25 YEARS SILVER JUBILEE

IN THE SERVICE OF NATION

ANNUAL REPORT 2012-2013

Project Directorate on Poultry

Rajendranagar, Hyderabad - 500 030

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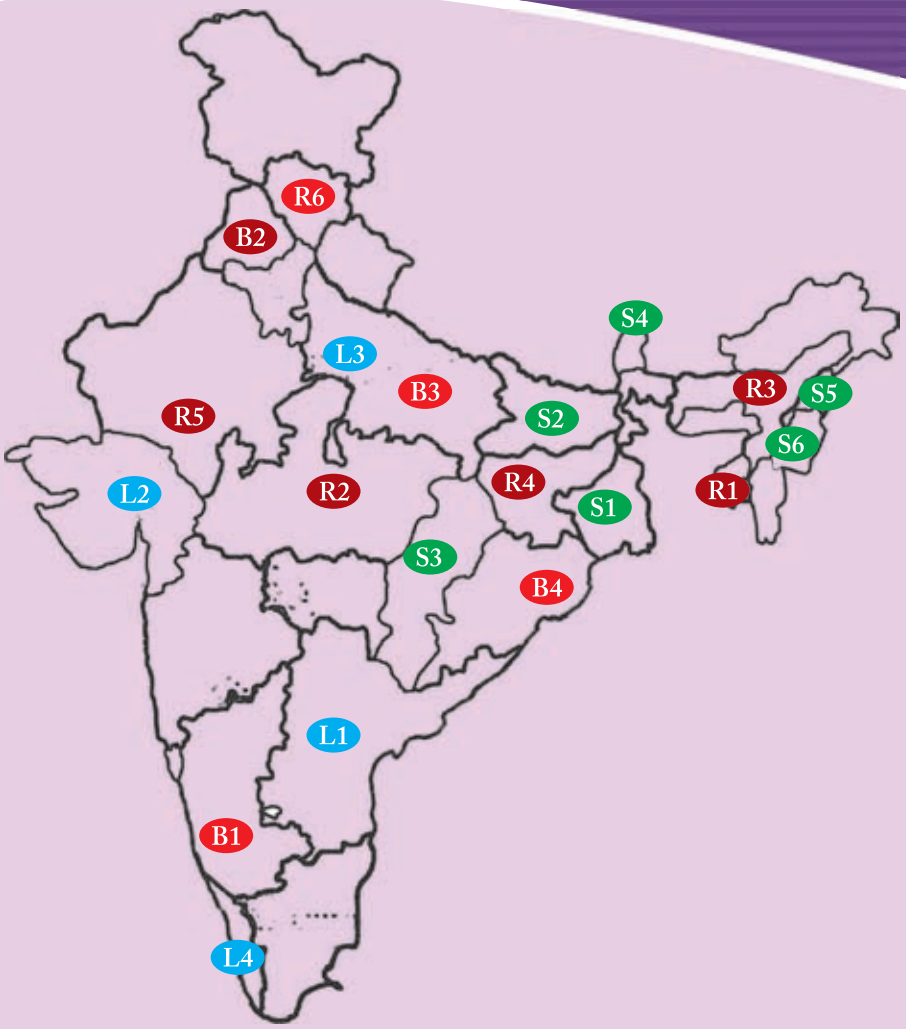
भाकृअनुप ICAR

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



AICRP Centers

Layer

L1. SVVU, Hyderabad
L2. AAU, Anand
L3. CARI, Izatnagar
L4. KVASU, Mannuthy

Broiler

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

Rural poultry

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

Poultry Seed Project Centres

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

ANNUAL REPORT
2012 - 2013

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

PDP

Annual Report

Correct Citation
Annual Report 2012-13
Project Directorate on Poultry
Rajendranagar, Hyderabad-500 030
Andhra Pradesh, India

Published by
Dr. R.N. Chatterjee
Project Director (Acting)

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Front Cover
Srinidhi variety developed by PDP

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

Inside Back Cover
Glimpses of IPSACON 2012

Back Cover
Hon'ble DDG (AS) Prof. K.M.L. Pathak releasing *Srinidhi* variety

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

Project Directorate on Poultry completed 25 years of its fruitful existence contributing to the over all development of the poultry and celebrating its silver jubilee. The dedicated and continued efforts of the staff of this directorate fulfilled the mandated responsibilities and made significant contribution in the field of genetics and breeding, nutrition, health and biotechnology. I feel privileged to present the Annual Report for the year 2012-13.

The emphasis was enhancement of rural poultry production in the country through development of improved germ plasm for rural poultry that are well adapted to various agro- climatic conditions of the country. The names of most popular chicken varieties *Vanaraja* and *Gramapriya* have become synonymous with the directorate and they are seen through length and breadth of the country. I feel proud to announce that the Directorate has developed another new dual purpose promising variety *Srinidhi* for the benefit of the rural and tribal farmers. This variety was released by Honorable DDG(AS), Prof. K.M.L.Pathak on the eve of silver jubilee celebration of the directorate.

Under AICRP on Poultry Breeding elite layer and broiler pure line showed consistent improvement over the years. The performance of broiler and layer crosses in the field and RSPPT are quite encouraging. The six rural poultry centres located at different parts of the country are taking care of collection and conservation of local germ plasm and development of location specific varieties. The Udaipur centre developed a location specific variety *'Pratapdhan'* for the benefit of rural farmers of Rajasthan. The variety was also released by Hon'ble DDG (AS), Prof. K.M.L. Pathak during AICRP

and PSP annual review meeting held at Udaipur.

The six poultry seed project centres completed the establishment of infrastructure facilities and about 2.5 lakhs chicks were supplied to rural farmers during the year. The farmers in the respective region are happy to have *Vanaraja* and *Gramapriya* at their door steps and they are getting supplementary income by rearing of these birds.

The pure line broiler and layer populations maintained at this directorate showed consistent improvement in the primary trait of selection through conventional breeding. Various native breeds like Aseel, Ghagus and Nicobari fowl are being collected and conserved at this directorate. The gene lines maintained are being used in alleviating heat stress and augmenting productivity of poultry.

The directorate is under taking research in poultry genomics through functional genomics, epigenetics and gene silencing technology for improving the poultry production. Work on mitochondrial DNA is in progress to know the genetic diversity of indigenous breeds and pure lines maintained at the directorate.

The research conducted in the area of nutrition established nutrient requirements and feeding

schedules for various strains and varieties evolved at this Directorate. Work is also in line to alleviating toxic principles in non-conventional feed stuffs and their possible use in substituting the costlier feed ingredients. Production of designer eggs and meat through nutritional manipulation is under progess. Health section is adopting conventional and molecular methods in poultry disease diagnosis and prophylaxis.

Further, several externally funded projects by DST, DBT, NICRA and other collaborative projects were under taken by the directorate. Besides, some contract research projects are in progress in health and nutrition areas.

The directorate has supplied about 4.5 laks of improved germplasm to the farmers throughout the country through various Govt. agencies and NGOs. I am happy to mention that the directorate has earned Rs.149.70 lakhs through supply of germ plasm and sales of eggs and culled birds.

I am extremely happy that the scientists of this directorate got several awards and recognition for their significant contribution

I place on record my deepest sense of gratitude to Dr. S. Ayyappan, Secretary (DARE) & Director General (ICAR) for his ever inspiring and valuable guidance and stewardship extended during the period. I am grateful to Secretary, ICAR and Financial Advisor, ICAR for their constant support in development of this Directorate.

I am grateful 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. S.C. Gupta, ADG (AP&B), Dr.Gaya Prasad, ADG (AH), Dr. Vineet Bhasin, Principal scientist (AGB) and other scientific and Administrative Officials of the ICAR Head Quarters for their help from time to time in growth and development of this Directorate.

The research progress achieved, could not have been possible without the support and sincere contribution of all the scientists at the Directorate and different centers of AICRP and Seed Project. I also, thank the other staff for effectively supporting the scientists in their research endeavor. I thank the editorial committee in bringing out this Report in appreciable manner.

(R.N. Chatterjee)

Abbreviations

AAU	Anand Agricultural University / Assam Agricultural University
AICRP	All India Coordinated Research Project
ANGRAU	Acharya N.G. Ranga Agricultural University
APARD	Andhra Pradesh Academy of Rural Development
APAU	Andhra Pradesh Agricultural University
ARIS	Agricultural Research Information System
ASM	Age at Sexual Maturity
BAU	Birsa Agricultural University
CARI	Central Avian Research Institute
CAS	Centre of Advanced Studies
CKVV	Chattisgarh Kamadhenu Viswavidyalaya
Concn	Concentration
CP	Crude Protien
CPCSEA	Committee for the Purpose of Control and Supervision on Experiments on Animals
CPDO	Central Poultry Development Organization
CRIDA	Central Research Institute for Dryland Agriculture
CSKHPKVV	Chaudhury Srawan Kumar Himachal Pradesh Krishi Viswavidyalaya
d	Day(s)
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DNA	Deoxyribonucleic Acid
DOR	Directorate of Oilseeds 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 Science University
GP	Glutathione Peroxidase
GR	Glutathione Reductase
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
JNKVV	Jawaharlal Nehru Krishi Viswa Vidyalaya
KVASU	Kerala Veterinary and Animal Science University
KVAFSU	Karnataka Veterinary, Animal and Fishery Sciences University
KVK	Krishi Vignan Kendra
LP	Lipid Peroxidase
MAFSU	Maharashtra Animal and Fishery Sciences University
MANAGE	National Institute of Agricultural Extension Management
MD	Marek's Disease
ME	Metabolizable Energy
mill	Million
mm	Millimeter(s)
MPPCVV	Madhya Pradesh Pasu Chikitsa Viswa Vidyalaya
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 Reseliant Agriculture
NIRD	National Institute of Rural Development
OUAT	Orissa University of Agriculture and Technology
PCR	Polymerase Chain Reaction
PHA-P	Phytohemagglutinin-P
ppm	Parts Per Million
QRT	Quinquennial Review Team
RAC	Research Advisory Committee
RAU	Rajendra Agricultural University
SAU	State Agricultural University
SRBC	Sheep Red Blood Cells
SVU	State Veterinary University
SVVU	Sri Venkateswara Veterinary University
TES	Total Eggs Set
TSA	Total Sulfur-Containing Amino Acids
U	Unit(s)
VBRI	Veterinary Biologicals and Research Institute
WBUAFS	West Bengal University of Animal and Fishery Sciences
wks	Weeks

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Executive Summary

Project Directorate on Poultry, a constituent of Indian Council of Agricultural Research accomplished the responsibility of coordinating and monitoring ICAR-sponsored network programme alongwith undertaking applied research with due emphasis on developing chicken varieties to meet the needs of rural, tribal and other underprivileged sections of the society. The externally aided projects funded by DST and other agencies were also undertaken. The progress in various activities during 2012-13 has been briefed below.

Research at the Directorate

Genetics and Breeding

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

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 (tinted egg layer line), PD-4 (evolved from Aseel), Ghagus and Nicobari were maintained for use in developing rural chicken varieties. In PD-1 line, during S-6 generation, ASM, EW40 and EP40 were 188.58±0.05 days, 54.61±0.01 g and 46.29±0.04 eggs, respectively. The shape index, shell thickness, Haugh index, albumen%, yolk% and shell % at 40 weeks were 77.46±0.48, 0.34±0.005 mm, 91.83±1.10, 56.12±0.55, 32.14±0.54 and 11.74±0.18, respectively. The shank length (76.45±0.002 mm) and body weight (667.58±0.04 g) at 6 weeks of age increased in the S-7 generation as compared to last generation. In PD-2 line, body weights at 4 and 6 weeks and shank length at 6 weeks were 233.9 and 462.9 g and 65.76 mm, respectively. The 40 weeks egg production showed an improvement of 1 egg over previous generation on phenotypic scale. In PD-3 line, ASM, EW40, EP40 and EM40 were 172.76 ± 0.06 days, 54.86±0.01 g, 74.35±0.04 eggs and 3923.23±3.16 g, respectively in G-2 generation. The egg mass showed an improvement of 1111g as compared to previous generation. In PD-4 line, egg production up to 72 weeks of age was 150.8 eggs. The 16 weeks BW and SL were 87.6±20.2g and 110.5±2.3 mm, respectively. In *Ghagus*-ecotype, body weights of male and female birds at 40 weeks of age were 2548±36 and 1663±43 g, respectively during G-1 generation. ASM was 196.1±3.5 days. Under the conservation programme, eggs of Nicobari fowl were received from CARI, Port Blair and chicks were hatched. In addition, Aseel germplasm was collected from Bhimavaram, West Godavari District and Shankarapally, Ranga Reddy District. A male line for egg type rural poultry was evaluated for juvenile and production performance during SL-2 generation. The 6 weeks BW and SL was 489.51 ±0.04 g and 69.56 ±0.002 mm, respectively. Shank length, the primary trait of selection increased marginally from the previous generation. The 40 weeks egg production (80.76±0.07 eggs) increased by 11 eggs as compared to the previous generation. A random bred rural control population was also evolved for comparing the performance of different rural lines maintained.

A dual purpose rural variety, *Srinidhi* was developed at the Directorate with body weights of 37.35, 131.8, 329.8 and 668.4 g at day old, 2, 4 and 6 weeks age in battery brooders. The shank length at 6 weeks of age was 75.63 mm. This bird complements the body weight gain of *Vanaraja* and egg production of *Gramapriya* and is well suited for rural area because of its long shanks and multiple coloured plumages.

Four new crosses viz. PD-1 X PB-2 (B), PD-1 X PD-3 (R), PD-1 X PD-4 (A) and PD-1 X IWI (W) were developed. The ASM and 72 weeks egg production of A, B, R and W crosses were 158±1.10, 160±1.79, 157±2.00 and 149±0.64 days and 161.9±4.36, 113.4±4.14, 219.1±5.27 and 212.5±3.24 eggs, respectively. The overall performance was better in W compared to others under intensive system of rearing. A three way cross (PD1 X IWI X PD3) was produced in which the body weight of birds at 4 weeks of age was 171.2 g.

Layer populations

Two layer lines, IWH and IWI completed 72 weeks of production in their G-1 generation while IWK completed 72 weeks in its S-9 generation. All these three lines showed significant improvement in 72 weeks egg production. The body weights of IWI, IWH and IWK population at 8, 16 and 20 weeks showed significant improvement over their previous generation. The ASM increased by 3 to 5 days in these populations, respectively. The layer control population completed 72 weeks in its S-9 generation and the 72 weeks egg production was 222.1±2.06 eggs. The S-10 generation of control layer population was regenerated. The ASM and 72 weeks egg production remained stable in control population.

Broiler populations

Two synthetic coloured broiler lines, male (PB-1) and female (PB-2) were maintained and evaluated alongwith a control population. In PB-1 line, body weight at 20 and 40 weeks marginally increased as compared to previous generation. ASM was increased by 1 day in S-22 generation. The 5 weeks body weight (996±0.72 g) was increased by 119g in S-23 generation. In PB-2 line, egg production upto 40 weeks and egg weight at 40 week was 57.86g 67.05±0.54 eggs, respectively. The egg production remained stable over the previous generation. The average body weights at 5 and 6 weeks were 829.32±2.38 and 969.30g, respectively. The ASM reduced by 15 days over the previous generation. The performance of control broiler remained stable. Two gene lines, naked neck and dwarf maintained as resource populations. The ASM reduced by 3-4 days in both the gene lines over their previous generation. The 6 weeks body weight was 913.18±1.04 and 71.98±0.04 g, respectively in naked neck and dwarf lines.

Molecular Genetics

Three candidate genes involved in regulating muscle growth, namely, Activin receptor 2A (ACTVNR2A), Activin receptor 2B (ACTVNR2B) and Follistatin (FSTN) were characterized in chicken. The coding region of these genes was polymorphic with 6 haplotypes in ACTVNR2A, 4 haplotypes in ACTVNR2B and 6 haplotypes in FSTN genes. The ACTVNR2A haplogroups showed significant ($P<0.05$) effect on body weight at 6 weeks where h1h6 haplogroup had the highest body weight. Microarray study in broiler line over Indigenous line revealed that during embryonic stage, 10126 transcripts were up-regulated and 5254 transcripts were down-regulated on day 7 and 2104 transcripts were up-regulated and 1539 transcripts were down-regulated on day 18. A total of 7 mitochondrial genes viz., ATPase6, ATPase8, ND-1, ND-2, ND-3, ND-4L and ND-6 were characterized in different breeds and varieties maintained at the Directorate. Subtle variations were identified in the nucleotide sequences of different genes and the phylogenetic analysis showed different clusters for various breeds. A differential expression profile of Heat Shock protein 70 gene (Hsp70) in chicken (Naked neck, PB-2 and PD-3) was prepared in which significant variation in expression was observed in the breeds at 2nd and 4th week. In all the breeds, the heat treated embryos expressed

lower levels of Hsp 70 as compared to their normal counterparts indicating the epigenetic thermal adaptation during embryonic stage with an ability for combating heat stress during post natal life.

Nutrition, Physiology and Health

Use of Betaine in diet of Vanaraja birds reduced lipid peroxidation and increased the activity of SOD. High betaine inclusion levels in MBM is detrimental to growth, whilst low levels of betaine inclusion in SBM diets (deficient in glycine), may stimulate uric acid synthesis to meet the bird's antioxidant requirements to the detriment of its growth. The lipid peroxidation reduced significantly in broilers fed with *Tulsi* extract as compared to those fed diet without the *Tulsi* extract. The activity of glutathione peroxidase progressively increased with increase in concentration of *Amla* extract and maximum response was observed at 150 ppm. The feed efficiency in group fed 0.10% KCl was significantly better than those fed the control diet during summer months. A level of 260 meq of electrolyte balance provided better performance in broilers. Layer performance was not affected by dietary electrolyte balance during summer. The lipid peroxidation was significantly reduced in groups fed with both vitamin E and C as compared to those fed one vitamin or control group. Immune responses (HI titre and CMI response to PHA-P) were not affected by vitamin E and C. Lipid peroxidation decreased and activities of catalase and glutathione peroxidase increased in birds fed Zn, Cr and Se as compared to those fed the control diet. The mortality was considerably reduced in layers fed organic Cr as compared to those fed the control diet (without Cr in diet). The activities of SOD and GPx increased in birds fed organic Se and vitamin E as compared to the control group. The *Karanja* seed cake detoxified with Isopropanol (IPA) (1:3), NaOH (2% of cake) or NaOH+HCl (2% of cake in 1:1 ratio) after extraction of oil in 2 stages (expelling and extraction with hexane) was tested in broiler chicken diet. The IPA detoxified *Karanja* cake could be used upto 3% in the diet of broiler chicken without any adverse effect on performance and other variables studied. The toxic effects of *Karanja* cake on broiler chicken could not be alleviated by dietary supplementation of protease, phytase or liver tonic. Molasses inclusion in diet showed no effect indicating that the toxic effects of *Karanja* cake on broiler chicken were not due to poor palatability. A feeding trial was conducted utilizing broiler breeder pullets (PB-2) from 33-56 weeks of age to evaluate the impact of different supplemental levels of organic Se (0.15; 0.25; 0.35; 0.45 mg/kg) on their performance. The production performance was better realized from organic Se at level as low as 0.15 ppm during the 24-week production period in PB-2 line. The organic Se at 0.15 ppm and 0.25 ppm were effective for production performance and hatchability, respectively. Organic Se at 0.15 ppm level was adequate to support breeder and progeny performance. The supplementation of organic Se in chick diets at minimum level 0.15 ppm was essential. A total of five various nutrient density diets were formulated and tested in PD-3 line. The production parameters such as body weight, feed intake and feed efficiency did not differ significantly in different group of birds, but egg production during the 38-41 weeks of period was higher in the birds fed 2.5% higher nutrient density diet as compared to other groups. The sperm concentration, appearance, motility and semen volume did not differ among these various dietary groups in PD-3 line. In commercial chicken, dietary supplementation of Ration Plus resulted in increased body weight gain and better feed conversion ratio. Further, supplementation of encapsulated enzymes resulted in marginal

increase in body weight and FCR as compared to those fed diet supplemented with un-encapsulated enzymes. The body weight gain and feed intake did not differ among the various dietary groups, but the better FCR was recorded among the birds fed with Vitamin E at 0.2 g/kg diet and Se at 0.15 mg/kg diet as compared to other groups. Supplementation of vegetable oils in the diets at various concentrations did not affect the body weight gain, feed intake and feed conversion ratio in *Krishibro* birds.

An exposure of eggs to higher incubation temperature (2°C higher than normal) improved the sperm concentration in cocks. The semen quality of Ghagus ecotype at 48 weeks was evaluated. Supplementation of selenium in inorganic form to PB-2 cocks indicated a negative effect on the semen quality.

Mortality pattern and causes of mortality were determined among pure line chicken populations. Birds were screened for ALV before regeneration and only negative birds were used for the purpose. Avian leukosis tumour virus B locus in three White Leghorn chicken lines (IWH, IWI and IWK) and one indigenous chicken line were determined. The *TVB**S1 and *TVB**S3 alleles were found in White Leghorn lines, whereas only *TVB**S1 allele was detected in indigenous chicken. A study was conducted in order to determine the prevalence of *M.gallisepticum* in Indian poultry farms. The isolation of *M. gallisepticum* from choanal swabs was performed using standard culture techniques and identified by Polymerase Chain Reaction (PCR) technique. Selected Detection of specific antibodies against *M. synoviae* using the ELISA techniques was performed. The prevalence of *M. gallisepticum* in different regions was 18.64% in Central, 01.00% in East, 1.76% in North and 11.25% in South. The prevalence of *M. gallisepticum* was 12.45% in Commercial Layers, 09.20% in Broiler Parents and 7.85% in Commercial Broilers.

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

The layer lines maintained at different Institutes included IWD and IWF strains at SVVU, Hyderabad; IWN and IWP strains at KVASU, Mannuthy and AAU, Anand; and IWH and IWI strains at CARI, Izatnagar. The KVASU, Mannuthy centre has evaluated the S-26 generation of IWN and IWP populations up to 64 weeks of age. The hen house and hen day egg production up to 64 weeks of age increased by 3.5 and 4.8 eggs, respectively over previous generation in IWP. The egg production on hen day basis up to 72 weeks for IWN and IWP were 313.7 and 301.4 eggs, respectively, at Mannuthy. The average genetic response for egg production to 64 weeks of age in IWN (3.70 eggs) was higher than IWP (2.35 eggs) in the last nine generations. The centre supplied 28,858 germplasm during the year.

The S-10 generation of IWN and IWP strains was evaluated up to 64 weeks of age at AAU, Anand centre. The egg production up to 64 weeks of age increased in IWN (by 5.3 eggs), IWP (by 13.9 eggs) and control (by 3.7 eggs) over previous generation. The egg production upto 72 weeks of age were 288 and 277 eggs in IWN and IWP, respectively. The egg weight increased by 0.49 g in IWN and 0.24 g in IWP at 64 weeks of age as compared to last generation. The average genetic response of egg production upto 64 weeks of age in both the selected strains (1.65 in IWN and 2.40 in IWP) was positive over last 10 generations. The egg production of IWN X IWP and IWD X IWK up to 72 weeks of age was 300.8 and 264.3 eggs,

respectively. The egg production of IWD and IWK up to 64 weeks of age was 226.5 and 210.6 eggs, respectively. The centre supplied 2055 germplasm during the year.

The S-30 generation of IWD and S-29 generation of IWF were regenerated and evaluated upto 40 weeks at SVVU, Hyderabad. The egg production up to 40 weeks of age in IWD and IWF were 103 and 109 eggs, respectively. Corresponding egg weight was 50.3 and 51.1 g. The average genetic response for egg production up to 40 weeks of age for last 12 generations was 0.57 egg in IWD and 0.45 egg in IWF, respectively. The centre supplied 5000 germplasm during the year.

The S-32 generation of IWH, IWI and control population was regenerated and evaluated up to 28 weeks of age at CARI, Izatnagar centre. The age at sexual maturity in IWH, IWI, IWC, HI, J X HI and JGHI were 149.1, 154.1, 168.7, 147.0, 147.3 and 152.8 days, respectively. The egg weight at 32 weeks of age increased in IWH by 0.29 g as compared to last generation. The center supplied 5559 germplasm during the year. On hen day egg production basis amongst the ten entries at RSPPT, the Anand centre stood first and Izatnagar stood third.

Poultry for meat

The broiler lines maintained at different Institutes included coloured synthetic broiler lines CSML (sire line) and CSFL (dam line) and corresponding control at CARI, Izatnagar; a synthetic dam line (SDL) and CSML at OUAT, Bhubaneswar; and a synthetic sire (PB-1) and dam line (PB-2) at GADVASU, Ludhiana and KVAFSU, Bengaluru.

At KVAFSU, Bengaluru, average 5 weeks body weight was 1022 g and 1041 g in PB-2 and PB-1, respectively. The average genetic and phenotypic response in PB-2 was -7.32 and 6.07 g, respectively over last 7 generations. Egg production up to 40 weeks of age increased over previous generation in PB-2, but decreased in PB-1 and control. Feed conversion ratio was 2.12 in PB-2, 2.16 in PB-1 and 2.08 in control population.

The Ludhiana centre regenerated S-37 generation of PB-2 and S-5 generation of PB-1 population along with PDP control population. The body weight at 5 weeks of age was 1189,1178 and 975 g in PB-2, PB-1 and control population, respectively. Over the last six generations the 5 weeks body weight in PB-2 improved by 25.68 and 25.80 g per generation on phenotypic and genetic scale, respectively. The feed efficiency up to 5 weeks of age improved in PB-2 whereas it decreased in PB-1 and control population. The egg production up to 40 weeks of age decreased in both selected populations and increased in control population as compared to previous generation. Commercial cross in the field attained a body weight of 1551 and 2003 g at 6 and 7 weeks of age, respectively.

CARI, Izatnagar centre evaluated CSML and CSFL and Control Population. Body weight at 5 weeks was improved in all the populations. FCR was 1.97, 2.06 and 2.23 in CSML, CSFL and control population, respectively. The egg production upto 40 weeks of age increased in CSML and decreased in CSFL. The genetic response was 4.28 g per generation in CSML and 3.62 g per generation in CSFL for 5 weeks body weight over last 8 generations. The corresponding phenotypic responses were 16.45 g and 15.79 g per generation.

The Bhubaneswar centre evaluated S-16 generation of SDL and S-4 generation of CSML affected with Avian Influenza. Hence, these two populations were culled and disposed off. Later, fertile eggs of CSML and CSFL were obtained in December, 2012 from CARI, Izatnagar. Body weight at 5 weeks of age was 1070 g in CSFL and 1094 g in CSML.

At 37th RSPPT (Gurgaon), CARIBRO-Dhanraja secured II rank by attaining 1.44 and 1.84 Kg body weight at 6 and 7 weeks, respectively with a mortality of 6%. The strain cross from Bengaluru centre recorded 1216 and 1688 g at 6 and 7 weeks of age, respectively with corresponding FCR of 2.197 and 2.172 in the 38th RSPPT.

Rural Poultry

A total of six centres, namely, ICAR Research Complex for NEH region, Agartala; JNKVV, Jabalpur; AAU, Guwahati; BAU, Ranchi; MPUAT, Udaipur and CSKHPKVV, Palampur. The Agartala centre was declared positive for bird flu and accordingly, all the birds were culled. The permission for restocking of birds was received on September 2012. Fertile eggs of coloured broiler dam line were procured from CARI, Izatnagar and hatched at the Institute hatchery. The local Tripura black indigenous stock was established by purchasing birds from the farmers of Tripura.

Jabalpur centre reproduced the G-4 generation of Kadaknath and Jabalpur colour populations and evaluated up to 40 weeks of age. The hen house egg production of Jabalpur colour up to 40 weeks was 82.5 eggs, which was decreased by 2.3 eggs over previous generation. In Kadaknath, the egg production up to 40 weeks of age was 53.9 eggs and showed improvement of 7.7 eggs over previous generation. The CSML recorded 1075 g body weight at 6 weeks of age, matured at 173 days and produced 46.4 eggs up to 40 weeks of age with egg weight of 61.8 g at 40 weeks. A commercial dual type cross produced 143 eggs under intensive system and 84 eggs under extensive system of rearing.

The Guwahati centre reproduced the native population and evaluated along with Dahlem Red and PB-2 populations. The ASM and hen housed egg production was 182 days, 32.93 and 63.40 eggs upto 40 and 52 weeks of age, respectively. Centre developed BN cross (PB-2xNative), DN cross (Dahlem Red xNative), DBN cross (PB-2 x Native female x Dahlem Red males) and BND cross (PB-2 x Native male x Dahlem Red female). The 20 weeks body weight was 878, 1058, 1632, 1528 and 1869 g, respectively in native, DN cross, BN cross, DBN cross and BND cross. Age at at sexual maturity was 168,186,155 and 162 days in native, DN cross, BN cross and DBN crosses, respectively. The 40 week egg production was 51 and 52 eggs in native and DN cross, respectively.

CSKHPKV, Palampur centre evaluated Native (G-2) up to 32 weeks, Dahlem Red upto 40 weeks. The 5 weeks body weight was 238, 298, 308 and 344 g in native, Dahlem Red, NR cross and NDxDR cross, respectively. The age at sexual maturity in native and Dahlem Red birds was 174 and 146 days, respectively. The Dahlem Red produced 80.89 eggs up to 40 weeks of age.

MPUAT, Udaipur centre evaluated G-2 generation of native germplasm up to 52 weeks of age and G-3 generation was regenerated. Centre also evaluated RIR and coloured synthetic male line and different crosses. The centre produced three 3-way crosses viz; RN crossXRIR (RNR cross), Native X NR cross and BN cross X RIR (BNR cross). The body weight of BNR (dual type) was higher than RNR and NRR crosses (egg type). The body weight of BNR males were 29.1 and 33.4 % higher than RNR cross at 20 and 40 weeks of age, respectively. Similarly, the BNR females were 13.6 and 25.6 % superior to RNR crosses. The RNR cross was only 6.1 and 3.9 % superior in hen day egg production at 40 and 52 weeks of age than BNR cross, respectively. The centre developed a dual purpose variety i.e *PRATAPDHAN* for rural poultry.

Two pedigreed random bred control populations (one for layer and the other for broiler) were

continuously evaluated and reproduced at Project Directorate on Poultry, Hyderabad. Samples of hatching eggs from these populations were sent to different centers of the AICRP on Poultry Breeding during the time of regeneration.

Poultry Seed Project

Six centres under Poultry Seed Project i.e. three in NEH region (ICAR Research Complex for NEH region, Nagaland Regional Centre, Jharnapani; ICAR Research Complex for NEH region, Sikkim Regional Centre, Gangtok; ICAR Research Complex for NEH region, Manipur Regional Centre, Imphal) and three in the main land (Bihar Agricultural University, Patna; West Bengal University of Animal and Fishery Sciences, Kolkata; Chattisgarh Kamadhenu Viswa Vidyalaya, Raipur). A total of 3,09,028 chicks of improved germplasm were distributed to the farmers in their respective regions.

Patna centre produced 66,739 (46,221 *Vanaraja* & 20,518 *Gramapriya*) day old chicks of rural poultry germplasm during the period. Kolkata centre supplied 1,29,236 chicks to the rural farmers of West Bengal. The average hen house egg production in batch III (78-88 weeks), batch IV (55 to 90 weeks), batch V (24 to 73 weeks), batch VI (22 to 61 and Batch VII (23 to 39 weeks) are 34.9, 58.4, 53.2, 52.3 and 39.5%, respectively. The egg weight, percent hatchability on total and fertile egg set was 61.3, 58.4, 53.2, 52.3 and 46.5 g, 73.99, 86.72, 77.64, 82.28, and 74.07, 84.48, 86.72, 85.34, 87.41 and 79.48, respectively. Chicks of *Vanaraja* and *Gramapriya* were supplied to Sundarban, Nadia, West Midnapur and South Dinajpur in West Bengal. At Durg centre, about 550 (equal number of *Vanaraja* and *Gramapriya*) day old chicks of rural chicken germplasm were procured from PDP, Hyderabad.

At Jharanapani centre, all the works and infrastructure is completed. Two batches of *Vanaraja* and *Gramapriya* parent stocks were procured from PDP, Hyderbad. Under the tribal sub plan component of PSP, a total of four training cum demonstration programs were conducted for 204 farmers for creating awareness and hands-on training in poultry rearing. Under TSP of Poultry Seed Project, 8,757 *Vanaraja* and *Gramapriya* chicks were distributed among the beneficiaries. During the period a total of 45,150 birds were distributed to farmers of Nagaland, Assam, Meghalaya and Arunachal Pradesh. At Gangtok centre, a total of 38,478 and 9,668 fertile eggs of *Vanaraja* and *Gramapriya* were produced. A total of 16,802 birds were distributed to Lower Chawang and Upper Chawang, Mangan, Pakyong, Ongchu Jongu, Tingvong areas of Sikkim state. At Imphal centre, 1,425 *Vanaraja* and 945 *Gramapriya* parent were reared during the period. A total of 51,124 chicks were supplied to the farmers.

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. Also training was imparted to farmers and other beneficiaries at the directorate. The directorate has supplied a total of 87,807 hatching eggs, 2,71,858 day old chicks and 1626 grown up birds which generated an income of Rs. 77.75 lakhs revenue to the directorate. The directorate has released a new and promising dual purpose chicken variety *"Srinidhi"* which has completed field trials and has been highly accepted by the farming community. The directorate has been constantly working in partnership mode with related line departments for the benefit of the stakeholders.

Awards and Recognitions

The scientists of this institute have bagged several awards from different associations and societies for

best article, best poster and best oral presentation. Dr. U. Rajkumar, Sr. Scientist was awarded with EICA fellowship for international training. Shri. J. Srinivas Rao, T-6 was awarded Rashtra Bharati Puraskar for the year, 2012.

Other Activities

During the Silver jubilee year, the directorate has taken up different activities like organising stakeholders meeting, conducting short courses, training and scientist industry interface which have benefitted the poultry farmers. The directorate also organised the IPSACON 2012 conference which was attended by poultry fraternity from India and abroad. Several meeting of the Quinquennial review team were conducted for assessment of the activities of this directorate. The Research advisory committee and Institute management committee constantly monitored and suggested improvement in research, administration and financial management. The budget utilized during the period was Rs. 414.45 Lakhs (Plan) and Rs. 702.71 Lakhs (Non-Plan) at the Directorate and Rs. 593.00 Lakhs and Rs. 200.00 Lakhs were utilized by the AICRP and Seed project, respectively. The Directorate generated revenue of Rs. 125.78 Lakhs during the financial year, mainly by supplying Germplasm and sale of poultry produce.

1. Introduction

1.1 History

The Project Directorate on Poultry is one of 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 aegis of Indian Council of Agricultural Research. The Institute was originated under the flagship of 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. In addition to 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 primary focus of the research at the Institute has been put forth towards the application of quantitative genetic principles for enhancing productivity of various chicken germplasm. To support these activities, research on nutrition, health, physiology and molecular genetics has formed an integral component of the core research programme. In addition, 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.

The concerted holistic efforts made by AICRP centers resulted in the release of seven promising varieties of chicken for commercial utilization by 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 in 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, *Pratapdhan* 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. The activities of the Directorate further expanded

during XI plan by introducing a new network 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.

Furthermore, the research taken up at this Directorate resulted in evolving two promising chicken crosses for rural poultry farming i.e., *Vanaraja*, a dual-purpose bird and *Gramapriya*, predominantly a layer, meant for free-range and backyard farming. These two chicken varieties have become extremely popular and are being reared in all the country. Several user agencies are involved for dissemination in the country covering the southern, northern, eastern and northeastern states including Jammu and Kashmir, Lakshadweep, North Eastern states, 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. In addition to 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.

Today, India has been 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. The rural backyard poultry in this context has been one of the most valuable commodities for the landless or marginal farmers to earn their livelihood and balanced food. The Directorate has taken a lead in this direction to meet the needs of rural farmers by adopting a holistic approach to develop high performing, better adaptable and disease resistant germplasm suitable for backyard farming with low input system.

Research is actively 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 under backyard systems of rearing. Nutritional research at the directorate resulted in development of few important technologies which 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, seromonitoring 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. The molecular characterization of various chicken lines used in the AICRP programme has been initiated at this Directorate to measure population dynamics of the lines including genetic distance among themselves. 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 operating 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. The organizational set up of the Institute has been dipicted in figure 1.

1.4 Financial outlay

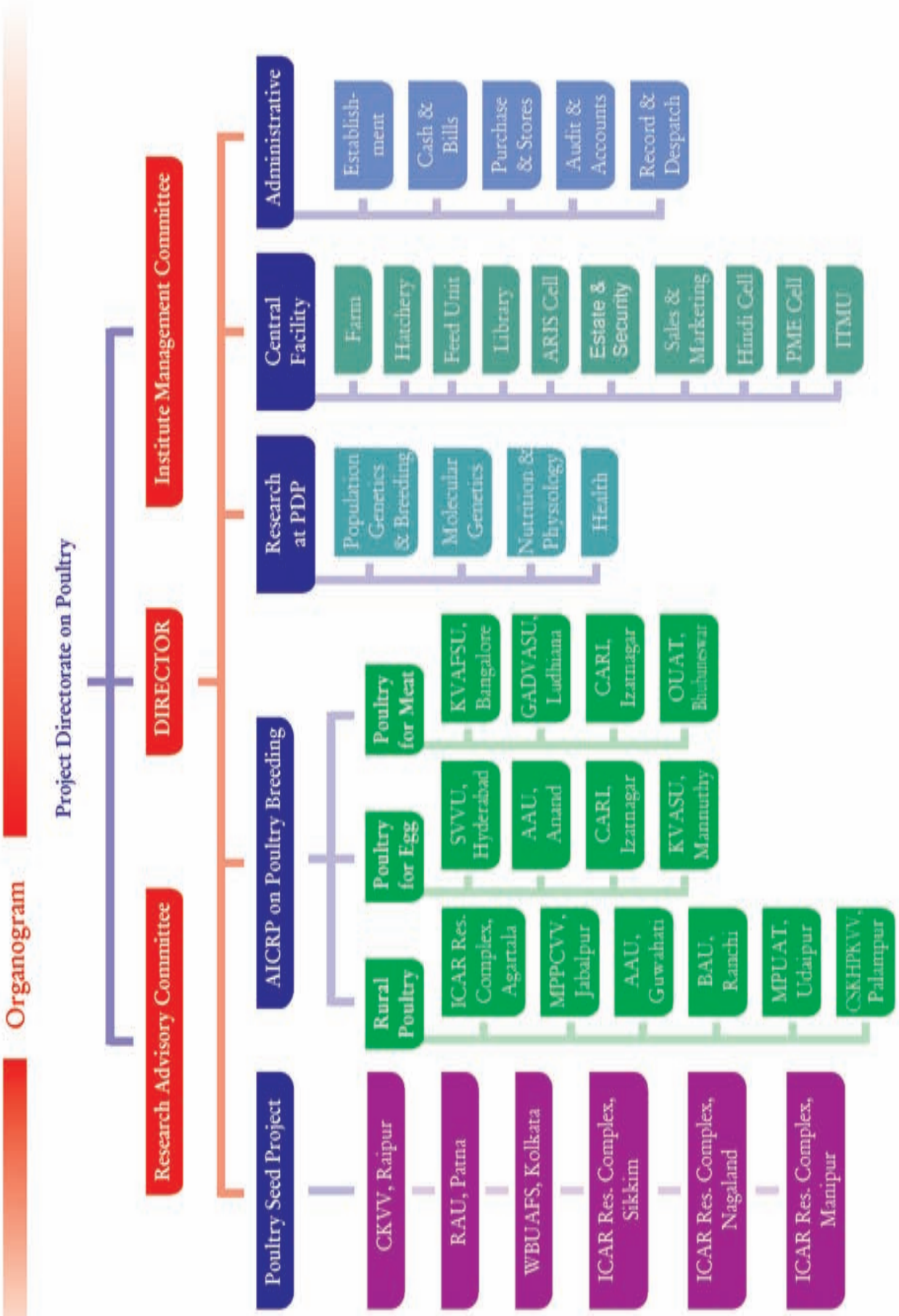
(Rs lakhs)

Component	Plan		Non-Plan		Receipts
	Budget	Expenditure	Budget	Expenditure	
PD on Poultry	416.00	414.45	702.94	702.71	125.78
AICRP	593.00	593.00	-	-	-
Seed Project	200.00	200.00	-	-	-

1.5 Staff position

Cadre	Sanctioned	Cadre in position as on March 31, 2013
RMP	01	Vacant
Scientists	15	15
Technical	16	14
Administrative	14	12
Skilled support	16	14
TOTAL	**62**	**55**

Organogram


Project Directorate on Poultry
Research Advisory Committee
DIRECTOR
Institute Management Committee
Poultry Seed Project
CKVV, Raipur
RAU, 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
MPPCVV, Jabalpur
AAU, Guwahati
BAU, Ranchi
MPUAT, Udaipur
CSKHPKVV, Palampur
Poultry for Egg
SVVU, Hyderabad
AAU, Anand
CARI, Izatnagar
KVASU, Manuthy
Poultry for Meat
KVAFSU, Bangalore
GADVASU, Ludhiana
CARI, Izatnagar
OUAT, Bhubaneswar
Research at PDP
Population Genetics & Breeding
Molecular Genetics
Nutrition & Physiology
Health
Central Facility
Farm
Hatchery
Feed Unit
Library
ARIS Cell
Estate & Security
Sales & Marketing
Hindi Cell
PME Cell
ITMU
Administrative
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 was used as male parent for production of terminal cross of Vanaraja, which was used for backyard poultry farming. The birds of S-6 generation were evaluated for different production traits and are presented in Table 1.

Table 1. Production performance and heritability estimates in PD-1 line (S-6)

Traits	Mean ± SE	$h^2_{(S+D)}$
Shank length (mm)		
40wks	-	0.67 ± 0.23
Body wt (g)		
20 wks	1986 ± 0.36	0.07 ± 0.14
40 wks	2647 ± 0.50	0.01 ± 0.14
Wt at sexual maturity (g)	2243 ± 0.55	0.17 ± 0.15
ASM (d)	188.5 ± 0.05	0.04 ± 0.14
EW (g)		
40 wks	54.61 ± 0.01	0.11 ± 0.16
EP (no.)		
40 wks	46.29 ± 0.04	0.03 ± 0.14

Least square estimates for egg weight at 28, 32, 36 and 40 weeks of age were 47.37 ± 0.01, 50.95 ± 0.01, 53.58 ± 0.01 and 54.61 ± 0.01 g, respectively. Egg weight increased in the present generation compared to last generation. Egg quality traits measured at 40 weeks of age. Shape index, Haugh unit and shell thickness were 77.46 ± 0.48, 91.83 ± 1.10 and 0.34 ± 0.005 mm, respectively. Albumen, yolk and shell % were 56.12 ± 0.55, 32.14 ± 0.54 and 11.74 ± 0.18, respectively.

A total of 3,281 chicks were hatched in four hatches along with one hatch of Control broiler in S-7 generation. The fertility between different hatches of PD-1 varied from 89.25 to 92.78%. Hatchability between different hatches on total egg set and fertile egg set basis varied from 83.65 to 88.81% and 93.65 to 96.13%, respectively. Hatchability increased as compared to last generation. Fertility and hatchability on total egg set and fertile egg set basis in Control broiler was 54.80 and 97.86%, respectively. Least square estimates and heritability of juvenile traits are presented in Table 2.

Male of PD-1 line

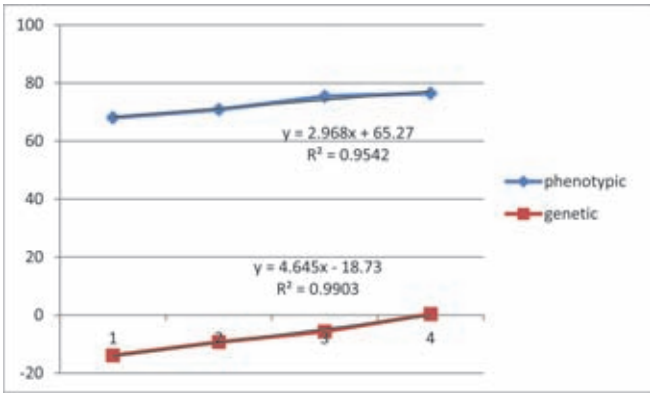
Female of PD-1 line

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

Traits	Mean ± SE	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
Body wt (g)				
2 wks	135.6 ± 0.006	0.26 ± 0.07	0.21 ± 0.05	0.24 ± 0.05
4 wks	346.6 ± 0.019	0.15 ± 0.05	0.09 ± 0.04	0.12 ± 0.03
6 wks	667.5 ± 0.04	0.13 ± 0.04	0.10 ± 0.04	0.11 ± 0.03
Shank length (mm)				
6 wks	76.45 ± 0.002	0.06 ± 0.03	0.07 ± 0.04	0.06 ± 0.02
Keel length (mm)				
6 wks	87.15 ± 0.002	0.06 ± 0.04	0.04 ± 0.04	0.05 ± 0.02

The shank length and body weight at 6 weeks of age increased in the S-7 generation compared to previous generation. Mortality (0-6 week) was 4.14%, which was less as compared to previous generation. Shank length increased by 1.06 mm as compared to last generation. Genetic correlations were positive and high in magnitude between body weights and shank length. Average phenotypic response per generation for last four generations for 6 weeks shank length was 2.97 mm and average genetic response per generation for last four generation was 4.64 mm (Fig 1).

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



Control broiler and Vanaraja were reared up to 6 week to know the trend of shank length. Shank length at 6 weeks of age of control broiler and Vanaraja commercial were 76.08 ± 0.59 and 65.52 ± 0.49 mm, respectively, which was lower compared to previous generation. Corresponding body weights at 6 week of age were 743 ± 14 and 466 ± 9g, respectively. The mortality% from 0 to 6 weeks of age was 4.73 and 2.24% in Vanaraja and control broiler, respectively.

Body weights of female birds at 8, 10, 12, 14 and 18 weeks of age were 974 ± 4.08, 1215 ± 6.18, 1387 ± 9.17, 1581 ± 11.10 and 1728 ± 11.56g, respectively under feed restriction programme. Shank length at 10, 12, 14 and 18 weeks of age were 100.6 ± 0.14, 103.6 ± 0.13, 106 ± 0.14 and 107.2 ± 0.17 mm, respectively. There was an increase of 6.65 mm in shank length from 10 to 18 weeks of age in present generation.

2.1.1.2 Improvement of PD-2 line

PD-2 line was developed from coloured random bred control population. This line was used as female for production of Vanaraja chicks. The egg production upto 52 weeks of age was used as selection criteria. The S-11 generation was reproduced in four hatches. The body weight at 4 and 6 weeks was 233.9 and 462.9 g, respectively. The shank length at 6 weeks of age was 65.76 mm. As this line being selected for egg production upto 52 weeks of age, the juvenile body weight showed declining trend. The production traits along with heritability estimates have been presented in Table 3. The 40 week egg production showed an improvement of 1 egg as compared to previous generation on phenotypic scale. Egg quality traits at different ages is presented in table 3 a.

Table 3. Means and heritabilityof production traits in PD-2 line (S-11)

Traits	Mean	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
ASM(d)	166.4±0.15		0.35±0.17	0.37±0.14
Body wt (g)				
20 wks	1921±0.47	0.32±0.18	0.24±0.19	0.29±0.13
40 wks	2619±0.54	0.45±0.21	0.32±0.18	0.38±0.15
EW (g)				
28 wks	46.53±0.02	0.59±0.20	0.45±0.15	0.32±0.16
32 wks	48.92±0.03	0.58±0.23	0.41±0.15	0.45±0.17
40 wks	51.57±0.02	0.49±0.24	0.38±0.13	0.48±0.18
EP (no.)				
40 wks	76.58±0.13	0.20±0.08	0.15±0.07	0.17±0.06

Table 3 a. Egg quality traits at different ages in PD-2

week's	28	32	36	40	52	64	72
Egg wt (g)	47.84	50.16	52.84	53.32	55.4	57.36	58.84
Shape Index	76.01	75.56	75.48	76.12	76.49	78.91	77.23
colour	6.43	7.11	7.18	7.45	7.38	7.22	7.31
Haugh uinit	81.16	82.34	82.96	84.16	85.25	82.31	79.39
Yolk index	0.39	0.41	0.4	0.43	0.42	0.39	0.36
Albumin index	0.1	0.09	0.1	0.11	0.12	0.08	0.06
Shell thickness (mm)	0.35	0.36	0.37	0.41	0.4	0.41	0.4
Yolk %	26.75	28.49	30.63	31.09	31.96	32.09	33.48
Albumin %	64.91	63.24	60.53	59.95	58.92	59.49	58.36
shell %	8.34	8.27	8.84	8.96	9.12	8.42	8.16

A pair of PD-2 birds

2.1.1.3 Improvement of PD-3 line

The PD-3 line was developed from the Dahlem Red population. This line was used as a female line for production of coloured varieties for free range farming. The criterion of selection was part period egg mass upto 40 weeks of age. During the current year, G-2 generation was reproduced. The mean and heritabilities of production traits have been presented in Table 4. The egg mass showed an improvement of 1111 g as compared to previous generation. The sire component of heritability for egg mass was more than the dam component indicating scope for further improvement. Egg quality traits at different ages is presented in Table 4 a.

A pair of PD-3 birds

Table 4. Means and heritability of production traits in PD-3 line and control (G-2)

Traits	Selected	Control	Heritability		
			h^2_S	h^2_D	$h^2_{(S+D)}$
ASM(d)	172.8± 0.06	176.5±0.06	0.30±0.13	-0.15±0.07	0.07±0.08
Body wt (g)					
20 wks	1243±0.63	1271±0.73	0.21±0.17	0.01±0.11	0.11±0.10
40 wks	1663±0.61	1705±0.74	1.28±0.40	0.28±0.15	0.78±0.22
EW (g)					
28 wks	48.04±0.01	49.16±0.01	0.26±0.09	0.25±0.05	0.23±0.12
32 wks	50.75±0.01	51.36±0.01	0.35±0.20	0.27±0.12	0.21±0.16
40 wks	54.86±0.01	55.16±0.02	0.29±0.12	0.32±0.19	0.31±0.20
EP (no.)					
40 wks	74.35±0.04	65.04±0.05	0.20±0.12	0.18±0.07	0.19±0.07
EM (g)					
40 wks	3923±3.16	3588±4.35	0.22±0.12	0.19±0.10	0.20±0.09

Table 4 a. Egg quality traits at different ages in PD-3

week's	28	32	36	40	52	64	72
Egg wt (g)	48.04	50.17	51.73	54.73	55.64	56.82	59.31
Shape Index	75.36	74..48	75.39	75.96	76.09	79.53	79.43
colour	5.73	6.21	7.28	7.39	7.26	7.42	7.32
Haugh uinit	79.83	80.64	82.73	83.97	84.23	82.91	78.89
Yolk index	0.4	0.39	0.4	0.41	0.42	0.39	0.38
Albumin index	0.09	0.1	0.09	0.12	0.11	0.09	0.07
Shell thickness (mm)	0.36	0.35	0.36	0.41	0.4	0.39	0.4
Yolk %	25.32	27.18	29.43	32..06	32.74	33.39	33.85
Albumin %	65.76	64.15	62.56	58.95	58.14	57.44	58.22
shell %	8.92	8.67	9.01	8.99	9.12	8.67	8.93

2.1.1.4 Evaluation of crosses developed for rural poultry

a. Evaluation of juvenile traits of *Srinidhi* at different places

The *Srinidhi*, a promising new dual purpose rural variety was released by Prof. K.M.L.Pathak, Hon'ble DDG (AS) on 2nd March 2013. The body weight at day old, 2, 4 and 6 weeks was 37.35, 104.1, 279.0 and 564.8 g in deep litter system and the corresponding values in battery brooders were 37.35, 131.8, 329.9 and 668.5 g, respectively. The shank length at 6 weeks of age was 67.54 and 75.63 mm in deep litter and battery brooders, respectively. The mortality was less than 1% under both the systems of rearing. Around 170 birds were distributed to 17 SHG female farmers of Gangulapally village in Ranga Reddy district. The body weight at different ages during growing period is presented in Table 5.

At Ranchi, the body weight of *Srinidhi* birds at day old, 2, 4, 6 and 8 weeks was 32.43, 83.72, 174.3, 457.8 and 677.7 g, respectively. The body weight at 20 weeks of age was ranged between 1508 to 2076 g. The age at first egg was 157 days at the farm and in the field; it ranged from152-190 days. The mortality ranged from 2 to 4.5 % between 0 to 8 weeks of age. The body weights at different ages during growing period is presented in Table 5.

Table 5. Body weight of *Srinidhi* in farm and field conditions of A.P and Jharkhand

Age	PDP		Ranchi	
	Farm	Field	Farm	Field
Body wt (g)				
10 wks	1000	-	926.3	874.9
12 wks	1330	1166	1337	1199
16 wks	1412	1469	1879	1554
18 wks	1755	1719	1965	1748
20 wks	1986	1899	2266	1924

Srinidhi in rural backyard of Jharkhand

b. Evaluation of crosses developed using PD-1 line

The PD-1 line was used to develop several crosses, which was evaluated further both in farm and field conditions. Age at sexual maturity in PD-1 x PB-2 (B), PD-1 x PD-3 (R), PD-1 x PD-4 (A) and PD-1 x IWI (W) were 160±1.79, 158±1.10, 157±2.00 and 149±0.64 days, respectively. Egg production upto 40 weeks of age in A, B, R and W crosses were 70.50±2.44, 55.29±2.18, 88.78±2.17 and 92.43±1.45 eggs, respectively. Corresponding egg production up to 72 weeks of age were 161.98±4.36, 113.49±4.14, 219.12±5.27 and 212.58±3.24 eggs. Egg weight at 40 weeks of age in A, B, R and W crosses were 54.52, 56.63, 53.69 and 54.66 g, respectively. Significant difference ($P \leq 0.05$) between the crossbreds were observed for both the traits. Among the crosses, R cross produced highest eggs followed by W, A and B crosses. Mortality during 20 to 72 weeks was lowest in W cross (1.49%), followed by A (4.84 %), R (7.84 %) and B cross (13.79 %). The overall performance was better in W as compared to other crosses under intensive system of rearing. Egg quality traits were recorded in different crosses at 28, 40, 52 and 64 weeks of age and it was observed that genotype affected significantly ($P \leq 0.05$) egg weight and shell thickness at all the ages of measurements, whereas, significant

(P≤0.05) difference for shape index, albumen index and Haugh unit were observed for 28, 52 and 64 weeks of age. Age effect was significant (P≤0.05) for all the egg quality traits in all the crosses except for yolk colour where age effect was significant (P≤0.05) for W only. Egg weight increased as the age advanced and most of the egg quality parameters decreased at older ages.

PD-1 x PD-4 was distributed to 5 farmers in Warangal District at 6 weeks of age. Mortality due to predator attack in PD-1 x PD-4 from 6-20 weeks of age was 69 %. No mortality was observed due to diseases. Body weight of male and female in the field at 20 weeks of age were 1794 and 1446 g, respectively. Birds started laying at 202 days and produced 26.12 eggs upto 40 weeks of age with egg weight of 50.70 g. Farmers sold the male birds and egg at premium price and felt happy with the performances.

PD-1 x PD-4 cross in the field

PD-1 x IWI Cross

PD-1 x PB-2 cross

PD-1 x PD-3 cross

PD-1 x PD-4 cross

c. Development of 3-way crosses

Since the performance of PD-1 x IWI was better with low mortality, a three way cross PD-1 x IWI x PD-3 was developed. Body weight at 4 weeks of age was 171.2 g.

2.1.1.5 Maintenance and evaluation of native germ plasm

a. Evaluation of PD-4 line

PD-4 line was evaluated for growth and production traits upto 72 weeks of age in S-2 generation. Egg production upto 72 weeks of age was 150.8 eggs. The body weights of male and female at 72 weeks of age were 3156 ± 27.4 and 2133±36.1 g, respectively while corresponding shank lengths were 135.23±0.7 and 104.9±0.4 mm. S-3 generation was reproduced in four hatches. The least square means and heritability estimates of various growth and production traits upto 40 weeks were presented in Table 6. Despite use of less number of dams (70) for regeneration the performance with respect to the 16 weeks body weight (primary trait) was maintained. Mortality observed during 0-8 weeks, 9-20 weeks and 21-40 weeks of age was 11.77, 19.23 and 2.32%, respectively.

A pair of PD-4 birds

Table 6. Least square means and heritabilities of growth and production traits of PD-4 line

Traits	Mean ± SE	$h^2_{(S+D)}$
Body wt (g)		
day old	33.63±0.11	0.77±0.12
8 wks	456.7±3.7	0.40±0.06
16 wks	1188±20.2	0.11±0.02
24 wks	1617±9.1	0.62±0.12
32 wks	1841±9.96	0.59±0.11
40 wks	1987±13	-
Shank length (mm)		
8 wks	69.8±0.3	0.32±0.05
16 wks	110.5±2.3	0.12±0.02
40 wks	106.4±0.3	
EW (g)		
32 wks	44.3±0.52	0.27±0.05
36 wks	45.9±0.22	0.26±0.05
40 wks	47.1±0.23	0.46±0.09
ASM (d)	162.3±0.5	0.41±0.08
EP (no.)		
40 wks	52.0±0.97	-

A total of 50 sires and 150 dams selected for higher 16 weeks body weight were used for regeneration of S-4 generation. A total of 769 chicks were hatched in two hatches. The fertility was 80.72% while hatchability on total egg and fertile egg set basis were 58.99 and 73.08%, respectively.

b. Evaluation of Ghagus-ecotype

During G-0 generation, body weights were recorded during juvenile and growing period in *Ghagus*-ecotype (Table 7). The birds having complete white plumage were discarded. Body weight of female birds at 24 weeks of age was 1377±36 g which increased to 1616 ±39 g at 32 weeks of age. Body weight of male and female at 40 weeks of age were 2548±36 and 1663±43 g, respectively. Mortality observed from 0-8, 9-20 and 21-40 weeks of age were 27.2, 3.3 and 16.3%,

respectively. Age at sexual maturity was 196.1±3.5 days. The total egg production from 22-49 weeks of age was 37.1±2.3 eggs. Egg weight at 40 weeks of age was 45.48±0.42 g. Egg quality traits recorded at 32 and 40 weeks of age are presented in Table 8. G-1 generation of *Ghagus* was reproduced in four hatches. The fertility was 88.96% while hatchability recorded on total egg and fertile egg set basis was 80.19 and 89.75%, respectively.

Male bird of Ghagus

Female bird of Ghagus

Table 7. Body weight and shank length during juvenile and growing periods in *Ghagus*-ecotype

Traits	Male	Female	Combined sex
Body wt (g)			
0 day	29.6±0.48	29.2±0.38	29.4±0.30
4 wks	110.7±3.3^{a}	100.±2.2^{b}	104.4±1.9^{ab}
8 wks	404.3±12.4^{a}	346.0±8.0^{c}	369.9±7.2^{b}
12 wks	782.6±20.2^{a}	649.9±14.1^{c}	704.3±12.6^{b}
16 wks	1220±29.6^{a}	1009±20.9^{c}	1096±18.8^{b}
20 wks	1635±38.3^{a}	1329±30.2^{c}	1451±26.0^{b}
Shank Length (mm)			
8 wks	66.9±0.89^{a}	62.6±0.70^{b}	64.4±0.57^{b}
12 wks	93.01±0.94^{a}	85.7±0.78^{c}	88.7±0.65^{b}
16 wks	110.8±1.10^{a}	100.7±0.92^{c}	104.9±0.79^{b}
20 wks	119.4±1.23^{a}	108.2±1.14^{c}	112.7±0.93^{b}

Means having common superscript in a row did not differ significantly (P≤0.05)

Table 8. Egg quality parameters of *Ghagus*-ecotype at 32 and 40 weeks

Traits	32 week	40 week
Egg weight (g)	43.43±0.79[b]	48.60±1.63[a]
Shape index	77.08±0.86	76.73±0.87
Yolk colour	6.05±0.28	6.15±0.21
Yolk index	0.48±0.005[a]	0.37±0.006[b]
Albumen index	0.145±0.005[a]	0.087±0.005[b]
Haugh unit	96.33±0.78[a]	72.40±1.08[b]
Shell thickness (mm)	0.365±0.008	0.373±0.006
Yolk %	29.04±0.46[b]	31.89±1.12[a]
Albumen %	60.53±0.44	59.46±1.11
Shell %	10.43±0.18[a]	8.65±0.15[b]

Means having different superscripts for a particular trait differ significantly (P≤0.05).

c. Collection and evaluation of Nicobari fowl

Nicobari fowl eggs were collected from CARI, Port Blair and the 52 chicks hatched. Body weight at 8, 16, and 20 weeks of age in pooled sex were 256±12.65, 931±42.86, 1315±51.42 g, respectively. Body weights of male and female at 24 weeks of age were 1720±100 and 1502±48 g, respectively. Corresponding shank lengths were 86.81±4.14 and 77.53±2.00 mm. Mortality from 0-8 and 9-20 weeks were 11.54 and 5.76%, respectively.

d. Conservation of Aseel germplasm

Aseel germplasm was collected from its home tract in Andhra Pradesh for conservation and for utilizing in development of new rural chicken variety. A total of 344 fertile eggs were collected from Bhimavaram, West Godavari Dist., AP (6 farmers) and Shankarapally, Ranga Reddy Dist., AP (2 farmers) in 5 batches. A total 171 chicks were hatched from these eggs. The fertility was 60% and hatchability on total and fertile eggs set was 50 % and 84%, respectively. The body weight at day old, 4 and 6 weeks was 28.71, 128.0 and 258 g, respectively. The shank length at 6 weeks was 55.29 mm.

2.1.1.6 Development of male line for production of egg type rural poultry

The male line with shank length as selection criterion was evaluated for juvenile and production performance during SL-2 generation. Among juvenile traits, the body weight at day old, 2, 4 and 6 weeks of age was 35.99± 0.001, 111.1±0.06, 234.9±0.02 and 489.5±0.04 g, respectively. Shank length at 4 and 6 weeks was 49.12±0.002 and 69.56±0.002 mm, respectively. The breast angle at 6 weeks of age was 80.19°±0.002 indicating the fair breast muscle in the male line chicken. The Shank length (primary trait for selection) increased non-significantly from the previous generation. The heritability estimates for different traits have been presented in Table 9. The body weight and shank length were positively and highly correlated.The immune response parameters were evaluated in a sample of 20 birds, 10 each from male and female birds at 6 weeks of age. The cell mediated immune response for PHAP was 0.65 mm in males and 0.79 mm in females. The humoral immune response to SRBC was 6.75 and 6.11 $\log_2$ in males and females, respectively.

Table 9. Heritability estimates in male line for egg type rural poultry

Parameter	h^2_S	h^2_D	h^2_{S+D}
Body wt (g)			
Day old	0.10 ±0.11	0.19 ±0.09	0.15±0.11
2 wks	0.26 ±0.10	0.36 ±0.08	0.31 ±0.06
4 wks	0.26 ±0.10	0.36 ±0.08	0.31 ±0.06
6 wks	0.18±0.08	0.18±0.07	0.18±0.05
Shank length (mm)			
4 wks	0.21 ±0.07	0.29 ±0.06	0.25 ±0.05
6 wks	0.24±0.08	0.26±0.07	0.25±0.05
Breast angle (°)			
6 wks	0.01±0.02	0.06±0.04	0.04±0.03

The ASM was 153.71±0.05 days, which decreased by 3 days from SL-1 generation (Table 10). The target body weight at 20 week is maintained below 2100 g for better egg production during the laying phase. The egg production upto 30 and 40 weeks increased by 4 and 11 eggs, respectively, compared to previous generation.The SL-3 generation was reproduced with 50 sires and 250 dams after screening for ALV in pedigreed mating. A total of 3703 chicks were produced in four hatches with fertility of 86.00%. The hatchability on fertile egg set was 93.00 % and total egg set was 80.00%.

A pair of male line for egg type rural poultry

Table 10. Production performance of male line for egg type rural poultry

Traits	Means	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (d)	153.7±0.05	—	0.05 ±0.23	0.51±0.23
Body wt. (g)				
20 wks	2076± 0.63	0.23 ±0.21	0.69±0.38	0.45±0.24
30 wks	2470±0.93	0.63±0.31	0.15±0.31	0.39±0.23
40 wks	2584±1.00	0.56±0.28	0.12±0.17	0.30±0.22
EW (g)				
24 wks	42.36±0.01	0.16 ±0.22	0.51 ±0.41	0.22±0.26
28 wks	47.60± 0.01	0.91 ±0.33	—	0.34±0.26
30 wks	49.32±0.01	0.26±0.35	0.31±0.35	0.28±0.23
36 wks	52.34±0.02	0.64±0.33	0.49±0.33	0.56±0.28
40 wks	54.93±0.02	0.59±0.28	0.01±0.29	0.29±0.21
EP (no.)				
30 wks	35.58± 0.05	0.12 ±0.22	0.09 ±0.17	0.10±0.11
40 wks	80.76±0.07	0.14±0.11	0.10±0.21	0.12±0.14

Table 11. Egg quality traits in male line for egg type rural poultry

Traits	Age (weeks)			
	28	32	36	40
EW (g)	47.09	49.33	52.05	52.48
Shape index	0.75	0.74	0.75	0.76
Albumin weight (g)	30.41	30.01	31.41	31.68
Albumin index	0.81	0.79	0.78	0.76
Haugh Unit	87.59	83.35	84.63	79.24
Yolk weight (g)	12.60	14.92	16.03	16.39
Yolk colour	5.27	7.11	6.70	7.38
Yolk height (mm)	17.01	17.14	17.28	16.95
Shell weight (g)	4.08	4.40	4.61	4.41
Shell thickness (mm)	0.36	0.36	0.35	0.34

Egg quality traits at different ages were evaluated in male line during the second generation. The different egg quality traits are presented in Table 11.

Development of control population for rural lines

A random bred control population was evolved for comparing the performance of rural lines. The first generation was reproduced with 15 sires and 45 dams after screening for ALV. A total of 450 chicks were produced in S-1 generation. The 4 and 6 week body weights were 243.5 and 491.4 g. The shank length at 6 weeks of age was 67.90 mm. The ASM was 159.8 days. The body weight at 20, 30 and 40 weeks of age was 1,920, 2,346 and 2581 g, respectively. The egg production upto 30 and 40 weeks of age was 34.18 and 83.65 eggs, respectively.

2.1.2. Maintenance and evaluation of layer populations

2.1.2.1 Pure line layer populations

The IWH and IWI populations completed 72 weeks production in their G-1 generation while IWK completed 72 weeks in its S-9 generation. All these three lines showed significant improvement in 72 weeks egg production. The egg production was 257.5±3.33 eggs in IWH, 252.9±2.01 eggs in IWI, 239.9±1.91eggs in IWK population. The G-2 generation of IWH and IWI population was regenerated using 50 sires and 114 dams in four hatches. The S-10 generation of IWK population was regenerated using 50 sires and 200 dams in three hatches. The fitness traits of the pure line and control population are given in Table 12. The hatchability on total egg set improved significantly ($P<0.05$) in the IWH population. The growth and production performance of the layer pure lines and control population is given in the Table 13. The 8, 16 and 20 week body weights of IWI, IWH and IWK population showed significant improvement over their previous generation. The ASM increased by 3 to 5 days in IWI, IWH and IWK populations, respectively.

A male of IWH line

Table 12. Fitness parameters of layer pure lines

Population	No. of hatches	Eggs set	Fertility (%)	Hatchability (%)		Good Chicks
				TES	FES	
IWH (G-2)	4	2377	76.8	52.7	68.6	1254
IWI (G-2)	4	3842	71.2	51.5	69.9	1987
IWK (S-10)	3	2449	80.7	64.5	80.0	1580
Control (S-10)	7	2146	70.2	59.1	84.2	1269

Table 13.Growth and production traits of layer pure lines

Traits	IWH (G-2)	IWI (G-2)	IWK (S-10)	Control (S-10)
Body wt (g)				
4 wks	154.3	153.7	147.1	144.4
8 wks	365.7	354.3	409.4	426.9
16 wks	1054	1031	1008.8	1074.3
20 wks	1134	1100.0	1293.8	1199.1
ASM (d)	146.0	149.3	147.8	155.6
EP (no.)				
24 wks	10.50	11.28	12.22	8.32

2.1.2.2 Random bred layer control population

The layer control population completed 72 weeks in its S-9 generation and the 72 week egg production was 222.1±2.06 eggs. The S-10 generation of control layer population was regenerated using 37 sires and 74 dams in seven hatches. All the fitness parameters viz., fertility, hatchability on TES and FES reduced in the S-10 generation. The ASM remained stable in control population. The juvenile body weights at different ages improved over the last generation. The layer control population was stable for the last eight years for all the traits up to 72 weeks of age.

2.1.3. Maintanance 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)

The PB-1 population was evaluated for growth and production traits during S-22 generation (Table 14). The criterion of selection was 5 weeks body weight. As compared to previous generation, 20 weeks and 40 weeks body weight were marginally increased. ASM was increased by 1 day. Egg production upto 40 weeks was decreased by 1.6 eggs.

Table 14. Production performance of Synthetic Coloured Broiler Male line (S-22)

Trait	Mean±S.E
Body wt (g)	
20 wks	2400±3.28
40 wks	3287±4.10
ASM (d)	172±1.10
EW (g)	
32 wks	54.82±0.08
40 wks	56.16±0.09
EP (no.)	
40 wks	50.72±0.06

The S-23 generation was regenerated with 70 sires and 350 dams. Summary of selection records is presented in Table 15. Effective number, average selection differential and intensity of selection increased in the current generation as compared to previous generation. Expected response was marginally decreased. A total of 5056 chicks were hatched. The fertility was 87.69% and hatchability on total and fertile eggs set 79.40% and 90.56%.

A male of PB-1 line

Table 15. Summary of selection records of PB-1 (S-23)

Particulars	Magnitude
Sires used	70
Dams used	350
Sires contributed	70
Dams contributed	350
Effective number	233.3
Rate of inbreeding	0.0021
Average selection differential	167
Intensity of selection(σ)	1.42
Expected response ($h^2\sigma P$) g	82

Performance of juvenile traits of S-23 generation is presented in Table 16. The primary trait of selection i.e 5 weeks body weight was increased

by 119 g as compared to previous generation. Body weights at remaining ages also improved. Genetic response for 5 weeks body weight was 14.40 g and phenotypic response was 13.30 g over last 5 generations (Fig. 2).

Table 16. Performance of juvenile traits of PB-1 in S-23 generation

Traits	Mean ± SE
Body wt (g)	
4 wks	636 ± 0.59
5 wks	996 ± 0.72
6 wks	1206 ± 0.43
Shank Length (mm)	
5 wks	76.96 ± 0.08
Breast Angle (°)	
5 wks	84.86 ± 0.06
Feed efficiency (0-5 wks)	2.31

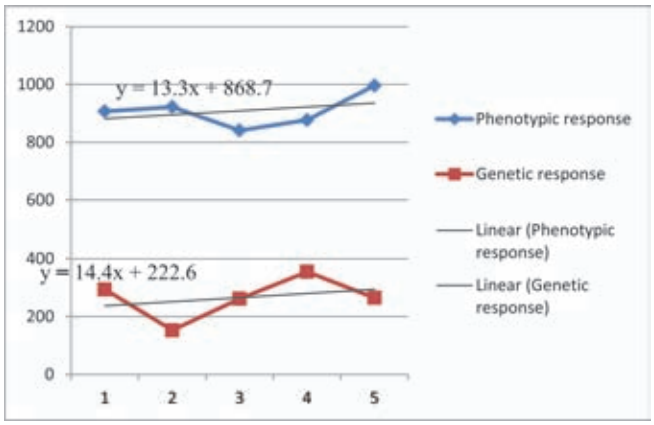


Fig. 2. Genetic and phenotypic response of 5wk body weight in PB-1

2.1.3.2 Coloured broiler female line (PB-2)

In PB-2 line, the production traits were recorded during the S-21 generation. The average egg weight at 40 weeks of age was 57.86 g which was decreased by 0.5 g as compared to previous generation. The average egg production at 40 weeks of age was 67.05 ± 0.54 eggs in the current generation which was similar to previous generation (67.49 eggs). The 52 and 64 weeks egg production in S-21 generation was 120.2 ± 1.34 and 153.6 ± 2.51 eggs, respectively, which was similar to the egg production of previous generation. The egg weight at 64 weeks was 62.76 ± 0.69.

A female of PB-2 line

The regeneration of S-22 generation was reproduced in four hatches with 60 sires and 300 dams. The parents were selected on the basis of 5 weeks body weight and 40 weeks part period egg production. The selection differential for 5 weeks body weight was 124 g on combined sex basis with 0.81 s intensity of selection. The effective population size was 200 and the level of inbreeding was maintained at 0.003. A total of 4659 eggs were set for incubation of which 3283 healthy chicks were obtained. The overall fertility was 80.3%, while the hatchability on total and fertile egg set was 70.5 and 87.8%, respectively.

The 5 weeks body weight, the principal selection trait showed reduction by 65 g over the previous generation. However, on genetic scale, there is an improvement of 2.93 g in 5 weeks body weight over the last nine generations. The average body weights at 5th and 6th week were 829.3 and 969.3 g, respectively. The shank length and breast angle at 6 weeks of age were 80.77 ± 0.10mm and 87.05 ± 0.06°, respectively. The overall mortality up to 5 weeks of age was 8.92%. The average age at sexual maturity reduced drastically by 15 days over the previous generation which could be due to increased body weight attributed to relaxation

in feed restriction. The average 20 weeks body weight (2631±14.2g) was higher than the optimum body weight expected for better production performance. The Grower house mortality up to 20 weeks of age was 21.67 %.

2.1.3.3 Random bred control population for broilers

Body weights at 20 and 40 weeks in control broiler increased over previous generation. ASM was decreased by 14 days. Egg weights at 32 and 40 weeks were improved in G-11 generation as compared to previous generation. Egg production upto 40 weeks was decreased by 2.76 eggs (Table 17). The G-12 generation of control broiler was regenerated with 1562 chicks. The fertility was 87.16% and hatchability on total and fertile eggs set was 81.93 and 94.0%, respectively. Body weight at 4 and 5weeks of age was 492±0.06 and 731±0.08 g. The shank length at 5weeks of age was 74.09±0.04 mm. The feed efficiency during 0 to 5 weeks was 2.40.

Table 17. Production traits of Control Broiler (G-11)

Traits	Mean±S.E
Body wt (g)	
20 wks	2116±2.03
40 wks	2933±3.10
ASM (d)	180±0.98
EW (g)	
40 wks	57.27±0.09
EP (no.)	
40 wks	54.30±0.13

2.1.4 Maintenance and evaluation of gene lines

2.1.4.1 Naked neck (Na) and Dwarf (Dw) gene lines

The production traits of the naked neck and dwarf gene lines in S-10 generation are given in Table 18. The ASM reduced by 3-4 days in both the gene lines over their previous generation. The egg weight reduced slightly at all ages and both the gene lines compared to their previous generation. The egg production reduced by 5 eggs in naked neck whereas it increased by 6 eggs in the dwarf line. The regeneration of S-11 generation of naked neck gene line was taken up in two hatches with 30 sires and 90 dams. The overall fertility was 91.1%, while the hatchability on total and fertile egg set was 74.7 and 82.0%, respectively. The regeneration of S-11 generation of Dwarf gene line was taken up in two hatches with 35 sires and 105 dams. The overall fertility was 86.8%, while the hatchability on total and fertile egg set was 82.7 and 95.3%, respectively. The fertility improved in both the gene lines while the hatchability on total and fertile egg set remained stable in both lines. The juvenile conformational traits of the gene lines in their S-11 generation are given in Table 19. The conformational traits, 4 and 6 week body weight reduced in both the gene lines over their earlier generation.

Table 18. Production performance of gene lines in S-10 generation

Traits	Naked neck	Dwarf
ASM (d)	154.5	133.3
Body wt (g)		
20 wks	2236	2032
40 wks	3184	2616
EW (g)		
28 wks	52.25	43.52
32 wks	55.62	47.78
40 wks	61.27	54.19
EP (no.)		
40 wks	64.01	68.07

2.2 Molecular Genetics

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

Activin receptor2A (ACTVNR2A), Activin receptor 2B (ACTVNR2B) and Follistatin (FSTN) genes were characterized in chicken. Coding region of these three genes were polymorphic with 6 haplotypes in ACTVNR2A, 4 haplotypes in ACTVNR2B and 6 haplotypes in FSTN genes. The ACTVNR2A haplogroups showed significant ($P \leq 0.05$) effect on body weight at 6 weeks where h1h6 haplogrouphad the highest body weight. Haplogroups of ACTVNR2B gene had significant ($P \leq 0.05$) effect body weight at day1 and 6 weeks. On day 1, h1h3 haplogroup showed the highest body weight and at 6 weeks, h1h2 group had the highest body weight. Myostatin gene expression decreased from day 7 to day 18 embryo in broiler and layer chicken. During post hatch period, expression decreased from day 1 to 6th week in both the lines. IGF-1 expression increased from day 7 to day 18 in broiler while in layer it was decreased during embryonic stage. During post hatch period, IGF-1 expression increased from day 1 to 6thwk in both broiler and layer chicken. Microarray study revealed that on day 7, 10,126 transcripts were up-regulated and 5,254 transcripts were down-regulated in broiler over Aseel chicken. On day 18, 2,104 transcripts were up-regulated and 1,539 transcripts were down-regulated in muscle of broiler over Indigenous chicken.

2.2.2 Mitochondrial genome characterized

Seven mitochondrial genes viz., ATPase6, ATPase8, ND-1, ND-2, ND-3, ND-4L and ND-6 were characterized in different breeds, varieties maintained at this directorate. Subtle variations were identified in the nucleotide sequences of

A pair of naked neck chicken

Table 19. Juvenile and conformational traits of gene lines in S-11 generation

Gene line	Naked neck	Dwarf
Body wt (g)		
4 wks	452.0±0.08	391.8±0.04
6 wks	913.2±1.04	772.2±0.94
Shank length (mm)		
6 wks	79.85±0.05	71.9±0.04

A pair of dwaf chicken

different genes and the phylogenetic analysis showed different clusters for various breeds.

2.2.3 Epigenetic modulation

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. The performance (reproductive, juvenile growth, immune response and serum biochemical parameters) in Naked neck (NN), Punjab Broiler-2 (PB-2) and Dahlem Red (DR) chicken exposed to 2°C increased incubation temperature for 3 h each on 16th, 17th and 18th day of incubation was evaluated in a randomized block design. The birds were reared at high ambient temperatures (32°C-45°C) during summer season. Higher incubation temperature had no effect on hatchability. There were no significant differences between the *in ovo* heat exposed or normal incubated chicks in weekly body weight, feed intake and feed conversion ratio. Similarly there were no significant difference between the treatments in immune and serum biochemical parameters. There was significant ($P \leq 0.01$) difference between the genotypes in body weight, feed intake and feed conversion ratio. PB-2 birds recorded significantly ($P \leq 0.01$) higher body weight from 14th day to till 42nd day. The NN birds had significantly ($P \leq 0.05$) higher FRAP value and Cell mediated immune response to PHA-P. The lipid peroxidation was significantly ($P \leq 0.05$) higher in PB-2 birds indicating high stress. In conclusion, pre natal exposure of 2°C increased incubation temperature had no effect on juvenile growth, immune response and serum biochemical parameters in chickens reared at high ambient temperature, whereas significant breed differences were observed.

2.2.4 Gene expression profile under different climatic conditions

An experiment was conducted to study the differential expression profile of Heat Shock protein 70 gene (Hsp70) in chicken (Naked neck, PB-2 and DahlemRed) which were subjected to epigenetic modulation through exposure of embryos to elevated incubation temperatures. Significant variation in the Hsp70 expression was observed in the breeds at 2nd and 4th week. At day old, the expression of Hsp 70 was almost similar in all the three breeds which might be because of the reason that the chicks have not been exposed to the ambient temperatures for sufficient time. At 2nd and 4th weeks of age, significant breed variation was observed. The Hsp70 expression was highest in PB-2 followed by Dahlem Red and naked neck chicken, indicating the better heat tolerance of the naked neck birds. Differential tissue expression of the Hsp 70 was noticed in the tissues. At all ages and in all the breeds studied the spleen exhibited highest Hsp-70 expression. The liver, breast muscle and thigh muscles showed lowest expression of Hsp70. The effect of heat treatment of embryos was significant in the differential expression of Hsp 70. The heat treated embryos expressed lower levels of Hsp 70 compared to their normal counterparts. The study concluded that the epigenetic thermal adaptation during embryonic stage had a positive effect in combating heat stress during their post natal life.

2.3 Poultry Nutrition

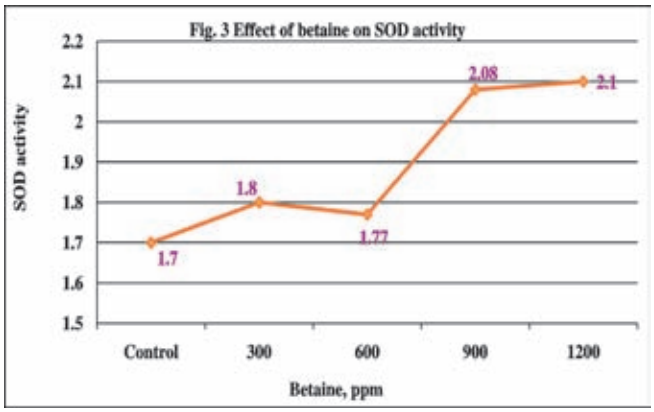
2.3.1 Development of climate resilient practices through nutritional, genetic and physiological strategies to enhance tolerance to heat stress in commercial and backyard poultry

A total of 11 experiments were conducted under this project during the period under report to find out the possible nutritional solutions to combat heat / summer stress in both commercial and rural chicken varieties. Three experiments each on Varanaja and commercial layer (Babcock) and 5 experiments on commercial broiler (Cobb 400)

were conducted. The details of work done and salient finding of each experiment is as follows.

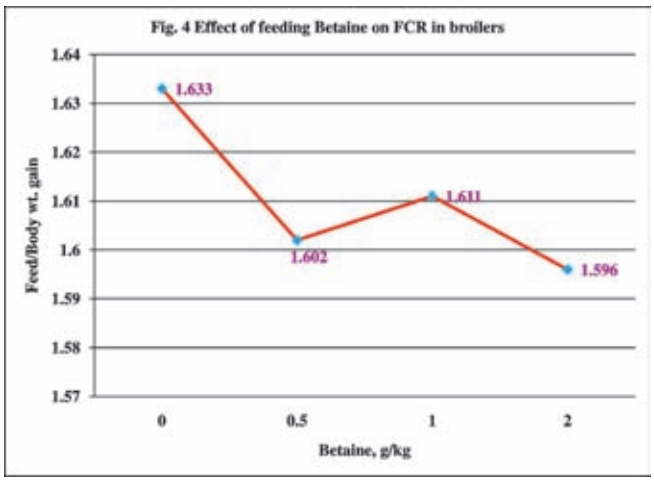
2.3.1.1 Effect of feeding different concentrations of betaine on performance of Vanaraja birds

Four concentrations of Betaine (300, 600, 900 and 1200 mg/kg) was fed in the form of sulfate to *Vanaraja* birds from day 1 to 42 d of age during summer (24 March to 7th May 2012). Each diet was fed to 9 replicates. The performance (body weight gain and feed efficiency) were not affected (P≤ 0.05) by feeding Betaine. Lipid peroxidation reduced and activity of super oxide dismutase (SOD) increased (Fig. 3) significantly with increase in level of Betaine in diet.



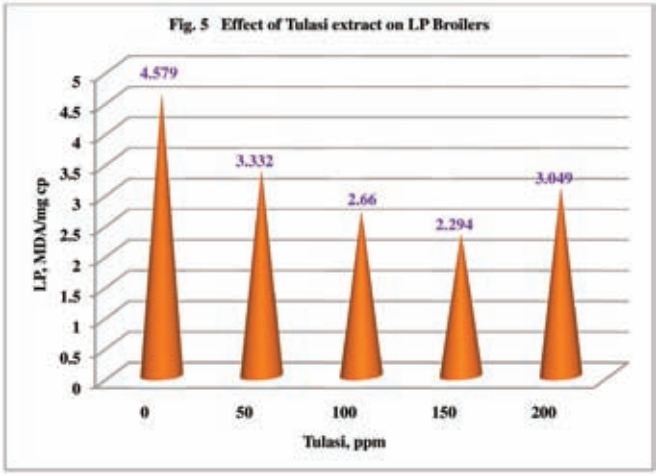
2.3.1.2 Effect of supplementing betaine anhydrous on performance, immune response and carcass traits in commercial broilers

A trial was conducted with an aim of determining the beneficial effect of supplementing betaine anhydrous at different concentrations (0, 0.5, 1 and 2 kg/tonne) in broiler diet. Growth and feed efficiency increased (Fig.4) linearly as betaine level was increased. Higher betaine inclusion levels in meat and bone meat diet is detrimental to growth, whilst lower levels of betaine inclusion in soyabean meal diets (deficient in glycine), may stimulate uric acid synthesis to meet the bird's antioxidant requirements to the detriment of its growth.



2.3.1.3 Effect of incorporating Tulsi extract at different concentrations on performance of commercial broilers

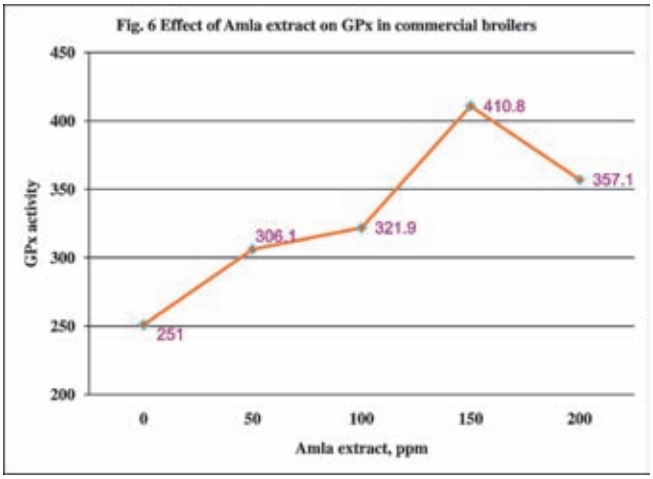
Tulsi extract obtained from a commercial source was supplemented in diets of broilers from day 1 to 42 d of age (21 March to 5th May 2012) at 4 graded concentrations (50, 100, 150 and 200 mg/kg). Each diet was fed to 12 replicates. The performance data suggested body weight, feed efficiency and lipid peroxidation were not affected with supplementation of the herbal extract. However, lipid peroxidation (LP) reduced significantly in broilers fed *Tulsi* extract compared to those fed diet without the herbal extract (Fig.5).



2.3.1.4 Effect of incorporating Amla extract at different concentrations on performance of commercial broilers

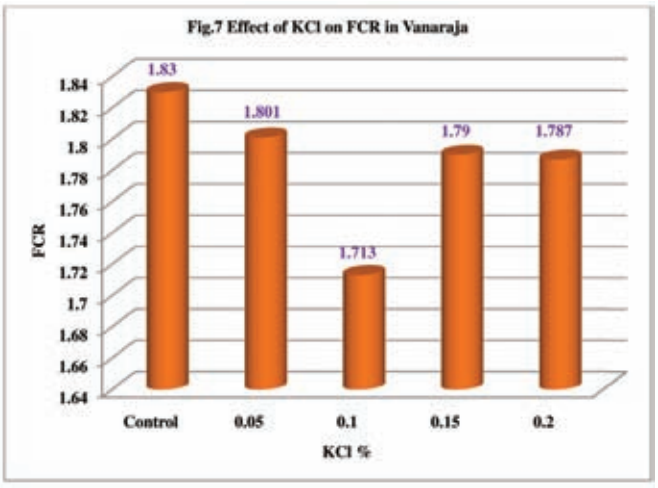
Amla extract obtained from a commercial source was supplemented in diets of broilers from day 1

to 42 d of age. Each diet was fed to 12 replicates. The performance data suggested that body weight and feed efficiency were not affected (P≤0.05) with supplementation of the herbal extract However, lipid peroxidation in serum was significantly reduced in broilers fed *Amla* extract compared to those fed diet without the herbal extract. Whereas, the activity of glutathione peroxidase increased progressively with increase in concentration of *Amla* extract and maximum response was observed at 150 ppm (Fig.6).



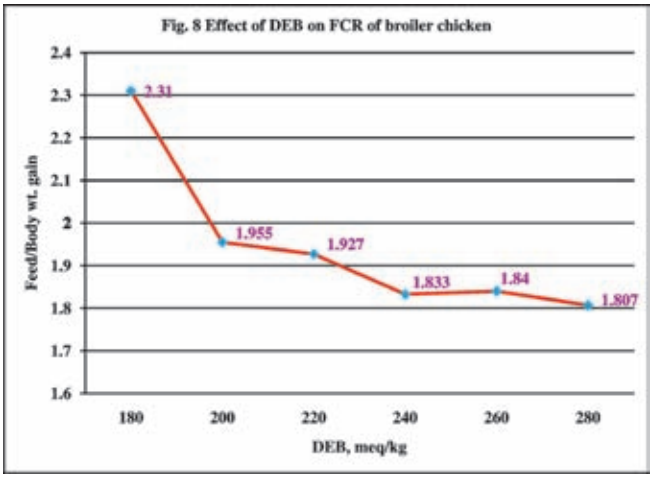
2.3.1.5 Effect of feeding different concentrations of KCl on performance of Vanaraja birds

Four concentrations of feed grade KCl (0.05, 0.10, 0.15 and 0.20%) was fed to *Vanaraja* birds from day 1 to 42 d of age (24 March to 7th May 2012). Each diet was fed to 9 replicates of 6 birds in each. The performance data suggested body weight, lipid peroxidation and activity of SOD, FRAP, GPx, HI titre and CMI to PHA-P were not affected(P≤0.05) with KCl supplementation to Vanaraja chick diet. However, the feed efficiency in group fed 0.10% KCl was significantly better than those fed the control diet during summer months (Fig.7).



2.3.1.6 Effect of graded concentrations of dietary electrolyte balance (DEB) on performance, immune response and anti-oxidant activity in commercial broilers

Various concentrations (160 to 280 meq/kg diet with 20 incremental levels) of DEB were fed to commercial broilers. Weight gain and feed efficiency increased with increase in level of dietary electrolyte balance above 240 meq/kg diet (Fig.8). Therefore, a level of 260 meq of electrolyte balance is needed for better performance of broilers.



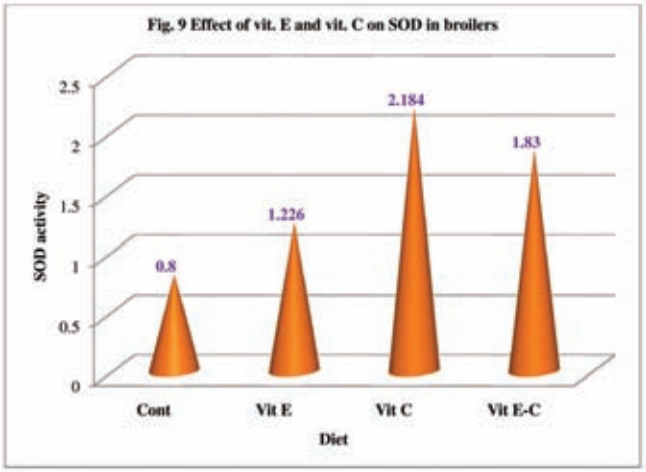
2.3.1.7 Effect of dietary electrolyte balance on performance of WL layers

The effect of supplementing graded concentrations (160, 180, 200, 220, 240 and 260 meq/kg) of

dietary electrolyte balance (DEB) on performance and egg shell quality was estimated in WL from 69 to 76 weeks of age during summer season (April to June 2012). Egg production (75.7 to 76.9%), egg weight (55.5 to 55.7g), feed intake (92.7 to 93.7g/b/d) and egg shell thickness (0.370 to 0.392 mm) were not affected by the variation in DEB in WL layer diet. Layer performance was not affected by DEB within the range of 160-260 meq/kg during summer.

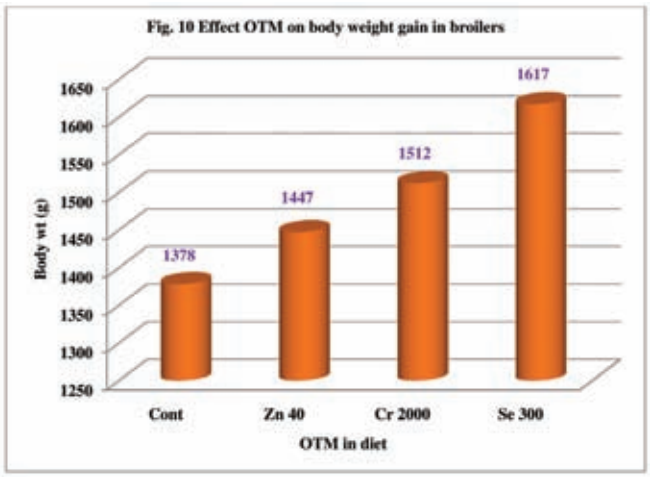
2.3.1.8 Effects of supplementing vitamin E and ascorbic acid on performance and anti-oxidant activities in commercial broilers

Vitamin E and C were supplemented independently each at 250 mg / kg diet and their combination. These groups were compared with a group fed diets without these vitamins. Each diet was fed to 10 replicates consisting of 5 birds each from 1-42d of age. Supplementation of vitamins alone or combination did not influence body weight gain and feed efficiency. Supplementation of vitamin C alone or in combination with vitamin E significantly increased the activity of super oxide dismutase (SOD) (Fig.9). The lipid peroxidation was significantly reduced in groups fed both vitamins together compared to those fed alone or control group. Immune responses (HI titre and CMI response to PHA-P) were not affected due to the treatments employed.



2.3.1.9 Effects of supplementing organic trace minerals on performance and anti-oxidant activities in commercial broilers

Organic form of Zn (40 mg/kg), Cr (2mg/kg) and Se (0.30 mg/kg) were supplemented in commercial broiler diets. Body weight gain and feed efficiency increased by supplementing organic form of trace minerals tested (Fig.10). However, the performance of broilers is significantly higher in groups fed Cr and Se followed by Zn fed groups. Lipid peroxidation decreased and activities of catalase and glutathione peroxidase increased in the TM fed groups compared to those fed the control diet.



2.3.1.10 Effect of supplementing organic chromium on performance of WL layers

The effect of supplementing 4 graded concentrations (100, 200, 300 and 400 mcg/kg) of organic Cr on performance and egg shell quality was estimated in WL from 54 to 68 weeks of age during summer season (March to June 2012). Egg production (79.2 to 81.8%), egg weight (53.76 to 54.26 g), feed intake (89.9 to 91.4 g/b/d) and body weight were not affected by supplementing organic Cr in layer diet. However, mortality was considerably reduced in layers fed organic Cr compared to those fed the control diet without Cr in diet (Fig.11).

2.3.1.11 Effect of supplementing graded concentrations of organic Se and vitamin E on performance, antioxidant activity and hatchability of Vanaraja female parent line

To find out the possible benefits of supplementing organic Se (0.15 and 0.13 mg/kg) and vitamin E (100 and 200 mg/kg) each at two different concentrations on performance, antioxidant activity and hatchability of *Vanaraja* female parent line was studied. A control diet without any of the above nutrients was maintained as control. *Vanaraja* female line at about 28 weeks of age was housed in individual cage (5 bird/replicate). Each diet was fed to 12 replicates. The egg production, feed efficiency, feed intake, egg weight, fertility, hatchability, weight of DOC, HI titre, LP, FRAP were not affected (P > 0.05) with supplementation of the herbal extract (Table 20). However, activities of SOD and GPx increased in birds fed organic Se and vitamin E compared to the control group.

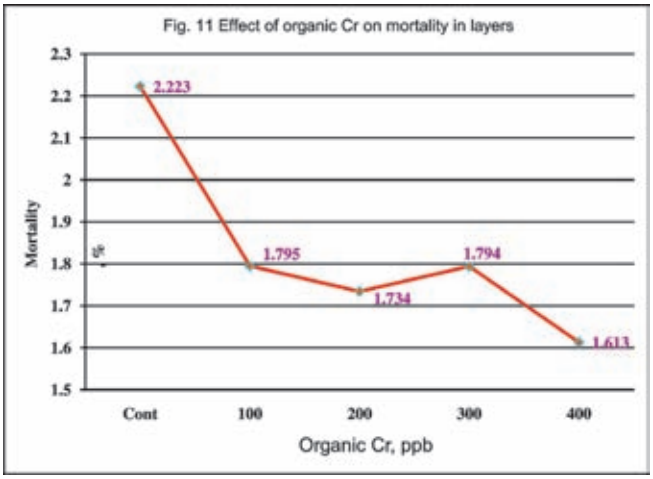


Table 20. Performance of *Vanaraja* female line fed vitamin E (mg/kg) and organic Se (mg/kg)

Se	Vit E	EP (%)	FI (g/b)	FI/egg (g)	E W (g)	SOD	GPx
0	0	51.87	119.7	254.2	53.80	2.797c	209.2c
0.15	100	54.88	120.6	238.3	51.82	3.659ab	276.0a
0.15	200	54.04	121.0	308.4	53.39	4.487a	227.8bc
0.30	100	52.13	119.2	267.6	53.60	4.936a	242.0ab
0.30	200	54.44	122.8	246.5	53.59	4.570a	256.2ab
P		0.773	0.167	0.261	0.323	0.055	0.011
N		12	12	12	12	12	12
SEM		0.9039	0.485	10.72	0.333	0.2565	6.557

2.3.2 Detoxification of Karanja (*Pongamia glabra*) seed cake and its utilization in broiler and layer chicken diets (DST sponsored) (Collaboration with IICT & Roshni Biotech, Hyderabad)

2.3.2.1 Variously processed Karanja cake in broiler chicken diet

The karanja seed cake detoxified with Isopropanol (IPA) (1:3), NaOH (2% of cake) or NaOH+HCl (2% of cake in 1:1 ratio) after extraction of oil in 2 stages (expelling and extraction with hexane) was tested in broiler chicken diet at graded levels (3, 6 and 9%) on *iso-caloric* and *iso-nitrogenous* basis against a control broiler diet. A total of 390 day-old commercial broiler chickens were divided at random into 13 experimental groups with 6 replicates of 5 birds each and housed in 3-tiered battery brooders. Each of the 13 experimental diets was fed *ad lib* to one of the experimental groups from day 1 to 42 days of age. IPA treated *Karanja* cake at 3% level in diet gave body weight, which was similar to that of control, while at 6 and 9% levels, the IPA detoxified cake improved the performance, which was intermediate to the control and the *Karanja* cake groups (Table 21). Immune reposes were not affected; DM and fat digestibility decreased at 9% KC, while NaOH or IPA treatment improved the variable significantly;

Table 21. Effect of dietary inclusion of detoxified *Karanja* cake at graded levels on broiler chicken

Karanja cake		Body	Feed	FCR	Liver	Giblet	DM digesti-
Type	%	wt(g)	intake, (g)		Wt(%)	Wt (%)	bility(%)
-	-	2088^{a}	3490^{ab}	1.71^{c}	1.86^{f}	4.00^{f}	74.6^{a}
KC (control)	3	1955^{bc}	3310^{cd}	1.74^{c}	2.29^{de}	4.64^{de}	71.5^{abc}
KC (control)	6	1693^{ef}	3176de	1.93^{ab}	2.45^{cde}	4.97^{cde}	68.9^{abc}
KC (control)	9	1358^{g}	2609^{h}	2.00^{a}	2.88^{a}	5.68^{a}	67.3^{bc}
NaOH- KC	3	1972^{bc}	3410^{abc}	1.77^{c}	2.17^{e}	4.68^{de}	74.3^{a}
NaOH- KC	6	1758de	3296^{cde}	1.93^{ab}	2.46^{bcde}	4.85^{de}	70.5^{abc}
NaOH- KC	9	1585^{f}	2947^{f}	1.92^{ab}	2.76^{ab}	5.43^{abc}	69.4^{abc}
NaOH+HCl-KC	3	1958^{bc}	3332^{bcd}	1.74^{c}	2.21^{e}	4.52^{e}	71.2^{abc}
NaOH+HCl-KC	6	1756de	3134^{e}	1.83^{bc}	2.57^{abcd}	5.03^{cd}	67.7^{bc}
NaOH+HCl-KC	9	1438^{g}	2763^{g}	1.99^{a}	2.73^{abc}	5.51^{ab}	66.0^{c}
IPA-KC	3	2056^{ab}	3511^{a}	1.75^{c}	2.24^{de}	4.86^{de}	72.5^{ab}
IPA-KC	6	1859^{cd}	3218de	1.78^{c}	2.25^{de}	4.85^{de}	70.6^{abc}
IPA-KC	9	1595^{f}	2954^{f}	1.91^{ab}	2.39^{cde}	5.05^{bcd}	72.2^{abc}
SEM		*27.32*	33.29	0.015	*0.042*	*0.063*	0.56
P		*0.001*	0.001	0.001	*0.0001*	*0.0001*	6
N		*6*	6	6	*6*	*6*	0.05

KC – Karanja cake IPA – Isopropyl alcohol

Means bearing atleast one common superscript in a column do not differ significantly (P≤0.05)

It could be inferred that IPA detoxified *Karanja* cake could be used upto 3% in of broiler diet without any adverse effect on performance and other variables studied.

2.3.2.2 Efficacy of feed enzymes and liver tonic in improving performance of broilers fed KC

An experiment was conducted for testing the efficacy of feed enzymes, viz. protease and phytase, and liver tonic in improving performance of broilers fed KC at 6% level in diet. Protease (4000 IU/kg), phytase (400 U/kg) or liver tonic (0.1%) were supplementation to broiler diet containing 6% IPA treated *Karanja* cake. Body weight, feed intake and feed conversion efficiency were depressed by *Karanja* cake and IPA treated *Karanja* cake (Table 22). Phytase improved body wt. at 21 days, while no effect was observed at 42 days.

Protease and liver tonic showed no effect. Similarly, other variables were not affected by the dietary inclusion of enzymes and liver tonic. The results indicated that the toxic effects of *Karanja* cake on broiler chicken could not be alleviated by dietary supplementation of protease, phytase or liver tonic.

Table 22. Effect of dietary supplementation of feed enzymes or liver tonic on broilers fed IPA detoxified *Karanja* cake at 6 weeks of age

Karanja cake		Body	Feed	Liver	Giblet	Bursa
Type	Additive in diet	wt. (g)	intake (g)	(g/kg)	(g/kg)	(g/kg)
-	-	2006^{ab}	3076^{ab}	1.744^{bc}	4.089^{abcd}	0.080^{abc}
-	Protease(4000 IU/kg)	2018^{ab}	3035^{abcd}	1.649^{c}	3.738^{d}	0.066^{c}
-	Phytase(400 u/kg)	2097^{a}	3200^{a}	1.768^{bc}	3.831^{cd}	0.070^{bc}
-	Liver Tonic(0.1%)	2069^{a}	3207^{a}	1.900^{bc}	3.974^{cd}	0.066^{c}
KC	-	1767^{d}	2876^{d}	2.324^{a}	4.527^{a}	0.056^{c}
KC	Protease(4000 IU/kg)	1770^{d}	2893^{cd}	2.240^{a}	4.527^{a}	0.072b^{c}
KC	Phytase(400 u/kg)	1806^{cd}	2999^{bcd}	2.261^{a}	4.492^{ab}	0.101^{a}
KC	Liver Tonic(0.1%)	1886^{cd}	3011^{bcd}	2.240^{a}	4.505^{ab}	0.081^{abc}
IPA	-	1919^{bc}	3041^{abcd}	1.766^{bc}	4.060^{bcd}	0.074^{bc}
IPA	Protease(4000 IU/kg)	1865^{cd}	3033^{abcd}	1.763^{bc}	4.107^{abcd}	0.095^{ab}
IPA	Phytase(400 u/kg)	1907^{bc}	3062^{abc}	1.741^{bc}	3.951^{cd}	0.058^{d}
IPA	Liver Tonic(0.1%)	1883^{cd}	3099^{ab}	2.023^{ab}	4.270^{abc}	0.064^{d}
SEM		15.98	18.43125	0.0398	0.0496	0.0027
P		0.000	0.001	0.000	0.000	0.007
N		6	6	6	6	6

KC – Karanja cake IPA (Isopropyl alcohol) treated KC

Means bearing atleast one common superscript in a column do not differ significantly ($P \leq 0.05$)

2.3.2.3 Effect of Molasses on broiler chickens fed IPA treated Karanja cake

Another experiment was conducted for evaluating the effect of sweetening agent, molasses (3% in diet) in broilers fed IPA treated *Karanja* cake. Molasses inclusion in diet showed no effect indicating that the toxic effects of *Karanja* cake on broiler chicken were not due to poor palatability (Table 23).

2.3.2.4 Variously processed Karanja cake in WL layers

A layer experiment was conducted for studying the effect of variously processed *Karanja* cake at 3 and 6% in WL diet from 26 to 37 weeks of age. The treatments tested were NaOH (2%), NaOH &HCl (1% each) and Ca(OH)2 (2%). The dietary inclusion of solvent extracted *Karanja* cake upto 6% in diet found to be safe for laying chickens as no adverse effect was observed on production performance as well as egg quality (Table 24). Also, no difference could be observed among the groups fed variously processed *Karanja* cake.

Table 23. Effect of dietary inclusion of molasses on broiler chickens fed IPA treated *Karanja* cake

IPA-Karanja cake %	Molasses (%)	Body wt., (g)	Feed intake (g)	FCR
-	-	1418[a]	2442[a]	1.725
6	-	1245[b]	2178[b]	1.969
6	3	1229[b]	2103[b]	1.925
SEM		25.82	38.84	0.029
P		0.0001	0.0001	0.0001
N		8	8	8

Means bearing atleast one common superscript in a column do not differ significantly (P≤0.05)

Table 24. Effect of feeding variously processed Karanja cake on production performance of WL layer

Treatment	Eggs/ bird	% HHEP	Egg wt., g	Feed/ bird/day	Feed/12 eggs
Control	81.42	96.92	55.62	106.8	1324
3%SKC	81.50	97.03	56.62	109.6	1357
6% SKC	81.88	97.47	56.12	108.5	1336
3% NaOH treated SKC	82.83	98.61	56.17	108.6	1321
6% NaOH treated SKC	81.54	97.07	56.89	106.6	1318
3% NaOH&HCl treated SKC	81.25	96.73	56.80	109.5	1359
6% NaOH&HCl treated SKC	81.00	96.43	55.98	107.6	1338
3% $Ca(OH)_2$ treated SKC	82.33	98.02	56.05	113.1	1384
6% $Ca(OH)_2$ treated SKC	79.92	95.13	56.53	106.9	1350
N	6	6	6	6	6
P	0.411	0.410	0.568	0.166	0.337
SEM	0.269	0.3198	0.151	0.565	6.758

SKC – Solvent extracted Karanj cake, HHEP : hen housed egg production

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

2.3.3 Effect of selenium supplementation on coloured broiler breeder and its progeny

2.3.3.1 Supplementation of organic and inorganic Se on production performance and hatchability

A feeding trial was conducted utilizing broiler breeder pullets (PB-2) from 33-56 weeks of age to evaluate the impact of different supplemental levels of organic Se (0.15; 0.25; 0.35; 0.45 mg/kg) on their performance. A control diet without Se supplementation and a test group with inorganic Se (Na_2SeO_3) were offered for comparison.

The breeders offered organic Se 0.15 to 0.25 ppm in diets maintained significantly (p£0.05) higher egg production than inorganic Se 0.15 ppm or the control diet (Table 25). The average egg weight was not different for the Se levels tested in this experiment. However, the feed required to produce dozen eggs was minimum (2704 g feed/doz eggs) in breeders fed organic Se at 0.15 ppm which was significantly better than those fed with inorganic Se 0.15 ppm or without Se. The production performance was better realized from organic Se at level as low as 0.15 ppm during the 24-week production period in PB-2 line.

Female breeders of six dietary group were inseminated with semen drawn from males of PB-2 that were also maintained on similar levels of Se, and the fertile eggs so produced were tested for fertility and hatchability (Table 26). A total of 959 fertile eggs were collected with the number ranging from 141 to 191 eggs in different groups. The percent fertility was not affected. The hatchability on total eggs set remained non-significant.

Table 25. Effect of Se in breeder diets on egg production, egg weight, egg mass and feed efficiency

Se (mg)		Production parameters			
		Egg number	Egg prod (HD%)	Egg wt (g)	Feed g/doz
Org	0.00	102	60.75^{b}	59.83	2895^{a}
	0.15	108	64.52^{a}	60.87	2704^{c}
	0.25	110	65.21^{a}	60.34	2682^{c}
	0.35	106	63.09^{ab}	59.81	2773^{abc}
	0.45	106	63.63^{ab}	59.40	2749^{bc}
Inorg	0.15	103	61.16^{b}	60.24	2862^{ab}
P value			0.008	0.07	0.004

Means within a column bearing similar superscript are not statistically significant (p≤0.05)

Table 26. Effect of supplemental Se on fertility and hatchability in broiler breeders

Se (mg)		Egg set (no)	Fertility (%)	Hatchability (%)	Hatch losses (%)
Org	0.00	143	90.59	82.85	10.28
	0.15	141	90.70	86.55	4.27
	0.25	191	95.78	90.17	6.40
	0.35	159	91.30	84.70	7.17
	0.45	168	93.07	88.62	4.66
Inorg	0.15	157	91.86	82.04	10.60
P value			0.675	0.48	0.482

Means within a column bearing similar superscript are not statistically significant (p≤0.05)

2.3.3.2. Effect of Se supplementation in progeny diets at levels similar to parents or with no Se inclusion on the performance of broiler chicks

The chicks hatched from breeders offered 6 different test diets, were identified separately and similar levels of organic Se (0.15, 0.25, 0.35 or 0.45 ppm) and inorganic Se (0.15 ppm) and no Se supplementation were offered to them from 0-6 weeks of age. Broiler chicks (270 no) were distributedin 6 treatments x 9 replicate x 6 chicks in battery cages. Chicks hatched from parents that were fed organic Se at 0.15 ppm during production period and continued with similar level of Se up to 6 weeks of age, were significantly heavier (1563 g) than those derived from parents fed inorganic Se (1453 g) or the control diet (1402 g) (Table 27). However, FCR was not influenced by Se levels in the diets. The results suggeststhat organic Se at 0.15 ppm was adequate to support breeder and progeny performance.

In the 2nd trial, chicks evolved from breeders offered 6 different test diets were offered no supplemental Se, anticipating the support of maternal Se for chicks up to 6 weeks of age. The growth in different groups varied between 1473 g and 1515 g, and was not significant (Table 28). Minimum level of Se, 0.15 ppm was perhaps required to compliment maternal Se as noticed in the earlier trial with broiler chicks.

Table 27. Supplementation of similar levels Se in broiler parents and their progeny and their complimentary effect of broiler chicken performance at 6 weeks of age

Se (mg) in parents	Se (mg) in progeny	B.Wt (g)	Broiler performance at 6 weeks		
			W.gain (g)	FCR	Leg scores
Org 0.00	Org 0.00	1444^{b}	1402^{b}	1.97	1.66^{a}
0.15	0.15	1563^{a}	1520^{a}	1.99	1.69^{a}
0.25	0.25	1539^{a}	1498^{a}	2.00	1.69^{a}
0.35	0.35	1534^{a}	1492^{a}	1.92	1.28^{b}
0.45	0.45	1579^{a}	1536^{a}	1.99	1.90^{a}
Inorg 0.15	Inorg 0.15	1453^{b}	1411^{b}	2.04	1.91^{a}
SEM		10.91	10.89	0.014	0.052
P value		0.0001	0.0001	0.315	0.007

Means within a column bearing similar superscript are not statistically significant ($p \leq 0.05$)

Table 28. Effect of different supplemental levels of Se in broiler breeder diets and no supplemental Se in progeny diets on the performance of chicks at 6 weeks of age

Se (mg) in parents	Se (mg) in progeny	Broilerperformance at 6 weeks			
		B.Wt (g)	W.gain (g)	FCR	Leg scores
Org 0.00	Org 0.00	1515	1474	1.92	1.46^{abc}
0.15	0.00	1497	1456	1.98	1.66^{ab}
0.25	0.00	1488	1445	1.99	1.65^{ab}
0.35	0.00	1493	1450	2.01	1.24^{c}
0.45	0.00	1473	1430	2.06	1.76^{a}
Inorg 0.15	0.00	1503	1463	1.97	1.35^{bc}
SEM		11.30	11.31	0.015	0.051
P value		0.934	0.911	0.210	0.027

Means within a column bearing similar superscript are not statistically significant ($p \leq 0.05$)

2.3.4 Optimization of dietary allowances for production and reproduction in Dahlem Red layers (PD-3)

2.3.4.1 To optimize the dietary allowances for optimum production in Dahlem Red layers

A study was carried out to optimize the major nutrients for Dahlem Red layers. Five diets were formulated i.e., one basal diet with optimum nutrients, two diets with lower (2.5% and 5%) and two diets with higher (2.5% and 5%) nutrient allowances to conduct the feeding trial in Dahlem Red layers. A total of 240 Dahlem Red layers (31 weeks of age) were selected and divided into 5 groups, each having 8 replicates and each replicate have 5 birds. The trial was carried out up to 70 weeks of age. The body weight, change in body weight, feed intake and feed efficiency did not differ among the different dietary groups. However, the egg production during 38-41 weeks was higher among the groups fed 2.5% higher nutrient density diet compared to other groups (Table 29) Antibody titers against sheep red blood cells (SRBC) inoculation did not differ significantly among various dietary groups. Similarly, hatchability among the various dietary groups did not differ in the present experiment

2.3.4.2 Dietary nutrient allowance for optimum semen quality in Dahlem Red cockerels

Five various nutrient density diets were formulated and fed 45 cocks of Dahlem Red (9 in each group) for 3 months. Semen was collected at different intervals during the experiment. The group fed 2.5% over and above the normal diets revealed increased metabolic activity of the sperms (MTT dye reduction test). Further, the groups fed 5% below normal diet revealed higher dead and abnormal sperms. However, sperm concentration, appearance, motility and semen volume did not differ among the various dietary groups.

Table 29. Effect of feeding diets containing varying nutrient density on hen day egg production in Dahlem Red Layers (PD-3)

Age in weeks	I	II	III	IV	V	SEM	P value
	Hen day egg production (%)						
31-34	63.88^{a}	63.06^{a}	62.76^{a}	73.57^{b}	75.31^{b}	1.36	0.01
35-38	59.08^{a}	59.20^{a}	62.82^{ab}	73.27^{b}	69.7^{ab}	1.69	0.02
39-42	55.56	61.24	63.80	62.17	59.13	1.88	0.69
43-46	45.80	46.73	47.34	48.07	46.58	1.97	0.99
47-50	39.30	34.27	41.61	37.50	39.29	2.48	0.91
51-54	38.78	38.52	44.34	41.34	41.44	2.25	0.92
55-58	37.90	30.79	40.87	39.27	37.43	2.24	0.68
59-62	32.18	31.62	32.91	30.24	39.88	3.11	0.41
63-66	29.61	27.98	32.50	33.10	36.31	2.78	0.27
67-70	16.80	25.89	19.85	25.81	28.47	1.90	0.35

2.3.4.3 Effect of feeding diets supplementing with Ration Plus (AgromanCytozyme Pvt. Ltd, Tardeo, Mumbai) on performance of broilers

An experiment was conducted to evaluate the efficiency of dietary supplementation of Ration Plus on performance, feed conversion ratio and mortality in commercial broilers up to 6 weeks.Two practical diets were formulated and one diet was supplement with Ration plus @ 1 litre/1000 kg feed and one diet without the product. Another two diets were formulated with 2.5% lower ME and fed with or without Ration Plus. A total of 240 broiler chicks were distributed

randomly into 4 treatment having 10 replicates with 6 chicks in each replicate. The body weight gain and feed efficiency were significantly higher at 1st, 3rd and 6th weeks of in birds fed Ration Plus compared to those groups fed diets without Ration Plus. The weight of the different slaughter parameters did not differ among various dietary groups. However, higher ready to cook yield was recorded in the groups fed diet supplemented with Ration Plus. Therefore, it is concluded that supplementation of Ration Plus increased body weight gain and feed efficiency in commercialbroilers.

2.3.4.4 Effect of dietary supplementation of encapsulated enzymes on productive performance of broilers

An experiment was conducted to determine the efficiency of dietary supplementation of encapsulated and non-encapsulated enzymes on performance of Krishibro chicks. A control diet was formulated with optimal nutrients (NRC 1994), and three basal diets containing lower (-5% ME, 7.5% CP and -20% NPP) nutrients and each of the basal diet was fed to the respective groups. Similarly, the basal diet with lower ME was supplemented with amylase (2500 U/kg), xylanase (2000 U/kg), cellulase (500 U/kg), hemicellulose (500 U/kg) and pectinase (500 U/kg) encapsulated and non-encapsulated forms. The basal diet with lower CP was supplemented with encapsulated and non-encapsulated protease (4000 U/kg). Similarly, basal diet with lower NPP was supplemented with encapsulated and non-encapsulated phytase (500 U/kg). A total of 350 day-old krishibro chicks were distributed randomly into 10 treatment groups having 7 replicates with 5 chicks in each replicate and fed *ad libitum* up to 6 weeks. Feeding various experimental diets did not affect the feed intake and body weight gain. However, the better FCR was recorded in the groups fed diet supplemented with encapsulated enzymes compared to other dietary treatments. Therefore, it is concluded that supplementation of encapsulated enzymes resulted in marginal increase in body weight and FCR compared to those groups fed diet supplemented with non-encapsulated enzymes.

2.3.5 Production of designer broiler chicken meat through nutritional manipulation

2.3.5.1 Effect of supplementing graded concentrations of Vit E and Se on performance, anti-oxidant response and nutrient content of various biological tissues.

About 432 chicks were divided in to 9 treatments having 8 replicates with 6 chicks in each replicate. The graded concentration of Vitamin E (0.1 to 0.2 g/kg diet) and Se (0.15 to 0.45 mg/kg diet) were supplemented in the diets and fed *ad libitum* up to 6 weeks of age. At the end of the experiment, 5 birds from each of the treatment were slaughters and tissue samples were collected for estimation of different anti-oxidant enzymes activity and other nutritional parameters. The body weight gain and feed intake did not differ among the various dietary groups. The better FCR was recorded among the groups fed with Vitamin E at 0.2 g/kg diet and Se at 0.15 mg/kg diet compared to other groups.

2.3.5.2 Effect of supplementing sunflower and linseed oil at different concentration at different growth phase in Krishibro chicken.

A total of 300 day old chicks (Krishibro) were selected and distributed randomly in to 60 battery brooder having 5 chicks in each with 10 replicate for each of the treatment. During the initial age (up to 3 weeks), the basal diet was fed to all the groups and from 4th weeks of age, the sunflower or linseed oil at different concentration was supplemented in the diets. Similarly, during the 5th and 6th weeks of age, sunflower and linseed oil was supplemented at different concentration in the diet. The diets were fed *ad libitum* throughout the experiment. At the end of the experiment, 6 birds

from each treatment were sacrificed and tissue samples (thigh muscle, breast muscle and liver) were collected for estimation of different biochemical parameters. Supplementation of vegetable oils did not affect the body weight gain, feed intake and feed conversion ratio in Krishibro birds in the present experiment.

2.4 Avian Physiology

2.4.1 Cellular and molecular studies of reproductive system in chicken

2.4.1.1 Evaluation of semen quality of males selected for regeneration

Male parents of different lines namely CB (n= 69), GML (n= 60), PD-4 (n= 79) and PB1 (n= 80) used for regeneration were evaluated for semen quality and birds with poor quality semen were recommended for discard from the breeding programme. The semen quality of Ghagus ecotype (35 males) at 48 weeks of age was also evaluated before regeneration (Table 30).

2.4.1.2 Dietary energy and protein modulation on semen quality of Dahlem Red males

This experiment aimed at studying different levels of dietary energy and protein concentrations on the semen quality parameters in Dahlem Red males. The experimental diets provided to the males were i) diet containing below 5% energy and protein of basal diet, ii) diet containing below 2.5% energy and protein of basal diet, iii) basal diet (2600 kcal energy, 16% CP), iv) diet containing above 2.5% energy and protein of basal diet and v) diet containing above 5% energy and protein of basal diet. Males of 39 weeks old were used to test the experimental diets. The birds were fed continuously for 12 weeks. The semen quality was examined at four weeks interval. The group fed with 2.5% above the normal levels had significantly ($P \leq 0.05$) higher values in MTT dye reduction test that indicates the metabolic activity of the sperms. The group fed with 5% lower than the normal levels had significantly ($P \leq 0.05$) higher dead sperms at 4 weeks after starting of feeding the experimental diets (Table 31). There was no significant difference between the groups in any of the parameters at 8 and 12 weeks of the experiment.

Table 30. Semen quality of Ghagus ecotype

Parameter	Nean ± SE (n= 35)
Volume (ml)	0.71±0.45
Appearance	3.54±0.14
Motility (%)	52.28±2.81
Sperm Concentration (million /μl)	4.85±0.32
MTT Formazan (nm/min/million sperms)	25.63±2.25
Live Sperms (%)	88.99±1.15
Dead Sperms (%)	11.00±1.15
Abnormal sperms (%)	1.86±0.47

Table 31. Effect of feeding varying energy and protein concentrations on semen quality in Dahlem Red males

Diet	5% below basal diet	2.5% below basal diet	basal diet	2.5% above basal diet	5% above basal diet
4 weeks (43 weeks of age)					
Volume (ml)	0.56 ± 0.06	0.63 ± 0.08	0.58 ± 0.06	0.6 ± 0.06	0.65 ± 0.08
Appearance	3.22 ± 0.14	3.57 ± 0.30	3.11 ± 0.11	3.33 ± 0.16	3.55 ± 0.29
Motility (%)	50.55 ± 2.65	50.71 ± 3.59	52.22 ± 1.82	54.44 ± 3.67	52.22 ± 5.32
Concentration (million /μl)	3.61 ± 0.342	4.04 ± 0.41	3.89 ± 0.26	3.59 ± 0.32	3.81 ± 0.34
MTT Formazan (nm/min/million sperms)	22.77 ± 0.91^{B}	23.33 ± 0.52^{B}	22.83 ± 0.65^{B}	27.59 ± 0.73^{A}	25.6 ± 0.70^{AB}
Live Sperms (%)	87.14 ± 1.95^{B}	93.62 ± 1.71^{A}	94.22 ± 1.43^{A}	93.86 ± 1.09^{AB}	93.98 ± 1.27^{A}
Dead Sperms (%)	12.86 ± 1.95^{A}	6.38 ± 1.71^{B}	5.77 ± 1.43^{B}	6.13 ± 1.09^{AB}	6.02 ± 1.27^{B}
Abnormal sperms %	3.47 ± 0.93	3.99 ± 1.56	2.93 ± 0.64	3.43 ± 1.58	5.36 ± 3.67
8 weeks (47 weeks of age)					
Volume (ml)	0.51 ± 0.05	0.51 ± 0.07	0.56 ± 0.06	0.59 ± 0.07	0.63 ± 0.08
Appearance	3.22 ± 0.14	3.14 ± 0.14	3.0 ± 0.00	3.22 ± 0.15	3.16 ± 0.16
Motility (%)	52.22 ± 2.90	52.14 ± 3.24	53.12 ± 2.26	53.88 ± 5.23	55.83 ± 3.35
Concentration (million /μl)	4.67 ± 0.27	4.17 ± 0.44	4.53 ± 0.18	4.02 ± 0.38	4.38 ± 0.29
MTT Formazan (nm/min/million sperms)	22.96 ± 0.84	23.17 ± 1.33	23.66 ± 0.98	25.63 ± 1.17	26.99 ± 0.95
Live Sperms (%)	90.60 ± 1.03	88.94 ± 0.67	86.47 ± 1.83	91.77 ± 1.83	91.29 ± 1.99
Dead Sperms (%)	9.39 ± 1.03	11.05 ± 0.67	13.52 ± 1.83	8.22 ± 1.83	8.70 ± 1.99
Abnormal sperms (%)	2.58 ± 0.82	0.56 ± 0.21	1.92 ± 0.69	4.47 ± 2.92	5.92 ± 5.48
12 weeks (51 weeks of age)					
Volume (ml)	0.42 ± 0.07	0.53 ± 0.08	0.50 ± 0.08	0.55 ± 0.07	0.58 ± 0.07
Appearance	3.22 ± 0.15	3.16 ± 0.17	3.25 ± 0.16	3.22 ± 0.15	3.5 ± 0.22
Motility (%)	52.22 ± 1.88	52.5 ± 2.23	52.5 ± 1.99	52.66 ± 4.08	51.66 ± 2.58
Conc (million /μl)	4.55 ± 0.33	4.38 ± 0.26	4.09 ± 0.30	3.51 ± 0.47	4.82 ± 0.34
MTT Formazann (nm/min/million sperms)	23.89 ± 2.07	23.92 ± 2.38	25.50 ± 1.19	27.61 ± 1.81	27.44 ± 1.49
Live Sperms (%)	92.63 ± 0.87	93.22 ± 0.95	92.46 ± 1.36	92.46 ± 0.87	91.72 ± 1.35
Dead Sperms (%)	7.36 ± 0.87	6.77 ± 0.95	7.53 ± 1.36	7.53 ± 0.87	8.27 ± 1.35
Abnormal sperms (%)	3.12 ± 1.11	2.14 ± 0.69	2.86 ± 0.93	5.23 ± 2.90	6.46 ± 5.22

Values with different superscripts in a row differ significantly ($P \leq 0.05$)

2.4.1.3 Effect of supplementation of organic and inorganic selenium on semen quality in broiler breeder diets

Broiler breeder males (PB-2) were selected at 34 weeks age and grouped in to five and supplemented with different levels of organic selenium (0, 0.15, 0.25, 0.35, 0.45 ppm) and one level of inorganic selenium (0.15 ppm) in the feed till 58 weeks of age. The semen quality was analyzed at 4 weeks interval. Analysis of data revealed no significant difference between the groups supplemented with organic or inorganic selenium (Table 32). However, lipid peroxidation and alkaline phosphatase were found to be significantly ($P \leq 0.05$) higher in the seminal plasma of inorganic selenium fed group (Table 33). The results indicated that organic selenium supplementation did not have any improvement in semen quality and the selenium obtained from the unsupplemented diet is enough for optimum semen production. Supplementation of selenium in inorganic form to PB-2 birds indicates a negative effect on the semen quality.

Table 32. Effect of supplementation of Se on different semen quality parameters (32-58 weeks) in broiler breeders. (Mean ± SE).

Parameters	Se, mg/kg					
	0	0.15	0.25	0.35	0.45	0.15*
Volume (ml)	0.46 ± 0.08	0.66 ± 0.08	0.62 ± 0.08	0.54 ± 0.08	0.57 ± 0.08	0.65 ± 0.09
Appearance	3.71 ± 0.16	3.86 ± 0.16	3.64 ± 0.16	3.69 ± 0.16	3.86 ± 0.16	4.02 ± 0.19
Motility (%)	44.46 ± 1.98	40.00 ± 1.68	42.85 ± 1.94	41.63 ± 2.78	41.32 ± 2.76	43.44 ± 1.89
Sperm Concentration (million /μl)	5.62 ± 0.43	5.80 ± 0.43	5.29 ± 0.43	5.05 ± 0.44	5.43 ± 0.44	6.60 ± 0.50
MTT Formazan (nm/min/ million sperms)	17.12 ± 0.80	16.15 ± 0.80	17.27 ± 0.81	15.61 ± 0.81	16.04 ± 0.81	16.87 ± 0.93
Live Sperms (%)	80.96 ± 2.32	83.54 ± 1.26	83.79 ± 2.12	80.31 ± 2.56	83.71 ± 1.71	81.42 ± 2.63
Dead Sperms (%)	19.03 ± 2.31	16.45 ± 1.25	16.20 ± 2.12	19.69 ± 2.56	16.29 ± 1.71	18.57 ± 2.63
Abnormal sperms (%)	1.10 ± 0.20	1.28 ± 0.15	1.10 ± 0.17	1.39 ± 0.23	1.17 ± 0.15	1.04 ± 0.15

** Inorganic Selenium*

Table 33. Effect of Se in breeder diets on seminal plasma

Parameters	Se, mg/kg					
	0	0.15	0.25	0.35	0.45	0.15 *
Protein (g/dl)	0.82 ± 0.03^{b}	0.92 ± 0.02^{ab}	0.82 ± 0.02^{b}	0.93 ± 0.03^{ab}	1.01 ± 0.02^{a}	0.94 ± 0.03^{a}
ALP (U/L)	39.07 ± 3.12^{bc}	46.13 ± 3.16^{ab}	31.66 ± 3.11^{c}	29.58 ± 3.11^{c}	45.98 ± 3.12^{ab}	53.75 ± 3.11^{a}
LP (moles of MDA/g Protein)	0.75 ± 0.09^{b}	0.98 ± 0.08^{ab}	0.67 ± 0.07^{b}	0.60 ± 0.09^{b}	0.62 ± 0.09^{b}	1.28 ± 0.07^{a}

Means with different superscripts in a row differ significantly ($P \leq 0.05$) ** Inorganic Selenium*

ALP = Alkaline Phosphatase *LP = Lipid Peroxidation*

2.4.1.4 Supplementation of organic selenium in diets of parents and progeny on semen quality at sexual maturation

Male chicks produced from broiler breeders that were supplemented three levels of organic selenium (0, 0.25, 0.45 ppm)and one level of inorganic selenium (0.15 ppm) were identified group wise and provided similar levels of selenium as their parents from day old. Semen was collected at 28 weeks of age and evaluated for volume, appearance, motility, sperm concentration, MTT dye reduction assay, live, dead and abnormal sperms. There was no significant ($P > 0.05$) difference between the groups indicating that selenium obtained from unsupplemented diet is enough for optimum semen quality.

2.4.1.5 Effect of temperature on semen quality

Semen quality of Dahlem Red males that were produced from eggs incubated at normal and high temperature (2°C higher than normal) was evaluated during 29 and 39 weeks of age. The males from higher incubation temperature (HT) group had significantly ($P \leq 0.05$) higher sperm concentration than that of the birds produced from normal incubation temperature (NT) at both the periods of evaluation. The abnormal sperm percentage was significantly ($P \leq 0.05$) lower in the higher incubation temperature group. An insemination trial was conducted with fixed number of sperms (100 million sperms/bird) where the semen from HT and NT males were inseminated in the respective group females for five weeks. Three hatches were taken and the average fertility and hatchability in HT group were 81.21% and 72.12 respectively. In case of NT group the average fertility and hatchability were 79.78 and 70.19% respectively. The results indicate that exposure of eggs to higher incubation temperature (2°C higher than normal) may improve the semen quality.

2.4.1.6 Standardization of in ovo inoculation technique

In ovo inoculation of embryos at 18th day of incubation through yolk sac route (narrow end) was standardized. About 108 eggs were inoculated with Vit E at different concentrations (0, 2.5, 5.0, 7.5 and 10 mg) pilot study along with Indian ink as control to check the deposition of materials in to yolk sac. After inoculation the eggs were broken and the deposition of Indian ink was observed in the yolk sac.

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 MD, RD, Rickets and CRD. The lesions of collibacillosis were scored as 1+, 2+, 3+ and 4+. The samples from birds exhibiting lesions of collibacillosis were collected and subjected to isolation and identification of *E. coli* isolites as per the standard procedures. A total of 8 *E. coli* isolates were subjected to antibiotic drug sensitivity against 9 therapeutically significant commonly used antibiotics. The overall prevalence of Collibacillosis was 24.5% in meat type and 21.4% in egg type chickens. Based on the severity of the lesions the highest percentage of birds exhibited lesion score of 1+. Pure cultures of *E. coli* were isolated from the lesions and serotyping at Central Research Institute, Kasauli revealed presence of serotype O2. Most of the *E. coli* isolates tested were resistant to neomycin (100%), oxytetracyclin (100%), enrofloxacin (87.5%) and ciprofloxacin (100%) and sensitive to ceftiofur (100%), gentamicin (87.5%), colistin (75%) and ampicillin/cloxacillin (100%), while the cephalexin showed intermediate zone of inhibition to 75% of isolates tested.

2.5.1.2 Screening of pure lines for ALV and determination of ev loci and TVB in pure lines

A total of 3808 females and 1321 males belonging to 14 pure lines were tested for ALV of which 831 (21.8%) females and 54 males (4.1%) were

found positive. The overall prevalence was 17.3% (885/5129). All the Positive birds were eliminated by culling. Avian leucosis tumor virus B locus in three White Leghorn chicken lines (IWH, IWI and IWK) and one indigenous chicken (Kadaknath) was investigated. TVB alleles were determined using PCR-RFLP assay. PCR products TVB303 and TVB202 were amplified and digested using endonuclease enzymes *Nla*III and *Xba*I, respectively. Based on the electrophoretic patterns, the *TVB* alleles were determined. *TVB**S1 and *TVB**S3 alleles were found in White Leghorn lines, whereas only *TVB**S1 allele was detected in indigenous Kadaknath chicken. *TVB**S1 gene frequency was 0.96, 0.50, 0.96 and 1.00 in IWH, IWK, IWI and Kadaknath lines, respectively. The frequency of *TVB**S3 gene was 0.41, 0.50 and 0.41 in IWH, IWK, and IWI lines, respectively. The *TVB**S1/S1 genotype frequency was 0.92, 0.25, 0.92 and 1.00 in IWH, IWK, IWI and Kadaknath, respectively. The *TVB**S1/S3 was 0.08, 0.50 and 0.08 in IWH, IWK and IWI respectively. The *TVB**S3/S3 genotype was observed only in IWK with frequency of 0.25. In Kadaknath the genotype *TVB**S1/S1 was fixed.

2.5.1.3 Detection of endogenous avian leukosis virus infection in Kadaknath chicken

As a part of Avian Leukosis Virus (ALV) eradication program, pedigreed Kadaknath population was screened for ALV group specific antigen (p27) in two subsequent generations using ELISA. Positive birds were culled from first generation and progeny was hatched from ALV negative birds. The overall prevalence of ALV infection based on gs antigen ELISA was 82.2% (females 87.2%; males 68.8%) in the first generation and 77.02% (females 94.7%; males 44.3%) in the subsequent generation tested. From the second generation, the genomic DNA and total RNA were isolated from blood of 10 ALV positive and 7 ALV negative birds and were subjected to ALV subgroup specific PCR and RT-PCR. All the DNA (100%) and 88.2% of RNA samples both from ALV gs antigen positive and gs antigen negative, were found positive for ALV subgroup E by PCR and RT-PCR, respectively. The ALVE was also detected in vaginal swab samples by RT-PCR. All the samples were found negative for subgroup A, B, D and J and endogenous *ev*-1 and *ev*-21 loci. The high prevalence of ALV infection as detected by gs antigen ELISA and subgroup E detected by PCR and RT-PCR indicates that the Kadaknath chicken harboring ALV subgroup E and other ev sequences which may be expressing gs antigen and envelop sequences ALV-E as the ALV E PCR primrs anneals envelop gene. Inspite of culling of ALVgs antigen positive birds from first generation and using only ALV gs antigen negative birds for producing next generation did not significantly reduce the prevalence of ALV infection in the next generation. This can be attributed to the presence of ALV subgroup E and/or *ev* loci in the genome of the first generation of Kadaknath chicken but expressing undetectable levels of gs antigen. This might also be due to intermittent shedding of gs antigen in the vaginal secretions.

2.5.1.4 Evaluation of immune response to sheep red blood cell antigen in two breeds of chicken

The non specific immune response and non-responders in two chicken lines against SRBC were investigated. Birds of two breeds Dalhem Red (DR) and White Leghorn (WLH) were divided into three groups and 30 birds in each group. Blood was drawn from two sheep (A and B) and 0.5% SRBC was prepared with PBS. One group each from WLH and DR birds were injected with 0.1ml of SRBC from sheep A and other group with SRBC of Sheep B. The third group received PBS and served as control. Blood was drawn from all the birds on 5, 10 and 15 days post inoculation and serum was separated and antibody titers were determined against 0.75% SRBC (A and B) using micro-hemagglutination assay. The titers were expressed as $\log_2$ values. Both WLH and DR birds inoculated with PBS showed non specific HA titers 1.4-1.9 and 3.3-5.6, respectively. There was no significant difference in HA titers in both the

breeds of chicken between heterologous and homologous SRBC except on 15th day where the WLH birds showed significant difference in HA titers between heterologous and homologous SRBC antigen. The percentage of non responders was 2.5% in WLH and 12.5% in DR birds. The HA titers were significantly high in WLH birds as compared to that of DR birds on 5, 10, and 15 days post inoculation. In conclusion, the results indicate that there are non responders to SRBC in both WLH and DR and significant difference between breeds. Both WLH and DR birds exhibited nonspecific HA response that differs significantly between breeds.

2.5.1.5 Investigation of an outbreak of respiratory disease associated with Mycoplasma synoviae in naked neck chickens

An outbreak of respiratory disease, associated with *M.synoviae*, was investigated in 8 weeks old naked neck birds. The clinical signs observed were depression, nasal discharge, foamy eyes, swollen sinuses, moist rales, sneezing and increased mortality. Necropsy findings include mild to severe airsacculities with accumulation of frothy to cheesy exudates in air sacs. Tracheal swabs from affected birds were collected into Frey's media and incubated at 37°C for one day. DNA was extracted from cultures and swabs and subjected to PCR using primers specific for *M. gallisepticum*and *M. synoviae.* PCR products were sequenced and compared with reference strains. PCR results indicated that 8 out of 8 samples were positive for MS and one out of 8 was positive for MG. Presence of MS was further confirmed by sequencing of PCR products from three samples. Nucleotide sequence comparison reveled that MS sequence of this study were 96.9% to 99.0% similar to those of published sequence in Genebank. Phylogenetic analysis indicated that the sequences of present study were clustered with SP267 strains of MS. In conclusion, the observed clinical and necropsy findings, detection of M synoviae and sequence analysis demonstrated that MS was the causative agent of the outbreak of respiratory disease

2.5.2.1 Prevalence of M. gallisepticum by isolation and molecular identification

Present study was conducted in order to determine the prevalence of *M.gallisepticum* in Indian poultry farms. The data from this study would help in developing a strategy to prevent or alleviate the flock infection due to *M. gallisepticum*. Choanal cleft swabs and serum samples were obtained from Commercial Layer, Broiler Parent and Commercial Broiler farms located in major poultry growing areas in different geographical regions in the country. The isolation of *M. gallisepticum* from choanal swabs was performed using standard culture techniques and identified by Polymerase Chain Reaction (PCR) technique. Selected PCR products were sequenced for confirmation. Specific antibodies against *M. gallisepticum* were detected using ELISA techniques.

Based on the isolation and PCR results, 178 (10.38)out of 1715 samples tested were positive for *M. gallisepticum.* The prevalence of *M. gallisepticum* in different regions was 18.64% in Central, 01.00% in East, 1.76% in North and 11.25% in South. The prevalence of *M. gallisepticum* was 12.45% in Commercial Layers, 09.20% in Broiler Parents and 7.85% in Commercial Broilers. Out of 64 flocks tested, 17(26.56%) were found positive for *M. gallisepticum*. Region-wise flocks positive for *M. gallisepticum* were 31.82% in Central, 10.00% in East, 13.33% in North and 25.93% in South. The prevalence of *M.gallisepticum* in different categories of flocks was 31.03% in Commercial Layers, 20.00% in Broiler Parent and 10.00% in Commercial Broiler Out of 1827 serum samples from a total of 86 flocks, 803 (43.95%) samples were found positive by ELISA. The overall region-wise seroprevalence observed was 49.89% in Central, 56.50% in East, 57.61 % in North and 31.54% in South. The serological data of three types of birds tested revealed an overall prevalence

of 54.39% in Commercial Layers, 39.61% in Broiler Parents, and 20.80% in Commercial Broilers. When evaluating serological data by flock, 67 out of 86 (77.91%) flocks tested were found positive for *M. gallisepticum* antibody. Region wise flocks positive for *M. gallisepticum* antibody were 77.27% in Central, 70% in East, 84.62% in North and 75.00% in South. Serology data by flock type revealed prevalence of 91.67% in Commercial Layers, 77.50% in Broiler Parent and 30.00% in Commercial Broiler flocks. In the present study, 1694 birds (from 74 flocks) contributed both serum and swab samples, of which, 82 (04.84%) were found positive for both antibody and *M. gallisepticum*. Out of 74 flocks tested, by both ELISA and PCR, 11(14.86%) flocks were positive.

2.5.3 Innate immune gene polymorphisms associated with immune response and modulation of immune response with TLR agonists and Defensins

2.5.3.1 Identifying polymorphisms and genetic diversity of innate immune genes Toll-like receptors (TLRs) in pure line chickens maintained at PDP.

The full length coding region of TLR5 from Aseel birds was amplified with chicken specific primers and sequenced by primer walking method by synthesizing internal primers. The sequence has been submitted in Genbank (Acc. no. JX573117). The full length open reading frame (ORF) of Aseel TLR5 is 2586 nucleotides encoding 862 amino acids. The sequence analysis revealed that Aseel TLR5 shared 97-98% and 98-99% homology with other chicken breeds (WL, Hyline and Chinese varieties) at nucleotide and amino acid levels respectively. It also shared 80, 94, 95 and 99% homology with Zebra finch, common pheasant, turkey and Guinea fowl respectively. Further, the TLR5 mRNA expression levels were quantified in different tissues (heart, liver, spleen, intestine, bursa, bone marrow and muscle) of day-old Aseel and White Leghron chicks by SYBR-Green I based real time PCR assay. The investigation revealed that TLR5 mRNA expressions were significantly higher in liver, spleen, intestine and bursa of Aseel than White Leghorn chicken ($P < 0.01$). However, in bone marrow significantly higher expression was observed in WL than Aseel chicken ($P < 0.01$) and no significant difference in transcript expression was found in muscle and heart tissue.

2.5.3.2 Assessment of genetic diversity of the major histocompatibility complex (MHC) region in pureline chicken breeds and native chicken flocks using the LEI0258 microsatellite marker

A total of 150 samples from four pureline chicken breeds including WL (IWI-20; IWK-23), Dahlem red (DR-20), PB-1 (22) and two native chicken breeds Aseel (20) and Kadaknath (45) by using LEI0258 marker. After PCR amplification using LEI0258 marker from genomic DNA isolated from blood samples, the allele sizing was done on 8% polyacrylamide gel using UV tech software. Two related parameters heterozygosity (H_o) and the effective number of alleles (Ne) harbored by the populations were analyzed by PopGen 3.2 program to assess the genetic variability. Overall 22 differently sized alleles (182-552 bp) were identified. Indian native chicken breeds Aseel ($Na = 10$) and Kadaknath ($Na = 11$) population harbored more alleles compared with those of pureline populations ($Na = 5$-6). Analysis by using Fishers's exact test for Hardy- Weinberg's equilibrium (HWE) revealed that two populations IWI and Kadaknath deviated from the HWE ($P < 0.001$). The study also uncovered some private alleles in the population. Based on the results, one of the native chicken breed Kadaknath and pureline breed (IWI) have significantly higher MHC heterozygosity than other lines investigated.

3. Technology Assessed and Transferred

3.1 Germplasm Supply

The two rural chicken varieties developed by the Directorate i.e. *Vanaraja* and *Gramapriya* reached majority states in the country due to their physical characteristics, versatile greater adaptability to the diversified agro-climatic conditions and their production potential with minimum investment. About 87,807 hatching eggs were supplied to different organizations and NGOs. A total of 2,21,397 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 50,461 day old parent chicks of *Gramapriya*, *Vanaraja* and *Krishibro*, where the commercial chicks are being produced and supplied to the farmers

3.2 Exibitions

3.2.1 PDP stall attracts visitors at Poultry India 2012

PDP participated in Poultry India 2012 organized by IPEMA at Hitex Exhibition Complex, Hyderabad from 27 to 29th November 2012. PDP 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 8 to 10 thousand farmers, technocrats and scientists visited the PDP stall in 3 days.

3.2.2 PDP participated in farmers day at DRR

Participated in the farmers day organized by DRR on 28th October 2012, Hyderabad. PDP stall with live birds attracted the attention of the farmers and visitors at the exhibition. The literature on the improved chicken varieties was distributed to the farmers.

Farmers visiting PDP stall at DRR

3.2.3 Hon'ble Shri Tariq Anwar visits PDP stall at NAARM

An exhibition was organized on 7th January 2013 at NAARM, Hyderabad on the occasion of visit of Hon'ble Union Minister of State for Agriculture, Shri Tariq Anwar ji. Appraised about the significant contributions of PDP in empowering the rural and tribal people across the country. The live birds displayed in the exhibition attracted the dignitaries.

Hon'ble Shri Tariq Anwarji visits PDP stall at NAARM

3.2.4 Training program on poultry production and management for farmers

Five day training program was organized by the Directorate to the farmers from Ranchi and Jharkhand on scientific poultry rearing from 9th to 13th October 2012. About 41 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.

Farmers preparing feed in feed unit

3.3 Training for Poultry Seed Project technical staff

A five day training program was organized from 3rd -7th July 2012 for the Poultry Seed Project Staff in hatchery and breeder management for effective functioning of PSP centres as per the recommendations of the Annual review meeting. Eight members from different PSP centres participated in the training. Hand on training was imparted in day to day routine farm and hatchery operations, breeder management and common health problems.

PSP technical staff under training in hatchery

4. Education and Training

Staff of the institute participated in a number of training programmes and workshops organized by different organizations to update and gather knowledge in various disciplines of 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 1.

Table 1. Training and HRD activities of the Directorate

Sl. No.	Particulars of Training	Official(s)	Duration	Venue
1.	International Training Program on Poultry Production and Health	Dr. U. Rajkumar, Sr. Scientist	10th July -25th September 2012	EICA, Cairo, Egypt
2.	General management programme for scientists	Dr. M. Niranjan, Sr. Scientist	27th August –7th September 2012	ASCI, Hyderabad
3.	Workshop on reservation policy	Dr. Daryab Singh, T-9 Sri M.S.N. Acharyulu, Assistant	6th -8th September 2012	SVTPS, Jaipur, Rajasthan
4.	Attended winter short course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation vis-à-vis augmentation of productivity in Poultry and livestock species"	Dr. M. Niranjan, Sr. Scientist Dr. B. Prakash, Scientist	17th - 26th November 2012	PDP, Hyderabad
5.	Training programme on Hindi IT tools	Sri J. Srinivas Rao, T-6	19th – 23rd November 2012	BDL, Hyderabad
6.	Workshop on Right to Information Act-2005	Sri K.V.S. Satyanarayana, AAO	17th & 18th December 2012	ISTM, New Delhi
7.	CPCSEA Nominee Training Programme	Dr. M. Shanmugam, Scientist	4th - 8th March 2013	NIAW, Ballabgarh, Faridabad
8.	Workshop on Fixation of pay	Sri M.S.N. Acharyulu, Assistant	18th – 20th March 2013	ISTM, New Delhi

5. Awards and Recognition

The research and extension services of the Directorate including implementation of official language received appreciation from different professional bodies and Govt. organizations.

5.1 Award for best article/paper presentation

- Dr. G. Shyam Sunder et al. were awarded with Kerala Chapter Research Award of Indian Poultry Science Association in the field of Avian Nutrition and Feed Technology for the year 2012.

Dr. G.Shyam Sunder receiving Kerala Chapter Award

- Dr. T.R. Kannaki et al. awarded ISAGB best poster award in 2012 sponsored by Indian Society of Animal Genetics & Breeding
- Dr. M. R. Reddy and others awarded IPSACON 2012 best poster award in 2012 sponsored by Indian Poultry Science Association
- Dr. M. K. Padhi et al. awarded IMSACON-V best poster award in 2013 sponsored by Indian Meat Science Association
- Dr. T.K. Bhattacharya and others awarded IMSACON-V best poster award in 2013 sponsored by Indian Meat Science Association

5.2 Other awards and Recognition

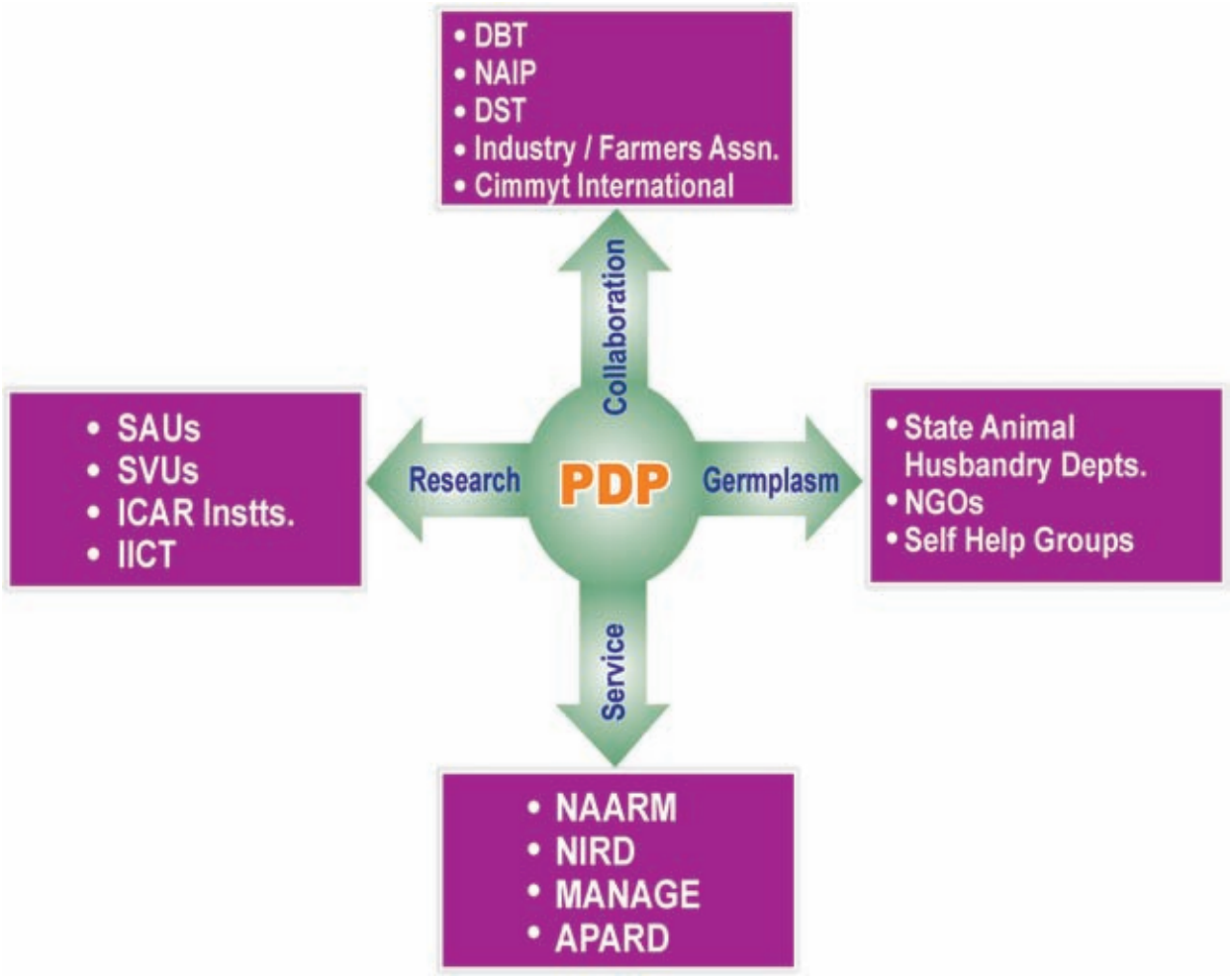
- Dr. U. Rajkumar, Sr. Scientist awarded EICA Fellowship for International training program on poultry production and health, sponsored by Egyptian Government
- Sri J. Srinivas Rao, T-6 awarded Rashtra Bharati Puraskar for the year 2012 conferred by Bharatiya Sanskriti Nirman Parishad, Hyderabad for efficient services in implementation of Hindi Language

Sri J. Srinivas Rao awarded Rashtra Bharati Puraskar

6. Linkages and Collaboration

The Directorate is well equipped with the state of art infrastructure facilities 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 local institutions like SVVU, ANGRAU and Osmania University for carrying out their dissertation works. The scientists of this Institute guided the research works of the students as co-chairman/members of the students' advisory committee. The library facilities were also utilized by the faculty and students of the local Institutions. Several trainees/students from neighboring Institutions like NAARM, SVVU, ANGRAU, TANUVAS, MANAGE, NIRD, IICT etc. visited the Directorate to have an exposure 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 PDP is in net work mode, having link with various SAUs, SVUs and ICAR institutions across the country. Besides two net work research programmes (AICRP and PSP), the Directorate is actively working with various stake holders of rural and commercial poultry farming fraternity like Animal Husbandry department of Chattisgarh, Orissa etc.,



Collaboration of PDP with different agencies

7. AICRP on Poultry Breeding and Poultry Seed Project

7.1 AICRP on Poultry Breeding

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

The 'Rural Poultry" component of the project included six centres, at ICAR Research Complex for NEH Region, Agartala, MPPCVV, Jabalpur, AAU, Guwahati, BAU, Ranchi, MPUAT, Udaipur and CSKHPKVV, Palampur. All the six centres are engaged in the development of location specific germplasm for augmenting rural poultry production utilizing local native and improved chicken germplasm.

Two pedigreed random bred control populations (one for layer and the other for broiler) were evaluated and reproduced at Project Directorate on Poultry, Hyderabad. Samples of hatching eggs from these populations were sent to different centers of the AICRP on Poultry Breeding during the time of regeneration. The commercials from layer and broiler populations were supplied to different user agencies either as hatching eggs or as day old chicks for commercial exploitation. As per the decision taken by the Council, the strains maintained at different AICRP centers and PDP were duplicated at various AICRP centres to be utilized in case of exigencies and as a resource population by the centre for three and four way crossing. The strains being duplicated at different AICRP centre are IWN at Hyderabad, IWF at Mannuthy, IWD and IWK at Anand and M1 and M2 at Jabalpur centre. All the four layer centres have developed three-way crosses for their performance evaluation and future exploitation.

Field testing of various commercial layer crosses is in progress.

7.1.1 Poultry for Eggs

The KVASU, Mannuthy centre has evaluated the S-26 generation of IWN and IWP populations up to 64 weeks of age during 2012-13. One hatch was evaluated upto 72 weeks of age and regenerated S-27 generation. The hen house and hen day egg production up to 64 weeks of age increased by 3.5 and 4.8 eggs, respectively, over previous generation in IWP (Table 1). Hen housed egg production upto 72 weeks of age were 308.2 and

297.5 eggs in IWN and IWP, respectively. Corresponding egg production on hen day basis were 313.7 and 301.4 eggs. The average genetic response for egg production to 64 weeks of age in IWN (3.70 eggs) was higher than IWP (2.35 eggs) in the last nine generations (Fig. 1). The egg weight at 64 weeks of age decreased over the previous generation in all the populations. The survivability in both the selected lines from 17-64 weeks of age was above 93.9 %. Fertility was more than 97 % in both the selected lines. Heritability estimates for egg production upto 64 weeks of age was low in magnitude. The centre has generated Rs.27.66 lakhs which was 80.03 % of the expenditures on feed cost. The centre was able to supply 28,858 germplasm during the year.

Table 1. Growth and production performances in S-26 generation of IWN and IWP and Control at Mannuthy

Traits	IWN		IWP		Control	
	n	Mean ± SE	n	Mean ± SE	n	Mean ±SE
Body wt (g)						
16 wks	1703	1062±3.03	1693	1073±2.67	92	957.4±14.48
40 wks	1647	1613±4.59	1642	1700±5.29	91	1524±18.53
64 wks	1611	1643±6.69	1593	1731±5.89	91	1589±23.30
ASM (d)	1684	138.8±0.23	1679	139.4±0.21	89	170.9±0.62
EW (g)						
28 wks	1642	51.48±0.09	1637	53.25±0.09	89	47.26±0.41
40 wks	1626	53.45±0.09	1610	55.06±0.09	88	51.10±0.29
64 wks	1438	54.09±0.10	1538	56.63±0.11	79	53.13±0.48
EP (no.) 40 wks						
HH	1703	124.1±0.61	1693	122.2±0.58	92	97.88±2.15
HD : 17-40 wks		127.47		123.9		98.72
HD : 21-40 wks		122.98		121.6		98.7
Survivor	1627	127.2±0.43	1648	124.4±0.47	91	98.93±1.90
EP (no.) 64 wks						
HH	1703	251.4±1.46	1693	254.6±1.31	92	209.9±3.92
HD : 17-64 wks		259.4		261.2		212.1
HD : 21-64 wks		257		258.9		212.1
Survivor	1607	261.2±1.02	1599	262.9±0.88	91	212.1±3.21
EP (no.) 72 wks						
HH	300	308.2±2.34	300	297.5±2.18		-
HD 17-72wks		313.7		301.4		-
Survivor		312.6±2.15		300.3±2.16		-

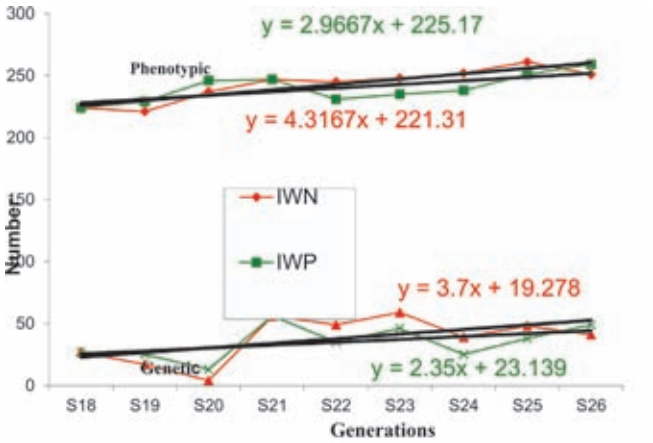


Fig. 1. Direct response to egg prod. (64 wks) in IWN & IWP at Mannuthy

The S-10 generation of IWN and IWP strains was evaluated up to 64 weeks of age at AAU, Anandcentre during 2012-13. One hatch in pure lines and N X P, D X K were evaluated upto 72 weeks of age. The centre regenerated S-11 generation and evaluated upto 16 weeks of age. Fertility and hatachability improved in S-11 generation compared to previous generation. The egg production up to 64 weeks of age increased in IWN (by 5.3 eggs), IWP (by 13.9 eggs) and control (by 3.7 eggs) over previous generation (Table 2). The egg production upto 72 weeks of age were 288 and 277 eggs in IWN and IWP, respectively. The egg weight increased by 0.49 g in IWN and 0.24 g in IWP at 64 weeks of age compared to last generation. The average genetic response of egg production to 64 weeks of age in both the selected strains (1.65 in IWN and 2.40 in IWP) was positive over last ten generations (Fig. 2). The egg production of IWN X IWP and IWD X IWK upto 72 weeks was 300.83 and 264.33 eggs, respectively. The egg production of IWD and IWK up to 64 weeks of age was 226.46 and 210.62 eggs, respectively. The survivability from 17-72 weeks of age in D X N X P was 95.66 and 96.00%, respectively. The survivability from 17-64 weeks of age was 93.7% in IWN and more than 92% in IWP. The centre has generated Rs.16.50 lakhs which is 44.96% of the expenditure on feed cost. The centre supplied 3,865 germplasm during the year.

Table 2. Performance of IWN & IWP strain and Control in S-10 generation at Anand

Traits		IWN	IWP	Control
No. of pullets housed		1828	1875	162
Age at first egg (d)		137.1 ± 0.28	139.1 ± 0.27	155.5 ± 0.97
Body wt (g)	16 wks	1059 ± 2.46	1115 ± 2.70	1024 ± 10.68
	40 wks	1457 ± 5.35	1505 ± 3.58	1484 ± 11.34
	64 wks	1503 ± 4.51	1553 ± 4.76	1564 ± 17.20
	72 wks	1524 ± 6.96	1616 ± 7.36	-
EP (no.)	40 wks	118.7 ± 0.38	115.5 ± 0.41	89.63 ± 1.22
	64 wks	249.9±0.68	243.6±0.74	197.1±2.28
	72 wks	288.3±1.18	277.2±1.28	-
EW (g)				
	40 wks	51.30 ± 0.07	52.64 ± 0.07	51.92 ±0.24
	64 wks	52.37±0.06	53.58±0.07	53.08±0.28
	72 wks	52.03±0.12	54.58±0.12	-
Feed Consumption (kg)				
	17-40 wks	19.82	19.03	18.59
	17-64 wks	40.60	39.91	38.64
	17-72 wks	47.16	46.65	-

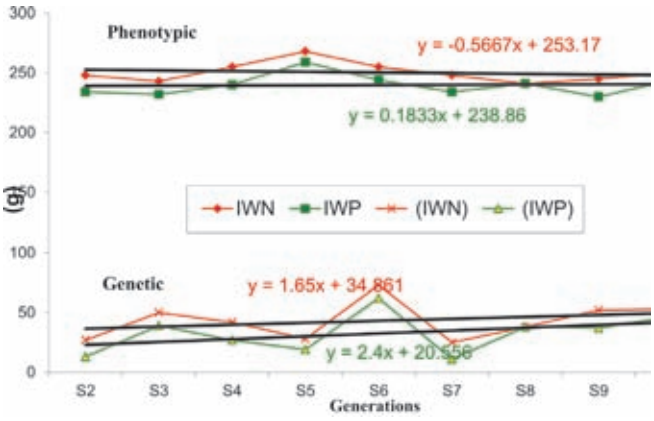


Fig. 2. Direct response to egg prod. (64 wks) in IWN & IWP at Anand

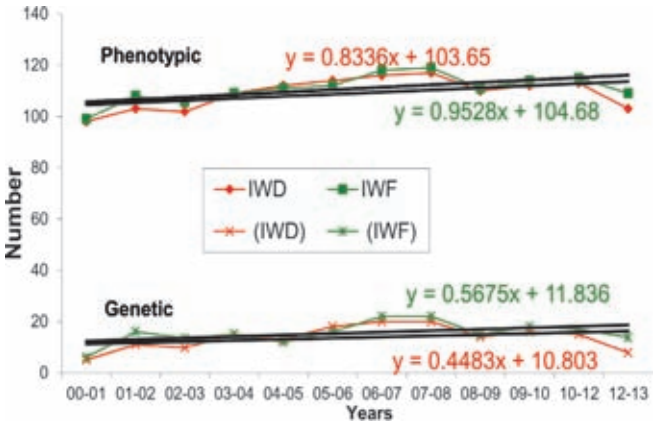


Fig. 3. Correlated response to 40wk egg prod. in IWD & IWF at Hyderabad

The S-30 generation of IWD and S-29 generation of IWF were regenerated and evaluated upto 40 weeks at SVVU, Hyderabad. Fertility and hatchability were decreased in both the strains compared to last generation. The egg production upto 40 weeks of age in IWD and IWF was 103 and 109 eggs, respectively (Table 3). Corresponding egg weight was 50.3 and 51.1 g. The average genetic response for egg production up to 40 weeks of age for last 12 generations was 0.57 egg in IWD and 0.45 egg in IWF, respectively. There was an increase of 0.14 g per generation in egg weight at 40 weeks of age in IWF strain, on genetic scale for last 12 generations (Fig. 3). The survivability from 17-40 weeks of age was 78.27 %, in IWD and 79.12 % in IWF strains. The centre has generated Rs.5.98 lakhs which is 24 % of the expenditure on feed cost. The centre supplied 5,000 germplasm during the year.

The S-32 generation of IWH, IWI and control population was regenerated and evaluated up to 28 weeks of age at CARI, Izatnagar centre. The centre has also evaluated the HI (IWH x IWI) and IWJ x HI and JGHI crosses up to 28 weeks of age. The hatchability on total and fertile egg set increased in both the selected lines compared to previous generation. Phenotypic response for fertility was positive in both the lines (Fig. 4). The age at sexual maturity in IWH, IWI,IWC, HI, J X HI and JGHI were 149.1, 154.1, 168.7, 147.0, 147.3 and 152.8 days, respectively (Table 4). The egg weight at 32 weeks of age increased in IWH by 0.29 g compared to last generation. The center

Table 3. Performance of IWD (S-30), IWF (S-29) and Control population at Hyderabad

Traits		IWD (30)	IWF (29)	Control
Body wt (g)				
	16 wk	1180±4.68	1210±6.81	1180±7.75
	40 wk	1280±4.16	1237±7.04	1320±9.02
ASM (d)		150±0.18	148±0.14	154±0.18
EW (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
EP (no.)	40 wks			
	HH	103± 0.61	109±0.34	95.2±0.28

Table 4. Production performances of IWH, IWI and control in S-31 generation along with crosses at Izatnagar

Traits	IWH	IWI	IWC	HI	JHI	JGHI
	n=1098	n=867	n=370	n=324	n=113	n=111
Body wt (g)						
16 wks	1009±3.5	995±4.2	1019 ±6.6	1097 ±5.8	1137 ±13.7	1008 ±12.6
ASM (d)	149.1 ±0.5	154.1 ±0.4	168.7 ±0.7	147.0 ±0.7	147.3 ±1.5	152.8 ±1.0
EW (g)						
28 wks	47.02 ±0.08	48.03 ±0.09	47.58 ±0.11	47.81 ±0.14	45.76 ±0.26	46.13 ±0.23

n = number of pullets housed.

also evaluated immuno competence traits and microsatellite markers analysis during the present generation. The centre report approximate revenue of Rs. 45.77 lakhs and supplied 5559 germplasm during the year.

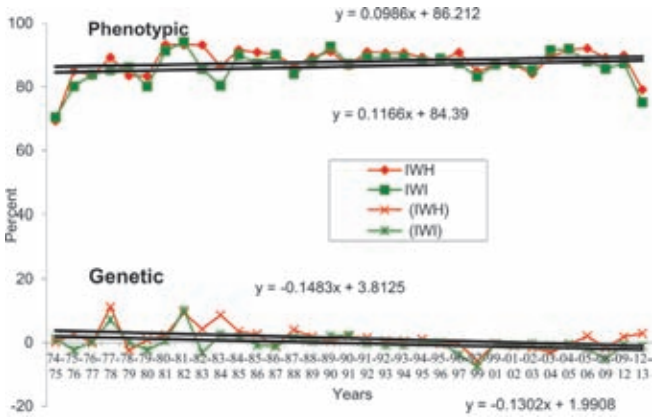


Fig. 4. Correlated response to percent fertility in IWH & IWI at Izatnagar

Random Sample Poultry Performance Test

Two AICRP centres on Poultry for egg had participated in the 21st Random Sample Poultry Performance Test, held at Gurgaon in the year 2011-2012. The hen housed egg production of layer strain crosses upto 72 weeks of age from Anand and Izatnagar centre from 17-72 weeks of age were 131.4 and 135.5 number, respectively. Corresponding egg production on hen day basis were 174.9 and 168.6 eggs. The average egg weight in Anand and Izatnagar centre were 50 and 49 g, respectively. On hen day egg production basis amongst the ten entries Anand centre stood first and Izatnagar third.

7.1.2 Poultry for Meat

The Bangalore centre evaluated production traits of S-17 generation and also evaluated juvenile traits of S-18 generation of PB-2. In addition to this S-4 generation production traits and S-5 generation juvenile traits of PB-1 was evaluated along with the PDP control population (Table 5).The average 5 weeks body weight was 1022 g and 1041 g in PB-2 and PB-1, respectively. The average genetic and phenotypic response in PB-2 was -7.32 and 6.07 g, respectively over last seven generations. In PB-1 age at sexual maturity was decreased by 7 days and increased by 4 days in PB-2 over previous generation, while in control population the age at sexual maturity decreased by 2 days. Egg production up to 40 weeks of age increased over previous generation in PB-2, but decreased in PB-1 and control. The mortality in the present generation during 0 to 5 weeks was 2.92, 1.62 and 1.58% in PB-2, PB-1 and control line, respectively. Mortality decreased marginally in all the populations over previous generation. The mortality during laying period increased in PB-2 and control and decreased in PB-1.The fertility was more than 88 % in both the selected populations. Feed conversion ratio was 2.12 in PB-2, 2.16 in PB-1 and 2.08 in control population. Genetic and Phenotypic response for 5 week body weight over 7 generations is presented in Fig. 5.

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

Trait		PB-1	PB-2	Control
Body wt (g)				
	5 wks	1041	1022	1008
	20 wks	2706	2145	2217
	40 wks	3375	3352	3135
FCR (0-5wks)		2.16	2.12	2.08
ASM (d)		173	182	206
EW (g)				
	32 wks	55.62	54.39	53.48
EP (no.)				
	40 wks	66.49	67.01	50.10
	52 wks	108.72	106.57	110.76

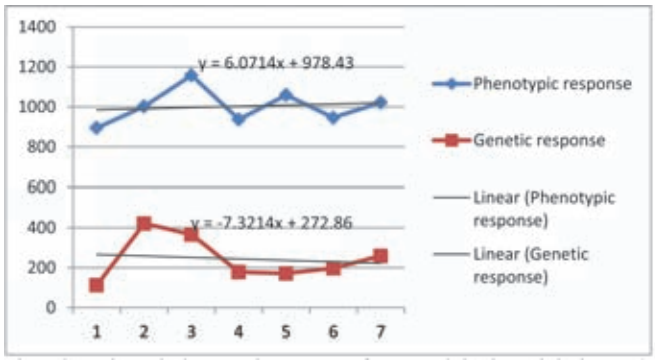


Fig. 5. Genetic and Phenotypic response for 5 week body weight in PB-2 at Bengaluru.

The Ludhiana centre regenerated S-37 generation of PB-2 and S-5 generation of PB-1 population along with PDP control population. The body weight at 5 weeks of age was 1189, 1310 and 975 g in PB-1, PB-1 and control population respectively. Over the last six generations the 5 weeks body weight in PB-2 improved by 25.68 and 25.80 g per generation on phenotypic and genetic scale, respectively. The feed efficiency up to 5 weeks of age improved in PB-2 whereas it decreased in PB-1 and control population (Table 6). The fertility remained above 87% and hatchability on fertile eggs set was 90.2% in PB-2 and 69.4% in PB-1. During the juvenile stage, the survivability was improved in PB-1 and control population as compared to previous generation. The age at sexual maturity decreased in PB-2 (16 days) where as it increased by 10 days in PB-1 and decreased by 23

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

Trait		PB-1	PB-2	Control
Body wt (g)				
	5 wks	1178	1189	975
	20 wks	2309	2238	2277
	40 wks	2847	2821	2913
FCR	(0-5 wks)	2.4	2.1	2.3
ASM (d)		167	149	155
EW (g)				
	36 wks	56.86	56.95	55.60
EP (no.)				
	40 wks	67.80	82.30	80.90
	52 wks	108.1	128.5	111.2

days in control population as compared to previous generation. The egg production up to 40 weeks of age decreased in both selected populations and increased in control population as compared to previous generation. Commercial cross in the field attained a body weight of 1551 and 2003 g at 6 and 7 weeks of age, respectively. Genetic and Phenotypic response over last 5 generations is presented in Fig. 6.

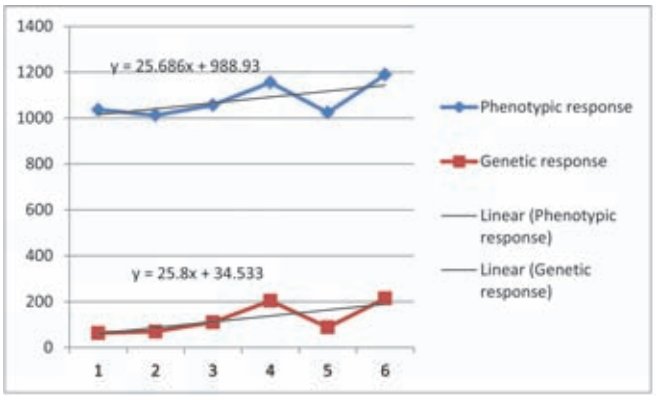


Fig. 6. Genetic and Phenotypic response for 5 week body weight in PB-2 at Ludhiana.

CARI, Izatnagar centre evaluated CSML and CSFL and Control Population (Table 7). Body weight at 5 weeks was improved in all the populations. FCR was 1.97, 2.06 and 2.23 in CSML, CSFL and control population respectively. ASM was increased in all populations. The 52 weeks egg production was increased by 7.8 eggs in CSML and 0.9 eggs in CSFL compared to previous generation. The egg production to 40 weeks of age was increased in CSML and decreased in CSFL. The genetic response was 4.28 g in CSML and 3.62 g per generation in CSFL for 5 weeks body weight over last 8 generations. The corresponding phenotypic responses were 16.45 g and 15.79 g per generation. The effective number improved in both CSML and CSFL and average effective selection differential decreased over the last generation in both the lines. The intensity of selection increased in CSML and decreased in CSFL as compared to previous generation. The fertility remained above 81% in both CSML and CSFL. The mortality was within 5% during 0-5 weeks of age in CSML and control population. Higher mortality (10%) was recorded in CSFL during 0-5 weeks of age. Genetic and phenotypic responses for 5 week body weight in CSML over last 8 generations are presented in Fig. 7.

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

Trait		CSML	CSFL	Control
Body wt (g)				
	5 wks	1175	1161	854
	20 wks	2151	2142	-
FCR	(0-5 wks)	1.97	2.06	2.23
ASM (d)	170	168	186	-
EW (g)				
	40 wks	62.96	61.69	-
EP (no.)				
	40 wks	64.50	65.80	56.02
	52 wks	103.8	98.9	92.10

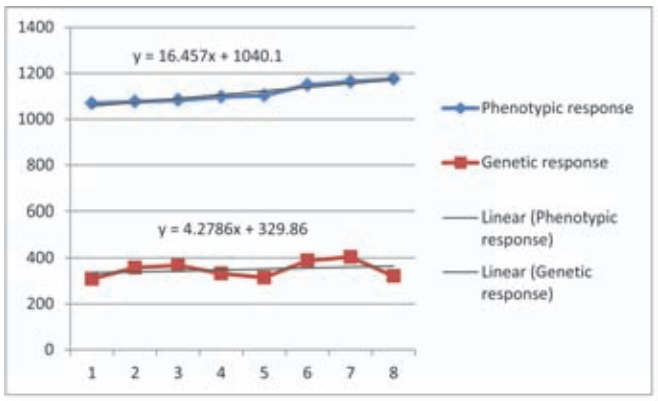


Fig. 7. Genetic and Phenotypic response for 5 week body weight in CSML at Izatnagar.

During the period at Bhubaneswar centre, S-16 generation of SDL and S-4 generation of CSML affected with Avian Influenza. Hence these two populations were culled and disposed off. As per the instructions from PDP, fertile eggs of CSML and CSFL were obtained in December, 2012 from CARI, Izatnagar. During the current year S-1 generation of CSFL and CSML were evaluated for juvenile traits. The fertility was above 89% in both the populations. Hatchability on fertile eggs set was 73.99% in CSFL and 89.69% in CSML. Mortality during 0-5 weeks of age was 6.71% in CSFL and 5.02% in CSML. Body weight at 5 weeks of age was 1070 g in CSFL and 1094 g in CSML.

Random Sample Poultry Performance Test

Some centres participated in the 38th Random sample poultry performance test at Gurgaon in the year 2012 – 13. The strain cross from Bengaluru centre recorded 1216 g and 1688 g at 6 and 7 weeks of age, respectively with corresponding FCR of 2.197 and 2.172, respectively. The dressing percentage was 69 %.

At 37th RSPPT (Gurgaon) CARIBRO-Dhanraja secured II rank by attaining 1.440 and 1.840 Kg body weight at 6 and 7 weeks respectively with a mortality of 6%. FCR at 0-6 and 0-7 weeks were 1.95 and 2.00 with dressing percentage of 73.67 and margin of receipt at 6-weeks as Rs. 15.02 and at 7-weeks Rs. 18.87.

7.1.3 Rural Poultry

During the current year, Agartala centre farm was declared positive for bird flu on 24th January, 2012 and on 27th January, 2012 all the birds were culled by rapid response team of the Govt. of Tripura. The permission for restocking of birds was received on 25th September, 2012. for restocking of birds. About 1200 nos. of fertile eggs of Coloured broiler dam line were procured from Central Avian Research Institute, Izatnagar (U. P.) and hatched at the Institute hatchery. A total of 850 day old chicks of Dahlem Red and 150 day old chicks of sire line of Gramapriya were procured from Project Directorate on Poultry, Hyderabad (A. P.). The Tripura black local indigenous stock was established by purchasing birds from the farmers of Tripura.

Jabalpur centre reproduced the G-4 generation of Kadaknath and Jabalpur colour populations and evaluated up to 40 weeks of age. The fertility was around 90% in both the populations. The hatchability on total and fertile eggs set was 83.16 and 89.18%, respectively, in Jabalpur colour population which showed improvement over previous generation. The Jabalpur colour pullets matured 4 days lately (152 days) as compared to previous generation. The egg weight at 40 weeks age remained similar (59.8 g) as compared to previous generation. The hen house egg production to 40 weeks was 82.5 eggs and it decreased by 2.3 eggs over previous generation. In Kadaknath population juvenile and adult body weights showed improvement as compared to previous generation. The Kadaknath pullets matured 3 days late as compared to previous generation. The egg production upto 40 weeks of age was 53.9 eggs and egg weight was 48.1 g and showed improvement of 7.7 eggs over previous generation. The CSML recorded 1075 g body weight at 6 weeks of age, matured at 173 days and produced 46.4 eggs up to 40 weeks of age with egg

weight of 61.8 g at 40 weeks. The egg production improved by 4.1eggs as compared to previous generation. The growth and egg production performance of Kd 50% : JBC 50% was evaluated upto 52 weeks of age under intensive and extensive system of management. This cross produced 106 eggs up to 52 weeks of age under intensive systes as against 73 eggs in extensive system. A commercial dual type cross (25% kd : 75% cross) produced 143 eggs under intensive system and 84 eggs under extensive system of rearing . Corresponding egg number for last year was 138 and 81 egg. This cross became more popular amomg the rural farmers locally and large number of chicks were supplied to the farmers. The center realized overall receipt of Rs.12,40,280/- which was 44.93% of the expenditure on feed cost.

During the current year, Guwahati centre reproduced the indigenous population with 1251 chicks. The indigenous population was evaluated along with Dahlem Red and PB-2 populations. The fertility was above 70% in both the population. The hatchability was very low which need improvement. The mortality was very high during brooding period (14-23 %) in all the populations. The age at sexual was lowest in indigenous population (182 days) and matured early by 8 days as compared to previous generation. The hen housed egg production of indigenous birds was 32.93 and 63.40 eggs upto 40 and 52 weeks of age, respectively. Dahlem Red females matured at 162.3 days. Centre also evaluated PB-2 x Indigenous cross as well as (PB-2 x indigenous) x Dahlem red cross. The five weeks body weight was 166 g in PB-2 x indigenous cross and 155 g in (PB-2 x Indigenous) x Dahlem Red. In PB-2 x indigenous cross the age at sexual maturity was 172.36 days. The egg weight at 20 and 40 weeks of age was 39.64 and 40.56 g, respectively. The hen housed egg production upto 40 and 52 weeks of age was 37.56 and 69.39 eggs, respectively. During the current year revenue generated by the center was Rs.1,05.968.50 which is 11.92% of feed cost.

Ranchi centre produced and evaluated desi and Dahlem Red. It alsoproduced BN cross (PB-2 x desi), DN cross (Dahlem Red x Native), DBN cross (PB2 x Desi female x Dahlem Red male) and BND cross (PB2 x Desi male x Dahlem Red female) and evaluation is in progress. The fertility ranged from 75.75 to 87.56% in all the lines and fertility improved in Desi, BN and DN crosses as compared to previous generation. The hatchability on total eggs set was low in all the lines except BND cross (80.89%). Hatchability on fertile eggs set remained above 77% in all the lines. Though, the mortality was very high during brooding period and growing (4.84-11.32%), it reduced considerably as compared to previous generation. The 20 week body weight was 878,1058, 1632, 1528 and 1869g, respectively, in native, DN cross, BN cross, DBN cross and BND cross. Age at at sexual maturity was 168, 186, 155 and 162 days in native, DN cross, BN cross and DBN crosses, respectively. The 40 week egg production was 51 and 52 eggs in native and DN cross, respectively. The center generated a receipts of Rs. 3,84,781/- through sale of birds and eggs which is 27.89% of the feed and upkeep cost.

CSKHPKV, Palampur centre evaluated Native (G-2) upto 32 weeks, Dahlem Red upto 40 weeks. N x R cross was evaluated upto 52 weeks both farm and field conditions. ND x DR cross evaluated upto 40 weeks in farm upto 32 weeks in the field. The fertlility remained above 85% in all the populations. The hatchability on total eggs set ranged from 74.49 to 84.08% in all the population s except ND x DR cross (60.40%). The mortality decreased during 0-5 weeks as compared to previous generation. The 5 week body weight was 238, 298, 308 and 344 g in native, Dahlem Red, NR cross and ND x DR cross,

respectively. The age at sexual maturity in native and Dahlem Red birds was 174 and 146 days, respectively. The DahlemRed produced 80.89 eggs up to 40 weeks of age. The NR and NDx D crosses were evaluated under farm and field conditions. In NR cross the hen housed egg production up to 40 weeks of age was 45.68 and 35.56 eggs, respectively, in farm and field conditions. The hen housed egg production up to 52 weeks of age was 80.91 and 67.65 eggs, respectively, in farm and field conditions. The hen housed egg production in ND x D cross was 57.39 eggs upto 40 weeks in the farm. The evaluation of ND x D cross is under progress.

During the current year MPUAT, Udaipur centre evaluated G-2 generation of native germplasm up to 52 weeks of age and G-3 generation was regenerated. Centre also evaluated RIR and coloured synthetic male line and different crosses. CSFL was procured from CARI, Izatnagar and evaluation is in progress. The fertility remained above 85% in all the three populations. The hatchability on total eggs set was highest in CSFL 78.5% and lowest in native population (67.30%). In native population the juvenile body weights at 8 weeks was 668 g during G-2 generation and it showed improvement of 186 g over G-1 generation. The pullets matuted 31 days early as compared to previous generation. The hen hosed egg production upto 40 and 52 weeks was 37.74 and 50.56 eggs, respectively and improved by15.8 and 13.19 eggs respectively, as compared to previous generation. In RIR population 20 weeks body weight in G-2 generation showed improvement. The age at sexual maturity delayed by 6 days during G-2 generation. The egg weight at 28 and 40 weeks of age was in normal range. The hen day and hen housed egg production upto 40 and 52 weeks of age decreased as compared to previous generation. The evaluation of CSFL is in progress.

The centre produced three 3 way crosses viz; RN cross x RIR (RNR cross), Native x NR cross and BN cross x RIR (BNR cross) and evaluated under farm conditions. The juvenile, adult and egg weights were better in BNR cross and age at sexual maturity and hen housed egg production were better in RNR cross in farm conditions. Among two egg type crosses namely RNR and NRR, the body weights of male, female and pooled at 20 weeks of age of RNR were 22.3, 2.4 and 6.5% higher over NRR crosses respectively. The corresponding values at 40 weeks of age were 24.8, 1.7 and 2.7%. The hen day egg production of RNR

Hon'ble DDG (AS) Prof. K.M.L. Pathak releasing the Pratapdhan variety

at 40 wks of age was higher by 37 % than NRR crosses. As expected the body weight of BNR (dual type) was higher than RNR and NRR crosses (egg type). The body weight of BNR males were 29.1 and 33.4 % higher than RNR cross at 20 and 40 wks of age respectively. Similarly, the BNR females were 13.6 and 25.6 % superior to RNR crosses. The respective values for pooled body weight were 17.6 and 27.5 %.On the other hand, the RNR cross was only 6.1 and 3.9 % superior in hen day egg production at 40 and 52 wks of age than BNR cross respectively Table 8. The center realized a receipt of Rs. 11.02 lakhs during the current financial which is 39.06% of expenditure on feed cost.

MPUAT, Udaipur developed on Dual purpose variety i.e *PRATAPDHAN* for rural poultryand it was released by Hon'ble Prof. K.M.L.Pathak, DDG (AS) during the last AICRP annual review meeting held at Udaipur.

Table 8. Performance of growth and production traits in different 3 way crosses

Traits	RNR-Cross (E-2)		NRR (E-1)		BNR-Cross (E-2)	
	(farm)	(field)	(farm)	(field)	(farm)	(field)
Body wt (g)						
2 wks	124.2±0.60	-	80.870.80±	-	183.22±1.30	-
4 wks	215.2±1.70	-	255.88±2.40	-	311.06±2.10	-
8 wks	513.3±4.40	-	564.88±5.70	-	678.14±6.30	-
12 wks	-	546.7±8.53	-	-	-	1084±29.6
20 wks	1653±16.40	1062 ± 18.85	1614±33.50	-	1877±16.40	1485±33.5
40 wks	1791±25.6	-	1761±36.50	-	2250±27.4	-
Age at 1st egg of the flock	121.5	180.50	122	-	128	178.67
ASM (d)	138.0±0.84	-	139	-	147±0.99	-
EW (g)						
28 wks	49.46±0.15	-	49.43±0.21	-	49.41±0.15	-
40 wks	53.42±0.30	-	53.44±0.38	-	53.84±0.20	-
EP (no.) 40 wks						
HD	76.69	58.62	55.97	-	72.31	57.49
HH	67.34	47.92	47.25	-	61.66	42.02
Survivor	86.23	67.09	67.74	-	78.91	84.04
EP (no.) 52 wks						
HD	101.1	-	-	-	97.31	-
HH	83.81	-	-	-	79.56	-
Survivor	121.1	-	-	-	110.46	-
EP (no.) 72 wks						
(E-1) HD	174.32	-	-	-	161.16	-
HH	81.56	-	-	-	76.72	-

7.2 Poultry Seed Project

The concept of "Poultry Seed Project" was evolved to increase the availability of rural chicken germplasm to remote areas of our country. In this endeavour, the Indian Council of Agricultural Research has initiated "Poultry Seed Project" during the XI five year plan and sanctioned six centers, three in the NE region and three in the different state Veterinary Universities. The main objective of this project is local production of improved chicken germplasm 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 main land centers are Rajendra Agricultural University, Patna, West Bengal University of Animal and Fishery Sciences, Kolkata, Chhattisgarh KamadenuViswaVidyalaya, Durg and three North Eastern centers are Regional Center, 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 Nodal Coordinating Unit, supplies parent chicks, co-ordinates and monitors the activities of different centres to enable them to achieve the set target for each centre.The seed project was launched on 15th May 2009 with a total budget out lay of Rs. 913.2 lakhs for the plan period. The revised target set for supplying chicks for main land and north east center during the year under report (2012-2013) are 0.5 and 1.0 lakhs chicks per annum, respectively and to collect feedback on the performance of the germplasm. All the centres achieved their set target except Durg and Sikkim.. Durg centre completed construction work and re has started rearing parent chicks in the newly constructed poultry house at the centre.

Patna centre has completed three cycles of parent rearing of *Vanaraja* and *Gramapriya* as per the standard management and feeding during brooding and growing period. The centre has produced 66,739 (46,221 *Vanaraja* and 20,518 *Gramapriya*) day old chicks of rural poultry germplasm during the period. Majority of birds were reared at the centre before supplying them as grownup chicks (6-8 weeks old birds) for rearing under backyards of farmers. The centre has initiated to supply day old chicks during this year to few interested farmers for nursery rearing before leaving them for free range farming in back yards.

Kolkata centre completed four cycles of parent rearing and three cycles are in progress. A total of 1,29,236 chicks of improved chicken germplasm were distributed in rural areas of West Bengal. The average calculated weekly mortality of parent stock of *Vanaraja* and *Gramapriya* is about 0.33 to 0.71% in a flock of about 2,073 birds. Infectious coryza, bacterial infection, heat stress, aspergellosis and coccidiosis were reported as the major causes of mortality in the parents. Mature body weight varied greatly from batch to batch perhaps due to environmental variation among batches. The average HH egg production in batch III (78-88 weeks, batch IV (55 to 90 weeks), batch V (24 to 73 weeks), batch VI (22 to 61 and Batch VII (23 to 39 weeks) are 34.9, 58.4, 53.2, 52.3 and 39.5%, respectively. The weight of egg, hatchability on total and fertile egg set is 61.3, 58.4, 53.2, 52.3 and 46.5g, 73.99, 86.72, 77.64, 82.28 and 74.07, 84.48, 86.72, 85.34, 87.41 and 79.48, respectively. Chicks of Vanaraja and Gramapriya were supplied to Sundarbans, Nadia, West Midnapur and South Dinajpur in West Bengal. More than 70% of farmers opined that better performance make them to rear these birds for backyard farming. The mature body weight of Vanaraja birds is 2.21 and 1.86 in males and females, respectively. Mortality

was higher (16.4%) during growing period (5-24 weeks) and almost lower (<0.3%) during laying phase (>24 weeks). Majority of farmers reared these birds either free range (40.7%) and semi range (35.2%) and few farmers (24%) reared the birds under confinement. Home made feed (70.5%) was major supplemental feed to the birds under backyards. The reported egg production under free range farming is 53%.

At Durg centre, all the construction and electrical works were completed and equipment were placed for function. About 550 (equal number of *Vanaraja* and *Gramapriya*) day old chicks of rural chicken germplasm were procured from PDP. The performance and mortality parameters are being recorded with standard managemental practices like medication and vaccination.

At Jharanapani centre all the works and infrastructure is completed. In the reporting year two batches of *Vanaraja* and *Gramapriya* parent stocks were procured from the nodal centre (PDP, Hyderbad). Both varieties of these birds grew as per the breed standards with 93.57 and 94.91% survivability upto 6 weeks of age in *Vanaraja* and *Gramapriya* birds. *Vanaraja* and *Gramapriya* parents produced 29.79 and 39.10% egg production from 25 to 39 weeks of age, respectively. About 82,900 and 18,000 fertile eggs of *Vanaraja* and *Gramapriya* were produced and set for chick production with 69.52 and 68.03% hatchability on total eggs set. Under the tribal sub plan component of PSP, a total of four training cum demonstration programs were conducted for creating awareness and hands on training in poultry rearing. Altogether 204 farmers from Dimapur, Kohima, Wokha, Peren, Longleng, Mon, Mokokchung, Zunheboto and Peren districts of Nagaland participated in the training program. Further, a total of 150 farmers were covered under TSP of Poultry Seed Project and given assistance by proving grownup chicks at subsidized rate and 8757 *Vanaraja* and *Gramapriya* chicks were distributed among the beneficiaries. During the period a total of 45,150 birds were distributed to farmers of Nagaland, Assam, Meghalaya and Arunachal Pradesh. The performance of *Vanaraja* birds under field condition was appraised from the demonstration unit established in previous year. Survivability of these birds under farmer backyard in Dimapur, Phek and Mokokchung is 98, 81 and 82.9%, respectively with a net profit of Rs 101.6, 196.4 and 98.1 per bird.

At Gangtok a total of 1032 parents of rural poultry germplasm was procured and reared as per the standard managemental practices. The mature body weight of male and female birds at 21 weeks of age was 2550 and 1850g, respectively. During the period a total of 38,478 and 9,668 fertile eggs of *Vanaraja* and *Gramapriya* were produced. During the period a total of 16,802 birds were distributed to Lower Chawang and Upper Chawang, Mangan, Pakyong, OngchuJongu, Tingvong areas of Sikkim state. The chick supply was affected due to technical problem in the incubator.

At Imphal centre, a total of 1425 *Vanaraja* and 945 *Gramapriya* parents were reared during the period. The average body weight at 20 weeks of age was 1039 and 1410 g in *Vanaraja* and *Gramapriya* respectively and corrosponding egg production (HH) was 34.62 and 38.45%, respectively. The average age at sexual maturity (ASM) for *Vanaraja* and *Gramapriya* recorded at 169 and 163 days respectively. The recorded percent fertility in *Vanaraja* and *Gramapriya* were 91.84%, and 94.36% respectively with a hatchability of 79.47 % and 80.72 % respectively. Mortality was 10.15 % and 13.99 % in *Vanaraja* and *Gramapriya* respectively upto 24 weeks of age with livability of 89.81 % and 85.83 % in *Vanaraja* and *Gramapriya* respectively. A total of 51,124 DOC of rural poultry germplasm was supplied by the centre out of the total 23,314 *Vanaraja* and 27,810 *Gramapriya* birds were supplied. Majority of the

birds were supplied to Chandel, Tamenglong and Senapati districts of Manipur. The average age at sexual maturity (ASM) for Gramapriya birds was found to be 169 days from the records of 125 adults and the average body weight at the corresponding age was around 1274.91 g. The egg weight (g) at ASM, 28, 40 and 58 weeks of age were 43.57, 45.24, 47.61 and 50.76 respectively. The information collected from 10 beneficiaries belonging to three locations at Pallel– 7(Chandel district), Tupul – 6 (Tamenglong district), and Kharam -2 (Senapati district) on the income generated by improved vairety birds. A total of 461 adults were maintained with the bird number ranging between 25 and 40. These birds generated a total sum of Rs.77, 448 /- from disposal of their produce. On an average an earning of Rs.170/- per bird was achieved by the beneficiaries. The range of earning varied from Rs. 1340/- to Rs.13, 312/- for each of the 15 beneficiaries. The minimum receipt per bird was Rs.86/- and the maximum was Rs. 693/- indicating the scope for realizing decent returns from these birds. The field data suggested the better adaptability and higher productivity of *Vanaraja* and *Gramapriya* birds under backyards of Manipur state.

8. List of Publications

8.1 Research Articles

8.1.1 International

Bhattacharya, T.K. and Chatterjee, R.N. 2013. Polymorphism of the myostatin gene and its association with growth traits in chicken. *Poultry Science*, 92:910-915.

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Haunshi, S., Shanmugam, M., Padhi, M. K., Niranjan, M., Rajkumar, U., Reddy, M. R., and Panda, A. K. 2012.Evaluation of two Indian native chicken breeds for reproduction traits and heritability of juvenile growth traits. *Tropical Animal Health and Production,* 44(5):969-973.

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Rama Rao, S.V., Prakash, B., Raju, M.V.L.N., Panda, A.K., Poonam, N.S. and Krishna Murthy, O. 2013. Effect of supplementing organic selenium on performance, carcass traits, oxidative parameters, and immune responses in commercial broiler chickens. *Asian-Australasiun Journal of Animal Sciences*, 26: 247-252.

Rama Rao, S.V., Raju, M. V. L. N., Ravindran V. and Panda, A. K. 2013. Influence of different concentrations of metabolisable energy at constant ratio to dietary protein, lysine, methionine, calcium and phosphorus on the

performance of White Leghorn layers in the tropics. *Animal Production Science.* http://dx.doi.org/ 10.1071/AN12145.

Rama Rao, S.V., Raju, M.V.L.N., Panda, A.K., Poonam, N.S., Krishna Murthy, O. and Shyam Sunder, G. 2012. Effect of dietary supplementation of organic chromium on performance, carcass traits, oxidative parameters, and immune responses in commercial broiler chickens. *Biological Trace Elements Research, 147*: 135-141.

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Chatterjee, R.N. and Bhattacharya, T.K. 2013. Poultry production in India- Augmenting its potential for enhanced animal protein source. *Proceedings of 100th Indian Science Congress*, held in Kolkata during 3rd to 7th January 2013, pp. 65.

8.3 Research abstracts presented in Symposia/ Conferences

Bhattacharya, T.K. and Chatterjee, R.N. 2013. Gene expression profiles of heart and liver tissues in broiler and layer chicken. *Proceedings of 100th Indian Science Congress*, held in Kolkata during 3rd to 7th January 2013, pp. 352.

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8.4 Technical/ Popular articles

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8.5 Books / Technical Bulletin

Success stories of AICRP on Poultry Breeding. Compiled and edited by M.K.Padhi, M.Niranjan and R.N. Chatterjee (2013), Project Directorate on Poultry, Rajendranagar, Hyderabad.

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Bhattacharya, T.K., Rajaravindra, K.S. and Shanmugam, M. 2012. Training Mannual of ICAR sponsored short training course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation vis-à-vis augmentation of productivity in poultry and livestock species". Project Directorate on Poultry, Rajendranagar, Hyderabad.

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8.6 Book chapters

Bhattacharya, T.K., Dhanasekaran, S. and Paswan, C. 2012. DNA cloning and expression of protein in prokaryotes. In: Training Mannual of ICAR sponsored short training course on "Recent development in epigenetics,

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Bhattacharya, T.K., Paswan, C. and Dhanasekaran, S. 2012. Statistics and bioinformatics. In: Training Mannual of ICAR sponsored short training course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation vis-à-vis augmentation of productivity in poultry and livestock species", published by Project Directorate on Poultry, Rajendranagar, Hyderabad, pp. 82-97.

Paswan, C., Bhattacharya, T.K. and Guru Vishnu, P. 2012. Epigenetic study. In: Training Mannual of ICAR sponsored short training course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation vis-à-vis augmentation of productivity in poultry and livestock species", published by Project Directorate on Poultry, Rajendranagar, Hyderabad, pp. 75-81.

Rajkumar, U. and Dange, M. 2012. Microsatellite. In: Compendium of Practical Manual of ICAR sponsored Winter short training course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation vis-à-vis augmentation of productivity in poultry and livestock species", published by Project Directorate on Poultry, Rajendranagar, Hyderabad, pp.56-58.

8.7 Compilation/Documentation

Chatterjee, R.N., Raju, M.V.L.N., Bhattacharya, T.K. and Rajkumar, U. 2013. PDP: 25 years in the service of nation. Project Directorate on Poultry, Rajendranagar, Hyderabad.

8.8 TV Talk (Live phone-in programme)

Raju, M.V.L.N. 2013. Commercial poultry production. March 24, 2013. Live phone-in programme, 6.30-7.00 PM, *Vyavasayam*, Gemini News Channel, Hyderabad.

9. Research Projects

A number of research projects in different disciplines funded by both the Institute as well as other Government Organizations are being carried out to explore new findings in the areas of applied aspects of poultry science. These projects cater 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.S. 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. R.N. Chatterjee
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. G. Shyam Sunder
9	Production of designer broiler chicken meat through nutritional manipulation	Dr. B. Prakash
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.T.R. Kannaki

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	Impact of climate change on poultry and adaptation strategies **(NPCC)**	Dr. M.R.Reddy
16	Development of climate resilient practices through genetic strategies to enhance tolerance to heat stress in commercial and backyard poultry **(NICRA)**	Dr.U. Rajkumar
17	Detoxification of karanj *(Pongamia glabra)* seed cake and its utilization in broiler and layer chicken diets **(DST)**	Dr. M.V.L.N. Raju
18	Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry **(National Fellow)**	Dr.T.K. Bhattacharya
19	Expression profiling of cytokines and chemokines: Scope for augmenting general immune competence in chicken **(DST)**	Dr. K.S. Rajaravindra
III	**CONTRACT RESEARCH PROJECTS**	
20	Prevalence of *Mycoplasma gallisepticum in India* **(Pfizer Contract Research)**	Dr. M.R. Reddy
21	Effect of dietary supplementation of encapsulated enzymes on productive performance of broilers **(DBT Contract Research)**	Dr. B. Prakash
22	Effect on feeding diets supplementing with ration plus on body weight gain, feed conversion efficiency and mortality in broiler birds **(Agroman Cytozyme Pvt. Ltd Contract Research)**	Dr. B. Prakash

10. Consultancy, Patents and Commercialization of Technology

10.1 Commercialization of technology

The Directorate 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 through out 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 87,807 hatching eggs, 2,71,858 day old chicks and 1,626 grown up chicks of vanaraja, Gramapriya, Swtasre and Krishibro birds which generatedaboutRs.77.75 laks rvenue during thecuirrent year. The embryonated eggs (23,725 in No.) were supplied for production of different cell culture vaccines.

Table 1. Germplasm supplied during 2012-13

Sl. No.	Particulars	No
A.	Hatching eggs	
	Vanaraja	30,345
	Gramapriya	8,263
	Swetasree (White Gramapriya)	47,888
	Krishibro	1311
	Total	*87,807*
B.	Day old chicks	
	Vanaraja	1,57,403
	Vanaraja parents	23,258
	Gramapriya	40,998
	Gramapriya parents	27,203
	Swetasree (White Gramapriya)	14,617
	Krishibro	8,379
	Total	*2,71,858*
C.	Grownup birds	1626
	Total revenue generated (Rs. Lakhs)	77.75

10.2 Consultancy

Scientists of the Directorate time to time offered technical inputs to the farmers and technical personalities involved in poultry farming and research.

10.2.1 Consultancy project

During the year 2012-2013, consultancy project was signed with Agroman Cytozyme Pvt. Ltd. 25/ 2 Tardeo, AC Market, Tardeo Mumbai, to evaluate the efficacy of the product on performance, feed conversion ratio and mortality in commercial broilers up to 6 weeks of age. The budget for the project was Rs. 40, 454/-.

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 was established in 1988 and 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 was 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 IGF-1-h1 insulin-like growth factor I IGF-1) gene, complete cds.	JN593011	Bhattacharya, T.K., Priyanka, M. and Chatterjee, R.N.
2.	*Gallus gallus* haplotype IGF-1-h2 insulin-like growth factor I (IGF-1) gene, complete cds.	JN593012	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N.
3.	*Gallus gallus* haplotype IGF-1-h3 insulin-like growth factor I(IGF-1) gene, complete cds.	JN593013	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N.
4.	*Gallus gallus* haplotype IGF-1-h4 insulin-like growth factor I(IGF-1) gene, complete cds	JN593014	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N.
5.	*Gallus gallus* haplotype IGF-1-h5 insulin-like growth factor I(IGF-1) gene, complete cds	JN593015	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N.
6.	*Gallus gallus* haplotype IGF-1-h6 insulin-like growth factor I(IGF-1) gene, complete cds.	JN593016	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N.
7.	*Gallus gallus* haplotype IGF-1-h7 insulin-like growth factor I (IGF-1) gene, complete cds.	JN593017	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
8.	*Gallus gallus* haplotype IGF-1-h8 insulin-like growth factor I(IGF-1) gene, complete cds	JN593018	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
9.	*Gallus gallus* haplotype IGF-1-h9 insulin-like growth factor 1(IGF-1) gene, complete cds.	JN609548	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
10.	*Gallus gallus* haplotype IGF-1-h10 insulin-like growth factor 1(IGF-1) gene, complete cds.	JN609549	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N

SL. No.	Title	Accession Number	Authors/ Workers
11.	*Gallus gallus* haplotype IGF-1-h11 insulin-like growth factor 1(IGF-1) gene, complete cds.	JN609550	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
12.	*Gallus gallus* haplotype IGF-1-h12 insulin-like growth factor 1(IGF-1) gene, complete cds.	JN609551	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
13.	*Gallus gallus* haplotype GnRH-I-h1 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609552	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
14.	*Gallus gallus* haplotype GnRH-I-h2 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609553	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
15.	*Gallus gallus* haplotype GnRH-I-h3 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609554	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
16.	*Gallus gallus* haplotype GnRH-I-h4 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609555	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
17.	*Gallus gallus* haplotype GnRH-I-h5 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds	JN609556	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
18.	*Gallus gallus* haplotype GnRH-I-h6 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds	JN609557	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
19.	*Gallus gallus* haplotype GnRH-I-h7 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609558	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
20.	*Gallus gallus* haplotype GnRH-I-h8 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds	JN609559	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
21.	*Gallus gallus* haplotype GnRH-I-h9 gonadotrophin-releasing hormone I(GnRH-I) gene, complete cds.	JN609560	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
22.	*Gallus gallus* haplotype GnRH-I-h10 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609561	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
23.	*Gallus gallus* haplotype GnRH-I-h11 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609562	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N

SL. No.	Title	Accession Number	Authors/ Workers
24.	*Gallus gallus* haplotype GnRH-I-h12 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609563	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
25.	*Gallus gallus* haplotype GnRH-I-h13 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609564	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
26.	*Gallus gallus* haplotype GnRH-I-h14 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609565	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
27.	*Gallus gallus* haplotype GnRH-I-h15 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609566	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
28.	*Gallus gallus* haplotype GnRH-I-h16 gonadotrophin-releasing hormone I (GnRH-I) gene, complete cds.	JN609567	Bhattacharya,T.K., Priyanka,M. and Chatterjee,R.N
29.	Mycoplasma synoviae strain MS-237 lipoprotein hemagglutinin (vlhA) gene, partial cds.	KC425324	Radhika,K., Mathew,L.P., Reddy, M.R., Dhanutha,N.R. and Kannaki,T.R.
30.	Mycoplasma synoviae strain MS-238 lipoprotein hemagglutinin (vlhA)	KC425325	Radhika,K., Mathew,L.P., Reddy, M.R., Dhanutha,N.R. and Kannaki,T.R.
31.	Mycoplasma synoviae strain MSG1745 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855834	Reddy,M.R., Lini,M.P., Dhanutha,N.R., Kannaki,T.R. and Reddy,D.N.
32.	Mycoplasma synoviae strain MSG510 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855832	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.
33.	Mycoplasma synoviae strain MSG410 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855830	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.
34.	Mycoplasma synoviae strain MSG1753 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855835	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.
35.	Mycoplasma synoviae strain MSG1258 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855833	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.

SL. No.	Title	Accession Number	Authors/ Workers
36.	Mycoplasma synoviae strain MSG508 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855831	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.
37.	Mycoplasma synoviae strain MSG398 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX855829	Reddy, M.R., Lini, M.P., Dhanutha, N.R., Kannaki, T.R. and Reddy, D.N.
38.	Uncultured Mycoplasma sp. clone DI39-3 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX827421	Reddy, M.R, Dhanutha, N.R., Lini, M.P., Nischala, T., Rincky, S.M. and Kannaki, T.
39.	Uncultured Mycoplasma sp. clone DI39-1 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX827419	Reddy, M.R, Dhanutha, N., Lini, M.P., Nischala, T., Rincky, S.M. and Kannaki, T.
40.	Uncultured Mycoplasma sp. clone DI39-2 lipoprotein hemagglutinin (vlhA) gene, partial cds.	JX827420	Reddy, M.R, Dhanutha, N., Lini, M.P., Nischala, T., Rincky, S.M. and Kannaki, T.

11. Committees

11.1 Institute research Committee (IRC) meeting

The annual meeting of the IRC for the year 2011-12 was held on 4th and 5th May 2012 at the directorate under the chairmanship of Dr. R. N. Chatterjee, Acting Project Director. Dr.A.K. Panda, Senior Scientist acted as the member secretary. All the Scientists of the directorate participated in the meeting. Respective principal investigators presented progress of the ongoing projects which were critically evaluated. Two new proposals were presented and discussed.

IRC meeting in progress

11.2 Research Advisory Committee (RAC) Meeting

The 6th meeting of the common RAC of central Avian research Institute, Izatnagar and Project Directorate on Poultry, Hyderabad was held at Project Directorate on Poultry, Hyderabad on 24th April, 2012 under the chairmanship of PadmasriDr.Lalji Singh, Vice Chancellor, Banaras Hindu university, Varanasi. The meeting was attended by the RAC members, viz., Dr.A.G. Khan, Dr. A.S. Ranade, Dr.K.S. Prajapati, Dr. S.S. Nagra and Sri D.Sudhakar, besides Dr.R.P.Singh, Director, CARI and Dr.R.N.Chatterjee, Acting Project Director, PD on Poultry. Dr. M.V.L.N. Raju, Principal Scientist & I/c PME cell, PDP, Hyderabad acted as the Member Secretary. HODs/Scientists from CARI and PDP presented the research progress in different disciplines. On reviewing the research work, the RAC made recommendations for further work at both the institutes. The chairman reiterated the need for molecular breeding for faster and effective improvement in productivity.

RAC meeting in progress

11.3 Half yearly Institute Research Committee meeting

Half yearly IRC meeting for the year 2012-13 was held on 22nd December 2012 under the chairmanship of Dr. R.N. Chatterjee, Acting Project Director. The progress reports of the institute as well as externally funded projects were presented by the principal investigators and were reviewed critically.

Half yearly IRC meeting in progress

11.4 QRT meeting

The ICAR constituted a Quinquennial Review Team (QRT) consisting of Dr. S.K. Dwivedi, Former Director, NRCE as Chairman, Dr. G.L. Jain,Chief Geneticist, VH group, Pune; Dr. N. Kandasamy, Retd. Prof.& Head (Animal Genetics and Breeding) Namakkal; Dr. S. N. Sharma, Retd.Prof.& Head (Veterinary Pathology), Lucknow; Dr. D.C Shukla,Retd. Prof. & Head (Physiology), Bareilly (UP); Dr. J. L. Vegad,Former Dean, Veterinary College, Jabalpur; Dr. A.S. Ranade,Professor (Animal Nutrition), Mumbai and Dr. S.V.N. Rao,Prof.& Head (Veterinary and AH Extension), Puducherry as members and Dr M. R. Reddy, Principal Scientist PDP as Member secretary. Three meetings of QRT were held at PDP, Hyderabad to review the work of PDP and its AICRP and PSP centres. The QRT reviewed the achievements and progress made by the Directorate during 2007-12. They also visited AICRP centres on Poultry for meat, egg, rural poultry and PSP. The Chairman QRT was present in IPSACON-2012 and keenly observed the capabilities of PDP scientists in the areas of team working, financial resource management, technical aspects of organizing international meets and hospitality arrangements. On 20th Dec 2012, the QRT Chairman presented the QRT report to the Institute Management Committee. Subsequently QRT report was printed and submitted to DG ICAR on 22nd Jan 2013.

11.5 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 2011-12 was held at MPUAT, Udaipur on 9th and 10th September, 2012. Dr. O.P. Gill, Vice Chancellor, MPUAT, Udaipur presided over the inaugural function and Prof. (Dr). K.M.L. Pathak, DDG (AS), ICAR was the chief guest. Other dignitaries were Director, Research, MPUAT, Udaipur, Dr. S.C. Gupta, ADG (AP&B) and Dr. R.N. Chatterjee, acting Director, PDP. The meeting was attended by the in-charge of all the centres of AICRP and PSP. Vice-chancellor of MPUAT appreciated the efforts of AICRP on Poultry Breeding for development of location specific rural poultry germplasm. DDG (As), ICAR mentioned that AICRP on Poultry Breeding is far ahead of other AICRPs and want to continue this project as Mission on Village Poultry in XII plan. Dr. S.C. Gupta, ADG (AP&B) congratulated all the centre in-charges for achieving targets set from time to time and requested to continue the same efforts in Mission mode. All the centre in-charges presented the progress report of their centre and discussion was made for the achievements. The future strategy for the next year both for AICRP and PSP was recommended.

Quinquennial Review Team Meeting

Annual Review meeting of AICRP and PSP

11.6 Institute Management committee (IMC)

The Institute Management committee (IMC) is one of the apex boards of the institute which looks after the overall functioning of the Institute by providing inputs and suggestions to the Director. The 30th IMC meeting was held on 20th December, 2012 under the chairmanship of Dr. R. N. Chatterjee, Acting Project Director during which several agendas including administrative, financial and related issues were discussed at length. Appropriate actions recommended by the committee were prepared and submitted to the council for approval so that they can be enacted at the directorate.

11.7 Institute Animal Ethics Committee (IAEC)

The 10th meeting of IAEC was held on 1st Sept. 2012, under the Chairmanship of Dr. R.N. Chatterjee, Project Director. The meeting was attended by the CPCSEA nominees viz. Dr. P. UdayKumar, Dr. N. Hari Shankar and Dr. Syed S.Y.H. Quadri from NIN, Hyderabad, apart from the members of the institute. The committee has examined and approved animal experimental protocols. The committee also visited the experimental farm and expressed satisfaction over the housing and management of the birds.

11.8 Other Committees

The 4th, 5th and 6th Quarterly meeting of 8th Institute Joint Staff Council (IJSC) were held on 28th June, 22nd September and 21st December, 2012, respectively. Different agendas were discussed and recommendations were made. The Institute grievance cell (IGC) conducted meetings on 27th June, 22nd September and 26th December, 2012 to discuss various issues related to the welfare of the staff. Also quarterly meetings of Women protection cell were held on 28th June and 17th September 2012 to discuss on issues of women safety and security.

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.	Conference/Seminar/ Workshop/Meeting	Name of scientist/Technical/ Administrative personnel	Schedule	Venue
1.	One day workshop on "Alternates to soyabean meal in poultry feed"	Director and all the scientists of PDP	16th May 2012	PDP, Hyderabad
2.	Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project	Dr. R.N. Chatterjee, Acting Director Dr. S.V. Rama Rao, Pr. Scientist Dr. M.K. Padhi, Pr. Scientist Dr. M. Niranjan, Sr. Scientist	9th & 10th September 2012	MPUAT, Udaipur
3.	3rd World Congress on Biotechnology	Dr. T.K. Bhattacharya, NF	13th – 15th September 2012	HITEX, Hyderabad
4.	Meeting on News Paper Report called by DDG (AS), ICAR	Dr. M.V.L.N. Raju, Pr. Scientist	15th October 2012	Krishi Bhavan, New Delhi
5.	Brainstorming Session on "Biotechnology- Augmentation of animal productivity- scope"	Dr. T.K. Bhattacharya, NF	22nd November 2012	Agri-Biotech Foundation and National nstitute of Animal Biotechnology (NIAB), Hyderabad
6.	National Symposium and XII Annual Conference of Indian Society of Animal Genetics and Breeding	Dr. R.N. Chatterjee, Acting Director Dr. B.L.N. Reddy, Pr. Scientist Dr. M.K. Padhi, Pr. Scientist Dr. T.K. Bhattacharya, NF Dr. U. Rajkumar, Sr. Scientist Dr. T.R. Kannaki, Scientist Dr. K.S. Rajaravindra, Scientist	22nd & 23rd November 2012	SVVU, Hyderabad

Sl. No.	Conference/Seminar/ Workshop/Meeting	Name of scientist/Technical/ Administrative personnel	Schedule	Venue
7.	XXIX Annual symposium and Conference of Indian Poultry Science Association	Director and all the scientific and technical staff	5th – 7th December 2012	PDP & SVVU, Hyderabad
8.	Sensitization meeting of Scientist In-charges for All PME Cells of ICAR	Dr. T.K. Bhattacharya, NF	8th December 2012	NDRI, Karnal
9.	2nd International Phytase Summit	Dr. S.V. Rama Rao, Pr. Scientist	11th – 13th December 2012	Rome, Italy
10.	Conference of Association for the Promotion of DNA Fingerprinting and Other DNA Technologies	Dr. K.S. Rajaravindra, Scientist	16th -19th December 2012	CCMB, Hyderabad
11.	Meeting of SMD (AS), ICAR for Directors & Nodal Officers on RFD targets 2013-14	Dr. M.V.L.N. Raju, Pr. Scientist	10th January 2013	NASC Complex, New Delhi
12.	5th Annual Conference and National Symposium of Indian meat science Association (IMSACON-V)	Dr. R.N. Chatterjee, Acting Director Dr. M.K. Padhi, Pr. Scientist Dr. T.K. Bhattacharya, NF Dr. M. Niranjan, Sr. Scientist Dr. U. Rajkumar, Sr. Scientist Dr. K.S. Rajaravindra, Scientist	7th – 9th February 2013	NRCM, Hyderabad
13.	Institute-Farmers-Industry Interface	Director and all scientists and staff of PDP	2nd March 2013	PDP, Hyderabad
14.	Annual Meeting-cum-Workshop on "Zonal technology management & Business Planning and Development perspective of ICAR"	Dr. M.R. Reddy, Pr. Scientist	6th March 2013	DOR, Hyderabad

13. Conference, Workshops, Short course etc. Organized

13.1 XXIX Annual Conference and National Symposium of Indian Poultry Science Association (IPSACON 2012) organized

The XXIX Annual Conference and National Symposium of Indian Poultry Science Association (IPSACON 2012) was organized by Project Directorate on Poultry as part of its Silver Jubilee celebrations in collaboration with Sri Venkateswara Veterinary University during 5th to 7th December 2012 at Rajendranagar, Hyderabad, India. The theme of the Conference was "Commercial and rural poultry production: Novel concepts and strategies to meet growing demand and changing consumer needs" pertinent to the current challenges faced by the poultry sector in the country.

The conference was inaugurated by Lt. General (Dr.) Narayan Mohanty, President, Veterinary Council of India, who was the Chief Guest for the inaugural function. A total of 326 registered delegates from across the country and abroad participated in the Conference, which included scientists, academicians, technocrats and delegates from research organizations, Universities, Govt. agencies, Poultry Industry, Farmers, Pharmaceutical manufacturers, Bankers, Insurers and others. In the inaugural function, several IPSA awards were presented by the Chief Guest Dr N. Mohanty.

A total of 31 invited papers were presented by leading scientists from India and abroad covering the 12 technical sessions to initiate the deliberations in the specified fields of poultry science. A total of 489 abstracts were received and published. The research abstracts were presented as oral or poster presentation in the respective session. Overall seven best posters were awarded certificate of appreciation and memento.

In addition, an exclusive session on "Farmers-Industry-Scientists Interface" was conducted bringing together the scientists, experts and clients on to single platform for having brainstorming discussion on the critical issues confronting the sector. The Conference ended with the Plenary cum Valedictory function on 7th December 2012 evening, which was graced by Dr S.K. Bandopadhay, Member, ASRB as the Chief Guest and Dr S.C. Mohapatra, Former Director, PDP and CARI as the Guest of Honour. The Chief Guest presented the Young Scientist awards and best poster awards. Dr. R.N. Chatterjee, Chairman, Organising Committee and Dr. M.V.L.N. Raju, Organising Secretary thanked the delegates, invitees, sponsors and others for making the Conference a success.

IPSACON 2012 : Inaugural session

13.2 Winter short course organized

An ICAR sponsored training course on "Recent development in epigenetics, structural and functional genomics for animal genetic resource conservation *vis-à-vis* augmentation of productivity in poultry and livestock species" was organized at the Directorate during 17h - 26th November 2012. During inaugural function, Dr. S.L. Goswami, Director, NAARM, Hyderabad was the Chief Guest and Dr. R.N. Chatterjee, Acting Director of this Institute presided over the function. Dr. Goswami highlighted the role of

Biotechnology in augmenting productivity of Livestock and Poultry for providing food security and livelihood in the country. He encouraged the young scientists to take up challenging biotechnology tasks to mitigate the problems of farmers. Dr. Chatterjee elaborated the basic norms and scope of biotechnological research in Animal Sciences with respect to production and disease resistance. Dr. T.K. Bhattacharya, Course Director narrated about the possible application of biotechnological tools in improvement programme and the role of this Directorate to generate human resources in the emerging areas of Biotechnology.

This training programme covered a comprehensive account of theoretical and practical aspects of molecular techniques such as PCR, realtime PCR, detection of SNPs, microsateilite, cell culture, gene cloning and expression, epigenetics, bioinformatics and statistical genomics etc.

In the training programme, 16 Professors/Head of Departments/Principal Scientists/Senior Scientists/Associate Professors/Scientists/ Assistant Professors come from different parts of the country participated and got acquainted with these basic and high end techniques of Molecular Biology and Biotechnology. The programme encompassed mostly practical aspects and the trainees performed molecular tools on their own hand. They appreciated the efforts of faculty members for teaching wet lab experiments and guiding them to solve their problems of laboratory works faced at their respective Institutes. The programme ended with a valedictory function held on 26th November 2012 with the optimistic views of initiating research works by the trainees in the respective areas at different parts of the country.

13.3 Workshop : Reduce pressure on soybean meal in poultry diets

The cost of poultry feed particularly the soybean meal increased enormously during the past one moth from Rs 20 to about Rs 45/- in May 1012. The escalation in cost of soybean meal was partly due to non-availability of the protein source and also exports of the material to other parts of the World. Non-availability and exorbitant price of Soybean meal increased the cost of production compared to the sale price of poultry produces (egg and chicken meat). The panic situation compelled the poultry farmers to think and use alternate protein sources in poultry diet. As the Directorate is known for its contribution in poultry nutrition, several poultry farmer associations requested the scientists of the Directorate to apprise the poultry farmers about

Dr. S.L. Goswami, Director, NAARM addressing the inagural session of short course

Dr. R.N. Chatterjee, Director, PDP giving certificates to the successful participants

the scope of using alternate protein sources in poultry diets. A one day workshop entitles "Strategies to minimize pressure on protein sources for poultry feeding" was organized on 16th May 2012 at the Directorate, which was jointly organized by AP Chapter of IPSACON and various poultry farmer's associations (AP Poultry Federation, NECC, AP Broiler Association and Broiler Breeder Association). Layer and broiler farmers, feed millers, breeding / hatchery companies, technocrats from the poultry industry, feed additive companies and field veterinarians attended the workshop. Several possible alternate approaches like optimization of dietary protein by balancing limiting amino acids, use of enzyme technology and possibility of using sunflower seed cake, til cake, rape seed cake, guar meal, cotton seed meal, and meat and bone meal, were discussed and most cost effective and practical solutions were suggested by the Scientists of Directorate based on the research work doe at the Directorate. Few of the solutions emerged in the work shop are being adopted by different poultry farmers across the region.

13.4 Scientist-Industry-Farmers interface organized

To commemorate the year long celebrations, Scientists- industry -farmers interface was organized on 2nd March 2013. Prof. K.M.L.Pathak, DDG (AS) was the Chief Guest of the function. Dr. S.L.Goswami, Director, NAARM and Dr. V.V. Kulkarni, Director, NRC Meat graced the occasion as Guests of honour. Prof. Pathak appreciated the efforts of the staff in popularizing the technologies and stressed the importance of effective collaboration with industry and other institutions to take the research from lab to the field. Dr. R.N.Chatterjee, Director congratulated all the staff members for their efforts in making the institution known by its technologies rather than by its name. Dr. T. Krishna Reddy, Director, Srinivasa Hatcheries Ltd., Vijayawada presented the overview of poultry industry and emphasized the needs of the industry at this crucial juncture when the industry is in cross roads. Shri Ranga Rao, CEO, Vileena Emu, Nuzvid, Andhra Pradesh highlighted the prospects of emu farming in the country.

Hon'ble DDG (AS) Prof. K.M.L.Pathak addressing the Scientists - Industry - Farmers interface

14. Distinguished Visitors

Renowned dignitaries from all over India as well as foreign institutions 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 2012-13 are as follows.

- Lt. General (Dr.) Narayan Mohanty, President, Veterinary Council of India, New Delhi
- Prof. K.M.L. Pathak, DDG (Animal Sciences), ICAR, New Delhi
- Dr. R.M. Acharya, Former DDG (Animal Sciences), ICAR, New Delhi
- Dr. V. PrabhakarRao, Vice-chancellor, SVVU, Tirupati
- Dr. R. Prabakaran, Vice-chancellor, TANUVAS, Chennai
- Dr. S.K. Bandopadhyay, Member, ASRB, New Delhi
- Dr. S. L. Goswami, Director, NAARM, Hyderabad
- Dr. Anubrata Das, Director, NRC on Pig, Guwahati
- Dr. S. C. Gupta, ADG (AP&B), ICAR, New Delhi
- Dr. Gaya Prasad, ADG(AH), ICAR, New Delhi
- Dr. B. S. Prakash, ADG (AN&P), ICAR, New Delhi
- Prof. P. Sudhakar Reddy, Registrar, SVVU, Tirupati
- Dr. Arjava Sharma, Director, PD on Cattle, Meerut
- Dr. R.K. Singh, Director, NRC on Equines, Hissar
- Dr. N. P. Singh, Director, ICAR research Complex for Goa, Goa
- Dr. J. M. Kataria, Joint director (Research), IVRI, Izatnagar
- Dr. A. K. Rawat, Joint Director, Dept. of Biotechnology, GOI, New Delhi
- Dr. R.N. Srinivas Gowda, Former Vice chancellor, KVAFSU
- Dr. S. C. Mohapatra, Former Director, PDP, Hyderabad
- Dr. S. K. Dwivedi, Former Director, NRC on Equine, Hissar
- Dr. V. Ayyagari, Former Director, PDP, Hyderabad
- Dr. R.P. Sharma, Former Director, PDP, Hyderabad

International dignitaries visits PDP

International delegation from Ethiopia visited the Directorate on Poultry on 28th December 2012. 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.

In addition, the scientist probationers of FOCARS, NAARM, extension workers from various NGOs, farmer trainees from NIRD, CRIDA and other ICAR institutions, officers from line departments visited the Directorate and appraised about different activities of the institute and the germplasm developed by this organization.

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 Project Director. The composition of the Institute's personnel is as follows.

Management Position

Dr. R. N. Chatterjee, Acting Project Director

Scientific staff

Dr. G. Shyam Sunder, Pr. Scientist
(Retd. on 31-03-2013)

Dr. N. Kondaiah, Pr. Scientist
(Retd. on 30-06-2012)

Dr. S. V. Rama Rao, Pr. Scientist

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

Dr. M. K. Padhi, Pr. Scientist

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

Dr. M. R. Reddy, Pr. Scientist

Dr. T. K. Bhattacharya, National Fellow

Dr. M. Niranjan, Sr. Scientist

Dr. U. Rajkumar, Sr. Scientist

Dr. Arun Kumar Panda, Sr. 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

Technical Staff

Sri Daryab Singh, T-9 (Hatchery Manager)

Dr. S. K. Bhanja, T-9 (Farm Manager)

Dr. R.V. Rao, T-7-8

Sri V. V. Rao, T-7-8

Sri A. Ravi Kumar, T-5

Smt. Minakshi Dange, T-7-8

Sri D. Pratap, T-6

Sri J. Srinivasa Rao, T-6 (Hindi Translator)

Sri G. Rajeswar Goud, T-4

Sri A. Subrahmanyam, T-4

Smt. Dhanutha, N.R, T-3

Sri Md. Maqbul, T-4 (Driver)

Sri M. Panthulu, T-3 (Driver)

Sri Md. Yousufuddin, T-2 (Driver)

Administrative Staff

Sri S. R. Meena, Admn. Officer

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

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

Sri B. Gandhi, Supdt. (Retd. on 31-08-2012)

Sri M.S.N. Acharyulu, Asst.

Smt. R.T. Nirmala Veronica, Asst.

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

Sri G. Srinivas Yadav, P.A (on deputation)

Skilled Support staff

Sri G. Vijay Kumar

Sri Syed Mujtaba Ali

Sri D. Ashok Kumar

Sri N. Manayam

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

Probation in r/o Dr. K. S. Rajaravindra has been cleared and appointed in the substantive capacity in post of scientist w.e.f. 26th June, 2010

Sri G. Srinivas Yadav joined this Directorate on 9th July 2012 as Personal Assistant on deputation

Promotions

Dr. B. L. N. Reddy has been promoted to principal scientist w.e.f. 1st January 2009

Dr. M.R. Reddy has been promoted to Principal Scientist w.e.f. 17th February 2012

Retirements

Dr. N. Kondaiah, Principal Scientist has retired from the council's service on superannuation w.e.f. 30th June 2012

Sri B. Gandhi, Supdt (Admn.) has retired from the council's service on superannuation w.e.f. 31st August 2012

Dr. G. Shyam Sunder, Principal scientist has retired from the council's service on superannuation w.e.f. 31st March 2013

16. Other Relevant Information

16.1 Experimental Hatchery

The directorate has a well-established hatchery designed on modern scientific principles and equipment. It is a central facility in which fumigation and storing of hatching eggs, incubation and hatching of pedigreed and commercial eggs will take place throughout year. There is awalk in cold room(50,000 hatching egg capacity, egg are stored at 14-15^{o} C and 85-90% relative humidity before setting in the incubator. The Data loggers were installed to monitor the temperature and humidity in setters, hatchers and in cold room. During the current year 87,927 hatching eggs were supplied. A total of 2,97,030 day old chicks were hatched and supplied inthis year. In addition, 23,725 embryonated eggs were supplied for diagnosis and vaccine production to different organizations.

16. 2 Experimental Farm

The Experimental Farm Unit located in Campus is having two divergent sections such as commercial Unit and pure Line Unit. The first one caters to the needs of the farmers and tribal populations of our country in terms of producing hatching eggs of commercial importance in addition to regular nutritional and health experiments which are conducted in the battery brooders located in the same unit. Whereas the second one (Pure Line Unit) fulfills the needs of the Scientists for pure line breeding research and has all the facilities to carry it out. During the reporting period a cage house has been added extra for further expansion of research facilities. The month average livestock reared was 20,436 nos. A total of 13, 39,376 eggs were produced during the year out of which 6, 04,888 eggs were hatching and the remaining ones were table eggs.

16.3 Feed Processing Unit

The unit served as a central facility for supplying compounded feed to all the flocks of the Directorate. The unit is equipped with 2 feed plants of 500kg capacity/hour (one vertical and one horizontal with bucket elevator), besides a go-down with a capacity to store 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. The feed ingredients were periodically procured and analyzed for their nutritional quality. Consignments those satisfy the quality considerations were only used. During the year 2012-13, the feed unit compounded 724 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.

16.4 Sale and Marketing Unit

The main activity of this unit was sale of culled birdsduring the selection programme, spent hens at the end of the breeding cycle and selling og surplus eggs for table purpose. Further, grown up chicks (around 6 weeks) of rural poultry germplasm were sold to farmers. During the current year this unit sold 7,76,760 table eggs, 28,667 culled/ spent hen and 1,626 grown up birds amounting to Rs.44,06,698.

16.5 Agricultural Knowledge Management Unit - AKMU (Formerly ARIS Cell)

The AKMU 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. The computer security from virus, spyware etc. is ensured by installing advanced versions of antivirus / antispyware software (McAFee in 2002 and Symantec in 2006) 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.

An exclusive website (www.pdonpoultry.org) has been maintained and updated with latest information for projection of Institute's activities. Further, public notices like tenders, quotations, recruitment advts., RTI, RFD, Citizen charter etc. have been 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

The Directorate conducted four quarterly meetings of Official Language Implementation Committee (OLIC) on 19-6-2012, 24-8-2012, 31-12-12 and 23-3-2013, in which different issues related to effective implementation of Hindi Language in office were discussed. The Directorate also conducted four Hindi workshops, i.e. on 30-5-12, 6-9-12, 19-12-12 and 25-3-13, for upgrading the Hindi skills of staff in day to day official work. The Directorate also celebrated Hindi Fortnight celebrations during 1-15 September 2012 and Hindi Day on 14th September 2012, during these celebrations different literary competitions were conducted for the staff. Dr.S.L. Goswami, Director, NAARM graced the occasion as the chief guest and he lightened the importance of Hindi language and its history, and he also released a Hindi booklet titled Uttam Swasth keliye sarvottam ahar anda, which was written by the scientists/officers of this Directorate. On this occasion all the winners of different competitions were awarded with cash prizes and certificate.

Hindi day organized 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 a trademark for chicken line developed at the Directorate was obtained from Indian Trademark office, Chennai for the trademark KRISHIBRO® (Trademark No.1941583). Applications for registration of two chicken lines developed at the directorate sent to NBAGR. One Patent application for the technology invented at the Directorate has been filed with Indian Patent office. Four MoUs for contract research were signed by the Directorate. Research publications of the Directorate from the year 2012-2013 have been compiled and

documented with ITMU. Prior art searches for patents were performed. Monthly reports were submitted to ZTMC at CIFT, Cochin. Two workshop-cum-training programmesorganised by ICAR institutes (NAARM, Hyderabad & CIFT, Cochin) were attended by staff of ITMU to broaden the knowledge and scope of protecting intellectual assets of the Directorate.

16.8 Library and Information Centre

The Directorate having a well organized library which is much helpful to scientists, technical staff as well as other visitors. To cater the needs of scientists, research scholars and technicians working in different disciplines, the library subscribed sixteen foreign and eight Indian journals and six hundred reference books on difference aspects of poultry science and livestock. Staffs of this institute are also utilizing services of Cera e-grantha project for research articles. In addition to this, daily news papers in Hindi, Telugu and English (two from each language) , Employment news and magazines are being procured in the library for benefit of the staff and visitors. Besides this, the library also equipped with good reprographic facilities like colored and black & white copiers, gestetner and binding facilities.

A View of Library

16.9 Games and Sports

The contingent of the directorate participated in the ICAR South Zone Sports Tornamentfrom18-22nd February, 2013at Sugarcane Breeding Institute, Coimbature. Dr.M.Shanmugam, Scientist of this institute bagged third position in cycle race. In addition, several competitions were held on eve of Silver jubilee celebration of the institute for staff and their families and the winners were duly rewarded with prizes.

16.10 PDP Celebrated Silver Jubilee

Project Directorate on Poultry completed 25 years of its existence on a high note with its technologies reaching to nuke and corner of the country. The low input chicken varieties, *Vanaraja* and *Gramapriya*have revolutionized the rural/ backyard poultry with their capacity to withstand harsh environment and perform well under field conditions. The two varities are present all over the country from Kashmir to Andaman and Gujarat to Arunachal Pradesh.

On the occasion of Silver Jubilee, 3-day long celebrations were conducted from 28th February to 2nd March 2013. A 3-day poultry science exhibition was organized from 28th February till 2nd March 2013 at the Directorate for the farmers and students. Farmers from Different places and students of local schools visited the exhibition. The live bird varieties exhibited in the pens, brooder with chicks and small incubator attracted the students and farmers. On 1st March 2013, the Institute's 25th Annual day was celebrated. The staff and their families actively participated in the activities.

Hon'ble DDG (AS) Prof. K.M.L.Pathak visiting poultry exhibition

To commemorate the year long celebrations, Scientists- industry -farmers interface was organized on 2nd March 2013. Prof. K.M.L.Pathak, DDG (AS) was the Chief Guest of the function. Dr.S.L.Goswami, Director, NAARM and Dr. V.V.Kulkarni, Director, NRC Meat graced the occasion as Guests of honour. Prof. Pathak appreciated the efforts of the staff in popularizing the technologies and stressed the importance of effective collaboration with industry and other institutions to take the research from lab to the field. Dr.R.N.Chatterjee, Director congratulated

Hon'ble DDG (AS) Prof. K.M.L.Pathak releasing the Silver Jubilee Compendium

all the staff members for their efforts in making the institution known by its technologies rather than by its name. Dr. T. Krishna Reddy, Director, Srinivasa Hatcheries Ltd., Vijayawada presented the overview of poultry industry and emphasized the needs of the industry at this crucial juncture when the industry is in cross roads. Shri Ranga Rao, CEO, Vileena Emu, Nuzvid, Andhra Pradesh highlighted the prospects of emu farming in the country.

Hon'ble. DDG (AS) Prof. K.M.L. Pathak inaugurated the new cage house in the farm primises.

A new promising variety, ***Srinidhi*** for rural poultry was released by DDG (AS) on the occasion. Dignitaries from the industry, farmers,

Hon'ble DDG (AS) Prof. K.M.L.Pathak inaugurating the new cage house

faculty from SVVU participated in the deliberations. The meeting concluded with assurance from the institute for better collaboration and farmers with industry in future.

16.11 Independence Day

The Directorate celebrated Independence Day on 15th August 2012. The Director hoisted the national flag and addressed the gathering. He remembered the great freedom fighters and their sacrificed for making the India independent. He narrated the progress of the institute in nutshell and appreciated the all the staff members for their cooperation and hard work.

Hon'ble DDG (AS) Prof. K.M.L. Pathak releasing the Srinidhi variety

16.12 Republic Day

The Republic day was celebrated in in the institute on 26th January,2013. On this occasion Director hoisted the National flag and addressed the staff of the directorate. The Director congratulated the staff for their sincere efforts in achieving the targets. He alsoemphasized on the need for constant and enthusiastic efforts by all the staff to achieve further heights in future.

Director addressing the gathering on Republic day

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