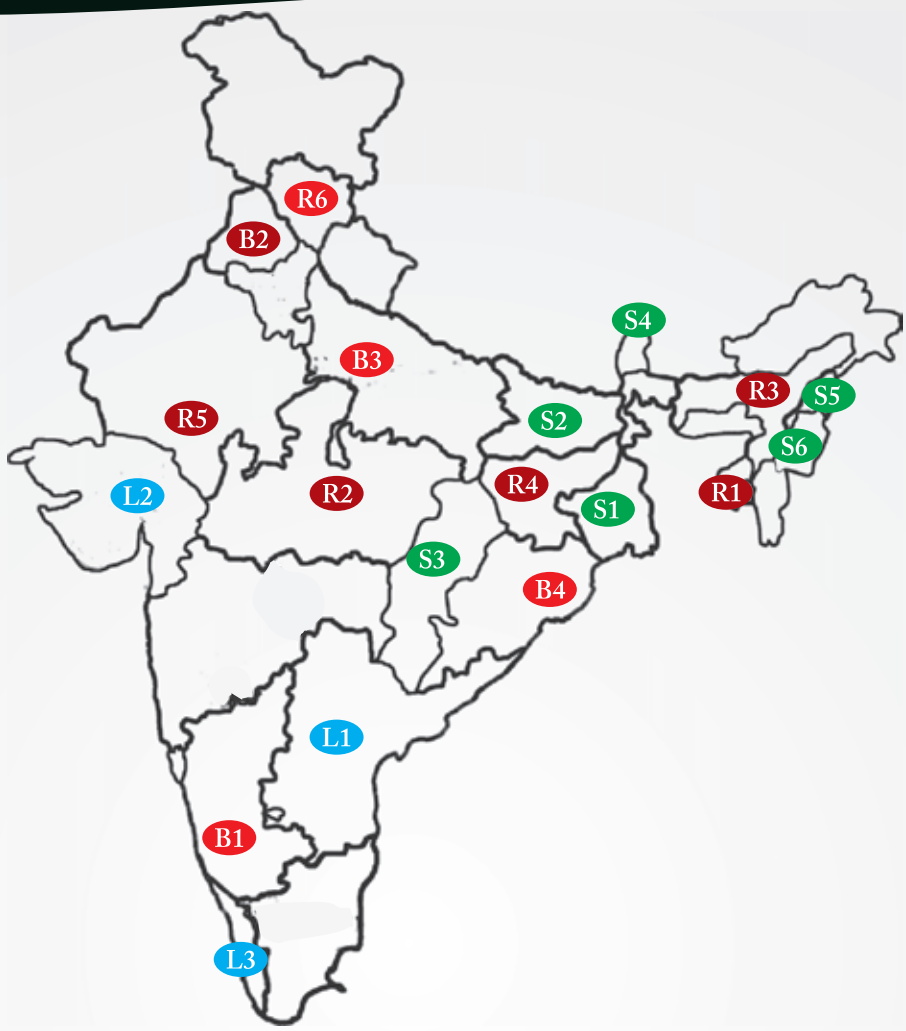
DPR
ANNUAL REPORT
2013-2014

कुक्कुट अनुसंधान निदेशालय
Directorate of Poultry Research
Rajendranagar, Hyderabad - 500 030
www.pdonpoultry.org

भाकृअनुप
ICAR

AICRP on Poultry Breeding and Poultry Seed Project Centres across the Nation



AICRP Centres

Layer

L1. SVVU, Hyderabad
L2. AAU, Anand
L3. KVASU, Mannuthy

Broiler

B1. KVAFSU, Bengaluru
B2. GADVASU, Ludhiana
B3. CARI, Izatnagar
B4. OUAT, Bhubaneswar

Rural poultry

R1. ICAR Res. Complex, Agartala
R2. NDVSU, Jabalpur
R3. AAU, Guwahati
R4. BAU, Ranchi
R5. MPUAT, Udaipur
R6. CSKHPKVV, Palampur

Poultry Seed Project Centres

S1. WBUAFS, Kolkata
S2. BAU, Patna
S3. CKVV, Durg
S4. ICAR Res. Complex, Sikkim
S5. ICAR Res. Complex, Nagaland
S6. ICAR Res. Complex, Manipur

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Directorate of Poultry Research
(Indian Council of Agricultural Research)
Rajendranagar, Hyderabad - 500 030, India
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Annual Report

Correct Citation
Annual Report 2013-14
Directorate of Poultry Research
Rajendranagar, Hyderabad-500 030
Telangana, India

Published by
Dr. R.N. Chatterjee
Director
Directorate of Poultry Research

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Front Cover
Male parent of Krishibro variety

Inside Front Cover
Location of AICRP on Poultry Breeding and Poultry Seed Project centres

Inside Back Cover
Inauguration of Silver Jubilee Block

Back Cover
Chicken varieties developed/maintained at DPR

Designed & Printed at
Heritage Print Services Pvt Ltd.
B-11/9, Modern Bread Lane,
IDA, Uppal, Hyderabad - 500 039
Phone : 040-27201927
E-Mail : heritageprint@gmail.com

Preface

The Directorate of Poultry Research in contributing to the overall development of the poultry in the country has completed twenty six years of its fruitful existence. It is my pleasure to inform that the institute has been elevated from the position of Project Directorate to Directorate in 2013. The mandated responsibilities were achieved by making significant contributions in the field of Genetics and Breeding, Nutrition, Health and Biotechnology. I feel privileged to present the Annual Report for the year 2013-14.

The impact of the poultry technologies developed for the rural farmers can be gauged by the supply of rural varieties by this Directorate. In addition to the popular chicken varieties, *Vanaraja* and *Gramapriya*, there is huge demand for the newly released variety *Srinidhi*. Performance of improved Aseel birds under low input free range system at farmers' field was evaluated and produced promising results.

Under AICRP on Poultry Breeding, overall improvement in the principal traits of elite layer and broiler pure lines during the year has been observed. The six rural poultry centres at different ecological regions of the country are collecting and conserving local germplasm for the development of location specific varieties. Satisfactory results were observed in the performance of layer and broiler crosses evaluated under field and RSPPT.

The six poultry seed project centres located across the country have established infrastructure facilities and by utilizing these facilities, about 2.07 lakhs chicks were supplied to rural farmers during the year. The farmers are happy and satisfied in having the popular rural varieties at their door steps through which supplementary income is earned.

Through selection and conventional breeding practices there is consistent improvement in the primary traits of the pure line broiler and layer populations maintained at this Directorate. Conservation of different native breeds like Aseel, Ghagus and Nicobari fowl is actively undertaken. Further, the existing gene lines are being used in development of different crosses for rural poultry.

The genome of Aseel maintained at this Directorate was sequenced and mitochondrial genes of different breeds were characterized. Study on epigenetic adaptation to high temperature is also being under progress.

Research efforts were made on use of non-conventional feed materials in the poultry diet as an alternative to costlier feed ingredients. Alleviation of heat stress by nutritional methods

was attempted. Efforts are being made to produce designer meat through nutritional manipulation.

Scientists of this Directorate undertook collaborative projects and extramural projects funded by ICAR, DST, DBT, NIAB and NICRA. Besides, few contract research projects were undertaken in health and nutrition areas.

The Directorate endeavours to propagate germplasm developed for the farmers throughout the country through visual media and participating in the exhibitions. I am happy to state that the Institute has earned Rs.139.75 lakhs revenue during the reporting period.

I am delighted that the scientists of this Directorate were bestowed with several awards and recognitions for their significant contribution. During this year, a new Silver Jubilee Block has been constructed for expanding laboratory space at the Directorate. It is also heartening to inform that a land of 10 acres has been received from the Veterinary College, SVVU, Hyderabad for expanding facilities to augment the supply of rural chicken varieties to the farmers in the country.

I wish to place my deepest sense of gratitude to Dr. S. Ayyappan, Secretary (DARE) & Director General (ICAR) for his inspiring and valuable guidance provided during the period. I am thankful to the Secretary, ICAR and Financial Advisor, ICAR for their continuous support in development of this Directorate.

I am extremely thankful to Prof. K.M.L. Pathak, DDG (Animal Science) for his keen interest, support and guidance for the overall development of the Directorate. I am thankful to Dr. B.S. Prakash, ADG (AN&P), Dr. Gaya Prasad, ADG (AH), Dr. R.S. Gandhi. ADG (AP&B), Dr. Vineet Bhasin, Principal Scientist (AG&B) and other Scientific and Administrative Officials of the ICAR Head Quarters for their help from time to time in the progress of this Directorate.

The research progress achieved could be possible only with the support and sincere contribution of all the scientists at the Directorate and different centres of AICRP and Seed Project. I also, thank the other staff for effectively supporting the scientists in their research endeavour. I thank the editorial committee in bringing out this Report in appreciable manner.

Date: 23rd June 2014

(R.N. Chatterjee)
Director

Abbreviations

AAU	Anand Agricultural University/ Assam Agricultural University
AICRP	All India Coordination Research Project
ALV	Avian Leukosis Virus
ANGRAU	Acharya N. G. Ranga Agricultural University
ASM	Age at Sexual Maturity
BAU	Birsa Agricultural University
CARI	Central Avian Research Institute
CLFMA	Compound Livestock Feed Manufacturers' Association
CAT	RBC Catalase
CSFL	Coloured Synthetic Female Line
CSML	Coloured Synthetic Male line
CP	Crude Protein
CPCSEA	Committee for the Purpose of Control and Supervision on Experiments on Animals
CRIDA	Central Research Institute for Dryland Agriculture
d	Day(s)
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DNA	Deoxyribonucleic Acid
DOR	Directorate of Oilseeds Research
DPR	Directorate of Poultry Research
EP	Egg Production
EW	Egg Weight
FCR	Feed Conversion Ratio
FES	Fertile Eggs Set
g	Gram (s)
GADVASU	Guru Angad Dev Veterinary and Animal Sciences University
GML	Gramapriya Male line
GPx	Glutathione Peroxidase
H:L ratio	Heterophyl : Lymphocyte Ratio
IAEC	Institute Animal Ethics Committee
ICAR	Indian Council of Agricultural Research
IRC	Institute Research Committee

IMC	Institute Management Committee
IPSA	Indian Poultry Science Association
IU	International Unit(s)
IVRI	Indian Veterinary Research Institute
KVASU	Kerala Veterinary and Animal Sciences University
KVAFSU	Karnataka Veterinary Animal and Fishery Sciences University
KVK	Krishi Vigyan Kendra
LPO	Lipid Peroxidation
MAFSU	Maharashtra Animal and Fishery Sciences University
MANAGE	National Institute of Agricultural Extension Management
MD	Marek's Disease
ME	Metabolizable Energy
mm	Millimeter(s)
MoU	Memorandum of Understanding
MPUAT	Maharana Pratap University of Agricultural and Technology
NAARM	National Academy of Agricultural Research Management
NAIP	National Agricultural Innovation Project
NCBI	National Center for Biotechnology Information
NDV	Newcastle Disease Virus
NICRA	National Initiative on Climate Resilient Agriculture
NIRD	National Institute of Rural Development
NDVSU	Nanaji Deshmukh Veterinary Science University
OUAT	Orissa University of Agriculture and Technology
PCR	Polymerase Chain Reaction
PHA-P	Phytohemagglutinin – P
PSP	Poultry Seed Project
RAC	Research Advisory Committee
SAU	State Agricultural University
SKC	Solvent extracted Karanj Cake
SOD	Super Oxide Dismutase
SRBC	Sheep Red Blood Cells
SVU	State Veterinary University
SVVU	Sri Venkateswara Veterinary University
TES	Total Eggs Set
U	Unit(s)
wks	Weeks

Contents

Executive Summary

Directorate of Poultry Research, a constituent of Indian Council of Agricultural Research accomplished the responsibility of coordinating and monitoring ICAR-sponsored network programme along with undertaking applied research with the emphasis on developing chicken varieties to meet the needs of rural, tribal and other underprivileged sections of the society. The extra mural projects funded by DST and other agencies were also undertaken. The progress in various activities during 2013-14 has been briefed below.

Research at the Directorate

Genetics and Breeding

Research undertaken in the field of Genetics and Breeding included the development of rural chicken varieties, maintenance and evaluation of layer and broiler pure lines, and maintenance of gene lines and conservation of native chicken germplasm.

Germplasm for rural poultry farming

A total of 6 pure lines i.e. PD-1 (*Vanaraja* male line), PD-2 (*Vanaraja* female line), PD-3 (Brown egg layer line), PD-4 (Improved Aseel), Ghagus, Nicobari and Aseel collected from field were maintained for use in developing rural chicken varieties. In PD-1 line, during S-7 generation, ASM, EW40 and EP40 were 203.7±0.06 days, 54.72±0.01 g and 38.17±0.04 eggs, respectively. The shank length (76.31±0.02 mm) and body weight (655.4±0.41 g) at 6 weeks of age slightly decreased in the S-7 generation as compared to last generation. In PD-2 line, the egg production upto 52 weeks in S-11 generation showed an improvement of 1 egg over previous generation on phenotypic scale. Body weights at 4 and 6 weeks and shank length at 6 weeks of age were 248.7±0.06 and 487.6±0.06 g and 66.24 mm, respectively in S-12 generation. In PD-3 line, ASM, EW40, EP40 and EM40 were 165.9±0.04 days, 54.49±0.05 g, 72.73±0.04 eggs and 3961±3.89 g, respectively in G-3 generation. The egg mass showed an improvement of 37.75 g as compared to previous generation. In SL-3 generation of *Gramapriya* male line (GML), shank length at 6 weeks of age, the primary trait of selection improved by 1.55 mm over the previous generation. The egg production up to 40 weeks of age was 82.5±0.05 eggs and it has increased marginally by 1 egg as compared to the previous generation. A random bred rural control population evolved for comparing the performance of different rural lines was also evaluated and maintained. In PD-4 line, the average body weight and shank length at 8 weeks of age were 428.4±0.20 g and 71.4±0.01 mm, respectively. The egg production upto 40 weeks and egg weight at 40 week was 51.2±0.09 eggs and 48.09± 0.30 g, respectively. The performance of PD-4 line was tested at farmer's field. At 40 weeks of age, average body weight of male and female birds of PD-4 line was 2334±59.2 and 1809±60.6 g, respectively. Average egg weight recorded at 34 and 40 weeks of age was 41.8±1.4 and 45.2±1.05 g, respectively. In G-1 generation of Ghagus breed, body weights at 8 and 16 weeks of age were 382.2±4.07 and 956.3±18.9 g, respectively. ASM, egg production upto 40 weeks and egg weight at 40 week were 177.3±1.2 days, 29.6±1.8 eggs and 47.2±1.01 g, respectively. Average daily feed intake of this bird during 40 weeks of age was 99.6±1.95 g. Body weight at 40 weeks of age in male and female birds was 2519±44.4 and 1609±39.5 g, respectively. During G-2 generation average body weight at 8 and 16 weeks of age on pooled sex was 387±3.76 and 1165±9.82 g, respectively. Ghagus and PD-4 breeds were genotyped for LEI0258 and MCW371 microsatellite markers linked to MHC locus. Heterozygosity was higher in Ghagus for both markers as compared to PD-4 line. From the results, it was evident that higher diversity exists in Ghagus breed with respect to MHC linked markers.

Under the conservation programme, Nicobari fowl eggs collected from CARI, Port Blair were maintained. In G-0 generation, ASM was 175.7±6.30 days. Body weight and shank length at 40 weeks of age was 1480±50 g and 83.5±2.1 mm, respectively in females. Egg production upto 40 and 60 weeks of age was 64.24.5 and 146.8±6.3 eggs, respectively while egg weight at

respective age was 46.30±0.78 and 54.08±0.66 g. In G-1 generation, body weight at 16 and 20 weeks of age were 913±22 and 1238±51.4 g, respectively. Body weight of Aseel birds (originated from Bhimavaram, Patancheru and Shankarapally) during G-0 generation at 16 and 20 weeks of age was 1082 and 1363 g, respectively. ASM, body weight and shank length at 40 weeks of age were 186 days, 2203 g and 119.3 mm, respectively. In G-1 generation, body weight at 16 and 20 weeks of age was 1122 and 1611 g, respectively.

Srinidhi, a dual purpose rural cross developed at the Directorate complements the body weight gain of *Vanaraja* and egg production of *Gramapriya* with multi-coloured plumage. Male and female birds of *Srinidhi* at Ranchi attained body weight of 2869 and 2306 g, respectively at 40 weeks of age. The age at first egg ranged from 163-180 days and egg production upto 40 weeks of age was in the range of 41-56 eggs. The annual egg production ranged from102-146 eggs in field. At Gangulapally village in Andhra Pradesh, age at first egg ranged from 158-189 days while egg production upto 40 weeks of age ranged from 32-45 eggs and annual egg production ranged from 90-129 eggs. The PD-1 X PD-4 cross was distributed to the farmers in Warangal, A.P. at 6 weeks of age. Egg production up to 72 weeks of age was 148 eggs and economics of rearing PD-1 X PD-4 birds up to 72 weeks of age at a farmer's field was worked out. Egg production up to 52 weeks of age of 3-way cross was 150.2±1.85 eggs with egg weight of 60.04 ±0.47 g.

Layer populations

Four layer chicken lines (G-2 generation of IWH and IWI lines and S-10 generation of IWK line and control populations) maintained at the Institute farm were evaluated for the performance. The ASM was 146.0±0.05, 148.9±0.02, 148.0±0.02 and 155.4±0.03 days, respectively in IWH, IWI, IWK and control populations. Egg production upto 64 weeks of age increased by 7, 9 and 19 eggs in IWH, IWI and IWK lines, respectively over the last generation. Egg weight at 64 weeks of age was 55.16±0.01, 55.67±0.01, 55.53±0.01 and 55.34±0.01 g, respectively in IWH, IWI, IWK and control lines. There was marginal increase in 64 weeks egg weight in IWH and control lines in S-10 generation. Egg production upto 72 weeks of age was 282, 279, 270 and 231 eggs in IWH, IWI, IWK and control lines, respectively. The layer control population was stable for egg production upto 64 weeks of age during last 10 generations.

Broiler populations

Three coloured broiler lines i.e. synthetic coloured broiler male line (PB-1), synthetic coloured broiler female line (PB-2) and control broiler (CB) populations were maintained and evaluated. In S-23 generation of PB-1 line, ASM decreased by 2 days while body weight at 20 (192 g) and 40 weeks (70 g) of age, egg weight at 40 weeks (1.26 g) of age and egg production upto 40 weeks (2.45 eggs) of age increased marginally as compared to last generation. The production performance of S-22 generation of the PB-2 line was evaluated. The egg weight at 40 weeks of age was 64.27±0.44 g which showed improvement over the last generation (57.86 g). Egg production upto 40 and 52 weeks of age were 64.02±0.76 and 116.5±1.98 eggs, respectively. Egg weight at 52 weeks of age was 65.67±0.73 g. Body weight at 40 and 52 weeks of age were 3063±29.1 and 3286±32 g, respectively. In S-23 generation, body weight at 5 weeks of age was 713.1±2.5 g and there was an improvement of 3.5 g/generation over the last 10 generations on genetic scale. Average shank length and breast angle at 5 weeks of age were 72.97±0.07 mm and 87.4±0.08, respectively. An experiment conducted to study the effect of heat stress on 5 different genetic groups (PB-1 X naked neck, PB-1XPB-2, PB-1 pure line, PB-2 pure line, and naked neck pure line) during the months of August and September, 2013 revealed that naked neck and naked neck cross obtained higher juvenile body weights as compared to other genetic groups. The body weight of control broiler population in G-13 generation at 4, 5 and 6 weeks of age was 333, 573 and 993 g, respectively. Shank length and breast angle at 5 weeks of age were 69.16 mm and 75.67°, respectively. Feed efficiency during 0-5 weeks of age was 2.32. Two gene lines, naked neck and dwarf

maintained as resource populations. In S-11 generation, the ASM increased by 7 and 5 days in naked neck and dwarf lines, respectively over the previous generation. The egg weight at 40 weeks of age remained stable in both the gene lines. The egg production up to 40 weeks of age increased by 1 and 7 eggs in naked neck and dwarf lines, respectively.

Molecular Genetics

In IGF1 gene, 12 haplotypes and in GHR gene, 8 haplotypes were observed in control broiler and layer chicken lines. The haplogroups had significant effect on body weight at day old and 6 weeks of age and daily gain between 4 to 6 weeks of age in control broiler population. The Cytosine methylation was detected in myostatin and IGF-1 promoters. *In vivo* studies of MSTN expression and effect indicated specificity of the protein and reiterated the negative effect on growth in chicken. The whole Aseel genome was sequenced indicating presence of approximately 23,000 genes. Six mitochondrial genes viz., CO-II, CO-III, ATPase6, ATPase8, ND-3 and ND-6 were characterized in different chicken breeds of chicken. In a study on expression profiling of cytokines and chemokines, the level of expression of two genes viz., IL-1α and IL-6 in WBC were quantified with qPCR using the SYBR green assay.

Three embryos each from heat exposed and normal were sacrificed on 17th day from each genetic group (NaNa, Nana and PB-2) for studying the heat shock protein genes. All Hsp genes (Hsp-70, Hsp-27, Hsp-90a and Hsp-60) significantly up-regulated in naked neck genotypes. The body weight at 6 weeks of age was significantly ($P<0.05$) lower in heat exposed birds (37.5 ^{o}C up to 42 days of age) as compared to the normal birds. The stress parameters like protein carbonyls, total antioxidant activity and SOD were in positive direction in heat exposed group.

Nutrition, Physiology and Health

The performance of broilers reared during summer (29.25 to 37.58 ^{o}C) was significantly better in groups fed with 100 kcal ME and 10 g CP less compared to those fed the recommended concentrations of these nutrients. Abdominal fat reduced with increase in dietary CP and the fat content increased with dietary ME concentration. Interaction between nutrient density and drinking water temperature did not influence body weight gain, feed intake and feed efficiency in *Vanaraja* chickens. Similarly, the temperature of drinking water also did not influence these performance variables. Dietary variation in nutrient density failed to elicit any response in body weight gain, while feed intake in groups fed ≥ 2800 kcal ME depressed as compared to those fed the lowest level of energy in diet (2700 kcal/kg). Feed efficiency improved with each increment in dietary nutrient density and the feed efficiency in groups fed the highest nutrient density was significantly better as compared to those fed 2700 or 2800 kcal ME/kg diet. Supplementation of organic Se (0.15, 0.30 and 0.45 mg/kg) in WL layer diet progressively reduced EP, FE and EM during hot summer season. However, mortality was reduced progressively with increase in concentration of organic Se in layer diet. Supplementing the organic form of Zn, Se and Cr at 20, 0.3 and 1 or 40, 0.15 and 2 mg/kg, respectively is required to harvest the optimum performance and improved anti-oxidant status in commercial broilers. Incorporation of rape seed meal at 5% level did not affect the feed intake; however the feed intake decreased progressively with increase in level of the alternate protein source in diet from 10 to 20% in *Vanaraja* birds. Supplemental Vitamin E (α tocopherol acetate, 200 mg/kg) elicited optimum retention in meat (42 mg/kg). Higher level of Se (organic, 0.30 mg/kg) in the boiler diet not only increased its concentration at tissue level but also increased the antioxidant activity of muscle tissue and reduced the concentration of malonidialdehyde. Among the various levels of supplemental selenium (0.15, 0.30, 0.45 mg/kg), 0.30 mg/kg elicited optimum retention in meat (152 µg/kg). The concentrations of antioxidant enzymes such as glutathione peroxidase and superoxide dismutase as well as TBA concentration in serum were not affected by incorporation of n-3 fatty acid sources in the diet. It is concluded that dietary inclusion of linseed oil significantly reduced the abdominal fat deposition in broiler chickens. In another experiment, it was concluded

that dietary inclusion of linseed oil could reduce abdominal fat deposition in broiler chickens.

Studies were conducted to evaluate IPA and DMC treated Karanj cake as well as solvent extracted Karanj cake (SKC) in diet as a source of protein, partially replacing soyabean meal. SKC could be used up to 9% without any adverse effect on egg production in laying chickens during 50 to 61 weeks of age. The results indicated that SKC could be used up to 3% in the diet of broiler chicken without any adverse effect. SKC beyond 3% level in diet was detrimental for the growth performance of *Krishibro* and *Srinidhi* chickens. In another study, SKC feeding depressed performance of layers in a dose dependant manner and IPA treated SKC showed no adverse effect upto 8% in diet. There was significant improvement in the nutritional value of Karanj cake with DMC treatment, which could be safely used upto 3% in the diet of broiler chickens without any adverse effects. The age related responses to feeding of SKC viz. at 0% (0-2wks), 0, 3 or 6% (3-4 wks) and 0, 6 or 9% (5-6 wks) in *Vanaraja* chicks were evaluated. Late introduction of SKC even at higher levels of 6 or 9% could be well tolerated by *Vanaraja* chicks till 6 weeks of age. A study conducted to optimize the nutrient requirement for PD-3 layers revealed that the diet with ME of 2600 kcal/kg along with 16% CP would be optimum for harvesting the maximum production potential in PD-3 layers.

In roosters of PD-3 line supplemented with organic zinc @ 100 mg/kg diet higher metabolic activity of sperm was detected. Organic selenium supplementation improved the sperm activity and live sperm percent in PD-3 males. Further, AI using semen from the organic selenium supplemented group gave higher fertility as compared to the control group. Layer control males were found to have higher sperm concentration and MTT dye reduction activity than those of PD-3 males. The semen quality of layer control and PD-3 lines was evaluated at 46 and 47 weeks of age. The layer control birds had better semen quality than that of PD-3 line. Roosters of 37 weeks of age had higher semen volume (0.48 ± 0.06 ml) and lower sperm DNA fragmentation percentage (24.6 ± 1.89) as compared to that of 23 and 65 weeks of age.

Mortality pattern and causes of mortality were determined among pure line chicken populations. Major causes of mortality were chronic respiratory disease (CRD), heat stress, collibacillosis, Marek's disease (MD), Aspergillosis and Rickets. The season wise incidence of CRD was 17.15% in summer (March-June), 6.37% in rainy (July-October) and 9.25% in winter (November-February). Aspergillosis was recorded in Dahlem Red (DR) and Nicobari breeds. Out of total mortality, the incidence of Aspergillosis was 9.23 and 7.58% in DR and Nicobari lines, respectively. Mortality due to MD was recorded in all lines with the highest frequency in DR followed by Ghagus, PB-1, Aseel and *Vanaraja*. A total 8.1% birds belonging to 14 pure lines tested for Avian Leukosis Virus (ALV) using antigen ELISA were found positive. All the positive birds were discarded. A total of 24 ALV strains isolated and identified by sub-group specific PCR. A total of 3 isolates were ALV-A, 7 isolates were ALV-B and remaining were mixture of ALV-A, B and C. The envelop gene of 1 ALV-A isolate (DPRE32) was sequenced and compared with reference strains. Multiple sequence alignment and phylogenetic analysis revealed that the isolate was closely related to ALV-A reference stain. TVB receptor status of Aseel (from field) and Red Jungle Fowl (RJF) were analyzed by PCR-RFLP. In Aseel, two alleles (S1 (0.57) and S3 (0.43) and 3 genotypes [(S1/S1 (0.31), S1/S3 (0.51) and S3/S3 (0.17)] were found while in Red Jungle fowl only 1 allele (S1) and 1 genotype (S1/S1) was found. It was inferred that the Red Jungle Fowl was susceptible to ALV subgroups B, D and E. In Aseel, genotypes S1/S1 and S1/S3 were susceptible to ALV subgroups B, D and E, while genotype S3/S3 was susceptible to ALV-B and ALV-D and resistant to ALV-E.

AICRP on Poultry Breeding

The AICRP on Poultry Breeding has three components, namely, Poultry for Egg, Poultry for Meat and Rural Poultry.

Poultry for Eggs

Layer lines maintained at different Institutes included IWN and IWP strains at KVASU, Mannuthy and AAU, Anand and IWD and IWF strains at SVVU, Hyderabad. The KVASU, Mannuthy centre has evaluated the S-27 generation of IWN and IWP populations upto 64 weeks of age. Hen housed and hen day egg production upto 64 weeks of age increased by 13.4 and 11.4 eggs, respectively over previous generation in IWN strain. In IWP, hen housed egg production upto 64 weeks of age increased by 1.0 eggs over previous generation. Hen housed egg production upto 72 weeks of age was 311.7 and 299.8 eggs in IWN and IWP strains, respectively while hen day egg production in corresponding strains were 313.7 and 302.3 eggs. The average genetic response for egg production to 64 weeks of age in IWN (3.14 eggs) was higher than IWP (1.56 eggs) strain during last 10 generations. The centre supplied 22,477 germplasm during the year. The S-11 generation of IWN and IWP strains were evaluated up to 64 weeks of age at AAU, Anand. Egg production up to 64 weeks of age increased by 9.64 eggs in IWN, by 11.05 eggs in IWP and by 21.52 eggs in control over previous generation. Egg production upto 72 weeks of age was 301.8 and 300.3 eggs in IWN and IWP, respectively. Egg weight at 64 weeks of age increased in both selected populations as compared to previous generation. The genetic response of egg production up to 64 weeks of age in both selected strains (1.08 in IWN and 1.93 in IWP) was positive over last 11 generations. Egg production of IWN X IWP and DK X NP upto 72 weeks of age was 301.3 and 275.7 eggs, respectively. Egg production of IWD and IWK upto 64 weeks of age was 243 and 217.7 eggs, respectively. The centre generated Rs.33.28 lakhs of revenue which was 103.94% of the expenditure on feed cost. The S-30 generations of IWD and S-29 generation of IWF were evaluated upto 64 weeks of age at SVVU, Hyderabad. Egg production upto 64 weeks of age in IWD and IWF were 228 and 231 eggs, respectively. Corresponding egg production upto 72 weeks of age were 276 and 280 eggs. Egg weights at 64 weeks of age in IWD and IWF were 56.0 and 54.3 g, respectively. The genetic response for egg production upto 64 weeks of age for last 12 generations were 0.77 egg in IWD and 0.30 egg in IWF, respectively. The centre supplied 5,100 chicken germplasm during the year.

Poultry for Meat

Broiler lines maintained at different Institutes included a synthetic sire (PB-1) and dam line (PB-2) at GADVASU, Ludhiana and KVAFSU, Bengaluru; CSML (sire line) and CSFL (dam line) and corresponding control at CARI, Izatnagar and CSFL and CSML at OUAT, Bhubaneswar. The Bengaluru centre evaluated production traits of S-18 generation and also evaluated juvenile traits of S-19 generation of PB-2 line. In addition to this, production traits of S-5 generation and juvenile traits of S-6 generation of PB-1 were evaluated along with the DPR control population. The average body weight at 5 weeks of age was 1,116 and 1,196 g in PB-2 and PB-1 lines, respectively. The average genetic and phenotypic response for 5 weeks body weight in PB-2 was 30.6 and 32.1 g, respectively over last 5 generations. Egg production upto 40 weeks of age increased over previous generation in PB-1 line. The centre earned revenue of Rs. 37.02 lakhs as receipt. Ludhiana centre regenerated S-38 generation of PB-2 and S-6 generation of PB-1 line along with DPR control population. Body weight at 5 weeks of age was 1,065, 1,068 and 604 g in PB-2, PB-1 and control populations, respectively. Over the last six generations, 5 weeks body weight in PB-2 improved by 15.1 and 61.4 g per generation on phenotypic and genetic scales, respectively. Feed efficiency upto 5 weeks of age improved in all the three populations. Commercial cross in the field attained body weight of 1,040 and 1,510 g at 5 and 7 weeks of age, respectively. The centre generated revenue of Rs. 20.47 lakhs which was 61.18% of the expenditure on feed cost. CARI, Izatnagar centre evaluated CSML and CSFL and Control Population. Body weight at 5 weeks of age improved in both selected populations. FCR was 2.0, 2.04 and 2.21 in CSML, CSFL and control population, respectively. ASM increased marginally in all populations. Egg production upto 52 weeks increased by 2.3 eggs in CSFL as compared to previous generation. Egg

production upto 40 weeks of age increased in CSML and CSFL. The genetic response was 13.3 g in CSML and 16.8 g per generation in CSFL for 5 weeks body weight over last 5 generations. The corresponding phenotypic responses were 19.8 and 19.2 g per generation. Bhubaneswar centre evaluated S-1 generation of CSFL and CSML for production traits and S-2 generation of CSFL and CSML were evaluated for juvenile traits. Body weight at 5 weeks of age was 784 g in CSFL, 740 g in CSML and 730 g in control population. Egg production percentage upto 52 weeks was 54.71 and 48.24% in CSFL and CSML lines, respectively. The centre generated revenue of Rs 8.67 lakhs which was 55.8% of the expenditure on feed cost. Bengaluru and Izatnagar centres participated in the 40th random sample poultry performance test at Gurgaon. The strain cross from Bengaluru centre recorded body weight of 1,532 and 1,988 g, respectively at 6 and 7 weeks of age with corresponding FCR of 2.22 and 2.40. The dressing percentage was 71.43%. CARIBRO-Dhanraja of Izatnagar centre attained body weight of 1,592 and 1,936 g, respectively at 6 and 7 weeks of age. FCR at 0-6 and 0-7 weeks were 2.14 and 2.37 with dressing percentage of 69.07.

Rural Poultry

A total of 6 centres, ICAR Research Complex for NEH region, Agartala; NDVSU, Jabalpur; AAU, Guwahati; BAU, Ranchi; CSKHPKV, Palampur and MPUAT, Udaipur were involved in rural poultry production under AICRP on Poultry Breeding. During the current year, Agartala centre evaluated Tripura black, Dahlem Red and CSFL populations along with ND (Tripura black x DR cross) cross. The age at first egg was 151 days in Dahlem Red and 172 days in Tripura Black. Egg production upto 40 weeks of age was 44 and 39 eggs in Dahlem Red and Tripura Black, respectively. In ND cross, age at first egg was 163 days, egg production upto 40 weeks of age was 59 eggs. The centre supplied 21,285 chicks of Tripura black, *Gramapriya* and other crosses. The Jabalpur centre reproduced G-5 generation of Kadaknath (Kd) and Jabalpur colour populations. In Kadaknath, body weight at 6 and 20 weeks of age was 298 and 1140 g, respectively. The pullets matured 4 days early as compared to previous generation. The Kd X JBC cross produced 139 eggs upto 72 weeks of age under extensive management system. A promising dual purpose chicken variety having 25% Kd:75% JBC inheritance produced 186 eggs under extensive system of rearing. This centre supplied 843 chicks and growers together and 8720 fertile eggs. Guwahati centre evaluated the native, Dahlem Red and PB-2 populations. The centre also evaluated BN (PB-2 X Native) and BND (PB-2 x Native male x Dahlem Red female) cross in farm and field conditions. A total of 2,959 hatching eggs and 7,792 day old chicks of three way cross and *Vanaraja* were supplied to the rural farmers of Assam, Meghalaya and Arunachal Pradesh. Ranchi centre evaluated G-2 generation of native population upto 72 weeks of age and G-3 generation was evaluated upto 20 weeks of age. The BN, BND and DBN (Dahlem Red males with PB-2 x Desi female) crosses were evaluated under farm and field conditions. Centre supplied 10,921 hatching eggs and 4,327 chicks to farmers. Palampur centre evaluated Native (G-2) and Dahlem Red birds upto 52 weeks of age. The ND (Native X Dahlem Red) X D (Dahlem Red) cross was evaluated upto 52 weeks of age both in farm and field conditions. The DR X Native cross was evaluated upto 20 weeks in the farm. The centre supplied 5,330 chicks of different crosses to the farmers. MPUAT, Udaipur evaluated G-3 generation of Native germplasm upto 40 weeks of age and G-4 generation was regenerated. Centre procured RIR and coloured synthetic male line and their evaluation is under progress. A total of 875 hatching eggs, 3,329 grower and 37,614 day old chicks of Pratapdhan and 547 day old chicks of Native population were supplied during the current year.

Poultry Seed Project

The Poultry Seed Project was evolved with a sole aim to increase the availability of rural chicken germplasm in remote areas of the country. Three mainland centres are Bihar Agricultural University, Patna; West Bengal University of Animal and Fishery Sciences, Kolkata; Chhattisgarh Kamdhenu Viswa Vidyalaya, Durg and

three north-eastern centres are Nagaland, Manipur and Sikkim regional centres of ICAR Research complex for NEH region. Patna centre completed three cycles of parent rearing of *Vanaraja* and *Gramapriya*. The centre distributed 45,706 improved germplasm to the rural farmers during the period. Kolkata centre completed the 3 batches of *Vanaraja* and *Gramapriya* rearing. A total of 64,251 chicks of *Vanaraja* and *Gramapriya* were supplied to various parts of West Bengal and adjoining North Eastern states. In Durg centre, two batches (*Vanaraja* and *Gramapriya*) of day old chicks were procured from DPR during the year. The average body weight at 19 weeks of age was 1,956 and 1,163 g in female parents of *Vanaraja* and *Gramapriya*, respectively. Jharnapani centre has two batches of parents in position presently at 21 and 59 weeks of age. A total of 55,912 birds were distributed to the farmers of Nagaland, Assam, Meghalaya and Arunachal Pradesh. At Gangtok centre, one batch of *Vanaraja* parents was procured and reared. A total of 2,615 birds were distributed to farmers across Sikkim through self help groups. At Imphal centre, two batches of parents were reared. A total of 38,638 *Vanaraja* birds were distributed to the farmers in Manipur.

Technology Transferred

During this year, the directorate has participated in several exhibitions and Kisan melas and propagated the varieties and technologies developed by the Institute. Training was imparted to farmers and other beneficiaries at the Directorate. *Vanaraja* and *Gramapriya*, the two rural chicken varieties developed by this Directorate reached majority of states in the country. About 65,154 hatching eggs were supplied to different organizations and NGOs. A total of 2,13,791 day old chicks of *Vanaraja*, *Gramapriya* and *Krishibro* were supplied to the farmers across the country during the period. The Directorate has supplied 47,030 day old parent chicks of *Gramapriya*, *Vanaraja* and *Krishibro*.

Awards and Recognitions

The scientists of this institute have bagged several awards from different Organizations/ Associations/Societies. Dr. T. K. Bhattacharya, National Fellow and Dr. R. N. Chatterjee, Director received Hari Om Ashram Trust Award conferred by Indian Council of Agricultural Research, New Delhi. Dr. S. V. Rama Rao, Principal Scientist was awarded CLFMA Appreciation Award for the year 2013 and 'Best Poultry Scientist' Award for the year 2014 from C. K. Rao Endowment Trust, Hyderabad. Dr. R. N. Chatterjee, Director has been conferred with NAVS fellowship, NAVS, New Delhi. Dr. T. R. Kannaki, Scientist was awarded with the Avitech Young Scientist award for best research paper by IPSA 2013.

Other Activities

The Directorate has taken up different activities like organising stakeholders meeting, conducting short courses, training and scientist industry interface meeting which have benefitted the poultry farmers. Sensitizing workshop for AICRP on Poultry Breeding and Poultry Seed Project was organized at the Directorate. Library Workshop on Open Sources eResources was also conducted. The Research Advisory Committee, Institute Research Committee and Institute Management Committee constantly monitored and suggested improvement in research, administration and financial management. Newly constructed Silver Jubilee block was inaugurated by the Honourable Director General, ICAR. The budget utilized during the period was Rs. 383.08 lakhs (Plan) and Rs. 771.44 lakhs (Non-Plan) at the Directorate and Rs. 469.74 lakhs and Rs. 156.27 lakhs were utilized by the AICRP and Seed Project, respectively under plan expenditure. The Directorate generated revenue of Rs. 139.75 lakhs during the financial year, mainly by supplying Germplasm and sale of poultry produce.

1. Introduction

1.1 History

The Directorate of Poultry Research is one among the premier institutions in the field of Poultry Science research and extension in the country. This institute was established on 1st March 1988 at Hyderabad, Andhra Pradesh under the flagship of Indian Council of Agricultural Research. The Institute has its origin from All India Coordinated Research Project (AICRP) on Poultry Breeding, an all India Net Work project launched by the Indian Council of Agricultural Research during IV five year plan with the objective of augmenting commercial poultry production and achieving self-sufficiency in the country. Initially, the coordinating unit of AICRP was located at the Poultry Research Division, Indian Veterinary Research Institute, Izatnagar till 1979, which monitored the activities of the AICRP centres located in different State Agricultural Universities (SAUs) and ICAR Institutes. Later on, it functioned from Central Avian Research Institute, Izatnagar till its elevation to the Directorate status in 1988. Apart from this, the activities of the Directorate were expanded by introducing new research programmes in Poultry Nutrition, Housing & Management under separate network programmes in selected SAUs, where the breeding units were already in existence. The research works in these areas continued till March 1993 after which the Nutrition along with Housing and Management activities was discontinued but, the research on breeding aspects continued. Consequently, the Directorate was entrusted the task of developing germplasm suitable for rural poultry production; maintenance and improvement of elite broiler and layer pure lines; maintenance of random bred control populations; and two gene lines (naked neck and dwarf) for augmenting productivity under tropical climate. The institute was elevated from the position of Project Directorate to Directorate on 18th September 2013.

The research focus at the Institute has been put forth towards the application of quantitative genetic principles to enhance productivity of various chicken germplasm. To support the core research programme research on nutrition, health, physiology and molecular genetics has been made an integral component. Additionally, several externally funded projects were also carried out at the Directorate to achieve the Institute's primary goals and objectives. Keeping in view the present needs of poultry farming in the country and to meet the challenges ahead, the Directorate has formulated a Perspective Plan, 'Vision 2050', in which thrust areas of the research programmes were identified.

AICRP centres made sustained efforts resulting in the release of seven promising varieties of chicken for commercial exploitation and utilization for the benefit of the farmers. The potential of these varieties has been regularly evaluated in Random Sample Poultry Performance Tests and found them suitable for intensive farming. Scientists at AICRP centres are continuously involved in developing new crosses incorporating various germplasm including indigenous stocks through two/more breed crosses. Till date, the most promising layer varieties released from AICRP centres are ILI-80 at CARI, Izatnagar; ILM-90 at KVASU, Mannuthy and ILR-90 at SVVU, Hyderabad, while the broiler varieties developed are B-77 and IBI-91 at CARI, Izatnagar; IBL-80 at GADVASU, Ludhiana and IBB-83 at KVAFSU, Bangalore. Further, a new dual purpose variety, *Pratpdhan* has been released by AICRP centre, MPUAT, Udaipur. The rural poultry component of AICRP programme has been strengthened with introduction of four new centres, besides the existing two centres for development of location specific crosses for rearing under backyard/extensive systems. During XI plan the activities of the Directorate further expanded by introduction of a new net work project, the Poultry Seed Project with six centres located in different states to increase the availability of rural chicken germplasm for rearing in remote areas of the nation. The Directorate is coordinating the activities of the Seed Project centres for rearing parent stock of improved rural poultry germplasm and supplying hatching eggs, day-old or grown-up chicks to meet the demand in rural and tribal areas.

At this Directorate, through research two promising chicken crosses for rural poultry farming were evolved i.e., *Vanaraja*, a dual-purpose bird and *Gramapriya*, predominantly a layer, meant for free-range and backyard farming. These two chicken crosses have become extremely popular and are being reared in every part of the country. Several user agencies in the country are involved in dissemination of the varieties covering the southern, northern, eastern and northeastern states including Jammu and Kashmir, Lakshadweep, and Andaman and Nicobar Islands. The Directorate also developed two crosses viz. *Krishibro*, a multicolored broiler and *Krishilayer*, a high yielding egg producing bird for commercial purposes. Besides these varieties, a new dual purpose variety, *Srinidhi* has been released and is being popularized in the country. Further research in this direction is underway for developing new crosses that could be of tailor-made for better adaptability under diversified regions in rural and tribal backyard conditions.

India is recognized as a rising power in the world in every sphere right from the economy to education, science and technology to infrastructure and health care to food security. India is basically an agriculture dependent country where more than 70% population lives on agriculture for their livelihood. In this context the rural backyard poultry has become one of the avenues for the landless or marginal farmers to earn their livelihood and balanced food. Thus to meet the needs of rural farmers the Directorate has taken a lead in this direction by adopting a holistic approach to develop high performing, better adaptable and disease resistant germplasm suitable for backyard farming with low input system.

Active research is being carried out to prepare package of practices for providing optimum nutrition, management and health coverage to the pure lines as well as crosses developed by the Directorate for intensive and backyard systems of rearing. Research in nutrition at this directorate resulted in development of few important technologies that have been adopted by the commercial and rural farmers to reduce cost of production. Besides nutritional knowhow, the directorate is also familiar among poultry farming community for its services in disease diagnosis, sero-monitoring and health care. The nutritional and health care solutions are being offered to all the stake holders of poultry farming including network programmes and contract research programmes being operated by the Directorate. The studies on advanced molecular genetic tools like SNP typing, microsatellite analysis, DNA marker based selection etc. have also been undertaken in evaluating and augmenting the productivity of various chicken germplasm maintained at this Directorate and at AICRP centres. To measure population dynamics of various chicken lines used in the AICRP programme molecular characterization has been initiated at this Directorate. The Directorate thus is actively engaged in augmenting the productivity of chicken by undertaking research in different aspects of Poultry Science to cater the needs of the country.

1.2 Mandate

The Directorate has been striving hard to realize its ***vision*** of "enhancing productivity of chicken for household nutritional security, income and employment generation" and the ***mission*** of "developing and propagating improved varieties of chicken for sustainable production under intensive and extensive systems". To achieve the goals, the following mandate of this Directorate has been implemented precisely.

- 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 to meet the needs of rural/tribal and other under-privileged sections of the society

1.3 Organogram

The Directorate is functioning with different wings and sections with required infrastructure and well devised functionalities. Different committees/disciplines formulated and approved by the council are guiding the Directorate for efficient and quick functioning of the Institute with greater transparency.

1.4 Financial outlay

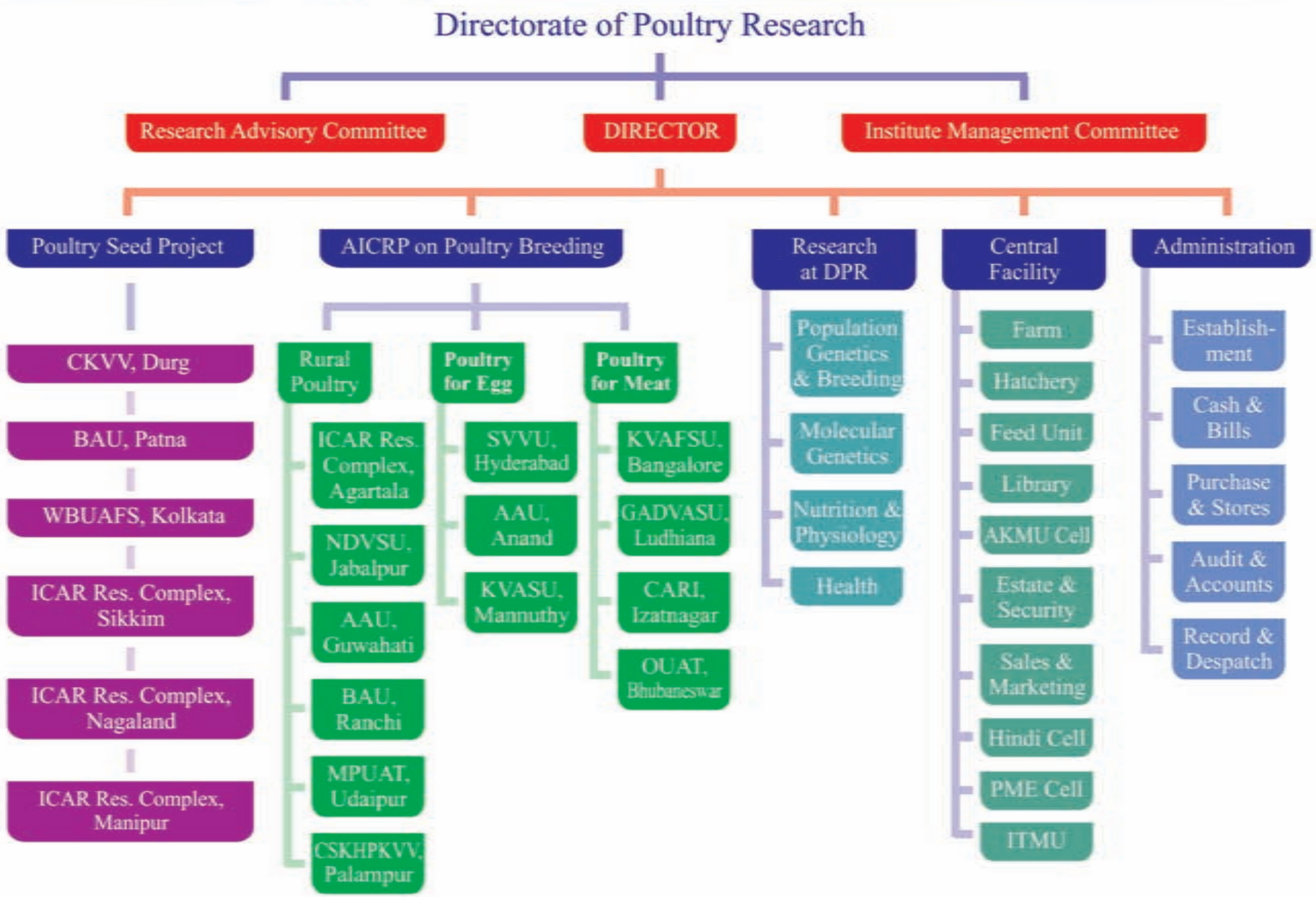
(Rs. lakhs)

Component	Plan		Non-Plan		Receipts
	Budget	Expenditure	Budget	Expenditure	
DPR	384.00	383.08	777.00	771.44	139.75
AICRP	538.13	538.13	—	—	—
Seed Project	173.00	173.00	—	—	—

1.5 Staff position

Cadre	Sanctioned	Cadre in position as on March 31, 2014
RMP	01	01
Scientists	15	14
Technical	16	14
Administrative	14	11
Skilled support	15	14
TOTAL	**61**	**54**

Organogram


Directorate of Poultry Research
Research Advisory Committee
DIRECTOR
Institute Management Committee
Poultry Seed Project
CKVV, Durg
BAU, Patna
WBUAFS, Kolkata
ICAR Res. Complex, Sikkim
ICAR Res. Complex, Nagaland
ICAR Res. Complex, Manipur
AICRP on Poultry Breeding
Rural Poultry
ICAR Res. Complex, Agartala
NDVSU, Jabalpur
AAU, Guwahati
BAU, Ranchi
MPUAT, Udaipur
CSKHPKVV, Palampur
Poultry for Egg
SVVU, Hyderabad
AAU, Anand
KVASU, Mannuthy
Poultry for Meat
KVAFSU, Bangalore
GADVASU, Ludhiana
CARI, Izatnagar
OUAT, Bhubaneswar
Research at DPR
Population Genetics & Breeding
Molecular Genetics
Nutrition & Physiology
Health
Central Facility
Farm
Hatchery
Feed Unit
Library
AKMU Cell
Estate & Security
Sales & Marketing
Hindi Cell
PME Cell
ITMU
Administration
Establish-ment
Cash & Bills
Purchase & Stores
Audit & Accounts
Record & Despatch

2. Research Achivements

2.1 Poultry Genetics and Breeding

2.1.1 Development of germplasm for backyard/free range farming for rural and tribal areas.

2.1.1.1 Evaluation of PD-1 line

The PD-1 line is used as male parent for production of *Vanaraja* commercial, a dual purpose bird for backyard poultry farming. The birds of S-7 generation were evaluated for different production traits and are presented in Table 1.

Table 1 Growth and production traits and heritability estimates in PD-1 line (S-7 generation)

Traits	Mean±SE (N=335)	$h^2_{(S+D)}$
Body wt. (g)		
20 wks	1925±0.54	0.19±0.18
40 wks	2671±14.42	-
At sexual maturity	2570±0.70	0.02±0.17
ASM (d)	203.7±0.06	0.25±0.18
Egg wt. at 40 wks (g)	54.72±0.01	0.40±0.22
Shank length at 40 wks (mm)	107.5±0.23	-
Egg number to 40 wks	38.17±0.04	0.13±0.18
Egg number to 52 wks	73.85±1.20	-

Average egg production of this line was 73.85±1.20 eggs up to 52 weeks of age. Average egg weight of first egg and egg weight at 28, 32 and 36 weeks of age were 49.93±0.02, 46.50±0.38, 50.67±0.29 and 54.49±0.01 g respectively. Egg quality traits were measured at 40 weeks of age. Shape index was 76.62±0.54 whereas Haugh unit was 84.85±1.16. Shell thickness was 0.33±0.006 mm. The albumen, yolk and shell percentage were 62.05±0.69, 30.12±0.65 and 7.83±0.15%, respectively. Survivability of birds during 20 to 40 weeks of age was 91.44%. In S-8 generation, a total of 2,744 good chicks of PD-1 line were produced using 50 sires and 250 dams. Along with this line, control broiler and *Vanaraja* commercial were also generated. Fertility of PD-1 line was 89.52% while hatchability on total and fertile egg set basis were 78.02 and 87.16% respectively. Fertility and hatchability on total and fertile egg set basis in control broiler were 82.07, 79.72 and 97.13% respectively. Least square means and heritability estimates of juvenile traits during S-8 generation are presented in Table 2.

Table 2 Least square estimates of juvenile traits and heritability of PD-1 (S-7 generation)

Traits	Mean±S.E. (N=2488)	h^2_S	h^2_D	h^2_{S+D}
Body wt. (g)				
0 day	37.30±0.01	0.18±0.13	---	---
2 wks	121.7±0.08	0.18±0.07	0.34±0.71	0.26±0.05
4 wks	307.9±0.22	0.26±0.08	0.20±0.06	0.23±0.05
6 wks	655.4±0.41	0.18±0.06	0.24±0.06	0.21±0.04
Shank length (mm)				
6 wks	76.31±0.02	0.08±0.04	0.16±0.06	0.12±0.05

Average phenotypic and genetic response per generation during last five generations for 6 weeks shank length was 2.21 and 3.02 mm, respectively (Fig. 1). Shank length reached the maximum length at 14 weeks of age and thereafter, no significant increase in the length was observed. During growing period (7 to 20 weeks), survivability was 92.12%.

Antibody titre to sheep red blood cells (SRBC) in PD-1, control broiler and *Vanaraja* commercial and Nicobari fowl was studied in a sample of 30 birds each (15 male and 15 female) at 8 weeks of age. There were no significant differences in SRBC titre among four genetic groups.

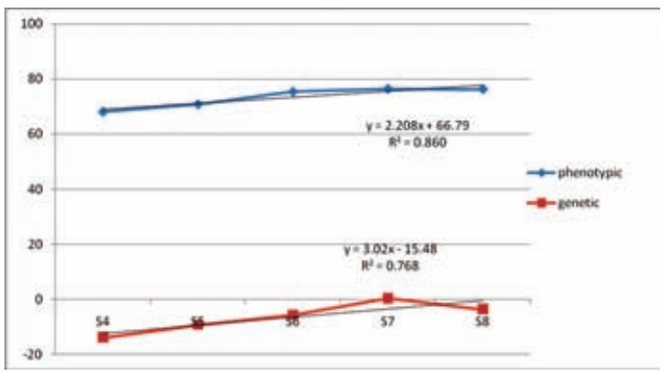


Fig. 1 Phenotypic and genetic response for shank length at 6 weeks of age in PD-1 line

2.1.1.2 Improvement of PD-2 line

PD-2 line is used as female line for production of *Vanaraja* chicks. The selection criterion in this line is egg number to 52 weeks of age. During S-11 generation, production traits were evaluated from 40-52 weeks of age. The body weight and egg weight at 52 weeks were 2914 and 53.86 g, respectively. The egg number to 52 weeks of age showed an improvement of 1.0 egg as compared to previous generation on phenotypic scale (Table 3). A total of 2032 chicks produced in S-12 generation using 59 sires and 177 dams. The fertility was 84.3% and hatchability on fertile and total egg set was 83.9 and 70.8% respectively. Among juvenile traits, the body weight at day old, 2, 4 and 6 weeks of age were

A pair of PD-2 birds

A pair of PD-1 birds

Table 3 Production traits up to 52 weeks in PD-2 line (S-11 generation)

Traits	Mean±S.E.	h^2_S	h^2_D	h^2_{S+D}
Body wt. at 52 wks (g)	2916±0.49	0.39±0.19	0.29±0.20	0.30±0.13
Egg wt. at 52 wks (g)	53.86±0.05	0.33±0.18	0.38±0.15	0.31±0.20
Egg number to 52 wks	116.06±0.06	0.29±0.15	0.21±0.14	0.20±0.09

38.0±0.04, 113.1±0.01, 248.7±0.06 and 487.6±0.09 g, respectively. The shank length at 6 weeks of age was 66.24±0.69 mm. As this line is being selected for higher egg number to 52 weeks of age, the juvenile body weight showed declining trend over generations.

2.1.1.3 Improvement of PD-3 line

PD-3 line is being used as a female line for production of *Gramapriya* chicks. The criterion of selection in this line is part period egg mass to 40 weeks of age. G-3 generation of this line was produced with 2357 chicks using 50 sires and 200 dams. The fertility in this line was 73.23% and hatchability on fertile and total eggs set was 87.75% and 63.17% respectively. Body weights at 0 day, 2, 4 and 6 weeks of age were 35.8, 74.3, 142.1 and 245.8 g, respectively. Shank length at 6 weeks of age was 52.1 mm. The production performance of the birds was presented in Table 4. The egg mass up to 40 weeks of age was improved by 37.75 g as compared to previous generation. The heritability for egg mass was higher from sire component than dam component indicating the scope for improvement. The genetic response for part period egg mass to 40 weeks of age was 81.0 g over last three generations.

A pair of PD-3 birds

Table 4 Production traits of selected and control populations of PD-3 line (G-3 generation)

Traits		Selected	Control	h^2_S	h^2_D	h^2_{S+D}
ASM (d)		165.9 ± 0.04	172.9±0.06	0.30±0.13	-0.15±0.07	0.07±0.08
Body wt. (g)						
	20 wks	1339±0.53	1336±0.73	0.21±0.17	0.20±0.19	0.21±0.13
	40 wks	1698±0.46	1598±0.74	0.21±0.17	0.20±0.19	0.61±0.13
Egg wt. (g)						
	28 wks	49.64±0.02	47.35±0.01	0.18±0.26	>1	0.23±0.12
	32 wks	50.23±0.01	50.12±0.01	0.35±0.20	0.27±0.12	0.21±0.16
	40 wks	54.49±0.05	52.30±0.02	0.29±0.12	0.32±0.19	0.31±0.20
Egg number						
	40 wks	72.73±0.04	69.56±0.05	0.18±0.12	0.16±0.07	0.14±0.07
Egg mass (g)						
	40 wks	3961±3.89 (3923±3.16)	3532±4.35	0.22±0.09	0.18±0.10	0.16±0.09

Table 5 Least square means and heritability estimates of juvenile traits of GML (SL-3 generation)

Traits	Mean±S.E.	h^2_S	h^2_D	h^2_{S+D}
Body wt. (g)				
4 wks	285±0.02	0.22 ±0.07	0.30 ±0.06	0.25 ±0.05
6 wks	577±0.04	0.23 ±0.07	0.28 ±0.06	0.26 ±0.04
Shank length (mm)				
6 wks	71.2±0.002	0.20 ±0.06	0.20 ±0.05	0.21 ±0.05
Breast angle (•)				
6 wks	96.5±0.002	0.15 ±0.05	0.19±0.04	0.17 ±0.04

2.1.1.4 Development of male line (GML) for production of egg type rural poultry

The SL-3 generation of Gramapriya male line (GML) with shank length as selection criterion was evaluated for growth and production performance. The shank length at 6 weeks of age improved by 1.55 mm over the previous generation. The heritability estimates of all juvenile traits were moderate indicating the scope for the improvement (Table 5).

The egg production up to 30 and 40 weeks of age was 31.3 ±0.06 and 82.5±0.05 eggs, respectively. Average egg number to 40 weeks of age increased marginally by 1 egg as compared to the previous generation. Heritability estimates for production traits were low to high (0.04 to 0 .51) from sire & dam components variance (Table 6). The SL-4 generation was reproduced with 50 sires and 250 dams. A total of 3014 chicks were produced with fertility of 89.56%. The hatchability on fertile and total egg set was 88.02 and 78.83% respectively.

A pair of Gramapriya Male Line birds

Table 6 Least square means and heritability estimates of growth and production traits of GML (SL-3 generation)

Traits	Mean±S.E.	h^2_S	h^2_D	h^2_{S+D}
ASM (d)	159.8±0.03	--	0.05 ±0.23	0.51±0.23
Body wt. (g)				
20 wks	1896±0.39	0.32±0.21	0.15±0.21	0.24±0.15
30 wks	2400±0.54	0.11±0.19	0.43±0.25	0.27±0.16
40 wks	2603±0.73	0.06±0.18	0.45±0.25	0.25±0.16
Egg wt. (g)				
28 wks	46.74±0.01	--	0.17 ±0.23	0.04±0.16
30 wks	48.92± 0.01	0.37 ±0.21	0.02±0.19	0.19±0.16
32 wks	50.56±0.01	0.35±0.20	0.03±0.20	0.19±0.17
36 wks	52.93 ±0.01	0.21±0.19	0.21±0.22	0.21±0.17
40 wks	54.93 ±0.01	0.62±0.28	0.32±0.21	0.47±0.20
Egg number				
40 wks	82.49±0.05	0.04±0.16	0.22±0.23	0.13±0.15

2.1.1.5 Development of control population for rural lines

A random bred control population was evolved for comparing the performance of rural lines. During G-2 generation, body weights at 4 and 6 weeks were 243.8 and 491.4 g respectively. The shank length and breast angle at 6 weeks of age were 69.20 mm and 93.65° respectively in this population. The ASM was 163.4 days. The body weights at 20, 30 and 40 weeks of age were 1800, 2390 and 2634 g respectively while the egg number up to 40 weeks of age was 78.50 eggs. During G-3 generation, fertility was 84.84% and hatchability on fertile and total egg set was 84.95 and 72.07% respectively.

2.1.1.6 Maintenance and evaluation of native chicken germplasm

a. Evaluation of PD-4 line

PD-4 line evolved from Aseel breed was evaluated for growth and production traits in S-4 generation. The least square means and heritability estimates of various growth and production traits are presented in Tables 7 and 8. Heritability estimates of growth traits in S-4 generation were high on sire component of variance indicting the presence of additive genetic variance in the population. Average body weight and shank length of male birds at 20 and 40 weeks of age were 2155±18.2 and 2819±22.6 g, and 128.9±0.4 and 129.5±0.4 mm, respectively. Average egg weights recorded at 28, 32 and 40 weeks of age were 41.64±0.28, 43.27±0.29 and 48.09± 0.30 g, respectively. In this generation, age at sexual maturity increased by 12.9 days as compared to previous generation (S-3) due to environmental factors. S-5 generation of PD-4 line was produced using 50 sires and 150 dams. A total of 913 chicks were hatched with average fertility of 80.70% and hatchability of 70.67 and 57.03% on fertile and total eggs set respectively.

Table 7 Least square means and heritability estimates of growth traits in PD-4 line (S-4 generation)

Traits	N	Mean±S.E.	h^2_s
Body wt. (g)			
0 day	713	30.32±0.13	-
8 wks	617	428.4±0.20	0.57±0.20
16 wks	549	1071±0.34	0.42±0.19
Shank length (mm)			
8 wks	617	71.4±0.01	0.43±0.17
16 wks	549	106.1±0.02	0.24±0.15

Table 8 Least square means and heritability estimates of growth and production traits in PD-4 line (S-4 generation)

Traits	Mean±SE (N=224)	$h^2_{(S+D)}$
Body wt. (g)		
24 wks	1527±0.69	0.55±0.12
40 wks	1821±0.81	0.15±0.33
Shank length (mm)		
24 wks	103.5±0.02	0.37±0.12
40 wks	105±0.002	0.57±0.32
ASM (d)	175.2±0.11	0.37±0.29
Egg number		
40 wks	51.2±0.096	0.32±0.28

Field evaluation of improved Aseel (PD-4) variety under free range system of rearing

A total of 150 chicks of improved Aseel variety weighing about 700 g at 10 weeks of age was distributed to 28 farmers of KVK adopted village, Timmareddyguda, Shabad mandal of Ranga Reddy district. Birds were reared under low input free range system. In lean period (July-August), birds were offered left over kitchen waste and they survived mostly on scavenging in the village. During harvesting season (December-January), farmers provided paddy, rice and jowar as supplementary feeding to birds besides scavenging. Data on growth and production performance was gathered by frequent visits. Average body weight and shank length recorded at 20 weeks of age were 1100±27.3 g and 107±1.21 mm

A pair of PD-4 birds

respectively on pooled sex basis. At 29 weeks of age, average body weight recorded was 1798±83.8 and 1448 ±64.5 g in male and female birds, respectively. Birds started laying eggs at 199 days of age. Body weight and shank length recorded at 34 weeks of age were 1722 ± 61.8 g and 102±0.74 mm in female birds while those in male birds were 2037±68.9 g and 122±1.38 mm, respectively. At 40 weeks of age, average body weight of male and female birds was 2334±59.2 and 1809±60.6 g, respectively. Average egg weight recorded at 34 and 40 weeks of age was 41.8±1.4 and 45.2±1.05 g, respectively. No incidence of disease was reported by the farmers but predation by the wild cat was noticed in bushy areas of village. Improved Aseel variety seems to be the promising native chicken for low input free range system of rearing for enhancing meat and egg production in rural and tribal areas.

b. Evaluation of Ghagus-ecotype

The G-1 generation of Ghagus generated by random mating was evaluated for growth and production traits. Body weights at 0 day, 8 and 16 weeks of age were 29.59±0.13, 382.2±4.07 and 956.3 ± 18.9 g, respectively. Shank length at 8 and 16 weeks of age were 68.1±0.30 and 98.6±0.70 mm respectively. Body weight at 24 weeks of age was 1471±27.1 and 2019±33.02 g in female and male birds respectively. Average shank length at 24 weeks of age was 99.4±0.67 and 124.5±0.80 mm in female and male birds respectively. The age at sexual maturity was 177.3±1.2 days. Egg number to 40 weeks of age was 29.6±1.8 eggs. Egg weight at 28, 32 and 40 weeks of age was 40.1±0.58, 41.1±0.58 and 47.2±1.01 g respectively. Average daily feed intake during 20, 25, 30, 35 and 40 weeks of age was 99.0±3.69, 106.4±2.03, 110.2±2.22, 91.7±2.11 and 99.6±1.95 g, respectively with a total feed intake of 14210 g per bird during 21-40 weeks of age. Body weight at 40 weeks of age in male and female birds was 2519±44.4 and 1609±39.5 g, respectively. Shank length at 40 weeks of age in male and female birds was 128.6±0.78 and 100.4±0.63mm, respectively.

During G-2 generation a total of 1,073 good chicks were produced. Fertility was 90.82% and hatchability on fertile and total egg set basis was 89.65 and 81.41% respectively. Average body weights at 0 day, 4, 8 and 16 weeks of age on pooled sex were 28.3±0.10, 152±1.34, 387±3.76 and 1165±9.82 g respectively. Body weight of male and female birds at 16 weeks of age was 1350±13.3 and 1044±8.34 g respectively. Shank length at 8 and 16 weeks of age on pooled sex was 66.3±0.28 and 103.4±0.42 mm, respectively. Shank length of male and female birds at 16 weeks of age was 112.6±0.31 and 97.5±0.50 mm respectively. Average daily feed intake during 4, 5, 6, 7, and 8 weeks of age was 21.9, 24.9, 25.4, 25.6 and 26.7 g per bird per day with a total feed intake of 871 g per bird during 4 to 8 weeks of age. Egg quality study at 40 weeks of

PD-4 birds under free range system at farmers' field

age revealed that Ghagus breed had significantly lower egg, yolk, albumen and shell weights but better albumen index as compared to Aseel. These breeds did not differ in shape index, Haugh unit, yolk index, shell thickness, yolk, albumen and shell percentage, and yolk to albumen ratio.

Genotyping of Ghagus and PD-4 birds for Major Histocompatability Complex (MHC) linked markers

Ghagus and PD-4 birds were genotyped for LEI0258 and MCW371 microsatellite markers linked to MHC locus. Highest number of alleles (32 Nos.), ranging from 203-496 bp in Ghagus while 7 alleles, ranging from 216-360 bp in PD-4 birds were identified for LEI0258 marker. A total of 13 alleles, ranging from 189 to 249 bp in Ghagus and 6 alleles ranging from 198-204 bp were detected in Aseel for MCW371 marker. Heterozygosity was higher in Ghagus for both markers as compared to PD-4 birds. From the results, it was evident that higher diversity exists in Ghagus breed with respect to MHC linked markers. Further, it was observed that 274 bp allele of LEI0258 marker was most prevalent in PD-4 birds indicating lesser allelic variation of MHC haplotype linked marker in this line. Susceptibility of Ghagus to Marek's disease despite existence of higher allelic diversity in MHC linked marker indicates that non MHC factors might be contributing to its susceptibility to Marek's disease as observed in natural outbreaks.

Evaluation of PD-4 and Ghagus breeds for welfare traits

PD-4 and Ghagus breeds were evaluated for welfare traits at 44 weeks of age revealed that Ghagus birds had more tonic immobility (T.I.) duration and higher asymmetry of shank length than those of Aseel birds although no differences were observed for number of attempts to induce T.I. and asymmetry of shank width and middle toe length. Results indicated relatively better welfare status of Aseel birds as compared to Ghagus birds under similar management conditions.

c. Maintenance and evaluation of Nicobari fowl

Nicobari fowl eggs were collected from CARI, Port Blair and the chicks hatched (52 Numbers) were evaluated for different production traits up to 60 weeks of age (G-0 generation). Age at sexual maturity was 175.7±6.30

A pair of Ghagus birds

days. Body weight at sexual maturity and at 40 weeks of age was 1276±54 and 1480±50 g, respectively. Shank length at 40 weeks of age was 83.5±2.1 mm in female. Egg production up to 40 and 60 weeks of age were 64.2±4.5 and 146.8±6.3 eggs, respectively. Egg weights recorded at 28, 40, 52 and 60 weeks of age were 43.87±0.62, 46.30±0.78, 50.12±1.07 and 54.08±0.66 g, respectively. Egg quality parameters recorded at 40 weeks of age revealed that the parameters are in the range of good quality egg. No mortality between 20 to 40 weeks of age was recorded in female birds. In G-1 generation, the fertility and hatchability on total and fertile egg set basis were 86.06, 80.10 and 93.06%, respectively. Body weight at 8 weeks of age on pooled sex and at 16 and 20 weeks of age in females were 374±6, 913±22, 1238±51.4 g, respectively. Shank length at 16 and 20 weeks of age in females were 79.52±10.8, 82.61±0.91 mm. Survivability from 0-8 and 9-20 weeks of age were 95.4 and 96.1%, respectively.

d. Conservation and evaluation of Aseel population

A total of 344 fertile eggs of Aseel birds collected from the farmers of Bhimavaram, Patancheru and Shankarapally were hatched and 171 good chicks were produced. The fertility was 86% and hatchability on total

A flock of Aseel birds

and fertile egg set was 50 and 93%, respectively. Body weight at 0 day, 4, 6, 12, 16 and 20 weeks of age was 28.34, 126.7, 254.5, 704.6, 1082 and 1363 g respectively. Shank length at 6, 12, 16 and 20 week was 54.4, 87.2, 106.0 and 115.6 mm respectively. The age at first egg was 186 days and weight of first egg was 32.47 g. Body weight and shank length at 40 weeks of age were 2203 g and 119.3 mm respectively.

In G-1 generation, fertility was 67.18%. The body weight at 0 day, 4, 8, 12, 16 and 20 weeks of age was 28.6, 162.5, 521.7, 840, 1122 and 1611 g respectively. The corresponding shank lengths except 0 day were 45.6, 74.3, 94.8, 109.2 and 124.9 mm respectively.

Male and female birds of brown Nicobari and female bird of black Nicobari fowl

2.1.1.6 Evaluation of crosses developed for rural poultry

a. Evaluation of *Srinidhi* at farmers' field

Srinidhi variety was evaluated at farmers' filed to assess its potential for rural poultry farming. At Ranchi, the body weight of *Srinidhi* at 40 weeks of age for males and females in field condition was 2869 and 2306 g, respectively. The age at first egg was 160 days at the farm and it ranged from 163-180 days in the field. Egg production up to 40 weeks of age was 62.2 eggs at farm and 41-56 eggs in the field. The annual egg production ranged from102-146 eggs in field. The farmers were satisfied with body weight and egg production. At Gangulapally village in Andhra Pradesh, age at first egg ranged from 158-189 days. Egg production up to 40 weeks of age ranged from 32-45 eggs and annual egg production ranged from 90-129 eggs under backyard. Farmers were satisfied with body weight of males and egg production of females. The performance of *Srinidhi* was better at Ranchi because of better availability of scavenging feed base (Table 9).

Srinidhi at Farmer's Field

Table 9 Performance of *Srinidhi* in the farm and field conditions

Traits	DPR	Gangulapally (A.P.)	Ranchi (Jharkhand)	
			Farm	Field
Body wt. (g)				
20 wks	1986	1799	2266	1924
40 wks				
Males	3343	2643	3280	2869
Females	2616	2243	2503	2306
Age at first egg (d)	146	158-189	157	163-180
Egg wt. (g)				
40 wks	53.64	52.13	53.21	52.50
72 wks	56.24	54.38	55.28	55.19
Egg number				
40 wks	82.61	43.5 (32-45)	62.2	48.8 (41-56)
72 wks	219	90-129	203	102-146
Mortality (%)	5.16	26.67	6.53	29.64

Table 10 Economics of rearing PD-1 X PD-4 birds up to 72 weeks of age at a farmer's field

Output				Input (Rs.)	Net Profit (Rs.)
Produce	Quantity	Rate (Rs.)	Total (Rs.)		
Adult birds	5 male and 9 female (29.8 kg)	200/ kg live wt.	5980	3515	8195
Eggs	839	6 per egg	5034		
Chicks	58	12 per chick	696		
Total	11710	3515	8195		

b. Evaluation of PD-1 X PD-4 cross at farmer's field

PD-1 X PD-4 cross was distributed to 5 farmers in Warangal at 6 weeks of age. Egg production up to 72 weeks of age was 148 eggs. The profit from the venture was given in the Table 10. Input included supplemental feed, medicine and 20 number of 6 weeks old chicks.

Birds of PD-1 X PD-4 cross at farmer's field

Pullets of 3-way cross (PD-1 X IWI X PD-3)

Table 11 Growth and Production Performances of 3 - way cross

Traits	Male	Female
Body wt. (g)		
8 wks	624±9 (147)	511±8 (168)
12 wks	1207±45 (23)	826±12 (166)
16 wks	1670±62 (23)	1096±14 (161)
20 wks	-	1709±21
At sexual maturity -	1702±20 (125)	
Shank length		
16 wks (mm)	122.2±1.82 (23)	98.8±0.47 (161)
20 wks (mm)	-	99.6±0.39 (138)
Carcass traits at 16 wks		
Ready to cook yield (%)	66.12±0.36	-
Giblet (%)	4.84±0.14	-
Abdominal fat (%)	0.30±0.07	-
Production traits		
ASM (d)	-	163.1±1.33 (125)
Egg wt. (g)		
24 wks	-	45.77±0.53
28 wks	-	51.23±0.37
32 wks	-	54.49±0.42
40 wks	-	57.15±0.39
52 wks	-	60.04 ±0.47
Egg number		
40 wks	-	90.2±1.35 (120)
52 wks	-	150.2±1..85 (111)

Table 12 Egg quality parameters at different weeks of age in 3 - way cross

Traits	32 weeks (20)	40 weeks (30)	52 weeks (20)
Egg weight (g)	56.38±0.77^{c}	59.08±0.94^{b}	61.89±0.92^{a}
Shape index	74.57±1.68	74.88±0.57	75.73±0.64
Albumen index	0.13±0.005^{a}	0.13±0.004^{a}	0.11±0.007^{b}
Yolk index	0.44±0.008^{b}	0.49±0.007^{a}	0.47±0.006^{a}
Haugh unit	81.50±1.92^{b}	89.93±1.03^{a}	83.85±2.41^{b}
Yolk percentage	27.00±0.35^{b}	28.52±0.46^{a}	29.21±0.26^{a}
Shell percentage	8.20±0.21^{b}	8.15±0.15^{b}	9.49±0.10^{a}
Albumen percentage	64.80±0.31^{a}	63.33±0.48^{b}	61.30±0.26^{c}
Shell thickness (mm)	0.34±0.005^{b}	0.34±0.005^{b}	0.37±0.003^{a}

Values in parenthesis are number of eggs, Means having common superscript did not differ significantly (P<0.05).

c. Evaluation of 3-way cross

A 3-way cross, PD-1 X IWI X PD-3 was developed and its performance has been evaluated at the Institute farm. The performance has been presented in Table 11 Egg qualities are presented in Table 12.

2.1.2 Maintenance and evaluation of layer populations

2.1.2.1 Pure line layer populations

Three layer chicken lines (IWH, IWI and IWK) along with control line are maintained at the Institute farm to evaluate their performance.

The 40 weeks egg weight increased slightly in IWH and control lines. There was marginal increase in 64 weeks egg weight in IWH and control lines. The 40 weeks body weight increased in IWH line (80 g) over previous generation while it decreased in other three lines. The 40 weeks egg production improved by 5 eggs as compared to last generation in IWK line. Egg production up to 52 weeks showed improvement by 10, 8 and 15 eggs in IWH, IWI and IWK lines, respectively over previous generation (Table 13). Egg production up to 64 weeks of age was increased by 7, 9 and 19 eggs in IWH, IWI and IWK lines, respectively over the last generation. IWH line produced 282 eggs up to 72 weeks of age followed by IWI (279 eggs) and IWK (270 eggs) and control (231 eggs) lines. During G-3 generation, fertility was 76.44 and 81.48%, hatchability on total and fertile egg set basis was 55.28 and 72.24 and 59.67, 73.64 % in IWH and IWI lines, respectively. The fertility of IWK and layer control lines was 77.02 and 70.92% respectively while hatchability on fertile and total egg set basis were 87.32, 87.03 and 67.19, 61.73% respectively.

White Leghorn Male

Table 13 Production performance of layer pure lines

Traits	IWH (G-2)	IWI (G-2)	IWK (S-10)	Control (S-10)
Observations	269	471	455	365
ASM (d)	146.0±0.05^{c}	148.9±0.02^{b}	148.0±0.02^{b}	155.4±0.03^{a}
Body wt. (g)				
40 wks	1527±0.71^{a}	1411±0.35^{c}	1464±0.42^{b}	1504±0.48^{a}
52 wks	1598±0.76^{a}	1476±0.36^{c}	1538±0.43^{b}	1600±0.52^{a}
64 wks	1586±0.74^{b}	1474±0.39^{d}	1565±0.45^{b}	1650±0.55^{a}
72 wks	1633±19b (153)	1505±10d (273)	1726±18a (452)	1590c±7 (195)
Egg wt. (g)				
28 wks	46.32±0.01^{b}	46.81±0.01^{ab}	46.58±0.01^{b}	47.32±0.01^{a}
40 wks	52.43±0.21 (238)	52.85±0.16 (453)	53.04±0.25 (293)	53.18±0.35 (183)
64 wks	55.16±0.01	55.67±0.01	55.53±0.01	55.34±0.01
Egg number				
40 wks	107.8±0.04^{a}	106.3±0.03^{a}	104.3±0.03^{b}	92.6±0.04^{c}
52 wks	176.8±0.05^{a}	174.5±0.04^{a}	168.7±0.03^{b}	148.2±0.05^{c}
64 wks	237.2±0.06^{a}	234.1±0.05^{ab}	231.0±0.04^{b}	194.4±0.07^{c}
72 wks	282.0±1.88^{a} (153)	279.0±1.46^{a} (273)	269.8±1.15^{b} (452)	230.5±2.15^{c} (195)
Egg mass (g) 64 wks	13091±4^{a}	13019±3^{ab}	12824±3^{b}	10727±6^{c}

Means with different superscript in the row differ significantly (P<0.05), Values in parenthesis are number of observation only when different from as given in 2nd row.

2.1.2.2 Random bred layer control population

The layer control population was evaluated up to 64 weeks of age in S-10 generation. The ASM and body weight at 40 weeks of age almost remained stable in the present generation (Table 13). However, body weight at 52 and 64 weeks of age improved marginally in the present generation. Egg weights at 40 and 64 weeks of age have improved marginally in present generation. The egg production though increased by 1 egg at 40 weeks of age but it decreased by 0.50 and 6 eggs at 52 and 64 weeks of age respectively in the present generation as compared to last generation. However, the layer control line was stable for last 10 generations up to 64 weeks of age.

2.1.3 Maintenance and evaluation of coloured broiler populations

Three coloured broiler lines i.e. synthetic coloured broiler male line (PB-1), synthetic coloured broiler female line (PB-2) and control broiler (CB) populations were maintained and evaluated.

2.1.3.1 Coloured broiler male line (PB-1)

During this period, S-23 generation of PB-1 completed 40 weeks of age. Production traits were presented in Table 14. As compared to last generation, ASM decreased by 2 days while body weight at 20 (192 g) and 40 weeks (70 g) of age, egg weight at 40 weeks (1.26 g) of age and egg production up to 40 weeks (2.45 eggs) of age increased marginally. S-24 generation was regenerated with 68 sires and 340 dams.

Table 14 Production performance of PB-1 line (S-23 generation)

Trait	Mean±S.E
Body wt. (g)	
20 wks	2592±0.69
40 wks	3357±0.86
ASM (d)	169.70±0.02
Egg wt. (g)	
32 wks	54.80±0.01
40 wks	57.42±0.05
Egg number	
40 wks	53.17±0.05

A pair of PB-1 birds

Heat stress parameters in broilers

An experiment was conducted to study the effect of heat stress on 5 different genetic groups (PB-1 X Naked neck, PB-1XPB-2, PB-1 pure line, PB-2 pure line, and naked neck pure line) during the months of August and September, 2013. The temperature in the shed was increased by providing two halogen lamps of 1000 W in each pen in all genetic groups. Heat stress condition was created in all pens by maintaining temperature at 38-40 °C inside the shed. Body weights were recorded at 0 day, 2, 4, 5, 6 and 7 weeks of age. At 6 weeks of age heat stress parameters such as serum lipid peroxidation

A pair of PB-2 birds

(LPO), RBC catalase (CAT), glutathione peroxidase, alkaline phosphatase, super oxide dismutase (SOD) and H:L ratio were estimated. No significant differences in LPO, CAT and SOD were observed among different genetic groups. But significant differences were observed for GPx, ALP and H: L ratio between genetic groups. Lower estimates were recorded for all heat stress parameters in PB-1 X Naked neck cross and naked neck pure indicating heat resistance for these two genetic groups. For juvenile body weights in stressful conditions there was a significant difference between genetic groups. Naked neck and naked neck cross obtained higher juvenile body weights as compared to other genetic groups.

2.1.3.2 Coloured broiler female line (PB-2)

During the period, the production performance of S-22 generation of the PB-2 line was completed. The egg weight at 40 weeks of age was 64.27±0.44 g which showed improvement over the last generation (57.86 g). Egg production up to 40 and 52 weeks of age were 64.02±0.76 and 116.5±1.98, respectively. Egg weight at 52 weeks of age was 65.67±0.73 g. Body weight at 40 and 52 weeks of age were 3063±29.1 and 3286±32 g, respectively.

Regeneration of S-23 generation was done using 58 sires and 290 dams. The fertility was 79.50%, while the hatchability on total and fertile egg set was 70.90 and 89.18% respectively. Body weight at 5 weeks of age was 713.1±2.5 g in this generation. On genetic scale, there was a mild improvement of 3.5 g/generation over the last ten generations. Average shank length and breast angle at 5 weeks of age were 72.97±0.07 mm and 87.4±0.08 respectively.

2.1.3.3 Random bred broiler control population

During the period, G-12 generation of control broiler population completed 40 weeks of age (Table 15).

Table 15 Production traits of the control broiler (G-12 generation)

Traits	Mean±S.E
Body wt. (g)	
20 wks	2369±0.76
40 wks	3139±0.85
ASM (d)	170±0.03
Egg wt. (g)	
32 wks	53.22±0.01
40 wks	56.43±0.009
Egg number	
40 wks	56.59±0.07

G-13 generation of control broiler was regenerated with 1,711 chicks. The fertility in this line was 81.40% and hatchability on total and fertile eggs set was 68.22 and 83.80% respectively. The body weight at 4, 5 and 6 weeks of age was 333, 573 and 993g, respectively. Shank length and breast angle at 5 weeks of age were 69.16 mm and 75.67°, respectively. Feed efficiency during 0-5 weeks of age was 2.32.

2.1.4 Maintenance and evaluation of naked neck (Na) and dwarf (Dw) gene lines

Production traits of the naked neck and dwarf gene lines in their S-11 generation are given in the Table 16. The ASM increased by 7 and 5 days in naked neck and dwarf lines, respectively over the previous generation. The egg weight at 40 weeks of age remained stable in both the gene lines compared to their previous generation. The egg production up to 40 weeks of age increased by 1 and 7 eggs in naked neck and dwarf lines, respectively. In naked neck line, fertility was 81.2%, while the hatchability on total egg set and fertile egg set was 53.5 and 65.9% respectively. In dwarf line, fertility was 77.1%, while the hatchability on total egg set and fertile egg set was 60.2 and 78.1% respectively.

Table 16 Production performance of gene lines (S-11 generation)

Traits	Naked neck	Dwarf
ASM (d)	161.4	138.9
Body wt. (g)		
20 wks	2381	2113
40 wks	3007	2673
Egg wt. (g)		
28 wks	52.33	48.04
32 wks	59.64	53.76
40 wks	61.34	55.59
Egg number		
40 wks	65.81	75.24

2.2 Molecular Genetics

2.2.1 Functional genomics, epigenetic and gene silencing technology for improving productivity in poultry (National Fellow Project)

A study was conducted in control broiler and control layer population to analyse effect of IGF1 and GHR gene on growth traits, epigenetic modifications in promoter of MSTN and IGF1 gene, functional genomic analysis of MSTN and IGF1 gene and exploring sequence variability of Aseel genome from Red Jungle fowl. The open reading frame of 1380 bp of IGF1 and 1827 bp of GHR gene cloned in INSTA cloning vector and sequenced. In IGF1 gene 12 haplotypes and in GHR genes 8 haplotypes were observed. The haplogroups had significant effect on body weight at day old and 6 weeks and daily gain between 4 to 6 weeks in control broiler population. The Cytosine methylation was detected in myostatin and IGF-1 promoters. The methylation patterns of myostatin and IGF-1 promoters negatively correlated with gene expression. The mRNA expression of MSTN and IGF1 gene during pre- and post-hatch analysed. In vivo studies of MSTN expression and effect indicated specificity of the protein and reiterated the negative effect on growth in chicken. The whole Aseel genome was sequenced indicating presence of approximately 23,000 genes.

A pair of dwarf birds

2.2.2 Characterization of mitochondrial genome

Six mitochondrial genes viz., CO-II, CO-III, ATPase6, ATPase8, ND-3 and ND-6 were characterized in different chicken breeds and varieties maintained at this

A pair of naked neck birds

directorate. The CO-II gene was characterized in Aseel, PD-1, dwarf and PB-1. The CO-III gene was characterized in the Aseel, Dahlem Red, dwarf, Ghagus, Nicobari, Naked neck and PB-1 birds. The ATPase6 gene was sequenced in the Aseel, PD-1, naked neck and PB-2. The ATPase8 gene was characterized in the Aseel, PD-1, dwarf, Ghagus and PB-1. The ND-3 gene was sequenced in the Aseel, Kadaknath and PB-1. The ND-6 gene was characterized in the Aseel, PD-1, Ghagus, Nicobari and PB-1 birds. Nucleotide variations were identified in the sequences of different genes. The phylogenetic analysis showed different clusters for various breeds.

2.2.3 Expression profiling of cytokines and chemokines: Scope for augmenting general immune competence in chicken (DST-OYS Project)

During the period, primers were designed for IL-1α, IL-6, TNF-α and IFNγ genes. The level of expression of two genes viz., IL-1α and IL-6 in WBC were quantified with qPCR using the SYBR green assay. Gene expression levels varied significantly (P<0.05) in PB-1 birds for both genes.

2.2.4 Studies on epigenetic adaptations to high temperature in selected chicken populations

Thermal adaptation during embryogenesis has been one of the options to mitigate the heat stress during the post-natal life of chicken to improve the heat tolerance. An experiment was conducted at VCRI, Namakkal in an EC house. The embryos were pre-exposed to increased temperature (40.5 °C) and relative humidity (90%) for 6 hrs during 15th to 17th Day of incubation. Three embryos each from heat exposed and normal were sacrificed on 17th day from each genetic group (NaNa, Nana and PB-2) for studying the heat shock protein genes. All Hsp genes (Hsp-70, Hsp-27, Hsp-90a and Hsp-60) significantly up-regulated in Naked neck genotypes. The mRNA expression clearly reveals that the embryos were under stress immediately after continuous exposure to high temperature. The fertility and hatchability did not differ significantly among the birds of heat treated and normal groups.

The chicks were transported to VCRI, Namakkal and reared under normal brooding till 6th day. On 7th day, the chicks were distributed randomly (2: treatment x 3: breed x 6: replicates x 6: chicks) in to small pens. The temperature was maintained at 25 °C (normal) and 37.5 °C (Heat exposed) up to 42 days of age. The body weight at 6 weeks of age was significantly (P<0.05) lower in heat exposed birds as compared to the normal birds. The stress parameters like protein carbonyls, total antioxidant activity and SOD were in positive direction in heat exposed group indicating the advantageous effect of thermal adaptation due to pre-exposure during incubation. The same results were confirmed by Hsp-gene expression and hormonal assay.

On 42nd day, 6 birds were slaughtered and brain tissue was collected. All the 4 Hsp-genes studied were significantly (P<0.05) down-regulated in heat exposed and normally incubated naked neck (NaNa/Nana) birds in comparison with PB-2 birds indicating the effect of thermal conditioning. In PB-2 broiler birds, all the genes were significantly (P<0.05) down-regulated in heat exposed birds indicating the advantageous effects of thermal conditioning during incubation.

During 6th week, 6 birds from each incubation group of both breeds were slaughtered and blood collected. Serum was collected and analysed for circulating triiodothyronine (T_3) and corticosterone levels (Table 17). The results indicated that birds from *in ovo* heat exposure had lower T3 level and thereby, lower metabolic activity which is desired during heat stress condition.

Table 17 Effect of *in ovo* heat exposure on circulating T_3 and corticosterone levels

Genotypes	Triiodothyronine (T_3) (ng/ml)		Corticosterone (ng/ml)	
	Normal	Heat exposed	Normal	Heat exposed
Naked neck (NN)	1.47 ± 0.08^{a}	1.28 ± 0.06^{b}	2.64 ± 0.77	2.25 ± 0.74
PB-2	1.34 ± 0.03	1.31 ± 0.09	3.42 ± 1.07	3.1 ± 1.07

$^{a, b}$ *Figures bearing different superscripts in a row differ significantly (P<0.05)*

2.2.4.1 Expression of heat shock protein genes in Dahlem Red chicken

A total of 672 eggs from Dahlem Red were incubated at 37.5 ^{o}C from which one batch of eggs (336) was exposed to 40.5 ^{o}C at embryonic day of 15th, 16th and 17th for 6 hours. On 17th day, 6 embryos from each group were slaughtered to study the heat shock protein gene expression in the brain tissue. On 5th, 6th and 7th day post-hatch, chicks from both groups were again exposed to 44 ^{o}C temperature for 6 hours in a modified battery brooder in which the temperature was maintained by artificial heater. The mRNA expression of Hsp70, 90a and Hsp27 genes was evaluated in the brain and thymus tissue. These three heat shock protein genes decreased significantly in the heat exposed group as compared to the control group. The T_3 hormone was significantly reduced in the heat challenged groups. Similar results were obtained in thymus, but not significant between the heat exposed and normal birds. The experiment clearly shows the advantageous effect of thermal adaptation during incubation on postnatal performance.

2.3 Poultry Nutrition

2.3.1 Development of climate resilient practices through nutritional, genetic and physiological strategies to enhance tolerance to heat stress in commercial and backyard poultry

A total of 4 experiments were conducted during the period under review to find out the possible nutritional solutions to ameliorate heat stress in both rural and commercial broilers and layers. One experiment each on rural chicken (*Vanaraja*) and White Leghorn layers (Babcock) and two on commercial broilers (Cobb 400) were conduced. All the experiments were conducted in battery brooders by placing 5-6 birds per each replicate and 10-12 replications per treatment. In all experiments, performance (egg production / body weight gain and feed efficiency), slaughter (broilers), anti-oxidant (lipid peroxidation, ferric reducing ability in plasma, glutathione peroxidase and super oxide dismutase) and immune (antibody titres against ND vaccine and CMI response to PHA-P) responses were studies as per the protocol.

2.3.1.1 Interaction between dietary ME and CP on performance of commercial broilers reared in tropical summer

This experiment was conducted both in batteries and floor pens during summer season (29.25 to 37.58^{o} C). The same dietary treatments were used for both experiments, and the diets were arranged in a 3 x 3 factorial design with 3 levels (high, medium and low) of ME and CP. Each diet was offered to 10 replicates. Day-old Cobb 400 broilers were used, and the diets were fed *ad libitum* from 0 to 42 days. The concentration of the high, medium, and low ME diets were 2950, 2850 and 2750 kcal/kg, 3050, 2950 and 2850 kcal/kg, and 3150, 3050 and 2950 kcal/kg in the starter, grower and finisher diets, respectively. Similarly the concentrations of CP during the respective phases were 25.19, 23.94 and 22.63%, 21.03, 19.98 and 18.94%, and 19.55, 18.65 and 17.65%.

Interactions was not significant between ME and CP on BWG and FI but not for FCR at 42 days of age. Conversely, in floor experiment, there were interactions ($P<0.05$) on BWG, FI and FCR. Birds fed low ME in batteries had higher ($P<0.01$) FCR compared with those fed medium or high ME. Birds reared in floor pens had reduced FI when dietary CP was decreased to medium level but further reduction to low CP had no effect. Nevertheless, reducing dietary energy reduced ($P<0.01$) the relative weights of RTC and AF in broilers raised in battery brooders, but breast weight was not affected. Conversely, reducing dietary CP did not affect RTC and BrW but AF was higher ($P=0.032$) in birds fed low CP compared with those fed high CP. The BrW of broilers fed low CP in floor pens was lower ($P=0.041$) compared with those fed high or medium protein diets (Table 18). The results suggested that the performance of broilers reared during summer (29.25 to 37.58^{o} C) was significantly better in groups fed 100 kcal ME and 10 g CP less compared to those fed the recommended concentrations of these nutrients. Abdominal fat reduced with increase in dietary CP and the fat content increased with dietary ME concentration.

2.3.1.2 Effect of water temperature and nutrient density on performance, oxidative parameters and immunity in Vanarja birds during summer

The experiment was conducted by housing 480 day old *Vanaraja* birds in 80 stainless steel battery brooder pens. Half of the pens were provided with tap water and another half with cold water (less 5 °C compared to the tap water temperature). Each group was fed with four graded concentrations of dietary nutrients (2700, 2800, 2900 and 3000 kcal ME/kg diet) in 2 x 4 factorial pattern. The experiment was conducted during May and June 2013. Interaction between nutrient density and drinking water temperature did not influence body weight gain, feed intake and feed efficiency in *Vanaraja* chickens. Similarly the temperature of drinking water also did not influence these performance variables. Dietary variation in nutrient density also failed to elicit any response in body weight gain, while feed intake in groups fed ≥ 2800 kcal ME depressed the compared to those fed the lowest level of energy in diet (2700 kcal/kg). Feed efficiency improved with each increment in dietary nutrient density and the feed efficiency in groups fed the highest nutrient density was significantly better compared to those fed 2700 or 2800 kcal ME/kg diet (Fig. 2).

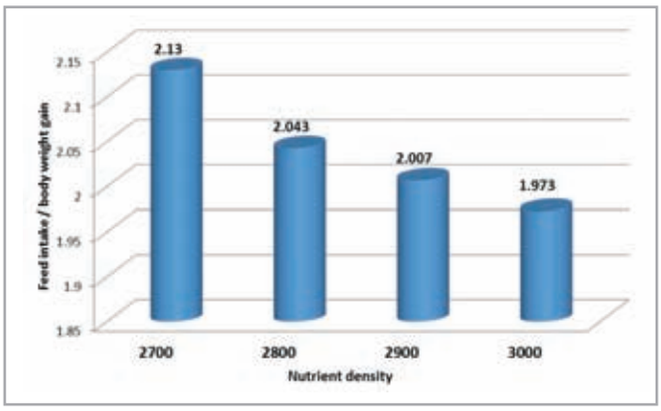


Fig. 2 Effect of nutrient density of FCR in *Vanaraja* (8 to 49 d of age)

Table 18 Dietary effects on performance and carcass traits of broilers at 42 days of age

Diets	Battery brooder						Floor Pen					
	BWG (kg)	FI (kg)	FCR (kg/kg)	RTC (g/kg live BW)	BrW	AF	BWG (kg)	FI (kg)	FCR (kg/kg)	RTC (g/kg live BW)	BrW	AF
HME.HCP	1.90^{abcd}	3.02^{abc}	1.59	804	221	13.7	2.03^{bc}	3.77^{cd}	1.86^{ab}	788	246	15.0
HME.MCP	1.92^{abc}	2.92^{bc}	1.52	765	213	15.5	2.12^{bc}	3.63^{cde}	1.72^{b}	797	234	16.7
HME.LCP	1.92^{abc}	3.03^{abc}	1.57	769	215	17.3	2.15^{b}	3.89^{bc}	1.81^{ab}	775	233	17.8
MME.HCP	2.02^{a}	3.14^{ab}	1.55	765	206	9.9	2.33^{a}	4.29^{a}	1.85^{ab}	774	225	21.7
MME.MCP	1.79^{cd}	2.80^{c}	1.57	759	217	13.2	2.03^{bc}	3.48^{e}	1.73^{b}	782	246	17.4
MME.LCP	1.86^{bcd}	2.94^{bc}	1.58	761	218	11.8	2.07^{bc}	3.71^{cde}	1.79^{ab}	762	216	12.5
LME.HCP	1.86$_{bcd}$	2.95^{bc}	1.59	749	214	8.5	2.11^{bc}	3.74^{cde}	1.78^{ab}	786	250	10.2
LME.MCP	1.98^{ab}	3.20^{a}	1.61	750	216	6.6	2.13^{b}	4.07^{ab}	1.91^{a}	766	236	14.5
LME.LCP	1.77^{d}	2.88^{c}	1.62	756	211	12.4	1.94^{c}	3.55^{de}	1.83^{ab}	763	226	14.8
Main effects												
HME	1.92	2.99	1.56^{y}	779^{x}	216	15.5^{x}	2.10	3.76	1.80	787	238	16.5
MME	1.89	2.96	1.57^{y}	762^{y}	214	11.6^{y}	2.14	3.83	1.79	773	229	17.2
LME	1.87	3.01	1.61^{x}	752^{y}	213	9.2^{y}	2.06	3.79	1.84	772	237	13.2
HCP	1.93	3.04	1.58	773	214	10.7^{b}	2.16	3.93^{a}	1.83	782	240^{a}	15.6
MCP	1.90	2.97	1.57	758	215	11.8^{ab}	2.09	3.73^{b}	1.79	782	239^{a}	16.2
LCP	1.85	2.95	1.59	762	215	13.8^{a}	2.05	3.71^{b}	1.81	767	225^{b}	15.0

BWG: Body weight gain; FI: Feed intake; FCR: Feed conversion ratio; RTC: Ready to cook yield; BrW: Breast weight; AF: Abdominal fat; HME: High ME; MME: Medium ME; LME: Low ME; HCP: High CP; MCP: Medium CP; LCP: Low CP; $^{a, b, c, d, e}$ *or* $^{x, y}$*: Means having common superscript in a column do not vary significantly.*

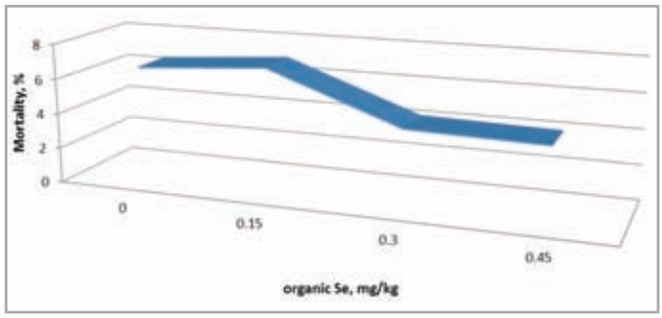


Fig. 3 Effect of supplementing organic Se on mortality of WL layers during summer

2.3.1.4 Effect of supplementing organic form of zinc, selenium and chromium in broiler chicken diet during summer

An experiment was conducted to study the effect of supplementing organic form of Zn, Se and Cr at different concentrations on performance, anti-oxidant activity and immune responses in broiler chicken. Two concentrations of each Zn (20 and 40 mg/kg), selenium (0.15 and 0.30 mg/kg) and chromium (1 and 2 mg/kg) were supplemented to maize – soybean meal based basal diet in 2 × 2 × 2 factorial design. Each diet was allotted randomly to 10 replicates and fed *ad libitum* from 1 to 21 d of age. At the end of the experiment, blood samples were collected for estimation of anti-oxidant and immune responses. The higher BWG and better FCR were recorded among the groups fed diets supplemented OTM compared to group fed control diet (CD) (Table 19). Lipid peroxidation (LP) in plasma lowered (P<0.01) in groups fed Cr and Se supplemented diet compared to group fed CD. The better FCR was recorded in groups fed Zn, Se and Cr at 20, 0.3 and 1 or 40, 0.15 and 2 mg/kg, respectively compared to those group fed other dietary treatments. Super oxide dismutase activity in plasma was higher (P<0.01) in groups fed diet supplemented Zn, Se and Cr at 20, 0.3 and 1 mg/kg, respectively compared to those group fed CD. Based on the results (Table 19), it is concluded that supplementing the organic form of Zn, Se and Cr at 20, 0.3 and 1 or 40, 0.15 and 2 mg/kg, respectively is required to harvest the optimum performance and improved anti-oxidant status in commercial broilers.

Table 19 Anti-oxidant and immune responses in commercial broilers fed different concentrations of organic trace minerals

Zn (mg/kg)	Se (mg/kg)	Cr (mg/kg)	BWG (g)	FCR	ND titre (log_2)	CMI response (%)	SOD (units/ml)	FRAP (µM)
Interaction								
0	0	0	687.4	1.248^{a}	7.250	54.76	3.408^{b}	1605
20	0.15	1	719.1	1.246^{ab}	7.375	55.32	3.605^{ab}	1698
20	0.15	2	704.0	1.219^{bc}	7.250	53.96	4.401^{ab}	1792
20	0.30	1	745.3	1.208c	7.125	59.73	4.517a	1757
20	0.30	2	718.8	1.223^{abc}	6.875	55.85	3.964^{ab}	1570
40	0.15	1	706.4	1.205^{c}	7.250	57.54	4.257^{ab}	1612
40	0.15	2	714.6	1.205^{c}	7.250	54.36	4.460^{ab}	1753
40	0.30	1	727.5	1.231^{abc}	7.000	66.00	4.245^{ab}	1687
40	0.30	2	702.6	1.218^{bc}	7.500	56.97	4.061^{ab}	1725
SEM			19.04	0.009	0.41	7.22	0.33	102.4
P value		0.01	0.63	0.01	0.14	0.41	0.35	

BWG: body weight gain; FCR: feed conversion ratio; FRAP: Ferric reducing activity in plasma; SEM: Standard error mean; SOD: Superoxide dismutase; PHAP: Phytohaemoagglutinin-P.

Table 20 Performance of *Vanaraja* female parents (8 to 49 d of age) fed graded concentrations of fortified rape seed meal

Diet	Body wt. gain (g)	Feed intake (g)	Feed/Body wt. gain
Control	971.6[a]	2054[a]	2.116[d]
RSM 5%	905.1[b]	1985[a]	2.193[c]
RSM 10%	711.7[c]	1610[b]	2.266[b]
RSM 15%	526.3[d]	1218[c]	2.318[b]
RSM 20%	436.1[e]	1046[d]	2.397[a]
P	0.001	0.001	0.001

Values in parenthesis are number of eggs, Means having common superscript did not differ significantly (P<0.05).

2.3.2 Effect of incorporating graded concentrations of fortified rape seed meal on performance of *Vanaraja* birds

An experiment was conducted by housing 375 *Vanaraja* birds in 75 battery brooder pens at the rate of 5 birds in each replicate (pen). A control diet containing soybean meal was prepared with standard concentrations of nutrients. Fortified RSM was incorporated at 5, 10, 15 and 20% in diet. Each diet was fed ad libitum to 15 replications from day 8 to 49 d of age.

Rape seed meal contains 35.51% crude protein and 0.64% methionine, 1.68% lysine, 1.42% threonine, 0.47% tryptophan and 1.65% valine. Performance data indicated significant and progressive reduction in BWG and feed efficiency in *Vanaraja* chicks compared to those fed the control diet (Table 20). Incorporation of RSM at 5% did not affect the feed intake, however the feed intake decreased progressively with increase in level of the alternate protein source in diet from 10 to 20%.

2.3.3 Production of designer broiler chicken meat through nutritional manipulation

2.3.3.1 Enrichment of chicken meat with antioxidants (vitamin E and selenium) optimized

Chicken meat is good sources of protein, minerals and vitamins; they can be effectively utilized as important delivery systems to the needy populations. Consumers are more and more interested in products enriched with beneficial components which in turn will improve their health. Attempts were made to enrich the broiler chicken meat with antioxidants like vitamin E and selenium through dietary manipulation. Feeding broiler chicken with alpha-tocopheryl acetate (Vitamin E) at 200 mg/kg diet for 4 weeks prior to slaughter is necessary to optimize muscle content and stability against lipid peroxidation. Supplemental Vitamin E (α tocopherol acetate, 200 mg/kg) elicited optimum retention in meat (42 mg/kg). Higher level of Se (organic, 0.30 mg/kg) in the boiler diet not only increased its concentration at tissue level but also increased the antioxidant activity of muscle tissue and reduced the concentration of malonidialdehyde (lipid oxidation products). Among the various levels of supplemental selenium (0.15, 0.30, 0.45 mg/kg), 0.30 mg/kg elicited optimum retention in meat (152 µg/kg).

2.3.3.2 Effect of omega-3 fatty acid source (linseed oil) on performance, carcass yield and composition, and antioxidant status of broiler chickens

Two experiments were conducted to evaluate the sources of omega-3 (ω-3) fatty acid sources (Linseed oil) vs. sunflower oil (ω-6) on performance, meat composition and antioxidant status of broilers. In the first experiment, sunflower oil (SFO) was replaced by either 50 or 100% with linseed oil (LSO) during entire six week period. Dietary replacement of SFO with LSO had no influence on body weight gain and feed conversion efficiency of broiler chickens. Carcass yields as well as breast meat

Table 21 Effect of dietary inclusion of linseed oil on performance and carcass characteristics of broiler chickens at six weeks of age

Diet	Body weight (g)	Feed conversion ratio	Dressed weight (%)	Breast meat (%)	Abdominal fat (%)
D-1 (SFO)	1479	1.88	71.75	16.60	1.34[a]
D-2 (LO)	1508	1.90	71.05	16.79	0.89[b]
D3 (SFO + LO)	1489	1.89	71.07	16.40	1.12[ab]
SEM	9.59	0.02	0.45	0.15	0.08
P value	0.210	0.515	0.883	0.691	0.051

yield were not affected. However, abdominal fat content was significantly (P<0.05) reduced in the LSO group (Table 21). The concentrations of antioxidant enzymes such as glutathione peroxidase and superoxide dismutase as well as TBA concentration in serum were not affected by incorporation of n-3 fatty acid sources in the diet. It is concluded that dietary inclusion of linseed oil significantly reduced the abdominal fat deposition in broiler chickens.

In the second experiment, SFO was replaced by LO by either 50 or 100% during the finisher phase (22-42 days). Dietary replacement of SFO with LO during finisher phase had no influence on performance parameters (body weight and feed conversion ratio), carcass characteristics (dressed weight and breast meat) and antioxidant enzyme activities (glutathione peroxidase and superoxide dismutase). However, abdominal fat content was significantly reduced in the dietary group where LO was exclusively used. These findings further suggested that dietary inclusion of linseed oil could reduce abdominal fat deposition in broiler chickens.

2.3.4 Detoxification of Karanj (*Pongamia glabra*) seed cake and its utilization in broiler and layer chicken diets (*DST sponsored*)

In collaboration with IICT and Roshni Biotech, Hyderabad, studies were conducted to evaluate IPA and DMC treated Karanj cake as well as solvent extracted Karanj cake in diet as a source of protein, partially replacing soyabean meal.

2.3.4 .1 Solvent extracted Karanj cake in layer diet at higher levels

Solvent extracted Karanj cake (SKC) was evaluated at graded levels (0, 6, 9 and 12%) in the diet of layer chicken (50-61 weeks of age, n=160) on *isonitrogenous* and *isocaloric* basis in 3 laying periods of 4 weeks each. The hen day egg production was depressed (P<0.01) at 12% level of SKC (60.1%) and the performance at the remaining levels of SKC (71.1-74.8%) was similar. The groups fed 9 and 12% SKC recorded the lowest feed intake (82.5 and 78.1 g/bird/d, respectively) in comparison to the remaining groups (90.2 and 88.4% in control and 6% SKC, respectively). Sensory evaluation of eggs indicated no significant differences among the treatments. The results suggest that SKC could be used up to 9% without any adverse effect on egg production in laying chickens during 50 to 61 weeks of age.

2.3.4.2 Solvent extracted Karanj cake in broiler chicken diet

Two-week old male commercial broiler chicks (n=75) were fed SKC at 3 and 6% levels on *isonitrogenous* basis till 6 weeks of age. Body weight was significantly (P<0.01) depressed by SKC at 6% level (1365.3 g), while feeding SKC upto 3% level (1600 g in control and 1576.6 g in 3% SKC) showed no effect. Similar trend was observed in feed consumption. Carcass variables, organ weights and serum biochemical profile were also not affected. The results indicated that SKC could be used up to 3% in the diet of broiler chicken without any adverse effect.

2.3.4 .3 Solvent extracted Karanj cake in the diet of Krishibro and Srinidhi chickens

The effect of dietary inclusion of SKC (0, 3, 6 and 9%) was evaluated on *Krishibro* and *Srinidhi* chicks in 4x2 factorial manner. Each of the experimental group had 8 replicates of 6 chicks each. Body weight was significantly low in the groups fed 6 and 9% SKC. No significant interactions between the SKC level and genotype of birds were observed. The feed intake was not affected by SKC level in diet, whereas *Srinidhi* consumed less feed throughout the trial. Ready to cook yield was significantly ($P<0.01$) low in all the groups fed SKC in comparison to the control group. Liver, gizzard and giblet weights increased progressively as the SKC level in diet increased. Bursa and pancreas weight increased at the higher levels of SKC (6 and 9%). Significant interaction was recorded which indicated that the adverse effect of SKC on RTC was less pronounced in *Srinidhi*. On the contrary, the differences in organ weights (bursa, spleen, and pancreas) were significant in *Srinidhi* among the dietary treatments. The results indicate that SKC beyond 3% level in diet was detrimental for the growth performance of *Krishibro* and *Srinidhi* chickens.

2.3.4 .4 IPA treated Karanj cake (KC) in the diet of laying chickens

Isopropyl alcohol (IPA) detoxified Karanj cake was evaluated at graded levels (0, 4, 8 and 12%) in *isocaloric* and *isonitrogenous* diet of layer chicken (n=252 nos.) from 25 to 36 weeks of age. The hen-day egg production was significantly ($P<0.01$) low at the highest level of 12% karanj cake (either SKC or IPA-KC) (Table 22). The egg production was higher with IPA-KC than in SKC at all the levels indicating beneficial effects of IPA treatment of karanj cake. The feed intake was statistically comparable in the groups fed SKC at 4 and 8% levels, which were however significantly lower than in the control. The feed intake at 12% SKC was significantly ($P<0.01$) lower than at the lower levels of SKC. On the contrary, IPA treatment improved the feed intake. Feed consumed for 12 eggs was significantly ($P<0.01$) low at 12% SKC. It is concluded that SKC feeding depressed performance of layers in a dose dependant manner and IPA treated SKC showed no adverse effect up to 8% in diet.

Table 22 Effect of feeding IPA treated Karanj cake on performance of layer chicken (from 25 to 32 weeks)

Type of KC	% in diet	HDEP (%)	Feed intake (g)	Feed/ 12 eggs
-	-	95.44^{a}	109.82^{a}	1382.6^{b}
SKC	4	92.66^{a}	103.89^{b}	1352.5^{b}
SKC	8	88.13^{a}	99.45^{c}	1361.4^{b}
SKC	12	59.76^{c}	86.55^{e}	1886.7^{a}
IPA-KC	4	93.68^{a}	107.05^{ab}	1379.0^{b}
IPA-KC	8	92.06^{a}	103.94^{b}	1358.1^{b}
IPA-KC	12	78.90^{b}	95.41^{d}	1464.3^{b}
n		9	9	9
P		0.0001	0.0001	0.0001
SEM		1.7558	1.0534	35.636

Means bearing at least one common superscript in a column do not differ significantly ($P<0.05$)

Table 23 Effect of dietary inclusion of DMC treated Karanj cake on broiler chicken

Karanj cake		Body wt. (g)	Feed Intake (g)	Liver, (%)	Giblets, (%)
Type	% in diet				
-	-	2087.4^{a}	3615.2^{a}	1.82^{d}	4.12^{d}
KC	3	1790.5^{bc}	3162.1^{b}	2.02^{bcd}	4.21^{cd}
KC	4.5	1760.2^{bcd}	3134.3^{b}	2.16^{b}	4.57^{bc}
KC	6	1552.3^{d}	2939.6^{b}	2.39^{a}	4.97^{a}
DMC-KC	3	1953.1^{ab}	3462.2^{a}	1.89^{cd}	4.26^{cd}
DMC-KC	4.5	1674.3^{cd}	3086.9^{b}	2.01^{bcd}	4.46^{bcd}
DMC-KC	6	1560.0^{d}	3019.7^{b}	2.11^{bc}	4.72^{ab}
SEM		33.93	45.006	0.036	0.060
P		0.0001	0.0001	0.0001	0.0001
N		9	9	9	9

Means bearing at least one common superscript in a column do not differ significantly (P<0.05)

2.3.4.5 DMC treated Karanj cake in the diet of broiler chickens

The feeding value of dimethyl carbonate (DMC) detoxified Karanj cake was tested at graded levels (3, 4.5 and 6%) in the diet of broiler chicken (n=315). Feeding of karanj cake significantly depressed body weight from the lowest level tested (3% onwards) (Table 23). DMC treatment significantly (P<0.01) improved the performance at 3% level of Karanj cake, which was similar to that of control. The feed intake was significantly (P<0.01) low in all the test groups, except 3% DMC-KC in comparison to control. The liver weight increased at 4.5 and 6% levels of Karanj cake. On the contrary, liver weight at 4.5% of DMC-KC was statically comparable to that of control. The gizzard weight also increased at the highest level of 6% KC. The results indicate significant improvement in the nutritional value of Karanj cake with DMC treatment, which could be safely used up to 3% in the diet of broiler chickens without any adverse effects.

2.3.4.6 Solvent extracted Karanj cake in Vanaraja diet: age related responses

The age related responses to feeding of solvent extracted Karanj cake (SKC), viz. at 0% (0-2 wks), 0, 3 or 6% (3-4 wks) and 0, 6 or 9% (5-6 wks) in *Vanaraja* chicks (n=336) were evaluated. No adverse effect of SKC on growth, feed intake and FCR of *Vanaraja* chicks at the tested levels was observed (Table 24). Thus late introduction of SKC even at higher levels of 6 or 9% could be well tolerated by *Vanaraja* chicks till 6 weeks of age.

2.3.5 Optimization of dietary allowances for production and reproduction in PD-3 line

A study was carried out to optimize the nutrient requirement for PD-3 layers. For the purpose, nine diets had metabolizable energy (ME) of 2500, 2600 and 2700 kcal/kg and crude protein (CP) of 14, 16 and 18% and were fed into 3×3 factorial design. A total of 270 number of PD-3 layers (29 weeks of age) were selected and divided into 9 groups, each having 6 replicates and each replicate with 5 birds. The trial was carried out up to the 52 weeks of age. The mean value of feed intake, number of eggs, egg production and egg weight did not differ among the various dietary groups (Table 25). Whereas, the egg mass and FCR was improved among the birds fed diet with ME of 2600 or 2700 kcal/kg along with 16 or 18% CP compared to those groups fed diet with ME of 2500 kcal/kg. Similarly, hatchability among the various dietary groups did not differ in the present experiment. The glutathione peroxidase (GSH Px) and lipid peroxidation activities in serum of various dietary groups did not differ in the present experiment. Therefore, it is concluded that the diet with ME of 2600 kcal/kg along with 16% CP would be optimum for harvesting the maximum production potential in PD-3 layers.

Another experiment was conducted to optimize the nutrient requirement for PD-3 chicks during the 6 to 14 weeks of age. The growing PD-3 chicks of 6 weeks old (360 numbers) were divided in to six dietary groups of each group having the 12 replicate with 5 birds in each replicate. Six diets were formulated with two levels of ME (2800 and 2650 kcal) and three levels of crude protein (16, 18 and 20%) and fed the birds from 6 to 14 weeks. The feed intake was higher among the birds fed diet with 2650 kcal ME compared to those fed diet having 2800 kcal ME during 6, 7 and 8 weeks (Table 26). However, feed intake during the subsequent period did not differ among different groups. Similarly, body weight gain in different dietary groups did not differ from 6 to 14 weeks of age among different groups. However, the marginally increase in body weight was recorded among the birds fed diet with ME of 2650 kcal and crude protein of 16 or 18% compared to other dietary groups.

Table 24 Effect of age related responses to dietary inclusion of solvent extracted Karanj cake (SKC) in *Vanaraja* chicks

SKC % in diet			Body wt. (g)		Feed intake (g)	
0-2 wks	3-4 wks	5-6 wks	Week 3	Week 6	0-3 wks	0-6 wks
0	0	0	281.56	702.69	463.36	1543.71
0	0	6	279.04	654.31	470.42	1473.09
0	0	9	281.65	661.56	476.11	1498.12
0	3	6	281.12	655.06	484.53	1463.09
0	3	9	276.69	654.29	472.94	1469.22
0	6	6	268.61	634.87	457.99	1439.78
0	6	9	274.38	669.98	470.82	1468.80
		SEM	2.509	6.053	3.734	11.298
		P	0.809	0.106	0.629	0.292
		N	8	8	8	8

Means bearing at least one common superscript in a column do not differ significantly (P<0.05)

Table 25 Effect of feeding diet with varying levels of ME and CP on performance of PD-3 birds from 29-52 weeks (six periods)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8	Diet 9	SEM
Feed intake (g)	2714	2653	2579	2665	2624	2608	2674	2591	2634	13.5
Egg numbers	14.40	13.96	13.61	15.13	16.92	14.63	16.03	15.43	15.40	0.26
HHEP (%)	51.43	49.86	48.60	54.02	60.43	52.26	57.26	55.12	55.00	0.93
Egg weight (g)	50.93	50.19	49.06	51.90	53.30	51.88	51.52	51.77	51.59	0.38
Egg mass (g)	709^{b}	688^{b}	658^{b}	762^{ab}	868^{a}	744^{ab}	807^{ab}	776^{ab}	775^{ab}	14.8
FCR	0.26^{b}	0.26^{b}	0.26^{b}	0.29^{ab}	0.33^{a}	0.29^{ab}	0.30^{ab}	0.30^{ab}	0.29^{ab}	0.03
Hatchability (%)	86.41	83.60	88.4	90.14	85.7	86.1	84.0	88.30	90.1	3.11
GSH Px (units/ml)	139.4	147.8	136.0	138.7	137.9	136.3	138.0	140.2	139.4	3.14
LP (nmol MDA/mg protein)	1.91	1.83	1.94	2.11	1.85	2.04	1.88	2.31	1.94	0.12

Means with different superscripts in a row differ significantly (P<0.05); HHEP: Hen house egg production, FCR: Feed conversion ratio (Egg/ Feed Intake), GSH Px: Glutathione peroxidase, LP: Lipid peroxidation; three levels of energy (2500, 2600 and 2700 kcal/kg) and three levels of crude protein (14, 16 and 18%) were used in the experimental diets

Table 26 Effect of feeding diet with varying levels of energy and proteins on average value of feed intake (g/bird/week) in PD-3 birds from 6-14 weeks of age

Age in weeks	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	SEM	P
6	287.4^{ab}	288.9^{ab}	275.4^{b}	312.5^{ab}	326.1^{a}	314.6^{ab}	7.08	0.01
7	342.5^{ab}	331.0^{ab}	314.6^{b}	363.3^{a}	363.6^{a}	342.1^{ab}	4.68	0.01
8	352.5^{ab}	333.8^{b}	326.1^{b}	360.8^{ab}	386.5^{a}	358.7^{ab}	5.33	0.01
9	433.8	413.9	405.8	435.4	443.0	436.6	4.80	0.16
10	430.3	443.4	433.5	469.0	461.0	459.6	6.06	0.33
11	499.2	507.2	486.5	505.8	514.3	535.7	7.23	0.51
12	535.8	520.3	500.2	526.7	539.3	530.6	6.56	0.58
13	529.0	528.0	490.5	525.9	529.2	527.6	7.39	0.62
14	462.9	458.3	448.7	481.1	459.7	451.7	6.32	0.75

Means with different superscripts in a row differ significantly (P<0.05)

Table 27 Supplementation of organic zinc on Dahlem Red rooster semen quality

Parameters	0 mg/kg	40 mg/kg	70 mg/kg	100 mg/kg	SEM
Volume (ml)	0.57	0.65	0.56	0.52	0.06
Appearance	3.12	3.62	3.50	3.37	0.17
Initial sperm motility (%)	46.88^{ab}	43.44^{b}	51.56^{ab}	55.00^{a}	1.19
Sperm concentration (million/ µl)	4.24	4.85	5.00	4.85	0.32
MTT dye reduction test (nM of MTT Formazan /min/million sperm)	22.40^{b}	22.17^{b}	25.73^{ab}	27.93^{a}	1.17
Live sperm (%)	86.82	87.13	92.24	92.72	0.96
Abnormal sperm (%)	4.14	3.88	3.49	2.61	0.36
Seminal plasma SOD (U/mg protein)	410.15	364.96	366.04	466.16	30.70
Seminal plasma LP (nmol MDA/mg protein)	1.31	2.07	1.27	1.44	0.34
Aniline blue positive sperm (%)	19.81	16.36	17.47	18.74	2.03
Serum parameters					
SOD (U/mg protein)	130.83	120.98	131.24	93.17	6.21
LP (nmol MDA/mg protein)	1.86	1.78	2.03	1.85	0.07

Means with different superscripts in a row differ significantly (P<0.05)

2.4.2 Effect of dietary organic selenium and zinc supplementation on semen quality in PD-3 males

An experiment was conducted to determine the optimum level of organic selenium in the diet of PD-3 males. Thirty males of 29 weeks old were equally grouped and supplemented with organic selenium at different levels (0, 0.15, 0.35 mg/kg diet) in the feed. Organic zinc was supplemented at 100 mg/kg diet in feed except in control group. Semen quality was evaluated at 4 and 8 weeks after feeding. An artificial insemination trial with fixed dose

sperm (100 million sperm in 0.1 ml semen) with the semen from treatment groups was done in PD-3 females (29 weeks of age). The results indicated that organic selenium supplementation improved the sperm activity and live sperm percent. Furthermore, AI using semen from the organic selenium supplemented group gave significantly higher fertility percentage as compared to the control group (Table 28). However, the hatchability of eggs was not affected by organic selenium supplementation.

2.4.3 Comparative evaluation of PD-3 and layer control populations for semen quality parameters

In a series of experiments the semen quality of layer control and PD-3 lines was studied to identify factors responsible for poor semen quality in PD-3 line. The semen quality of both the lines was evaluated at 29 weeks of age. Eleven birds from each line were randomly selected and semen collected by abdominal massage. Semen samples were evaluated for different gross semen parameters. Layer control males were found to have higher sperm concentration and MTT dye reduction activity than those of PD-3 males (Table 29). At 30th week, an artificial insemination (AI) trial was conducted using fixed dose of sperm (100 millions) in 0.1 ml of semen. Semen from each line was pooled and inseminated into 20 birds of respective lines. Eggs were collected from 2nd day after AI for 20 days and fertility was assessed on 18th day of incubation by candling. No significant difference in fertility was observed between the two lines (Fig. 4).

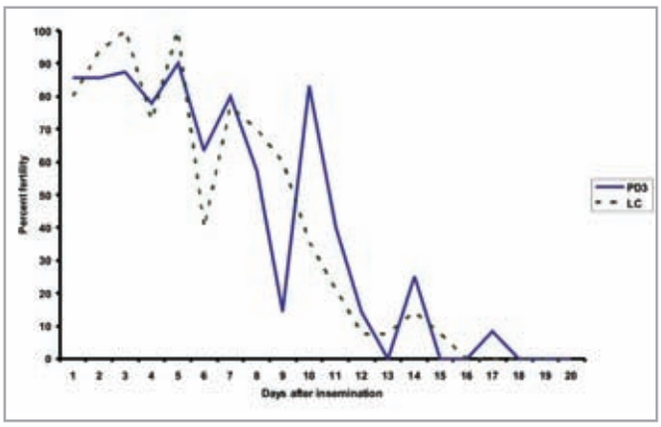


Fig. 4 Percent fertility in PD-3 and White leghorn layer after fixed dose insemination

Table 28 Supplementation of organic selenium on Dahlem Red rooster semen quality

Parameters	0 mg/kg	0.15 mg/kg	0.35 mg/kg	SEM
Volume (ml)	0.59	0.55	0.52	0.06
Appearance	3.70	3.53	3.60	0.21
Initial sperm motility (%)	59.25	63.68	65.88	2.46
Sperm concentration (million/ µl)	4.64	4.90	4.74	0.32
MTT dye reduction test (nM of MTT Formazan /min/million sperm)	23.75^{b}	24.84^{ab}	27.56^{a}	0.91
Live sperm (%)	79.41^{b}	82.98^{b}	94.02^{a}	2.24
Abnormal sperm (%)	5.28	4.64	3.85	0.98
Seminal plasma lipid peroxidation (nmol MDA/mg protein)	2.88	2.29	1.74	0.44
Fertility (%)	39.10^{b}	71.40^{a}	65.32^{a}	3.40
Hatchability on FES (%)	69.36	67.77	70.67	4.69

Means with different superscripts in a row differ significantly (P < 0.05)

Table 29 Semen quality of PD-3 and White Leghorn layer males at 29 weeks of age

Parameters	Layer control	PD-3
Volume (ml)	0.30 ± 0.04^{b}	0.49 ± 0.05^{a}
Initial sperm motility (%)	53.64 ± 2.34	49.10 ± 1.63
Sperm concentration (million/µl)	5.96 ± 0.30^{a}	4.85 ± 0.32^{b}
MTT Formazan (nM/min/million sperm)	21.01 ± 1.29^{a}	17.91 ± 1.16^{b}
Dead sperm (%)	5.87 ± 0.72	8.47 ± 1.65
Abnormal sperm (%)	0.99 ± 0.20^{b}	2.55 ± 0.53^{a}
Hypo-osmotic swelling test (HOST) (%)	92.97 ± 1.03^{a}	87.65 ± 1.02^{b}

Means with different superscripts in a row differ significantly (P < 0.05)

Table 30 Semen quality of PD-3 and White Leghorn layer males at 46 and 47 weeks of age

Parameters	Layer control (n=18)	PD-3 (n=18)
Volume (ml)	0.30 ± 0.04^{b}	0.40 ± 0.03^{a}
Appearance	3.81 ± 0.27^{a}	3.25 ± 0.13^{b}
Initial sperm motility (%)	58.44 ± 2.83	52.19 ± 2.29
Sperm concentration (million/µl)	4.47 ± 0.43^{a}	3.38 ± 0.40^{b}
MTT Formazan (nM/min/million sperm)	30.28 ± 0.73	28.95 ± 1.30
Dead sperm (%)	8.83 ± 1.25^{a}	6.40 ± 0.47^{b}
Abnormal sperm (%)	0.76 ± 0.23^{b}	2.88 ± 1.18^{a}
Aniline blue staining (%)	83.41 ± 2.43	81.35 ± 3.37
COMET score (AU)	100.06 ± 19.68	110.00 ± 19.65

Means with different superscripts in a row differ significantly (P < 0.05)

The semen quality of Layer control and PD-3 lines was evaluated at 46 and 47 weeks of age and compared. The average values of different parameters are given in Table 30. The layer control birds had better semen quality than that of PD-3 line. The abnormal sperm percent was lower in layer control line but there was no difference in aniline blue staining which indicates the nuclear maturity of sperm. The comet assay that measures the level of apoptosis also did not show any difference between the lines (Fig. 5). Thus, it can be inferred that the abnormal sperms observed in semen may be due to other developmental abnormalities and may not be due to defects in nuclear maturity.

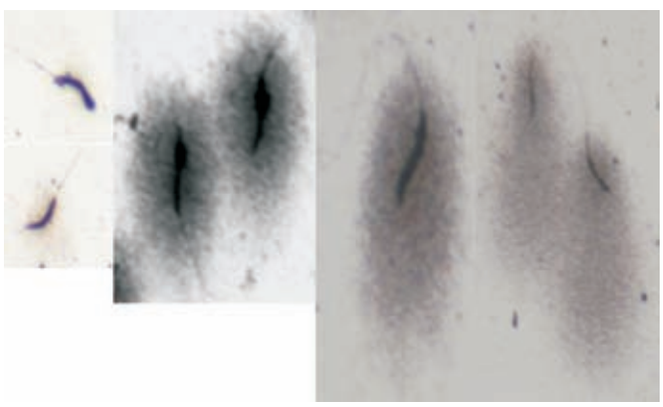


Fig. 5 Different patterns of sperm comet stained with silver stain. The scoring of comets was done according to the size and movement of comet. The scores given in the representative pictures are a=0, b=1, c=2, d=3, e=4.

2.4.4 Sperm chromatin dispersion (SCD) test to assess semen quality of different age roosters during hot climatic condition

An experiment was conducted to evaluate the semen quality of roosters of different ages during hot climatic condition. Semen from roosters (n=8 / age group) of 23, 37 and 65 weeks of age was collected by abdominal massage and evaluated for different gross semen parameters. The sperm membrane integrity was evaluated by hypo-osmotic swelling test (HOST) and sperm DNA fragmentation was assessed by Sperm Chromatin Dispersion (SCD) test (Fig. 6). The seminal plasma cortisol level was assessed by enzyme immunoassay kit. The shed average Temperature Humidity Index (THI) during the experiment period was 79.32. Semen volume and sperm DNA fragmentation were significantly different (Pd"0.05) between the age groups tested. Roosters of 37 weeks age had higher semen volume (0.48 ± 0.06 ml) and lower sperm DNA fragmentation percentage (24.62 ± 1.89) during study period. None of the other parameters were influenced by the age of the birds. The results indicated that semen quality is affected by the age of the birds.

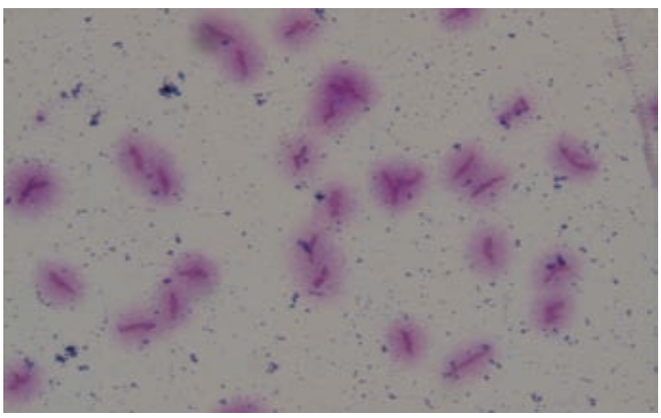


Fig. 6 Sperm Chromatin Dispersion (SCD) test

2.4.5 Screening of pure line males for semen quality

Pedigreed male parents of different lines namely, PB-2 (n=65), PD-1 (n=68), CB (n=60), GML (n=75), PD-4 (n=75), PB-1 (n=89), IWH (n=60), IWK (n=60), IWA (n=60) and IWI (n=70) were evaluated for semen quality before commencing the regeneration of birds and birds with poor quality semen were recommended for removal from the breeding programme.

2.5 Avian Health

2.5.1 Disease monitoring and control in pure line chickens

2.5.1.1 Mortality pattern and causes of mortality

Mortality pattern and causes of mortality were determined among pure line chicken populations. Major causes of mortality during the period under report include chronic respiratory disease (CRD), heat stress, collibacillosis, Marek's disease (MD), Aspergillosis and Rickets (Table 31). Microscopic examination of tracheal tissue from CRD case revealed extensive thickening of mucosal layer due to severe infiltration of mononuclear cells and engorgement of capillaries (Fig. 7). The season wise incidence of CRD was 17.15% in summer (March-June), 6.37% in rainy (July-October) and 9.25% in winter (November-February). The vlhA gene of *M. synoviae* isolates and Mgc2 gene of *M. gallisepticum* isolates were sequenced and compared with reference strains. Aspergillosis was recorded in Dahlem Red (DR) and Nicobari breeds. Out of total mortality, the incidence of Aspergillosis was 9.23% and 7.58% in DR and Nicobari lines respectively. Mortality due to MD was recorded in all lines with highest frequency in DR followed by Ghagus, PB-1, Aseel and *Vanaraja*.

Table 31 Mortality due to colibacillosis, CRD, coccidiosis and heat stress

Cause	Mortality (%)								
	Broiler				Layer				Total
	Chick	Grower	Adult	Total	Chick	Grower	Adult	Total	
Colibacillosis	10.2	5.65	3.18	6.73	3.40	2.66	2.40	2.90	4.89
CRD	11.0	14.0	10.2	12.00	15.00	11.70	6.30	11.00	11.49
Coccidiosis	4.95	3.90	0.00	3.04	7.41	3.20	0.10	3.78	3.39
Heat Stress	3.3	14.4	13	9.19	1.21	1.19	2.40	1.56	5.58

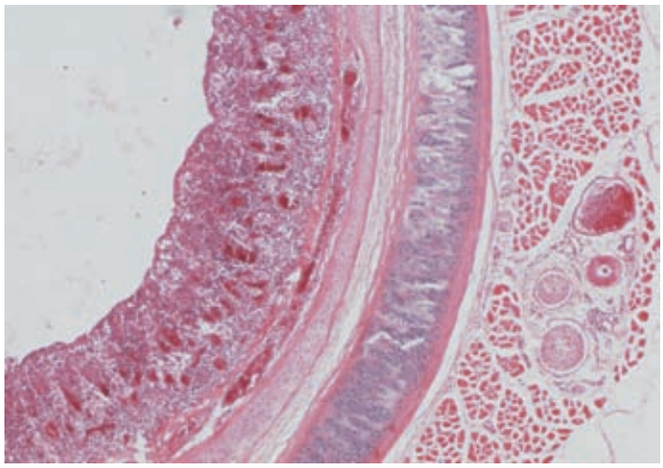


Fig. 7 Tracheal tissue revealing extensive thickening of mucosal layer due to severe infiltration of mononuclear cells and engorgement of capillaries

2.5.1.2 ALV infection status

A total of 5,883 birds belonging to 14 pure lines were tested for Avian Leukosis Virus (ALV) by using antigen ELISA. A total of 475 birds out of 5883 (8.1%) were found positive (Table 32). ELISA. ALV shedding and ALV antibody were determined by antigen ELISA and antibody ELISA, respectively. Based on the presence and absence of Viremia, Antibody and Shedding, the birds were divided into 8 categories (Table 33). A total of 24 ALV strains isolated and identified by sub group specific PCR. A total of 3 isolates were ALV-A, 7 isolates were ALV-B and remaining were found to be mixture of ALV-A, B and C. The envelop gene of 1 ALV-A isolate (DPRE32) was sequenced and compared with reference strains. Multiple sequence alignment and phylogenetic analysis revealed that the isolate is closely related to ALV-A reference stain (Fig. 8). All the positive birds were discarded.

TVB receptor status of Aseel (from field) and Red Jungle Fowl (RJF) were analyzed by PCR-RFLP (Fig. 9). In Aseel, two alleles (S1 (0.57) and S3 (0.43) and 3 genotypes [(S1/S1 (0.31), S1/S3 (0.51) and S3/S3

Table 32 Prevalence of avian leukosis in various chicken lines

Line	Females			Males			Total		
	NT	NP	P (%)	NT	NP	P (%)	NT	NP	P (%)
PB-1	346	10	2.9	98	7	7.1	444	17	3.8
PB-2	344	69	20.1	69	4	5.8	413	45	10.9
CB	329	32	16.9	81	3	3.7	410	35	15.4
IWI	479	44	9.2	193	0	0.0	692	44	6.4
IWK	466	13	2.8	177	3	1.7	643	16	2.5
IWH	272	7	2.6	166	5	3.0	438	12	2.7
Layer control	379	76	20.1	211	8	3.8	590	84	14.2
PD-2	458	109	23.8	160	2	1.3	618	111	18.0
PD-4	232	15	6.5	102	2	2.0	334	17	5.1
Dw	67	2	3.0	48	1	2.1	115	3	2.6
Na	96	0	0.0	31	0	0.0	127	0	0.0
GML	421	16	3.8	94	3	3.2	515	0	0.0
GMLC	83	5	6.0	28	0	0.0	111	0	0.0
Cornish	362	89	24.6	71	2	2.8	433	91	21.0
Total	4334	487	11.2	1529	40	2.6	5883	475	8.1

NT: Number tested NP: Number positive; P: Positive

(0.17)] were found while in Red Jungle fowl only 1 allele (S1) and 1 genotype (S1/S1) was found. Based on the results, it is inferred that the Red Jungle Fowl was susceptible to ALV subgroups B, D and E. In Aseel, genotypes S1/S1 and S1/S3 were susceptible to ALV subgroups B, D and E, while genotype S3/S3 was susceptible to ALV-B and ALV-D and resistant to ALV-E. The endogenous virus loci including ev15, ev16, ev9, ev4, ev21 and ev6 were investigated in Aseel and RJF. It was found that all the tested birds were found to be homozygous negative for *ev* loci tested.

Table 33 Categories of avian leukosis virus infection

Category	Line A		Line C		Line D		Line E	
	No	%	No	%	No	%	No	%
V-A-S-	9	30.0	2	6.7	9	30.0	1	3.3
V-A+S+	0	0.0	11	36.7	4	13.3	15	50.0
V+A+S+	0	0.0	2	6.7	2	6.7	6	20.0
V+A+S-	0	0.0	0	0.0	2	6.7	0	0.0
V+A-S-	0	0.0	1	3.3	3	10.0	0	0.0
V+A-S+	0	0.0	2	6.7	4	13.3	1	3.3
V-A+S-	21	70.0	1	3.3	3	10.0	2	6.7
V-A-S+	0	0.0	11	36.7	3	10.0	5	16.7
Total	30	100.0	30	100.0	30	100.0	30	100.0

V:Viremia; A:Antibody S: Shedding

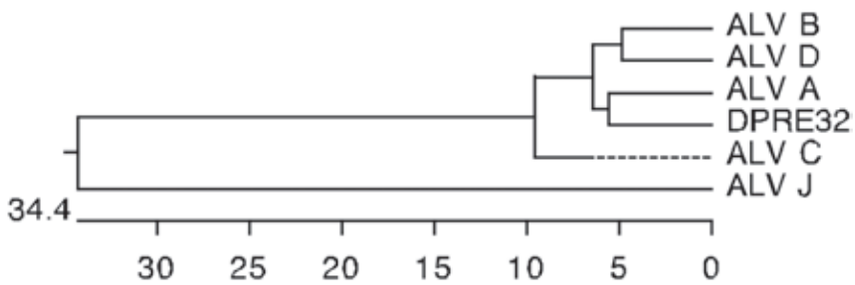


Fig. 8 Phylogenetic tree of ALV-A isolate based on envelop gene nucleotide sequence

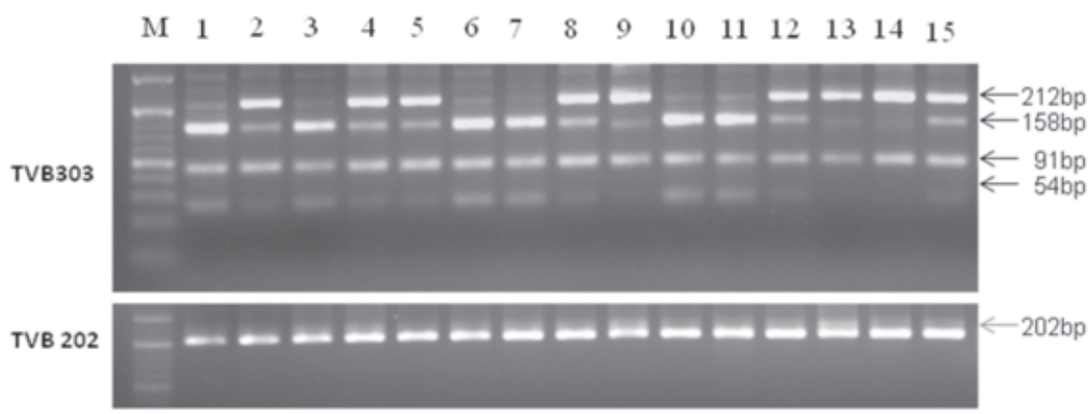


Fig. 9 Electrophoresis patterns of the PCR product TVB303 and TVB202 digested with endonuclease *NlaIII* and *Xbal*, respectively. Based on the TVB303 and TVB202 digestion patterns, the samples are classified into different genotypes. Lane M: 20 bp ladder; lane 1, 3, 6, 7, 10 and 11: birds with S1/S1 genotype; lanes 2, 4, 5, 8, 9, 12, 13 and 15: birds with S1/S3 genotype and lane 14: birds with S3/S3 genotype.

3. Technology Assessed and Transferred

3.1 Germplasm supply

Vanaraja and *Gramapriya* the two rural chicken varieties developed by this Directorate reached majority of states in our country due to their physical characteristics, greater adaptability to the diversified agro-climatic conditions and their production potential with minimum investment. About 65,154 hatching eggs were supplied to different organizations and NGOs. A total of 2,13,791 day old chicks of *Vanaraja*, *Gramapriya* and *Krishibro* were supplied to the farmers across the country during the period. To meet the larger section of the society in farthest areas, the Directorate has supplied 47,030 day old parent chicks of *Gramapriya*, *Vanaraja* and *Krishibro*, where the commercial chicks are being produced and supplied to the farmers.

3.2 Exhibitions

3.2.1 DPR stall attracts visitors at Poultry India 2013

DPR participated in Poultry India 2013 organized by IPEMA at Hitex Exhibition Complex, Hyderabad from 25 to 27th November 2013. DPR stall attracted the attention of all the delegates. The technologies developed by the Institute especially the improved chicken varieties; *Vanaraja and Gramapriya* attracted the poultry farmers. About 5000 thousand farmers, technocrats and scientists visited the DPR stall in 3 days.

3.2.2 DPR participated in Farmers' day at DRR

The Institute participated in the farmers' day organized by DRR, Hyderabad on 20th October 2013. Our stall attracted the attention of the farmers and visitors at the exhibition. The literature on the improved chicken varieties was distributed to the farmers.

3.2.3 DPR participated in Farmers' day at CRIDA, Hayatnagar

The Institute participated in the farmer's day organized by CRIDA on 13th September 2013 at Hayatnagar Farm, Hyderabad. DPR stall attracted the attention of the farmers and visitors at the exhibition. The literature on the improved chicken varieties was distributed to the farmers.

3.2.4 DPR stall attracts visitors at Global Millet Meet 2013

DPR participated in the exhibition organized by DSR, Hyderabad during 18th to 20th December 2013 on the occasion of Global Millet Meet. DPR stall attracted the attention of the farmers and scientists at the exhibition. The literature on the improved chicken varieties was distributed.

3.2.5 DPR participated in Krishi Vasant 2014

DPR participated in Krishi Vasant, the biggest National Agriculture Fair cum Exhibition from 9th to 13th February 2014 at Nagpur, Maharashtra. Lakhs of farmers across all states of the country participated in the mela. Thousands of rural and progressive farmers and several dignitaries from various government and NGOs visited the DPR stall. All were appraised about the low input improved rural chicken varieties developed by the Directorate. DPR staff also participated in the scientific sessions/farmers –scientist interface in Telugu language as expert.

DPR staff interacting with farmers at Krishi Vasant

3.2.6 Training program on Scientific Poultry Farming for farmers

A 6 day training program was organized by the Directorate on scientific poultry farming for the farmers from Iza, Mahabubnagar, Andhra Pradesh from 27th January to 1st February 2014. Eight farmers participated in the training program. The farmers were exposed to different routine poultry farm operations and rural poultry. The farmers expressed their satisfaction about the training program. The program was sponsored by Access Development services, an NGO based at Hyderabad.

Interactive session of farmers in progress

3.2.7 Training program on Poultry Production and Disease Management for extension functionaries from Odisha

The Institute organized a 6 days training program on 'Poultry Production and Disease Management' for the extension officers working with the tribal farmers of the Odisha during 10th-15th March 2014. The program was sponsored by an NGO 'Swarna Jyoti Women Poultry Co-operative Federation Ltd.,' Parabeda, Jeypur, Koraput, Odisha. A total of 10 extension workers participated in this training program. The participants were exposed to various activities related to poultry farming with more emphasis on disease management, diagnosis and treatment. The training was imparted with lectures from scientists and practical sessions with hands on training on various aspects of backyard poultry production using improved crosses, common diseases of poultry, diagnosis, management and prevention, post-mortem examination, poultry farm and hatchery management, feed formulation, duck production and management, etc. The participants expressed their satisfaction for the training program.

Extension personnel trainees with DPR staff

4. Education and Training

In the training programmes organized by different institutions staffs of the Directorate participated to update and gather knowledge in different aspects including science and technology, administration and financial management. It is a fact that time to time refresher courses are very much necessary for the staff to get acquainted with the new inventions, technologies developed and rule position in the field of science and technology, and administration. The details of training programmes attended by the staff have been stated in the following Table.

Table 1 Training and HRD activities of the Directorate

S.No.	Particulars of training	Official (s)	Duration	Venue
1	Short course on recent advances in proteomics for biomarker discovery	Dr. M. Shanmugam, Scientist	8th -17th July 2013	NDRI, Karnal.
2	DBT Crest training programme	Dr. A. K. Panda, Pr. Scientist	1st October 2012 - 5th August 2013	Oregon State University, Corvallis, USA
3	Management training programme on consultancy projects management.	Dr. T. R. Kannaki, Scientist	1st -7th August 2013	NAARM, Hyderabad
4	International training in the area of 'Marker assisted selection on analysis of qualitative trait data using pedigree based and genomics methods of statistical analysis'	Dr. K.S.Rajaravindra, Scientist	18th November 2013 - 20th January 2014	Department of Animal Science, Iowa State University, USA

TALKS DELIVERED

- Dr. Santosh Haunshi, Sr. Scientist delivered a seminar on "Identification of genes and genetic markers for resistance to Marek's disease in chicken".
- Dr. B. Prakash, Scientist delivered seminar on "Nutrigenomics".
- Dr. A.K. Panda, Sr. Scientist delivered a seminar on "Effect of oxidative stress and its evaluation through antioxidant and gene expression system".
- Dr. M.R. Reddy, Pr. Scientist delivered a talk on "Use and maintenance of laboratory note books and auxillary data files".
- Dr. (Mrs.) T.R. Kannaki, Scientist delivered seminar on "LAMP based rapid diagnosis of Marek's disease in chicken".

5. Awards and Recognition

The research and extension services of the Directorate received appreciation from different professional bodies and government organizations.

- Dr. T. K. Bhattacharya, National Fellow and Dr. R. N. Chatterjee, Director received Hari Om Ashram Trust Award conferred by Indian Council of Agricultural Research, New Delhi.
- Dr. S. V. Rama Rao, Principal Scientist was awarded CLFMA Appreciation Award for the year 2013.
- Dr. R. N. Chatterjee, Director has been conferred with NAVS Fellowship, NAVS, New Delhi.
- Dr. T. R. Kannaki, Scientist was awarded with the Avitech Young Scientist award for best research paper presentation at Indian Poultry Science Association (IPSACON 2013), CARI, Bareilly, India- 22-23 November 2013.
- Dr. S. V. Rama Rao was awarded with the 'Best Poultry Scientist' Award for the year 2014 from C. K. Rao Endowment Trust, Hyderabad.

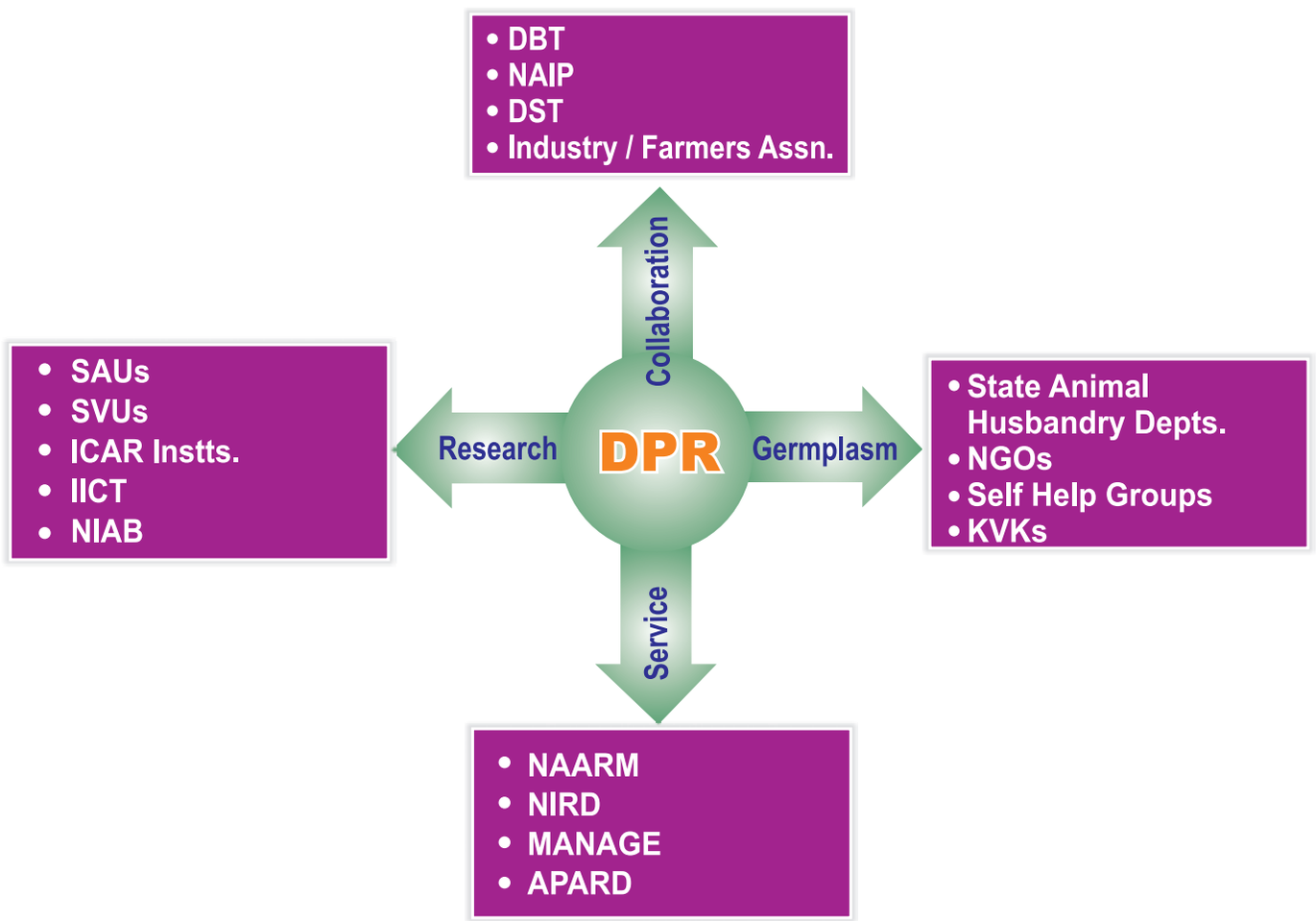
Dr. S. V. Rama Rao, Pr. Scientist receiving CLFMA award

Dr. R. N. Chatterjee, Director receiving NAVS Fellowship

6. Linkages and Collaborations

Equipped with the state of art infrastructure facilities, the Directorate is well positioned for conducting advanced research in the fields of Poultry Genetics and Breeding, Nutrition and Health. The facilities available at this Institute were utilized by the students of institutions like SVVU, Hyderabad; IVRI, Izatnagar for carrying out their dissertation works. The scientists of this Institute guided the research works of the students as Thesis Guide/Co-chairman/members of the students' advisory committee. The faculty and students of the local Institutions utilized the library facilities. Several trainees/students from neighbouring Institutions like NAARM, SVVU, ANGRAU, TANUVAS, MANAGE, NIRD, IICT, etc. visited the Directorate to get exposed to the applied aspects of poultry farming, research and extension. One collaborative project on "Detoxification of karanja (*Pongamia glabra*) seed cake and its utilization in broiler and layer chicken diets" with IICT, Hyderabad sponsored by Dept. of Science & Technology, Govt. of India is going on at the Directorate.

The action mode of DPR is in net work mode, having link with various SAUs, SVUs and ICAR institutions across the country. Besides two network research programmes (AICRP and PSP), the Directorate is actively working with various stake holders of rural and commercial poultry farming fraternity like Animal Husbandry departments of Chattisgarh and Odisha.



Collaboration of DPR with different agencies

7. AICRP on Poultry Breeding and Poultry Seed Project

7.1 AICRP ON POULTRY BREEDING

The AICRP on Poultry Breeding has been in operation with the aim of developing high yielding layer and broiler varieties for intensive farming and also for evolving location specific varieties for rural poultry utilizing both indigenous and exotic chicken germplasm. The AICRP on poultry breeding has three components, namely, Poultry for Egg, Poultry for Meat and Rural Poultry. The 'Poultry for egg' component of the project included IWD and IWF strains at SVVU, Hyderabad; IWN and IWP strains at KVASU, Mannuthy and AAU, Anand. All the layer strains were subjected to selective breeding through intra-population selection. Selection (using individual, full-sib, and half-sib information) for egg production up to 64 weeks of age with superimposed independent culling level for egg weight at 28 weeks of age and layer house viability has been continued to achieve the set target in the layer stocks.

The Poultry for Meat component for the project included a synthetic sire (PB-1) and dam line (PB-2) at GADVASU, Ludhiana and KVAFSU, Bengaluru; coloured synthetic broiler lines such as CSML (sire line) and CSFL (dam line) and corresponding control at CARI, Izatnagar and a synthetic dam line (SDL) and CSML at OUAT, Bhubaneswar. They were all subjected to selective breeding through mass selection for 5 weeks body weight with due weightage for conformation traits in male lines, 5 weeks body weight, egg production and hatchability in female lines, have been continued to be traits of importance to achieve the target in the meat stocks.

7.1.1 Poultry for Eggs

7.1.1.1 Mannuthy centre

The KVASU, Mannuthy centre has evaluated the S-27 generation of IWN and IWP populations up to 64 weeks of age during 2013-14. One hatch was evaluated up to 72 weeks of age and S-28 generation was regenerated. The hen housed and hen day egg production up to 64 weeks of age increased by 13.44 and 11.43 eggs respectively over previous generation in IWN strain (Table 1). In IWP, hen housed egg production up to 64 weeks of age increased by 1.03 eggs over previous generation. Hen housed egg production up to 72 weeks of age was 311.7 and 299.8 eggs in IWN and IWP strains, respectively while hen day egg production in corresponding strains were 313.7 and 302.3 eggs. The average genetic response for egg production to 64 weeks of age in IWN (3.14 eggs) was higher than IWP (1.56 eggs) strain in last ten generations (Fig. 1). The egg weight decreased at 40 weeks of age in both populations compared to last generation but egg weight at 64 weeks increased in IWN compared to last generation. The survivability in both selected lines from 17-64 weeks of age was above 94.17%. Fertility was more than 91% in both the selected lines. The centre has generated Rs. 44.74 lakhs which was 149.13% of the expenditures on feed cost. The centre supplied 22,477 germplasm during the year.

7.1.1.2 Anand centre

The S-11 generation of IWN and IWP strains were evaluated up to 64 weeks of age at AAU, Anand during 2013-14. One hatch in pure lines and IWN X IWP, DK X NP were evaluated up to 72 weeks of age. The centre initiated regeneration of S-11 generation. The egg production up to 64 weeks of age has increased in IWN by 9.64 eggs, in IWP by 11.05 eggs and in control by 21.52 eggs over previous generation (Table 2). The egg production up to 72 weeks of age was 301.8 and 300.3 eggs in IWN and IWP, respectively. The egg weight increased by 0.91 g in IWN and 0.46 g in IWP at 40 weeks of age compared to last generation. The egg weight at 64 weeks of age also increased in both selected populations as compared to previous generation. The

Table 1 Growth and production performances (S-26 generation) of IWN, IWP and Control at Mannuthy

Traits		IWN		IWP		Control	
		n	Mean ± SE	n	Mean ± SE	n	Mean ±SE
Body wt. (g)							
	16 wks	1736	1118±2.94	1776	1133±2.18	13	1035±35.23
	40 wks	1682	1446±4.16	1702	1485±4.21	13	1400±51.80
	64 wks	1636	1547±4.78	1659	1547±4.63	13	1440±56.62
ASM (d)		1718	139.0±0.68	1757	139.1±0.18	13	145.3±1.94
EW (g)							
	28 wks	1688	48.98±0.43	1705	49.74±0.08	13	46.60±1.02
	40 wks	1661	51.91±0.48	1647	52.09±0.09	13	52.61±1.17
	64 wks	1593	55.03±0.49	1609	56.53±0.11	13	54.95±1.31
EP (No.)	40 wks						
	HH	1722	128.0±1.73	1767	124.6±0.60	13	103.8±8.80
	HD : 17-40 wks		129.1		126.7		103.8
	HD : 21-40 wks		126.0		122.8		103.8
	Survivor	1627	129.5±0.38	1718	126.9±0.51	13	103.8±8.80
EP (No.)	64 wks						
	HH	1722	264.8±2.86	1767	255.1±1.31	13	218.6±12.66
	HD : 17-64 wks		270.8		262.2		218.6
	HD : 21-64 wks		267.7		257.6		218.6
	Survivor	1620	272.0 ±0.75	1670	262.4±0.98	13	218.6±12.66
EP (No.)	72 wks						
	HH	300	311.7±2.34	300	299.8±2.18		-
	HD 17-72 wks		313.6		302.1		-
	Survivor		313.7±1.90		302.3±1.80		-

HH : Hen Housed ; HD : Hen Day

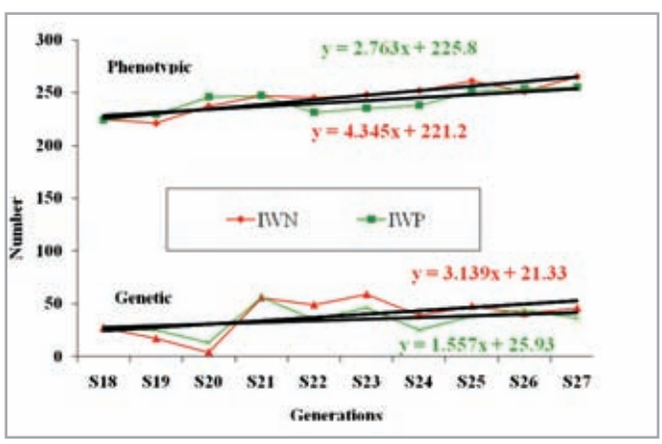


Fig. 1 Direct response to egg production up to 64 weeks of age in IWN and IWP strains

average genetic response of egg production up to 64 weeks of age in both selected strains (1.08 in IWN and 1.93 in IWP) was positive over last 11 generations (Fig. 2). The egg production of IWN X IWP and DK X NP up to 72 weeks of age was 301.3 and 275.7 eggs, respectively. The egg production of IWD and IWK up to 64 weeks of age was 243 and 217.7 eggs, respectively. The survivability from 17 to 72 weeks of age in N X P and DK X NP was 91.33 and 88.67%, respectively. The centre generated Rs. 33.28 lakhs of revenue which was 103.94% of the expenditure on feed cost. The centre has evaluated the NxP cross up to 72

weeks of age under field condition. The IWN X IWP cross produced 275.6 and 214.9 eggs, on hen day and hen housed production, respectively under field condition (Table 3).

7.1.1.3 Hyderabad centre

The S-30 generation of IWD and S-29 generation of IWF were evaluated up to 64 weeks of age at SVVU, Hyderabad. One hatch was evaluated up to 72 weeks of age in both selected lines and regenerated S-31 and S-30 generations of IWD and IWF, respectively. Fertility and hatchability increased in both the strains compared to last generation. The egg production up to 64 weeks of age in IWD and IWF were 228 and 231 eggs, respectively (Table 4).Corresponding egg production up to 72 weeks of age were 276 and 280 eggs. Egg weights at 64 weeks of age in IWD and IWF were 56.0 and 54.3g, respectively. The average genetic response for egg production up to 64 weeks of age for last 12 generations were 0.77 egg in IWD and 0.30 egg in IWF,

Table 2 Performance of IWN and IWP strains and Control (S-11 generation)

Traits		IWN	IWP	Control
No. of pullets housed		1867	1825	76
ASM (d)		145.26±0.23	144.91±0.25	151.07±1.04
Body wt. (g)				
	16 wks	1059±2.46	1656±4.03	1749±4.07
	40 wks	1755±7.73	1115±2.70	1689±4.68
	64 wks	1787±4.57	1775±8.56	1024 ± 10.68
	72 wks	1551 ± 21.09	1784 ± 15.90	-
EP (No.)	40 wks			
	HH	112.54	116.72	119.28±0.39
	HD	98.93	110.39	116.63±0.43
	Survivor	-	-	103.39±1.75
EP (No.)	64 wks			
	HH	232.23	246.88	259.60±0.69
	HD	199.74	234.89	254.60±0.84
	Survivor	-	-	218.56± 4.08
EP (No.)	72 wks		301.84±1.26	300.32±1.49 -
Egg wt. (g)				
	28 wks	49.39±0.07	49.80±0.08	48.39 ± 0.49
	40 wks	52.21±0.07	53.10±0.07	51.53 ± 0.30
	64 wks	54.24±0.09	55.61±0.11	55.30 ± 0.40
	72 wks	54.20±0.11	54.87±0.16	-
Feed Con. /bird (kg)				
	17-40 wks	19.02	19.53	19.97
	17-64 wks	39.03	39.65	39.44
	17-72 wks	45.53	46.22	-

HH : Hen Housed ; HD : Hen Day

Table 3 Performance of IWN X IWP cross under field conditions

Traits		Nitinkumar Shastri, Dist.-Valsad	
No. of pullets housed		300	
Body wt. (g)			
	16 wks		1135
	40 wks		1570
	64 wks		1665
	72 wks		1726
Age at first egg in the flock (d)		120	
Age at 50 % Prod. (d)		148	
Age at peak Prod. (d)		168	
HHEP		**%**	**EN**
	17-40 wks	60.38	101.44
	17-64 wks	61.25	205.80
	17-72 wks	54.82	214.89
HDEP		66.61	111.90
	17-40 wks	70.71	237.59
	17-64 wks	70.30	275.58
	17-72 wks		
Egg wt. (g)	28 wks	49	
	40 wks	51	
	64 wks	53	
	72 wks	53	
Feed Cons. (kg)	0-8 wks	1.486	
	9-16 wks	3.361	
	17-40 wks	8.453	
	17-64 wks	8.314	
	17-72 wks	4.57	
Mortality (%)	0-8 wks	11.69	
	9-16 wks	5.69	
	17-40 wks	4.66	
	17-64 wks	11.33	
	17-72 wks	15.00	

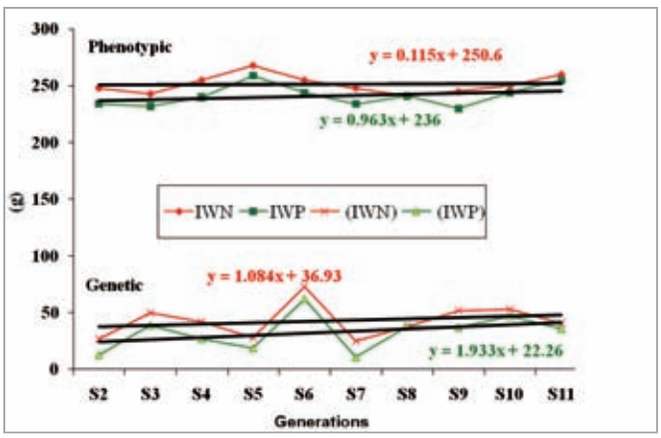


Fig. 2 Direct response to egg production up to 64 weeks of age in IWN and IWP strains

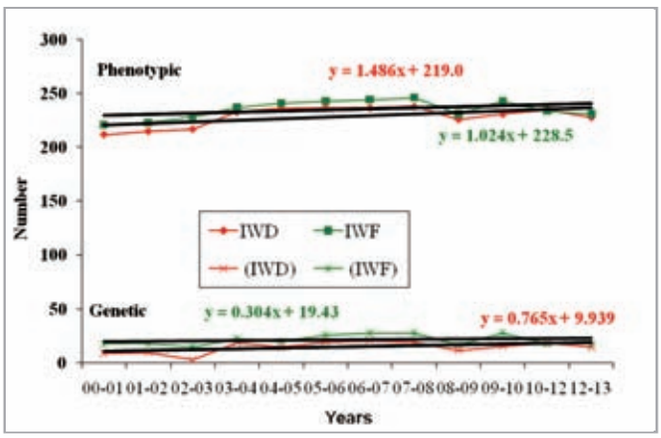


Fig. 3 Direct response up to 64 wks egg production in IWD & IWF strains

respectively (Fig. 3).The centre has generated Rs. 8.18 lakhs which is 51.41% of the expenditure on feed cost. The centre supplied 5,100 chicken germplasm during the year.

Random Sample Poultry Performance Test

Two AICRP centres on poultry for egg had participated in the 23rd random sample poultry performance test, held at Gurgaon in the year 2012-2013. The hen housed egg production of layer strain crosses up to 72 weeks of age from Anand and Hyderabad centre were low. The average egg weight in both centres was 45 g. On hen day egg production basis, amongst the three entries, Anand centre stood first and Hyderabad centre was in third position.

Table 4 Performance of IWD (S-30 generation), IWF(S-29 generation) and Control populations

Traits		IWD	IWF	Control
Pullets housed (No.)		2250	2215	NA
Body wt. (g)				
	16 wks	1180±4.68	1210±6.81	1180±7.75
	40 wks	1280±4.16	1237±7.04	1320±9.02
	64 wks	1309±7.87	1295±5.38	1355±8.85
ASM (d)		150±0.18	148±0.14	154±0.18
Egg wt. (g)				
	28 wks	46.6±0.10	47.9±0.11	47.1±0.22
	40 wks	50.3±0.26	51.1±0.14	51.2±0.53
	64 wks	56.0±0.10	54.3±0.44	53.1±0.24
Survivor EP (No.)				
	40 wks	105± 0.34	110±0.21	95.2±0.28
	64 wks	228±1.27	231±1.49	213±2.58
	72 wks	276±2.28	280.1.02	-

7.1.2 Poultry for Meat

7.1.2.1 Bengaluru centre

The Bengaluru centre evaluated production traits of S-18 generation and also evaluated juvenile traits of S-19 generation of PB-2 line. In addition to this, production traits of S-5 generation and juvenile traits of S-6 generation of PB-1 were evaluated along with the DPR control population. The average body weight at 5 weeks of age was 1,116 and 1,196 g in PB-2 and PB-1 lines, respectively. The average genetic and phenotypic response for 5weeks body weight in PB-2 was 30.60 and 32.10 g, respectively over last 5 generations. Egg production up to 40 weeks of age increased over previous generation in PB-1 but decreased in PB-2. The fertility was more than 88% in both the selected populations. Feed conversion ratio was 2.00 in PB-2, 2.08 in PB1 and 2.51 in control population. Genetic and phenotypic response for 5 weeks body weight in PB-2 is presented in Fig. 4. The centre earned revenue of Rs. 37.02 lakhs as receipt which was 99.17% of the expenditure on feed cost.

7.1.2.2 Ludhiana centre

The Ludhiana centre regenerated S-38 generation of PB-2 and S-6 generation of PB-1 populations along with control broiler population. The body weight at 5 weeks of age was 1,065, 1,068 and 604 g in PB-2, PB-1 and control populations respectively (Table 6). Over the last six generations, 5 weeks body weight in PB-2 improved by 15.14 and 61.45 g per generation on phenotypic and genetic scales respectively. The feed efficiency up to 5 weeks of age improved in all the three populations.The fertility remained above 77% and hatchability on fertile eggs set was 79.2% in PB-2 and 85.6% in PB-1. During the juvenile stage, the survivability improved in PB-2 as compared to previous generation. Commercial cross in the field attained body weight of 1,040 and 1,510 g at 5 and 7 weeks of age respectively. Genetic and phenotypic response in PB-2 is presented in Fig. 5. The centre generated revenue of Rs. 20.47 lakhs that was 61.18% of the expenditure on feed cost.

Table 5 Performance of PB-1, PB-2 and control broiler population at Bengaluru

Traits	PB-1	PB-2	Control
Body wt. (g)			
5 wks	1196	1116	808
20 wks	2428	2289	-
40 wks	3372	3482	-
FCR (0-5wks)	2.08	2.00	2.51
ASM (d)	181	188	-
Egg wt. (g)			
32 wks	56.07	55.01	-
EP (No.)			
40 wks	72.79	56.79	-
52 wks	111.89	97	-

7.1.2.3 Izatnagar centre

CARI, Izatnagar centre evaluated CSML and CSFL and Control population. Body weight at 5 weeks of age improved in both selected populations but decreased in control populations. FCR was 2.0, 2.04 and 2.21 in CSML, CSFL and control population respectively. ASM increased marginally in all populations. The 52 weeks egg production increased by 2.30 eggs in CSFL as compared to previous generation (Table 7). The egg production up to 40 weeks of age increased in CSML and CSFL. The genetic response was 13.30 g in CSML and 16.80 g per generation in CSFL for 5 weeks body weight over last 5 generations. The corresponding

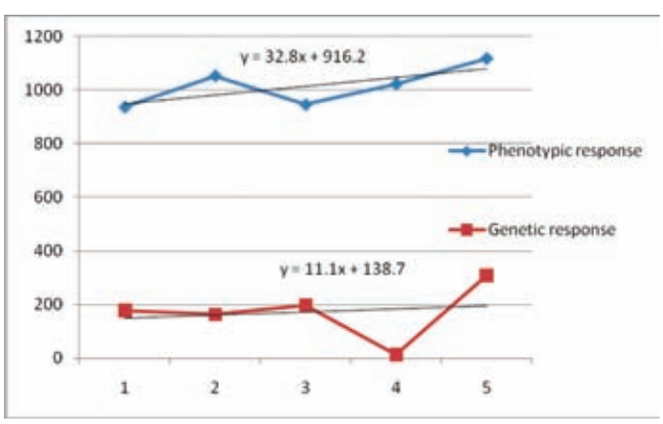


Fig. 4 Genetic and phenotypic response for 5 weeks body weight in PB-2 at Bengaluru

Table 6 Performance of PB-1, PB-2 and control population at Ludhiana

Traits	PB-1	PB-2	Control
Body wt. (g)			
5 wks	1068	1065	604
20 wks	2435	2210	2432
40 wks	2912	2739	3368
FCR (0-5 wks)	1.95	1.60	1.17
ASM (d)	179.8	157.1	160.8
Egg wt. (g)			
36 wks	56.9	57.1	57.8
EP (No.)			
40 wks	56.2	80.6	73.2
52 wks	133	125	122

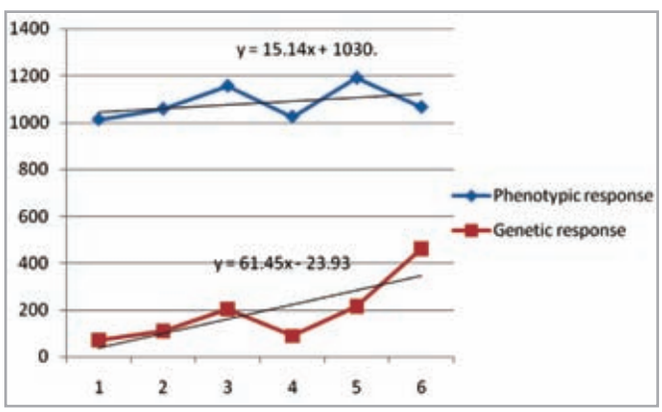


Fig. 5 Genetic and phenotypic response for 5 week body weight in PB-2 at Ludhiana

phenotypic responses were 19.80 and 19.20 g per generation. The fertility remained above 81% in both CSML and CSFL. Genetic and phenotypic response for 5 weeks body weight in CSML is presented in Fig. 6.

7.1.2.4 Bhubaneswar centre

Bhubaneswar centre evaluated S-2 generation of CSFL and CSML for juvenile traits. S-1 generation of CSFL and CSML were evaluated for production traits. The fertility was more than 93% in both the selected populations. Hatchability on total eggs set was more than 81% in both the selected populations and improved as compared to previous generation. Body weight at 5 weeks of age was 784 g in CSFL, 740 g in CSML and

Table 7 Performance of CSML, CSFL and control population at Izatnagar

Traits	CSML	CSFL	Control
Body wt. (g)			
5 wks	1188	1175	754
20 wks	2395	2278	2153
FCR (0-5 wks)	2.0	2.04	2.21
ASM (d)	172	169	187
Egg wt. (g)			
36 wks	62.6	61.84	-
EP (No.)			
40 wks	65.20	66.0	57.40
52 wks	99.40	101.20	92.80

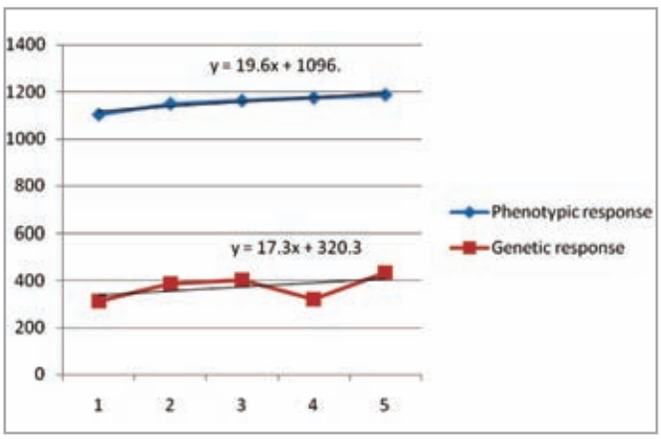


Fig. 6 Genetic and Phenotypic response for 5 wk body weight in CSML at Izatnagar

730 g in control population. The 40 weeks egg production percentage was 35.64 in CSFL, 29.17 in CSML populations (S-1 generation). The 52 weeks egg production percentage was 54.71 and 48.24 in CSFL and CSML, respectively. The centre generated revenue of Rs. 8.67 lakhs which was 55.8% of the expenditure on feed cost.

Random Sample Poultry Performance Test

Bengaluru and Izatnagar centres participated in the 40th random sample poultry performance test at Gurgaon in the year 2013–14. The strain cross from Bengaluru centre recorded body weight of 1,532 and 1,988 g respectively at 6 and 7 weeks of age with corresponding FCR of

2.22 and 2.40. The dressing percentage was 71.43%.CARIBRO-Dhanraja of Izatnagar centre attained body weight of 1,592 and 1,936 g respectively at 6 and 7 weeks of age. FCR at 0-6 and 0-7 weeks were 2.14 and 2.37 with dressing percentage of 69.07.

7.1.3 AICRP on Rural Poultry

A total of 6 centres, ICAR Research Complex for NEH region, Agartala; NDVSU, Jabalpur; AAU, Guwahati; BAU, Ranchi; CSKHPKV, Palampur and MPUAT, Udaipur were involved in rural poultry production under AICRP on Poultry Breeding. These centres were engaged in development of location specific rural poultry varieties. The varieties are being developed utilizing local native and improved chicken germplasm.

7.1.3.1 Agartala centre

During the current year, Agartala centre evaluated Tripura black, Dahlem Red and CSFL populations along with ND (Tripura black x DR cross) cross. The body weight at 20 weeks was 1,681 and 1,101 g in Dahlem Red and Tripura Black, respectively. The age at first egg was 151 days in Dahlem Red and 172 days in Tripura Black. Egg production up to 40 weeks of age was 44 and 39 eggs in Dahlem Red and Tripura Black, respectively. In ND cross, age at first egg was 163 days, egg production upto 40 weeks of age was 59 eggs. During the year, the centre supplied 21,285 chicks of Native (Tripura black), *Gramapriya* and other crosses. The centre realized overall receipt of Rs.8.38 lakhs which was 45.56% of the expenditure on feed.

7.1.3.2 Jabalpur centre

During the current year, the Jabalpur centre reproduced G-5 generation of Kadaknath (Kd) and Jabalpur colour populations. The fertility remained above 90% in all populations. Hatchability on total and fertile egg set basis improved in Kadaknath, M1 and M2 populations. Due to mortality, the centre took second batch of all populations and evaluated up to 28 weeks of age. In second batch also fertility remained above 90% except in M1 and M2 populations (79.80-81.73%) which might be attributed to transportation of eggs from DPR, Hyderabad. In second batch also, the mortality during brooding period was high (6.42 to 15.93%). The age at sexual maturity was delayed by 3 days due to lower body weight at 20 weeks of age. In Kadaknath, body weight at 6 and 20 weeks of age was 298 and 1,140 g, respectively. The pullets matured 4 days early as compared to previous generation. The CSML population showed improvement of 22 g in 6th week body weight as compared to previous generation. The Kd X JBC cross produced 139 eggs up to 72 weeks of age under extensive management system. A promising dual purpose chicken variety having 25% Kd: 75% JBC inheritance produced 186 eggs under extensive system of rearing. During the year, the centre supplied 843 chicks and growers together and 8720 fertile eggs. The centre realized overall revenue of Rs.2.92 lakhs which was 13.07% of the expenditure on feed.

7.1.3.3 Guwahati centre

Guwahati centre evaluated the native, Dahlem Red and PB-2 populations. The centre also evaluated BN (PB-2 X Native) and BND (PB-2 x Native male x Dahlem Red female) cross in farm and field conditions. The fertility was above 75% in all the populations except BN cross (63.57%). The hatchability was very low which needs improvement. The mortality reduced considerably in all lines as compared to previous generation. Native birds matured early by 6 days and Dahlem Red pullets by 4 days as compared to previous generation. In native population, egg weight showed marginal improvement and egg production up to 52 weeks of age improved by 1 egg as compared to previous generation. In BN cross, the 5 weeks body weight was 205 g in the farm and 154 g in the field. The hen housed egg production up to 52 weeks of age was 70 eggs in the farm as against 56 eggs in the farmers' field. The BN cross showed better body weight, ASM, egg weight and egg production as compared to previous generation. The 5thweek body weight of BND cross was 175 and 141 g, respectively in farm and field conditions. The age at sexual maturity was 153 days in the farm and 174 days in the field. The hen housed egg production up to 40 and 52 weeks of age was 47 and 85 eggs in the farm while corresponding values in the field were 40.54 and 71.87 eggs, respectively. A total of 2,959 hatching eggs and 7,792

day old chicks of three way cross and *Vanaraja* have been supplied to the rural farmers of Assam, Meghalaya and Arunachal Pradesh. During the current year, revenue generated by the centre was Rs. 2.11 lakhs which was 12.63% of the feed cost.

7.1.3.4 Ranchi centre

During the current year, Ranchi centre evaluated G-2 generation of native population up to 72 weeks of age and G-3 generation was evaluated up to 20 weeks of age. The BN, BND and DBN (Dahlem Red males with PB-2 x Desi female) crosses were evaluated under farm and field conditions. The fertility ranged from 75.17 to 89.37% in all lines. The fertility improved in all lines and crosses except in native chicken population as compared to previous generation. The mortality was high (4.29-13.8%) in all lines. In Native population, pullets in the G-3 generation matured 6 days early as compared to G-2 generation. The annual hen housed egg production of Native population was 79.49 eggs during G-2 generation. In Dahlem Red, age at first egg was 166 days. In BN cross, hen housed egg production up to 72 weeks of age showed improvement of 6 eggs as compared to previous evaluation. In three way crosses, age at first egg of the flock was the lowest in DBN (164 days) than BND (173 days) in the farm during 3rd evaluation. The hen housed egg production up to 72 weeks of age was more in DNB cross (149 eggs) than BND cross (130 eggs) during 2nd evaluation under farm conditions. Under field conditions, BND cross (63.98 eggs) produced more eggs than DNB cross (60.38 eggs) up to 52 weeks of age. Centre supplied 10,921 hatching eggs and 4,327 chicks to farmers. The centre generated the revenue of Rs. 5.01 lakhs through sale of birds and eggs which is 27.07% of the feed and upkeep cost.

7.1.3.5 Palampur centre

CSKHPKV, Palampur centre evaluated Native (G-2) and Dahlem Red birds up to 52 weeks of age. The ND X D ((Native X Dahlem Red) X Dahlem Red) cross was evaluated up to 52 weeks of age both in farm and field conditions. The DR X Native cross was evaluated up to 20 weeks in the farm. The fertility remained above 87% in all populations. The hatchability on total eggs set ranged from 69.90 to 78.62% and the hatchability on fertile eggs set ranged from 78.16 to 86.44% in all populations. During the current year, mortality during 0 to 5 weeks of age was in normal range. Mortality was high (7.9-16.26%) during 6 to 20 weeks of age in all populations. The 5thweek body weight was 293 and 238 g in Dahlem Red and Native birds respectively. The age at sexual maturity in native and Dahlem Red birds was 174 and 150 days, respectively. The Dahlem Red produced 69.38 eggs up to 40 weeks of age whereas Native population produced 36.68 eggs. The egg production up to 52 weeks of age was 104 and 59 eggs in Dahlem Red and Native populations, respectively. The NDxD cross was evaluated under farm and field conditions from 40 to 52 weeks of age. The hen housed egg production in NDxD cross was 96.65 eggs in farm and 85.96 eggs in the field conditions. The centre supplied 5,330 chicks of different crosses to farmers. The centre realized revenue of Rs. 7.25 lakhs, which was 60.88% of expenditure on feed cost.

7.1.3.6 Udaipur centre

MPUAT, Udaipur evaluated G-3 generation of Native germplasm up to 40 weeks of age and G-4 generation was regenerated. Centre procured RIR and coloured synthetic male line and their evaluation is under progress. The fertility remained in the range of 75.43 to 90.16% in all populations. The hatchability on total eggs set was the highest in RIR (78.5%) and lowest in BNR cross (53.2%). The mortality was high (>12.0%) in Native population at all periods of growth. In Pratapdhan, mortality was high (>10%) during 6 to 20 and 20 to 40 weeks of age. In native population, the body weight at 8 weeks of age during G-3 generation showed improvement (5 g) over G-2 generation. The pullets matured 8 days late as compared to previous generation. The hen housed and hen day egg production up to 40 weeks was 30.54 and 41.57 eggs, respectively. During the third evaluation (E-3), *Pratapdhan* was evaluated up to 20 weeks of age. The body weight at 4 and 8 weeks of age showed improvement and 20 weeks body weight decreased during the current year as compared

to previous year. A total of 875 hatching eggs, 3,329 grower and 37,614 day old chicks of *Pratapdhan* and 547 day old chicks of Native population were supplied during the current year. The centre realized the revenue of Rs. 9.44 lakhs during the current financial year, which was 54.22% of expenditure on feed cost.

7.2 POULTRY SEED PROJECT

The Poultry Seed Project was evolved with a sole aim to increase the availability of rural chicken germplasm in remote areas of the country. In this endeavour, the Indian Council of Agricultural Research has initiated "Poultry Seed Project" during the XI five year plan and sanctioned six centres, three in the northeast region and three in other parts of the country. The project has been strengthened during the XII plan by adding five more centres to cater the needs of the farmers in their respective regions. The main objective of this project is production of improved chicken germplasm at the centre and supply of the same to various stake holders in the remote areas to target production enhancement of egg and meat covering 5,000-15,000 farm families per annum for augmenting rural poultry production, socio-economic indexing of the target groups and linking small scale poultry producers with organized market.

Three mainland centres are Bihar Agricultural University, Patna; West Bengal University of Animal and Fishery Sciences, Kolkata; Chhattisgarh Kamdhenu Viswa Vidyalaya, Durg and three north-eastern centres are ICAR Research complex, Nagaland regional centre, Jharnapani; ICAR Research complex, Sikkim regional centre, Gangtok; ICAR Research complex, Manipur regional centre, Imphal. The Directorate as a coordinating unit, supplies parent chicks to the centres, co-ordinates and monitors the activities of different centres to enable them to achieve the set target for each centre (Table 8). The target set for supplying chicks for mainland and North-East centres during the year under report (2013-14) were 0.5 and 1.0 lakhs chicks per annum, respectively and to collect feedback on the performance of the germplasm. During the year, a total of 2,07,122 improved chicken varieties have been distributed in their respective regions/states.

Patna centre has completed three cycles of parent rearing of *Vanaraja* and *Gramapriya*. The centre has distributed 45,706 improved germplasm to the rural farmers during the period in Bihar. Majority of the chicks were reared at the centre during nursery (till 6-8 weeks) period then supplied to the farmers for free range farming. The hatchability on TES and FES in *Vanaraja* and *Gramapriya* was 43.03 and 53.06, and 37.2 and 48.61% respectively. The corresponding fertility was 81.08 and 76.52% respectively. The average egg weight at 40 weeks of age in *Vanaraja* and *Gramapriya* was 51.18±0.62 and 49.15±0.62 g respectively. The body weight at 20 and 40 weeks of age in *Vanaraja* was 2141 and 2486 g respectively.

Kolkata centre has completed the 3 batches of *Vanaraja* and *Gramapriya* rearing and 3 batches are under rearing presently at various stages. The average hen housed egg production was 35.6 during 40 to73 weeks and 31.3 during 74 to 83 weeks in *Vanaraja* birds. In case of *Gramapriya*, the hen housed egg production from 23-74 weeks of laying period was 44.4. The egg weight ranged from 44.9 g during 25 to 45 wks to 60.7 g during 74 to 83 weeks in *Vanaraja* birds. The average hatchability on total egg set (TES) ranged from 73.7% during 74 to 83 weeks of age to 77.6% during 23 to 56 weeks of age while on fertile egg set (FES) basis, it ranged from 82.2 during 26 to 34 weeks to 86.1% during 62 to 86 weeks, respectively in *Vanaraja*. The hatchability on TES and FES was 70.5 and 81.5% in *Gramapriya* in a laying cycle up to 73 weeks of age respectively. A total of 64,251 chicks of *Vanaraja* and *Gramapriya* were supplied to various parts of West Bengal and adjoining North Eastern states.

In Durg centre, two batches (*Vanaraja* and *Gramapriya*) day old chicks were procured from DPR during the year. The average body weight at 19 weeks of age was 1,956 and 1,163 g in female parents of *Vanaraja* and *Gramapriya*.

Jharnapani centre has two batches of parents in position presently at 21 and 59 weeks of age. Both *Vanaraja* and *Gramapriya* varieties had 91.39 and 93.25%

survivability up to 6 weeks of age, respectively. The HH egg production up to 40 and 72 weeks of age was 51.54 and 46.61 in *Vanaraja* and while it was 42.29 and 27.10 in *Gramapriya*, respectively. The hatchability percentage was 64.89 on TES basis and 76.95 on FES basis in *Vanaraja* and 51.93 on TES and 69.16 on FES basis in *Gramapriya*. During the period, a total of 55,912 birds were distributed to farmers of Nagaland, Assam, Meghalaya and Arunachal Pradesh.

At Gangtok centre, one batch of *Vanaraja* parents was procured and reared. The mature body weight of male and female birds at 21 weeks of age was 2,400 and 2,100 g, respectively. The HH production up to 30 weeks of age was about 40% in *Vanaraja* birds. The fertility and hatchability was 90.1 and 77.6% on FES basis, respectively during the period. A total of 2,615 birds were distributed to farmers across Sikkim through self help groups.

At Imphal centre, two batches of parents were reared. The average body weight at 24 weeks of age was 2,165 and 2,357 g in male and female parents of *Vanaraja* chicken. The Age at sexual maturity was 161 days in *Vanaraja* female parent. The body weight at 73 weeks of age ranged from 2,924 to 3,378g with an average egg weight of 54 to 62 g in *Vanaraja* birds. The hatchability on fertile egg set ranged from 76 to 83%. A total of 38,638 *Vanaraja* birds were distributed to the farmers in Manipur. Field data on performance of *Vanaraja* and *Gramapriya* were collected at different places from Manipur. The body weight at 24 and 40 weeks of age was 2,286 and 3,129 g in males and 1,537 and 2,538 g in females in *Vanaraja* respectively.

Table 8 Centre wise distribution of gemplasm under Poultry Seed Project

Sl. No.	Centre	Germplasm
1	West Bengal University of Animal and Fishery Sciences, Kolkata	64,251
2	Bihar Agricultural University, Patna	45,706
3	Chathisgarh Kamdhenu Viswa Vidyalay, Durg	—
4	Regional Centre, ICAR Reseacrh complex, Jharnapani	55,912
5	Regional Centre, ICAR Reseacrh complex, Gangtok	2,615
6	Regional Centre, ICAR Reseacrh complex, Imphal	38,638
	Total	**2,07,122**

8. List of Publications

8.1 Research Articles

8.1.1 International

Aziza, A.E., Panda, A.K., Quezada, N. and Cherian, G. 2013. Nutrient digestibility, egg quality and fatty acid composition of brown laying hens fed camelina or flaxseed meal. *Journal of Applied Poultry Research*, 22: 832-841.

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Haunshi, S. and Cheng, H.H. 2014. Differential expression of Toll-like receptor pathway genes in chicken embryo fibroblasts from chickens resistant and susceptible to Marek's disease. *Poultry Science*, 93:550-555.

Kannaki, T.R, Reddy, M.R. and Verma, P.C. 2014. Toll-like receptors gene expression in the gastrointestinal tract of salmonella serovarpullorum-infected broiler chicken. *Applied Biochemistry and Biotechnology*. DOI: 10.1007/s12010-014-0864-8.

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Paswan, C., Bhattacharya, T.K., Nagaraj, C.S., Chaterjee, R.N. and Jayashankar, M.R. 2013. SNPs in minimal promoter of myostatin (GDF-8) gene and its association with body weight in broiler chicken. *Journal of Applied Animal Research*, DOI:10.1080/09712119.2013.846859.

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Rama Rao, S.V., Prakash, B., Raju, M.V.L.N., Panda, A.K. and Murthy, O.K. 2014. Effect of supplementing non-starch polysaccharide hydrolyzing enzymes in guar meal based diets on performance, carcass variables and bone mineralization in Vanaraja chickens. *Animal Feed Science and Technology*, 188: 85-91.

Shanmugam, M. and Rama Rao, S.V. 2013. Effect of dietary ellagic acid supplementation on semen quality parameters in chickens. *Animal Production Science*, DOI:10.1071/AN13110.

Shanmugam, M., Niranjan, M., Kulkarni, R., Bhattacharya, T.K. and Chatterjee, R.N. 2013. Semen quality in white leghorn chicken selected for egg production traits. *Turkish Journal of Veterinary and Animal Sciences*, 37: 747-749.

Shanmugam, M., Vinoth, A., Rajaravindra, K.S., Rajkumar, U. 2014. Evaluation of semen quality in roosters of different age during hot climatic condition. *Animal Reproduction Science*, 145: 81-85.

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8.1.2 National

Bhattacharya, T.K., Chatterjee, R.N., Rajkumar, U., Bhanja, S.K. and Niranjan, M. 2014. Genetic variability in the coding region of growth hormone receptor gene in layer chicken. *Indian Veterinary Journal*, 91:56-58.

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Panda, A.K., Lavanya, G., Pradeep Kumar Reddy, E., Raju, M.V.L.N., Rama Rao, S.V and Shyam Sunder, G. 2013. Apparent metabolizable energy and feeding value of high lysine maize (Nityashree) in broiler chickens. *Indian Journal of Animal Sciences*, 83: 542-545.

Paswan, C., Bhattacharya, T.K., Nagraja, C.S., Chatterjee, R.N., Jayashankar, M.R. and Dushyanth, K. 2013. Nucleotide variability in partial promoter of IGF-1 gene and its association with body weight in fast growing chicken. *Journal of Animal Research*, 3: 31-36.

Rajkumar, U., Kanyakumari, R., Raju, M.V.L.N., Panda, A. K., Niranjan M. and Rama Rao, S.V. 2014. Evaluation of performance of Vanaraja and Srinidhi varieties of rural poultry during nursery phase under different feeding regimes. *Indian Veterinary Journal*, 91(3): 95-97.

wathi, B., Gupta, P.S.P., Nagalakshmi, D., Rajasekhar Reddy, A. and Raju, M.V.L.N. 2013. Immunomodulatory and cortisol sparing effect of Tulsi (*Ocimum sanctum*) in heat stressed broilers. *Tamilnadu Journal of Veterinary and Animal Sciences*, 9 (1): 23-28.

8.2 Research Abstracts Presented in Symposia/Conferences

8.2.1 International

Panda, A.K. and Cherian, G. 2013. Effect of manipulating incubation temperature on body weight, oxidative stress, antioxidant status, and fatty acid profile of day old broiler chicks, P.269. *Proceedings of the Poultry Science Association 102nd Annual Meeting Program* held at San Diego, California, USA during 22nd-23rd July 2013, pp-75.

Yigit, A.A. Bullock, C.J., Causso, N.G., Oliveira, R.S., Panda, A.K. and Cherian G. 2013. Maternal polyunsaturated fatty acid supplementation affects antioxidant capability, oxidative status and tissue fatty acids of hatching chicks. P.389. *Proceedings of the Poultry Science Association 102nd Annual Meeting Program* held at San Diego, California, USA during 22nd-23rd July 2013, pp-90.

8.2.2 National

Bhattacharya, T.K., Chatterjee, R.N., Dushyanth, K., Rajkumar, U., Niranjan, M. and Reddy, B.L.N. 2013. Polymorphism of activin receptor 2A (ACVR2A) gene and its association with carcass traits in broiler chicken. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, Bareilly, U.P. during 22nd-23rd November 2013, pp. 21.

Dushyanth, K., Bhattacharya, T.K., Sitaramamma, T., Chatterjee, R.N., Guru Vishnu, P. and Paswan, C. 2013. Expression of GDF8 at slaughter age in fast and slow growing chicken. *Proceedings of International symposium on "Conceptual Advances in cellular Homeostasis Regulated by Proteases and Chaperons"* held at TATA Institute of Cancer Research, Navi Mumbai during 3rd-6th December, 2013, pp. 17.

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Haunshi, S., Padhi M.K. and Niranjan, M. 2013. Sustainable rural poultry production through conservation and improvement of native chickens. *Proceedings of National Conference on Agro Biodiversity Management for Sustainable Rural Development*, held at NAARM, Hyderabad during 14th-15th October, 2013, pp. 72.

Kannaki, T.R., Verma, P.C. and Reddy, M.R. 2013. Molecular characterization of duck TLRs, mRNA expressions in selected tissues and cytokine response to invitro TLR agonists stimulation. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, Bareilly, U.P. during 22nd-23rd November 2013, pp 226.

Niranjan, M. Rajkumar, U., Haunshi, S. and Padhi, M.K. 2013. Evaluation of PD-2 line up to 40 weeks of age. *Proceedings of XXX Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, 22nd-23rd November, 2013, pp.11.

Padhi, M.K. and Chatterjee, R.N. 2014. Performance of Nicobari fowl an indigenous chicken breed of Andaman and Nicobar Islands in Andhra Pradesh. *Proceedings of XIth National Symposium on Harmonizing Phenomics and Genomics for Sustainable Management of Livestock for Upliftment of Rural Masses*, held at NBAGR, Karnal during 6 to 7th, February, 2014, pp 152-153.

Padhi, M.K. Chatterjee, R.N., Niranjan, M., Haunshi, S., Rajaravindra, K.S. and Rajkumar, U. 2013. Production performance of four different crossbreds developed for backyard poultry farming under intensive system of rearing. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, Bareilly, U.P. during 22nd-23rd November 2013, pp.1.

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Reddy, B.L.N. and Rajaravindra, K.S. 2014. Evaluation of juvenile and slaughter parameters in Krishibro A coloured commercial broiler cross in summer. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, Bareilly, U.P. during 22nd-23rd November 2013, pp 10.

Selvaramesh, A.S., Kumar, P., Mishra, C., Bhattacharya, T.K., Saxena, V.K., Sahoo, N.R., Bhushan, B., Tiwari, A.K. and Sharma, D. 2013. PCR-SSCP and nucleotide sequencing of Mx1 gene in Naked neck breed of chicken. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar, Bareilly, U.P. during 22nd-23rd November 2013, pp. 29.

Shanmugam, M., Vinoth, A., Rajaravindra, K.S. and Rajkumar, U. 2013. Evaluation of semen quality in roosters of different age during hot climatic condition. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar during 22nd-23rd November 2013, pp 106.

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8.3 Invited / Lead Papers

Bhattacharya, T.K. and Chatterjee, R.N. 2013. Transgenesis in poultry: Approaches, applications and biosafety considerations. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar during 22nd-23rd November 2013, pp. 39-46.

Panda, A.K. and Prakash, B. 2013. Feed safety an emerging concern in poultry production. *Proceedings of XXX Annual Conference and National Symposium of Indian Poultry Science Association*, held at CARI, Izatnagar during 22nd-23rd November 2013, pp. 73-80.

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8.4 Review Articles

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8.5 Books

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Bhattacharya, T.K. 2014. Animal genomics for conservation and production: a practical approach. Edited by Bhattacharya, T.K., Published by Agrotech Publishing Academy, Udaipur, India.

8.6 Book Chapters

Shanmugam, M. 2014. Semen Biotechnology. In: Animal genomics for conservation and production: a practical approach, Ed. Bhattacharya, T.K. Agrotech Publishing Academy, Udaipur, India, pp 117-127.

Raju, M.V.L.N. and Rama Rao, S.V. 2013. Total quality management of poultry feed. Training programme on poultry production for the field veterinarians of AP, 15-17th April 2013, Dept. of Poultry Science, CVSc, Rajendranagar, Hyderabad.

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Kannaki, T. R. 2014. Post mortem examination. In training manual 'Poultry Production and Disease Management' of Poultry Research, Hyderabad. Pp 103-113.

Niranjan, M. 2014 Backyard Poultry: Improved chicken varieties with special emphasis to Vanaraja and Gramapriya. In training manual 'Poultry production and disease management', Directorate of Poultry Research, Hyderabad, pp.1-4.

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Rajkumar, U. and Rama Rao, S.V. 2014. Propagation and economics of improved chicken crosses for backyard farming in rural and tribal areas of India. In training manual 'Poultry production and disease management', Directorate of Poultry Research, Hyderabad, pp.50-55.

8.7 Bulletins/Training Manuals/Folders

Bhattacharya, T.K. and Chatterjee, R.N. 2014. Tellicherry: An Indigenous chicken breed. Bulletin, Published by Directorate of Poultry Research, Rajendranagar, Hyderabad.

Haunshi, S., Prakash, B. and Reddy, M.R. 2014. Poultry production and disease management. Training manual, Directorate of Poultry Research, Hyderabad.

Rao, J.S., Rao, V.V. and Bhattacharya, T.K. (2014). An overview of DPR Library Resources. Folder, Published by Directorate of Poultry Research, Hyderabad.

8.8 Technical/Popular Articles

Panda, A.K. 2013. Alternative vegetable protein supplements to soybean meal for poultry feeding. *Poultry Line*, 4: 17-18.

Panda, A.K. 2013. Corn distillers dried grains with soluble (DDGS) as poultry feed. *Poultry Line*, 5: 17-18.

Panda, A.K. 2013. Crude glycerine as poultry feed. *Hind Poultry*, 4: 17-18.

Panda, A.K. 2013. Precision feeding in Poultry. *Poultry Line*, 11: 16-18.

Panda, A.K. 2014. Production of designer broiler chicken meat through dietary manipulations. *Hind Poultry*, 32: 31-34.

Chatterjee, R.N. and Niranjan M. Srinivas, J. 2013. Gharelu kukkut palankeliye nayeaayaam, *Kheti*, 66(4): 28-30.

Reddy, M.R. 2013. Marek's disease vaccination problems and solutions. *Technoforum*, 1: 9-13.

9. List of Ongoing Research Projects

A number of research projects under different disciplines funded by both the Institute as well as other Government Organizations are being carried out to enhance existing knowledge in the areas of applied aspects of poultry science. These projects address the need of the scientific as well as the farming community engaged in this profession. The research projects presently going on at this Directorate have been enlisted below.

Sl. No.	Project Title	PI
I	**INSTITUTE PROJECTS**	
A	**Breeding and Molecular Genetics**	
1	Development and improvement of male lines for dual purpose germplasm for backyard farming	Dr. M.K. Padhi
2	Maintenance and evaluation of native germplasm of chicken	Dr. Santosh Haunshi
3	Development, improvement and evaluation of female lines for backyard/free range farming	Dr. M. Niranjan
4	Development of male line for production of egg type rural poultry	Dr. U. Rajkumar
5	Maintenance of elite layer germplasm evolved by various AICRP centers	Dr. M.K. Padhi
6	Genetic characterization and improvement of a synthetic coloured broiler female line for various economic traits	Dr. K.S. Rajaravindra
7	Maintenance of coloured broiler population for development of climate resilient broilers	Dr. B.L.N. Reddy
B	**Nutrition and Physiology**	
8	Supplementation of organic selenium in broiler breeder (PB2) diets and its influence on production performance of parents and their progeny	Dr. M. Shanmugam
9	Production of designer broiler chicken meat through nutritional manipulation	Dr. A. K. Panda
10	Optimization of dietary allowances for production and reproduction in brown laying hens (PD-3)	Dr. B. Prakash
11	Cellular and molecular studies of reproductive system in chicken	Dr. M. Shanmugam
C	**Health**	
12	Disease monitoring and control in pure line chicken	Dr. M.R. Reddy
13	Innate immune gene polymorphism associated with immune response and modulation of immune response with TLR agonists and defensins	Dr. M.R. Reddy

Sl. No.	Project Title	PI
II	**EXTERNALLY FUNDED PROJECTS**	
14	Development of climate resilient practices through genetic strategies to enhance tolerance to heat stress in commercial and backyard poultry **(NICRA)**	Dr. S.V. Rama Rao
15	Detoxification of karanj *(Pongamia glabra)* seed cake and its utilization in broiler and layer chicken diets **(DST)**	Dr. M.V.L.N. Raju
16	Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry **(National Fellow)**	Dr. T.K. Bhattacharya
17	Expression profiling of cytokines and chemokines: Scope for augmenting general immune competence in chicken **(DST)**	Dr. K.S. Rajaravindra

10. Consultancy, Patents and Commercialization of Technologies

10.1 Commercialization of Technologies

The Directorate of Poultry Research has developed two varieties of chicken for backyard farming, namely *Vanaraja* and *Gramapriya* and two varieties for intensive farming, namely *Krishibro* and *Krishilayer*. The *Vanaraja* and *Gramapriya* have been widely distributed across the country and the Institute played a pivotal role in popularizing the concept of rural and backyard poultry. In this context, it is to mention that for wide and efficient distribution of these two backyard varieties of chicken throughout the country, a national project in the name of 'Seed Project' funded by the ICAR has been initiated during the XI plan. The *Krishibro* and *Krishilayer* varieties have also been popular among farmers and have been distributed in substantial numbers to the farmers and other agencies. The directorate has supplied total of 63,754 hatching eggs, 2,60,821 day old chicks and 2,732 grown up chicks of *Vanaraja, Gramapriya, Srinidhi and Krishibro* birds which generated about Rs. 128.59 lakhs revenue during the current year. The embryonated eggs (9563 in No.) were supplied for production of different cell culture vaccines.

Table 1 Germplasm supplied during 2013-14

Sl. No.	Particulars	No.
A.	Hatching eggs	
	Vanaraja	18,916
	Gramapriya	8, 633
	Swetasree (White Gramapriya)	7,422
	Krishibro	1,216
	Srinidhi	5,706
	Layer	20,601
	Control broiler	1,260
	Total	63,754
B.	Day old chicks	
	Vanaraja	1,48,786
	Vanaraja parents	29,716
	Gramapriya`	41,176
	Gramapriya parents	15,215
	Swetasree (White Gramapriya)	1,848
	Krishibro	8,723
	Srinidhi	10,235
	Layer	3,023
	Krishibro parents	2,099
	Total	2,60,821
C.	Grown up birds	2732
	Total revenue generated (Rs. Lakhs)	128.59

10.2 Consultancy

Scientists of the Directorate from time to time offered technical inputs to the farmers and technical personalities involved in poultry farming and research. The revenue under consultancy head generated during the year was 4.63 lakhs rupees.

10.2.1 Consultancy project

Directorate of Poultry Research and Abhay Cotex Pvt Ltd., Jalna, Maharastra entered in to a Memorandum of Understanding (MOU) for one year to conduct research on rape seed meal as a protein supplement in commercial broiler diet.

10.2.2 Contract Research

A contract research project with Pfizer Pharmaceuticals India Pvt. Ltd. was concluded. The prevalence of *Mycoplasma synoviae* and nephro-pathogenic infectious bronchitis in poultry industry was determined.

10.3 Accession in the NCBI Genbank

The NCBI Genbank is the international repository for molecular biology information including gene and protein sequences, SNPs, gene maps etc. and conducts research in computational biology, develops software tools for analyzing genome data, and disseminates biomedical information. The Genbank established in 1988 provides inputs for the better understanding of molecular processes affecting animal and human health and disease, growth and their production. A number of gene sequence data were submitted to the Genbank and the accession numbers were received. These sequence information have been stated below.

SL. No.	Title	Accession Number	Authors / Workers
1.	Gallus gallus haplotype h1 activin receptor type 2A (ACVR2A) gene, exons 2, 4 and partial cds.	KF583559	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth, K. and Guru Vishnu, P.
2.	Gallus gallus haplotype h2 activin receptor type 2A (ACVR2A) gene, exons 2, 4 and partial cds.	KF583560	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
3.	Gallus gallus haplotype h3activin receptor type 2A (ACVR2A)gene, exons 2, 4 and partial cds.	KF583561	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
4.	Gallus gallus haplotype h4activin receptor type 2A (ACVR2A)gene, exons 2, 4 and partial cds.	KF583562	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
5.	Gallus gallus haplotype h6activin receptor type 2A (ACVR2A) gene, exons 2, 4 and partial cds.	KF583563	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
6.	Gallus gallus haplotype h7activin receptor type 2A (ACVR2A) gene, exons 2, 4 and partial cds.	KF583566	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
7.	Gallus gallus haplotype h7activin receptor type 2A (ACVR2A) gene, exons 2, 4 and partial cds.	KF583564	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
8.	Gallus gallus haplotype h7activin receptor type 2A (ACVR2A) gene, exons 2 and partial cds.	KF583567	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.

SL. No.	Title	Accession Number	Authors / Workers
9.	Gallus gallus haplotype h7activin receptor type 2A (ACVR2A) gene, exons 2 and partial cds.	KF583565	Bhattacharya,T.K., Chatterjee, R.N., Dushyanth,K. and Guru Vishnu,P.
10.	Infectious bronchitis virus isolate IBV001 spike glycoprotein (S1) gene, partial cds.	KF809769	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
11.	Infectious bronchitis virus isolate IBV005 spike glycoprotein (S1) gene, partial cds.	KF809770	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
12.	Infectious bronchitis virus isolate IBV014 spike glycoprotein (S1) gene, partial cds.	KF809771	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
13.	Infectious bronchitis virus isolate IBV018 spike glycoprotein (S1) gene, partial cds.	KF809772	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
14.	Infectious bronchitis virus isolate IBV022 spike glycoprotein (S1) gene, partial cds.	KF809773	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
15.	Infectious bronchitis virus isolate IBV025 spike glycoprotein (S1) gene, partial cds.	KF809774	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
16.	Infectious bronchitis virus isolate IBV136 spike glycoprotein (S1) gene, partial cds.	KF809775	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
17.	Infectious bronchitis virus isolate IBV151 spike glycoprotein (S1) gene, partial cds.	KF809776	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
18.	Infectious bronchitis virus isolate IBV208 spike glycoprotein (S1) gene, partial cds.	KF809777	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
19.	Infectious bronchitis virus isolate IBV236 spike glycoprotein (S1) gene, partial cds.	KF809778	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
20.	Infectious bronchitis virus isolate IBV238 spike glycoprotein (S1) gene, partial cds.	KF809779	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
21.	Infectious bronchitis virus isolate IBV256 spike glycoprotein (S1) gene, partial cds.	KF809780	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
22.	Infectious bronchitis virus isolate IBV257 spike glycoprotein (S1) gene, partial cds.	KF809781	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
23.	Infectious bronchitis virus isolate IBV267 spike glycoprotein (S1) gene, partial cds.	KF809782	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.

SL. No.	Title	Accession Number	Authors / Workers
24.	Infectious bronchitis virus isolate IBV270 spike glycoprotein (S1) gene, partial cds.	KF809783	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
25.	Infectious bronchitis virus isolate IBV298 spike glycoprotein (S1) gene, partial cds.	KF809784	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
26.	Infectious bronchitis virus isolate IBV379 spike glycoprotein (S1) gene, partial cds.	KF809785	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
27.	Infectious bronchitis virus isolate IBV382 spike glycoprotein (S1) gene, partial cds.	KF809786	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
28.	Infectious bronchitis virus isolate IBV385 spike glycoprotein (S1) gene, partial cds.	KF809787	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
29.	Infectious bronchitis virus isolate IBV386 spike glycoprotein (S1) gene, partial cds.	KF809788	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
30.	Infectious bronchitis virus isolate IBV398 spike glycoprotein (S1) gene, partial cds.	KF809789	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
31.	Infectious bronchitis virus isolate IBV415 spike glycoprotein (S1) gene, partial cds.	KF809790	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
32.	Infectious bronchitis virus isolate IBV422 spike glycoprotein (S1) gene, partial cds.	KF809791	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
33.	Infectious bronchitis virus isolate IBV431 spike glycoprotein (S1) gene, partial cds.	KF809792	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
34.	Infectious bronchitis virus isolate IBV438 spike glycoprotein (S1) gene, partial cds.	KF809793	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
35.	Infectious bronchitis virus isolate IBV439 spike glycoprotein (S1) gene, partial cds.	KF809794	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
36.	Infectious bronchitis virus isolate IBV470 spike glycoprotein (S1) gene, partial cds.	KF809795	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
37.	Infectious bronchitis virus isolate IBV506 spike glycoprotein (S1) gene, partial cds.	KF809796	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
38.	Infectious bronchitis virus isolate IBV572 spike glycoprotein (S1) gene, partial cds.	KF809797	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.

SL. No.	Title	Accession Number	Authors / Workers
39.	Infectious bronchitis virus isolate IBV573 spike glycoprotein (S1) gene, partial cds.	KF809798	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
40.	Infectious bronchitis virus isolate IBV586 spike glycoprotein (S1) gene, partial cds.	KF809799	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
41.	Infectious bronchitis virus isolate IBV595 spike glycoprotein (S1) gene, partial cds.	KF809800	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
42.	Infectious bronchitis virus isolate IBV598 spike glycoprotein (S1) gene, partial cds.	KF809801	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
43.	Infectious bronchitis virus isolate IBV626 spike glycoprotein (S1) gene, partial cds.	KF809802	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.
44.	Infectious bronchitis virus isolate IBV628 spike glycoprotein (S1) gene, partial cds.	KF809803	Reddy, M.R., Lini, M.P., Dhanutha, N.R. and Kannaki, T.R.

11. Committees

11.1 Institute Research Committee Meeting

The annual meeting of the IRC for the year 2012-13 was held on 29th & 30th April 2013 at the Directorate under the chairmanship of Dr. R. N. Chatterjee, Director. Dr. T. K. Bhattacharya acted as member secretary. All the scientists presented their annual progress and discussed at length about the achievements, shortcomings and shortfalls.

Annual IRC meeting in progress

Half yearly review meeting of IRC (2013-14) was held on 18th November 2013 at DPR under chairmanship of Dr. R. N. Chatterjee, Director, DPR. Dr. T. K. Bhattacharya acted as member secretary. All scientists presented progress reports of the Institute as well as externally funded research projects and discussed about the achievements, shortcomings and way forward to address the shortcomings.

Half yearly IRC meeting in progress

11.2 Research Advisory Committee Meeting

The 7th Meeting of the Common Research Advisory Committee of CARI and DPR was held on 3rd July 2013 at CARI, Izatnagar under the Chairmanship of Dr. R. Prabakaran, Vice Chancellor, TANUVAS, Chennai. The HODs/Scientists from CARI and DPR participated in the meeting and presented the research progress in different disciplines. The Chairman appreciated the scientists of CARI and DPR for the overall research achievements and reiterated the need for continuation of the recommendations of 6th RAC; strengthening transfer of technology; germplasm supply through private partnership; support to commercial poultry farmers and corporate sector and developing video films on successful technologies.

11.3 Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project

Annual review meeting of AICRP on Poultry Breeding and Poultry Seed Project (PSP) for the year 2012-13 was held at AAU, Anand on 12th & 13th August 2013. Dr. A. M. Shekh, Vice Chancellor, AAU, Anand presided over the inaugural function and Dr. K. M. L. Pathak, DDG (AS), ICAR was the chief guest. Other dignitaries were Dr. K. B. Kathiria, Director Research, Dr. A. M. Thaker, Dean, Veterinary College, AAU, Anand and Dr. R.N. Chatterjee, Director, DPR. The meeting was attended by the in-charges of all the centres of AICRP and PSP. Vice chancellor of AAU, Anand appreciated the efforts of AICRP on poultry breeding and importance of small scale commercial poultry. DDG (AS), ICAR mentioned that AICRP on Poultry Breeding is an important component of Animal Science Division from IV Plan. He emphasized that realizing the importance of poultry, the Council intends to promote backyard poultry in Mission Mode approach. Dr. R. N. Chatterjee, Director, DPR gave brief history of AICRP on Poultry Breeding. He also highlighted the achievements of AICRP and PSP. All the centre in-charges presented the progress report of their respective centres and discussion was made on the achievements, shortfalls and future strategy for the next year both for AICRP and PSP. Recommendations to improve the performance of different centre of AICRP and PSP were prepared.

Annual review meeting of AICRP on Poultry Breeding and Poultry Seed Project in progress

11.4 Institute Management Committee Meeting

The 31st and 32nd Institute management committee (IMC) meeting of the Directorate was held on 27th September 2013 and 17th February 2014 under the chairmanship of Dr. R. N. Chatterjee, Director. In this meeting various issues pertaining to administration and finance were discussed and recommendations were made for implementation with the Council's approval.

11.5 Institute Animal Ethics Committee (IAEC)

The 12th and 13th IAEC meetings of DPR were held on 17th August 2013 and 13th February 2014 respectively. The meetings were chaired by Dr. R.N. Chatterjee, Director, and were attended by the CPCSEA nominees' viz. Dr. P. Uday Kumar, Dr. N. Hari Shankar and Dr. Syed S.Y.H. Quadri from NIN, Hyderabad, apart from the members of the institute. The committee has reviewed ongoing research projects and approved four new projects. The committee also visited the experimental farm and expressed satisfaction over the housing and management of the birds.

11.6 Institute Bio-safety Committee (IBSC)

The 3rd and 4th IBSC meetings of the DPR were held on 10th April 2013 and 3rd March 2014 respectively under the Chairmanship of Dr. R.N. Chatterjee, Director, DPR. The meetings were attended by Dr. Aparna Dutta Gupta, DBT nominee, Dr. V. Dinesh Kumar, outside expert, Dr. A. Debnath, Medical officer besides the members from the Directorate. The committee reviewed ongoing research projects and approved new research proposals. The medical reports of staff working under IBSC approved research projects were maintained.

11.7 Other Committees

The 7th, 8th, 9th and 10th meetings of 8th Institute joint staff council (IJSC) were held respectively on 5th April 2013, 11th July 2013, 12th November 2013 and 24th March 2014 at this Directorate and relevant issues were discussed and recommendations made.

12. Participation of Scientists in Seminars, Conferences, Meetings and Workshops

Scientists, technical and administrative personnel of the Directorate participated in a number of seminars, symposia, conferences, meetings, workshops etc. to present their research findings and their expertise in different fields of Poultry Science and other related disciplines.

Sl. No.	Symposia / conferences / seminars /meetings/ workshops	Scientist(s)	Duration	Venue
1	Annual summit of Society for Technology Management (STEM)	Dr. U. Rajkumar, Pr. Scientist	15th-17th May 2013	STEM, Chennai
2	Combined RAC meeting DPR and CARI	Dr. R.N. Chatterjee, Director Dr. S.V. Rama Rao, Pr. Scientist Dr. M.V.L.N. Raju, Pr. Scientist Dr. M. K. Padhi, Pr. Scientist Dr. T.K. Bhattacharya, NF Dr. M.R. Reddy, Pr. Scientist	3rd July 2013	CARI, Izatnagar
3	National Workshop on Strategies for Strengthening NARS Libraries under e-Granth	Sri. J. Srinivas Rao, Sr. Technical Officer	5th & 6th July 2013	IARI, New Delhi
4	Annual Review Meeting of A.I.C.R.P. on Poultry Breeding & Poultry Seed Project	Dr. R. N. Chatterjee, Director Dr. S. V. Rama Rao, Pr. Scientist Dr. M. K. Padhi, Pr. Scientist Dr. M. Niranjan, Pr. Scientist	12th & 13th August 2013	Anand Agricultural University, Anand
5	Sixth Extension and Continuous Education Council meeting, MAFSU	Dr. U. Rajkumar, Pr. Scientist	13th August 2013	MAFSU, Nagpur
6	Meeting for finalization of DARE/ICAR Annual Report 2013-14 of Animal Science Division, ICAR	Dr. M. V. L. N. Raju, Pr. Scientist	30th September 2013	NASC complex, New Delhi
7	National Conference on 'Agro-biodiversity Management for Sustainable Rural Development'	Dr. Santosh Haunshi, Sr. Scientist	14th & 15th October 2013	NAARM, Hyderabad

Sl. No.	Symposia / conferences / seminars /meetings/ workshops	Scientist(s)	Duration	Venue
8	Mid-term Review Meeting of RFD 2013-14 of Animal Science Division, ICAR	Dr. M. V. L. N. Raju, Pr. Scientist	22nd October 2013	NASC complex, New Delhi
9	National Workshop on KOHA – Library management software	Dr. T. K. Bhattacharya, NF, Sri. J. Srinivas Rao, Sr. Technical Officer	25th & 26th October 2013	ANGRAU, Hyderabad
10	XXX Conference and National Symposium of Indian Poultry Science Association	Dr. R. N. Chartterjee, Director Dr. M. K. Padhi, Pr. Scientist Dr. M. R. Reddy, Pr. Scientist Dr. M. Niranjan, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist Dr. A. K. Panda, Pr. Scientist Dr. S. Haunshi, Sr. Scientist Dr. M. Shanmugam, Scientist Dr. T. R. Kannaki, Scientist	22nd & 23rd November 2013	CARI, Izatnagar
11	Workshop on 'Income Tax'	Sri. S. R. Meena, Admin. Officer	25th & 26th November 2013	ISTM, New Delhi
12	5th EFC meeting of DARE/ICAR's XII plan to consider the Proposal of Directorate of Poultry Research (DPR), AICRP on Poultry Breeding and Poultry Seed project	Dr. R.N. Chatterjee, Director Dr. M. K. Padhi, Pr. Scientist	11th December 2013	Krishi Bhavan, New Delhi
13	National seminar of Indian Association of Hill Farming on "Emerging challenges and prospective strategies for hill agriculture in 2050"	Dr. U. Rajkumar, Pr. Scientist Dr. B. Prakash, Scientist	23rd-25th January 2014	ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani
14	Midterm review meeting of ICAR RC II	M. K. Padhi, Pr. Scientist	24th January 2014	CIFRI, Barrackpore, Kolkata

Sl. No.	Symposia / conferences / seminars /meetings/ workshops	Scientist(s)	Duration	Venue
15	Management Development Workshop on Technology Management for Researchers	Dr. M. Niranjan, Pr. Scientist Dr. T. R. Kannkai, Scientist	27th-31st January 2014	NAARM, Hyderabad
16	Food Safety Seminar at All India Network Project on Pesticide Residues	Dr. A. K. Panda, Pr. Scientist	7th February 2014	ANGRAU, Hyderabad
17	NAIP Cross Learning Workshop Hyderabad chapter	Dr. A. K. Panda, Pr. Scientist	18th February 2014	DOR, Hyderabad
18	Workshop on “Current Scenario of Rodenticides and their Future Outlook"	Dr. A.K.Panda, Pr. Scientist Dr. M. Shanmugam, Scientist	21st & 22nd February 2014	DOR, Hyderabad
19	Sensitizing Workshop of AICRP on Poultry Breeding and Poultry Seed Project	Dr. R. N. Chartterjee, Director Dr. S.V. Rama Rao, Pr. Scientist, Dr. M.V.L.N. Raju, Pr. Scientist Dr. M. K. Padhi, Pr. Scientist Dr. T.K. Bhattacharya, NF Dr. M. R. Reddy, Pr. Scientist Dr. M. Niranjan, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist S. Haunshi, Sr. Scientist Dr. K. S. Rajaravindra, Scientist Dr. T. R. Kannaki, Scientist	22nd February 2014	DPR, Hyderabad
20	Project Development Workshop under Shortlisted Concept Notes- National Fund for Basic, Strategic and Frontier Application Research in Agriculture	Dr. T. R. Kannaki, Scientist	20th-22nd March 2014	NAARM, Hyderabad.
21	Brainstorming Workshop on “Soybean for Household Food and Nutrition Security”	Dr. A. K. Panda, Pr. Scientist	21st& 22nd March 2014	NASC, New Delhi

13. Conferences, Workshops, Short courses, etc. Organized

13.1 Library Workshop on Open Sources eResources

A one-day workshop-cum-seminar on "Open Sources eResources" was conducted on 7th December, 2013 under NAIP eGranth project at DPR, Hyderabad. In the workshop, Dr. K. Veeranjaneyulu, University Librarian, ANGRAU, Hyderabad delivered a comprehensive lecture along with practical demonstration on 'eResources' available online. He demonstrated the participants how to access open source information including journals, books, thesis etc. available freely in the internet, and also to access information from Cera, Agricat, Krishikosh, Krishiprabha etc. The workshop was inaugurated and presided over by Dr. R.N. Chatterjee, Director, DPR. During presidential address, he emphasized about the importance of online resources for utilizing them in day to day research and other activities. He appreciated the works done by the Institute Library under eGranth project. At the beginning of the programme a brief lecture on the theme of the workshop was delivered by Dr. T. K. Bhattacharya, National Fellow and CPI of eGranth project. A total of 30 participants (Scientists and technical officers from DPR; Professor from Veterinary College, SVVU, Hyderabad and Library staffs from ANGRAU, Hyderabad) attended the workshop. In the programme, a folder on "An Overview of DPR Library Resources" was released by the Director, and Dr. K.Veeranjaneyulu. The seminar ended with vote of thanks proposed by Shri J. Srnivas Rao, Sr. Technical Officer and CCPI, eGranth project.

Workshop-cum-Seminar of eGranth Project in progress

13.2 Sensitizing Workshop for AICRP on Poultry Breeding and Poultry Seed Project

A one day sensitizing workshop for AICRP on Poultry Breeding and Poultry Seed Project was held at Directorate of Poultry Research on 22nd February, 2014. Dr. R. N. Chatterjee, Director, DPR, presided over the workshop. Dr. R. S. Gandhi, ADG (AP&B), ICAR, New Delhi was also present in the workshop. All the centres In-charge of AICRP on Poultry Breeding and

Sensitizing workshop for AICRP and PSP

Poultry Seed Project including the representative scientists of new seed project centres and all scientists of DPR participated in the workshop. Director, DPR at the outset welcomed the participants and thanked ICAR for approval of XII plan EFC for AICRP and PSP. He emphasised the targets set for each centre to be achieved in time and suggested to all the centres of AICRP and PSP to carry out the work with the available budget with a request to take personal interest. Dr. Gandhi elaborated the action to be taken to achieve the target as per RFD taking a holistic approach with involvement of multi disciplinary resource personnel. Dr. S.V. Rama Rao, I/c PSP and Dr. M. K. Padhi, I/c AICRP cell presented the technical programme and budget approved for the XII plan. All the centres In-charges presented progress of their respective centres in brief.

14. Distinguished Visitors

From all over India and Foreign institutions dignitaries visited the Directorate during the period to get acquainted with the on-going activities and achievements of the Directorate. The distinguished personalities who visited the Directorate during 2013-14 are as follows.

1. Dr. S. Ayyappan, Director General, ICAR, New Delhi
2. Prof. K. M. L. Pathak, DDG (AS), ICAR, New Delhi
3. Dr. S.K. Bandyopadhyay, Member, ASRB, New Delhi
4. Dr. V. Prabhakar Rao, Vice Chancellor, SVVU, Tirupathi
5. Dr. A. Padma Raju, Vice Chancellor, ANGRAU, Hyderabad
6. Dr. A. C. Varshney, Vice Chancellor, UPPDDUPCVVV, Mathura
7. Dr. S. L. Goswami, Director, NAARM, Hyderabad
8. Dr. B. S. Prakash, ADG (AN&P), ICAR, New Delhi
9. Dr. R. S. Gandhi, ADG (AP&B), ICAR, New Delhi
10. Dr. B. C. Viraktamath, Director, DRR, Hyderabad
11. Dr. K. S. Varaprasad, Director, DOR, Hyderabad
12. Dr. J. V. Patil, Director, DSR, Hyderabad
13. Dr. V. V. Kulkarni, Director, NRC on Meat, Hyderabad
14. Dr. J. M. Kataria, Director, CARI, Izatnagar (U.P.)
15. Dr. (Mrs.) Indu Sharma, Project Director, Directorate of Wheat Research, Karnal
16. Dr. R. P. Sharma, Former Project Director, PD on Poultry, Hyderabad
17. Dr. Satish Kumar, Dean, National Institute of Animal Biotechnology, Hyderabad
18. Dr. H. N. N. Murthy, Dean, KVAFSU, Hasan
19. Dr. Vineet Bhasin, Principal Scientist (AG&B), ICAR, New Delhi

International Trainees visit DPR

Twenty seven International trainees from Afro Asian countries visited the Directorate of Poultry Research on 5th November, 2013. They were appraised about the activities of the Directorate and technologies developed at the Institute. They appreciated the efforts of the Institute for upliftment of the poor rural people of the country.

International Trainees at the Directorate

15. Personnel

The institute is functioning with a systematic hierarchy and arrangement of the personnel under the administrative control of the directorate. To achieve the mandate assigned for this directorate, the scientific, administrative, technical and supporting staff under the guidance of the Director. The composition of the Institute's personnel is as follows.

Management Position

Dr. R. N. Chatterjee, Director

Scientific Staff

Dr. S. V. Rama Rao Pr. Scientist

Dr. M. V. L. N. Raju, Pr. Scientist

Dr. B. L. N. Reddy, Pr. Scientist

Dr. M. K. Padhi, Pr. Scientist

Dr. M. R. Reddy, Pr. Scientist

Dr. M. Niranjan, Pr. Scientist

Dr. U. Rajkumar, Pr. Scientist

Dr. Arun Kumar Panda, Pr. Scientist

Dr. Santosh Haunshi, Sr. Scientist

Dr. B. Prakash, Scientist

Dr. M. Shanmugam, Scientist

Dr. (Mrs.) T. R. Kannaki, Scientist

Dr. K. S. Rajaravindra, Scientist

National Fellow

Dr. T. K. Bhattacharya, NF

Technical Staff

Dr. Daryab Singh, Chief Technical Officer

Dr. S. K. Bhanja, Chief Technical Officer

Dr. R.V. Rao, Chief Technical Officer

Sri V. V. Rao, Assistant Chief Technical Officer

Smt. Minakshi Dange, Assistant Chief Technical Officer

Sri D. Pratap, Sr. Technical Officer

Sri J. Srinivasa Rao, Sr. Technical Officer

Sri. A. Ravi Kumar, Technical Officer

Sri G. Rajeswar Goud, Technical Officer

Sri A. Subrahmanyam, Sr. Technical Assistant

Smt. N. R. Dhanutha, Sr. Technical Assistant

Sri Md. Maqbul, Sr. Technical Assistant

Sri M. Panthulu, Technical Assistant

Sri Md. Yousufuddin, Sr. Technician

Administrative Staff

Sri S. R. Meena, Admn. Officer

Sri K.V. S. Satyanarayana, Asst. Admn. Officer

Sri C. Bagaiah, Asst. Fin. & Acc. Officer

Sri M.S.N. Acharyulu, Assistant

Smt. R.T. Nirmala Veronica, Assistant

Smt. T.R. Vijaya Lakshmi, U.D.C,

Smt. M. Kamala, U.D.C

Sri Rajesh Parashar, L.D. C

Sri L.V. B. Prasad, L.D.C

Sri R. Sudarshan, L.D.C

Secretarial Staff

Smt. O. Suneeta, P.S.

Skilled Support Staff

Sri G. Vijay Kumar

Sri Syed Mujtaba Ali

Sri D. Ashok Kumar

Sri N. Manyam

Sri K. Charles

Sri G. Narasimha

Sri Manzoor Ahmed

Sri D. Srinivas

Sri M. Narasing Rao

Sri V. Ravinder Reddy

Sri P. Shankaraiah

Sri K. Venkataiah

Sri D. Shiva Kumar

Smt. K.Vimala

Appointments

Dr. R.N. Chatterjee, Acting Project Director has assumed the charge of regular Director of the DPR w.e.f. 12th September 2013

Promotions

- Dr. M. Niranjan has been promoted to Principal Scientist w.e.f. 23rd April 2012.
- Dr. U. Rajkumar has been promoted to Principal Scientist w.e.f. 11th November 2012
- Dr. T. K. Bhattacharya has been promoted to Principal Scientist w.e.f. 18th January 2013.
- Dr. A. K. Panda has been promoted to Principal Scientist w.e.f. 23rd December 2013.
- Dr. Santosh Haunshi has been promoted to the next higher pay band in the post of Sr. Scientist w.e.f. 2nd July 2012
- Dr. M. Shanmugam has been promoted to the next higher research grade pay w.e.f. 7th January 2012
- Dr. (Mrs) T. R. Kannaki has been promoted to the next higher research grade pay 7th January 2012.
- Dr. K. S. Rajaravindra has been promoted to the next higher research grade pay w.e.f. 26th June 2012.
- Smt. N. R. Dhanutha, has been promoted to next higher grade of Senior Technical Assistant (Field/ Farm Tech.) w.e.f. 21st March 2012.
- Sri G. Rajeswar Goud, has been promoted to the next higher grade of Technical Officer (Farm Tech.) w.e.f. 1st January 2012.

Transfer

Sri G. Srinivas Yadav, Personal Assistant (on deputation) relived from this Directorate on 31st August 2013 and joined DOR, Hyderabad.

16. Other Relevant Information

16.1 Experimental Hatchery

A hatchery designed on modern scientific principles and furnished with excellent equipments is located at this Directorate. It is a central facility in which fumigation and storing of hatching eggs, incubation and hatching of pedigreed and commercial eggs take place throughout the year. There is a cold room with 50,000 hatching egg capacity, where eggs are stored at 14-15 ^{o}C and 85-90% relative humidity before setting in the incubator. Data loggers were installed to monitor the temperature and humidity in setters, hatchers and in cold room. During the current year, 63,754 hatching eggs were supplied. A total of 2,60,821 day old chicks were hatched and supplied in this year. Additionally 9,563 embryonated eggs were supplied for diagnosis and vaccine production to different organizations.

16.2 Experimental Farm

The Experimental Farm Unit located in the campus is having two sections namely Commercial Unit and Pure Line Unit. Commercial Unit caters to the needs of the farmers and tribal populations of our country by producing hatching eggs of commercially important varieties in addition to regular nutritional and health experiments which are conducted in the battery brooders located in this unit. The Pure Line Unit caters to the needs of the Scientists for breeding research and has all the facilities to carry it out. During the reporting period a semi-intensive poultry house has been added for simulating the semi-intensive rearing system of rural birds. The month average livestock reared was 22,942 birds. From the farm unit a total of 14,84,621 eggs were produced during the year, out of which 5,74,371 eggs were hatching and the remaining ones were table eggs.

Experimental farm for semi-intensive system of rearing

16.3 Feed Processing Unit

The unit serve as a central facility for producing and supplying compounded feed to all the flocks of the Directorate. The unit is equipped with two feed plants of 500 kg capacity/hour (one vertical and one horizontal with bucket elevator), besides a go-down with a capacity for storing 180-200 tonnes of raw materials. The feed is prepared using raw materials like maize, soyabean meal, DORB, deoiled sunflower cake, shell grit/lime stone powder, DCP and several additives like amino acids, vitamins etc. Periodically the required feed ingredients were procured and on arrival at the Directorate, analyzed for their nutritional quality. Consignments those satisfy the quality considerations were only used. In the current year the feed unit compounded 823 MT of feed and supplied to the various layer and broiler lines maintained at the Directorate, besides experimental chicks maintained under different ad-hock schemes. A small quantity of compounded feed was also supplied to the farmers along with the rural germplasm. A new feed plant of half ton capacity was installed to meet the higher requirements of the stock kept at the Directorate.

16.4 Sales and Marketing Unit

Sale of culled birds during the selection programme, spent hens at the end of the breeding cycle and selling of surplus eggs for table purpose forms the main activity of this unit. In addition grown up chicks of rural poultry germplasm were also sold to farmers. In the current

year, this unit sold 9,88,400 table eggs, 33,322 culled/ spent chicken and 2,732 grown up birds amounting to Rs. 60,25,782.

16.5 Agricultural Knowledge Management Unit (AKMU)

The AKMU is one of the central units of this Directorate and has computer and server systems, integrated with user terminals within the Directorate through Local Area Network (LAN). The Unit is equipped with 2 servers, 3 computer systems, and an advanced scanner having provision for editing scanned objects. For statistical analysis of research data, advanced versions of software like SAS and SPSS (version 12) are routinely used. Adobe Creative Suite (Premium 1.1) is used for advanced applications like PDF conversion, editing of PDF files and photographs etc. Protection of the computer from virus, spyware etc. is ensured by installing advanced versions of antivirus/antispyware/antimalware softwares for the server as well as its nodes on the LAN. Local area network has enabled easy communication/ data storage/data transfer among the users in the Directorate.

This unit maintained the official website of the Directorate, www.pdonpoultry.org, and the site is updated with latest information for projection of Institute's activities. Additionally public notices like tenders, quotations, recruitment advts., RTI, RFD, Citizen charter etc. was also published on the website for wider publicity. Internet facility at the users' desk has been provided through BSNL broadband service. Electronic mail has been used extensively for communicating with Council and other Institutes/agencies.

16.6 Hindi Cell

As part of Hindi implementation activities the Directorate conducted four quarterly meetings of Official Language Implementation Committee (OLIC) on 7th June 2013, 19th August 2013, 4th December 2013 and 20th March 2014 in which different issues related to effective implementation of Hindi Language in office were discussed. The Directorate effectively implemented the OL rules/orders received from the OL Dept. and as well Council and provided all encouragement to the staff. The Directorate also conducted four Hindi workshops 27th June 2013, 6th September 2013, 19th December 2013 and 22nd March 2014 for upgrading the Hindi skills of staff in day to day official work. The Directorate also celebrated Hindi fortnight celebrations during 1st to15th September 2013 and Hindi Day on 14th September 2013, during these celebrations different literary competitions were conducted for the staff. Dr. S. L. Ghanshyam, Reader, BJR College, Hyderabad, graced the occasion as the chief guest and highlighted the importance of Hindi language and its history. During Hindi fortnight celebrations different literary competitions were conducted for the staff, all the winners and runners of these competitions were awarded with cash prizes and certificate on this occasion. Town Official Language Implementation Committee meetings were also attended during this period (18th April 2013, 23rd October 2013 and 26th March 2014) and suggestions and guidance noted for further better Hindi implementation in our Institute. Inspection was carried out for Hindi activities in the Directorate by Shri Pradeep Singh, Asst. Director (OL), DOR, Hyderabad on 21st October, 2013 and he was satisfied with the Hindi activities that were effectively implemented in this institute.

Hindi Day celebration at the Directorate

16.7 Institute Technology Management Unit (ITMU)

Institute Technology Management Unit was established at this Directorate during XI plan. During the period under report an application for registration of a chicken line developed at the directorate (PD-1: Vanaraja Male Line) was submitted to NBAGR. Complete specification of a patent application for the technology invented at the Directorate has been filed with Indian Patent office. One MoU for contract research with Abhay Cotex Pvt. Ltd. and one MoU for advisory consultancy with Indbro Research and Breeding Farms Pvt. Ltd. were signed by the Directorate. Research publications of the Directorate from the year 2013-2014 have been compiled and documented with ITMU. A National workshop organized by CIFT Cochin was attended by staff of ITMU to broaden the knowledge and scope of protecting intellectual assets of the Directorate. Brochures and prototype for one of the institute's technology was showcased at "International Conference-cum-Exhibition, Agribusiness and Food Processing", Hyderabad. Guest lecture on "Commercialization of Technology in Agriculture and Allied Sciences" was delivered by Dr. Vilas Tonapi, Principal Scientist, Directorate of Sorghum Research for the benefit of DPR scientists.

16.8 Library and Information Centre

The Directorate is having a library with very much informative resourceful material, which is much helpful to the readers like scientific, technical, administrative staff of the institute. Besides this the other users from veterinary university and industry people utilize the resource material available in the library. The library has been subscribing 18 foreign journals and 8 Indian journals and has around 700 books on different aspects of poultry science and livestock as well other general subject books. The Directorate was also utilizing the services of Cera consortia for searching research articles. The library subscribed daily newspapers in Hindi, Telugu and English (each language two papers) for our regular readers. During this year the library got a project entitled "Strengthening of digital library and information Management under NARS (e-Granth)" under Component-1 of NAIP. In this project the library resources were completely shared with other partners through KOHA integrated software. This is a platform where all the consortia partners can share their resources easily. We also digitalized all our publications (such as annual reports, newsletters, un-priced books) and prepared a CD, which was released during institute foundation day celebrations. Two workshops were conducted during this period; the first one was on "Open Sources eResources" on 7th December 2013 under NAIP eGranth. In the workshop, Dr. K. Veeranjaneyulu, University Librarian, ANGRAU, Hyderabad delivered a comprehensive lecture along with practical demonstration on 'eResources' available online. The second workshop was conducted on Library automation using KOHA software, on 20th March 2014. All the scientific, technical and administrative staffs attended the same.

16.9 Inauguration of Silver Jubilee Block

Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR inaugurated the newly built Silver Jubilee Block at Project Directorate on Poultry, Rajendranagar, Hyderabad in presence of Prof. K. M. L. Pathak, Deputy Director General (Animal Science) and Dr. R. N. Chatterjee, Acting Project Director, PDP on 20th July 2013. The occasion was graced by dignitaries like Dr. V. Prabhakar Rao, Vice Chancellor, Sri Venkateswara Veterinary University, Tirupati; Dr. A. Padma Raju, Vice Chancellor, Acharya N. G. Ranga Agricultural University, Hyderabad; Dr. S. L. Goswami, Director, NAARM and the Directors of local ICAR institutes, besides several other invitees from SVVU, ANGRAU, local ICAR

institutes, state A. H. Dept., poultry industry, farmers' associations, NGOs etc.

The 2-story Silver Jubilee Block has been constructed for expanding laboratory space at PD on Poultry with a total floor space of 12000 SFT. The majestic building has been built with state of the art design for providing good ventilation and maximum space utility. It has 6 labs, 12 sitting rooms and a seminar room, besides common facilities. One of the labs at prominent location has been earmarked for Central Instrumentation Facility. The total cost of the building was Rs. 3.14 crores. Dr. Ayyappan appreciated the design of the building and congratulated the institute for creating such a nice facility. Prior to this, Dr. Ayyappan also paid a quick visit to the hatchery, farm and also the recently acquired site for creating Germplasm Supply Unit in the SVVU campus. Following inauguration of the Silver Jubilee Block, a meeting was organized. Dr. R.N. Chatterjee, Acting PD, PDP welcomed the dignitaries and gave a brief account of profile and salient achievements of PDP during the past 25 years since its establishment in 1988. He specially mentioned the contributions of PDP in promoting rural poultry production through the most popular varieties developed by the institute, i.e. *Vanaraja* and *Gramapriya*, which have been in great demand across the country including NEH, Jammu & Kashmir and A & N islands. Prof. K.M.L.Pathak, DDG (AS) expressed satisfaction of the work progress at the institute and indicated future thrust areas of research for the institute. Dr. S. Ayyappan lauded the contributions of PDP in improving livelihood status of rural and tribal people through backyard poultry production and emphasized that PDP is one of the few institutes of ICAR that have excelled in supplying improved germplasm to farmers of the country. Dr. Ayyappan suggested to strengthen research in consortia mode employing multi-disciplinary approach involving the local SAUs, ICAR institutes and other line departments, particularly on food platform for

Silver Jubilee Block

Dr. S. Ayyappan inaugurating the Silver Jubilee Block in presence of Prof. K.M.L.Pathak, DDG (AS) and other dignitaries

Dr. S. Ayyappan addressing the gathering in presence of Prof. K.M.L.Pathak, DDG (AS) and other dignitaries

effectively tapping the health benefits of cereals and value added products. He also suggested formulating strategy for meeting requirements of agriculture sector during exigencies. Dr. V. Prabhakar Rao, VC, SVVU; Dr. A. Padma Raju, VC, ANGRAU and Dr. S.L. Goswami, Director, NAARM assured all the cooperation and support in addressing the issues of poultry and allied sectors. The meeting ended with vote of thanks.

16.10 National Science Day celebrated

The Directorate of Poultry Research, Hyderabad has celebrated National Science Day on 28th February to commemorate the remarkable discovery of Sir C.V. Raman by popularizing the science among masses. With on this occasion, the Institute has organized an exhibition on Poultry Science by highlighting several technologies and varieties developed at the Institute. Students from different schools, scientists and others have visited the exhibition stall and appreciated different chicken varieties at the Institute. In the morning, Director, Dr. R.N. Chatterjee has inaugurated the exhibition stall in presence of Dr. P.K. Jain, Scientist F from International Advanced Research center for Powder metallurgy & New Materials (ARCI), Hyderabad and other scientists and staffs of the Institute. On the eve of National Science Day celebrations, the Institute has organized a scientific programme where Dr. P. K. Jain, Scientist-F from ARCI, Hyderabad delivered a lecture on Nanotechnology and its application in day to day activities. In the occasion, Director, Dr. R.N. Chatterjee explained about the activities of the Institute and its role for the benefit of the farmers particularly in the rural area. He also narrated the role of science in everyday life and emphasized for popularizing science for upliftment of countrymen in particular the rural farmers. At the beginning of the programme, Dr. T.K. Bhattacharya, ICAR National Fellow welcomed all the guests and dignitaries in the

Dr. P. K. Jain (Invited speaker) delivering Science Day lecture

National Science day celebration and informed about the history of commemorating National Science day in the country. The programme ended with vote of thanks proposed by Dr. M. Shanmugam, Scientist of the Institute.

16.11 Farmers-Scientists Interface and Institute Foundation Day celebrated

Directorate of Poultry Research, Hyderabad celebrated its 27th Foundation day on 1st March 2014. A Farmers-Scientists Interface was organized on this occasion. Farmers from Timmareddyguda village, Shabad Mandal, Ranga Reddy district of Andhra Pradesh attended the programme. They spoke about their experiences of

Digitalised Institute Publications being released

rearing improved variety of chicken distributed to them by the Directorate. They expressed their satisfaction and happiness about the performance of the variety. With on this occasion, Professors and Heads of Divisions of Veterinary College, SVVU, Hyderabad; dignitaries from other local ICAR Institutes; ANGRAU, Hyderabad also participated.

Dr. S. L. Goswami, Director, NAARM graced the occasion as Chief Guest of the event. He congratulated all the staff of the institute on the occasion of foundation day celebration and insisted on working constantly with farmers for their development and the importance of constant dialogue with the stakeholders. He suggested the Directorate to adopt a village for validation of technologies and successful performance of varieties developed by the Directorate.

Dr. R. P. Sharma, Former Director, Project Directorate on Poultry, addressed the gathering as Guest of Honour. He emphasized on development of more number of chicken varieties for rural farmers in the country depending upon their needs and available resources.

Farmers at the Exhibition on Institute Foundation Day celebrations

Dr. R. N. Chatterjee, Director, Directorate of Poultry Research briefed the gathering about the research activities, programmes and developmental works initiated at the Institute. He also mentioned about the achievements of the Institute and its role in strengthening rural economy by supplying different chicken varieties suitable for rural and tribal farmers.

Dr. S.L. Goswami, Director, NAARM released a CD entitled "Digitalised Institute Publications" containing all annual reports, news letters and other publications of the Directorate since its inception in 1988. Dr. R.P. Sharma, Former Director of PD on Poultry released the Newsletter of the Institute for the period of July-December 2013.

At the beginning of the programme, Dr. T. K. Bhattacharya, National Fellow and Chairman of the Organizing Committee welcomed the dignitaries and mentioned about the role of poultry sector and its contribution in the country. The programme ended with the vote of thanks proposed by Dr. U. Rajkumar, Senior Scientist of the Institute.

16.12 Independence Day

DPR celebrated Independence Day on 15th August 2013. The Director hoisted the national flag and addressed the gathering. The Director recounted the great contribution of the freedom fighters and how nation got Independence. He also mentioned about the research and development contribution of DPR and future challenges to be addressed.

16.13 Republic Day

DPR celebrated Republic Day on 26th January 2014. On this occasion, the Director hoisted the national flag and addressed the gathering. He emphasised the continuation of hard work put by the staff members in making the institute's research output helping the farming community. He congratulated the staff for their untiring efforts in achieving the fixed targets of the institute.

Director hoisting the National Flag and addressing the gathering on Republic Day

Inauguration of Silver Jubilee Block

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Directorate of Poultry Research

Rajendranagar, Hyderabad - 500 030, India.
Ph.: +91 (40) 2401 5651/7000/8687
Fax : +91 (40) 2401 7002; E-mail : pdpoult@nic.in
www.pdonpoultry.org

भाकृअनुप
ICAR