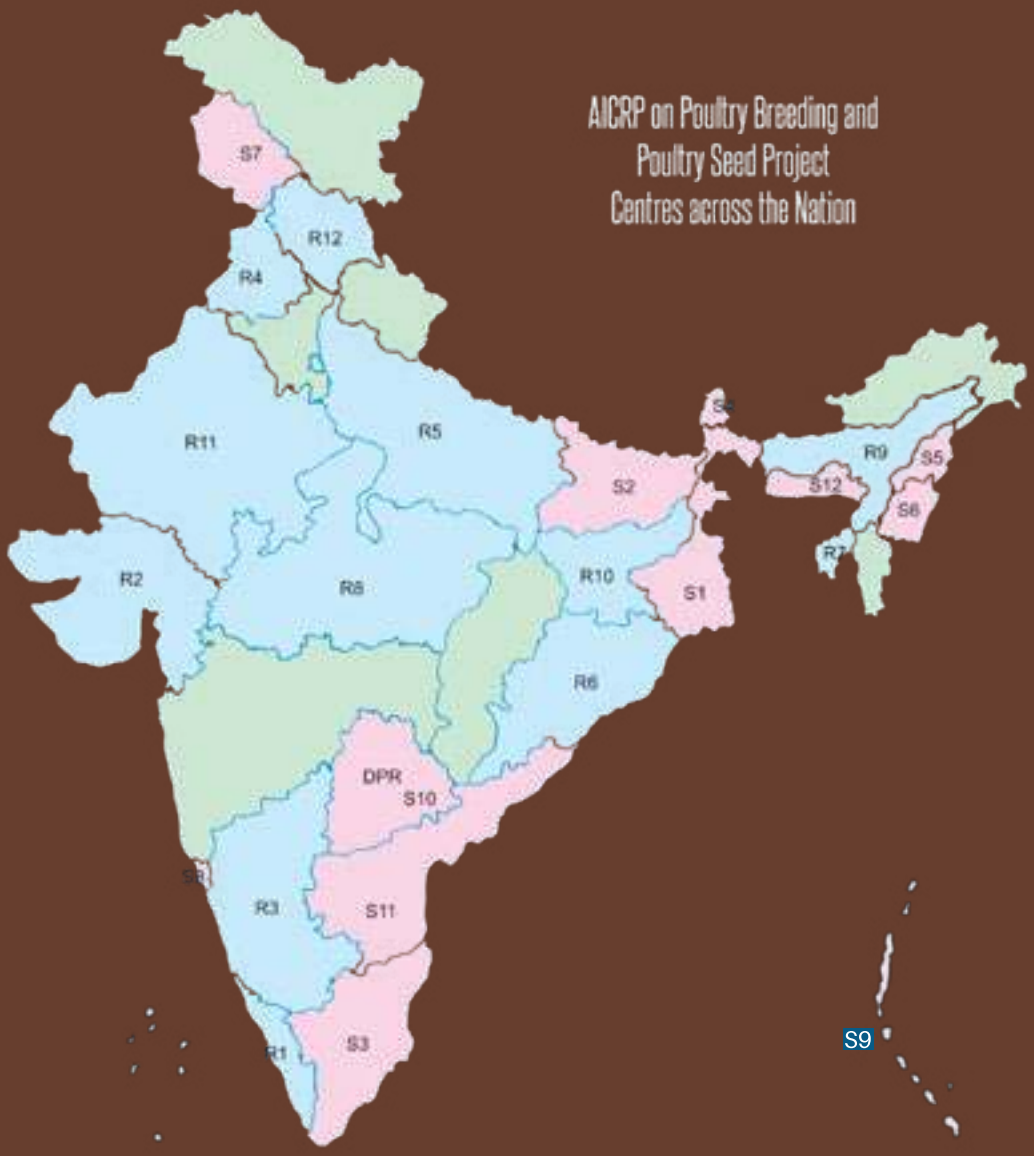
ANNUAL REPORT 2022

भाकृअनुप – कुक्कुट अनुसंधान निदेशालय

ICAR - Directorate of Poultry Research

Rajendranagar, Hyderabad - 500 030



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Front Cover

Adult parent birds

Inside Front Cover

Location of AICRP on Poultry Breeding and Poultry Seed Project centres

Inside Back Cover

QR codes of social networking sites of ICAR-DPR, Hyderabad

Back Cover

Khaki Campbell Duck

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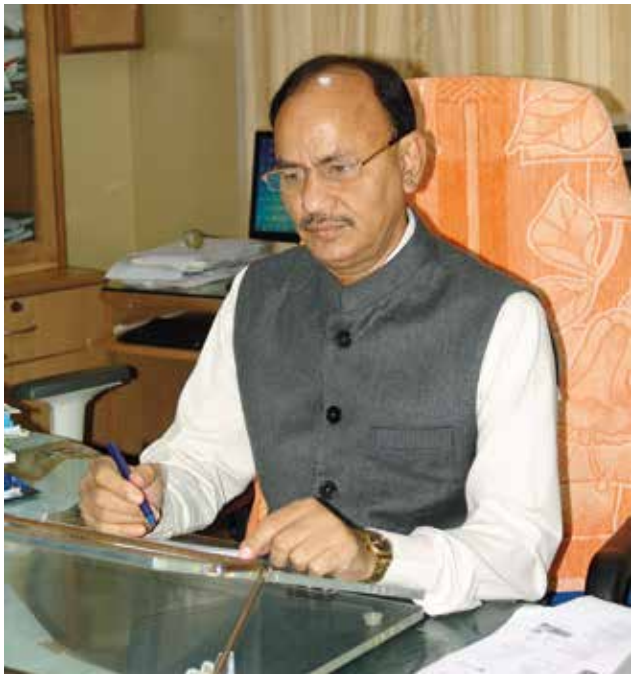
PREFACE



I am pleased to present the Annual Report of ICAR-Directorate of Poultry Research, Hyderabad for the year 2022. The Directorate effectively carried out the mandated research work of the Institute in its endeavour of serving the poultry farmers, entrepreneurs and other stakeholders. In the coastal regions, the requirements of improved duck varieties are being addressed by continuous development and supply by the regional station of the Directorate.

The rural, broiler, layer pure lines and native chicken germplasm are being maintained and constantly improved for various economic traits of interest. An Aseel cross developed for meat purpose was evaluated at farmers' field and the economics analysed. The carcass characteristics, meat quality and nutritional composition of Kadaknath chicken was studied. Furthermore, the whole genome assembly of Kadaknath chicken was generated and annotated. Genomewide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs during the asymmetric ovarian development of chicken was carried out. The blastodermal cells of Kadaknath chicken was cryopreserved. Research in other areas of nutrition, health and physiology aided in the realization of genetic potential of the pedigreed populations. In these allied areas, to indicate a few, studies were conducted with different combination of probiotic, essential oil, enzymes and butyric acid as an alternative of AGP on broiler performance, optimum level of Black Soldier Fly larvae meal in chicken diet, identification and characterization of residual feed intake specific SNPs in coloured broilers, synthesis and use of nano minerals and hormone and amino acid expression after organic selenium supplementation. Experiments were carried to evaluate application of IoT in poultry production. Poultry litter was mixed with other carbon sources and converted to useful vermicompost. The ALV infection status in the farm was monitored and molecular characterized. The research findings at the Directorate were widely circulated through different extension methodologies.

Work on duck species at the Regional Station of the Directorate has made notable progress in various aspects of duck farming that includes improvement in egg production in a cross and dietary requirement and feed composition for optimum growth and production.

The Directorate has to its credit several extra mural projects funded by DST-SERB, DBT, NICRA, etc. and collaborative projects with the industry under PPP mode. The research output was communicated through publications in peer reviewed journals, magazines and electronic media.

The Directorate coordinated and monitored the All India Coordinated Research Project on Poultry Breeding, which has 12 centres maintaining elite layer, broiler and rural germplasm. The Directorate also monitored the 12 Poultry Seed Project centres spread all over the country and supplied the improved germplasm to the farmers.

The Directorate has organized several meetings and training programmes under DAPSC, STC, and Skill development programmes. The institute demonstrated different technologies from the institute by participating in exhibitions, melas, and farmers field programmes. A total of 3.75 lakhs germplasm including 41,829 parents were distributed by the Directorate to various beneficiaries. A total of Rs. 232.84 lakhs revenue was generated during the year. The AICRP centres and PSP centres supplied 5.85 and 3.58 lakhs germplasm, respectively, with a revenue generation of Rs. 197.66 lakhs and Rs. 159.47 lakhs, respectively.

I am extremely grateful and indebted to Dr. Trilochan Mohapatra, former Secretary, DARE and Director General, ICAR, and Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR for their support and guidance extended for the development of this Directorate. I express my sincere gratitude to the Secretary, ICAR and Financial Advisor, ICAR for their support. I am thankful to Dr. B. N. Tripathi, DDG (AS), Dr. V.K. Saxena, ADG (AP&B) and other scientific and administrative staff of ICAR headquarters for their constant help and support rendered to this Directorate. I also place on record my appreciation to the scientific, technical, administrative and supporting staff of this Directorate and also those working in the AICRP and PSP centres, who have been tirelessly working for the welfare of poultry farmers. I congratulate the editorial team for the commendable job in bringing out this Annual report in an appreciable manner.

Date: 12 July 2023

(R.N. Chatterjee)
Director

CONTENT

ABBREVIATIONS

AAU	Anand Agricultural University/Assam Agricultural University
AICRP	All India Coordinated Research Project
ARS	Agricultural Research Service
AFE	Age at first egg
AGP	Antibiotic growth promoters
AMR	Antimicrobial resistance
ASM	Age at Sexual Maturity
BW	Body Weight
BWG	Body weight gain
CARI	Central Avian Research Institute
CBH	Cutaneous Basophile Hypersensitivity
CD	Control diet
CMI	Cell mediated immunity
CP	Crude Protein
CPCSEA	Committee for the Purpose of Control and Supervision of Experiments on Animals
CPDO	Central Poultry Development Organization
CRIDA	Central Research Institute for Dryland Agriculture
d	Day(s)
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DNA	Deoxyribonucleic Acid
DPR	Directorate of Poultry Research
DST	Department of Science and Technology
EM	Egg mass
EP	Egg Production
EW	Egg Weight
FCR	Feed Conversion Ratio
g	Gram(s)
H:L ratio	Heterophyl: Lymphocyte Ratio
HDEP	Hen Day Egg Production
HHEP	Hen Housed Egg Production
IAEC	Institutional Animal Ethics Committee
IBSC	Institute Bio-safety Committee
ICAR	Indian Council of Agricultural Research IMC Institute Management Committee
IPSA	Indian Poultry Science Association
IRC	Institute Research Committee
IU	International Unit(s)
IVRI	Indian Veterinary Research Institute
KVK	Krishi Vignan Kendra

LC	Layer Control
LP	Lipid Peroxidation
MANAGE	National Institute of Agricultural Extension Management
MD	Marek's Disease
ME	Metabolizable Energy
mm	Millimeter(s)
NAARM	National Academy of Agricultural Research Management
NCBI	National Center for Biotechnology Information
NDV	Newcastle Disease Virus
NGO	Non-Governmental Organization
NIRDPR	National Institute of Rural Development & Panchayat Raj
Nos.	Number
NPP	Non-Phytate Phosphorus
NRC	National Research Centre
OUAT	Odisha University of Agriculture and Technology
PCR	Polymerase Chain Reaction
PHA-P	Phytohemagglutinin-P
PJTSAU	Professor Jayashankar Telangana State Agriculture University
ppm	Parts Per Million
QRT	Quinquennial Review Team
RAC	Research Advisory Committee
RC	Rural Control
RBC	Red Blood Cell
RTC	Ready to cook
SAU	State Agricultural University
SL	Shank Length
PVNRTVU	P.V. Narasimha Rao Telangana Veterinary University
SEP	Survivors' Egg Production
SERB	Science and Engineering Research Board
SVU	State Veterinary University
SVVU	Sri Venkateswara Veterinary University
TSA	Total Sulfur-containing Amino Acids
U	Unit(s)
wks	Weeks

EXECUTIVE SUMMARY

The ICAR-Directorate of Poultry Research, a premier Institute under Indian Council of Agricultural Research, is mandated to carryout basic and applied research to enhance productivity of poultry, develop new germplasm for rural poultry husbandry and capacity building. The Directorate also undertakes short term research projects sponsored by other funding agencies and contract research programs under PPP mode. The salient achievements for the year 2022 are summarized below.

Research at the Directorate

Genetics and Breeding

The research in genetics and breeding focuses on improvement of pure lines and development of varieties for rural poultry production, conservation and improvement of indigenous chicken germplasm, and maintenance and evaluation of layer, broiler and gene lines.

Germplasm for rural poultry farming

Two male lines, PD-1 (*Vanaraja* male line) and PD-6/ GML (*Gramapriya* male line) and two female lines, PD-2 (*Vanaraja* female line) and PD-3 (*Gramapriya* female line) have been improved for the various growth and production traits and used in the production of rural chicken varieties. The body weight and shank length at 4 and 6 weeks of age were 416.3 and 834.0 g and 63.24 and 84.08 mm, respectively. The 20 weeks body weight was 1896 g with a shank length of 110.6 mm. The ASM was 178.8 days. The 40 weeks egg production was 38.25 eggs with 58.24 g egg weight.

In PD-6 line the juvenile traits and production traits upto 40 weeks were evaluated for S-11 generation. The body weight at 2, 4 and 6 weeks of age were 158.59±0.05, 383.59±2.34 and 848.38±3.26g, respectively. The shank length at 4 and 6 weeks of age were 67.67±0.001 and 87.56±0.001mm respectively. The shank length at 6 weeks of age showed a response 2.60mm per generation over the last 6 generations at Phenotypic scale. The ASM, bodyweight at 20 weeks, 40 weeks were172.88±0.07 days, 2123.61±0.93g, 2629.64±0.93g respectively. The egg weight at 28, 32, 36 and 40 weeks of age were 49.81±0.01g, 51.37±0.01g, 53.31±0.04 and 54.79±0.02g, respectively. The egg production at 40 weeks of age was 69.72±020 eggs.

In PD-2 line, the ASM was 162.47±0.07 days, egg weight, at 52 weeks was 55.99±0.03, and egg production up to 52 weeks of age was 134.06±0.98 and egg mass up to 52 weeks of age was 7624.49±4.05. In S-19 generation, a total of 1836 chicks were produced by random mating. The fertility was 86.04% and hatchability on total and fertile eggs set was 80.16% and 93.16%, respectively. The body weight at 2, 4 and 6 weeks of age was 169.61±0.06, 340.76±0.05 and 710.77±4.98g, respectively and shank length at 6 weeks of age was 78.43±0.001. The shank length showed marginal improvement of 1.01mm.

The PD-3 line is being selected for higher 40-week egg mass. The juvenile body weight at 4 and 6 weeks of age was 163.96±0.01 and 285.88±0.02 g, respectively. The corresponding shank length was 44.06±0.001 and 54.79±0.001 mm, respectively. The ASM was 147.6 ±0.01 days, which reduced in desired direction compared to the previous generation. The least squares mean for body weight at 20 and 40 weeks were 1614 ± 0.21 and1794 ± 0.23 g, respectively. The egg weight at 40 weeks was53.64g. The part period egg production at 40 weeks of age was 97.87 eggs, which reduced by 2 eggs from previous generation. The egg mass at 40 weeks of age was 5239 g. The egg production and egg mass at 40 weeks of age reduced marginally from the last generation. The heritability of EM40 and EP40 was 0.13 and 0.18, which were low in magnitude. The genetic and phenotypic response for EM 40 was 54 and 232 g and for EP40 was 1.14 and 3.47 eggs per generation, respectively over last 10 generations. S-11 generation, a total of 3163 chicks of PD-3 line were produced by pedigreed mating of 50 sires and 250. The fertility was 85.1% and hatchability on FES was 90.08% and TES was 76.66%.

RIR, a new female line was introduced in the Directorate. From 1000 fertile eggs 866 good chicks were produced. The fertility was 92.74% and hatchability on FES was 87.84% and TES was 81.47%. The day-old body weight was 41.5 g. The body weight at 4, 6 and 16 weeks of age was 146.7, 344.4 and 1327 g in females and 157.3, 386.4 and, 367.3, 1734 g in males respectively. The corresponding shank length was 43.52, 59.15 and 98.81 mm in females and 45.09, 62.91 and 119.1 mm in males, respectively.

Native chicken populations

A total of 1118 chicks were produced in G-9 generation and was evaluated up to 40 weeks of age for growth and production traits. The fertility was 84.09 % and hatchability was 81.90 (FES) and 68.87 (TES). The ASM was 203.5 days. The body weight and shank length at 4 and 6 weeks of age was 97.87 and 242.61 g and 36.48 and 54.56 mm, respectively on pooled sex. The 20- and 40-weeks body weight of hens was 1322 and 1845 g, respectively. The egg weight was 46.42 g at 40 weeks of age. The part period egg production up to 40 weeks of age was 19.45 eggs. The performance of the Aseel X PD-1 crossbred chicken developed for meat purpose under intensive system at farm and field conditions was carried out for the second time.

In *Vanashree*, evolved from Aseel (PD-4), the production performance of fourth and fifth hatches during S-12 generation were evaluated up to 40 weeks of age. A total 919 good chicks of *Vanashree* in S-13 generation were hatched in two hatches by mating of 50 sires with 150 dams in 1:3 ratio. The average fertility recorded was 84.49% and the hatchability on fertile and total eggs set was 91.11 and 76.98%, respectively. The growth traits of these chicks up to 20 weeks of age were recorded.

Ghagus, an indigenous chicken breed has been selected for higher body weight at 8 weeks of age. The S-4 generation (2nd and 3rd hatches) of *Ghagus* was evaluated for production traits from 21 to 40 weeks. There was significant increase in egg production as compared to the previous generation. The selection differential and selection intensity for body weight at 8 weeks of age was 83.9 g and 0.69 σ, respectively. A total of 135 dams and 50 sires contributed progenies to the S-5 generation. A total of 954 pedigreed chicks were hatched in S-5 generation and the birds were evaluated for growth traits up to 20 weeks of age. Body weight of male and female birds at 20 weeks of age was 2227±19.3 (N-135) and 1644±9.82g (N=308), respectively. Shank length of male and female birds at 20 weeks of age was 128.9±0.39 (N-135) and 104.1±0.28mm (N=308), respectively.

Nicobari, an important indigenous breed of chicken is being evaluated and conserved as a purebred random mating population at the Institute. The G-9 generation was produced and evaluated for growth and production traits up to 20 weeks of age. A total of 574 good chicks was produced in two hatches in G-9 generation by inseminating 2 females with the semen of 1 male (1:2 ratio). The fertility recorded was 88.31%, while hatchability on fertile and total egg set was 95.75 and 84.56%, respectively. The birds were evaluated for growth traits at 4 weeks interval up to 20 weeks of age. Body weight at 4 (208.2±1.70g), 8 (558.8±4.92g) and 12 weeks (886.4±7.84g) of age has improved by 43.7, 148 and 73g, respectively while the shank length (68.85±0.47mm) at 8 weeks of age increased by 7.67mm as compared to the previous generation (G-8). The production performance G-9 generation was evaluated up to 40 weeks of age.

Kadaknath, an indigenous chicken, breed was evaluated for egg production performance up to 72 weeks of age in the G-2 generation. Egg production up to 40, 64 and 72 weeks of age were 77.31±0.92, 166.8±1.89, and 188.7±2.16 eggs, respectively. Egg weight at 40 weeks of age was 44.75±0.15 g. G-3 generation of Kadaknath was regenerated by pedigreed random matting. A total of 46 sires and 138 dams, which were negative for ALV, were utilized. About 1,177 eggs were set and 1004 good chicks were produced in 3 hatches. Fertility was 94.31%. Hatchability on the TES and FES was 86.75 and 91.98 %, receptively. A study was carried out to investigate the carcass and meat quality traits and nutritional profile of the meat of the Kadaknath in comparison with commercial broilers.

Broiler populations

PB-1 flock was regenerated by pooled semen random matting. A total of 1134 good chicks were obtained in 3 hatches. Fertility was 92.17%. Hatchability on TES and FES was 87.79 and 95.25%, respectively. A total of 1500 fertile eggs were received from the AICRP-PB Ludhiana centre and 1439 were set. A total of 1058 good chicks were obtained. The S-1 generation (Ludhiana and DPR germplasm) of PB-1 was evaluated for juvenile growth traits. The overall means for body weight at 0 days, 2, 4, 5 and 6 weeks of age were 39.81, 252.0, 756.8, 1023 and 1342 g, respectively. Corresponding performance for Ludhiana germplasm alone was 42.57, 286, 799, 1149 and 1414 g, respectively. About 540 adult females of PB-1 (about 225 Ludhiana and 315 DPR germplasm) were housed and egg production was evaluated. PB-1 flock was regenerated by pooled semen random mating and a total of 2381 eggs were set. A total of

1960 good chicks were obtained in three hatches. Fertility, Hatchability on TES and FES basis were 91.47, 84.21 and 92.06 %, respectively.

The G-20 generation of control broiler line was regenerated. A total of 1221 good chicks were obtained in 2 hatches. Fertility was 87.75 and hatchability on TES and FES basis was 84.14 and 95.89 %, respectively. The G-20 generation was evaluated for juvenile growth traits. Average body weight at day old, 2, 4, 5, and 6 weeks of age were 35.04, 205.4, 562.7, 842.5 and 1,072 g, respectively. The sank length and breast angle at 5 weeks of age was 77.69 mm and 72.15 ^{0} respectively. About 425 adult females were housed and egg production was evaluated. The average body weight in females at 20 weeks was 2,526 g. The ASM was 166.03 days. Egg weights at 28, 32, 36 and 40 weeks of age were 49.88, 52.68, 54.03 and 57.39 g, respectively. Egg production up to 32 and 40 weeks of age was 40.33 and 72.58 eggs. The flock was regenerated by pooled semen random mating and a total of 1050 eggs were. A total of 900 good chicks were obtained in a single hatch in the G-21 generation. Fertility, hatchability on TES and FES basis were 91.90, 87.05 and 94.72 %, respectively.

The S-2 generation of PB-2 (Bengaluru) was regenerated by random mating in 3 hatches. The body weights at 4, 5 and 6week and shank length at 5 weeks were 709±1.36g, 985±2.81, 1214±5.26g and 82.28±0.15mmrespectively. Adult performance of PB-2 population up to 40 weeks were recorded. ASM, body weight at 20 and 40 weeks, egg weight at 28, 32, 36, 40 weeks were 159±2.10 days, 2316±23.28g, 2967±26.39g, 51.58±0.82g, 54.90±0.72g, 55.64±0.68g, 57.75±0.80g respectively. Egg production at 40 weeks was 75.49±1.30. S-1 generation of PB-2 was reproduced by random mating. Percent fertility, percent hatchability on TES and FES were 92.19, 86.28 and 93.59 respectively. A total of 3344 good chicks were obtained.

The S-19 generation of Naked Neck and dwarf were regenerated by random mating. In Naked Neck fertility, hatchability on TES and FES were 88.69, 74.28 and 83.75% respectively. The corresponding values in dwarf were 83.15, 69.81and 83.96%. A total of 377 good chicks were obtained in 4 hatches. Naked Neck juvenile traits such as 4 and 6 weeks bodyweight and 6 weeks shank length were 592±1.31g, 1050±2.20g and 89.62±0.71mm respectively. The corresponding values in dwarf were 481±1.42g, 791±2.81g and 78.36±0.78 mm respectively. Adult performance traits of Naked Neck such as ASM, 20, 40 weeks body weight, 28, 32, 36 and 40 weeks egg weight and 40 weeks egg production were 157±2.81days, 2454±22.23g, 2849±22.38g, 48.65±0.91g, 50.95±0.62g, 53.45±0.61g, 55.10±0.71g and 61.78±1.28 eggs respectively. The corresponding values in Dwarf gene line were 160±2.35 days,1931±20.12g, 2515±28.12g, 48.38±0.72g, 50.56±0.68g, 53.08±0.58g, 53.15±0.52g and 67.05±1.72eggs.

Layer populations

Two elite lines viz., IWH and IWI are under selection for higher egg numbers, whereas IWK, IWD, IWF, IWN, IWP and Layer Control (LC) are under random breeding programme. During reporting period, the growth and production traits up to 72 weeks were evaluated. Evaluation of three and two way layer crosses was completed. The three-way cross (DKH) birds exhibited multi-coloured plumage in contrast to the white plumage with colour patches in other two ways crosses viz., CHx, VHx, KxH and DRx. The DKH pullet and cockerel weighed 1354.53 and 1647.35g, respectively. These multi-coloured birds have thin shank and are capable of good flight which is desirable quality to escape from predators. These birds resemble mostly like a desi fowl. The annual egg production of DKH birds was 239.20± 2.96 with optimum egg weight at all ages. The farm evaluation of this promising cross capable of producing more than 200 brown eggs is completed at farm level.

Molecular genetics

Kadaknath F1 progenyPacBio Sequal II subreads into paternal and maternal haplotypes with well-defined k-mers specific to paternal and maternal Illumina data. A total of 1778006 HiFi (33770360517bp) reads having average read length of 18993.39 bp were generated from the PacBio Sequal II subreads. The segregation resulted in785202 maternal haplotypes reads (15017152695 bp) with an average reads length of 19125.21bp while paternal haplotypesread were 919345 (17583798297 bp) with an average read length of 19126.44 bp. A total of 73459 (4.13%) reads were unassigned. Using the assigned reads the haplotype-binned reads were assembled separately. To associated the Kadaknath genomic information

with the functional trails the meat profile of the Kadaknath *vis-a-vis* commercial broiler chicken was carried out. In the Kadaknath genotype, significantly ($p<0.05$) lower mean percent carcass traits were observed for the head, feather, leg, back and neck while giblet, intestine, breast, and breast meat were reported to be higher in the commercial broilers. The carcass weight and dressing percent of broilers were significantly ($P<0.05$) higher than Kadaknath birds. There was a significant difference observed between collagen solubility and collagen of broilers' meat than the meat of Kadaknath birds. Kadaknath muscle contains higher protein content compared to commercial broilers. The meat fat per cent recorded in commercial broilers was significantly ($P<0.05$) higher than in Kadaknath.

The magnum primary cell culture was established with optimized culture condition for analysing expression of transgenic cassette containing human tissue plasminogen activator (htPA) and human erythropoietin genes under *in vitro* condition. The htPA cDNA of 1689 bp was synthesized and cloned in a transgenic construct consisting of chicken ovalbumin promoter, ovalbumin poly A tail and chicken histone gene. The whole construct was cloned in pUC57 vector for further multiplication of the construct. The hERP cDNA of 582 bp was synthesized and was cloned in a transgenic construct consisting of chicken ovalbumin promoter, ovalbumin poly A tail and chicken histone gene sequence. The total length of the construct was of 3112 bp. The whole construct was cloned in pUC57 vector for further multiplication of the construct.

In a sex-specific differentiation of gonad study, the datasets (SRR4029458, SRR4029457, SRR4029464, SRR4029463, SRR4029460, SRR4029459) from NCBI were used to study the differentially expressed genes in embryonic 6th day (E6) vs embryonic 12th day (E12) and post hatch day 1 (D1) to know about the regression of right ovary in the embryonic and post-hatch period. The differentially expressed significant up and down-regulated genes during E6 to E12 were found to be 373 and 520, respectively. The significantly up-regulated genes (FGG, APOH, AHSG, HSD17B1, NME7, PROCA1, MLKL etc) during E12 was found to be involved in the pathways related to fibrinolysis, endopeptidase inhibitory activity, peptidase inhibitory activity etc., when compared to E6. The differentially expressed significant up and down-regulated genes during E12 to D1 were found to be 708 and 1136 respectively. The significantly down-regulated genes (TRAF5,CALML3, FGG, APOH, etc.,) during D1 was found to be involved in the pathway regulating the programmed cell death when compared to E12, suggesting higher programmed cell death during E12 and complete degeneration of right ovary during the post-hatch period. KEGG pathway analysis revealed HSD17B1, STEAP3, NME7, CALML3, PROCA1 and MLKL genes were involved in the various pathways leading to the right ovary regression.

The procedure for cryopreservation of stage X blastodermal cells isolated from freshly laid Kadaknath hatching eggs was standardized. The blastodermal cells were cryopreserved using 10% dimethyl sulphoxide (DMSO) in 0.25ml plastic straws. The blastodermal cells were cryopreserved in the presence of 0.1 or 0.2M sucrose. Sucrose at both the concentrations evaluated significantly improved the post-thaw live cell percent. In another experiment Kadaknath blastodermal cells were cryopreserved in the presence of 0.1, 0.2 or 0.4M trehalose. The percent live cells evaluated in the post-thawed samples indicated that trehalose at any of the concentrations evaluated did not improve the live cell percent compared to control.

Established the PGC bank of Indigenous native chicken breeds for conservation of native chickens (CRP on Agro-biodiversity). Under this we have cryo-preserved PGCs of 2 native chicken breeds namely, Kadaknath and Punjab Brown at the Institute.

Nutrition

The CO_2 equivalents for broiler and layer production was calculated based on field data collected from three locations of the country. Butyric acid in combination with organic trace minerals and NSP enzyme/phytase improved feed conversion efficiency.

Three experiments were conducted to find out viable alternate feed additives for antibiotic growth promoters in broiler chicken diet utilizing certain strains of probiotics (Bacillius velezensis, Bacillius pumilus and Bacillus amyloliquefaciens either alone or in combination –Bacitracin methylene di salicylate (BMD) was used as the antimicrobial compound in the control diet. In the first experiment the basal diet was supplemented with different strains of probiotic

named BAG17, CSG1.1, ZBMG3, PPG6, FG12 and ZBLS6 to compare the efficacy of these strains as potential alternatives to the AGP tested. The body weight gain and feed intake were not affected by supplementation of either AGP or different probiotic cultures to NC diet. The ready took yield was influenced by the treatment effect. The CMI response in broiler chicken was not affected by the dietary variations in AGP and probiotic supplementation. The HI titre was significantly affected by probiotic supplementation in the diet. Except ZBLS6 strain, all probiotic cultures significantly improved the digestibility of protein. The protein digestibility in CSG1.1, ZBMG3 or FG12 groups was similar to those fed the AGP supplemented group. The energy digestibility was similar to the AGP fed group in majority of the probiotic fed groups except PPG6 or ZBLS6, whose energy digestibility was lowest among the groups tested in the current study. The study indicated that feed antibiotic can be replaced with majority of probiotics strains tested in the current study without affecting the broiler performance. However, the performance varied among different strains of probiotics tested. Three combinations of enzymes with butyric acid, essential oil and probiotic was tested where the BWG and FI were not affected by the dietary treatments. The feed intake was significantly improved in broilers fed all the alternatives tested compared to those fed control diet. All the slaughter variables tested except the relative weight of breast meat was affected by the treatments

Six caecal metagenomic DNA samples from each of the three groups namely BMD, Negative control and the phytase+encapsulated EO were used for shotgun sequencing (Novaseq 600, 150 x 2 PE read). Taxonomic profiling was done using Kaiju, resistome analysis was done using Groot. The study indicated that the AGP BMD as well as the alternative to AGP phytase plus EO mix increased abundance of some of the beneficial bacteria in gut as compared to the negative control Large numbers of ARGs were detected in all the samples indicating omni presence of antibiotic resistance in chicken gut. It was concluded that the AGP in diet can be replaced with a combination of enzyme with BA, EO or probiotic without compromising the broiler performance. AGP in broiler chicken diet can be replaced with combination of enzymes (phytase and xylanase) and enzymes with essential oil without affecting the broiler performance.

The larva of Black soldier fly (BSF) (*Hermetiaillucens*) shows potential for use as an effective and sustainable source of protein in poultry diet. BSF larva meal (BSFLM) was tested at 0, 12, 15 and 18% levels in the diet of Vanaraja chicks in two experiments. The results of two experiments indicate that BSFLM at 15% and above levels in diet was detrimental for the performance of Vanaraja chicks, while at 12% BSFLM in diet mixed responses were observed in performance and other variables.

In the process of identification and characterization of residual feed intake (RFI) specific SNPs and candidate genes in coloured broiler an experiment has been initiated where twelve high RFI and 12 low RFI birds were slaughtered and samples collected and preserved for further sequencing and analysis for identification of SNPs etc.

A study was conducted to evaluate the effects of feeding biosynthesized zinc nano particles in comparison with organic and inorganic zinc on performance, blood biochemical profile in commercial broilers. Birds were supplemented with 40 mg of either one of the different zinc forms. i.e. inorganic zinc sulphate, commercial Zn NP, biosynthesized Zn NP and organic zinc. The results indicated that supplementation of nano zinc has beneficial effects over feeding inorganic zinc to birds.

A project was initiated to develop real time poultry environment monitoring and limited control using IoT sensors to reduce environmental stress on poultry birds and to study vocalization of poultry and correlate it with bird health, stress, gender ultimately aiming to develop an early warning system.

A study was undertaken to determine the effect of feeding low phytate maize (LPM) with varying levels of dietary non-phytate phosphorous (NPP) on performance and intestinal gene expression of NaPi-IIb, PiT-1 and PiT-2 in *Gramapriya* birds. This study demonstrated that feeding diets with LPM improved BWG and FCR in *Gramapriya* birds during nursery phase. Feeding diets with varying levels of NPP and NM or LPM influenced the expression profile of genes involved in active transport of P in small intestine of chickens.

Physiology

Plasma levels of Melatonin, Ghrelin, progesterone and estradiol during early laying period (24-28 weeks, EP) and mid-laying period (32-36 weeks, MP) were estimated in Vanaraja, Aseel, Ghagus and Nicobari breeds. In the treatment group, Se yeast product was supplemented @ 0.15g/kg for Vanaraja and 0.05g/kg feed for Aseel, Ghagus and Nicobari breeds. Gene expression studies for hormones melatonin, ghrelin receptors and amino acid transporters B^0AT, CAT, LAT2 and LAT4 were analysed.

Vermicompost was prepared with poultry litter mixed with paddy straw as supplement with C/N ratios of 35:1, 30:1 and 25:1 in a duration of 92 days. showing the feasibility of cage poultry litter generated in poultry farms successfully converted into vermicompost. The vermicompost thus produced was evaluated in the field as bio-fertilizer for green gram variety WGG-45. The fertilizer application resulted in beneficial effects on different aspects such as plant height, number of branches per plant, 50% maturity, stover yield and seed yield. A feeding trial was conducted to study the effects of supplementing moringa dry leaves powder and earthworms. Beneficial effects were observed in the egg production and immune parameters in earthworm treatment group.

Health

ALV infection status in native chickens were studied. Locus specific PCR was made to determine the status of avian leukosis subgroup E loci such as ev3, ev6, ev9 and ev21 loci in few lines maintained at the Directorate. The molecular characteristics of avian leukosis virus subgroup J has been studied by whole genome sequencing of the proviral DNA extracted from the tumour sample.

A total of 86 poultry *Escherichia coli* was isolated and the phenotypic antimicrobial sensitivity pattern of various antibiotics studied and found that highest resistance was observed for Ampicillin followed by Cefpodoxime. Poultry *Staphylococcus aureus* samples were also isolated and the phenotypic antimicrobial sensitivity pattern of various antibiotics studied.

The expression of transcripts of immune genes showed differential expression pattern in comparison to uninfected control embryos of native chicken breeds for Mesogenic Newcastle disease virus. Experimental Newcastle virus infection in coloured broiler and Vanaraja chicken indicated differential response, morbidity, mortality and immune response.

Extension

An Ex-post Facto study was conducted in Mancheral district of Telangana (TS) and Guntur district of Andhra Pradesh (AP) among Scheduled Caste (SC) households to study the poultry production and food security status. In AP majority of the SC household (74.6%) belong to landless category whereas 78% SC households of TS belong to marginal land holding category.

There was no significant difference in intake of egg in SC community of both the states. Chicken meat intake was found 9.16 and 8.03kg/person/year in TS and AP. Chicken meat consumption was significantly higher in SC community of AP than that of TS. Food security score of SC community of AP was found significantly higher than their counterpart in TS.

Regional Station, Bhubaneswar

First time in the regional station Kuzi X Khaki Campbell recorded more than 300 eggs and no earlier report in any breed or crosses reached 300 eggs upto 72 weeks of age. Fertility was better in Khaki and Kuzi X Khaki Campbell. Hatchability ranges from 73.65 to 94.72 % in different genetic groups on fertile egg set basis. Fertile eggs (1000 Nos) of Kuttanad-Chemballi ducks were procured from Government Duck farm, Niranam, Kerala and were set for hatching. The mean body weight of day old ducklings was 37.97 ± 0.13 g. The 8th week mean body weight was 1281.34 ± 6.20 g and 1193.06 ± 5.28 g for male and female ducklings, respectively. The average daily gain (ADG) was highest during 5th week 37.24 g and started declining after 12^{lth} week age in case of male growers. Age at first egg of the flock was 121 days. Transplantation of Gonadal tissues from Kadaknath (KN) chickens to White Leghorn Chickens and Khaki Campbell Ducks, as surrogates, suggested that Kadaknath male gonads were readily accepted when transplanted at day-old stages. The results showed that the transplanted male gonads continued to grow with equal efficiency, inside both intra- and interspecies surrogate hosts (WL chicken and KC ducks), demonstrating evolution of two suitable intra- and inter-species donor-host system where transplanted gonads, upon surgical recovery, were found to retain potentials to fertilize eggs of KN females and give rise to pure-line KN

chicks. Effect of two major feed-origin Mycotoxins, Aflatoxins (AFB1) and Ochratoxin (OTA) upon egg production efficiency of Ducks was analyzed which revealed that AFB1-levels emerged as the significant and most influencing factor, with most other factors as non-significant or secondary, for impact on egg production; while both the mycotoxins along with other abiotic factors, had limited of virtually-non-significant impacts on egg sizes.

Diet containing 2600 k cal ME/ kg and 16% CP were optimum for White Pekin ducks during starter stage. Similarly, for layer ducks the feed containing 2700 k cal ME / kg and 18 % CP were optimum for growth and production of White Pekin ducks during layer stages. White Pekin ducks can be raised on exclusive wheat or broken rice-based diets during second year of laying under intensive rearing system; however, mixture of wheat and broken rice in equal ratio increased the metabolisability of the nutrients of the feed. Replacement of fish meal by soybean meal with addition of amino acids i.e. lysine and methionine improved the egg quality i.e. shape index, albumen and yolk index and haugh unit. The production of earthworm in cement concrete ring was standardised. The proximate composition of earthworm meal revealed that it contains high amount moisture and crude protein. Among 3 litter materials, dry sand was found better among all in respect of performance and physiological parameters. "Duck Meat Tikka" was developed in laboratory with good organoleptic acceptance.

AICRP on Poultry Breeding

The AICRP is being operated at twelve centres viz. KVASU, Mannuthy; AAU, Anand; KVAFSU, Bengaluru; GADVASU, Ludhiana; OUAT, Bhubaneswar; ICAR-CARI, Izatnagar; ICAR RC for NEH Region, Agartala; NDVSU, Jabalpur; AAU, Guwahati; BAU, Ranchi; MPUAT, Udaipur and CSKHPKVV, Palampur. The main objectives of the project are development of location specific chicken varieties; conservation, improvement, characterization and application of native chicken, elite layer and broiler germplasm and development of package of practices for village poultry and entrepreneurships in rural, tribal and backyard areas. In addition, KVASU, Mannuthy and AAU, Anand centres are to maintain two elite layer germplasm (IWN and IWP). Similarly, KVAFSU, Bangalore; GADVASU, Ludhiana; OUAT, Bhubaneswar and ICAR-CARI, Izatnagar are to maintain four elite broiler germplasm (PB-1, PB-2, CSML and CSFL).

Pedigreed random bred control populations (control layer and control broiler) were maintained at ICAR-DPR, Hyderabad. Samples of hatching eggs from these populations were sent to different centres of AICRP on Poultry Breeding to measure the genetic progress. During the year, a total of 5,85,374 chicken germplasm was distributed to 4,819 farmers/ beneficiaries from different centres. An amount of Rs. 197.66 lakhs revenue was generated through sale of the improved chicken germplasm during the year.

The Mannuthy centre evaluated the S-33 generation of IWN and IWP strains of White Leghorn. The hen housed, hen day and survivors' egg production were 295.82, 323.70 and 328.78, respectively in IWN strain and 286.32, 318.03 and 324.08, respectively in IWP strain of White Leghorn. The body weight at 16, 40 and 64 weeks of age was 1180, 1524 and 1643g, respectively in IWN strain and 1113, 1490 and 1634 g, respectively in IWP strain of White Leghorn. The egg weight at 28, 40 and 64 weeks of age was 48.01, 51.48 and 54.01g, respectively in IWN strain and 48.73, 52.02 and 55.12g, respectively in IWP strain of White Leghorn. The evaluation of S-7 generation of native chicken is in progress. The second field trial of three-way cross for backyard purpose is also in progress. Under SCSP scheme, 140 farmers were distributed with a wood coop and 8 numbers of eight weeks old *Tellicherry* native chicken each. The centre has distributed 44,519 germplasm to 453 needy farmers and generated revenue of Rs. 12.00 lakhs.

AAU, Anand (Gujarat) centre has evaluated native chicken i.e. A*nkaleshwar* and White Leghorn strains (IWN, IWP, IWD, IWK strains and Control birds) during the year 2022. The egg production up to 40 weeks of age was 83.30 eggs in S-3 generation of *Ankaleshwar* chicken, which was higher (81.50) as compared to S-2 generation. Egg production up to 72 weeks of age was 303.40 and 301.70 eggs in IWN and IWP strains (S-2 generation), respectively. Egg production up to 64 weeks of age was 233.90 and 222.60 eggs in IWD and IWK strains (S-9 Generation), respectively. The centre has supplied a total of 50,496 chicken germplasm to 1,018 farmers. The centre has generated the revenue of Rs. 31.38 lakhs during the year 2022.

The Bangalore centre evaluated PB-1 (male line) and PB-2 (female line) and native chicken populations during the year 2022. The age at sexual maturity of PB-1 and PB-2 was 196.0 and 209.6 days, respectively and they produced 65.06 and 54.34 eggs, respectively up to 52 weeks of age. The fifth week body weight for PB-1 and PB-2 birds was 1082 and 1018 g respectively. The body weight of native chicken females at 8, 20, 40 and 52 weeks of age was 248.7, 1067, 1273 and 1389 g, respectively. Native chickens produced 30.35 eggs up to 52 weeks of age. During the calendar year a total of 1,60,759 germplasm was distributed to 299 farmers with a revenue generation of Rs. 42.92 lakhs.

The GADVASU, Ludhiana centre evaluated PB-1 and PB-2 lines and native chicken (Punjab Brown). The body weight at 5 weeks of age was 1228, 1121 and 887 g in PB-1, PB-2 and control broiler, respectively. The average egg production up to 40 weeks of age in PB-1, PB-2, and control broiler was 65, 70 and 59 eggs, respectively. The body weight in Punjab Brown at 4, 8, 16, 20 and 40 weeks of age was 346, 652, 1445, 2039 and 2744 g, respectively. The average egg production up to 36 weeks for Punjab Brown was 55 eggs. A total of 84,886 germplasms were supplied to 412 farmers. The revenue generation was around Rs. 29.64 lakhs during 2022.

OUAT, Bhubaneshwar centre evaluated the performance of pure lines such as CSFL and CSML and *Hansli* native chickens. The fifth week body weight of CSFL on combined sex basis was 1018 g with FCR of 1.94 while that of CSML was 1123 g with FCR of 1.93. The eighth week body weight of *Hansli* chickens on combined sex basis was 603.1g with FCR of 4.26. The body weight of *Hansli* birds at 20 weeks on combined sex basis was 1583g. The centre supplied a total of 1078 germplasm to 27 farmers and generated the revenue of Rs. 57,651 during 2022.

The ICAR-CARI, Izatnagar centre evaluated the local native chicken, CSML and CSFL and their crosses during the year 2022. The germplasm supply was 20,361. A total of 29 farmers were benefited.

MPUAT, Udaipur centre evaluated Mewari and *Pratapdhan* populations during the year. The hatchability on total eggs set improved in all the populations. The body weight at 40 weeks of age was 1680 g in Mewari females. The body weight of female at 20 weeks of age was 2018 g in *Pratapdhan*. The egg production at 52 weeks of age was 53.13 eggs in Mewari chicken. The annual egg production (up to 72 weeks of age) in Mewari and *Pratapdhan* was 101.13 and 162.49 respectively. Three training programmes were organized during the reporting period, benefitting 158 tribal farmers under TSP component of the project. A total of 33,005 improved chicken germplasm was distributed to 656 farmers during the calendar year. The revenue of Rs 10.01 lakhs was generated from the distribution of germplasm. Two research papers were published in journals having NAAS rating of more than 6.0 during the report period.

AAU Guwahati centre evaluated the Kamrupa variety, indigenous chicken, Dahlem Red breed and cross of PB-2 x indigenous chicken germplasm. The Kamrupa bird attained the body weight of 1220±145 g under field conditions and 1561 ± 185 g under farm conditions at 20 weeks of age. Further, at 40 weeks of age, the Kamrupa birds attained the body weight of 1960 ± 435 g under field conditions and 2480±625 g under farm conditions. The *Kamrupa* birds produced 131.4 and 162.6 eggs up to 72 weeks of age on a survivor basis, respectively under field and farm conditions. Similarly, the indigenous birds exhibited body weight of 1350±116 g at 20 weeks and 1780±151 g at 40 weeks of age. The Indigenous birds also produced 116.4 eggs up to 72 weeks of age. The Dahlem Red breed weighed 1420±129.6 g while the PB2 × Indigenous breed weighed 1971 ± 221 g at 20 weeks of age. The Dahlem Red breed produced 221.6 eggs, whereas the PB2 × Indigenous breed produced 129.8 eggs up to 72 weeks of age. During the 2022 calendar year, a total revenue of Rs. 7, 85,805 only was generated through supply of 35,407 numbers of improved germplasm to 141 farmers, contributing to the dissemination of improved genetic resources and supporting the agricultural community.

The Palampur centre evaluated the native chicken, Dahlem Red, DN cross and *Himsamridhi* during the year. In native germplasm, G-10 generation was evaluated up to 72 weeks of age. HDEP at 52 weeks and 72 weeks was 78.65 and 119.65 eggs respectively. The Dahlem Red population was evaluated (G-9 gen.) up to 52 weeks with HDEP of 144.17 eggs. The Dahlem Red X Native (DN) cross birds were produced and evaluated up to 52 weeks of age. HDEP at 40 weeks and 52 weeks was 67.36 and 108.65 eggs respectively. The chicks of *Himsamridhi* (DND) have

been produced and evaluated at farm and field level up to 52 weeks. The HDEP of *Himsamridhi* (DND) at 40 weeks and 52 weeks was 72.53 and 119.34 eggs respectively. The overall fertility was good (89.00%) and ranged between 83.60% for DR to 90.25% for Native, whereas the overall hatchability was 69.02% and 77.55% on TES and FES basis respectively. A total of 64,323 chicks were supplied to 672 farmers of Himachal hill region. The centre realized receipts of Rs 25.28 lakhs on account of sale of various poultry products.

Agartala (Tripura) centre evaluated the BND cross, Tripura Black, and Dahlem Red populations. The sixth evaluation of BND Cross for production performance has been completed at the institute farm and at the farmer's field. In the E-6 evaluation of the BND cross, the 72 weeks egg production was 159.3 and 138.8 eggs under farm and field conditions, respectively. The performance of the previous generation of Tripura Black and Dahlem Red has been completed up to 52 weeks at the farm. The 40 weeks body weight of Tripura Black females, males and pooled sex basis was 1555, 1836 and 1662 g, respectively. There was an improvement in the body weight of Tripura Black in the present generation as compared to the previous generation. The egg production up to 40 weeks (40.0) and 52 weeks (65.0) of age showed a slight reduction in Tripura Black. The egg production in Dahlem Red up to 52 weeks of age was 113.5. A total of 13 training programmes were organized on poultry farming for 772 rural farmers. A total of 21,747 poultry germplasms were supplied among 762 farmers. The centre has generated a total of Rs. 11,47,462 only revenue during the calendar year.

The Jabalpur centre evaluated G-2 population of *Jabalpur colour* and *Kadaknath* breed. *Jabalpur colour* attained body weight of 705.3g at 6 weeks and 1536 g at 20 weeks with age at sexual maturity was 155 days. Hen day EP up to 40 and 52 weeks was 99.80 and 162.0 eggs in *Jabalpur colour. Kadaknath* attained body weight of 399.4g at 6 weeks and adult body weight 1123 g at 20 weeks with age at sexual maturity was 167 days. *Narmadanidhi* (75% *Jabalpur colour* col and 25% *Kadaknath*) were evaluated under farm and field conditions. Body weight at 8 weeks under farm conditions was recorded 1010 and 725g for males and females, respectively. Under field rearing body weight at 8 weeks of age of male and female birds was 772 and 687g, respectively. The 20 weeks body weight of male (1506 and 1436g) and female (1384 and 1206g) birds under farm and field conditions were recorded. In farm rearing, birds matured at 168 days and laid 109 egg up to 52 weeks of age with egg weight of 49.0g. Under field rearing egg production up to 52 weeks of age was 93.2 eggs with egg weight of 47-48 g. A total of 28,096 chicken germplasm was distributed to 203 farmers with revenue receipts of Rs. 22.02 lakhs during the calendar year.

The Ranchi centre evaluated native chicken, Dahlem Red, PB-2 and Jharsim populations. The hen day egg production of native chickens was 176.32 eggs (G-9) at 72 weeks of age. The hen day egg production in Jharsim was 133.23 eggs up to 64 weeks of age. The centre supplied 40697 germplasm among 147 farmers and other agencies. The revenue receipt was Rs. 4.52 lakhs.

Poultry Seed Project

The Indian Council of Agricultural Research had initiated Poultry Seed Project (PSP) during the XI Five-year Plan. The main objective of this project is local production of improved chicken germplasm and supply to various stake holders in the remote areas to target production enhancement of egg and meat for augmenting rural poultry production, socio-economic condition of the target groups and linking small scale poultry producers with organized market.

The PSP centres are located at BASU, Patna; ICAR-RC for NEH region, Nagaland centre, Jharnapani; ICAR-RC for NEH region, Gangtok; ICAR-RC for NEH region, Imphal; TANUVAS, Hosur; ICAR-CCARI, Panaji; ICAR-CIARI, Port Blair; SKUAST, Srinagar; PVNRTVU, Warangal; SVVU, Tirupati; ICAR-RC for NEH region, Umiam and WBUAFS, Kolkata. The Directorate as a coordinating unit, supplies parent chicks and co-ordinates, and monitors the activities of different centres to enable them to achieve their set targets. The targets set for supplying chicks for mainland and north-eastern centres during the year 2022 were between 0.4 and 1.0 lakhs chicks per annum for different centres and to collect feedback on the performance of the germplasm under backyard farm conditions. A total of 3,58,588 improved chicken varieties have been distributed in their respective regions/states with a revenue receipt of Rs. 159.47 lakhs during the year.

Technologies transferred

The technologies and varieties developed at the institute were propagated widely throughout the country. Three contract research projects were under operation during the period. One technology developed at this Directorate was commercialised and one patent was granted. A total of 1,41,967 hatching eggs, 1,91,635 day-old chicks, and 6,179 grown-up birds of *Vanaraja*, *Gramapriya*, *Srinidhi*, *Vanashree*, *Krishibro*, native chickens, etc. were supplied by DPR, to the farmers and different organizations including Government agencies across the country. In addition, 41,829 parent chicks of different varieties were also supplied.

From the AICRP and Poultry Seed Project centres, another 585,374 and 3,58,588 numbers of germplasm, respectively were supplied. Through functional linkages with line departments and other agencies, the Directorate has been playing a pioneering role in promoting rural poultry production in the country.

ICAR-DPR implemented the Development Action Plan for SC (DAPSC) in Andhra Pradesh, Telangana, Tamilnadu and West Bengal during the year. Under the plan, On-field training programs were organized and farmer families were trained on different aspects of backyard poultry farming. Input distribution programmes were also organized in these states to start "Backyard Poultry Farming" to improve livelihoods and nutritional security of SC families. The Directorate introduced improved chicken varieties and native chickens, with an aim to improve the economic and living standards of tribal farmers under the Scheduled Tribe Component Program. Grownup birds, night shelters, feeders and waterers were distributed to benefit the tribal farmers. A mother unit was established in collaboration with ITDA, Utnoor, Telangana for distribution of grownup birds to tribal farmers of Adilabad district. To empower tribal farmers through Backyard Poultry Farming in NEH region, training and input distribution was implemented in the three states of NEH region viz. Arunachal Pradesh and Mizoram.

Other activities

During the year, a total of 35 research papers, 1 review paper, 20 popular/technical articles, 4 book chapters and 1 technical bulletin were published by the scientists of the institute. In addition, 30 research abstracts were presented in different conferences. Other priority programmes such as *Mera Gaon Mera Gaurav* and *Swacch Bharath* were implemented. The Institute Management Committee, Research Advisory Committee and Institute Research Committee continuously monitored and suggested the measures required for improvement in research, administration and financial management of the Institute. At the Directorate, the budget utilized during the period was Rs. 2942.26 lakhs and at AICRP and Poultry Seed Project centers, Rs. 619.34and Rs. 391.25 lakhs, respectively were utilized. A total revenue of Rs. 589.97 lakhs (DPR-232.84, AICRP- 197.66 and PSP-159.47 lakhs Rs.) was generated during the year 2022.

1. INTRODUCTION

HISTORY

The ICAR-Directorate of Poultry Research (formerly Project Directorate on Poultry) was established on 1st March 1988 at Hyderabad, Andhra Pradesh under the aegis of Indian Council of Agricultural Research. The Institute originated from All India Coordinated Research Project (AICRP) on Poultry Breeding, an all India Network 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. In the beginning, the coordinating unit of AICRP was located at the Poultry Research Division, Indian Veterinary Research Institute, Izatnagar till 1979, which later functioned from Central Avian Research Institute, Izatnagar till its elevation to the Directorate status in 1988. The institute was elevated from the position of Project Directorate to Directorate on 18th September 2013. Further elevation to "Indian Institute of Poultry Research" (as recommended by QRT) is under active consideration with Council. The regional station, Bhubaneshwar was transferred from CARI to DPR during July 2020. Accordingly, the total scientific strength of DPR has increased to 33.

The primary research focus at the Institute has been towards the application of quantitative genetic principles to enhance productivity of various chicken germplasm with special emphasis to meet the needs of rural and tribal people of the country. To support the core research programme research on nutrition, health, physiology and molecular genetics has been made an integral component. In addition, several externally funded projects were also carried out at the Directorate to achieve the Institute's primary goals and objectives.

The AICRP on Poultry Breeding was started during IV plan and has made significant contribution in the development of poultry sector in India over a period of time. Seven promising varieties of chicken were released for commercial exploitation for the benefit of the intensive poultry farming. Rural component of the project was added during XI plan with two centres and further strengthened in XII plan period by adding 4 more centres to carryout research in rural poultry farming. The AICRP on poultry breeding was completely re- oriented towards the rural poultry from 2014-15 with all the 12 centres to cater to the needs of the rural/tribal farmers across the country. The primary objective of the AICRP centre is to develop location specific rural chicken varieties utilizing the local native germplasm. The constant efforts of the scientists led to the development of 5 location specific varieties, viz. *Pratapdhan* (MPUAT, Udaipur), *Kamrupa* (AAU, Guwahati), *Jharsim* (BAU, Ranchi), *Narmadanidhi* (MPUAT, Jabalpur) and *Himsamridhi* (CSKHPKVV, Palampur). During XI plan, the activities of the Directorate were further expanded by introduction of 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 Poultry Seed Project was further strengthened by addition of five new centres from 2014-15 and another centre from 2017-18, thus totalling to 12. The Directorate, besides coordinating the ICAR network projects, is carrying out research in core areas of Poultry Science and supplying rural chicken germplasm to meet the demand in rural and tribal areas.

At this Directorate, three promising chicken varieties for rural poultry farming were evolved i.e., *Vanaraja,* a dual-purpose bird, *Gramapriya*, predominantly a layer, and *Srinidhi*, a dual-purpose bird meant for free-range and backyard farming. Recently, a new variety *Vanashree* (PD-4) has been developed from Aseel and is being popularised as a high producing improved native bird. These chicken varieties have become extremely popular and are being reared in every part of the country. Several user agencies in the country are involved in dissemination of the varieties covering the southern, northern, eastern and north-eastern states including Jammu and Kashmir, Lakshadweep, and Andaman and Nicobar Islands. The Directorate also developed two crosses viz. *Krishibro*, a multi-coloured broiler and *Krishilayer*, a high yielding egg producing bird for commercial purposes. Further research in this direction is underway for developing new crosses that could be tailor-made for better adaptability under diversified regions in rural and tribal backyard conditions.

Active research is being pursued to prepare package of practices for providing optimum nutrition, management and health coverage to the pure lines as well as crosses developed by the Directorate for intensive and backyard systems of rearing. Research in nutrition at this Directorate resulted in development of technologies that have been adopted

by the commercial and rural farmers to reduce cost of production. Besides nutritional knowhow, the Directorate is also familiar among poultry farming community for its services in disease diagnosis, seromonitoring and health care. The nutritional and health care solutions are being offered to 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 RNAi (gene silencing), SNP typing, microsatellite analysis, DNA marker-based selection, etc. and bioinformatics have also been undertaken in evaluating and augmenting the productivity of various chicken germplasm maintained at this Directorate. The Directorate thus is actively engaged in augmenting the productivity of chicken by undertaking research in different aspects of Poultry Science to cater to the needs of the country.

VISION

- To enhance productivity of chicken for household nutritional security, income and employment generation.

MISSION

- To develop and propagate improved varieties of chicken for sustainable production under intensive and extensive systems.

MANDATE

- Basic and applied research to enhance productivity of poultry
- Development of new germplasm for rural poultry husbandry
- Capacity building

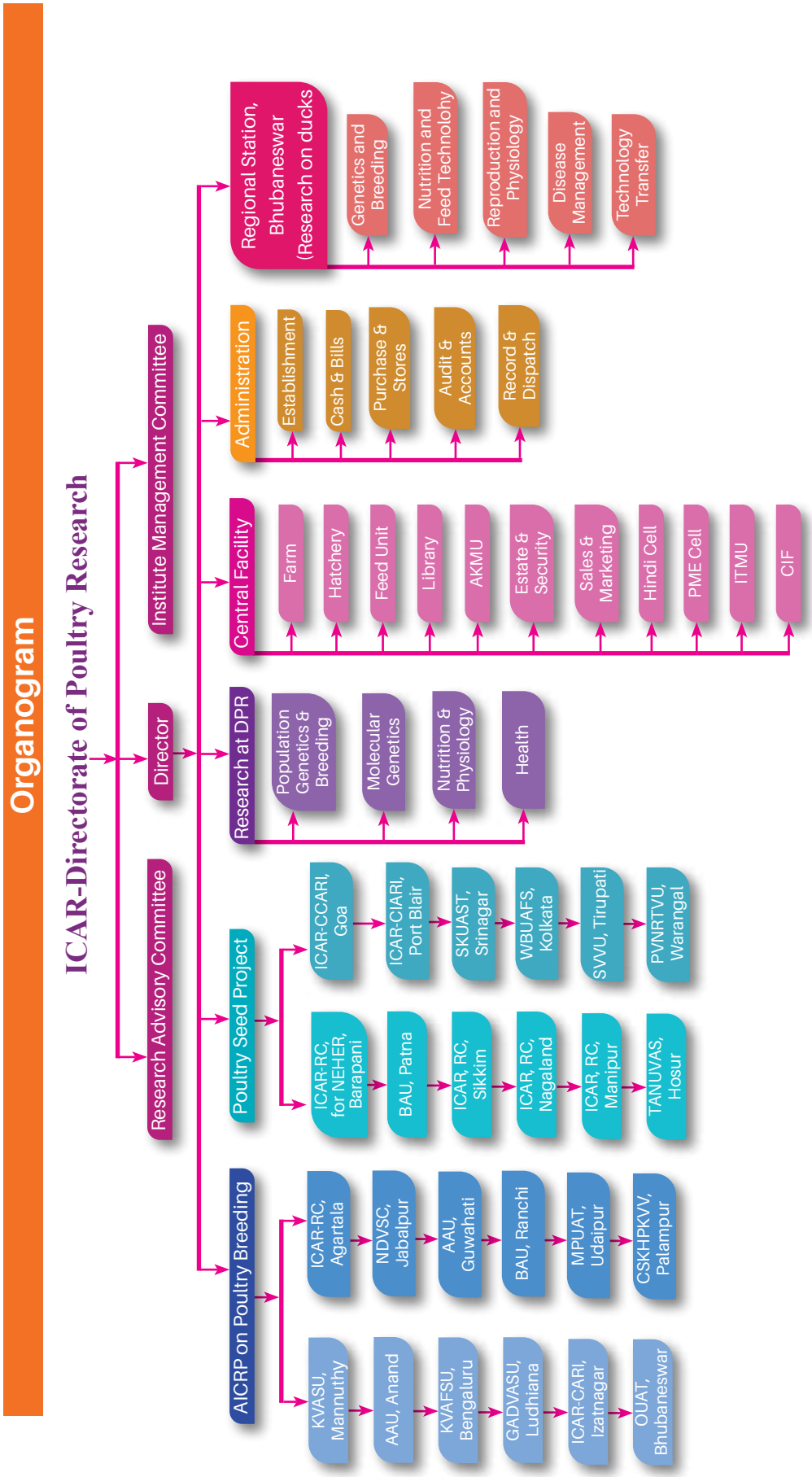
Financial outlay (Rs. lakhs)

Component	Budget	Expenditure	Receipts
DPR	2942.26	2942.26	232.84
AICRP	619.34	619.34	197.66
Seed Project	391.25	391.25	159.47

#Above indicated budget, expenditure and receipts figures are calculated proportionately from the allocations/ receipts of the years 2021-2022 and 2022-2023.

Staff position (as on December 31, 2022)

Cadre	Head Quarter, Hyderabad		RS. Bhubaneswar		Total	
	Sanctioned	In Position	Sanctioned	In position	Sanctioned	In position
RMP	01	01	-	-	01	01
HoDS	02	00	-	-	02	00
HoRC	00	00	01	00	01	00
Scientists	21	21	09	09	30	30
Technical	16	12	02	02	18	14
Admin.	23	09	-	01	23	10
Skilled Support	14	12	05	02	19	14
Total	77	55	17	14	94	69


Organogram
ICAR-Directorate of Poultry Research
Institute Management Committee
Director
Research Advisory Committee
Regional Station, Bhubaneswar (Research on ducks
Genetics and Breeding
Nutrition and Feed Technolohy
Reproduction and Physiology
Disease Management
Technology Transfer
Administration
Establishment
Cash & Bills
Purchase & Stores
Audit & Accounts
Record & Dispatch
Central Facility
Farm
Hatchery
Feed Unit
Library
AKMU
Estate & Security
Sales & Marketing
Hindi Cell
PME Cell
ITMU
CIF
Research at DPR
Population Genetics & Breeding
Molecular Genetics
Nutrition & Physiology
Health
Poultry Seed Project
ICAR-CCARI, Goa
ICAR-CIARI, Port Blair
SKUAST, Srinagar
WBUAFS, Kolkata
SVVU, Tirupati
PVNRTVU, Warangal
ICAR-RC, for NEHER, Barapani
BAU, Patna
ICAR, RC, Sikkim
ICAR, RC, Nagaland
ICAR, RC, Manipur
TANUVAS, Hosur
AICRP on Poultry Breeding
ICAR-RC, Agartala
NDVSC, Jabalpur
AAU, Guwahati
BAU, Ranchi
MPUAT, Udaipur
CSKHPKVV, Palampur
KVASU, Mannuthy
AAU, Anand
KVAFSU, Bengaluru
GADVASU, Ludhiana
ICAR-CARI, Izatnagar
OUAT, Bhubaneswar

GENETICS AND BREEDING

Genetic improvement of rural parent lines and development promising chicken varieties suitable for free range poultry farming

PD-1 line was regenerated in a random mating after 15 generation of selection for higher shank length. PD-3 line was evaluated for production performance during S-10 generation and regenerated (S-11). RIR, a new female line was procured from Indbro research farms Pvt Ltd., Hyderabad. Aseel was evaluated for growth and production characters.

PD-1 line

PD-1 population was regenerated using random mating to improve the variability in the population. PD-1 population was evaluated for juvenile traits in base population. The body weight and shank length at 4 and 6 weeks of age were416.3 and 834.0 gand 63.24 and 84.08 mm, respectively. The 20 week body weight was 1896 g with a shank length of 110.6 mm. The ASM was 178.8 days. The 40 week egg production was 38.25 eggs with 58.24 g egg weight.

Simulation study with selection index and individual selection in PD-1 line

In the present study, the selection index was constructed utilizing the five generations data of Vanaraja Male line (PD-1) for body weight (BW-6) and shank length (SL-6) at 6 weeks of age with variance, covariance estimates and heritability of both the traits. The SI was employed on three generations data on simulation basis and the selection parameters were estimated and compared with the mass selection actually practiced in the population. The least squares mean of SL-6, the primary trait of selection increased from 76.63±0.002 (G-I) to 82.85 ±0.002 mm (G-II), subsequently reduced to 80.17± 001 mm (G-III). The body weight also followed similar trend with increase in G-II and reduced in next generation. Generation had significant effect (P≤0.05) on both SL-6 and BW-6. The heritability estimates for SL-6 and BW-6 were moderate with 0.21 to 0.28 for Shank length and 0.22 to 0.27 for body weight at six weeks of age. The two traits exhibited high degree of positive association with 0.87 to 0.92 correlation coefficient. The genetic and phenotypic variance for BW-6 was 2566.28 and 13298.4 and for SL-6 was 5.42 and 32.25, respectively. The covariance between the traits was 93.98 for BW-6 and 520.06 for SL-6. The economic value for each trait was given based on the market value of Rs. 120/ kg chicken meat. The economic value estimated was Rs. 0.12/ g for body weight and Rs. 1.074/mm shank length. The final weightage for body weight and shank length was 1:8.95. Thus, the selection index constructed was I= 0.2260*BW6, g + 0.7717*SL6, mm. Selection differential was higher in SI method on pooled basis compared to mass selection in all three generations for the primary trait, SL-6. The response to selection and selection intensity was also higher in SI method compared to mass selection. A similar trend was observed for BW-6 with respect to selection differential and response to selection.

The selection differential, response and intensity were higher in SI method compared to the mass selection for SL-6 the primary trait of selection. The SI constructed with two highly heritable and correlated traits (BW-6 and SL-6) resulted in better performance in a simulation study in Vanaraja male line chicken. The study concluded that SI was superior to mass selection based on the results in Vanaraja male line chicken. However, the magnitude of h^2 was important before inferring the superiority of the SI in a breeding program. Further studies in a population with above 0.40 heritability may provide the better inference to decide the superiority of the selection method.

Table 1. Least squares mean, heritability and correlation coefficients for SL-6 and BW-6 in PD-1 chicken line.

Gen.	SL-6, mm		BW-6, g		r_g (SL-6 & BW6)	n
	Mean*	h^2	Mean*	h^2		
G-1	76.63±0.002 ^{c}	0.28±0.07	668.67±0.04 ^{c}	0.27±0.05	0.87	2182
G-II	82.85±0.002^a	0.25±0.09	814.63±0.03 ^{a}	0.26±0.07	0.92	2376
G-III	80.17±0.001 ^{b}	0.21±0.03	747.56±0.08 ^{b}	0.22±0.08	0.89	2130

*Mean with different superscripts with in the column differ significantly (P≤0.05)

Table 2. Selection differential (mm) and response to selection (mm) for shank length at six weeks of age, the primary trait in PD-1 chicken line

Generation	Male		Female		Pooled	
	Mass selection	Selection index	Mass selection	Selection index	Mass selection	Selection index
Selection Differential						
G-1	9.60	10.21	6.10	7.11	7.85	8.66
G-II	5.67	7.69	4.14	6.14	4.91	6.92
G-III	7.08	7.96	3.44	6.23	5.26	6.96
Response to selection						
G-1	2.69	2.86	1.71	1.99	2.19	2.43
G-II	1.42	1.92	1.04	1.54	1.23	1.73
G-III	1.56	1.69	0.76	1.37	1.12	1.53

Table 3. Selection differential (mm) and response to selection (mm) for body weight at six weeks of age in PD-1 chicken line

Generation	Male		Female		Pooled	
	Mass selection	Selection index	Mass selection	Selection index	Mass selection	Selection index
Selection Differential						
G-1	185.95	257.80	110.18	159.87	148.06	208.84
G-II	129.57	242.41	87.70	162.34	108.63	202.38
G-III	164.84	459.43	77.52	210.53	121.18	334.98
Response to selection						
G-1	50.21	69.61	29.75	43.17	39.98	56.39
G-II	33.69	63.03	22.80	42.21	28.24	52.62
G-III	34.62	96.48	16.28	44.21	25.44	70.36

Table 4. Selection Intensity for SL-6 and BW-6 using both methods of selection

Generation	SL-6, mm		BW-6, g	
	Mass selection	Selection index	Mass selection	Selection index
G-1	1.11	1.23	1.08	1.52
G-II	0.82	1.15	0.79	1.46
G-III	0.67	0.88	0.59	1.63

Table 5. Spearman rank correlation coefficients between selection index and mass selection

Generation	BW-6 (SI&MS)		SL-6(SI&MS)	
	Male	Female	Male	Female
G-1	0.96**	0.98**	0.52**	0.60**
G-II	0.95**	0.97**	0.69**	0.58**
G-III	0.99**	0.99**	0.60**	0.73**

** Correlation significant at the 0.01 level

PD-3 line

Juvenile performance

A total of 2854 chicks were evaluated for juvenile traits in S-10 generation. The body weight at 4 and 6 weeks of age was 163.96±0.01 and 285.88±0.02 g, respectively. The corresponding shank length was 44.06±0.001 and 54.79±0.001 mm, respectively.

Table 6. Body weights at different weeks in PD-3 (S-10)

Parameter	Body weight (g)		Shank length (mm)	
	PD-3 (n=2854)	DRC	PD-3 (n=2854)	DRC
4	163.96±0.01	130.54	44.06±0.001	40.26
6	285.88±0.02	222.48	54.79±0.001	48.82

Production performance (S-10)

The selected population of 826 hens was evaluated for growth and production performance up to 40 weeks of age during S-10 generation. The ASM was 147.6 ±0.01 days, which reduced in desired direction compared to the previous generation. The least squares mean for body weight at 20 and 40 weeks were 1614 ± 0.21 and1794 ± 0.23 g, respectively. The egg weight at 40 weeks was53.64g. The egg weight reduced marginally. The part period egg production at 40 weeks of age was 97.87 eggs, which reduced by 2 eggs from previous generation. The egg mass at 40 weeks of age was 5239 g. The egg production and egg mass at 40 weeks of age reduced marginally from the last generation. The heritability estimates for production traits were low to high from sire & dam components variance. The heritability of EM40 and EP40 was 0.13 and 0.18, which were low in magnitude (Table 7). The genetic and phenotypic correlations are presented in Table 8. The genetic and phenotypic response for egg mass and egg production are presented in Fig 1 and 2, respectively. The genetic and phenotypic response for EM 40 was 54 and 232g and for EP40 was 1.14 and 3.47 eggs per generation, respectively over last 10 generations.

Table 7. Production performance of PD-3 (S-10) line

Traits	Means		Heritability		
	PD-3 (n=826)	DRC	h^2	h^2	$h^2_{(S+D)}$
ASM (days)	147.58±0.01	147.65	0.37±0.12	0.51±0.28	0.42±0.16
Body weight, g					
20 wks	1613.50± 0.21	1614.11	0.56±0.16	0.87 ±0.32	0.71±0.20
40 wks	1794.08± 0.23	1799.24	0.57±0.16	0.94±0.31	0.75±0.17
Egg weight, g					
28 wks	49.99±0.005	50.07	0.58±0.16	0.56±0.34	0.57±0.19
32 wks	50.87±0.005	50.94	0.65±0.16	0.87±0.31	0.75±0.18
36 wks	52.38±0.004	52.41	0.46±0.12	0.45±0.39	0.44±0.21
40 wks	53.64±0.004	53.59	0.37±0.14	0.38±0.33	0.37±0.18
Egg production, no.					
40 wks	97.87±0.02	91.51	0.07 ±0.06	0.27 ±0.22	0.13±0.11
Egg Mass, g					
40 wks	5239±1.31	4963.91	0.05±0.04	0.36±0.23	0.18±0.12

Table 8. Correlation coefficients between the economic traits

	BW20	BW40	ASM	EW40	EP40	EM40
BW20	-	0.74	0.28	0.37	0.18	0.28
BW40	0.60	-	0.18	0.33	-0.17	-0.11
ASM	-0.23	0.09	-	0.27	-0.31	0.23
EW40	0.17	0.16	0.12	-	-0.23	0.22
EP40	0.06	-0.16	-0.46	0.13	-	0.98
EM40	0.12	-0.09	0.38	0.08	0.94	-

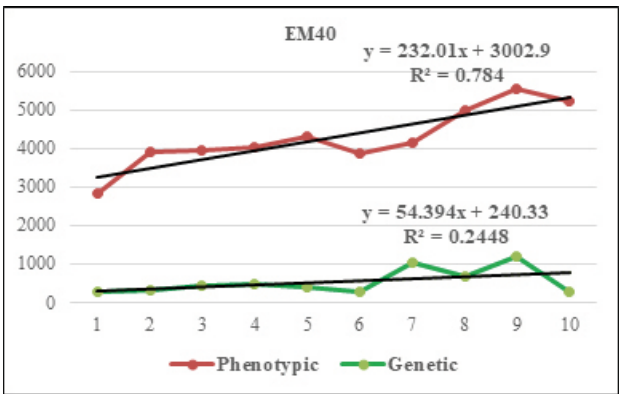


Fig. 1. Selection response for egg mass at 40 weeks of age in PD-3 line

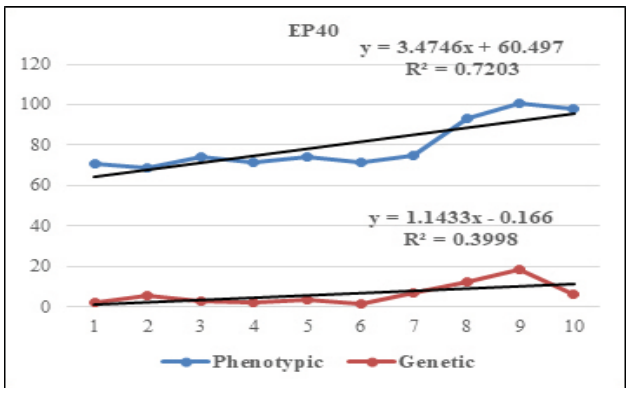


Fig. 2. Correlated response for egg production at 40 weeks of age in PD-3 line

Regeneration of PD-3 line

PD-3 population was regenerated using 50 sires and 250 dams in a pedigreed mating during S-11 generation. A total 3163 chicks were produced in S-11 generation. The fertility was 85.1% and hatchability on fertile egg set (FES) was 90.08 and on total egg set (TES) was 76.66%, respectively. The hatchability has shown the increasing trend from the last generation.

Rhode Island Red

RIR, a new female line was brought from M/S Indbro Research and Breeding farms, Hyderabad. A total 1000 fertile eggs were brought and incubated at ICAR-DPR hatchery. A total 866 good chicks were produced. The fertility was 92.74 and hatchability on FES was 87.84 and TES was 81.47. The chicks were reared till 16 weeks of age. The day old body weight was 41.5 g, much higher comparable to broiler chicks. The body weight at 4, 6 and 16 weeks of age was 146.7, 344.4 and 1327 g in females and 157.3, 386.4 and, 367.3, 1734 g in males respectively. The corresponding shank length was 43.52, 59.15 and 98.81 mm in females and 45.09, 62.91 and 119.1 mm in males, respectively.

Aseel

The Aseel population was regenerated in G-9 generation randomly, restricting AI with in plumage patterns. A total of 1118 chicks were produced in three hatches. The fertility was 84.09 % and hatchability was 81.90 (FES) and 68.87 (TES). The fertility and hatchability on FES were maintained with nominal increase in TES.

Aseel chicken was evaluated up to 40 weeks of age for growth and production traits in G-9 generation. The ASM was 203.5 days. The body weight and shank length at 4 and 6 weeks of age was 97.87 and 242.61 g and 36.48 and 54.56 mm, respectively on pooled sex. The 20 and 40 week body weight of hens was 1322 and 1845 g, respectively. The egg weight was 46.42 g at 40 weeks of age. The part period egg production up to 40 weeks of age was 19.45 eggs, which was almost similar to the previous generation.

Economic evaluation of Aseel crosses for meat purpose

The performance of the Aseel X PD-1 crossbred chicken developed for meat purpose under intensive system at farm and field conditions was carried out for

the second time. A total of 1360 birds were evaluated, of which 1080 birds were distributed to 10 farmers in different villages of Siddipet and Mahbubnagar district. 280 birds were housed in institute farm. The mean bodyweights of the crossbred chicken differ significantly (P≤0.01) between farm and field conditions at all ages of rearing except for day-old bodyweight. Significantly (P≤0.01) higher body weights were recorded in field conditions at 2nd, 4th, 6th weeks of age compared to farm conditions. Whereas higher bodyweights were observed during 8th, 10th and 12th weeks of age in farm conditions in comparison to field birds. Shank lengths of the birds reared in field conditions were significantly (P≤0.01) higher than that of the farm birds at 4th and 6th weeks of age whereas in 8th, 10th and 12th weeks, mean shank lengths of the farm birds were higher than that of the field birds.

The overall FCR for the birds reared in farm and field conditions were 2.30 and 3.01 respectively. Birds in field conditions have shown more feed intake than farm birds from initial weeks of the experiment. Comparatively higher body weights were recorded in field conditions up to six weeks of age. However, comparatively lower body weights were recorded in field conditions in the last few weeks due to addition of low-quality feed ingredients by farmers in feeding. The overall mortality (%) under farm and field conditions were 6.7% and 9.9% respectively.

Analysis of variance for the effect of sex revealed significant effect (P≤0.01) on pre-slaughter live weight, Dressing percentage, Feather weight, Legs, Heart, Gizzard, Abdominal Fat. In the present study mean value of pre-slaughter live weight for males and female chickens was 2141.85±46.95g and 1544.1±26.08g respectively. Legs, feather, and live weight were significantly higher in males than female birds, while dressing percentage, gizzard and abdominal fat were significantly higher in females than male birds.

The economic analysis of the cross bred birds was carried out from two districts taking the input and output cost of the rearing. Unlike commercial poultry production, the cost of production for rearing indigenous crossbred chicken varied from farmer to farmer due to inclusion of locally available feed grains for feeding to reduce cost of feeding. The average cost of production, average gross revenue, net profit and BCR obtained from rearing crossbred chicken under intensive system in Siddipet district were Rs.17030, Rs.34520, Rs.17490 and 2.03 whereas in Mahbubnagar district were Rs.18280, Rs. 33905, Rs.15625 and 1.94.

Table 9. Least squares mean for body weights and Shank length of crossbred chicken at biweekly intervals from 0-12 weeks of age

Age	System of rearing		P value
	Farm	Field	
N	261	975	
Body weight, g			
0 day	38.63 ± 0.26	39.89±0.14	0.062
2nd week	117.37±1.35^{b}	154.3±.727^{a}	0.01
4th week	237.70±3.43^{b}	303.17±1.83^{a}	0.01
6th week	529.09±6.57^{b}	549.36±3.51^{a}	0.01
8th week	826.05±8.29^{a}	781.94±4.43^{b}	0.01
10th week	1149.19±9.11^{a}	996.68±4.87^{b}	0.01
12th week	1482.61±12.55^{a}	1234.69±6.71^{b}	0.01
Shank length, mm			
4th week	53.50±0.30^{b}	59.39±0.16^{a}	0.01
6th week	73.43±0.37^{b}	75.33±0.20^{a}	0.01
8th week	88.69±0.40^{a}	87.24±0.21^{b}	0.01
10th week	103.49±0.43^{a}	99.15±0.23^{b}	0.01
12th week	115.25±0.54^{a}	110.83±0.29^{b}	0.01

Age	System of rearing		P value
	Farm	Field	
Mortality, %			
0-6 weeks	4.2	6.2	
7-12 weeks	2.5	3.7	
Overall	6.7	9.9	

Mean with different superscripts in a row differ significantly (P≤ 0.01)

Table 10. Average bi-weekly feed consumption, cumulative feed consumption and FCR of crossbred birds in farm and field conditions

Week	Biweekly feed intake per bird (g)		Cumulative feed intake per bird (g)		Feed conversion ratio (FCR)	
	Farm	Field	Farm	Field	Farm	Field
2nd week	128.2	153.8	128.2	153.8	1.63	1.34
4th week	230.8	256.4	359.0	410.3	1.92	1.72
6th week	610.3	625.6	969.2	1035.9	2.09	2.54
8th week	702.6	887.2	1671.8	1923.1	2.37	3.81
10th week	728.2	943.6	2400.0	2866.7	2.25	4.39
12th week	1189.7	1010.3	3589.7	3876.9	3.57	4.24
Overall FCR					**2.30**	**3.01**

Values were derived from overall feed consumption of all birds in farm and field conditions

Table 11. Least squares mean for meat quality traits of crossbred chicken slaughtered at 12 weeks of age (Expressed as percentage of live weight)

Traits	Male	Female	P value	Overall
N	**20**	**20**		**40**
Live weight, g	2141.85±46.95^{a}	1544.1±26.08^{b}	0.001	1842.97±54.35
Dressing percentage, %	74.62±0.30^{b}	76.09±0.44^{a}	0.01	75.35 ±0.29
Blood yield, %	4.76±0.26	4.15±0.36	0.188	4.45±0.22
Feather, %	9.18±0.56^{a}	5.21±0.26^{b}	0.01	7.19±0.44
Breast, %	17.20±0.46	18.67±0.30	0.12	17.93±0.29
Legs, %	22.18±0.27^{a}	20.88±0.22^{b}	0.01	21.53±0.20
Wings, %	9.76±0.25	9.78±0.10	0.960	9.77±0.13
Back and neck, %	20.92±0.49	21.21±0.29	0.609	21.06±0.28
Heart, %	0.45±0.01	0.41±0.01	0.027	0.43±0.01
Liver, %	1.80±0.04	1.88±0.05	0.307	1.84±0.03
Gizzard, %	1.83±0.07^{b}	2.21±0.07^{a}	0.01	2.02±0.05
Bursa, %	0.17±0.01	0.17±0.01	0.777	0.17±0.01
Spleen, %	0.19±0.01	0.23±0.01	0.091	0.21±0.01
Abdominal Fat, %	0.29±0.06^{b}	0.73±0.11^{a}	0.01	0.51±0.07

Means with different superscripts in a column differ significantly (P≤0.01)

Table. 12. Economics of crossbred chicken reared by ten farmers in field conditions for 0–12weeks of age in Siddipet and Mahbubnagar districts (five farmers from each district)

Gross returns (Sale of birds)	SIDDIPET		MAHBUBNAGAR	
	Quantity (kg)	Amount (Rs.)	Quantity (kg)	Amount (Rs.)
INPUT				
1. Cost of chicks @ Rs.30/bird		15000		15000
2. Feed cost				
a. DPR feed @ Rs.30/Kg	1450	43500	-	-
b. Commercial broiler feed @ Rs. 42/Kg.	100	4200	1350	51300
c. Broken rice @ Rs.5/Kg	300	1500	300	1500
d. Maize @ Rs.24/Kg	400	9648	450	10800
e. Rice bran @ Rs.30/Kg	250	7500	300	9000
Total cost of feed		66348		72600
3. Vaccination and Medicines		3800		3800
Total input cost		**85148**		**91400**
Input cost/one unit		**17030**		**18280**
OUTPUT				
1. Directly to Consumers:	**No. of birds**	**Amount (Rs.)**	**No. of birds**	**Amount (Rs.)**
Males @ Rs.600/bird	16	9600	9	5400
Males @ Rs.550/bird	19	10450	21	12100
Males @ Rs.500/bird	55	27500	47	23500
Females @ Rs.450/bird	32	14400	26	11700
Females @ Rs.400/bird	28	11200	32	12800
Total	**130**	**73150**	**135**	**65500**
2. To Retail meat centres				
Rs.250/kg	170	63750	155	58125
3. To Whole sellers				
Rs.170/kg	140	35700	180	45900
Total Gross Income		**172600**		**169525**
Net Income (Profit)		**87452**		**78125**
Total Income/unit		**34520**		**33905**
Net Income/unit (Farmer)		**17490**		**15625**

PD-2 line

PD-2 line is developed from coloured random bred control population. This line is used as female for production of Vanaraja chicks. The selection criteria is egg mass to 52 weeks. The production traits were evaluated upto 72 weeks of age during S-18 generation. The means with standard error for ASM, body weight, egg weight, egg production and egg mass upto 72 weeks of age were presented in Table 13.

The next generation was regenerated by random mating. The fertility was 86.04%and hatchability on FES and TES were 80.16% and 93.16% respectively. A total of 1836 chicks were produced in S-19 generation.Among the juvenile traits, the body weight at 2, 4 and 6 weeks of age and shank length at 6 weeks of age was evaluated. The means with standard error for body weight at 2, 4 and 6 weeks of age 169.61±0.06, 340.76±0.05 and 710.77±4.98g, respectively and shank length at 6 weeks of age was 78.43±0.001. The shank length showed marginal improvement of 1.01mm.

Table 13. Least square means production traits in PD-2 line (S-18) and Rural control

Traits	PD-2	Rural control
Age at Sexual Maturity (d)	162.47±0.07	190.38
Body weight at (g) 20wks	2204.46±1.23	2006.89
40wks	2545.28±0.94	2441.45
52wks	2673.89±0.96	2509.45
Egg weight at (g) 28wks	49.67±0.01	46.74
32wks	51.73±0.02	51.92
36wks	53.34±0.01	52.52
40wks	54.94±0.02	52.99
52wks	55.99±0.03	54.98
Egg Production (no.)		
40wks	86.80±0.94	70.26
52wks	134.06±0.98	116.19
Egg Mass (g) 52wks	7624.49±4.05	6365.82

PD-6 line

The PD-6 line was developed from coloured random bred control population. This line is used as male for production of *Gramapriya* variety and the selection criteria is shank length at 6 weeks of age. The junvenile traits were evaluated for S-11 generation. A total of2202 chicks were produced. Among the juvenile traits, the body weight at 2,4 and 6 weeks of age were 158.59±0.05, 383.59±2.34 and 848.38±3.26g, respectively. The shank length at 4 and 6 weeks of age were 67.67±0.001 and 87.56±0.001mm. respectively. The shank length at 6 weeks of age showed a response 2.60mm per generation over the last 6 generations at Phenotypic scale. During the S-11 generation the production traits were evaluated upto 40 weeks of age. The means with standered error for ASM, body weight at 20 week, 40 week were 172.88±0.07 days, 2123.61±0.93g, 2629.64±0.93g respectively. The egg weight at 28,32, 36 and 40 weeks of age were 49.81±0.01g, 51.37±0.01g, 53.31±0.04 and 54.79±0.02g, respectively. The egg production at 40 weeks of age was 69.72±020 eggs.

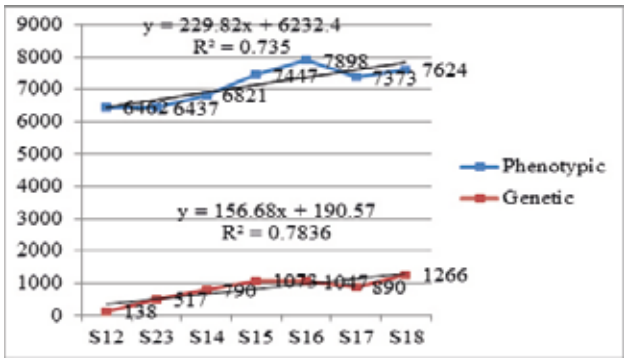


Fig.3. Selection response response for Egg Massup to 52 weeks of age in PD-2 line

Fig.4. Phenotypic response for shank length at 6 weeks of age in PD-6 line

Genetic improvement and evaluation of native chicken breeds

Vanashree

Vanashree, evolved from Aseel (PD-4), is being improved for body weight through individual selection in males and also for egg production up to 40 weeks of age through independent culling level selection in females. The production performance of fourth and fifth hatches of *Vanashree* birds during S-12 generation were evaluated up to 40 weeks of age. Age at sexual maturity, age at 50% production and age at peak production (83.02%) were 174.7±1.46, 191 and 210 days, respectively. Hen housed, hen day and SEP egg production up to 40 weeks was 49.41±1.49, 51.44 and 50.63±1.50 respectively. Egg weight at 28, 32, 36 and 40 weeks was 45.49±0.26, 46.54±0.26, 46.36±0.56, 47.87±0.28g, respectively. Egg mass up to 40 weeks of age was 2424±71.83g. The bodyweight of cocks and hens at 40 weeks was 1855±23.6 and 2844±57.6g, respectively. The shank length of cocks and hens at 40 weeks was 134.4±0.70 and 106.99±0.40 mm, respectively. The liveability observed during 21-40 weeks of age in hens and cocks was 93.58 and 96.55%, respectively.

Selection records: A total of 50 cocks having the highest body weight at 6 weeks of age were selected through individual selection and 150 hens having the highest body weight at 6 weeks and egg production up to 40 weeks of age were selected through independent culling level and mated in 1:3 ratio to produce the S-13 generation. The selection differential and selection intensity for 6 weeks bodyweight was 21.77g and 0.29σ, respectively. The selection differential and selection intensity for egg production up to 40 weeks of age was 7.29 Nos and 0.32 σ, respectively. A total of 135 dams and 50 sires contributed progenies to the S-13 generation. Therefore, the effective population size was 145.94 and rate of inbreeding was 0.0034.

Regeneration of S-13 generation

A total 919 good chicks of *Vanashree* in S-13 generation were hatched in two hatches by mating of 50 sires with 150 dams in 1:3 ratio. The average fertility recorded was 84.49% and the hatchability on fertile and total eggs set was 91.11 and 76.98%, respectively. There was significant improvement in the hatchability on fertile eggs set in this generation as compared to the previous generation. Hatchability on FES improved by 3.44%, as compared to the previous generation.

Growth traits: A total of 919 chicks of S-13 generation were wing banded and housed for the evaluation of growth traits up to 20 weeks of age. Least square means and heritability estimates of juvenile growth traits of *Vanashree* in the S-13 generation are presented in Table 14. Heritability estimates of juvenile growth traits on sire component of variance were high (except for 8-week body weight and 6- and 8-weeks shank length) indicating that there is ample additive genetic variance in the *Vanashree* population for these traits. There was an improvement of 10.1g in 6-week body weight and 24.9 g in 8-week body weight and 1.05 and 0.87mm in 6 and 8-week shank length, respectively as compared to the previous generation.

The body weight and shank length of pullets at 20 weeks of age was 1595±8.34g (N=309) and 106.8±0.21 mm (N=309), respectively while those of cockerels were 2160±19.4g (N=111) and 132.2±0.46 mm (N=111), respectively. Body weight of males and females at 20 weeks was almost comparable to those observed during previous generation while shank length (0.7 and 0.3 mm) was higher than the previous generation. The liveability of chicks averaged over first and second hatches during 0-8 weeks of age was better (95.21%) and it has improved by 1.06% over the previous generation (94.15%).

Table 14. Juvenile growth traits of *Vanashree* (S-13)

Traits	N	Mean±S.E.	$h^2_{(Sire)}$
Body weight (g)			
0 day	918	34.35±0.10	0.44±0.26
4 wks	892	200.6±1.33	0.41±0.16
6 wks	874	382.6±2.27	0.38±0.15
8 wks	872	605.2±3.37	0.20±0.13
Shank length (mm)			
6 wks	874	64.71±0.61	0.21±0.11
8 wks	869	79.08±0.19	0.27±0.07 (S+D)

Ghagus

Ghagus, an indigenous chicken breed is being improved for body weight at 8 weeks ofage. The S-4 generation (2nd and 3rd hatches) of *Ghagus* was evaluated for production traits from 21 to 40 weeks (Table 15). There was significant increase in egg production as compared to the previous generation. Hen housed, Survivors' and hen day egg production up to 40 weeks increased by 17.81, 16.92 and 16.28 eggs, respectively as compared to the previous generation. Similarly, the 40 weeks egg mass increased by 766g compared to the previous generation. Higher liveability was observed during 21-40 weeks in hens (96.61%) as compared to the previous generation (91.50%). In males, it was 95.61%.

Table 15. Production traits of *Ghagus* breed (S-4)

Traits	Mean±S.E.	N
ASM (d)	162.4±**0.76**	230
Age at 50% production (d)	171.0	-
Age at peak production (d)	186.0 (69.8%)	-
Egg production 40 wks (Nos.)		
Survivors' EP	52.16±1.48	224
HHEP	51.78±1.46	231
HDEP	51.89	-
Egg mass 40 wks (g)	2448±69.51	224
Egg weight (g)		
28 wks	46.06±0.34	192
32 wks	46.36±0.42	133
36 wks	46.37±0.42	77
40 wks	46.94±0.43	101

HHEP: Hen housed egg production, HDEP: Hen day egg production, figure in parenthesis is production percentage.

Selection records: After evaluating the production performance up to 40 weeks of age, a total of 150 hens and 50 sires having highest 8 week's body weight were selected and used to produce the S-5 generation through pedigree mating in 1:3 ratio. The selection differential and selection intensity for body weight at 8 weeks of age was 83.9 g and 0.69 σ, respectively. A total of 135 dams and 50 sires contributed progenies to the S-5 generation. Therefore, the effective population size was 145.9 and rate of inbreeding was 0.0034.

Regeneration of S-5 generation: A total of 954 pedigreed chicks were hatched in S-5 generation. The information on reproductive traits such as fertility and hatchability observed in the parents of S-5 generation is presented in Table 16. There was significant improvement in the fertility by 6.53%. This is the highest fertility recorded so far in this breed. Similarly, the hatchability on fertile eggs set and total egg set improved by 1.12 and 7.08%, respectively as compared to the previous generation.

Table 16. Fertility and hatchability of *Ghagus* (S-4) while regenerating S-5 gen.

Hatch	Fertility (%)	Hatchability (%)		Good chicks (Nos.)
		FES	TES	
1	93.88	92.93	87.24	502
2	93.28	93.83	87.52	452
Average	**93.60**	**93.35**	**87.38**	**954**

Growth traits: The S-5 generation of *Ghagus* birds was evaluated for growth traits upto 20 weeks of age. Body weights at day old, 4, 6 and 8 weeks of age were recorded while the shank length was recorded at 6 weeks of age (Table 17). Body weight at 4 weeks of age improved by 19.5g, while the bodyweight at 8 weeks of age improved by 63.6g when compared to the previous generation. Similarly, the shank length at 8 weeks of age improved by 5.09mm when compared to that recorded during S-4 generation. Heritability estimates of juvenile growth traits were moderate on sire component of variance. This indicates that there is still some additive genetic variance present in the *Ghagus* population for growth traits.

Body weight of male and female birds at 20 weeks of age was 2227±19.3 (N-135) and 1644±9.82g (N=308), respectively. Shank length of male and female birds at 20 weeks of age was 128.9±0.39 (N-135) and 104.1±0.28mm (N=308), respectively. There was an improvement of 51g in 20 week's body weight (1644±9.82g) and 0.6mm in shank length (104.1±0.28mm) of female birds in this generation. Liveability during 0-8 and 9-20 weeks of age was 95.60 and 93.97%, respectively.

Table 17. Juvenile growth traits of *Ghagus* (S-5)

Sl. No.	Age	N	Mean±S.E	$h^2_{(Sire)}$
Body weight (g)				
1	0-day	954	33.33±**0.10**	0.20±**0.21**
2	4 wks	936	**228.4±1.47**	0.23±**0.11**
3	8 wks	906	**621.3±6.07**	0.26±**0.11**
Shank length (mm)				
4	8 wks	904	**78.77±0.32**	0.35±**0.07** (S+D)

Maintenance and evaluation of *Nicobari* breed

Nicobari, an important indigenous breed of chicken is being evaluated and conserved as a purebred random mating population at the Institute. The G-9 generation was produced and evaluated for growth and production traits up to 20 weeks of age.

Regeneration of G-9 generation: The pedigreed population of *Nicobari* with a total of 574 good chicks was produced in two hatches in G-9 generation by inseminating 2 females with the semen of 1 male (1:2 ratio). The fertility recorded was 88.31%, while hatchability on fertile and total egg set was 95.75 and 84.56%, respectively. There was improvement in the fertility (1.19%) and hatchability on fertile egg set (9.34%) and total egg set (9.28%) in G-9 generation.

Growth traits: The G-9 generation of the *Nicobari* breed was evaluated for growth traits at 4 weeks interval up to 20 weeks of age (Table 18). The growth performance of *Nicobari* breed on sex wise as well as pooled sex is presented in Table 8. The effect of sex on growth traits was significant from 4 weeks onwards. Hatch effect was also significant during four and 8 weeks of age. Thereafter, no hatch effect was observed. Body weight at 4 (208.2±1.70g), 8 (558.8±4.92g) and 12 weeks (886.4±7.84g) of age has improved by 43.7, 148 and 73g, respectively while the shank length (68.85±0.47mm) at 8weeks of age increased by 7.67mm as compared to the previous generation (G-8). Liveability during 0-8, 9-20 and 0-20 weeks of age was 97.24, 97.46 and 96.28%, respectively. The liveability was excellent during all periods of growth and it was higher than that observed during previous generation (93.46, 85.73 and 80.13%, respectively).

Table 18. Growth performance (Mean±S.E.) of *Nicobari* (male and female) birds (G-9)

Sl.No.	Traits	N	Males	N	Females	P-value	Hatch effect	Pooled sex
Body weight, g								
1	0 day	282	30.69±0.13	252	30.26±0.14	NS	NS	30.46±0.09
2	4 wks	279	215.9±2.24	251	201.7±2.35	0.011	0.008	208.2±1.70
3	8 wks	280	599.9±6.31	252	515.0±6.64	0.003	0.012	558.8±4.92
4	12 wks	275	984.8±8.84	246	776.8±9.33	0.013	0.413	886.4±7.84
5	16 wks	277	1347±9.79	245	1002±10.4	0.010	0.126	1184±10.4
6	20 wks	74	1495±23.8	214	1195±11.6	0.033	0.155	1266±12.6
7	40 wks	71	2196±31.2	184	1597±16.5	0.064	0.833	-
Shank length, mm								
1	8 wks	153	71.42±0.61	136	65.96±0.65	0.0001	NS	68.85±0.47
2	12 wks	275	90.30±0.56	246	80.34±0.59	0.018	0.189	85.64±0.46
3	16 wks	277	101.6±0.59	282	86.43±0.63	0.037	0.641	94.48±0.54

Production performance: The production performance of *Nicobari* breed in G-9 generation was evaluated up to 40 weeks of age (Table 19). The ASM in this generation reduced by 10 days. The survivors' egg production up to 40 weeks of age was almost similar to the one recorded during previous generation with almost similar egg weights at 28, 32, 36 and 40 weeks of age. The egg mass recorded up to 40 weeks of age was slightly higher than that recorded during G-7 generation (3455±83.3) but lesser than that recorded during G-8 generation with a smaller number of observations (3647±141.2g, N=59). The 40 weeks egg mass recorded in this breed is perhaps the highest among all native chicken breeds maintained in the institute. The liveability observed during 21-40 weeks of age in hens and cocks was 91.80 and 95.97%, respectively.

Table 19. Production performance of *Nicobari* breed (G-9)

Traits	Mean±S.E.	N
ASM, d	161.5±**1.05**	215
Age at 50% production, d	167.0	
Age at peak production, d	191.5 (73.6%)	-
Egg production 40 wks, Nos.		
Survivors' EP	73.40±1.48	195
HHEP	71.11±1.49	216
HDEP	74.82	-
Egg mass 40 wks, g	3501±70.77	195
Egg weight, g		
28 wks	41.86±0.26	184
32 wks	46.27±0.25	188
36 wks	46.85±0.28	161
40 wks	47.70±0.26	158

HHEP: Hen housed egg production, HDEP: Hen day egg production, figure in parenthesis is production percentage.

Carcass Characteristics, Meat Quality and Nutritional Composition of Kadaknath

The study was carried out to investigate the carcass and meat quality traits and nutritional profile of the meat of the Kadaknath in comparison with commercial broilers. At the age of 27 weeks, 20 male birds of Kadaknath were randomly selected and fasted for 12 h. A total of 12 live broilers (male) of about 5 weeks of age were purchased from the retail market. The Kadaknath chickens and commercial broilers were selected on an equal body weight basis in such a way that their average body weights (1700 and 1760 g) were not significantly different from each other for the comparative study. The yield of carcass (dressing percentage) and breast was significantly higher in broilers (Table 20). The yield of organs such as liver, heart and gizzard (giblets) was significantly lesser in the Kadaknath breed when compared to those of broilers at 27th weeks of age.

Table 20. Carcass characteristics of Kadaknath and commercial broilers (Mean±S.E.).

Traits	Genotypes		*p* Value
	Kadaknath	Broilers	
Live weight (g)	1707 ± 15.9	1762 ± 54.7	NS
Yield of cut up parts (%)			
Breast	15.1 **±0.18** [b]	21.9 ± 0.47 [a]	0.0001
Legs	21.9 **±0.33** [a]	19.6 ± 0.30 [b]	0.0001
Wings	8.4 **±0.12** [a]	7.9 ± 0.15 [b]	0.0133
Back	15.3 ± 0.52 [a]	12.4 ± 0.24 [b]	0.0003
Neck	3.2 ± 0.09 [a]	1.9 ± 0.16 [b]	0.0001
Yield of organs (%)			
Liver	1.2 ± 0.06 [b]	2.7 ± 0.12 [a]	0.0001
Heart	0.5 ± 0.01 [b]	0.6 ± 0.02 [a]	0.0020
Gizzard	1.9 ± 0.08 [b]	2.9 ± 0.17 [a]	0.0001
Giblet	3.7 **±0.19** [b]	6.2 ± 0.20 [a]	0.0001
Skin	6.6 ± 0.15	6.4 ± 0.22	0.3578
Testes	0.9 ± 0.11	Trace	
Yield non-edible parts (%)			
Head	4.3 ± 0.09 [a]	2.7 ± 0.07 [b]	0.0001
Shank/Feet	4.2 ± 0.07 [a]	3.5 ± 0.18 [b]	0.0001
Blood and feather	11.3 ± 0.34 [a]	7.0 ± 0.56 [b]	0.0001
Abdominal fat	-	1.1 ± 0.10	-

Data bearing different superscripts row wise differ significantly. NS-Non-significant

Meat Quality Traits

The pH of muscles recorded at 24 and 48 h post-slaughter was significantly higher in Kadaknath than that of broilers (Table 21). The decline in pH of meat both at 24 and 48 h post-slaughter was highest in broilers as compared to the Kadaknath. The weight of the meat from breast part was higher in broilers whereas it was significantly higher in the drumstick part of Kadaknath. When breast, thigh and legs taken together, the higher quantity of meat was recorded in broilers as compared to the Kadaknath. Thigh bones of Kadaknath were heavier than broilers. The meat–bone ratio of breast and thigh parts was higher in broilers while that of the drum was significantly higher in Kadaknath. Overall, a higher meat–bone ratio was seen in broilers as compared to the Kadaknath.

Table 21. Meat quality parameters of Kadaknath and commercial broilers (Mean±S.E.).

Traits	Genotypes		*p* Value
	Kadaknath	Broilers	
pH of breast muscle			
45 min	6.53 ± 0.02	6.53 ± 0.02	NS
24 h	6.47 ±0.02 [a]	6.38 ±0.02 [b]	0.0120
48 h	6.37 ± 0.02 [a]	6.26 ± 0.02 [b]	0.0001
Decline in pH after 24 h	0.06 ± 0.01 [b]	0.15 ± 0.02 [a]	0.0003
Decline in pH after 48 h	0.16 ± 0.02 [b]	0.27 ± 0.02 [a]	0.0002
Meat weight (g)			
Breast	174.50 ±4.54 [b]	305.90 ±14.79 [a]	0.0001
Thigh	147.30 ±3.49	153.08 ±6.26	0.3884
Drumstick	136.00 ±3.20 [a]	112.20 ±4.25 [b]	0.0001
Total of breast and legs	457.80 ±7.59 [b]	571.20 ±24.10 [a]	0.0001
Bone weight (g)			
Breast	71.60 ±3.17	76.25 ±3.73	0.3611
Thigh	35.95 ±0.91 [a]	31.92 ±1.61 [b]	0.0252
Drumstick	50.20 ±1.40	50.17 ±2.26	0.9895
Total of breast and legs	157.70 ±4.18	158.30 ±5.91	0.9347
Meat–bone ratio			
Breast	2.57 ± 0.17 [b]	4.04 ± 0.13 [a]	0.0001
Thigh	4.14 ±0.14 [b]	4.89 ±0.23 [a]	0.0002
Drumstick	2.74 ±0.08 [a]	2.26 ±0.09 [b]	0.0007
Total	2.94 ± 0.09 [b]	3.61 ± 0.07 [a]	0.0001

Data bearing different superscripts row wise differ significantly. NS; Non-significant

The breast and thigh muscles of Kadaknath were significantly darker and less yellow than muscles of respective parts of broilers (Table 22). The colour intensity and chroma (saturation index) of breast and thigh muscles were significantly higher in broilers than in respective muscles of Kadaknath. However, there was no difference in redness (a*) and hue of meat of Kadaknath and broilers. Within a genotype, the breast muscles of Kadaknath were significantly lighter, less red, more yellow and had more chroma than its thigh muscles. Similarly, in broilers, the breast muscles were significantly lighter, more yellow and had less hue than the thigh muscles. The average total colour difference (ΔE) between the thigh muscles of Kadaknath and broilers was 13.19±1.18 and that of the breast muscles of Kadaknath and broilers was 8.94±1.91. The ΔE value between breast and thigh muscles of Kadaknath was 8.07±0.64 and that of breast and thigh muscles of broiler was 6.14±0.71. All four ΔE were higher than 4 indicating that the colour difference between respective muscles (thigh or breast) of broilers and Kadaknath and between thigh and breast muscles within the breed (Kadaknath and broilers) can be visually appreciated. The total colour difference was particularly high for the thigh muscles of Kadaknath and broilers as compared to the breast muscles of these two genotypes.

Table 22. Meat colour characteristics of Kadaknath and broilers after averaging 4 observations of each sample (Mean±S.E.).

Traits	Genotypes		*p* Value
	Kadaknath	Broilers	
L* **(lightness)**			
Breast	42.44 ± 0.91 ^{Ba}	50.92 ± 1.01 ^{Aa}	0.0001
Thigh	35.37 ± 0.41 ^{Bb}	47.48 ± 1.03 ^{Ab}	0.0001
p value	0.0001	0.0266	
a* **(redness)**			
Breast	−0.61 ± 0.18^{b}	−1.06 ± 0.19^{b}	0.1081
Thigh	2.18 ± 0.29 ^{a}	2.90 ± 0.45 ^{a}	0.1924
p value	0.0001	0.0001	
b* **(yellowness)**			
Breast	6.23 ± 0.49^{Ba}	8.99 ± 0.31^{A}	0.0001
Thigh	4.17 ± 0.27^{Bb}	8.98 ± 0.30^{A}	0.0001
p value	0.0001	0.9699	
Hue (H*)			
Breast	−0.63 ± 0.29^{b}	−1.18 ± 0.25^{b}	0.1934
Thigh	0.95 ± 0.14^{a}	1.26 ± 0.05^{a}	0.1089
p value	0.0001	0.0001	
Chroma (C*)			
Breast	6.36 ± 0.45^{Ba}	9.08 ± 0.30^{A}	0.0001
Thigh	4.80 ± 0.33 ^{Bb}	9.56 ± 0.28 ^{A}	0.0001
p value	0.009	0.2637	

Data bearing different uppercase superscripts row wise and figures bearing different lowercase superscript column wise (under each trait) differ significantly.

Nutrient Composition Analysis

The breast meat of Kadaknath had significantly more protein content and less moisture, less fat, less ash and less gross energy content than those of breast meat of broilers (Table 23).

Table 23. Proximate principles (on dry matter basis) of meat of Kadaknath and commercial broilers (Mean±S.E.).

Traits (%)	Genotypes		*p* Value
	Kadaknath	Broilers	
Moisture	73.50 ± 0.14 ^{b}	74.68 ± 0.22 ^{a}	0.0001
Crude protein	24.24 ± 0.16 ^{a}	23.09 ± 0.23 ^{b}	0.0002
Lipids (Fat)	1.24 ±0.09 ^{b}	1.61 ±0.06 ^{a}	0.0075
Total ash	1.19 ± 0.03 ^{b}	1.30 ± 0.04 ^{a}	0.0310
Gross Energy * (kcal/kg)	4259 ± 16.4 ^{b}	4420 ± 16.5 ^{a}	0.0001

*Calculated, Data bearing different superscripts row wise differ significantly.

Amino Acid Profile

The analysis of the composition of amino acids in meat samples revealed that (Table 24) lysine, methionine, phenylalanine, valine and arginine were the most abundant indispensable amino acids in both genotypes. Among dispensable amino acids, glutamic acid, proline and tyrosine were the most abundant in both types of chickens. The Kadaknath meat was rich in leucine and tryptophan while broiler meat was rich in histidine, methionine and threonine indispensable amino acids. It was observed that the Kadaknath meat had significantly higher content of most of the dietary non- indispensable amino acids (except tyrosine) as compared to the broiler meat. Overall, the Kadaknath meat had contained significantly higher quantity of 11 amino acids in comparison to 3 amino acids in broilers while no significant difference was seen in the content of 5 amino acids. The Kadaknath meat had significantly higher content of amino acids (alanine, asparagine, glutamic acid, glycine and serine) which are known to impart a sweet and umami (savoury) taste to the meat as compared to the broiler meat. The study concluded that the carcass and meat quality traits and nutrient composition of Kadaknath birds differed from those of commercial broilers. Although both genotypes differed in the contents of both dispensable and indispensable amino acids, there was no considerable difference in meeting the WHO recommended daily requirements (adult human) of indispensable amino acids.

Table 24. Amino acid composition of Kadaknath and broiler meat on fresh weight basis (Mean±S.E.).

Amino Acids (g/100 g of Meat)	Genotypes		*p* Value
	Kadaknath	Broilers	
Indispensable amino acids			
Arginine	2.00 ± 0.10	2.24 ± 0.11	0.1371
Histidine	0.030 ± 0.001 [b]	0.036 ± 0.002 [a]	0.0182
Leucine	1.14 ± 0.05 [a]	0.93 ± 0.09 [b]	0.0324
Lysine	4.00 ± 0.17	4.20 ± 0.22	0.4761
Methionine	2.52 ± 0.08 [b]	3.03 ± 0.18 [a]	0.0062
Phenylalanine	2.37 ± 0.07	2.52 ± 0.23	0.4498
Threonine	0.87 ± 0.04 [b]	1.04 ± 0.08 [a]	0.0422
Tryptophan	0.005 ± 0.0008 [a]	0.002 ± 0.0003 [b]	0.0222
Valine	2.48 ± 0.074	2.66 ± 0.15	0.2386
Non-indispensable amino acids			
Alanine	0.37 ± 0.04 [a]	0.12 ± 0.01 [b]	0.0002
Aspargine	0.04 ±0.003 [a]	0.02 ±0.002 [b]	0.0001
Aspartic acid	0.10 ± 0.013 [a]	0.03 ± 0.003 [b]	0.0002
Citrulline	0.02 ± 0.002 [a]	0.006 ± 0.0009 [b]	0.0001
Cysteine	0.024 ± 0.004 [a]	0.007 ± 0.0008 [b]	0.0038
Glutamic acid	2.78 ± 0.12 [a]	1.89 ± 0.14 [b]	0.0001
Glycine	0.002 ± 0.0002 [a]	0.0006±0.000005 [b]	0.0002
Proline	2.25 ± 0.11 [a]	1.71 ± 0.12 [b]	0.0035
Serine	0.69 ± 0.05 [a]	0.31 ± 0.04 [b]	0.0001
Tyrosine	1.15 ± 0.07	1.35 ± 0.15	0.1981
Tasty amino acids *	4.74 ± 0.21 [a]	3.38 ± 0.24 [b]	0.0003

*Tasty amino acids: sum of alanine, asparagine, glutamic acid, glycine, serine and threonine, data bearing different superscripts row wise differ significantly.

Genetic improvement of synthetic coloured broiler male line (PB-1) and maintenance of Broiler Control population

Genetic improvement of synthetic coloured broiler male lines (PB-1)

Regeneration and strengthening of the flock

PB-1 flock was regenerated by pooled semen random matting. A total of 1134 good chicks were obtained in 3 hatches. Fertility was 92.17%. Hatchability on total egg set and fertile eggs set was 87.79 and 95.25%, respectively. As compared to the last generation there is an improvement in fertility. To add variability and strengthen the flock size, hatching eggs were procured from the AICRP-PB Ludhiana centre. A total of 1500 fertile eggs were received and 1439 were set. A total of 1058 good chicks were obtained.

Table 25. Incubation and hatching performance of PB-1population (S-1)

Hatches	No of eggs set	No of eggs transferred	Fertility (%)	Hatchability (%)		Total No of good chicks
				TES	FES	
Ludhiana-1	1439	1231	85.55	76.72	89.68	1058
DPR-2	434	400	92.17	87.79	95.25	371
DPR-3	486	428	88.07	79.42	90.19	377
DPR-4	442	404	91.40	87.33	95.54	386
DPR- Overall	1362	1232	90.46	84.65	93.59	1134
Overall	2801	2463	87.93	80.58	91.64	2192

Performance of Juvenile traits in S-1 Generation

During the period under the report, the S-1 generation (Ludhiana and DPR germplasm) of PB-1 was evaluated for juvenile growth traits. The overall means for body weight at 0 days, 2, 4, 5 and 6 weeks of age were 39.81, 252.0, 756.8, 1023 and 1342g, respectively. Corresponding performance for Ludhiana germplasm alone was 42.57, 286, 799, 1149 and 1414 g, respectively.

Table 26. Performance of Juvenile traits in PB-1 (S-1)

Traits/ Generation	S-1 (Ludhiana & DPR combined)
Body weight (g) 0 day	39.81±0.15 (643)
4 wks	756.8±5.2 (696)
5 wks	1050±3.9 (2104)
6 wks	1342±5.8 (767)
Breast angle (^{0}) 5wks	74.04±0.16 (687)
Shank length (mm) 5 wks	83.92±0.13 (1721)

Table 27. Production Performance of PB-1

Traits	S-1 (Ludhiana & DPR combined)
Body weight at 20 wks	
Male	3,317±41.8 (74)
Female	2,573±14.9 (489)
Body weight at 40 wks	
Male	4,339±66.5 (61)
Female	3,195±19.2 (446)
ASM, days	169.74±1.03 (447)
Egg weight, g	
28 wks	53.13±0.24 (368)
32 wks	55.14±0.24 (374)
36 wks	57.73±0.27 (345)
40 wks	59.68±0.27 (339)
Egg Production (Nos)	
28 wks	20.51±0.52 (395)
32 wks	37.12±0.72 (403)
40 wks	72.85±1.06 (343)

About 540 adult females of PB-1 (about 225 Ludhiana and 315 DPR germplasm) were housed and egg production was evaluated. The average body weight at 20 weeks in females was 2,573 g. The ASM was 169.74 days. Egg weights at 28, 32, 36 and 40 weeks of age were 5313, 55.14, 57.73 and 59.68 g, respectively. Egg production up to 32 and 40 weeks of age was 37.12 and 72.85 eggs.

Regeneration of the PB-1 flock

PB-1 flock was regenerated by pooled semen random mating and a total of 2381 eggs were set. A total of 1960 good chicks were obtained in three hatches. Fertility, Hatchability on TES and FES basis were 91.47, 84.21 and 92.06%, respectively. There is an improvement in fertility and hatchability parameters compared to the last generation.

Table 28. Incubation and hatching performance of PB-1population (S-2)

Hatches	No of eggs set	No of eggs transferred	Fertility (%)	Hatchability (%)		Total No of good chicks
				TES	FES	
1	839	765	91.18	84.15	92.29	696
2	890	833	93.60	86.18	92.08	750
3	652	580	88.96	81.60	91.72	514
Overall	2381	2178	91.47	84.21	92.06	1960

Pedigreed random bred broiler control line (CB)

Regeneration of the CB flock (G-20)

Available adult females were mated with pooled semen and regenerated. A total of 1221 good chicks were obtained in 2 hatches. Fertility was 87.75 and hatchability on TES and FES basis was 84.14 and 95.89 per cent, respectively. Fertility and hatchability were improved compared to the previous two generations.

Table 29. Incubation and hatching performance of broiler control population (G-20)

Hatches	No of eggs set	No of eggs transferred	Fertility (%)	Hatchability (%)		Total No of good chicks
				TES	FES	
1	703	635	90.33	88.62	98.11	614
2	766	654	85.38	80.03	93.73	607
Total/ Average	1469	1289	87.75	84.14	95.89	1221

Performance of Juvenile traits (G-20)

During the period under the report, the G-20 generation of the control broiler line was evaluated for juvenile growth traits. Average body weight at day old, 2, 4, 5, and 6 weeks of age were 35.04, 205.4, 562.7, 842.5 and 1,072 g, respectively. The sank length and breast angle at 5 weeks of age was 77.69 mm and 72.15 ^{0} respectively.

Table 30. Performance of Juvenile traits in CB (G-20)

Traits/ Generation	G-20
Body weight (g) 0 day	35.04±0.14 (349)
4 wks	562.7±4.93 (579)
5 wks	842.5±5.37 (1166)
6 wks	1,072±7.5 (713)
Breast angle (^{0}) 5 wks	72.15±0.26 (351)
Shank length (mm) 5 wks	77.69±0.20 (688)

Table 31. Production Performance of CB

Traits	G-20
Body weight at 20 wks	
Male	3,275±31.6 (68)
Female	2,526±9.53 (441)
Body weight at 40 wks	
Male	4,270±46.1 (65)
Female	3,053±17.52 (403)
ASM, days	166.03±0.78 (408)
Egg weight, g	
28 wks	49.88±0.23 (367)
32 wks	52.68±0.21 (347)
36 wks	54.03±0.21 (343)
40 wks	57.39±0.24 (354)
Egg Production (Nos)	
28 wks	21.26±0.47 (387)
32 wks	40.33±0.61 (391)
40 wks	72.58±0.89 (346)

Production Performance of CB

About 425 adult females were housed and egg production was evaluated. The average body weight in females at 20 weeks was 2,526 g. The ASM was 166.03 days. Egg weights at 28, 32, 36 and 40 weeks of age were 49.88, 52.68, 54.03 and 57.39 g, respectively. Egg production up to 32 and 40 weeks of age was 40.33 and 72.58 eggs.

Regeneration of the CB flock (G-21)

CB flock was regenerated by pooled semen random mating and a total of 1050 eggs were. A total of 900 good chicks were obtained in a single hatch in the G-21 generation. Fertility, Hatchability on TES and FES basis were 91.90, 87.05 and 94.72%, respectively. There is an improvement in fertility and hatchability (TES) parameters compared to the G-20 generation.

Table 32. Incubation and hatching performance of CB (G-21)

Hatches	No of eggs set	No of eggs transferred	Fertility (%)	Hatchability (%)		Total No of good chicks
				TES	FES	
Overall	1050	986	91.90	87.05	94.72	900

Performance of Kadaknath

Kadaknath, an indigenous chicken, breed was evaluated for egg production performance up to 72 weeks of age in the G-2 generation. Egg production up to 40, 64 and 72 weeks of age were 77.31±0.92 (399) 166.8±1.89 (341) and 188.7±2.16 (299) eggs, respectively. Egg weight at 40 weeks of age was 44.75±0.15 (358) g.

G-3 generation of Kadaknath was regenerated by pedigreed random matting. A total of 46 sires and 138 dams, which were negative for ALV, were utilized. About 1,177 eggs were set and 1004 good chicks were produced in 3 hatches. Fertility was 94.31%. Hatchability on the total egg set and fertile egg set was 86.75 and 91.98%, receptively.

Table 33. Incubation and hatching performance in Kadaknath (G-3)

Hatch No	No of eggs set	No of eggs transferred	Fertility (%)	Hatchability (%)		Total No of good chicks
				TES	FES	
1	490	467	95.31	87.55	91.86	423
2	248	229	92.34	87.10	94.32	212
3	439	414	94.31	85.65	90.82	369
Overall	1177	1110	94.31	86.75	91.98	1004

The overall mean of body weight at 0 day and 4, 8, 12, 14 and 16 weeks of age were 29.75, 166.5, 489.1, 808.9, 960.5 and 1,121g, respectively. There is an improvement in body weights over the previous generation (BW12: 695.8g, BW16: 1,038g). The average shank length measured at 16 weeks of age was 101.92 mm. The average body weight of males and females at 16 weeks of age were 1,305 and 988 g, respectively and corresponding values during the previous generation were 1,237 and 915g, respectively.

Table 34. Growth performance of Kadaknath (G-3)

Traits	G-3
Body weight at (g)	
0 day	29.75±0.11 (786)
4 wks	166.5±1.06 (912)
8 wks	489.1±3.17 (914)
12 wks	808.9±6.04 (834)
14 wks	960.5±6.80 (831)
16 wks	1,121±7.98 (826)
16 wks: Male	1,305±12.52 (257)
16 wks: Female	988.01±6.62 (423)
Shank Length (mm)	
16 wks	101.92±0.33 (824)

A total of about 440 adult female birds were housed for performance evaluation. Body weight at 20 weeks of age was 1,615 g in males and 1,202 g in females. The ASM was 173.05 days and maintained as compared to the previous generation (173.25 days). Egg production up to 32 weeks was 41.79 eggs and which showed an improvement of 3.46 eggs compared to the previous generation.

Table 35. Adult Body Weight in Kadaknath (G-3)

Traits	G-3
Body weight at (g)	
20 wks: Male	1,615±12.38 (265)
20 wks: Female	1,202±8.60 (425)
Shank Length at (mm) 20 wks	
Male	116.35±0.41 (265)
Female	97.68±0.36 (425)
Body weight at 40 wks (g)	
Male	2,405±45.2 (52)
Female	1,525±12.21 (370)
Shank Length at (mm) at 40 wks	
Male	121.21±0.95 (52)
Female	95863±0.25 (370)

Table 36. Production performance of Kadaknath (G-3)

Traits	G-3
ASM (d)	173.05±0.80 (392)
Egg weight at (g)	
28 wks	40.13±0.15 (340)
Egg Production (Nos)	
32 wks	41.79±0.70 (384)

Table 37. Juvenile trait performance of PB-2 S-2 generation Bengalure and S-0 generation of Ludhiana

Trait	S-2 generation of Bengalure Mean± S.E	S-0 Generation of Ludhiana Mean±S.E
4WK Body weight(g)	709±1.36	651±1.10
5WK Body weight(g)	985±2.81	954±2.32
5WK Shank length (m.m)	82.28±0.15	79.28±0.20
6WK Body weight	1214±5.26	1254±4.10

Table 38. Adult performance traits in PB-2 Population up to 40WK of age

Trait	Mean±S.E
ASM (Days)	159±2.10
20WK Body weight(g)	2316±23.28
40WK Body weight (g)	2967±26.39
28WK Egg wight(g)	51.58±0.82
32WK egg weight(g)	54.90±0.72
36WK egg weight(g)	55.64±0.68
40WK egg weight(g)	57.75±0.80
40WK egg production (No)	75.49±1.30

Genetic improvement of coloured Synthetic broiler female line (PB-2)

S-2 generation of PB-2 (Bengaluru) was regenerated by random mating. It is regenerated in 3 hatches. The body weights at 4, 5 and 6week and shank length at 5weekwere 709±1.36g, 985±2.81, 1214±5.26g and 82.28±0.15mmrespectively. The corresponding values in S-0 generation of Ludhiana population were 651±1.10g, 954±2.32g, 1254±4.10 and 79.28±0.20 mm. Adult performance of PB-2 population up to 40 weeks were recorded. ASM, bodyweight at20 and 40 week, Egg weight at 28, 32, 36, 40 week were 159±2. 10 days, 2316±23.28g, 2967±26.39g, 51.58±0.82g, 54.90±0.72g, 55.64±0.68g, 57.75±0.80g respectively. Egg production at 40 week was 75.49±1.30. S-1 generation of PB-2 was reproduced by random mating. Percent fertility, percent hatchability on total eggs set (HTES) and percent hatchability on fertile eggs set (HFES) were 92.19, 86.28 and 93.59 respectively. A total of 3344 good chicks were obtained.

Dwarf and Naked Neck gene lines:

S-19 generation of Naked Neck and dwarf were regenerated by random mating. In Naked Neck percent fertility, percent hatchability on total eggs set (HTES) and hatchability on fertile eggs set (HFES) were 88.69, 74.28 and 83.75 respectively. A total of 598 good chicks were obtained in 2 hatches. The corresponding values in dwarf were 83.15, 69.81and 83.96. A total of 377 good chicks were obtained in 4 hatches. Naked Neck juvenile traits like 4 and 6 week bodyweight and 6 week shank length were in 592±1.31g, 1050±2.20g and 89.62±0.71mm respectively. The corresponding values in dwarf were 481±1.42g, 791±2.81g and 78.36±0.78mm respectively. Adult performance traits of Naked Neck like ASM, 20, 40 week bodyweight, 2832, 36 and 40 week egg weight and 40 week egg production were 157±2.81 days, 2454±22.23g, 2849±22.38g, 48.65±0.91g, 50.95±0.62g, 53.45±0.61g, 55.10±0.71g and 61.78±1.28 eggs respectively. The corresponding values in Dwarf gene line were 160±2.35 days, 1931±20.12g, 2515±28.12g, 48.38±0.72g, 50.56±0.68g, 53.08±0.58g, 53.15±0.52g and 67.05±1.72 eggs here is no change in the traits values in Naked Neck and Dwarf gene lines when compared with the last generation.

Table 39. Juvenile trait performance of Naked Neck and Dwarf Population S-19 generation

S.No.	Trait	Naked Neck Mean±S.E	Dwarf Mean±S.E
1	4WK Body weight (g)	592±1.31	481±1.42
2	6WK body weight (g)	1050±2.20	791±2.81
3	6WK Shank length (m.m)	89.62±0.71	78.36±0.78

Table 40. Adult Performance Traits of Naked Neck and Dwaf Population S-19 generation

S.No.	Trait	Naked Neck Mean±S.E	Dwarf Mean±S.E
1	ASM(Days)	157±2.81	160±2.35
2	20WK Body weight(g)	2454±22.23	1931±20.12
3	40WK Body weight (g)	2849±22.38	2515±28.12
4	28WK Egg weight(g)	48.65±0.91	48.38±0.72
5	32WK Egg Weight(g)	50.95±0.62	50.56±0.68
6	36WK Egg Weight (g)	53.45±0.61	53.08±0.58
7	40WK Egg weight (g)	55.10±0.71	53.15±0.52
8	40WK egg production (No.)	61.78±1.28	67.05±1.72

Improvement and maintenance of elite layer germplasm

Under the layer project, two elite lines viz., IWH and IWI are under selection for higher egg number whereas IWK, IWD, IWF, IWN, IWP and Layer Control (LC) are under random breeding programme. During reporting period, the growth and production traits up to 72 weeks were evaluated. Evaluation of three and two way layer crosses was completed. The growth and production traits of the pure lines and their crosses were presented in Table 41 and 41, respectively. The three way cross (DKH) birds exhibited multi-coloured plumage in contrast to the white plumage with colour patches in other two ways crosses viz., CHx, VHx, KxH and DRx. The DKH pullet and cockrel weighed 1354.53 and 1647.35g, respectively. These multi-coloured birds have thin shank and are capable of good flight which is desirable quality to escape from predators. These birds resemble mostly like a desi fowl. The annual egg production of DKH birds was 239.20± 2.96 with optimum egg weight at all ages. The farm evaluation of this promising cross capable of producing more than 200 brown eggs is completed at farm level. Field trials of the tree way cross is initiated and is in progress.

A flock of three way cross (DKH) birds

Table 41. Least square means and SE (g) of body weights in layer lines and their crosses

Line	4WK	8WK	16WK	20 WK	40 WK	52 WK	64 WK	72 WK
IWH (S-8)	-	435.86±3.10	1033.40±5.40	1255.30±6.54	1522.13±10.06	1531.07±9.86	1587.45±10.92	1609.97±11.57
IWI(S-8)	189.09±2.36	412.31±3.74	915.74±5.47	1134.77±6.33	1390.65±10.08	1374.42±11.43	1450.83±11.01	1487.66±12.25
IWK (S-16)	-	424.78±4.60	942.71±6.25	1162.40±7.04	1385.30±11.51	1393.89±12.55	1431.87±12.99	1507.52±13.90
LC(S-16)	193.48±2.45	431.06±4.61	984.14±5.65	1226.01±6.98	1500.50±10.61	1510.68±11.98	1589.81±11.97	1640.85±12.43
IWD(G-3)	-	-	-	1206.82±10.12	1461.88±15.50	1508.24±18.17	1610.63±20.69	1572.77±20.15
IWF(G-3)	-	-	-	1160.84±10.86	1435.15±14.70	1498.90±17.59	1496.28±20.93	1608.34±21.62
IWN (G-1)	117.63±5.49	306.35±17.59	1012.46±32.89	1278.67±42.72	1589.78±34.89	1564.14±20.32	1588.75±22.92	1606.42±26.91
IWP (G-1)	106.07±4.63	307.85±14.21	980.10±20.63	1214.92±32.41	1519.90±37.35	1554.60±29.41	1572.50±28.85	1597.22±28.44
DKH	-	447.88±4.18	1067.25±7.88	1354.53±8.89	1676.76±13.29	1689.22±14.81	1733.24±14.82	1875.74±17.49
CHx	328.64±5.13	781.14±9.16	1568.15±13.54	1801.24±15.91	2124.16±39.24	2284.56±30.30	2355.78±32.52	2546.65±37.18
VHx	280.33±4.64	648.14±8.20	1428.50±12.18	1740.58±13.48	2012.76±24.46	2101.81±22.54	2226.65±24.76	2301.49±28.78
KxH	289.66±4.28	338.50±5.17	1039.61±13.44	1111.61±12.04	1648.68±23.40	1636.46±23.96	1685.63±25.93	1774.16±28.25
DRx	339.11±6.50	442.70±7.61	1248.47±14.48	1404.91±18.85	1782.13±21.36	1833.53±26.99	1963.54±29.68	1960.08±45.82

CHx = PD-1 x IWH; VHx = PD-2 x IWH; KxH = Kadaknath x IWH; DRx = PD-3 x IWH; DKH = PD3 x (KxH)

Table 42. Least square means and SE of production traits in layer lines and their crosses

Line	ASM (days)	EW28 (g)	EW40 (g)	EW52 (g)	EW64 (g)	EW72 (g)	EP40 (Nos.)	EP52 (Nos.)	EP64 (Nos.)	EP72 (Nos.)
IWH (S-8)	136.33 ± 0.43	48.18 ± 0.15	50.65 ± 0.18	55.08 ±0.24	54.55±0.29	55.76±0.27	117.57 ±0.84	183.84±1.38	243.39±2.29	273.52±2.70
IWI (S-8)	141.35 ± 0.60	48.08 ± 0.17	49.77 ± 0.22	54.56 ±0.28	53.99±0.30	55.08±0.37	113.56 ±0.95	179.37±1.48	231.54±2.33	261.73±2.86
IWK (S-16)	142.64 ± 0.71	47.52 ± 0.18	51.06 ± 0.23	56.36 ±0.29	55.86±0.33	56.77±0.31	107.02 ±1.13	171.45±1.66	227.59±2.53	261.01±3.15
LC (S-16)	148.70 ± 0.65	48.15 ± 0.16	50.96 ± 0.18	54.59±0.26	54.86±0.23	56.20±0.26	99.17 ± 0.93	161.91±1.29	217.25±1.91	250.16±2.23
IWD (G-3)	150.79 ± 0.54	48.12 ± 0.26	52.97 ± 0.26	53.23±0.40	53.90±0.38	54.86±0.41	116.32 ±1.15	178.43±1.93	229.78±3.59	260.06±4.78
IWF (G-3)	150.52 ± 0.65	46.49 ± 0.26	50.33 ± 0.29	51.17±0.31	53.17±0.40	52.95±0.43	113.59 ±1.31	161.99±3.44	216.42±3.50	246.44±4.40
IWN (G-1)	141.92 ± 0.29	45.15± 0.67	51.33± 0.54	52.63± 0.52	53.15± 0.90	51.67± 0.77	111.10± 5.89	178.90± 11.09	261.50± 7.76	292.25± 11.85
IWP (G-1)	143.00 ± 0.81	43.31± 0.92	49.10± 0.77	50.40± 1.22	52.87± 1.04	53.27± 0.74	124.33± 1.83	193.56± 3.60	238.78± 3.76	271.45± 5.93
DKH	148.24 ± 0.94	50.98 ± 0.21	51.94 ± 0.24	56.43±0.37	56.55±0.31	58.69±0.37	100.11± 1.20	149.60±2.11	205.90±2.64	239.20±2.96
CHx	142.54 ± 0.92	51.47 ± 0.33	54.19 ± 0.48	57.87±0.44	59.24±0.42	59.92±0.90	79.76 ± 1.76	117.10±3.23	163.90±4.13	190.20±4.85
VHx	142.46 ± 0.90	51.61 ± 0.33	53.41 ± 0.44	56.70±0.45	57.27±0.35	58.44±0.46	99.65 ± 2.09	155.30±3.14	213.50±3.92	249.40±4.53
KxH	158.28 ± 0.83	45.11 ± 0.26	48.44 ± 0.32	49.89±0.33	52.04±0.32	53.88±0.36	96.25 ± 1.30	158.30±2.61	217.380±3.62	246.80±4.27
DRx	145.57 ± 0.42	53.23 ± 0.33	54.45 ± 0.43	58.15±0.37	60.16±0.45	61.13±0.59	105.79 ±1.97	163.90±3.68	223.00±5.35	253.70±6.30

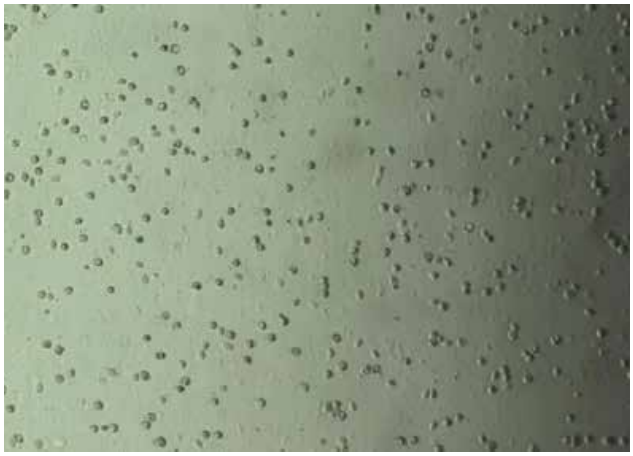
MOLECULAR BIOLOGY

Generation of whole genome assembly of native Kadaknath chicken and its annotation

Kadaknath F1 progeny PacBio Sequal II subreads were seperated into paternal and maternal haplotypes with well-defined k-mers specific to paternal and maternal Illumina data. A total of 1778006 HiFi (33770360517bp) reads having average read length of 18993.39 bp were generated from the PacBio Sequal II subreads. The segregation resulted in 785202 maternal haplotypes reads (15017152695 bp) with an average reads length of 19125.21bp while paternal haplotypes read were 919345 (17583798297 bp) with an average read length of 19126.44 bp. A total of 73459 (4.13%) reads were unassigned. To associated the Kadaknath genomic information with the functional trails the meat profile of the Kadaknath *vis-a-vis* commercial broiler chicken was carried out. In the Kadaknath genotype, significantly ($p<0.05$) lower mean percent carcass traits were observed for the head, feather, leg, back and neck while giblet, intestine, breast, and breast meat were reported to be higher in the commercial broilers. The carcass weight and dressing percent of broilers were significantly ($P<0.05$) higher than Kadaknath birds. In the present study, water-holding capacity of Kadaknath meat was significantly($P<0.05$) higher than broiler meat. The Kadaknath chicken muscle contained a significantly higher total collagen but the collagen solubility was significantly ($P<0.05$) lower than those of commercial broiler muscle. There was a significant ($P<0.05$) difference observed between collagen solubility and collagen of broilers' meat than the meat of Kadaknath birds. The variation in the collagen content may be attributed to the age and genotype effect. The shear force values reflect that meat tenderness is directly correlated with bird age as the older birds increased in total collagen content. Kadaknath muscle contains remarkably higher protein content compared to commercial broilers ($P<0.05$).

Chicken primary magnum cell culture established for *in vitro* studies

A total of three hens of White Leghorn chicken maintained at the Experimental farm of ICAR-Directorate of Poultry Research, Hyderabad was included in the study. All the birds were sacrificed as per the protocol of IAEC of the Institute and the magnum tissues were collected for establishing primary cell culture. The magnum primary cell culture was established with optimized culture condition. The primary magnum cell culture will be used for analysing expression of transgenic cassette containing human tissue plasminogen activator (htPA) and human erythropoietin genes under *in vitro* condition.



Chicken primary magnum cell culture

Construction of transgenic cassette for human tissue plasminogen activator (htPA) gene

The htPA cDNA of 1689 bp was synthesized and was cloned in a transgenic construct consisting of chicken ovalbumin promoter, ovalbumin poly A tail and chicken histone gene. The total length of the construct was of 4219 bp. The whole construct was cloned in pUC57 vector for further multiplication of the construct. In addition, chicken magnum cell culture was optimized for *in vitro* expression of the protein.

Construction of transgenic cassette for human erythropoietin (hERP) gene

The hERP cDNA of 582 bp was synthesized and was cloned in a transgenic construct consisting of chicken ovalbumin promoter, ovalbumin poly A tail and chicken histone gene sequence. The total length of the construct was of 3112 bp. The whole construct was cloned in pUC57 vector for further multiplication of the construct. In addition, chicken magnum cell culture was optimized for *in vitro* expression of the protein. The primary magnum cell culture has been established and transgenic constructs for htPA and hERP have been cloned in pUC57 plasmid vector for functional study.

Genomewide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs during the asymmetric ovarian development of Chicken

In chickens, sex-specific differentiation of gonads is evident from embryonic day 6–6.5 (E6–6.5/ stage 29–30) and there is an asymmetry in the development between left and right gonads after E8 (stage 34), leading to complete regression of the right ovary at adult stage. In the present study, the datasets (SRR4029458, SRR4029457, SRR4029464, SRR4029463, SRR4029460, SRR4029459) from NCBI were used to study the differentially expressed genes in embryonic 6th day (E6) vs embryonic 12th day (E12) and post hatch day 1 (D1) to know about the regression of right ovary in the embryonic and post-hatch period. The complete study was carried out using Galaxy server, ShinyGO 0.76 and g:Profiler to perform the differential gene expression and functional enrichment analysis. The differentially expressed significant up and down-regulated genes during E6 to E12 were found to be 373 and 520, respectively. The significantly up-regulated genes (FGG, APOH, AHSG, HSD17B1, NME7, PROCA1, MLKL etc.) during E12 was found to be involved in the pathways related to fibrinolysis, endopeptidase inhibitory activity, peptidase inhibitory activity etc., when compared to E6. Similarly, the differentially expressed significant up and down-regulated genes during E12 to D1 were found to be 708 and 1136 respectively. The significantly down-regulated genes (TRAF5, CALML3, FGG, APOH, etc.,) during D1 was found to be involved in the pathway regulating the programmed cell death when compared to E12, suggesting higher programmed cell death during E12 and complete degeneration of right ovary during the post-hatch period. KEGG pathway analysis revealed HSD17B1, STEAP3, NME7, CALML3, PROCA1 and MLKL genes were involved in the various pathways leading to the right ovary regression.

Cryopreservation of blastodermal cells and production of chicken chimera

Effect of addition of sucrose and trehalose during cryopreservation of Kadaknath blastodermal cells

The procedure for cryopreservation of stage X blastodermal cells isolated from freshly laid Kadaknath hatching eggs was standardized. The blastodermal cells were cryopreserved using 10% dimethyl sulphoxide (DMSO) in 0.25ml plastic straws. The blastodermal cells were stained before and after cryopreservation procedure by 0.4% trypan blue and live cell percentage calculated. The blastodermal cells were cryopreserved in the presence of 0.1 or 0.2M sucrose. The percent live cells during pre and post cryopreservation were evaluated. Sucrose at both the concentrations evaluated significantly ($P<0.05$) improved the post-thaw live cell percent. However, there was no difference between the two levels of sucrose evaluated. In another experiment Kadaknath blastodermal cells were cryopreserved in the presence of 0.1, 0.2 or 0.4M trehalose. The percent live cells evaluated in the post-thawed samples indicated that trehalose at any of the concentrations evaluated did not improve the live cell percent compared to control. In conclusion, inclusion of sucrose at 0.1 or 0.2M concentrations during blastodermal cell cryopreservation improves the post-thaw live cells.

Primordial germ cell (PGC) conservation for various registered breeds of poultry (CRP on Agrobiodiversity)

The object of the project is to conserve indigenous chicken breeds of our country by cryopreserving the primordial germ cells (PGC). During this period PGCs of Kadaknath and Punjab Brown were cryopreserved.

NUTRITION

Life Cycle Analysis for carbon footprint reduction through dietary modulations in broiler meat production (NICRA)

Data were obtained from commercial broiler and layer farms from different locations in the country. For broiler production, data were collected from i) Telangana (Ranga reddy, Medak, Nalgonda, Mahabubnagar, and Hyderabad districts) ii) Namakkal and iii) Pollachi in Tamil Nadu on the CO_2 equivalents. From each location, data were collected from about 50 farms. The field data were collected from each farm on feed raw materials used, water and fossil fuels used, vaccines given, health care products used, power requirement, manure production, dead bird disposal, transportation of chickens, slaughterhouse waste etc. Based on the data thus collected, the CO_2 equivalents for the 3 locations have been determined as Telangana: 5.054$\pm$0.525 kg/kg meat, Namakkal: 4.225$\pm$0.122 kg/kg meat and Pollachi: 5.67+0.234 kg/kg meat. Wide variation was observed among the 3 locations, which could be due to the feed raw materials used, flock performance, litter material used etc. Similarly, data on layer production were collected from Namakkal (5 farms) and Mysore (3 farms) areas. The CO_2 equivalents/kg egg mass ranged from 3.82 to 8.17 at Namakkal and 4.88 to 5.22 at Mysore. In addition, a feeding trial was conducted using different nutraceuticals (organic trace minerals, protease, butyric acid, protease, betaine, phytase, NSP enzyme, emulsifier in diet of commercial broilers. Butyric acid in combination with organic trace minerals and NSP enzyme/phytase improved feed conversion efficiency.

Chicken or egg: Drivers of antimicrobial resistance in poultry in India (DBT: India UK collaborative)

The primary aim of the project is to find out viable alternate feed additives for antibiotic growth promoters in broiler chicken diet. In continuation to the previous research work, the scientist at ICAR-DPR focussed on testing and identification of potential alternatives for anti-biotic growth promoters (AGP). In the current year under report three experiments were conducted in this project utilizing certain strains of probiotics (Bacillius velezensis, Bacillius pumilus and Bacillus amyloliquefaciens either alone or in combination – Experiment 1), and two experiments on development of products (Experiment 2 and 3) The protocol of all the three experiments was the same. In all the experiments, a positive control with BMD and a negative control (NC) without BMD or test products were maintained to compare the efficacy of alternatives in broiler diet. Bacitracin methylene di salicylate (BMD) was used as the antimicrobial compound in the control diet. Each diet was fed *ad libitum*to 7-12 replicates of 25 broilers in each pen from day 1 to 35/42d of age. Performance, slaughter variables, nutrient digestibility and gut microbial count were studied to test the efficacy of the alternatives to AGP in broiler diet.

Effect of supplementing various promising strains of probiotics in broiler chicken fed diets devoid of antibiotic growth promoter

An experiment was carried out to study the performance, carcass traits and immune responses in broiler chicken fed different strains of probiotic in broiler diet. A maize - soybean meal – meat cum bone meal based standard broiler diet containing all the nutrients as per the standard was prepared to serve as the basal diet (Table 1). The basal diet was supplemented with BMD (AGP) which served as the positive control (PC). The BD without AGP or probioic served as the negative control (NC). The BD was supplemented with different strains of probiotic named BAG17, CSG1.1, ZBMG3, PPG6, FG12 and ZBLS6 to compare the efficacy of these strains as potential alternatives to the AGP tested.

Table 1. Ingredient and nutrient composition (g/kg) of basal diets for three different phases

Ingredient	Pre starter (1-14d)	Starter (15-28d)	Finisher (29-42d)
Maize	566.5	611.1	662.6
oil-veg	26.1	33	31.360
Soya DOC 45%	336.1	289.4	243.9
Meat cum bone meal	40	40	40
salt	3.666	3.667	3.665
Sodium bi-carbonate	1.000	1.000	1.000
Dicalcium phosphate	10.440	8.51	5.94
LSP-powder	7.351	5.338	4.349
DL-Methionine	3.259	2.671	2.199
L-Lysine HCL	2.187	2.034	2.033
L-Threonine	0.659	0.386	0.216
Additives[1]	2.700	2.700	2.700
Nutrient Name			
M.E (Kcal/kg)	3000	3100	3150
Protein (%)[2]	22.59	20.77	19.09
Dig. Lysine (%)	1.25	1.12	1.01
Dig. Methionine (%)	0.64	0.56	0.49
Dig TSAA (%)	0.929	0.832	0.750
Calcium (%)[2]	0.880	0.760	0.660
Available Phosphorus (%)	0.420	0.380	0.330
Sodium (%)	0.180	0.180	0.180
Dig. Threnine (%)	0.829	0.742	0.669
dig. Leucine (%)	1.734	1.630	1.536
dig. Iso-leucine (%)	0.842	0.764	0.690
dig. Valine	0.967	0.865	0.787

[1]Supplies per kg diet: retinol acetate 2475 µg, cholecalciferol 30 µg, α-tocopherol 12 mg, menadione 2 mg, thiamine 1.2 mg, pyridoxine 2.4 mg, cyanocobalamine 0.01 mg, niacin 1.9 mg, pantothenic acid 12 mg, Mn 50 mg, Zn 112.5 mg, Fe 60 mg, Cu 10 mg, I 1.2., choline Cl 0.5g, hydrated sodium calcium alumino silicate 1g.

[2]Analyzed values

Performance

Feeding of the NC diet devoid of AGP significantly ($P<0.05$) reduced the feed efficiency compared to those fed the PC diet having AGP at the end of the experiment (Table 2). However, supplementation of majority of probiotic strains (ZBG17, CSG1.1, ZBMG3, FG12, ZBLS6) significantly improved the feed efficiency compared to the NC group. The FE in CSG1.1 or ZMBG3 was similar to those fed the AGP in PC diet. The PPG6 strain was inefficient to improve the FE compared to those fed the NC diet group. However, the body weight gain and feed intake were not affected ($P>0.05$) by supplementation of either AGP or different probiotic cultures to NC diet.

Table 2. Effect of supplementing various strains of DFM on performance of broiler chicken fed diets devoid of antibiotic growth promoter

Probiotic	1-28th Day			1-42th Day		
	BWG, g	FI, g	FI/BWG	BWG, g	FI, g	FI/BWG
BMD	1445	2130	1.475^{C}	2639	4327	1.640^{D}
NC	1398	2094	1.498^{A}	2577	4322	1.677^{A}
ZBG17	1408	2099	1.491^{AB}	2604	4325	1.661^{B}
CSG1.1	1410	2099	1.489^{AB}	2636	4358	1.653^{BCD}
ZBMG3	1425	2115	1.484^{C}	2660	4371	1.643^{CD}
PPG6	1390	2084	1.499^{A}	2603	4331	1.664^{AB}
FG12	1411	2106	1.492^{AB}	2619	4338	1.657^{BC}
ZBLS6	1407	2102	1.494^{AB}	2614	4340	1.660^{B}
P	0.078	0.710	0.004	0.178	0.966	0.000
N	12	12	12	12	12	12
SEM	4.434	6.033	0.002	7.589	11.49	0.002

DFM direct fed microbes; BWG body weight gain; FI feed intake; BMD chemical growth promoter; P probability; **N** number of replicates; **SEM** standard error of mean; **ABCD** means having common superscripts in a column do not differ significantly (P<0.05)

Slaughter variables

In general the ready took yield was significantly (P<0.05) influenced by the treatment effect (Table 3). The RTC was lowest in PC compared to other groups. The meat yield in CSG1.1 or ZBLS6 groups was significantly higher than those fed the PC and the meat yield in other groups was intermediate. The relative weights of breast meat, abdominal fat and liver were not affected (P>0.05) by the treatment groups.

Table 3. Effect of supplementing various strains of DFM on slaughter variables (g/kg live weight) of broiler chicken fed diets devoid of antibiotic growth promoter

Treat	RTC	Breast	Abdfat	Liver
BMD	783.2^{C}	271.7	12.83	18.19
NC	796.1^{ABC}	277.1	13.74	19.86
ZBG17	792.6^{ABC}	283.5	12.00	16.93
CSG1.1	799.2^{AB}	272.6	14.05	17.60
ZBMG3	786.9^{BC}	266.8	15.61	19.63
PPG6	792.3^{ABC}	280.4	13.56	18.08
FG12	797.5^{AB}	279.3	15.01	17.68
ZBLS6	802.6^{A}	279.2	14.61	19.07
P	0.041	0.272	0.323	0.115
N	12	12	12	12
SEM	1.594	1.738	0.383	0.287

DFM direct fed microbes; BMD chemical growth promoter; **NC** negative control, RTC ready to cook yield, Abd fat abdominal fat, **P** probability; **N** number of replicates; **SEM** standard error of mean; **ABC** means having common superscripts in a column do not differ significantly (P<0.05)

Immune response

The CMI response in broiler chicken was not affected (P>0.05) by the dietary variations in AGP and probiotic supplementation (Table 4). The HI titre was significantly affected by probiotic supplementation in the diet. There was no significant difference between the AGP and NC diet fed groups. Supplementation of CSG1.1 or ZBMG3 significantly improved (P<0.05) the humoral immune response compared to those fed the PC. The improvement in other groups was intermediate between PC and the above probiotic culture supplemented groups.

Apparent ileal digestibility of protein and energy

Removal of AGP in broiler diet (NC) significantly (P<0.05) reduce the apparent ileal digestibility protein and energy (Table 4) compared to those fed the AGP supplemented PC diet. Except ZBLS6 strain, all probiotic cultures significantly improved the digestibility of protein compared to those fed the NC diet. The protein digestibility in CSG1.1, ZBMG3 or FG12 groups was similar to those fed the AGP supplemented group. The energy digestibility was similar (P<0.05) to the AGP fed group in majority of the probiotic fed groups except PPG6 or ZBLS6, whose energy digestibility was lowest among the groups tested in the current study.

Table 4. Effect of supplementing various strains of DFM on immune responses and ileal digestibility of nitrogen and energy in broiler chicken fed diets devoid of antibiotic growth promoter

Treat	Immune responses		Ileal digestibility coefficient	
	CMI, %	HI titre, log 10	Nitrogen	Energy
BMD	65.58	4.333^{C}	0.687^{A}	0.602^{A}
NC	66.50	5.167^{BC}	0.566^{D}	0.531^{BC}
ZBG17	69.70	5.333^{ABC}	0.626^{BC}	0.572^{AB}
CSG1.1	75.40	6.417^{A}	0.650^{ABC}	0.574^{AB}
ZBMG3	71.10	6.083^{AB}	0.674^{AB}	0.577^{AB}
PPG6	70.51	5.417^{ABC}	0.621^{C}	0.537^{B}
FG12	64.98	5.250^{BC}	0.661^{ABC}	0.563^{AB}
ZBLS6	63.25	5.417^{ABC}	0.573^{D}	0.490^{C}
p	0.733	0.007	0.001	0.001
N	12	12	12	12
SEM	1.765	0.136	0.0071	0.0064

DFM direct fed microbes; CMI cell mediated immune response, HI haemogglutinin inhibition, BMD chemical growth promoter; **NC** negative control, **P** probability; **N** number of replicates; **SEM** standard error of mean; **ABCD** means having common superscripts in a column do not differ significantly (P<0.05).

The study indicated that feed antibiotic can be replaced with majority of probiotics strains tested in the current study without affecting the broiler performance. However, the performance varied among different strains of probiotics tested. Certain probiotic strains improved the meat yield and humoral immune response. The beneficial effects of probiotics could be explained due to their potential benefits in improving the digestibility of protein and energy.

Effect of supplementing different combination of probiotic, essential oil, enzymes and butyric acid as an alternative of AGP on broiler performance

In this experiment, three combinations of enzymes with butyric acid, essential oil and probiotic was tested and another group was fed the enzymes without other additives. These concepts were tested with PC and NC diets. Each diet was fed to 12 replicates of 25 broiler males per replicate.

Results indicated that BWG and FI were not affected by the dietary treatments. However, the FCR was affected at both day 21 and 35 (Table 5). The FE in NC group was significantly lower than the PC group. Inclusion of the enzyme alone or in combination with the probiotic significantly improved the feed efficiency similar to those fed the PC at day 21. While the FE in broilers fed the combination of enzyme with BA or EO gave significantly higher performance than those fed the PC. Similarly, the FE was significantly improved in broilers fed all the alternatives tested compared to those fed either PC or NC.

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Table 5. Performance of broilers fed combination of neutraceuticals as potential alternatives to antibiotics for alternatives (BMD)

Treatment	1-3 wk			1-5 wk		
	BWG, g	FI, g	FI/BWG	BWG, g	FI, g	FI/BWG
PC	900.3	1170	1.299^{B}	1703	2729	1.603^{A}
NC	893.9	1181	1.321^{A}	1692	2729	1.613^{A}
Phytase	897.9	1169	1.302^{B}	1727	2727	1.579^{BC}
Butric acid	910.6	1172	1.287^{C}	1733	2722	1.571^{BC}
E-Oil	916.3	1175	1.282^{C}	1749	2738	1.565^{C}
B subtilis	902.5	1169	1.295^{B}	1723	2731	1.585^{B}
P	0.562	0.980	0.000	0.514	1.000	0.000
N	7	7	7	7	7	7
SEM	3.788	4.842	0.002	9.044	13.46	0.003

BWG body weight gain; **FI** feed intake; **PC** positive control (with AGP), **NC** negative control (without AGP and the test product); P probability; **N** number of replicates; **SEM** standard error of mean; **ABCD** means having common superscripts in a column do not differ significantly (P<0.05)

All the slaughter variables tested except the relative weight of breast meat was significantly (P<0.05) affected by the treatments employed in the current study (Table 6). The relative eight of RTC yield in NC group was significantly lower than those fed E+BA and the meat yields in other groups including PC was intermediate. The relative weight of abdominal fat in PC was significantly higher than those fed the NC. The fat deposition in E+EO or E+probiotic was similar to those fed the NC and the fat deposition in other groups was intermediate. The immune responses (both HI and CMI) were not affected by inclusion of either AGP or its alternatives tested in the current study.

Table 6. Slaughter variables and immune responses in broilers fed combination of neutraceuticals as potential alternatives to antibiotics for alternatives (BMD)

Treat	Slaughter variables, g/kg				Immune responses	
	RTC	Breast	Abd fat	Liver	CMI, %	ND titer, log 10
PC	733.6^{AB}	245.7	13.71^{A}	23.24^{AB}	79.43	3.571
NC	731.3^{B}	241.0	9.197^{B}	24.97^{A}	70.14	3.857
Phytase	750.2^{AB}	254.1	11.44^{AB}	24.72^{A}	84.71	3.429
Butric acid	756.0^{A}	256.8	12.65^{AB}	21.74^{B}	75.00	3.571
E-Oil	752.7^{AB}	254.3	9.871^{B}	22.68^{AB}	74.29	4.143
B subtilis	736.0^{AB}	240.6	9.719^{B}	23.10^{AB}	85.40	4.429
P	0.085	0.342	0.047	0.079	0.241	0.696
N	7	7	7	7	7	7
SEM	3.239	2.750	0.506	0.365	2.144	0.198

RTC ready to cook yield; Abdfat abdominal fat; **CMI** cell mediated immune response; **ND** Newcastle disease; **PC** positive control (with AGP), **NC** negative control (without AGP and the test product); P probability; **N** number of replicates; **SEM** standard error of mean; **ABCD** means having common superscripts in a column do not differ significantly (P<0.05)

Gut microbiome and resistome analysis in the controls and best performing groups

Six caecal metagenomic DNA samples from each of the three groups namely BMD, Negative control and the phytase + encapsulated EO were used for shotgun sequencing (Novaseq 600, 150 x 2 PE read). Taxonomic profiling was done using Kaiju, resistome analysis was done using Groot.

The study indicated that the AGP BMD as well as the alternative to AGP phytase plus EO mix increased abundance of some of the beneficial bacteria in gut as compared to the negative control (Fig 1 to 3). Large numbers of ARGs were detected in all the samples indicating omni presence of antibiotic resistance in chicken gut.

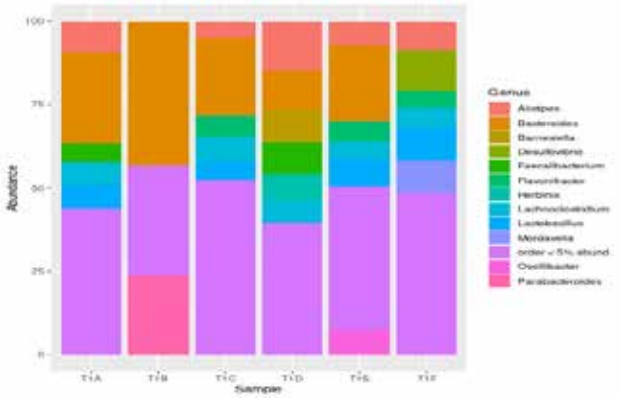


Fig. 1. Relative abundance of different Genera in the Positive control (BMD) group

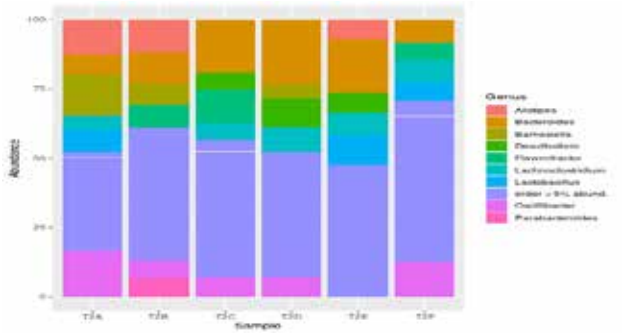


Fig. 2. Relative abundance of different Genera in the negative control group

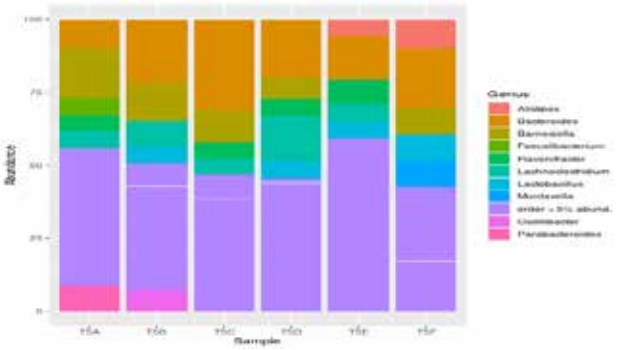


Fig. 3. Relative abundance of different Genera in the Phytase plus EO group

Based on the results, it can be concluded that the AGP in diet can be replaced with a combination of enzyme with BA, EO or probiotic without compromising the broiler performance (particularly the feed efficiency).

Identification of effective neutraceutical mix to replace AGP in broiler diet

In an experiment, two combinations of enzymes (phytase and xylanase) and enzymes with essential oil (EO) was tested as alternatives to AGP (PC) and a negative control (NC) diet was fed to test the hypothesis. All the 4 diets were with 12 replicates each containing 25 broiler males per replicate, which were reared on built up litter floor.

The results of the experiment, suggested that the BWG and FCR were significantly influenced ($P<0.05$) while the FI was not affected ($P>0.05$) by the treatments (Table 7). At both 21 and 42d of age the BWG and FCR were significantly reduced in NC compared to those fed the AGP (PC). The BWG at the end of experiment was significantly higher in broilers fed the enzymes or enzymes with EO compared to those fed either PC or NC diets. The FE in broilers fed the NC was significantly lower than those fed the PC. Supplementation of enzymes improved the FCR similar to the PC and the combination of enzymes with EO improved the FE significantly higher than those fed AGP supplemented PC diet.

Table 7. Performance of broilers fed enzymes and combination of enzymes with essential oils as alternatives to AGP

Treatment	1-3wk			1-5 wk		
	BWG, g	FI, g	FI/BWG	BWG, g	FI, g	FI/BWG
PC	815.5^{AB}	1073	1.316^{B}	2117^{B}	3576	1.690^{B}
NC	798.2^{B}	1061	1.329^{A}	2072^{B}	3561	1.718^{A}
Phytase+ Xylasase	829.1^{A}	1088	1.312^{B}	2173^{A}	3633	1.672^{BC}
Phytase+Xylasase+Eoil	832.9^{A}	1089	1.307^{B}	2181^{A}	3636	1.668^{C}
P	0.003	0.099	0.006	0.001	0.076	0.001
N	10	10	10	10	10	10
SEM	3.907	4.613	0.002	10.83	12.84	0.0045

BWG body weight gain; **FI** feed intake; **PC** positive control (with AGP), **NC** negative control (without AGP and the test product); **P** probability; **N** number of replicates; **SEM** standard error of mean; **ABCD** means having common superscripts in a column do not differ significantly ($P<0.05$).

Based on the results, it is concluded that AGP in broiler chicken diet can be replaced with combination of enzymes (phytase and xylanase) and enzymes with essential oil without affecting the broiler performance.

Evaluation of Insect larva meal as a novel protein source in chicken diet

The larva of Black soldier fly (BSF) (*Hermetiaillucens*) shows potential for use as an effective and sustainable source of protein in poultry diet. The research efforts initiated previously were continued for evaluating the feeding value of BSF larva meal for chickens.

BSF larva meal in the diet of Vanaraja chicks

Two feeding experiments were conducted for testing BSF larva meal (BSFLM) at graded levels in the diet of Vanaraja chicks reared in battery brooders. In the 1st experiment, BSF larva meal (BSFLM)was tested at 0, 12 and 15% levels on *iso-caloric* and *iso-nitrogenous* basis in the diet of Vanaraja chicks from 0-6 weeks of age. The body weight gain (BWG) was favorably affected by BSFLM inclusion in diet during the 1st week, where significantly higher BWG was recorded in both the groups fed BSFLM (Table 8). However, this effect waned off soon and no such effect was observed during 2nd and 3rd weeks of age. On the other hand, from 4th week onwards, BSFLM at the higher level of 15% in diet significantly depressed the BWG, while it was intermediate or similar to the control group at 12% level during 4th and 5th weeks of age, but at the end of the experiment (6th week), BWG was significantly low at both 12 and 15% levels of BSFLM.

The feed intake (FI) was significantly higher in both the groups fed BSFLM in comparison to control during the initial 3 weeks, but subsequently the FI was similar among the groups. The FCR was unaffected during the 1st week, but from the 2nd week till end of

the experiment, the FCR increased significantly with each incremental level of BSFLM. The dressing yield, weight of breast, liver, bursa, giblets and abdominal fat were not affected (Table 9). The ND titres decreased at the 15% level of BSFLM, whereas the serum biochemical profile and crude protein retention were unaffected.

Table 8. Effect of BSF larva meal (BSFLM) in diet on performance of Vanaraja chicks

BSF larva meal, %	Body wt.gain, g			Feed intake, g			FCR
	0-1wk	0-4wks	0-6wks	0-1wk	0-3wks	0-6wks	0-6wks
0	49.8^{b}	446.7^{a}	858.7^{a}	79.7^{b}	545.5^{b}	1864	2.17^{c}
12	55.3^{a}	424.7^{ab}	813.0^{b}	87.3^{a}	566.9^{a}	1914	2.35^{b}
15	54.5^{a}	403.4^{b}	787.5^{b}	89.6^{a}	564.6^{a}	1905	2.41^{a}
P	0.003	0.002	0.000	0.008	0.048	0.215	0.001
N	14	14	13	14	14	13	13
SEM	0.735	5.267	7.527	1.411	3.943	12.19	0.019

Table 9. Effect of BSF larva meal (BSFLM) in diet on slaughter variables, serum biochemical profile, immune response and nutrient retention in Vanaraja chicks

BSF larva meal, %	RTC (g/kg live wt)	Liver (g/kg live wt)	Abd.Fat (g/kg live wt)	Serum protein (g/dl)	Serum triglycerides (g/dl)	Serum urea (mg/dl)	ND-titer (Log 2 value)	CP retention, %
0	655.7	20.0	13.8	5.31	181.5	61.3	7.23^{ab}	81.64
12	625.2	20.4	11.2	5.41	153.9	62.8	8.15^{a}	79.95
15	619.3	19.7	12.0	5.63	163.1	62.8	6.39^{b}	81.86
P	0.22	0.82	0.53	0.16	0.70	0.42	0.04	0.45
N	13	13	13	13	13	13	13	3
SEM	9.13	0.44	0.96	1.00	13.28	0.55	0.29	1.09

In the 2nd experiment, the BSFLM was evaluated at 0, 9, 12, 15 and 18% levels in the diet of Vanaraja chicks on *iso-caloric* and *iso-nitrogenous* basis. The diets were fed *ad libitum* from 0-6 weeks of age. The inclusion of BSFLM in diet at levels ≥15% significantly (P≤0.01) depressed body weight from 2nd week of age onwards, while no effect was recorded at the other levels of 9 and 12% (Fig.4). The feed intake was significantly reduced at the highest level of 18% during 0-3 weeks, whereas it was intermediate at 15% level of BSFLM in diet (Fig.5). On the other hand, during the overall 0-6 weeks period, the feed intake was significantly reduced at both 15 and 18% BSFLM in diet. Further, among all the groups, the highest feed intake was recorded at 9% BSFLM. The feed conversion ratio (FCR) was not affected during early life of chicks (0-3 weeks), while during the 0-6 weeks, the FCR was significantly (P≤0.01) affected by the dietary level of BSFLM. In comparison to the control group, the FCR was significantly higher in the groups fed BSFLM at 12% and higher levels. The FCR in general tended to increase with BSFLM level in diet and the highest FCR was recorded at the highest level (18%) of BSFLM.

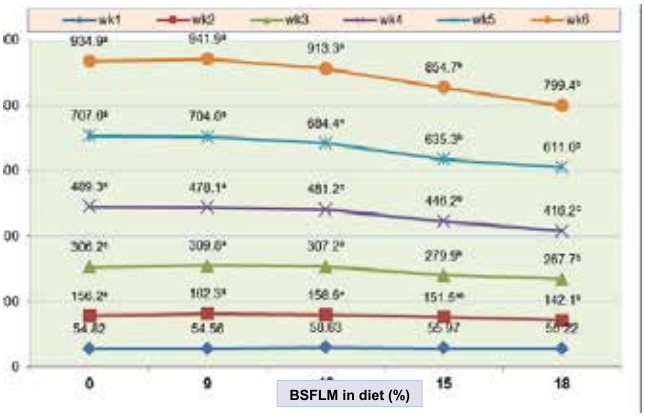


Fig 4. Effect of BSF larva meal in diet on body weight in Vanaraja chicks

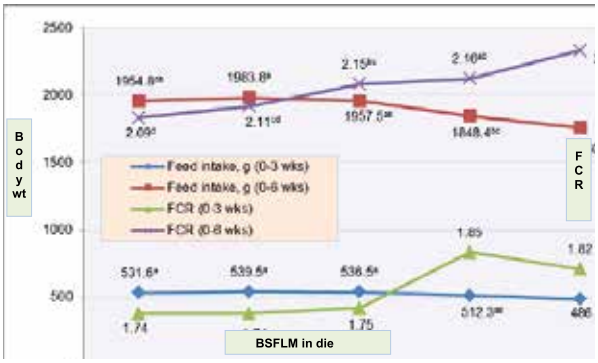


Fig. 5. Effect of BSF larva meal in diet on feed intake and FCR in Vanaraja chicks

The slaughter yield and abdominal fat content were not affected, but the weight of liver decreased with BSFLM inclusion in diet at 12% and above, while at 9% BSFLM, the liver weight was intermediate to control and the other higher levels of BSFLM (Table 10). The gizzard weight increased significantly ($P<0.01$) at the higher levels of 15 and 18% BSFLM. Similarly, the weight of bursa increased at the higher levels of 15 and 18% BSFLM. The weight of giblets was not affected. Further, the cellular immune response as assessed in terms of PHA-P response was not affected by the dietary levels of BSFLM. The overall results of both the experiments indicate that BSFLM at 15% and above levels in diet was detrimental for the performance of Vanaraja chicks, while at 12% BSFLM in diet mixed responses were observed in performance and other variables.

Table 10. Effect of BSF larva meal (BSFLM) in diet at graded levels on performance, slaughter variables and PHA-P response in Vanaraja chicks

BSFLM, %	RTC, g/kg	Liver, g/kg	Abd. Fat, g/kg	Gizzard, g/kg	Bursa, g/kg	Giblets, g/kg	PHA-P
0	630.5	19.1^{a}	12.6	22.4^{c}	2.56^{b}	46.8	114.4
9	629.8	18.1^{ab}	9.6	23.3^{bc}	3.78^{ab}	46.9	106.6
12	629.5	17.9^{b}	9.0	24.1^{bc}	4.33^{a}	47.8	97.3
15	617.4	17.8^{b}	9.5	26.1^{a}	4.60^{a}	49.8	97.2
18	622.6	17.5^{b}	10.3	24.6^{ab}	4.42^{a}	48.2	100.4
P – Value	0.318	0.032	0.355	0.002	0.067	0.062	0.104
N	10	10	10	10	10	10	10
SEM	5.23	0.35	1.34	0.60	0.49	0.77	5.13

Identification and characterization of residual feed intake specific SNPs and candidate genes in coloured broiler

A feeding trial was conducted involving 300 PB1 colour broiler pure line (male) birds from about 30 sire lines were place individually in battery brooder cages after brooding period of 28days followed by adjustment period of 13 d for recording of individual feed intake and BW for 7 week recording period. All birds were offered same diet as per institute feeding schedule/standard. Water was offered ad lib. Birds were weighed at weekly interval and also feed intake was recorded on weekly basis. Based on BW, ADG and feed intake (Table 11) a regression equation was fitted. Difference of Actual and predicted intake is taken as RFI. 6 birds died during experiment, hence finally data from 294 survived birds were analysed, few (4) outlier data were also removed if birds suffered from some disease during the experiment. Distribution of RFI data has been presented in Fig 6. Twelve high RFI and 12 low RFI birds were slaughtered and samples collected and preserved for further sequencing and analysis for identification of SNPs etc.

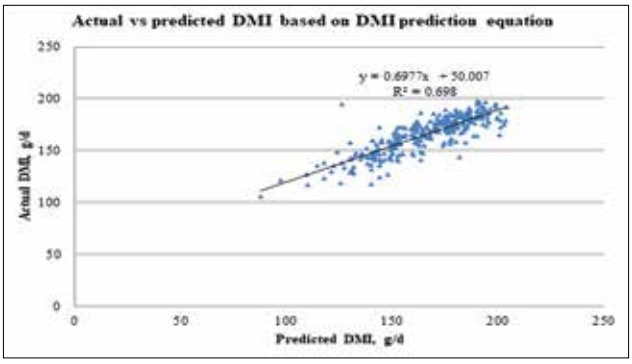


Fig. 6 Actual vs predicted DMI

Table 11. Summary of experimental dataset during test period of 7 week

	Initial BW	Final BW	Av BW	ADG	DMI	FCR	RFI
Range	700-1820	1959-4423	1329.5-3063.5	19.8-60.2	87.64-204.0	2.327-6.00	-68.9 to 38.41
Average	1395.1	3523.6	2459.4	43.4	165.6	3.869	0
N	290	290	290	290	290	290	290

Biosynthesis of different nano mineral particles using plant extracts and evaluation of their potential as feed supplement in poultry

Higher levels of mineral excretion from inorganic mineral supplemented poultry farms have raised concerns about environmental pollution and different countries are coming up with regulations to reduce mineral excretion from farms. Although organic mineral sources show better bioavailability than inorganic sources, nevertheless the use of organic minerals in broiler diet is limited due to high cost and low mineral levels. In recent years, there has been tremendous interest in use of nanoparticles in feeding poultry due to its better bioavailability and less requirement as compared to inorganic minerals. But the conventional chemical synthesis of nano-minerals suffers from disadvantage of environmental accumulation and pollution due to the non-biodegradable materials and hazardous chemicals. Due to this there is reluctance to use chemically synthesised nanoparticles for feeding poultry. Therefore, the present research work was initiated at the Directorate to biosynthesise different mineral nano particles using plant extracts and also to explore the feeding value of these nanoparticles in poultry. Methods were developed for biosynthesis of zinc and copper nano particles using plant extracts at the Directorate.

Biosynthesised nano zinc in the diet of commercial broiler chicken

A study was conducted to evaluate the effects of feeding biosynthesized zinc nano particles in comparison with organic and inorganic zinc on performance, blood biochemical profile in commercial broilers. A total of 375, one day old unsexed broiler chicks (Vencobb) were randomly assigned to five groups (75 chicks/group) having 15 replicates with 5 chicks per replicate. One group was control (T1) and other groups were supplemented with 40 mg of either one of the different zinc forms. i.e. inorganic zinc sulphate (T2), Commercial Zn NP (T3), biosynthesized Zn NP (T4) and organic zinc (T5). All birds were kept under the same managerial conditions. Zinc nano particles were biosynthesized from neem plant extract at the Directorate and characterized by using various techniques such as UV-Visible spectroscopy, particle

size analysis (PSA), fourier transformer infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) to analyse size, shape and other properties.

Results of the study indicated that there was no significant difference in cumulative body weight gain, feed intake and feed conversion ratio among the different sources of zinc fed groups **(Table 12).** However numerically better FCR was observed in biosynthesized nano zinc fed groups and body weight gain was also higher in nano zinc fed groups. Blood biochemical parameters, total protein, albumin, globulin, glucose, total cholesterol and serum enzymes SGOT and SGPT were also comparable among the groups and were within the physiological normal range indicating that the dietary supplementation with 40 mg of zinc oxide nano particles (either biosynthesized or commercial) did not have any negative effect on liver function and general health of broilers. Humoral immune response was significantly higher in nano zinc and organic zinc fed groups as compared to inorganic zinc and control groups, however, cellular immune response (PHA-P response) was not affected. Zinc concentration in plasma, tibia and meat were also significantly higher in Zn NP fed groups (T3&T4) as compared to inorganic zinc (T2) and control (T1) group birds. The meat of nano zinc fed group also showed significantly lower fat and cholesterol content and better antioxidant status as compared to other groups. The overall results indicated that supplementation of nano zinc has beneficial effects over feeding inorganic zinc to birds.

Table 12. Comparison of the effects of nano, inorganic and organic zinc supplementation on performance of commercial broilers

Treatment	At 21 days				At 42 days		
	BW/b (g)	FI/b (g)	FCR		BW/b (g)	FI/b (g)	FCR
Control	499.6	725.4	1.453		2381	3694	1.552
InorgZn	494.5	731.9	1.482		2417	3791	1.568
NanoZn (Comm)	516.8	721.7	1.406		2439	3765	1.544
Nano Zn (BioSyn)	496.0	727.1	1.469		2435	3728	1.531
Org Zinc	502.3	728.6	1.454		2412	3714	1.541
P – Value	0.746	0.994	0.106		0.674	0.745	0.947
N	15	15	15		15	15	15
SEM	5.644	7.021	0.009		17.03	25.30	0.004

BW: body weight, b: bird, FI: Feed intake, FCR; feed conversion ratio, SEM-Standard error of mean

IOT Solution for Smart Poultry Farm Practice (MeitY)

Lead centre: CDAC, Kolkata, Collaborating institute: ICAR-DPR, Hyderabad

The primary aim of the project is to develop real time poultry environment monitoring and limited control using IoT sensors to reduce environmental stress on poultry birds and also to study vocalization of poultry and correlate it with bird health, stress, gender and also to develop an early warning system.

Real time poultry environment monitoring using sensors

Environmental conditions, in particular improper temperature, relative humidity, dust and gaseous emissions (ammonia, CO_2), have a major impact on chicken performance and welfare. In this project, the lead Centre, Centre for Development of Advanced computing (C-DAC), Kolkata with inputs from the Directorate, has developed wireless sensor network for real time monitoring of these poultry environmental parameters which can be accessed any time through computer, laptop or mobile. These devices are deployed at different farms of the Directorate and are being tested for speed, accuracy, reliability **(Fig 7).** These devices are also installed in one commercial layer farm and one commercial broiler farm. In the next phase, it is also planned to develop IoT based framework and Decision-support system for alert generation.

Fig 7. Real time environmental monitoring of farm using fabricated wireless sensor node

Vocalization of chicken

Recent research suggests that vocalization frequency, intensity, pattern is an indicator of behaviour changes of birds and provide valuable clues regarding performance, health and other stress conditions. In this project, an Experimental facility for for collection of vocalization data of chicken is established at the Directorate **(Fig 8-9).** A pilot study was conducted to collect and analyse different sounds of chicken to create baseline data. Five different chicken vocalization sounds were separated and identified. Collection of bird vocalization data during experimentally induced or natural disease conditions are also under progress. Two virus challenge experiments were conducted to study the changes in vocalization in birds during virus (New Castle disease virus) exposure/infection and the data processed for early disease diagnosis using vocalization data.

Fig 8. Experimental facility for recording vocalization of chicken

Fig. 9. Recording of vocalization of chicken

Gender detection using vocalization of one day old chicks

Gender determination in chicks is an important task in poultry production. In India, in hatcheries, sexing of day old chick is done by either vent sexing or feather sexing method. However, these methods pose some limitations, such as operational difficulties and the need for highly skilled workers. The most common method is vent sexing, which relies heavily on expertise of the person involved and is difficult to be automated. This method is stressful and has negative effect on welfare and health of birds. Though feather sexing method is easier, however, the feather appearances are determined by specially selected genetic traits that must be present in the

chick strain. Most strains (breeds) of chickens do not have these feather sexing characteristics and not all chicks can be feather sexed. Therefore, this method is prone for more errors. And also at present, chicken sex identification methods need to be completed manually by professionals, which is time-consuming and laborious. Therefore, a pilot study was initiated at the Directorate by the project team to explore the possibility of gender determination using vocalization analysis of one day old chicks.

For identification of chicks' gender from sound/audio a laboratory set-up has been created at the Directorate. For chicks data collection - both a hand held audio recorder and *Mobile App* is being used. Using these recorded audio data, a POC system is being developed to identify the gender from the chicks audio. The project team is also extracting important features like spectral features (Melspectrogram, Mel-Frequency Cepstral Coefficients (MFCCs)) for the analysis from the collected audio data. Different classifiers like Decision Tree, K-Nearest Neighbours (KNN), Support Vector Machines (SVM), Artificial Neural Networks (ANN), deep neural network (DNN) are used for the analysis. Till now 651 chicks of different varieties/breed vocalization data were collected and the data is being processed to determine gender. Project team has developed the baseline system (V1.0) for identification of Male and Female chicks from the recorded chicks' voice (Fig10).

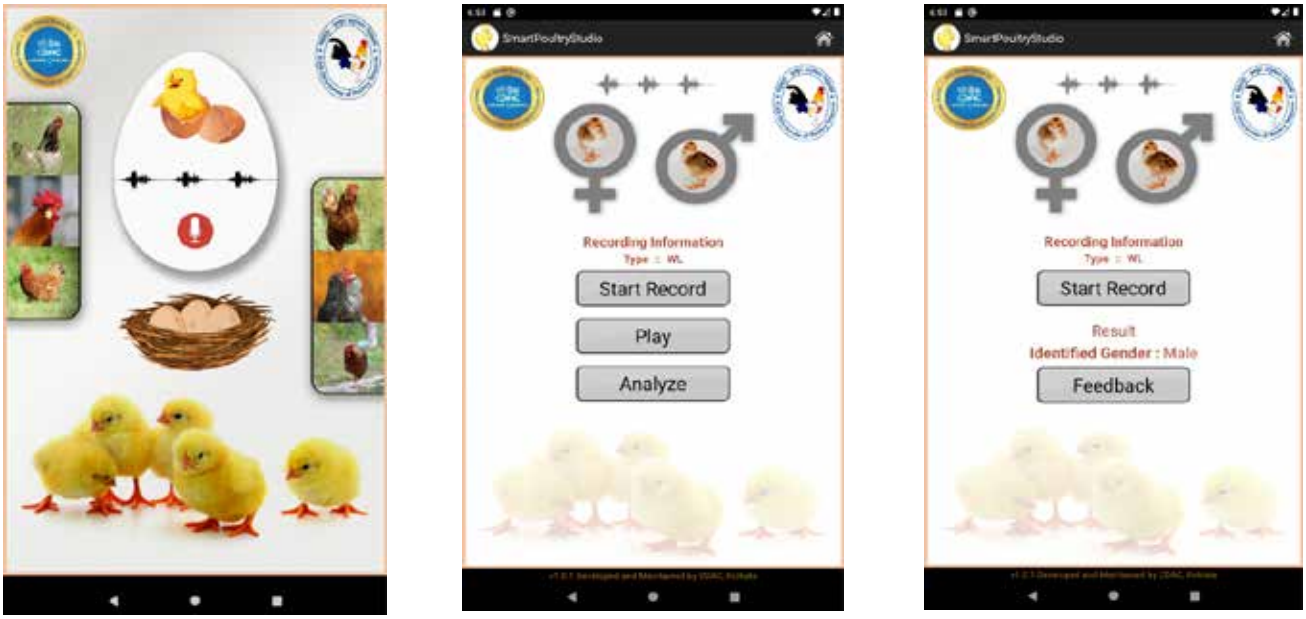


Fig. 10. Mobile APP for Gender Detection from vocalization of one day old chick

Effect of feeding low phyate maize on performance and intestinal phosphorus transporters in Gramapriya chickens during nursery phase

Researchers are aiming to increase the nutrient utilization and reduce the cost of feeding, which account 75-80% of chicken production. Maize is the preferred grain for computing poultry diets due to its high energy, low fibre, presence of pigments and essential fatty acids. The maize could also be a great source of P, if it is made available to the non-ruminant livestock, which is bounded by the phosphodiester bonds with inositol ring of phytic acid. Further, phytic acid lowers the bioavailability of Fe and Zn in the gut of simple stomached animals. Low phytase activity in the digestive tract of monogastric animals resulting the phytate-bound P is either entirely unavailable or poorly utilized. Subsequently, unutilized P excreted and contributing to the environmental pollution, especially in intensive and high density poultry production system.

It has been reported that the global phosphate resources limited and may be exhausted within the next 50-100 years. Further, an inadequate P sources supplementation is cost effective. Low phytate maize (LPM) mutants have been generated by latest plant breeding techniques. It has been reported that the LPM enhances the bioavailability of Fe and Zn, which are essentially required for metabolism and their deficiency disturbs growth. Therefore, LPM is going

to attract the attention of the poultry feed industry for enhancing the nutrient utilization.

P absorption mainly takes place in the small intestine through transcellular cellular pathway, which occurs through three types of phosphate co-transporters: type IIb Na-dependent phosphate co-transporter (NaPi-IIb); inorganic phosphate transporter 1 (PiT-1); and inorganic phosphate transporter 2 (PiT-2). We hypothesized that the feeding LPM or normal maize (NM) along with varying levels of dietary non-phytate phosphorous (NPP) is an important regulator of intestinal gene expression of NaPi-IIb, PiT-1 and PiT-2, which modulate the absorption of P at small intestine. Therefore, the present study was undertaken to determine the effect of feeding LPM with varying levels of NPP on performance and intestinal gene expression of NaPi-IIb, PiT-1 and PiT-2 in *Gramapriya* birds. A total of 432 one day-old *Grampriya* chicks were randomly distributed into six dietary treatments having 12 replicates with 6 chicks in each replicate. The experimental diets were formulated to contain each three levels of NPP (0.25, 0.33 and 0.45%) using normal maize (NM) or LPM. Higher body weight gain (BWG) and better feed conversion ratio (FCR) among the groups fed diet contained LPM compared to those groups fed diets with NM (Table 13). At the end of the experiment, intestinal tissue samples were collected for extraction of total RNA using standard protocol for determining the mRNA expression of gene of interest. Na-dependent phosphate co-transporter (NaPi-IIb) expression was higher among the groups fed NM. Further, the mRNA expression of NaPi-IIb was linearly increased among the groups fed lower levels of NPP (Table 14). At ileum, the PiT-1 expression was linearly increased with decreased levels of NPP supplementation. This study demonstrated the feeding diets with LPM revealed improved BWG and FCR in *Gramapriya* birds during nursery phase. Further, it is observed that feeding diets varying levels of NPP and NM or LPM influenced the expression profile of genes involved in active transport of P in small intestine of chickens. Understanding the expression profile of phosphorous transporters is novel insight into phosphorous absorption, which will contribute in modulating its utilization and excretions.

Table 13. Effect of feeding LPM and NM on performance in *Gramapriya* Birds during nursery phase

Items		Experimental Groups						Significance of effect (P)				Contrasts (P)	
		Normal Maize			Low Phytate Maize			Main effect			Interaction	L	Q
	NPP, %	0.25	0.33	0.40	0.25	0.33	0.40	SEM	Maize	NPP	Maize×NPP		
I Week	BWG/b (g)	36.59	38.93	42.28	39.82	41.38	41.95	0.763	0.25	0.12	0.61	0.04	0.99
	FCR	1.847	1.861	1.639	1.775	1.555	1.515	0.038	0.08	0.37	0.16	0.316	0.32
III Week	BWG/b (g)	186.2	206.9	212.4	208.2	208.9	226.2	2.887	0.03	0.01	0.37	0.01	0.95
	FCR	2.077	2.086	1.996	2.138	2.112	1.996	0.05	0.77	0.59	0.96	0.363	0.65
VI Week	BWG/b (g)	520	554.7	535.3	525.1	583.4	592.6	6.536	0.01	0.01	0.01	0.72	0.01
	FCR	2.473	2.332	2.698	2.471	2.328	2.366	0.022	0.01	0.01	0.01	0.27	0.01

BWG, body weight gain; FCR feed intake/BWG; L linear; Q Quadratic, NPP non-phytate phosphorous

Table 14. Expression profile of NaPi-IIb, PiT-1 and PiT-2 at duodenum, jejunum an ileum in *Granapriya* birds fed normal maize and low phytate maize

Items	Experimental Groups						Significance of effect (P)				Contrasts (P)	
	Normal Maize			Low Phytate Maize			Main effect			Interaction	L	Q
NPP, %	0.25	0.33	0.40	0.25	0.33	0.40	SEM	Maize	NPP	Maize×NPP		
DUODENUM												
PiT-1	1.53	1.64	92.4	0.74	1.87	10.5	15.18	0.38	0.33	0.47	0.20	0.46
PiT-2	10.2	29.9	11.7	188.0	3.08	49.4	16.4	0.24	0.39	0.28	0.29	0.38
NaPi-IIb	38.2	1.31	0.41	0.37	0.02	1.05	4.95	0.05	0.01	0.01	0.01	0.05
JEJUNUM												
PiT-1	1.30	8.56	2.43	6.51	3.39	19.5	1.68	0.07	0.16	0.02	0.06	0.65
PiT-2	0.52	0.88	1.11	0.42	0.26	1.90	0.25	0.96	0.19	0.51	0.10	0.73
NaPi-IIb	3.71	4.95	0.93	1.27	1.26	1.40	0.62	0.13	0.42	0.37	0.38	0.33
ILEUM												
PiT-1	580	43.88	3.63	390	94.4	279	69.3	0.70	0.02	0.29	0.03	0.06
PiT-2	1.41	18.4	27.6	15.5	0.48	4.36	5.44	0.45	0.85	0.39	0.60	0.82
NaPi-IIb	1.05	4.95	7.76	2.70	0.06	0.11	0.49	0.16	0.77	0.31	0.49	0.87

PiT1 and 2; inorganic phosphate transporter, NaPi-IIb; Na-dependent phosphate co-transporter

PHYSIOLOGY

Comparative Studies on Different Factors Influencing Egg Production in Chickens

Chickens belonging to Vanaraja (V), Aseel (A) Ghagus (G) and Nicobari (N) breeds were selected at 22 weeks of age. Study was conducted for early laying period (24-28 weeks, EP) and mid-laying period (32-36 weeks, MP). Plasma levels of Melatonin, Ghrelin, progesterone and estradiol during (EP) and (MP) were estimated in Vanaraja, Aseel, Ghagus and Nicobari breeds. Birds were sacrificed at 26 and 34 weeks of age for collection of jejunum and magnum tissue samples. The samples were processed for extraction of RNA. The RNA samples were further processed for production of cDNA. Gene expression studies for hormones melatonin, ghrelin receptors and amino acid transporters B^0AT, CAT, LAT2 and LAT4 were analysed by Real Time PCR using SYBR Green. For the treatment group, Se yeat product was supplemented @ 0.15g/kg for Vanaraja and 0.05g/kg feed for Aseel, Ghagus and Nicobari breeds.

When compared between the control groups (CGs) of different breeds Melatonin (MET), Ghrelin (GHL) were significantly more in Vanaraja and Ghagus breeds followed by Aseel and Nicobari. For sex steroid hormones, Estradiol (EST) concentration was more in Vanaraja and Aseel breeds followed by Ghagus and Nicobari breeds. Progesterone hormone (PROG) concentration was more in Ghagus and Nicobari breeds rest was followed by Vanaraja and Aseel breeds N>G>V. In Aseel, it increased. When compared between the CGS of EP and MP laying periods of respective breeds, concentration of MET, GHL and PROG was significantly less ($P<0.01$) during MP compared to EP or was not significant. The decrease in MET trend was V>G>A. In Nicobari it increased. The decrease in trend for ghrelin was observed to be A>V>N. Whereas, concentration increased in Ghagus. For progesterone similarly the trend observed was N>G>V in EP compared to MP. The decreasing trend for Estradiol was V>G. Whereas, the concentration increased in Aseel and Nicobari. The concentration of sex steroid hormones was directly proportional to egg production. The difference was significant at least at $P<0.05$.

Free aminoacids in plasma when compared between the CGS of different breeds it was observed that out of 19 amino acids maximum concentration was present in Aseel followed by Nicobari, Ghagus and Vanaraja during EP. At MP, the trend for maximum concentration was in Aseel followed by Vanaraja, Ghagus and Nicobari.

When compared between the mean BWs of CGS between EP and MP periods of different breeds, it was observed that gain in body weight of Aseel (469.4g) was maximum followed by Vanaraja (384.8),Nicobari (235.6) and Ghagus (144.4g), A>V>N>G.

Results for increase in mean egg production percentage between respective CGS of EP and MP revealed that the trend for increase was N>A>V, the increase in percentages being 16.5%, 12%, 0.8%, whereas in Ghagus it decreased by 3% at MP.

On treatment with Seleno yeast organic product, it was observed that during EP the concentration of plasma MET and GHL decreased in V and A compared to CG, being significant($P<0.01$) in Vanaraja for MET and Aseel for GHL($P<0.05$). The concentration of MET and GHL increased in Ghagus and Nicobari, being significant in Nicobari ($P<0.01$) for MET and for GHL ($P<0.05$) in Ghagus. AT MP treatment caused increase in concentration of MET and GHL in all the breeds. Increase in concentration of GHL was significant only in Aseel ($P<0.01$) and Nicobari ($P<0.05$) breeds. Se treatment decreased EST concentration significantly ($P<0.01$) in Vanaraja and increased in Aseel. The effect seen on EST levels was not significant in Ghagus and Nicobari at EP. The Se treatment increased EST levels in all the breeds at MP being significant only in Vanaraja ($P<0.05$) and Aseel ($P<0.05$). Whereas, PROG levels during EP decreased in all the breeds significantly. The PROG concentration increased at MP in TG in Vanaraja, Aseel and Nicobari but significantly ($P<0.05$) only in Vanaraja and Aseel. In Ghagus a significant opposite effect was seen.

Upon supplementation of Se BW of Vanaraja increased at EP (100g) at 28 weeks and at MP (99g,72g) significantly at 32 and 36 weeks of age. Significant at both EP and MP In Aseel breed BW decreased (7g) at EP and (3g) at MP 36 weeks. In Ghagus also BW decreased (20g) at EP, (11g,40g) at MP at 32 and 36 weeks respectively. In Nicobari BW increased (77g) at EP, (9g, 6g) and MP, being significant only at EP. The results were significantly different at least at $P<0.05$.

The mean egg production percentage in TG increased by 2% (P<0.05) at EP and 1.7% at MP. In Aseel, egg production percentage increased by 9% (P<0.01) at EP and 3.5% (P<0.05) at MP. In Ghagus, egg production percentage increased by 14% (P<0.01) at EP and 1.5% at MP. In Nicobari egg production percentage increased by 1.5% at MP. The trend at EP--G>A>V>N; The trend at MP---A>V>G=N when compared to CG.

Se treatment effect was observed on 19 amino acids, In Vanaraja at EP, the trend for increase in number of plasma amino acids was V(11)>N(8)>G(3)>A(1) at MP it was V (14)>G(11)>N(4)>A(2). At EP in magnum tissue trend observed was V(7)>A(6)>G(3)=N(3), at MP trend was G (11)>N (4)>V (3)>A(2) compared to CG.

Similarly, trend for increase in expression of amino acid transporters (aats)at EP in Jejunum was G(4)>V(3)>N(2)>A(0) where as at MP N(3)>A(2)>V(1)>G(0) when compared between Jejunum and Magnum tissues (Fig. 1a, b, c, d-4a, b, c, d). Similarly trend for expression of aats in magnum at EP was A(3)>V(3)>G(3)>N(2) whereas at MP expression of aats in magnum was N(3)>A(3)>G(2)>V(1) when compared to CG. The increase was significant at least at P<0.05.

Studies on Gene expression

Vanaraja

At EP in the jejunum tissue of treatment group, except for CAT (P<0.01), the expression of other three aats and hormone receptors MNTR decreased significantly (P<0.01). In the magnum tissue (TG), except for expression of BAT and MNTR (P<0.01) which decreased, rest of the aats CAT, and LAT2 and receptor GHLR increased significantly (P<0.01) (Fig 1 a, b). When compared between CG and TG, at MP, except for increase in expression of LAT4, LAT2 (P<0.001) in jejunum and magnum respectively, the expression of LAT4, BAT, CAT aats decreased significantly (P<0.01) in the magnum tissue of the treatment group, whereas, expression of both the hormone receptors did not significantly change in the tissues, if compared between the two groups (Fig. 1c, d).

Aseel

In jejunum at EP, upon supplementation, expression decreased significant only for BAT (P<0.01). MNTR expression increased (P<0.01). In the magnum tissue expression of all aats increased significantly (P<0.01) except for LAT 4, whereas expression of METR (P<0.05) and GHLR (P<0.01) decreased (Fig.2a, b). At MP upon supplementation, in jejunum expression of all aats and both hormone receptors decreased (P<0.01), only expression of LAT2 increased (P<0.01) whereas in magnum expression of LAT4 and MNTR increased (P<0.01) with no significant difference with the other parameters between the two groups (Fig. 2c, d).

Ghagus

At EP when compared between CG and TG groups, expression of BAT, LAT2, MNTR (P<0.01) and CAT, LAT4, GHLR increased (P<0.001) in jejunum and in magnum tissue MNTR, LAT2 (P<0.01) whereas LAT4, CAT, GHRL increased (P<0.001) (Fig. 3a, b). Similarly at MP, on comparison between two groups, expression of only GHLR increased (P<0.001), BAT, LAT4 decreased (P<0.01) in jejunum whereas in magnum expression of transporters LAT4 (P<0.001) and LAT2 (P<0.01) increased whereas BAT, CAT decreased (P<0.01) and hormone receptors decreased or without any significant change was observed with respect to other parameters on comparison between CG and TG Fig. 3c, d).

Nicobari

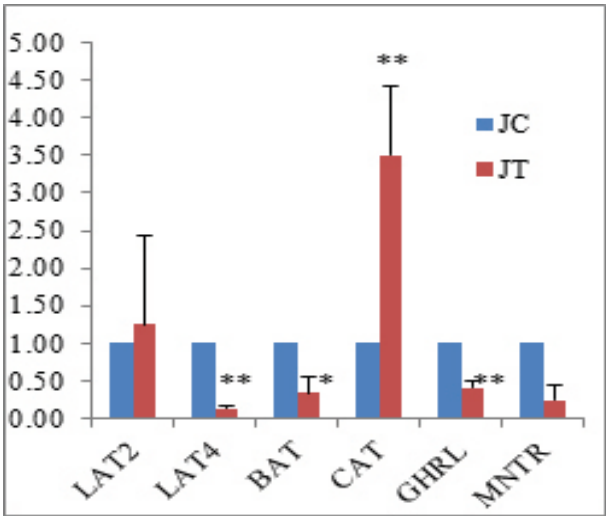
Upon treatment with Se at EP in jejunum tissue, expression of BAT increased (P<0.05) and LAT2 decreased (P<0.05). Expression of GHLR also decreased (P<0.05). There was no significant change in the expression of transporters and METR when compared with expression levels of respective CGs. In the magnum tissue, expression of LAT2 and LAT4 increased significantly, for METR and BAT the expression level did not change significantly compared to control (Fig. 4a, b). At MP in the jejunum except for LAT4, the expression of rest of the amino acid transporters and GHLR increased significantly (P<0.01) (Fig. 4c, d)

Known and Novel mi RNA were estimated in the magnum tissue of different breeds. The quality of raw reads was checked through the FastQC application and removed the adaptor through the cut adapt and filtering the read length ranging from 15 to 36 nt length. The unique read distribution of each sample has been calculated and used for the downstream

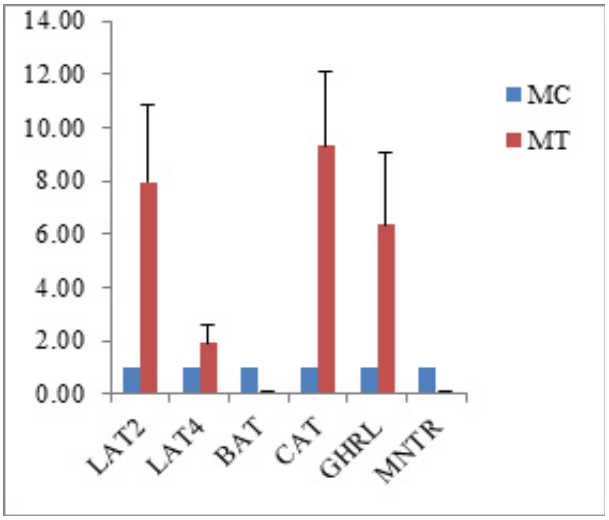
analysis. The unaligned unique and filtered reads that were not mapped on the RFAM database were processed further for the identification of known and novel miRNA. With default parameter, mirDeep2 algorithm was used by taking the *Gallus gallus* genome. For the identification of known miRNAs, *Gallus gallus* miRNAs sequences were taken as a reference. The mapped reads that were not identified as the known miRNAs are used for the prediction of novelmiRNAs. The known and novel miRNA of all the samples were used for the differential estimation using the edgeR package in Rstudio. With the log2fc > ± 1 and the FDR value ≤ 0.05, differential expression analysis was performed for the different pair wise combinations. Differentially expressed (DE) miRNA sequences were used to identify their putative targets in the differentially expressed genes. By using default parameters, mirdeep was used to identify the target by taking the reference for the same *Gallus gallus* genome data. Annotations for the targeted genes were carried out through the Uniprot database. Further studies on pathways and inferences are in progress.

Vanaraja

26 weeks

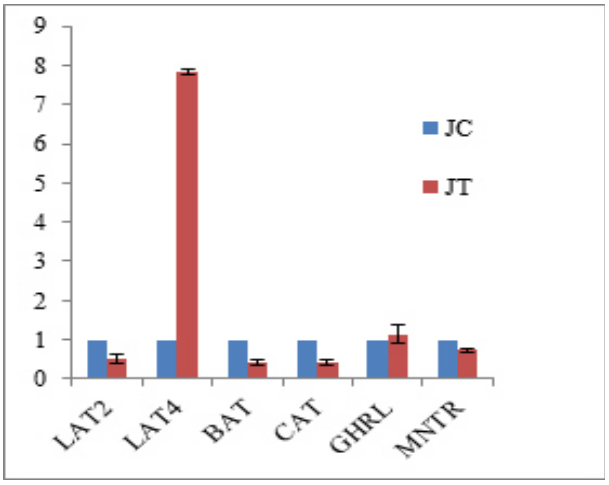


1 a

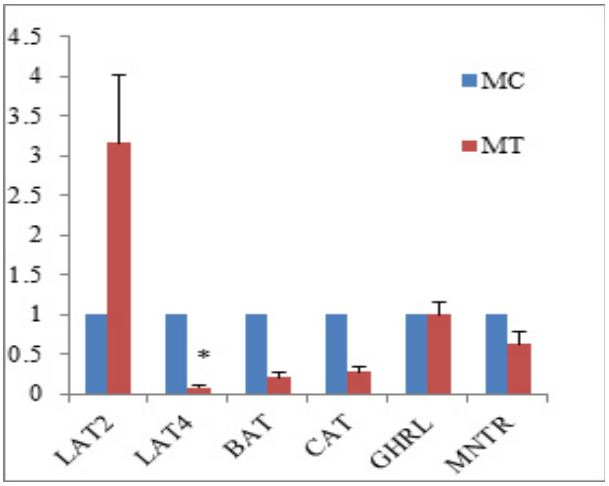


1 b

34 weeks



1 c

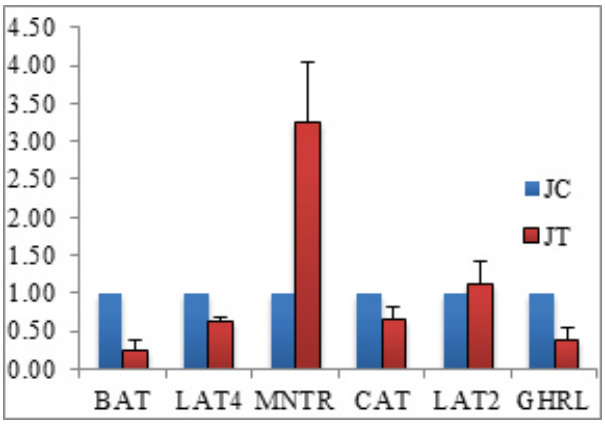


1 d

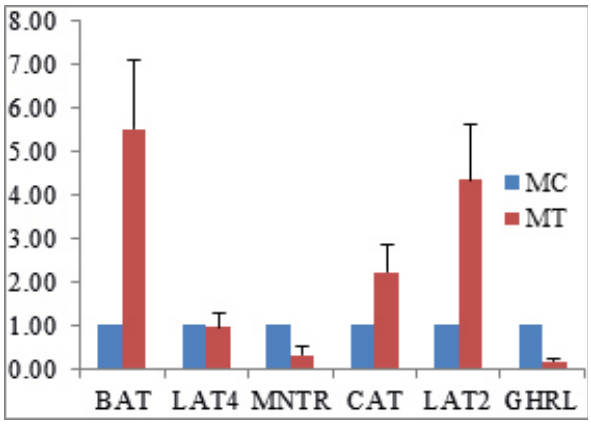
Fig. 1 a, b Gene expression of amino acid transporters and hormone receptors in jejunum(J) and magnum (M) tissue at EP FIG 1 c, d in jejunum (J) and magnum (M) tissue of Vanaraja chickens at MP.

*P<0.05,**P<0.01, ***P<0.001

26 weeks Aseel

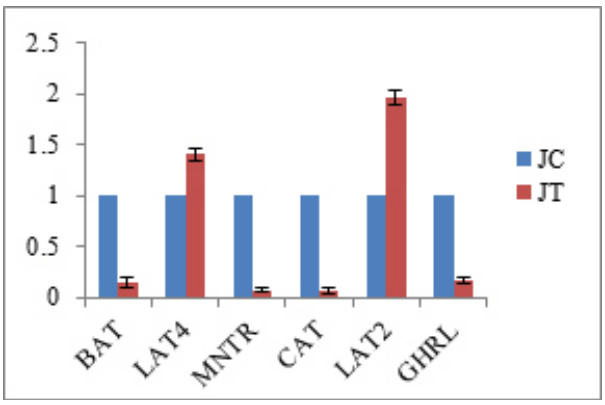


2a

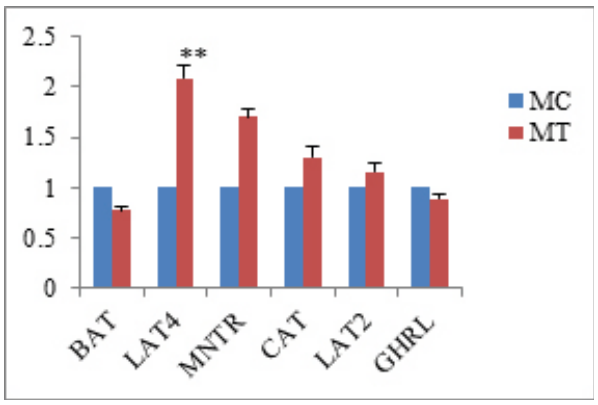


2b

34 weeks Aseel



2c

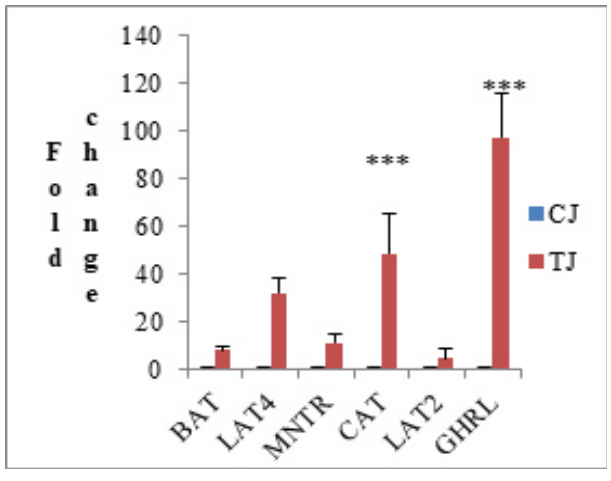


2d

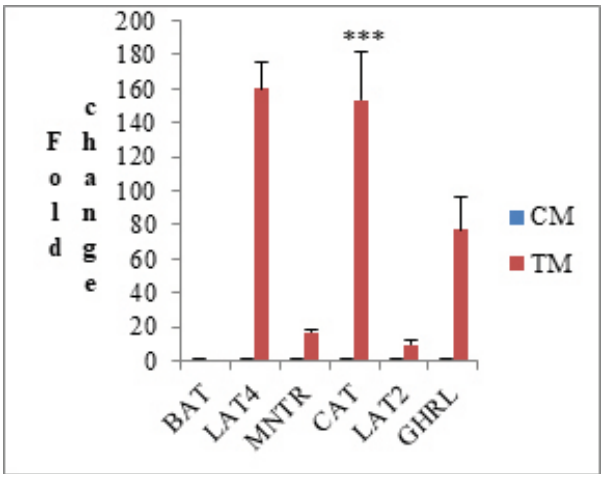
Fig. 2 a, b Gene expression of amino acid transporters and hormone receptors in jejunum(J) and magnum (M) tissue at EP FIG 2 c, d in jejunum (J) and magnum (M) tissue of Aseel chickens at MP.

*P<0.05, **P<0.01, ***P<0.001

26 weeks Ghagus

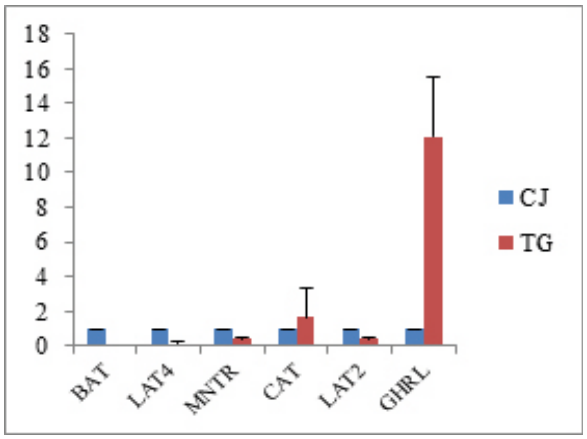


3a



3b

34 weeks Ghagus



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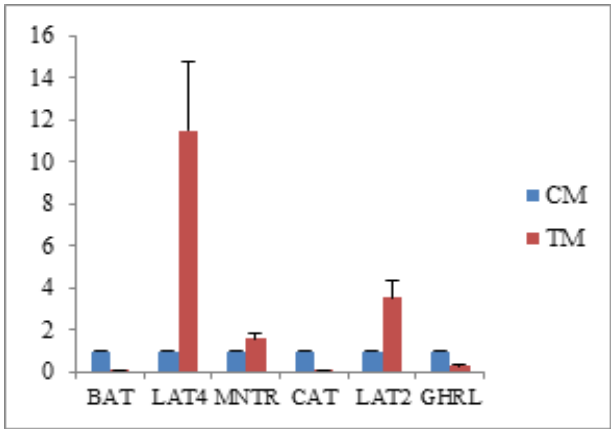
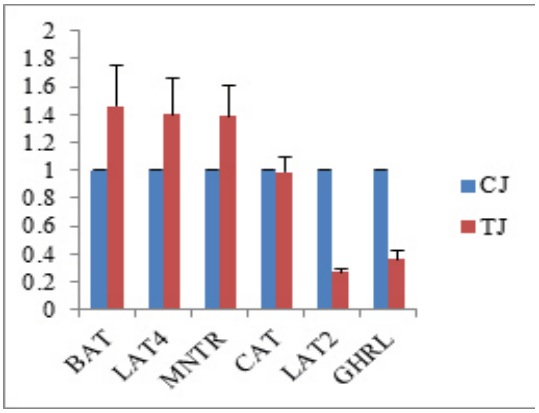


3d

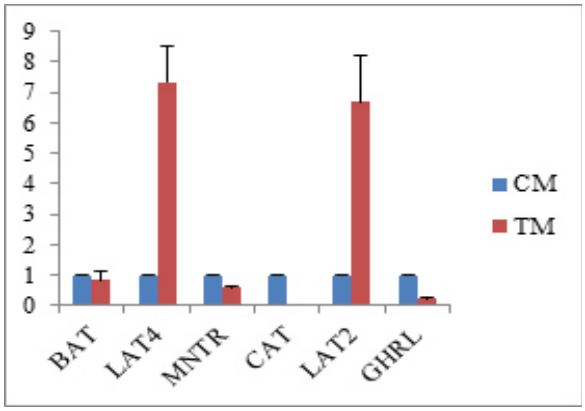
Fig. 3 a, b Gene expression of amino acid transporters and hormone receptors in jejunum(J) and magnum (M) tissue at EP FIG 3 c, d in jejunum (J) and magnum (M) tissue of Ghagus chickens at MP.

*P<0.05, **P<0.01, ***P<0.001

26 weeks Nicobari

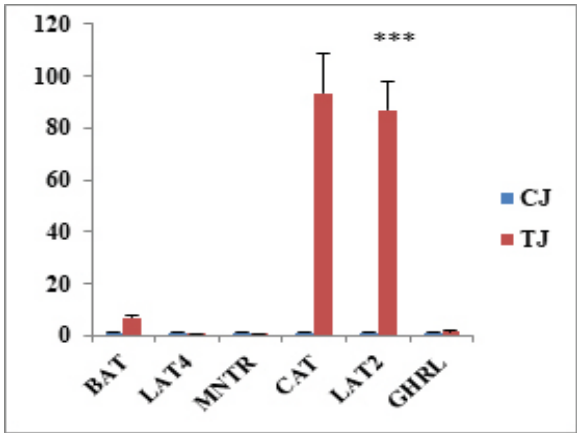


4a

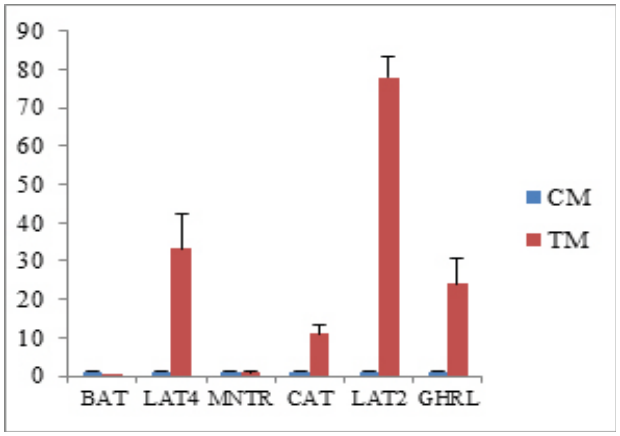


4b

34 weeks Nicobari



4c



4d

Fig. 4. a, b Gene expression of amino acid transporters and hormone receptors in jejunum and magnum tissue at EP FIG 4 c, d in jejunum (J) and magnum (M) tissue of Nicobari chickens at MP

*P<0.05,**P<0.01, ***P<0.001

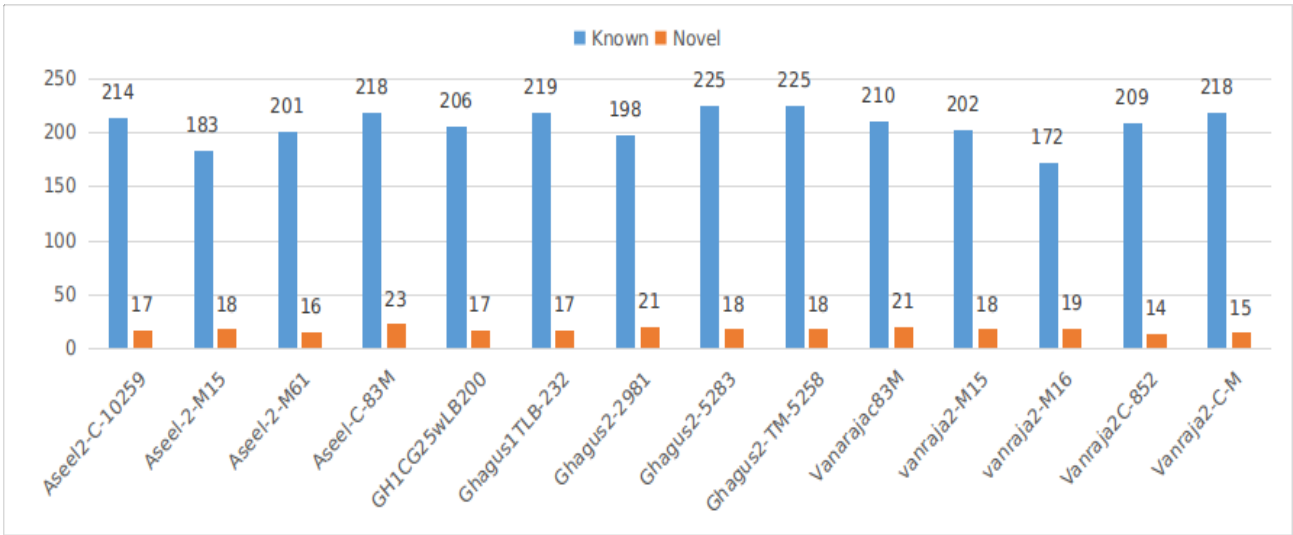


Fig. 5. Known and Novel miRNAs in in control and treatment groups of different breeds and Vanaraja

C- control, T- Treatment or without C is treatment group.

Sustainable Poultry Waste Management through composting

Intensive poultry production results in generation of large quantity of poultry litter. If the litter is disposed off in the field without any treatment, it may cause environmental pollution. This problem can be solved by utilizing the litter for productive purposes. The poultry litter generated, could be successfully converted into compost by mixing it with paddy straw in proper ratio of carbon to nitrogen (C/N ratio) content present in the litter as well as in paddy straw. Finally, vermicompost was developed from the compost by introducing earthworms into the pile of compost.

i) Vermicompost preparation with C/N ratio of 35:1

The compost was prepared having C/N ratio of 35:1 by mixing poultry litter with paddy straw having Relative Humidity 45%, pH 5.5 and Temperature 32^{0}C. 6 Kg of litter was mixed with 40 Kg of paddy straw. The humidity was maintained at around 45%. The temperature was changing due to the growth of the microbes inside the pile. The compost was ready on 47th day. Once the compost was ready, earthworms were introduced into the pile of compost for converting it into vermicompost. The final product (vermicompost) was ready on 45th day after introduction of earthworms. The Relative Humidity was 50%, pH was 5.5 and Temperature was 24^{0}C on 45th day.

Paddy straw

Paddy straw compost

Paddy straw vermicompost

ii) Vermicompost preparation with C/N ratio of 30:1

The compost was prepared having C/N ratio of 30:1 by mixing litter with paddy straw as supplement having Relative Humidity 45%, pH 5.5 and Temperature 32^{0}C. 8.7 Kg of litter was mixed with 40 Kg of paddy straw. The compost was ready on 47th day. Once the compost was ready, earthworms were introduced into the pile of compost for converting it into vermicompost. The final product (vermicompost) was ready on 45th day after introduction of earthworms. The Relative Humidity was 50%, pH was 5.5 and Temperature of the pile was 25^{0}C on the final day.

Compost with C/N ratio of 30:1

Vermicompost with C/N ratio of 30:1

iii) Vermicompost preparation with C/N ratio of 25:1

The compost was prepared having C/N ratio of 25:1 by mixing litter with paddy straw as supplement having Relative Humidity 45%, pH 5.0 and Temperature 31^{0}C. 14.3 Kg of litter was mixed with 40 Kg of paddy straw. The compost was ready on 47th day. After the compost was ready, earthworms were introduced into the pile for converting it into vermicompost. The final product (vermicompost) was ready on 45th day after introduction of earthworms. The Relative Humidity was 50%, pH was 5.5 and Temperature was 25^{0}C on the final day of vermicompost formation.

Compost with C/N ratio of 25:1

Vermicompost with C/N ratio of 25:1

Application of bio-fertilizers into the field

Different types of bio-fertilizers were produced which were applied to the field to see the effect on growth and production of the crop. Poultry litter with paddy straw compost and vermicompost with Carbon to Nitrogen ratios 35:1, 30:1, 25:1 were applied to the field at the village Devenoniguga, Pudur Mandal, Vikarabad, Telangana.

S.No.	Final product	C/N ratio	Group
1.	Control (C)		
2.	RDF (RDF)		
3.	Poultry litter with paddy straw compost	25:1	1
4.	Poultry litter with paddy straw compost	30:1	2
5.	Poultry litter with paddy straw compost	35:1	3
6.	Poultry litter with paddy straw vermicompost	25:1	4
7.	Poultry litter with paddy straw vermicompost	30:1	5
8.	Poultry litter with paddy straw vermicompost	35:1	6

The green gram variety WGG-45 was taken for the study. The date of sowing was 9.6.2022 and the crop was harvested on 14.8.2022. The total duration of the crop was 65 days and spacing between the plants was 45x10 cm. The plant population was 22 per m^2. Along with the control, recycled derived fertilizer, met from 18 kg urea and 125 kg SSP, was also applied to the field at Devenoniguda village, Pudur Mandal for crop production. Different parameters like plant height, number of branches per plant, age to 50% maturity, pod characteristics (average number of pods per plant, pod length, number of seeds per pod), seed index, stover yield and average seed yield were recorded. The details of the groups, bio-fertilizer and the C/N ratios are mentioned below. Land preparation, application of bio-fertilizers, seed sowing, irrigation, tagging and periodic growth till maturity of the crop has been depicted in the pictures mentioned below.

Plotting of experimental site

Sowing of green gram seed

15 – days growth of crop

30 – days growth of crop

60 – days growth of crop

Harvesting stage of crop

Effect of bio-fertilizers on plant height

Table 1. Effect of different types of bio-fertilizers on plant height at different stages of growth in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Plant height (cm)								
30 DAS	6.54±0.21^{a}	6.98±0.18^{a}	8.69±0.68^{b}	9.36±0.67^{bc}	8.56±0.68^{b}	9.02±0.68^{bc}	9.87±0.34^{c}	8.72±0.69^{b}
45 DAS	19.56±1.12^{a}	22.41±1.56^{b}	27.4±2.16^{d}	28.9±1.89^{e}	26.3±1.56^{c}	27.9±1.69^{d}	30.54±1.23^{e}	26.8±1.45^{c}
At harvest	36.14±2.47^{a}	40.21±2.16^{b}	45.23±3.12^{c}	47.52±2.67^{d}	44.65±3.14^{c}	46.89±3.12^{d}	48.23±2.68^{e}	44.95±3.12^{c}

It has been observed that maximum plant height was achieved in the group where poultry litter with paddy straw vermicompost having C/N ratio was 30:1 was applied. The plant height reached to the height of 48.23 cm at the time of harvest. This height was significantly different from all other groups of bio-fertilizers applied to the field. On 30th and 45th days also the plant height was recorded which were found to be 9.87 and 30.54 cm, respectively. Initially, the growth of the plants was found to be similar, however, at a later stage on day 45, the growth/height of the plants was found to be different in different groups of bio-fertilizers applied to the field. As a whole the plants height was found to be less in fields where compost was applied, however, there was no significant difference observed on 45 days after sowing compost and vermicompost having C/N ratio 35:1. Overall, it has been observed that the growth of plants in Control and RDF groups in terms of plant heights were 36.14 and 40.21 cm, respectively which were significantly less at the time of harvest as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on number of branches

Table 2. Effect of different types of bio-fertilizers on number of branches per plant at different stages of growth in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Number of branches per plant								
30 DAS	1.52±0.12^{a}	1.71±0.11^{a}	2.43±0.23^{b}	2.5±0.35^{b}	2.32±0.36^{b}	2.51±0.23^{b}	2.6±0.23^{b}	2.41±0.21^{b}
45 DAS	2.26±0.17^{a}	2.34±0.21^{a}	2.91±0.15^{c}	3.05±0.12^{c}	2.8±0.24^{c}	2.98±0.15^{c}	3.3±0.13^{c}	2.86±0.11^{c}
At harvest	3.7±0.19^{a}	4.2±0.23^{b}	5.45±0.24^{c}	5.9±0.23^{d}	5.13±0.17^{c}	5.68±0.25^{cd}	6.2±0.51^{d}	5.33±0.12^{c}

It has been observed that maximum number of branches was achieved in the group where poultry litter with paddy straw vermicompost was applied. The number of branches in group 5 reached to 6.2 at the time of harvest. This was significantly different from all other groups of bio-fertilizers applied to the field. On 30th and 45th days also the number of branches was recorded which were found to be 2.6 and 3.3, respectively. Initially, the growth of the plants was found to be similar, however, at a later stage on day 45, the growth/ number of branches of the plants was found to be different in different groups of bio-fertilizers applied to the field. Overall, it has been observed that the growth of plants in Control and RDF groups in terms of number of branches was 3.7 and 2.34, respectively which were significantly less at the time of harvest as compared to all other bio-fertilizer groups.

Effect of different types of bio-fertilizers on age to 50% maturity

Table 3. Effect of different types of bio-fertilizers on age to 50% maturity (days) at different stages of growth in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Average age to 50% maturity (days)	39.5±1.1 [d]	38.4±2.16 [c]	36.42±2.18 [a]	37.12±1.8 [b]	36.14±2.13 [a]	36.45±1.56 [a]	37.56±1.3 [b]	36.14±1.25 [a]

It has been observed that 50% maturity was attained fast in all the bio-fertilizers groups except in Control and RDF groups. Maximum growth was observed in vermicompost groups as the plants grew within 36-37 days which is the shortest time to attain 50% maturity. In Control and RDF groups the time taken to attain 50% maturity was between 38-39 days. However, there was no significant difference was observed between the poultry litter compost and vermicompost having C/N ratios 25:1 and 35:1.

Effect of bio-fertilizers on seed index

Table 4. Effect of different types of bio-fertilizers on seed index in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Seed index or 100 grain weight (g)	2.64±0.16 [a]	3.1±0.12 [a]	4.4±0.24 [c]	4.9±0.42 [c]	3.8±0.14 [b]	4.7±0.35 [c]	5.1±0.06 [c]	4.2±0.22 [c]

It has been observed that the seed index showed significantly high in all the bio-fertilizers groups except in Control and RDF groups. The grain weight was observed in vermicompost groups was very much comparable with that of compost groups having C/N ratios 25:1 and 30:1. The grain weight was significantly less in compost group of C/N ratio 35:1 as compared to all other groups of bio-fertilizers. Overall the seed index was found to be less in Control and RDF groups as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on average stover yield

Table 5. Effect of different types of bio-fertilizers on average stover yield in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Average Stover yield (q ha^{-1})	24.56±1.23 [b]	27.32±1.03 [b]	40.1±2.6 [cd]	41.3±2.6 [d]	39.1±1.69 [c]	40.3±2.81 [cd]	42.2±1.67 [e]	39.65±1.38 [cd]

It has been observed that the stover yield was high in all the bio-fertilizers groups except in Control and RDF groups. The stover yield was observed in vermicompost having C/N ratios of 35:1, 30:1 and 25:1 as 39.65, 42.2 and 40.3 q/ha, respectively and compost groups the yield was 39.1, 41.3 and 40.1 respectively in C/N ratios of 35:1, 30:1 and 25:1. The highest stover yield was recorded in the vermicompost group having C/N ratio 30:1 as compared to all other bio-fertilizer groups. In groups 1 and 4 there was no significantly different yield. Overall, the stover yield was found to be less in Control and RDF groups as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on average seed yield

Table 6. Effect of different types of bio-fertilizers on average seed yield in green gram

C/N ratio Treatments	Control	RDF	Compost			Vermicompost		
			25:1	30:1	35:1	25:1	30:1	35:1
			1	2	3	4	5	6
Avg. seed yield (q ha^{-1})	7.2±0.81 ^{a}	7.65±0.67 ^{ab}	10.2±0.92 ^{cd}	11.2±0.97 ^{d}	9.6±0.78 ^{c}	10.6±0.93 ^{cd}	11.88±0.68 ^{e}	9.9±0.71 ^{c}

It has been observed that the seed yield showed high in all the bio-fertilizers groups except in Control and RDF groups. The seed yield was observed to be highest in vermicompost group 5 where the yield was 11.88 quintals/hectare having C/N ratios of 30:1 followed by 11.2q/h in compost group having C/N ratio 30:1. However, there was significant difference observed between Compost group 1 (10.2 q/h) and vermicompost group 4 (10.6 q/h) and also the yield was comparable between compost and vermicompost groups having C/N ratio 35:1 which were found to be 9.6 q/h and 9.9 q/h, respectively. Overall the seed yield was found to be less in Control and RDF groups as compared to all other bio-fertilizer groups.

Poultry rearing with moringa and other feed base – an Integrated Farming System

A Feeding trial was conducted in the Moringa farm. There were three treatment groups besides one control group. Each group had 20 birds and had two replicates each. For the control group feed was made available all the time and treatment group (T1) was offered 65g feed and 30g broken rice per bird, the treatment group (T2) was offered 65g of feed along with 7g moringa dry leaves powder per bird and the last treatment group (T3) was offered 65g of feed and 4g earthworms per bird. The parameters recorded were body weight and egg production at different weeks of age of the birds as shown in Table 1 and 2. The immune parameters like PAHP, Hi Titer and SRBC were also analysed in the serum samples collected from the birds as shown in Table 3.

Table 1: Body weight (Kg)

Age	Control	Treatment 1	Treatment 2	Treatment 3	SEM	P value
Week 16	1515.10^{a}	1022.36^{b}	1041.73^{b}	1050.03^{b}	23.63	0.00
Week 18	1650.60^{a}	1028.73^{b}	1030.36^{b}	1070.80^{b}	28.13	0.00
Week 20	2149.83^{a}	1127.26^{d}	1350.93^{c}	1787.26^{b}	45.94	0.00
Week 24	2435.33^{a}	1756.43^{b}	1683.10^{b}	1684.60^{b}	37.26	0.00
Week 28	2164.96^{a}	1818.90^{b}	1673.60^{c}	1834.30^{b}	23.09	0.00
Week 32	1859.63^{a}	1835.56^{ab}	1736.13^{ab}	1715.60^{b}	19.43	0.01
Week 40	1936.66^{a}	1806.20^{b}	1827.56^{ab}	1717.80^{b}	16.88	0.00
Week 52	1986.80^{a}	1786.63^{b}	1719.90^{b}	1718.43^{b}	17.55	0.00
Week 64	2870.10^{a}	2685.03^{b}	2489.10^{c}	2584.20^{bc}	27.24	0.00
Week 74	2829.23^{a}	2725.36^{ab}	2471.60^{c}	2644.36^{b}	27.27	0.00

The body weight gain of the birds was recorded from the age 16 weeks till week 74. It was observed that at age 16 weeks to 18 weeks, there was a significant increase in body weight in the control group as compared to the other treatment groups. However, no significant difference was observed between the treatment groups. When the birds attained the age of 20 weeks, there was a significant difference in body weight observed between the control and treatment groups as well as between the treatment groups also. The highest body weight was 2149.83 Kg in the control group followed by the group where poultry feed and earthworms were fed (T3), the weight was 1787.26 Kg. This difference with the other groups was observed because of the presence of high protein content of the earthworms. The protein requirement of the birds was met from the earthworms given in the feed. At 24 weeks of age the body weight of the control group was 2435.33 Kg which was significantly different from all other three treatment groups. There was no significant difference found between the treatment groups. In all the age groups, the control group birds found to attain more body weight that any other treatment groups. At 28 weeks of age the body weights were 1818.90 and 1834.30 Kg which were significantly higher than the treatment group to which feed and moringa leaves powder was given. When the birds attained age between 32 to 52 weeks, there was no significant difference found between the treatment groups, however, the control group birds attained significantly higher body weight than the treatment groups. From the age 64 to 74 weeks of age, birds of T1 (2685.03 and 2725.36 Kg) and T3 (2584.20 and 2644.36 Kg) were found to attain higher body weight than T2 (2489.10 and 2471.60 Kg).

Table 2: Egg Production (%)

Age	Control	Treatment 1	Treatment 2	Treatment 3	SEM	P value
Week 26-29	71.60^{a}	54.79^{b}	43.99^{c}	64.12^{a}	1.75	0.00
Week 30-33	50.44^{b}	62.60^{a}	46.65^{b}	47.01^{b}	1.17	0.00
Week 34-37	41.87^{b}	56.63^{a}	46.20^{b}	42.90^{b}	1.06	0.00
Week 38-41	50.61^{b}	61.93^{a}	55.94^{ab}	53.34^{b}	0.99	0.00
Week 42-45	42.37^{ab}	50.45^{a}	41.25^{b}	44.88^{ab}	1.23	0.36
Week 46-49	41.50^{b}	50.88^{a}	37.45^{b}	40.01^{b}	0.97	0.00
Week 50-53	25.06^{c}	45.05^{a}	33.92^{b}	33.37^{b}	1.24	0.00
Week 54-57	32.69^{c}	49.55^{a}	34.91^{c}	39.54^{b}	0.99	0.00
Week 58-61	34.86^{c}	49.49^{a}	35.70^{c}	39.22^{b}	0.90	0.00
Week 62-65	38.15^{b}	48.43^{a}	38.18^{b}	40.86^{b}	0.69	0.00
Week 66-69	38.84	43.17	44.54	40.95	0.80	0.60

The egg production of the birds was recorded from the age group 26-29 weeks to 66-69 weeks. The recording was done on daily basis. In the age group 26-29 weeks the maximum percentage of eggs obtained was in the control group (71.60) followed by in the T3 group (64.12). However, there was no significant difference found between control and T3 groups but production percentage was observed to be lower in T1 (54.79) and T2 (43.99). In all other age groups, the production percentage was found to be higher in T1 as compared to control and other treatment groups. The egg production in the age between 30 weeks to 49 weeks was found to be comparable in treatment groups T2, T3 and control groups. In the age groups between 50 weeks to 61 weeks, the percentage of egg production in T3 was higher (40.01, 33.37 and 39.54) than in control group (25.06, 32.69 and 34.86). There was no significant difference between control, T2 and T3 groups in the age groups 62-65 weeks and 66-69 weeks.

Table 3: Immune Parameters

Immune Parameters	Control	T1	T2	T3	SEM	P value
PHA-P Wattle thickness	299.90^{a}	184.17^{b}	236.41^{ab}	279.95^{a}	12.50	0.00
ND Hi Titer	9.70^{a}	8.70^{b}	8.70^{b}	9.30^{ab}	0.10	0.00
SRBC HA Titer	5.30^{a}	3.40^{c}	4.20^{bc}	4.40^{ab}	0.15	0.00

Birds were evaluated for cell-mediated immune response (CMI) by phytohemagglutinin-P (PHA-P), hemagglutination inhibition (HI) assay against Newcastle disease virus (NDV) antigen and SRBS HA titer. The cutaneous basophil hypersensitivity response PHA-P% increase in wattle thickness (mm) was highest in control and T3 groups viz. 299.90±12.50 and 279.95±12.50 respectively which differed significantly with that of T1 (184.17±12.50). Hemagglutination inhibition test was performed to determine the serum antibodies against Newcastle disease (ND) virus. Again control (9.70±0.10) as well as T3 (9.30±0.10) groups showed highest HI antibody titer than T1 and T2 where level was to be 8.70±0.10. Antibody titers 21 days after injection with SRBC antigen were significantly different between control and two treatment groups T1 and T2. The HA titer was highest (5.30±0.15) in control and similar was the level (4.40±0.15) in T3.

HEALTH

Disease Monitoring, Surveillance and Control in Chicken Populations of DPR

The mortality pattern and causes of mortality were determined. Major disease recorded during the period under report were, RD, necrotic enteritis, coccidiosis, septicemia, egg-peritonitis etc.,A total of 1932 cloacal swabs collected from fourpureline populations (PD3, GML, PB1 and CB) were screened for ALV by Ag ELISA. The overall ALV positive percentage was 5.39%.

ALV infection Status in Native Chickens

A total of 81 blood samples (30 from Kadaknath, 19 from Ghagus, 7 from Aseel and 25 from White Leghorn) and 56 egg samples (30 from Kadaknath, 19 from Ghagus and 7 from Aseel) were collected from the birds of Kadaknath, Aseel and Ghagus which have high SPR value in ELISA to know the infection status of ALV. Molecular screening of buffy coat and albumen isolated from the blood and egg samples respectively revealed the positivity rate of 73.5% (22/30) in Kadaknath, 78.9% (15/19) in Ghagus and 85.7% (6/7) in Aseel from the buffy coat; 60% (18/30) in Kadaknath, 78.9% (15/19) in Ghagus and 100% (7/7) in Aseel from albumen. No samples from the White Leghorn were positive for ALV (0/25) which were used as a control. The birds which are positive for ALV in buffy coat samples were considered as viremic (V+) and the birds which are positive for ALV in albumen samples were considered as shedders (S+). Carrier status of the birds revealed 40% in Kadaknath, 68.4% in Ghagus and 85.7% in Aseel were viremic shedders (V+S+); 33.3% in Kadaknath, 10.5% in Ghagus and 0% in Aseel were viremic non shedders (V+S-); 16.6% in Kadaknath, 10.5% in Ghagus and 14.2% in Aseel were non viremic shedders (V-S+).

Status of *ev* loci in Native Chickens

Locus specific PCR was made to determine the status of avian leukosis subgroup E loci such as ev3, ev6, ev9 and ev21 loci. PCR screening of 81 buffy coat samples revealed that 100% of the birds in Kadaknath (30/30), Ghagus (19/19) and Aseel (7/7) were homozygously negative (-/-), whereas 12% (3/25) of the birds were homozygously positive (+/+) and 20% (5/25) of the birds were heterozygously positive (+/-) in White Leghorn forev3 locus; 10% (3/30) of the birds in Kadaknath and 15.7% (3/19) of the birds in Ghagus were homozygously positive (+/+) and 100% of the birds in Aseel (7/7) and White Leghorn (25/25) were homozygously negative (-/-) for the ev6 locus and 100% of the birds were homozygously negative (-/-) for both ev9 and ev21 loci in all the birds of Kadaknath, Ghagus, Aseel and White Leghorn.

The molecular characteristics of avian leukosis virus

The molecular characteristics of avian leukosis virus subgroup J has been studied by the whole genome

sequencing of the proviral DNA extracted from the tumor sample. The complete genome structure of the ALV J sequenced was 7614 nucleotides in length and was submitted in the GenBank under the accession number OK507207. Comparison of the nucleotide sequences of the major genes with the previous ALV J isolates revealed that the env gene was showing less homology of around 91% to 96% when compare to the gag and pol genes which is having homology of around 97% to 99.4%. Similar comparison of DPRJ21 with prototype strains of other ALV subgroups revealed that env gene having very low homology of around 71% to 72% confirmed that changes in the env gene determines the subgroup and the pol, gag regions were well conserved in all ALVs irrespective of its subgroup. The percentage identity of gp85 and gp37 nucleotide of DPRJ21 was highest with PK19FA01(97.8%) and HPRS-103 (96.3%) respectively. The synonymous (S) and non-synonymous (NS) substitutions in the nucleotide sequence of gp85 and gp37 revealed that NS/S ratio of DPRJ21 in gp85 and gp37 regions were 1.25 (15/12) and 0.5 (7/14) respectively. Though mutation in gp85 was present throughout the region, cluster of mutation were noticed in the hr1, hr2 and vr3. The phylogenetic analysis of the gp85 region with reference strains revealed that DPRJ21 was grouped along with HPRS-103, PK19FA01 and JS14NT01 isolates. Comparison of 3' UTR region with previous isolates revealed 109 bp deletion from the rTM, 15 bp deletion from the DR1 and only 31 bp were retained in the E element region. Similar type of deletion pattern was noticed in ALV J broiler isolates. Comparison of the U3 region of DPRJ21 with other ALV J isolates revealed a deletion of 48 nucleotides from this region in which 37 nucleotides were deleted from the 5' end of this region and 11 nucleotide deletion was noticed in the middle region (101 to 111 bases).

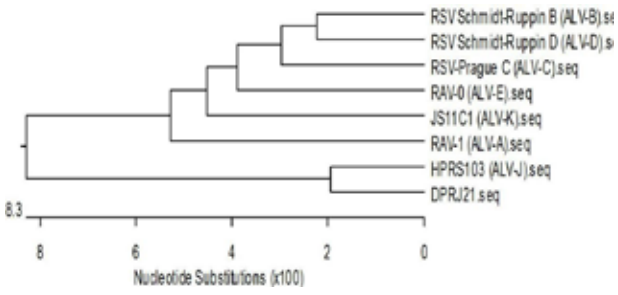


Fig.1. Phylogenetic analysis of the whole genome sequences of DPRJ21 and other ALV subgroups reference strain

Fig.2. Alignment of the amino acid sequences of gp85 of DPRJ21 along with the reference strains. The amino acid sequence of HPRS-103 is given at the top. The identical amino acid sequences were represented by dots (.), the non identical amino acids were represented by letters and the deletions were represented by - (dash)

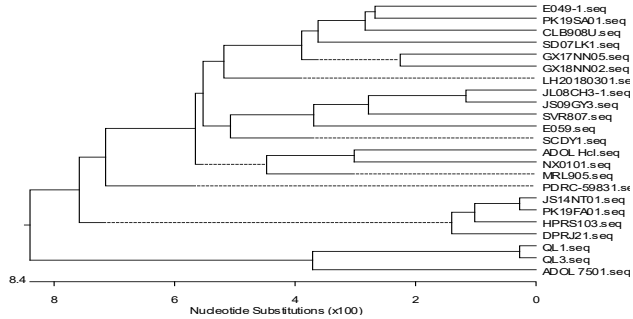
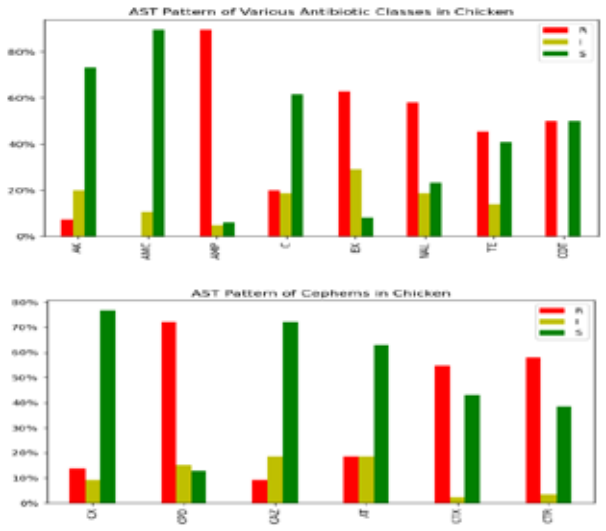


Fig.3. Phylogenetic analysis of gp85 nucleotide sequences of different ALV J reference strains

Indian Network of Fisheries and Animal Antimicrobial Resistance

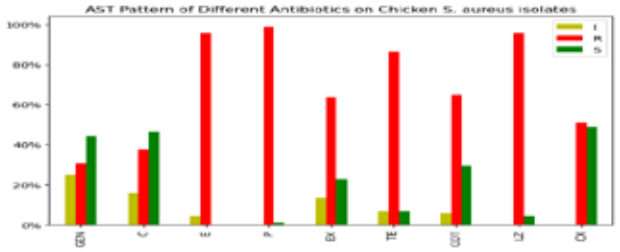
AST pattern of *Escherichia coli* isolates in chicken:

A total of 86 poultry *Escherichia coli* were isolated from 90 samples and the phenotypic antimicrobial sensitivity pattern of various antibiotics *viz.,* Amikacin (AK), Amoxiclav (AMC), Ampicillin (AMP), Chloramphenicol (C), Enrofloxacin (EX), Nalidixic acid (NAL), Tetracycline (TE), Cotrimoxazole (COT), Cefoxitin (CX), Cefpodoxime (CPD), Ceftazidime (CAZ), Aztreonam (AT), Cefotaxime (CTX) and Ceftriaxone (CTR) were assessedusing disk diffusion test. The percent susceptibility for different antibiotics are shown in Figures 1 and 2. Highest resistance was observed for Ampicillin followed by Cefpodoxime. Amoxiclav, Cefoxitin, Ceftazidime and Amikacin were few antibiotics having susceptibility for *Escherichia coli* isolates. Intermediate sensitivity pattern was higher for Enrofloxacin in poultry *E.coli.*



AST pattern of Staphylococcus aureus isolates in chicken:

A total of 88 poultry *Staphylococcus aureus*were isolated from 90 samples and the phenotypic antimicrobial sensitivity pattern of various antibiotics *viz.,* Gentamicin (GEN), Chloramphenicol (C), Erythromycin (E), Penicillin (P), Enrofloxacin (EX), Tetracycline (TE), Cotrimoxazole (COT), Linezolid (LZ), Cefoxitin (CX)were assessed using disk diffusion test. The percent susceptibility for different antibiotics are shown in Figure 3. Highest resistance was observed for Penicillin, Erythromycin, Linezolid, Tetracycline, Cotrimoxazole, Enrofloxacin. Cefoxitin, Gentamicin and Chloramphenicol have susceptibility for *S. aureus* isolates of chicken.



Differential virus load and immune gene expression in chicken embryos infected with Mesogenic Newcastle disease virus (NDV)

Embryos of native chicken breeds viz., Aseel and Kadaknath were inoculated with mesogenic R2b strain on 18th day of incubation along with White Leghorn embryos. On 21st day before hatching the chicks were sacrificed and tissue were harvested and virus load were quantified by real time PCR. Virus load is higher in lung tissue of Aseel and Kadaknath than White Leghorn; Whereas the virus load was higher in spleen of WL compared to Aseel and Kadaknath. Immune gene such as TLR3, TLR7, LITAF, IFN-α, IFN-γ, MHC-I, MHC-II, iNOS, IL-10, IL-12, IL-1β and CCL5 were quantified by real time PCR. The expression of transcripts of these genes also showed differential expression pattern in comparison to uninfected control embryos of respective breeds.

Differential response, morbidity, mortality and immune response to experimental Newcastle virus infection in colored broiler and Vanaraja chicken

The coloured broiler chicken (PB1) and Vanaraja chicken of 10 weeks old were experimentally infected with field Newcastle disease virus isolate by intranasal and oral route. The infected birds were kept in isolator, observed for morbidity, mortality percentage, mean death time, severity of lesion in dead birds etc., for 10 days post challenge. The oral and cloacal swab were collected from both infected and control birds of both breeds on 2nd, 5th and 10th day post challenge. The morbidity and mortality rate were comparatively higher in PB1 than vanaraja birds. Mean death time was shorter in PB1 birds. The virus load was nil by 10th post challenge in surviving PB1 birds, however the virus was still excreted by vanaraja birds until 10day post challenge. Surviving birds of both birds showed higher seroconversion for ND titer measured by HI and iELISA indicating induction of immune response.

Fig.1: Caecal tonsils showing petechial haemorrhages in PB1 birds (top) and no lesions in vanaraja birds (bottom)

Fig. 2: Chicken embryos showing haemorrhages on head and body upon inoculation with tissues from experimentally infected birds. (Left: control embryos; Right: Inoculated embryos)

EXTENSION

Assessment of ICAR-DPR germplasms in the field condition and their impact on food security and livelihood

An Ex-post Facto study was conducted in Mancheral district of Telangana (TS) and Guntur district of Andhra Pradesh (AP) among Scheduled Caste (SC) households to study the poultry production and food security status. A total of 140 households (73 from TS and 67 from AP) were selected for the study. Majority of the respondents were of middle age groups, illiterate, involved in laborour occupation and having no prior poultry farming exposure. More than 75% households in both states having dependency ratio more than 1. In AP majority of the SC household (74.6%) belong to landless category whereas 78% SC households of TS belong to marginal land holding category. Similarly, 56.7% respondents of AP were keeping poultry and whereas this figure was found only 17.8% in TS. The average flock size was 6.7 and 7.6 in TS and AP, respectively. Average household monthly income was found Rs. 6730 and 7100 and monthly income from poultry was Rs 1430 and 1040, respectively in TS and AP. Prior poultry farming experience in household, family size and household income were the factors which were positively contributing to adopt poultry farming whereas landholding contributed negatively.

In the study area 36.4% of respondents were keeping poultry and among the flock 35.2%, 24.1% and 40.7 birds were hen, cocks and chicks. About 95% respondents using night shelter to protect the birds in night and all the respondents used to clean the shelter regularly. About 17% respondents kept their birds on scavenging, 41.4% provided occasional feed supplementation along with scavenging and similar percentage respondent offered regular feed supplementation with scavenging. Amount of feed supplementation varied from 10-50g per bird. About 23.5% respondents offered only kitchen waste whereas 76.5% respondents offered grains along with kitchen waste as feed supplement. In the present study, 47.9% respondents used to offer feed during morning hours whereas 8.7% in afternoon, 21.7% in evening and 21.7% of respondent offered feed all the times. Majority of the respondent (80%) offered same drinking water as they used in household whereas 20% did not offer water to birds and bird used to drink drainage water. In the study area 21.1% respondents using vaccination for one or more diseases and 47.4% respondents used to go government dispensary for veterinary aids. Majority of birds found sick summer and rainy season (45% each). In the study area mortality in the chicken was found 18.1% in which 7.2 % due to predator attacked (40% of total mortality) and 10.8% due to diseases and other reasons (60% of total).

The birds start laying eggs at 20-32 weeks (average 24.4) and annual egg production was found in the range of 35-100 (average 65.4%) whereas hatchability of eggs varied from 60-100% (average 83.6%). Egg intake was found 0.31 and 0.32/person/day in TS and AP, respectively and 82.2% and 64.2% households did not meet the required egg intake of 0.5 egg/day/person in TS and AP, respectively. There was no significant difference in intake of egg in SC community of both the states. Chicken meat intake was found 9.16 and 8.03kg/person/year in TS and AP, respectively and 47.9% and 26.9% households did not meet the required egg intake of 10.5kg/year/person in TS and AP, respectively. Chicken meat consumption was significantly higher in SC community of AP than that of TS. Food security score of SC community of AP was found significantly higher than their counterpart in TS.

REGIONAL STATION, BHUBANESHWAR

Genetics and Breeding

Maintenance of Kuzi duck and evaluation of its crossbreds

Kuzi ducks of S2 generation were reared to record egg production upto 72 weeks of age and the duck day egg production per bird upto 72 weeks of age was 251.28±7.84egg. It was higher by 33 eggs compared to the S2 generation. Egg weight at 72 weeks of age was 73.24±0.24 g. Two crosses of Kuzi with Khaki Campbell were kept for 72 weeks of age to study its production potential and the egg production upto 72 weeks of age In Kuzi X Khaki Campbell (D X K) and Khaki Campbell X Kuzi (K X D) were 305.39±9.70 and 279.94±0.45eggs, respectively. First time in the regional station Kuzi X Khaki Campbell recorded more than 300 eggs and no earlier report in any breed or crosses reached 300 eggs upto 72 weeks of age. This needs to be further studied in a larger population for development of a cross for egg type.

During the year S3 generation of Kuzi were hatched and data collected upto initial phase of laying. Besides this for comparative study of purebreds with different crosses of Kuzi three purebreds Khaki Campbell (KC), White Pekin (WP) and Kuzi (KU) were hatched along with different crosses of Kuzi Viz: KU X KC, KCxKU, KU X WP and WP X KU. In S3 generation total ducklings kept at farm was 1200 in numbers and the fertility % was 71.70% and hatchability % on total egg set and fertile egg set basis were 79.37 and 82.80%, respectively. The fertility and hatchability improved over last generation so only two hatches were taken. It is to mention here that upto S2 generation pedigreed hatching were followed however due to lack of breeding pen the stock is being maintained as a non pedigreed selected line using 250 female and 50 males in each generation. The juvenile body weights at different weeks of age in both the hatches are presented in Table 1. The 8th week body weight which is the primary trait of selection was reduced by 80 g in current generation. The Shank, bill and keel length at 8 weeks of age in straight run ducklings were 70.91±0.13, 68.93±0.13 and 115.11±0.28 mm, respectively. The growing period body weight in male and female are presented in Fig1. During growing period not much gain in body weight recorded in male and in female only 200 gm weight gain observed in 10 to 16 weeks of age. The 20 week body weight in female was 1554±9.15 g. Age at different duck day production % and age at first egg of the flock are depicted in Fig. 2 and it was observed that from first egg of the flock to reached age at 90% duck day production the flock taken 44 days. The mortality % from 0-8 weeks of age was 4.88 % in Kuzi. The egg production data egg weight and egg quality parameters were measured and the data analysis is in progress.

The fertility and hatchability % in different genetic groups of pure and crosses are presented in Fig.3. Fertility % was better in Khaki and Kuzi X Khaki Campbell. Hatchability % ranges from 73.65 to 94.72% in different genetic groups on fertile egg set basis. The comparative juvenile body weight of different crosses of Kuzi (D) with Khaki Campbell (K) and White Pekin (W) along with purebreds are presented in Table 2. Significant ($P<0.05$) difference were observed between the genetic groups and the crosses of Whie Pekin and Kuzi recorded significantly higher weight than the Kuzi though lower than the White Pekin. Amongst all the genetic groups Khaki Campbell recorded lower body weight. Juvenile body weight showed that for medium meat type birds both the crosses of Kuzi with Whie Pekin may be used along with White Pekin which is a meat type duck. Further it was observed that the weight gain was high in D, K, DK, KD and DW upto 7 weeks of age and in WD, W the weight gain continued up to 8 weeks of age. The confirmation traits shank length, keel length and bill length are presented in Fig.3. Significant ($p<0.05$) difference between genetic groups for all the conformation traits were observed and amongst the purebreds highest measurements were observed in W followed by D and K. Amngst the crosses both the crosses in which White Pekin was one parent the measurements were higher than the other two crosses having Khaki Campbell as one parent. Carcass qualities were measured at 10 weeks of age in males and the eviscerated yield % ranges from 65.97 to 68.47 % in different genetic groups (Fig.4). Irrespective of genetic groups breast cut yield expressed as % of eviscerated yield was highest amongst the different cut up parts (Fig.5). The growing period body weight (12 week and 16 week) and initial laying period (20 week) body weight recorded in different genetic groups are presented in Fig. 6. Significant ($p<0.05$) difference between the genetic groups were observed for the body weights irrespective the age of measurements. Amongst purebreds White Pekin recorded significantly highest body weight followed by Khaki and Kuzi where as in crosses DW recorded highest body weight followed by WD, KD and DK irrespective the age of measurements. Age at first egg of the flock and age at different production level in different genetic groups were recorded and significant ($p<0.05$) difference between the genetic groups were observed for all the parameters studied. The age at different production level in different genetic groups are presented in Fig.7. It is to mention here that in White Pekin age at 80 % production level not reached in all the three replicates so that data were not given. D, K, KD and DK were reached different production level earlier than the other genetic groups indicating it has better prudential compared to others genetic groups. The egg number, egg quality and egg weight at different weeks of age were recorded and the analysis of data is in progress. Mortality from 0-8 weeks of age ranges from 2 to 9% in different genetic groups where

as during 8-16 weeks of age the mortality were low and ranges from 0 to 2 % in different genetic groups. The photographs of different genetic groups are given from photo1 to 7. During the period from the project bird a total of 25692 Kuzi ducklings were supplied to the farmers for duck farming.

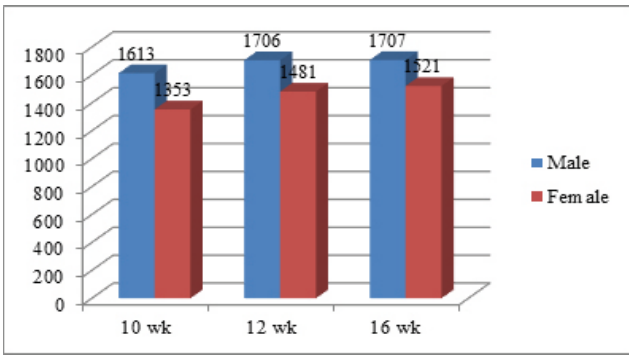


Fig.1. Growing period body weight (g) in S3 in Kuzi

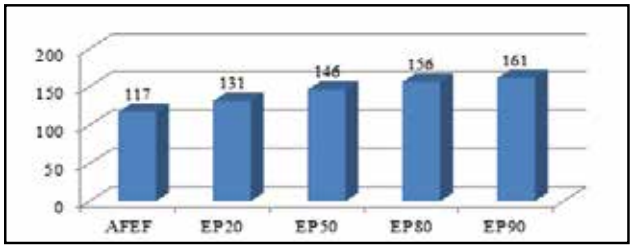


Fig. 2. Age in days at different production level in Kuzi duck.

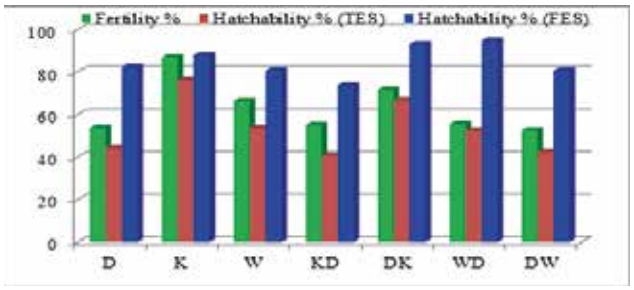


Fig. 3. Fertility and hatchability % (on total egg set and fertile egg set basis) in different genetic groups.

Table 1. Juvenile body weights in S3 generation of Kuzi.

Traits	Hatch 1	Hatch 2
Day old BW (g)	43±0.14 (773)	42±0.16 (429)
1wk BW (g)	90±0.45 (769)	111±2.28 (417)
2 wk BW (g)	136±1.11 (748)	244±3.28 (411)
3 wk BW(g)	358±2.51 (746)	413±5.61 (411)
4 wk BW (g)	533±3.50 (740)	636±7.62(409)
5 wk BW (g)	679±4.43 (740)	806±8.22 (405)
6 wk BW (g)	978±4.75 (738)	1043±10.74 (406)
7 wk BW (g)	1265±5.77 (738)	1207±7.29 (406)
8 wk BW (g)	1332±5.56 (736)	1380±7.95 (406)

In first column BW=Body weight, wk=week; Figures in parenthesis indicates number of observation.

Table 2. Comparative Juvenile performance of Kuzi (D), Khaki Campbell (K), White Pekin (W) and crosses of Kuzi with K and P (DK, KD, DW, WD).

Genetic groups	2wk BW	4 wk BW	6wk BW	8 wk BW
Purebred				
Khaki (101)	169.56^{e}±3.85	519.57^{e}±9.51	1040^{e}±11.81	1289^{d}±15.84
Kuzi (97)	242.91^{b}±5.71	729.59^{b}±12.97	1829^{a}±24.46	1441^{c}±16.52
White Pekin (98)	284.90^{a}±5.61	870.76^{a}±16.25	1191^{d}±14.65	2338^{a}±22.56
Crossbreds				
KD (79)	194.77^{d}±6.96	606.43^{d}±16.47	1160^{d}±16.90	1423^{c}±16.27
DK (133)	164.34^{e}±3.50	536.81^{e}±10.64	1033^{e}±12.47	1294^{d}±11.24
WD (147)	209.42^{c}±3.82	649.37^{c}±11.73	1347^{c}±17.94	1803^{b}±15.02
DW (142)	239.41^{b}±4.21	700.42^{b}±10.88	1466^{b}±16.88	1860^{b}±17.09

Means having even one common superscript in a column did not differ significantly ($p<0.05$). Figures in parentheses are number of observation. wk=week, BW=body weight

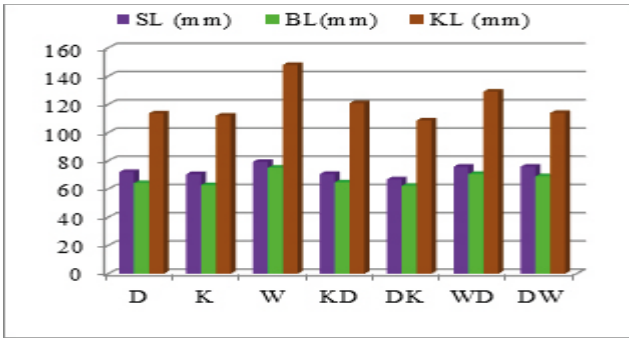


Fig.4. Conformation traits (Shank length, bill length and keel length) in different genetic groups at 8 week of age.

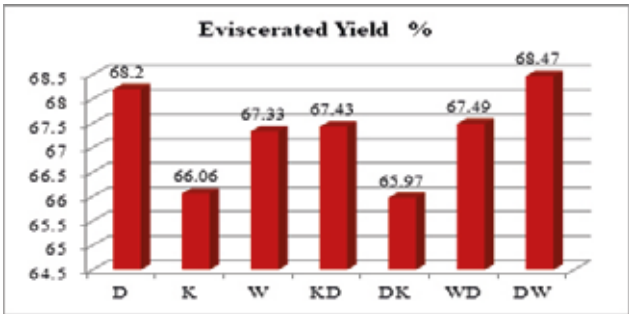


Fig.5. Eviscerated yield % in different genetic groups at 10 week of age in male duck.

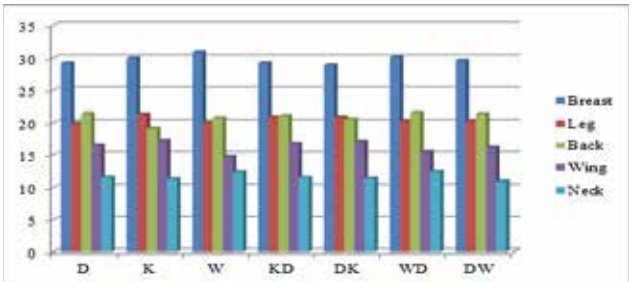


Fig.6. Cut up parts expressed as % of eviscerated yield in different genetic groups.

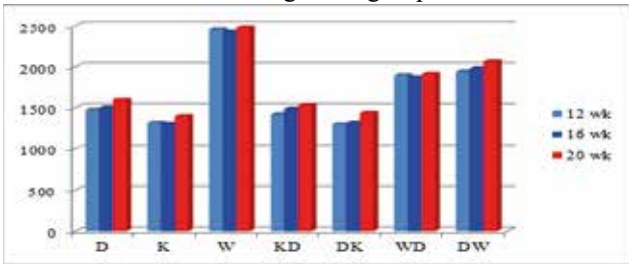


Fig.7. Growing and initial laying period body weight (g) in female of different genetic groups.

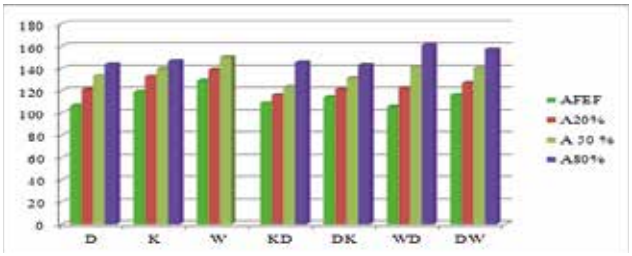


Fig.8. Age at different production % level in different genetic groups including age at first egg of the flock.

Photo 1. DK.

Photo 2. KD

Photo 3. DW

Photo 4. WD

Photo 5. Khaki

Photo 6. White Pekin

Photo7. Kuzi

Maintenance and Evaluation of Chemballi Ducks

1000 fertile eggs of Kuttanad-Chemballi ducks were procured from Government Duck farm, Niranam, Kerala. Hatching percentage based on total egg set and fertile eggs set was 64.87% and 72.88%, respectively. The mean body weight of day old ducklings was 37.97 ± 0.13 g. The mean body weight (gram) of ducklings at 2nd and 4thweek was 170.04 ±0.65 and 508.55 ±6.68, respectively. Effect of sex was highly significant (P<0.01) on body weight. The 8th week mean body weight of male ducklings was 1281.34 ± 6.20 g while female ducklings was 1193.06 ± 5.28 g. The mean body weight of male ducklings (gram) was 1694.28 ± 9.86 and 1654.44 ± 10.97 during 12lth and 20th week, respectively. The mean body weight of female ducklings (gram) was 1432.87 ± 5.52 and 1589.03 ± 8.78 during 12lth and 20th week, respectively. The average daily gain (ADG) was highest during 5th week 37.24 g and started declining after 12lth week age in case of male growers. Mortality was 1.26% in 0-4 weeks and nil during 4-8 week and 1.15% during 8-20th week. Age at first egg of the flock was 121 days. It may be concluded that, Kuttanad-Chemballi ducks has good adaptability to climatic conditions of Odisha showing good growth rate with very low mortality. The marketing of male birds for maximum profit should be done on 12lth week onwards as after that the body weight gain reduces.

Breeding for Development of Mycotoxin tolerant Meat Type Ducks

Experimental Studies on Transplantation of Gonadal tissues from Kadaknath (KN) Chickens to White Leghorn Chickens and Khaki Campbell Ducks, as surrogates, suggested that, Kadaknath male gonads were readily accepted when transplanted at day-old stages. The results showed that the transplanted male gonads continued to grow with equal efficiency, inside both intra- and interspecies surrogate hosts (WL chicken and KC ducks), demonstrating evolution of two suitable intra- and inter-species donor-host system where transplanted gonads, upon surgical recovery, were found to retain potentials to fertilize eggs of KN females and give rise to pure-line KN chicks.

Impacts of two major feed-origin Mycotoxins, Aflatoxins (AFB1) and Ochratoxin (OTA) upon egg production efficiency of Ducks was analyzed using Egg-production data of White Pekin-layers over 5 Annual-eggproduction cycles (2013-21), besides the impacts from prevailing abiotic factors: ambient temperature (low/high); Relative humidity (RH); seasons of year (summer, Rains, Autumn, Winter) and natural Production-peaks (early, Mid, Late, declining Production-peaks) across 21 to 72weeks of age (52Weeks) using SAS's GLM Procedure. Results revealed that AFB1-levels emerged as the significant and most influencing factor (P<0.05), with most other factors as non-signficant or secondary, for impact on egg production; while both the myctotoxins along with other abiotic factors, had limited of virtually-

non-significant impacts on egg sizes. The study concluded that for managing a sound egg production in a backyard-production sector, the most important factor is minimizing natural build up of AFB1 in duck-diets, while ambient-temperatures, RH levels and seasonal effects across different phases of lay, proved as non-significant or secondary factors influencing duck husbandry in coastal ecosystems.

Nutrition

Determination of optimum level of protein requirement for White Pekin ducks during grower stage (9-16 weeks).

An experiment was conducted to determine the optimum level of crude protein requirements of White Pekin ducks during grower stage. From the earlier experiment it was observed that 2600 k cal ME/ kg diet was sufficient for growth and nutrient utilization. So keeping this ME level, three experimental diets containing CP-14%, CP-16% and CP-18% were formulated. For this experiment, 180 grower ducks of combined sex were randomly divided into three groups having six replicates in each group with 10 birds in each replicate. Care was taken to distribute equal number males and females in each replicate. The birds were reared in deep litter system with paddy husk as litter materials the three experimental diets were provided to three groups, respectively. The birds were reared from 9th week to 16th week. Clean drinking water was made available round the clock. The feed was offered *ad libitum* twice daily. Daily feed offered and residue left, weekly body weights were recorded upto 16th week. After 16th week, a metabolism trial was conducted to determine the metabolizability of different nutrients.

The initial body weights of the ducks were 2141.11+23.11g, 2159.92+23.11g and 2152.58 +23.16g, whereas the final body weight was 2553.71+ 24.45g, 2531.39+25.62g and 2522.33+23.99g in CP-14, CP-16 and CP-18 groups, respectively. No significant differences between the groups were observed. The average daily feed intake was 217.92+2.93g, 220.03+0.29g and 218.81+0.27g, in CP-14, CP-16 and CP-18 groups, respectively without any statistically significant difference between the groups. The total feed intake from 9th to 16th week was 15.25+0.20 kg, 15.40+0.02 and 15.32+0.02 kg in CP-14, CP-16 and CP-18 groups, respectively. The FCR in CP-14, CP-16 and CP-18 groups were 23.66+1.13, 25.70+1.06 and 25.19+1.04, respectively. No significant difference between the groups with respect to FCR was observed. The findings of metabolizability of different nutrients in different treatment groups are presented in table 1. From the perusal of nutrient metabolizability data it was observed that the metabolizability of DM, OM and CP was significantly lower in CP-14 group than other two groups fed with higher levels of protein in the diet. However, significantly ($p<0.01$) higher CF metabolizability was observed in lowest CP fed groups, i.e. CP-14 group than CP-16 and CP-18 groups. NO significant difference with respect to EE metabolizability between the groups was observed.

Study to determine optimum level of protein requirement for White Pekin ducks during layer stage (20-35 weeks).

An experiment was conducted to determine the ideal level of protein requirement for White Pekin ducks during layer stage. For this experiment 108 female and 36 male white Pekin ducks were randomly divided into three groups with six replicates in each group. Care was taken to distribute six females and two males in each replicate. Three experimental diets were prepared with varied level of crude protein (CP) i.e. 16%, 18% and 20%. All the diets were iso-caloric with 2700 k cal ME/kg diet as in the earlier experiment it was observed that 2700 k cal ME/kg diet was optimum for growth and production of white

Table 1: Metabolizability of nutrients in different treatment groups

Particulars	CP-14	CP-16	CP-18	P	MSS
DM %	81.39^{b}+0.86	83.77^{ab}+0.85	84.80^{a}+0.43	0.015	3.3025
OM %	84.23^{b}+0.69	86.68^{a}+0.63	86.62^{a}+0.53	0.021	2.3298
CP %	73.97^{b}+2.40	78.74^{ab}+1.20	83.85^{a}+0.47	0.0018	14.895
CF %	85.38^{a}+0.76	81.42^{ab}+1.14	80.33^{b}+0.74	0.003	4.855
EE %	72.24+1.96	74.04+1.04	75.95+1.52	0.2695	14.403

Table 2: Average egg production and feed consumption in different treatment groups

Particulars	CP-16	CP-18	CP-20
Duck day egg production (%)	49.16+2.43	53.25+2.36	53.35+1.42
No. of egg produced per bird	55.06+3.06	59.64+2.64	59.75+1.59
Feed consumed per egg production (g)	589.93+32.80	539.75+21.82	547.60+11.60
Feed per dozen of egg production (kg)	7.08+0.39	6.48+0.26	6.57+0.19

Pekin ducks during layer stage. All the birds are reared in intensive system of rearing in deep litter system with paddy husk as litter material. The respective feed was provided to the respective treatment group such as CP-16, CP-18 and CP-20 group *ad libitium* twice daily. The feed offered and residue left were recorded daily to calculate the daily feed intake. Daily egg production and egg weights were upto 35th week. The egg quality parameters were recorded by breaking two eggs from each replicate at 25th, 30th and 35th week. N mortality was observed during the experimental period. The average daily feed intake was 217.54+0.79g, 217.04+1.95g and 221.96g in CP-16, CP-18 and CP-20 groups, respectively without showing any significant difference between the groups. The initial body weight at 20th week was 2597.81+35.57g, 2541.15+20.28g and 2563.06+18.64g and the final body weight at 25th week was 2680.15+31.25, 2632.39+26.22 and 2694.73+82.58g, respectively in CP-16, CP-18 and CP-20 groups. The duck day egg production, No of eggs produced per bird, feed consumed per egg and per dozen of production are presented in Table 2. The average duck day egg production was 49.16+2.73, 53.25+2.36 and 53.35+1.42 and feed consumed per dozen production was 7.08+0.39 kg, 6.48+0.26 kg and 6.57+0.19 kg, in CP-16, CP-18 and CP-20 groups, respectively without showing any significant difference between the groups.

Evaluation of broken rice or tuber crops based feed mixture supplement in White Pekin ducks in semi-intensive rearing system

(i) Effect of different cereals on the performance of White Pekin ducks during second year of laying under intensive rearing system

A study was conducted to find out the effect of feeding different cereals on the performance of White Pekin ducks during second year of laying under intensive rearing system. White Pekin ducks (45) in second year of laying (53 weeks) were divided into three groups with three replicates in each group and each replicate has five ducks. Three diets with wheat ($W_{100}BR_0$), wheat plus broken rice ($W_{50}BR_{50}$) and broken rice (W_0BR_{100}) were prepared and were offered randomly to the above groups for a period of 20 weeks till they attained 72 weeks. At the end of the feeding trial, a metabolic trial of 4-d collection period was conducted on six birds from each group in individual cages. All the diets were iso-nitrogenous (17.97-18.62, %CP) and iso-caloric (2614-2661, ME, Kcal/kg). The dry matter intake (171.69-180.09, g/d) was similar among the groups. The metabolisability (%) of DM, OM, CP, EE and CF in group $W_{50}BR_{50}$ was higher than W_0BR_{100}, but both were similar to $W_{100}BR_0$. The nitrogen intake (g/d) in $W_{100}BR_0$ group (5.58) and $W_{50}BR_{50}$ group (5.46) was similar and higher ($P<0.05$) than W_0BR_{100} group (5.17); but, the nitrogen outgo (g/d) in $W_{50}BR_{50}$ group (1.33) was lower than W_0BR_{100} group (1.64) and both were similar to $W_{100}BR_0$ group (1.53). The nitrogen balance in $W_{50}BR_{50}$ group (4.12) was higher than W_0BR_{100} group (3.53), but was similar to $W_{100}BR_0$ group (4.06). The total feed intake (23.87-25.03, kg) and egg production (5.78-5.83, dozen) was similar among the groups. There was no significant difference in the percentage of duck day egg production (DDEP) among $W_{100}BR_0$ group (49.86%), $W_{50}BR_{50}$ group (50.00%) and W_0BR_{100} group (49.57%). The feed conversion ratio (feed consumed in kg per dozen egg production) was similar among the groups and ranged from 4.13 to 4.32. The cost (Rs.) per egg in W_0BR_{100} (10.86) was lower than $W_{100}BR_0$ (11.71) and $W_{50}BR_{50}$ (11.24). The egg weight (74.59-75.88, g) was similar among the groups. The egg shape index (68.90-69.47) was similar among the groups. There was no difference ($P>0.05$) in albumen index (0.12-0.13), yolk index (0.42-0.43) and Haugh unit (85.92-87.93) among the groups. The egg contents *viz.* percentage of albumen (53.72-55.40) and yolk (33.35-33.79) were similar among the groups. The percentage of shell weights in W_0BR_{100} group (11.25) was significantly

lower than the $W_{100}BR_0$ group (12.66); but both the values were similar with $W_{50}BR_{50}$ group (11.93). It can be concluded that white Pekin ducks can be raised on exclusive wheat or broken rice based diets during second year of laying under intensive rearing system; however, mixture of wheat and broken rice in equal ratio increased the metabolisability of the nutrients of the feed.

Effect of replacing Fish meal by Soybean meal on the Nutrient Utilization and Egg Quality of Khaki Campbell laying ducks in late laying phase

A study was conducted to find out the effect of replacing fish meal by soybean meal on the performance of Khaki Campbell (KC) in late laying phase. Seventy two (72) numbers of Khaki Campbell laying ducks (83 weeks) were divided into three groups with three replicates in each group and each replicate had 8 KC laying ducks. Three experimental diets with fish meal (Control, T_1), without fish meal replacing fish meal completely by Soybean meal (T_2) and T_2+addition of Lysine and Methionine 50 % more than control diet (T_3) were prepared. All the diets were made isonitrogenous and isocaloric. The above diets were offered randomly to the experimental groups for a period of 16 weeks. During the experiment, the ducks were kept on deep litter system using rice husk as a litter material and fed the respective diets *ad lib.* Standard management practices were followed during the entire experimental period. The ducks had access to clean drinking water all the times. At the end of the biological trial, a metabolic trial was conducted with 4 days collection period by keeping the laying ducks in individual metabolic cages. The results indicated that egg production (nos and dozen) and DDEP percent were significantly ($P<0.05$) higher and FCR was significantly ($P<0.05$) better for ducks reared on T_1 compared to other groups. The dry matter, organic matter and crude fibre digestibilities were significantly ($P<0.05$) higher for ducks fed fish meal. However, the EE digestibility was significantly ($P<0.05$) higher for T_3 group. The egg quality parameters were significantly higher for T3 group. The feed cost to produce dozen egg was significantly higher for ducks in T3 group compared to ducks fed fish meal (T1 group). It is concluded that Khaki Campbell laying ducks fed diet without fish meal was deteriorated in terms of lower egg production, poor FCR, reduced nutrient utilization and higher feed cost to produce dozen egg but the egg quality was improved.

Production and utilization of earthworm based feed in White Pekin ducks

Production of earthworm in cement concrete rings

Cement concrete rings (Diameter-3ft Height-2ft) were fixed on cement concrete floor with provision of shade by covering the area with green net supported by bamboo frame. In the first treatment the cement concrete ring was filled with matured cow dung (15 days old) and biomass (green grass and dried leaves matured for 15 days) in alternate layers of 8 inch depth each in three layers. In the second treatment the cement concrete ring was filled with mixture (50:50) of matured cow dung and duck litter (15 days old) and biomass (green grass and dried leaves matured for 15 days) in alternate layers of 8inch depth each in three layers. Each ring was inoculated with 500grams of earthworm (*Eisenia foetida*) culture. From each ring 2.5-3.0 kg of fresh earthworm was harvested after a period of 70-80 days. They were killed in warm water and kept in hot air oven for drying. After drying the proximate composition was determined.

Fresh earthworm contained 13.74% DM and Earthworm meal contained 95.76% DM, 55.65% CP, 5.90% EE, 3.97% CF, 15.78% Total ash, 6.96% Acid insoluble ash and 18.70% NFE.

Proximate composition of Earthworm meal

Physiology and Reproduction

Duck Rearing management practices in farm condition for optimum productivity under changing climatic condition.

Study of suitable litter material in duck house

A total of 438 nos of Khaki campbell ducks (330 female and 108 male) of 30 wks age were selected for the experiment to study the suitable litter material in duck house. The female ducks were in laying stage. The ducks were divided into three groups with three replicates in each group. Three types of litter materials i.e. 1) Rice husk, 2) paddy straw cuttings and 3) Dry sand were used as litter material in the duck house. All

the birds were offered with duck layer mash (soaked in water) and sufficient clean drinking water. The ducks were allowed to "run-space" with provision of water channel during day time where feed and water were offered. The amount / quantity of litter material used are as follow:

Amount of litter material used in dck house

Day	Rice husk (kg)	Straw cut (kg)	Dry Sand (kg)
1st	50	40	200
10th	20	16	--
18th	20	16	--
23rd	20	16	100
26th	20	16	--
31st	20	16	--
Total amount(kg)	150	120	300

The litter material were added to the floor when the moisture content increased in the litter and fowl smell in the duck house is observed. As the ducks used to lay eggs during late night, so the eggs are collected daily from the floor of the house.

Rice Husk

Paddy Straw cuttings

Dry Sand

The microbial load in the litter were evaluated on 15th and 30th day of experiment by collecting samples from different locations in the duck house and are expressed as 10^9 cfu / gm (cfu : colony forming unit).

Evaluation of microbial load in litter: (x10^9 cfu / gm)

Day	Rice Husk	Straw cuttings	Dry sand
15th	2.85	3.34	1.11
30th	3.11	4.79	1.56

The effect of litter on growth performance was observed by recording body wt at 40th (initial), 42nd, 44th and 46thwk (end of expt) of age. However, no significant difference was observed w.r.t. litter material in duck house as the experimental birds are of 40 wks age when body wt gain is almost ceased. The weight observed is as follows:

Growth Performance of ducks maintained with three types of litter (40-46 wks)

	Age (wk)	Rice husk	Straw cutting	Dry Sand
Body wt (g)	40 wk	1378.22 ±11.59	13.90.28 ±12.72	1391.32 ±12.08
	42 wk	1386.03 ± 18.56	1375.42 ± 13.66	1407.95 ± 17.13
	44 wk	1377.84 ± 16.61	1381.12 ± 16.33	1424.83 ± 16.35
	46 wk	1405.14 ± 14.85	1377.70 ± 15.43	1428.25 ± 17.43

The effect of litter material on production and reproduction parameters was studied during the course of experiment. The eggs collected were graded for crack, dirty and cleaned category. The observation is as follow:

Evaluation of eggs (quantity and quality) collected from duck house with three types of litter material

Parameters	Rice husk	Straw cutting	Dry Sand
Total Egg prod (no)	2615	2605	2723
Crack eggs (no)	10	17	02
Dirty egg (no)	301	322	107
Cleaned eggs (no)	2304	2266	2614
Duck day egg prod (%)	79.24	78.94	82.52

The number of crack eggs were lowest in dry sand litter as it provides soft bed for egg laying in comparison to rice husk and straw cuttings. Again the number of dirty eggs is much more in straw cutting and rice husk litter than dry sand which was due to the fact that the first two types of litter decomposed very fast and retained moisture to a large extent. In contrast, the dry sand used to absorb the moisture of faecal material quickly and not decomposed like other two. Thus least number of dirty eggs are collected in the group where dry sand is used as litter material. Further, duck day egg production is the highest for dry sand litter (62.42 percent) which may be attributed to clean and hygienic environment in the duck house as compared to other two litter material.

In order to study the effect of litter material on reproduction parameters, the eggs collected from different systems were incubated separately in experimental hatchery with standard protocol. A total of six hatches were taken consecutively and observations recorded are as follows:

Reproduction parameters of ducks reared under three types of litter material

Parameters		Rice husk	Straw cutting	Dry Sand
Eggs set (no)		2605	2588	2721
Fertility (%)		86.04 (2241)	86.88 (2248)	88.01 (2395)
Ducklings hatched		2039	1999	2189
Hatchability %	TES	78.29	77.27	80.46
	FES	90.98	88.92	91.40

The fertility and hatchability percent was found to be the highest for the eggs collected from dry sand litter material followed by rice husk and straw cuttings. However, difference was not significant between the groups. Thus, considering the above observations, it may be concluded that dry sand may be used as litter material in duck house during egg laying period.

Development of Duck Egg and Meat Products

A meat product namely "Duck Meat Tikka" was prepared in laboratory in 3 batch trials with varying in marination and cooking time combinations. The combination with 20hrs marination and 35 min. fry-cooking was accorded organoleptic score as 5.60 - Good in the 8 point descriptive scale (8 indicates extremely desirable and 1 indicates extremely undesirable). The majority panel members suggested for averting a slight meaty flavour in after taste category.

Health

Monitoring of duck diseases and their biosecurity measures

A total of 250 ducks were reported to be died this year. (April 2022 to March 2023). The average mortality of duck revealed to be 0.99% (previously 4.13%) corresponding. Month wise highest mortality was in Dec, 2022 (50, 2.86%) and minimum mortality reported in July, 2022 (13, 0.53%).Highest cause of mortality found due to inaniation (81, 32.4%), followed by other major mortalities were Hepatitis (63, 25.2%), Egg bound condition (18, 7.2%), Gout (31, 4.40%), Omphalitis (9, 3.60%), cannibalism (9, 3.60%), drowning (6, 2.40%), Huddling (5, 2.00%), Egg peritonitis (3, 1.20%), septicaemia (2, 0.80%), Enteritis (2, 0.80%) and aspergillosis (2, 0.80%) etc.Age wise highest mortality found in adult (202) followed by duckling (46) and least in grower (2). Breed wise highest mortality was observed in White Pekin (100) followed by Khaki Campbell (60), Desi/Pati (52), Chambelli (22) and Muscovy (13) respectively. Samples from dead birds & sick birds were screened for the duck plague, duck hepatitis virus (DHAV), duck astro virus and found negative for all theses viral diseases. Health care and prophylactic measureswas provided proper to different breeds of duck.

Extension

A training-cum-demonstration camp on "Development of Entrepreneurship among Rural women on Scientific Practices of Duck Breeding, Hatching and Rearing– As a Strategy for livelihood Promotion (An Outreach Programme on Training through Demonstration for Farm Women) was conducted at Village – Bilipada, Via- Rasulpur, District – Jajpur, Odisha on 23 November, 2022 in collaboration with a local organization namely Utkalika Samiti.

TRANSFER OF TECHNOLOGY (TOT)

The Transfer of Technology Unit of the Directorate is engaged in propagation of technologies developed at the institute to different stakeholders of the sector. The propagation of the improved rural chicken varieties across the country is the main objective of the Unit.

The institute popularized the technologies through participation in exhibitions, Kisan Melas, Farmer's days, etc. across the country. The scientists delivered TV and Radiotalks on various aspects of poultry farming. Brochures, pamphlets and bulletins on different chicken varieties were prepared for distribution to the farmers. The details of the activities are as follows.

GERMPLASM SUPPLY

A total of 3,81,610 improved chicken germplasm was distributed to the farmers and other stake holders across the country during 2022 from DPR and different centres of AICRP on Poultry Breeding and Poultry Seed Project. At, ICAR-DPR, with the continuous efforts of the scientific, technical and other staff, the institute supplied 3,81,610 improved chicken germplasm during the year, out of which, 41,829 were the parents of improved chicken varieties.

Germplasm supply from hatchery **Germplasm Supply from Hatchery-2022**

A.	Hatching Eggs sold / Supplied	Nos
	Krishi bro	592
	Vanaraja	56404
	Gramapriya	35270
	Srindhi	12598
	Aseel	1470
	Vanashree	2064
	Ghagus	6319
	Kadaknath	9709
	Layer	11160
	Layer Control (CT)	840
	Broiler Control (CB)	1050
	Nicobari	142
	Embryonated eggs supply	**4349**
	Total	**141967**
B.	**Day Old Chicks Produced**	
1	**Comm.DOC Supply**	
	Krishi bro	3118
	Vanaraja	86858
	Gramapriya	50881
	Srindhi	8891
	Aseel	6503
	Vanashree	9338
	Ghagus	4387
	Kadaknath	19629
	Layer	876
	Nicobari	1154
	Total	**191635**
2	**Parent DOC Supply**	
	Krishi bro	442
	Vanaraja	27307
	Gramapriya	10705
	Srindhi	3375
	Total	**41829**
3	**Different pure line & comm for Farm**	**51720**
4	**Total Grown up Birds supply**	6179
5	**Total Feed supply in Kg**	5778
C.	**Revenue Generated**	
1	Germplasm Supply (Hatchery & TOT)	Rs.1,87,22,664

DAPSTC/TSP Program

The TSP programme aimed at improving the livelihood and nutritional security of remote tribal families through enhanced egg and meat production. Improved backyard chicken varieties and native chicken along with inputs were distributed at different tribal villages of Adilabad district.

Input distribution programme at Dopiguda and Mallapur villages (Indervalli Mandal)

ICAR-Directorate of Poultry Research, Hyderabad distributed native Kadaknath and Ghagus chicken and Gramapriya, improved backyard chicken to tribes of Dopiguda and Mallapur villages (Indervalli Mandal), Adilabad district (Telangana) on 8th April 2022 under the DAPSTC (TSP) programme. The programme aimed at improving the livelihood and nutritional security of remote tribal families through enhanced egg and meat production. Different inputs for backyard poultry rearing including the Gramapriya birds (439), night shelters (54), feeders (54), waterers (54) and feed (540kgs) were distributed to 54 farmers of Dopiguda village to establish a small backyard

unit as a subsidiary income provider. A total of 96 tribal farmers of Mallapur village were provided with Kadaknath (222) and Ghagus (575) grownup birds, night shelters (96), feeders (96), waterers (96) and feed (960kgs). Dr. S. V. Ramarao, Principal Scientist, ICAR-DPR addressed the farmers and explained the role of backyard poultry in sustainable rural livelihoods. Mr. K. Lakke Rao, Chairman, Aboriginal Tribal Welfare Advisory Committee, IDTA Utnoor, Village sarpanch and Peoples representatives from local bodies actively participated in the programme. The programme was attended by about 100 tribal farmers at Dopiguda and 200 farmers at Mallapur village including women in large numbers. The team of Scientists of this Directorate interacted with tribal beneficiaries and elaborated on scientific rearing of rural improved chicken varieties. Dr. U. Rajkumar, Dr.L.Leslie Leo Prince, Dr. B. Prakash and Mr. Ravikumar from the Directorate participated in the programme.

Tribal women beneficiaries with night shelter for birds at Mallapur village

Distribution of native chicken at Mallapur village

Tribal beneficiaries at Dopiguda village

Input distribution at Yapalguda tribal village

Institute distributed Vanaragra grownup birds to tribes of Yapalguda village, Adilabad district (Telangana) on 27th April 2022 under the DAPSTC (TSP) programme. Different inputs for backyard poultry rearing including the Vanaraja birds (500), feeders (75), waterers (75) and feed (750kgs) were distributed to 75 tribal farmers

Dr. Christina Z Chongthu, IAS, Secretary and Commissioner of Tribal Welfare Department of Telangana visited DPR

A preparatory meeting to create livelihood options and sustainable development of Tribal communities through backyard poultry was held at ICAR-DPR, Hyderabad on 7th June 2022. Dr. Christina Z Chongthu, IAS, Secretary and Commissioner of Tribal Welfare Department of Telangana informed that the Tribal Welfare Department is planning to implement the backyard poultry scheme for primitive vulnerable tribal groups (PvTGs) in Telangana state. The Secretary shared the plan and objectives and also explained their technical and other expatiations from ICAR-DPR. Dr. R. N. Chatterjee assured to provide the necessary technical support for establishing the mother unit, parent farm and hatchery unit at different ITDAs. He also informed that a regular supply of day old chicks of improved rural chicken varieties for rearing at mother units and parent germplasm for multiplication at parent farm will be provided. Dr. U. Rajkumar narrated the activities undertaken in the Adilabad district under the Tribal Sub Plan program of the institute. The Secretary and Officials of the Tribal Welfare Department visited the hatchery, pure line farm and moringa integrated farming system and appreciated the activities of the directorate Mr. K Shankar Rao, General Manager and Mr. Laxmi Prasad, Deputy Director from TRICOR and Dr. B. Prakash, Dr. L. Leslie Leo Prince and Dr. Vijayakumar Scientists associated with the TSP Cell of this Directorate participated in the meeting.

Establishment of mother unit at ITDA, Utnoor and collaboration with ITDAs

TSP Team visited ITDA, Utnoor on 16 September 2022 and interacted with the Project Officer, PO, ITDA, Utnoot and other officials. Team visited the mother unit and proper guidance were given for rearing of chicks. Suggestions were provided for renovation of old buildings to establish brooding shed, parent rearing shed and hatchery. Dr. L. Leslie Leo Prince, Dr. B. Prakash, Dr. Vijayakumar and Dr. S.K. Bhanja from the Directorate participated in the programme.

Day old chicks were provided to ITDA, Utnoor for rearing and distribution of grownup birds to tribal farmers of Adilabad district. A total of 4,843 days old chicks was provided to mother unit in 2 batches. ITDA distributed a total of 3,380 grownup birds to 169 beneficiaries.

Input distribution at Mankapur Village

Input distribution programme was organized on 16 September 2022 at Mankapur tribal village of Adilabad district. Kadaknath grownup birds (362 nos) and feed (325 kg) were distributed to 65 beneficiaries. Dr. L. Leslie Leo Prince, Dr. B. Prakash, Dr. Vijayakumar and Dr. S.K. Bhanja from the Directorate participated in the programme

Development Action Plan for Scheduled caste (DAPSC)

The Directorate implemented the Development Action Plan for SC (DAPSC) work in Tamilnadu, Andhra Pradesh, Telangana and West Bengal during the period.

Tamilnadu

The Directorate launched the DAPSC programme in the Chengalpattu District of Tamilnadu on February 24, 2022. Initially, two villages namely Valluvapakkam in Madhurandakam Block and Kayanallur in Chithamur Block were chosen for the project, and a total of 100 SC Families were identified. Onfield training progrmme was organized to the identified SC families on the backyard poultry rearing. Necessary inputs including 1000 Aseel grown up birds, 1000kgs of feed, and other inputs, were distributed to these SC beneficiaries, in order to establish small and sustainable backyard poultry units. These families also received 100 night shelters (50 in each village) to protect their birds from predatory attacks.

Andhra Pradesh

In Andhra Pradesh, two field training and input distribution programmes were organised in Mulpuru and Kuchipudi villages of Amruthalur Mandal, Guntur district, in association with Department of Animal Husbandry, Andhra Pradesh on 02.06.2022. A total of 200 SC families were trained on backyard poultry farming and 1038 grownup birds, 1000 kg of feed, 200 temporary night shelters and 200 packets of medicine and vitamins, and pamphlets on backyard chicken farming were distributed to these beneficiaries to start backyard poultry farming.

Input distribution under DAPSC at Kayanallur village, Tamilnadu

Telangana

During the period, in association with Department of Animal Husbandry, Telangana, one on field training cum input distribution programme was organised at Laxmipur village of Kottapalle mandal, Mancherial district in Telangana. A total of 32 SC families were trained on backyard poultry farming and a total of 300 grown up birds, 200 kgs of feed, 33 feeders and waterers and pamphlets on backyard chicken farming were distributed to the SC beneficiaries to start backyard poultry farming.

West Bengal

In West Bengal, as per the MoU signed between Directorate and ICAR-Central Institute of subtropical Horticulture, Krishi Vigyan Kendra, Malda (CISH-KVK), the DAPSC programme is being implemented by CISH -KVK, Malda. The Directorate has provided the financial support and parent stocks of Vanaraja, Aseel and Kadaknath and other inputs to the KVK, CISH, Malda for implementation of the DAPSC programme. The KVK is maintaining the parent stock, hatching eggs and supply the day old chicks and other inputs to the brooding centres to popularise the backyard poultry farming in the region.

NEH Component

Empowering Tribal Farmers through Backyard Poultry Farming in NEH Region.

Training and input distribution: The programme was implemented in the three states of NEH region viz. Arunachal Pradesh and Mizoram. A total of 900 farmers from Arunachal Pradesh and Mizoram were imparted trainings on improved backyard poultry management system. After successful completion of training, they were provided with improved one month old chicks, balanced feed for supplementation, feeders and waterer, veterinary medicines and vaccines.

Arunachal Pradesh

A total of 7 awareness cum training programmes were conducted covering 425 tribal farmers from 15 different localities (Kullung under Mengio circle of Papumpare district of Arunachal Pradesh). All the participating farmers were provided with improved varieties of chicks, concentrate poultry feed with some basic veterinary medicines for poultry. A total of 4250 chicks, 4250 kgs concentrate feed with veterinary medicines for poultry were provided to the participated farmers for their alternate income generation through poultry farming. The farmers were advised to rear their birds for 20 days under intensive system for adaptation/acclimatization. They were further advised to follow the vaccination schedule in consultation with Scientist, SMS of ICAR and KVKs and Veterinary officer of the state government in remote areas. Conducted awareness programme on backyard poultry farming in Kullung village, Papumpare Dist of Arunachal Pradesh. A total of 1070 Vanaraja chicks were distributed among 70 tribal farmers participated in the programme. The farmers were also advised to keep backyard poultry for better protein and nutrient availability.

Further, constructed one new poultry shed, a semi Californian 3 tier cage for layer installed within the FLD unit in West Kameng Dist. for demonstrationofimproved poultry rearing practices to the tribal farmers of Arunachal Pradesh.

Fig 1. Distribution of Chicks, Feeders and Waterers to the Tribal farmers of Arunachal Pradesh under NEH Component

Fig 2. Rearing of Vanaraja chicks (brooding stage) at West Kameng District of Arunachal Pradesh for distribution to the beneficiaries

Mizoram

A total of 5 training program were conducted with a 240 numbers of farmers from Bungtlang South (61 participants), Lawngtlai Dist, Lawngtlai (44 beneficiaries), Lawngtlai Dist, Reiek (52 beneficiaries), Mamit Dist, Nghalchawm (33 beneficiaries), Mamit Dist and Sihphir and Durtlang (50 Participant) Aizawl Dist. of Mizoram. Further, parent stock of Vanaraja birds maintained in College Poultry Farm to produce fertile eggs and produce chicks locally for distribution of tribal farmers under NEH component. Distributed assistance for building low cost housing structure for backyard poultry (Rs. 500/ Beneficiaries) with locally available materials. Inputs for backyard poultry (feeder, drinker and egg

collection tray) were distributed to the all trained poultry farmers.

Low cost backyard poultry housing with locally available materials at Bungtlang village of Mizoram

Training at BDO Conference Center, Reiek Village, Mamit District

Field visit to poultry farms in Bungtlang south village

Training at Lengte Village, Mamit District

Trainings imparted at RS - Bhubaneswar

A training-cum-demonstration camp on Development of Entrepreneurship among Rural women on Scientific Practices of Duck Breeding, Hatching and Rearing - As a Strategy for livelihood Promotion (An Outreach Programme on Training through Demonstration for Farm Women) was conducted at Village – Bilipada, Via- Rasulpur, District - Jajpur, Odisha on 23 November, 2022 in collaboration with a local organization namely Utkalika Samiti.

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4. TRAINING AND CAPACITY BUILDING

In the training programmes organised by different organisations, staff of the directorate participated to update and gather knowledge in different aspects including science and technology, administration and financial management. The details of the training programmes attended by the staff have been stated in the following table

S.No.	Particulars of training	Official(s)	Duration	Organiser/Venue
1	Short Term Bio informatics Training on NGS Hybrid Genome Assembly	Dr. S. Jayakumar, Senior Scientist	12-18 January 2022	Arraygen, Pune
2	Use of validated protocol for the estimation of AMU at farm level	Dr. D. Suchithra Sena, Principal Scientist	25-26 April 2022	NIPHM and ICAR-DPR, Hyderabad
3	Online Training Programme on National Pension System	Smt. T. R. Vijaya Lakshmi, A.A.O Smt. N. Siva Dharani, L.D.C	16-18 June 2022	ICAR, NRRI, Cuttack
4	Application of Bioinformatics in Agricultural Research and Education	Dr. S. Jayakumar, Senior Scientist	15-24 November 2022	ICAR-NAARM, Hyderabad
5	INFAAR WHONET Refresher Course Training	Dr. D. Suchithra Sena, Principal Scientist	05 December 2022	Kolkata
6.	Leadership development	Dr. S. S. Paul, Principal Scientist	12-23 December 2022	ICAR-NAARM, Hyderabad
7	Laboratory Assessor's training course	Dr. S. Jayakumar, Senior Scientist	19-23 December 2022	NABL, Gurgaon at ICAR-NAARM, Hyderabad

TRAININGS ORGANISED

S.No.	Particulars of training	Official(s)	Duration	Organiser/Venue
1	Advanced biotechnological approaches to augment productivity in poultry for ensuring food and nutritional security	Dr. R.N. Chatterjee Dr. T.K. Bhattacharya Dr. S.P. Yadav Dr. L. Leslie Leo Prince Dr. S. Jayakumar Dr. K. Vijayalakshmy	20-24 September 2022	ICAR-Directorate of Poultry Research, Hyderabad
2	AC&ABC online collaborative training programs on Poultry management for established agripreneures	Dr. Vijay Kumar Dr. S. Jayakumar	28-30 December 2022	ICAR-Directorate of Poultry Research, Hyderabad

- Dr. D. Suchithra Sena, Principal Scientist received Best Women Scientist Award at 5th International Hybrid Conference on Veterinary and Livestock.
- Dr. D. Suchithra Sena, Principal Scientist received Smt. Ava Roy Gold Medal in recognition of her outstanding contribution to the profession of Veterinary Medicine and Animal Sciences
- Dr. P.K. Naik, Principal Scientist was awarded 'Fellow of National Academy of Veterinary Nutrition and Animal Welfare (NAVNAW)' by 'Pashu Poshan Avam Pashu Kalyan Samittee, Bareilly' on September 21, 2022 in the 5th Annual Convention of National Academy of Veterinary Nutrition and Animal Welfare and National Conference on 'Coordinated Nutrition, Health and Extension Approach for Sustainable Livestock Production' held at College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur, MP, during September 21-22, 2022.

Dr. P.K. Naik, Principal Scientist awarded Fellow of National Academy of Veterinary Nutrition and Animal Welfare (FNAVNAW)

- Dr. S.S. Paul, Principal Scientist was awarded Outstanding associate editor 2022 award in Frontiers in Microbiology.
- Dr. S.S. Paul, Principal Scientist was awarded Fellow National Academy of Veterinary Sciences (India).

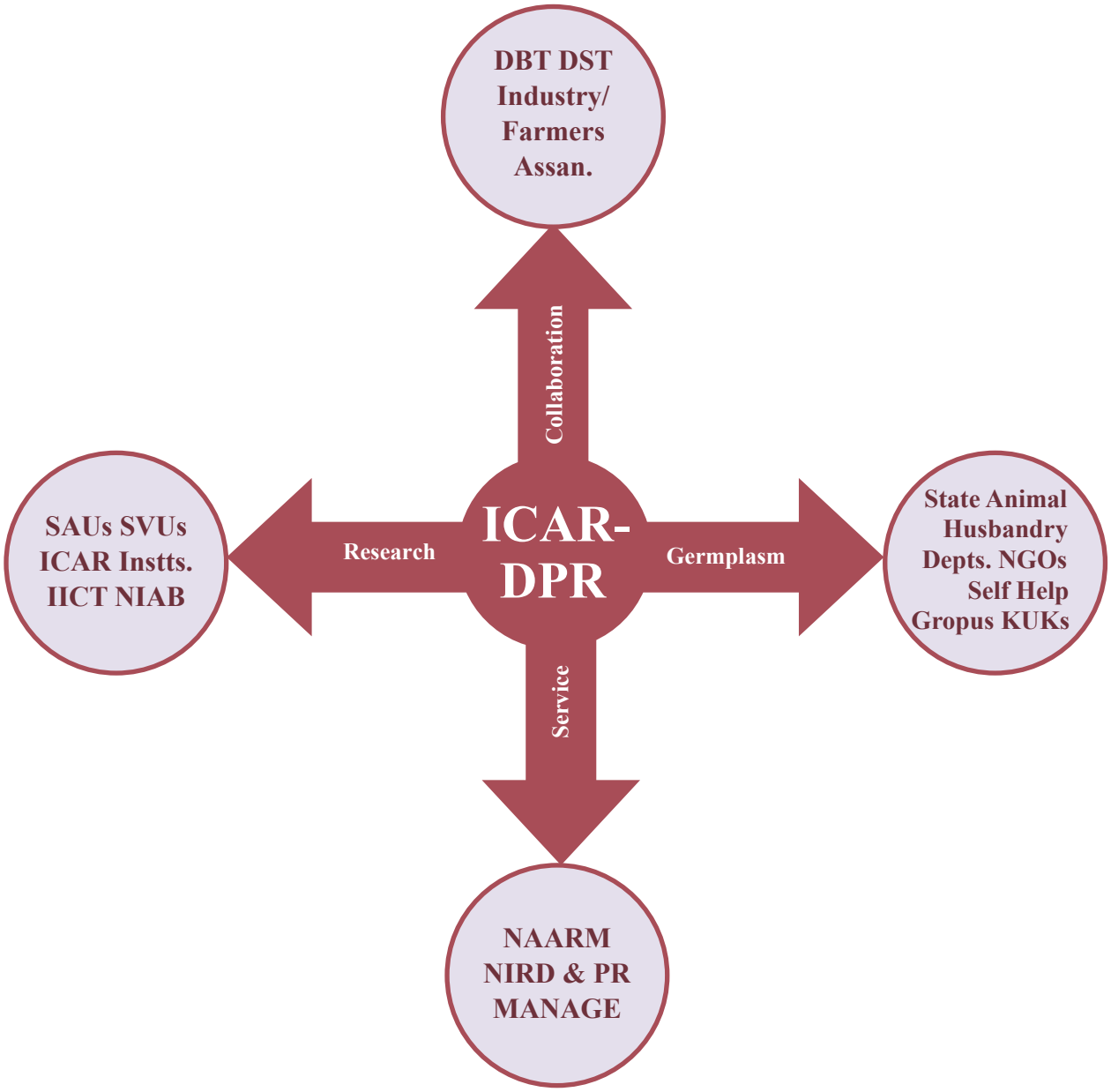
Best Oral Presentation Awards

- P. K. Naik, B. K. Swain, S. K. Sahoo, C. K. Beura, S. K. Mishra and D. Kumar were awarded the'Best Oral Presentation Award-2022' during the '5th Annual Convention of National Academy of Veterinary Nutrition and Animal Welfare (NAVNAW)' organized by College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur, M.P. during September 21-22, 2022.
- Dr. T.R. Kannaki received Best oral presentation award for the research paper on "Disease tolerance pattern & immune response to Newcastle disease virus infection in colored broiler and vanaraja chicken" at National conference on Native chicken held during 22-23rd September, 2022.
- Dr. D. Suchithra Sena, Principal Scientist received Best Oral presentation award (First) at the 39th Annual convention of ISVM and National conference on "Advancements in research and innovations in mitigation of diseases of livestock, companion, wild animals and poultry".

Best Poster Presentation Awards

- Kumar V was awarded the 3rd best poster presentation during the XXXVII Indian Poultry Science Association Conference and National Symposium at U.P. Pandit DeenDayal Upadhyaya Pasu Chikitsa Viswavidyalaya Evum GO Anusandhan Sansthan (DUVASU), Mathura during 4-6 Nov, 2022.
- N. Anand Laxmi, R.K. Mahapatra, M. Shanmugam and K.S. RajaRavindra were awarded the first best poster presentation award during the XXXVII Indian Poultry Science Association conference and National symposium on "Recent Advances in Sustainable Poultry Production for Livlihood and National Security" conducted by DUVASU , Mathura (UP) during Nov. 4-6, 2022.
- M. K. Padhi was awarded the Second best poster award 2022 during the IPSACON 2022 held at Mathura from 4-6 November, 2022.
- S. K. Panda, D. Kumar, G. R. Jena, R. C. Patra, S. K. Panda, K. Sethy, S. K. Mishra, B. K. Swain, P. K. Naik, C.K. Beura, S. Panda were awarded the first best poster presentation award 2022 during the XVIII AZRA International conference on "Advances in Applied Zoological research towards Food, feed & Nutritional security and Safer Environment" between 10-11 Nov 2022.
- B. K. Swain, P. K. Naik, S.K. Sahoo, C.K. Beura, S.K. Mishra and D. Kumar were awarded the first poster presentation award 2022 during the XXXVII IPSACON 2022 organized by Department of Poultry Science. CVSc&AH, UP. Pandit deendayal Upadhayaya Pashu Chikitsa Vighyan Vishwavidyalaya Evam Go-anushndhan Sansthan, Mathura, India during Nov. 4-6, 2022.

he Directorate has entered into collaborations with outstanding research and academic institutions of national and international repute in the field of poultry health, nutrition, breeding and biotechnology. The Directorate is a leading institution in the field of poultry research in the country and is equipped with the state of the art facilities, which are being used by the students of institutions like PVNRTVU, Hyderabad; PJTSAU, Hyderabad; KVAFSU, Bengaluru; NIAB, Hyderabad etc. for carrying out their research work. The scientists of this Directorate have guided many PG and PhD students as Co-chairmen/members of their advisory committees. Two major network programs of ICAR (AICRP on Poultry Breeding and Poultry Seed Project) have been implemented at 24 centres located across the country. The institute has a special linkage with State Animal Husbandry Departments, NGOs and KVKs by involving them in dissemination of technologies like supplying improved poultry germplasm developed at this Institute. The institute conducted training programmes in collaboration with other Institutes like MANAGE and Directorate of Extension, Govt. of India. Besides, participants/ students from neighboring institutions like NAARM, PVNRTVU, PJTSAU, MANAGE, NIRD&PR etc. visited the institute to have practical exposure to the applied aspects of poultry farming and the ongoing research activities.



Collaboratiopn of ICAR-DPR with different agencies

7. ALL INDIA COORDINATED RESEARCH PROJECT ON POULTRY BREEDING

The AICRP on Poultry Breeding is one of the successful projects of ICAR. The AICRP is being operated at twelve centres viz. KVASU, Mannuthy; AAU, Anand; KVAFSU, Bengaluru; GADVASU, Ludhiana; OUAT, Bhubaneswar; ICAR-CARI, Izatnagar; ICAR RC for NEH Region, Agartala; NDVSU, Jabalpur; AAU, Guwahati; BAU, Ranchi; MPUAT, Udaipur and CSKHPKVV, Palampur. The main objectives of the project are development of location specific chicken varieties; conservation, improvement, characterization and utilization of native chickens, elite layer and broiler germplasm and development of package of practices for village poultry and entrepreneurships in rural, tribal and backyard areas. In addition, KVASU, Mannuthy and AAU, Anand centres are to maintain two elite layer germplasm (IWN and IWP). Similarly, KVAFSU, Bangalore; GADVASU, Ludhiana; OUAT, Bhubaneswar and ICAR-CARI, Izatnagar are to maintain four elite broiler germplasm (PB-1, PB-2, CSML and CSFL).

Pedigreed random bred control populations (control layer and control broiler) were maintained at ICAR-DPR, Hyderabad. Samples of hatching eggs from these populations were sent to different centres of AICRP on Poultry Breeding to measure the genetic progress. During the year, a total of **5,85,374** chicken germplasm was distributed to **4,819** farmers/ beneficiaries from different centres. An amount of Rs. **197.66** lakhs revenue was generated through sale of the improved chicken germplasm during the year.

The Mannuthy centre evaluated the S-33 generation of IWN and IWP strains of White Leghorn. The hen housed, hen day and survivors' egg production were 295.82, 323.70 and 328.78, respectively in IWN strain and 286.32, 318.03 and 324.08, respectively in IWP strain of White Leghorn. The body weight at 16, 40 and 64 weeks of age was 1180, 1524 and 1643g, respectively in IWN strain and 1113, 1490 and 1634 g, respectively in IWP strain of White Leghorn. The egg weight at 28, 40 and 64 weeks of age was 48.01, 51.48 and 54.01g, respectively in IWN strain and 48.73, 52.02 and 55.12g, respectively in IWP strain of White Leghorn. The evaluation of S-7 generation of native chicken is in progress. The second field trial of three-way cross for backyard purpose is also in progress. Under SCSP scheme, 140 farmers were distributed with a wood coop and 8 numbers of eight weeks old *Tellicherry* native chicken each. The centre has distributed 44,519 germplasm to 453 needy farmers and generated revenue of Rs. 12.00 lakhs.

The AAU, Anand (Gujarat) centre has evaluated native chicken i.e. A*nkaleshwar* and White Leghorn strains (IWN, IWP, IWD, IWK strains and Control birds) during the year 2022. The egg production up to 40 weeks of age was 83.30 eggs in S-3 generation of *Ankaleshwar* chicken, which was higher (81.50) as compared to S-2 generation. Egg production up to 72 weeks of age was 303.40 and 301.70 eggs in IWN and IWP strains (S-2 generation), respectively. Egg production up to 64 weeks of age was 233.90 and 222.60 eggs in IWD and IWK strains (S-9 Generation), respectively. The centre has supplied a total of 50,496 chicken germplasm to 1,018 farmers. The centre has generated the revenue of Rs. 31.38 lakhs during the year 2022.

The Bengaluru centre evaluated PB-1 (male line) and PB-2 (female line) and native chicken populations during the year 2022. The age at sexual maturity of PB-1 and PB-2 was 196.0 and 209.6 days, respectively and they produced 65.06 and 54.34 eggs, respectively up to 52 weeks of age. The fifth week body weight for PB-1 and PB-2 birds was 1082 and 1018 g respectively. The body weight of native chicken females at 8, 20, 40 and 52 weeks of age was 248.7, 1067, 1273 and 1389 g, respectively. Native chickens produced 30.35 eggs up to 52 weeks of age. During the calendar year a total of 1,60,759 germplasm was distributed to 299 farmers with a revenue generation of Rs. 42.92 lakhs.

The GADVASU, Ludhiana centre evaluated PB-1 and PB-2 lines and native chicken (Punjab Brown). The body weight at 5 weeks of age was 1228, 1121 and 887 g in PB-1, PB-2 and control broiler, respectively. The average egg production up to 40 weeks of age in PB-1, PB-2, and control broiler was 65, 70 and 59 eggs, respectively. The body weight in Punjab Brown at 4, 8, 16, 20 and 40 weeks of age was 346, 652, 1445, 2039 and 2744 g, respectively. The average egg production up to 36 weeks for Punjab Brown was 55 eggs. A total of 84,886 germplasms were supplied to 412 farmers. The revenue generation was around Rs. 29.64 lakhs during 2022.

The OUAT, Bhubaneshwar centre evaluated the performance of pure lines such as CSFL and CSML and *Hansli* native chickens. The fifth week body

weight of CSFL on combined sex basis was 1018 g with FCR of 1.94 while that of CSML was 1123 g with FCR of 1.93. The eighth week body weight of *Hansli* chickens on combined sex basis was 603.1g with FCR of 4.26. The body weight of *Hansli* birds at 20 weeks on combined sex basis was 1583g. The centre supplied a total of 1078 germplasm to 27 farmers and generated the revenue of Rs. 57,651 during 2022.

The ICAR-CARI, Izatnagar centre evaluated the local native chicken, CSML and CSFL and their crosses during the year 2022. The germplasm supply was 20,361. A total of 29 farmers were benefited.

The MPUAT, Udaipur centre evaluated Mewari and *Pratapdhan* populations during the year. The hatchability on total eggs set improved in all the populations. The body weight at 40 weeks of age was 1680 g in Mewari females. The body weight of female at 20 weeks of age was 2018 g in *Pratapdhan*. The egg production at 52 weeks of age was 53.13 eggs in Mewari chicken. The annual egg production (up to 72 weeks of age) in Mewari and *Pratapdhan* was 101.13 and 162.49 respectively. Three training programmes were organized during the reporting period, benefitting 158 tribal farmers under TSP component of the project. A total of 33,005 improved chicken germplasm was distributed to 656 farmers during the calendar year. The revenue of Rs 10.01 lakhs was generated from the distribution of germplasm. Two research papers were published in journals having NAAS rating of more than 6.0 during the report period.

The AAU Guwahati centre evaluated the Kamrupa variety, indigenous chicken, Dahlem Red breed and cross of PB-2 x indigenous chicken germplasm. The Kamrupa bird attained the body weight of 1220±145 g under field conditions and 1561 ± 185 g under farm conditions at 20 weeks of age. Further, at 40 weeks of age, the Kamrupa birds attained the body weight of 1960 ± 435 g under field conditions and 2480±625 g under farm conditions. The *Kamrupa* birds produced 131.4 and 162.6 eggs up to 72 weeks of age on a survivor basis, respectively under field and farm conditions. Similarly, the indigenous birds exhibited body weight of 1350±116 g at 20 weeks and 1780±151 g at 40 weeks of age. The Indigenous birds also produced 116.4 eggs up to 72 weeks of age. The Dahlem Red breed weighed 1420±129.6 g while the PB2 × Indigenous breed weighed 1971 ± 221 g at 20 weeks of age. The Dahlem Red breed produced 221.6 eggs, whereas the PB2 × Indigenous breed produced 129.8 eggs up to 72 weeks of age. During the 2022 calendar year, a total revenue of Rs. 7, 85,805 only was generated through supply of 35,407 numbers of improved germplasm to 141 farmers, contributing to the dissemination of improved genetic resources and supporting the agricultural community.

The Palampur centre evaluated the native chicken, Dahlem Red, DN cross and *Himsamridhi* during the year. In native germplasm, G-10 generation was evaluated up to 72 weeks of age. HDEP at 52 weeks and 72 weeks was 78.65 and 119.65 eggs respectively. The Dahlem Red population was evaluated (G-9 gen.) up to 52 weeks with HDEP of 144.17 eggs. The Dahlem Red X Native (DN) cross birds were produced and evaluated up to 52 weeks of age. HDEP at 40 weeks and 52 weeks was 67.36 and 108.65 eggs respectively. The chicks of *Himsamridhi* (DND) have been produced and evaluated at farm and field level up to 52 weeks. The HDEP of *Himsamridhi* (DND) at 40 weeks and 52 weeks was 72.53 and 119.34 eggs respectively. The overall fertility was good (89.00%) and ranged between 83.60% for DR to 90.25% for Native, whereas the overall hatchability was 69.02% and 77.55% on TES and FES basis respectively. A total of 64,323 chicks were supplied to 672 farmers of Himachal hill region. The centre realized receipts of Rs 25.28 lakhs on account of sale of various poultry products.

The Agartala (Tripura) centre evaluated the BND cross, Tripura Black, and Dahlem Red populations. The sixth evaluation of BND Cross for production performance has been completed at the institute farm and at the farmer's field. In the E-6 evaluation of the BND cross, the 72 weeks egg production was 159.3 and 138.8 eggs under farm and field conditions, respectively. The performance of the previous generation of Tripura Black and Dahlem Red has been completed up to 52 weeks at the farm. The 40 weeks body weight of Tripura Black females, males and pooled sex basis was 1555, 1836 and 1662 g, respectively. There was an improvement in the body weight of Tripura Black in the present generation as compared to the previous generation. The egg production up to 40 weeks (40.0) and 52 weeks (65.0) of age showed a slight reduction in Tripura Black. The egg production in Dahlem Red up to 52 weeks of age

was 113.5. A total of 13 training programmes were organized on poultry farming for 772 rural farmers. A total of 21,747 poultry germplasms were supplied among 762 farmers. The centre has generated a total of Rs. 11,47,462 only revenue during the calendar year.

The Jabalpur centre evaluated G-2 population of *Jabalpur colour* and *Kadaknath* breed. *Jabalpur colour* attained body weight of 705.3g at 6 weeks and 1536 g at 20 weeks with age at sexual maturity was 155 days. Hen day EP up to 40 and 52 weeks was 99.80 and 162.0 eggs in *Jabalpur colour. Kadaknath* attained body weight of 399.4g at 6 weeks and adult body weight 1123 g at 20 weeks with age at sexual maturity was 167 days. *Narmadanidhi* (75% *Jabalpur colour* col and 25% *Kadaknath*) were evaluated under farm and field conditions. Body weight at 8 weeks under farm conditions was recorded 1010 and 725g for males and females, respectively. Under field rearing body weight at 8 weeks of age of male and female birds was 772 and 687g, respectively. The 20 weeks body weight of male (1506 and 1436g) and female (1384 and 1206g) birds under farm and field conditions were recorded. In farm rearing, birds matured at 168 days and laid 109 egg up to 52 weeks of age with egg weight of 49.0g. Under field rearing egg production up to 52 weeks of age was 93.2 eggs with egg weight of 47-48 g. A total of 28,096 chicken germplasm was distributed to 203 farmers with revenue receipts of Rs. 22.02 lakhs during the calendar year.

The Ranchi centre evaluated native chicken, Dahlem Red, PB-2 and Jharsim populations. The hen day egg production of native chickens was 176.32 eggs (G-9) at 72 weeks of age. The hen day egg production in Jharsim was 133.23 eggs up to 64 weeks of age. The centre supplied 40697 germplasm among 147 farmers and other agencies. The revenue receipt was Rs. 4.52 lakhs.

Table 1. Germplasm distribution, farmers benefited and revenue generation during 2022

Centre	Germplasm (Nos.)	Farmers (Nos.)	Revenue (Rs. in Lakhs)
KVASU, Mannuthy	44,519	453	12.00
AAU, Anand	50,496	1,018	31.38
KVAFSU, Bengaluru	160,759	299	42.92
GADVASU, Ludhiana	84,886	412	29.64
OUAT, Bhubaneswar	1,078	27	0.57
ICAR-CARI, Izatnagar	20,361	29	-
MPUAT, Udaipur	33,005	656	10.01
AAU, Guwahati	35,407	141	7.85
CSKHPKVV, Palampur	64,323	672	25.28
ICAR-RC NEH, Agartala	21,747	762	11.47
NDVSU, Jabalpur	28,096	203	22.02
BAU, Ranchi	40,697	147	4.52
Total	**5,85,374**	**4,819**	**197.66**

8. POULTRY SEED PROJECT

The Poultry Seed Project was evolved with an objective to increase the availability of rural chicken germplasm in remote areas of our country. In this endeavour, the Indian Council of Agricultural Research had initiated "Poultry Seed Project" during the XI Five-year Plan with six centres, three in the northeastern region and three in different state veterinary/agricultural universities. The project was strengthened during the XII plan by adding five more centres to cater to the needs of the farmers in their respective regions. At present, the project is being operated at 12 centres across the country. The main objective of this project is local production of improved chicken germplasm (fertile eggs, day old chicks and grownup chicks) and supply to various stake holders in the remote areas to target production enhancement of egg and meat for augmenting rural poultry production, socio-economic condition of the target groups and linking small scale poultry producers with organized market.

The PSP centres are located at Bihar Animal Sciences University, Patna; ICAR Research complex for NEH region, Nagaland centre, Jharnapani; ICAR – Research complex for NEH region, Sikkim centre, Gangtok; ICAR Research complex for NEH region, Manipur centre, Imphal; Tamil Nadu Veterinary and Animal Sciences University, Hosur; ICAR-Central Coastal Agricultural Research Institute, Panaji; ICAR-Central Island Agricultural Research Institute, Port Blair; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar; PVNR Telangana Veterinary University, Warangal; Sri Venkateswara Veterinary University, Tirupati; ICAR Research Complex for NEH Region, Umiam and West Bengal University of Animal and Fishery Sciences, Kolkata.

The Directorate as a coordinating unit, supplies parent chicks and co-ordinates, and monitors the activities of different centres to enable them to achieve their set targets. The targets set for supplying chicks for mainland and north-eastern centres during the year 2022 were between 0.4 and 1.0 lakhs chicks per annum for different centres and to collect feedback on the performance of the germplasm under backyard farm conditions. A total of 3,58,588 improved chicken varieties have been distributed in their respective regions/states with a revenue receipt of Rs. 159.47 lakhs during the year.

Hosur centre had distributed a sum of 59,655 germplasm of Vanaraja and Gramapriya varieties during the year 2022, which involved the sum of 29,018 and 30,637 germplasm of Gramapriya and Vanaraja, respectively. A sum of 1,266 farmers and entrepreneurs were given the germplasm and benefited. A sum of Rs. 14,91,983/- had been generated as revenue. Manipur centre maintained Vanaraja and Srinidhi parents. The total germplasm supplied was 12,420 and **r**evenue generated during the reporting period was Rs 14,61,345. A total farmer benefited under this project was 112 numbers from different districts of Manipur. One training of 3 days duration on Poultry Biosecurity and Disease Prevention was held on 14-16th December, 2022 and 30 farmers have benefited from the said training. Under the Poultry Seed Project, Sikkim centre has produced and distributed a total of 63,455 number. of Vanaraja day old chicks (DOC) to the farmers. A total of 34 brief training sessions were conducted on the day of chicks' distribution to the farmers regarding the feeding, housing and therapeutic management of chicks to reduce early mortality. Total revenue generated was Rs. 43,33,914.

A total of 82 male and 400 female chicks of Srinidhi and 276 female and 65 male parents of Gramapriya were reared at the Goa centre during the current year. A total of 20,836 numbers of poultry germplasm including fertile eggs were distributed to 1015 farmers with a revenue generation of Rs 5,09,935/-. Umiam center is maintaining Vanaraja and Gramapriya parent stock to provide a constant flow of fertile eggs and chicks from improved rural chicken varieties. Number of germplasm supplied during the year was 16270 with 791 beneficiaries. The total revenue generated during Jan-Dec 2022 was Rs. 8,92,774. The Poultry Seed Project's TSP component organized 6 farmer training sessions with field demonstrations. During 2022, ICAR Nagaland Centre reared one batch of Vanaraja and one batch of Srinidhi parent stock. A total 61,328 numbers of improved germplasm were supplied to 847 beneficiaries of 150 villages in different districts of Nagaland.

The Tirupati centre is maintaining parents of Vanaraja**.** Construction of two poultry sheds are completed during current year. A total number of 8,396 germplasm were supplied and an income of Rs 2,68,612/-was generated. The number of farmers benefitte are 175 apart from 80 farmers under SCSP program. The annual review meeting on AICRP

&PSP for the year 2021-22 was conducted at SVVU, Tirupati on September 8 and 9th 2022. The patna centre is maintained the parents of Vanaraja. A total of 42,043 numbers of poultry germplasm including fertile eggs were distributed to 1536 farmers with a revenue generation of Rs 18,80,751/-. Port Blair centre is maintaining Vanaraja patents and Nicobari breed. The total number of germplasms supplied was 8,612 chicks and revenue was Rs. 280167. Srinagar centre supplied 15,314 chicks and earned a revenue of Rs.2.85,640. The total number farmers benefited were 380. Warangal centre maintained 3 batches of Gramapriya parents at different age groups and native commercial stock of Aseel, Kadaknath, Ghagus and Vanashree. The centre supplied about 50,709 germ plasm including fertile eggs and day old chicks to about 800 farmers and generated revenue of Rs. 11.33 lakhs. A total of 3 trainings were conducted for 200 farmers under PSP for the reporting period.

Table 1. Centre-wise distribution of germplasm under Poultry Seed Project during 2022

Sl. No.	Centre	Germplasm (Nos.)	Revenue (Rs. in lakhs)
1	BASU, Patna	42,043	18.80
2	ICAR-RC, Jharnapani, Nagaland	61,328	34.08
3	ICAR-RC, Gangtok, Sikkim	63,455	43.34
4	ICAR-RC, Imphal, Manipur	12,420	14.62
5	TANUVAS, Hosur	59,655	14.92
6	ICAR-CCARI, Goa	20,836	5.10
7	ICAR-CIARI, Port Blair	8,162	2.80
8	SKUAST, Srinagar	15,314	2.86
9	ICAR-RC for NEHR, Umiam	16270	8.93
10	PVNRTVU, Warangal	50,709	11.33
11	SVVU, Tirupati	8396	2.69
12	WBUAFS, Kolkata	-	-
	Total	**3,58,588**	**159.47**

I. Headquarters, Hyderabad

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I. DPR, HYDERABAD

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
A	**INSTITUTE FUNDED PROJECTS**			
1.	Genetic improvement of rural parent lines and development of promising chicken varieties suitable for free range poultry farming (Project No. ANSCDPRSIL202000200072)	Dr. U. Rajkumar	Dr. M. Niranjan Dr. S. Haunshi Dr. L.L.L. Prince Dr. M.R. Reddy Dr. Vijay Kumar Dr. B. Prakash Dr. S. Jayakumar	2020-25
2.	Improvement and Evaluation of PD-2 and PD-6 lines for Rural Poultry Production (Project No. ANSCDPRSIL202000300073)	Dr. M. Niranjan	Dr. U. Rajkumar Dr. K.S. Rajaravindra Dr. T.R. Kannaki	2020-25
3.	Genetic improvement and evaluation of native chicken breeds (Project No. ANSCDPRSIL202000400074)	Dr. S. Haunshi	Dr. U. Rajkumar Dr. L.L.L. Prince Dr. T.R. Kannaki Dr. Suresh Devatkal (NRCM)	2020-25
4.	Improvement and maintenance of elite layer germplasm (Project No. ANSCDPRSIL202000500075)	Dr. K.S. Raja Ravindra	Dr. R.N. Chatterjee Dr. T.K. Bhattacharya (up to Nov 2022) Dr. M. Niranjan Dr. U. Rajkumar Dr. S. Haunshi Dr. L.L.L. Prince	2020-25
5.	Genetic improvement of synthetic coloured broiler male line (PB-1) and maintenance of Broiler Control population (Project No. ANSCDPRSIL202000600076)	Dr. L. Leslie Leo Prince	Dr. K.S. Rajaravindra Dr. T.K. Bhattacharya (up to Nov 2022) Dr. U. Rajkumar Dr. B.L.N. Reddy Dr. M. Niranjan	2020-25
6.	Genetic improvement of the coloured broiler female line (PB-2) (Project No. -ANSCDPRSIL201900100068)	Dr. B.L.N. Reddy	Dr. U. Rajkumar Dr. L.L.L. Prince	2019-24
7.	Generation of whole genome assembly of native Kadaknath chicken and its annotation (Project No. ANSCDPRSIL202000100071)	Dr. S.P. Yadav	Dr. S.S. Paul Dr. R.N.Chatterjee Dr. T.K. Bhattacharya (up to Nov 2022) Dr. S. Jaya Kumar	2020-22
8.	Genomic Characterization and Identification of Selection Sweeps and CNVs in Native Chicken and Duck (Project No. ANSCDPRSIL202200100091)	Dr. S.P. Yadav	Dr Jayakumar Dr S. S. Paul Dr. T.K.Bhattacharya (up to Nov 2022) Dr. R.N.Chatherjee Dr. Rajalaxmi Behera	2022-25

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
9.	Exploration of Genomic architecture of the Indian native ducks using whole genome sequencing and transcriptome analysis (Project No. ANSCDPRSIL202100200086)	Dr. T.K. Bhattacharya (up to Nov 2022)/ Dr. S. Jayakumar (from Dec, 2022)	Dr. R.N. Chatterjee Dr. C.K. Beura Dr. S.K. Mishra Dr. M.K. Padhi Dr. S.C. Giri Dr. S.P. Yadav Dr. S. Jayakumar (up to Nov 2022) Dr. D.C. Mishra-IASRI, New Delhi	2021-23
10.	Genome wide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs during the asymmetric ovarian development of Chicken (Project No. ANSCDPRSIL202100100085)	Dr. S. Jayakumar	Dr U. Rajkumar Dr M. Shanmugam Dr T. K. Bhattacharya Dr. S.P. Yadav	2021-2024
11.	Precision feeding of Atulya to exploitits comprehensive genetic potential (Project No. ANSCDPRSIL202100100084)	Dr. S.V. Rama Rao	Dr. M.V.L.N. Raju Dr. S.S. Paul Dr. A. Kannan Dr. B. Prakash	2021-24
12.	Evaluation of Insect larva meal as a novel protein source in chicken diet (Project No. ANSCDPRSIL202000700077)	Dr. M.V.L.N. Raju	Dr. S.V. Rama rao Dr. S.S. Paul Dr. B. Prakash Dr. A. Kannan Dr. M. Shanmugam Dr. M.R. Reddy	2020-23
13.	Identification and characterization of residual feed intake specific SNPs and candidate genes in coloured broiler (Project No. ANSCDPRSIL202100300087)	Dr. S.S. Paul	Dr. U. Rajkumar Dr. L L L. Prince Dr. SV. Rama Rao Dr. S. Jayakumar Dr. MVLN Raju Dr. SP Yadav Dr. B Prakash	2021-2024
14.	Biosynthesis of different nano mineral particles using plant extracts and evaluation of their potential as feed supplement in poultry (Project No. ANSCDPRSIL202000800078)	Dr. A. Kannan	Dr. S.S.Paul Dr. M.Shanmugam Dr. D.Rajendran (NIANP) Dr. M.Muthkumar (NRCM) Dr. R.Venkateshwarlu (IIMR)	2020-23
15.	Disease Monitoring, Surveillance and Control in Chicken Populations of DPR (Project No. ANSCDPRSIL202001100081)	Dr. M.R. Reddy	Dr. D.Suchitra Sena Dr. T.R.Kannaki Dr. S.K.Bhanja	2020-23

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
16.	Understanding the disease tolerance/ resistance in Indian native chicken breeds to Newcastle disease and novel control strategies (Project No. ANSCDPRSIL201900300070)	Dr. T.R. Kannaki	Dr. M.R.Reddy Dr. S.Haunshi Dr. S.P.Yadav	2019-22
17.	Poultry rearing with moringa and other feed base - an Integrated Farming System (Project No. ANSCDPRSIL202001200082)	Dr. R.K. Mahapatra	Dr. B.Prakash Dr. M.R.Reddy Dr. S.K.Bhanja	2020-24
18.	Cryopreservation of blastodermal cells and production of chicken chimera (Project No. ANSCDPRSIL202100400088)	Dr. M. Shanmugam	Dr. N. Anand Laxmi Dr. T.K. Bhattacharya (up to Nov 2022)	2021-24
19.	Assessment of ICAR-DPR germplasms in the field condition and their impact on food security and livelihood (Project No. ANSCDPRSIL202001300083)	Dr. Vijay Kumar	Dr. S.K.Bhanja Dr. M.Niranjan Dr. S.V.Rama Rao	2020-24
B	**EXTERNALLY FUNDED RESEARCH PROJECTS**			
1.	Life cycle Analysis for Carbon footprint reduction through dietary modulations in broiler meat production (NICRA-CGP)	Dr. S.V. Rama Rao	Dr. M.V.L.N. Raju Dr. S.S. Paul Dr. B. Prakash Dr. Vijay Kumar Dr. M. Shanmugam Dr. T.R. Kannaki	2021-24
2.	Effect of dietary supplementation of bio-fortified maize (QPM) on performance of chickens (ICAR-consortia research program)	Dr. B. Prakash	Dr. S.V. Rama Rao Dr. M.V.L.N. Raju	2018-23
3.	INFAAR (Indian Network of Fisheries and Animal Antimicrobial Resistance) (Net work project)	Dr. D. Suchitra Sena	Dr. M.R.Reddy Dr. S.K.Bhanja Dr. T.R.Kannaki	2020-24
4.	Enrichment of egg and meat by producing bovine Lactoferrin through development of transgenic chicken (DBT)	Dr. T. K. Bhattacharya (up to Nov 2022) Dr. KS Rajaravindra (From Nov 2022)	-	2022-25
5.	IoT Solution for Smart Poultry Farm practice (MeitY (Ministry of Electronics and Information Technology))	Dr. A. Kannan	Dr S V Ramarao Dr T R Kannaki Dr S K Bhanja	2022-23

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
6.	Development of transgenic chicken as bioreactor for easy and cost effective production of human therapeutic proteins - tissue plasminogen activator (htPA) and erythropoietin (hERP)- NASF Project	Dr. T. K. Bhattacharya (up to Dec 2022) Dr S Jayakumar (From Nov 2022)	Dr S. P.Yadav	2022-25
7.	Consortium Research Platform (CRP) on Agro- biodiversity (NBAGR)	Dr. T. K. Bhattacharya (up to Nov 2022) Dr Shanmugam M (from Nov 2022)	Dr Jayakumar Dr Shanmugam M (up to Nov 2022)	2021-26

List pf Projects completed during 2022

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
	Institute funded projects			
1.	Comparative studies on different factors influencing egg production in chicken (Project No. – ANSCDPRSIL201900200069)	Dr. Anand Laxmi	Dr. R.K. Mahapatra Dr. M. Shanmugam	2019-22
2.	Sustainable poultry waste management through composting (Project No. ANSCDPRSIL201700100063)	Dr. R.K. Mahapatra	Dr. N.Anand Laxmi Dr. M.Shanmugam Dr. S.K.Bhanja Dr. B.Prakash Dr. P.K.Pankaj (CRIDA) Dr. Md.Osman (CRIDA)	2017-22
	External funded projects			
1.	Chicken or egg: Drivers of antimicrobial resistance in poultry in India (DBT)	Dr. SV Rama Rao	Dr. S.S. Paul	2018-22
2.	Understanding the epigenetic methylation and miRNA mediated gene regulation of transcellular calcium transport genes in avian uterus during egg calcification (DST)	Dr. M. Shanmugam	Dr. R.N. Chatterjee	2018-22
3.	Development of Gene Knock out Chicken by Genome Editing with CRISPR/Cas for augmentation of productivity in poultry (DST)	Dr. T.K. Bhattacharya	-	2019-22
4.	Genome wide association study in Indigenous poultry breeds (ILRI)	Dr. T.K. Bhattacharya	Dr. R.N. Chatterjee Dr. S.P. Yadav Dr. L.L.L. Prince	2019-22

DPR RS, BHUBANESWAR : Institute Funded Projects

Sl. No.	Project Title	PI	Co-PIs	Duration
1	Meat quality determination of RC duck breeds	Dr. C.K. Beura	Dr.B.K. Swain Dr.P.K. Naik Dr. S. K. Mishra Dr. D. Kumar	2021-23
2	Breeding for development of mycotoxin tolerant meat type ducks (Project No. ANSCDPRSIL202100500089_B)	Dr. S. K. Mishra	Dr. C. K. Beura Dr.P.K. Naik Dr.B.K. Swain Dr. D. Kumar Dr. Rajalaxmi Behera	2021-25
3	Maintenance of Kuzi duck and evaluation of its crossbreds (Project No. ANSCDPRSIL202200200092_B)	Dr.M.K.Padhi	Dr S.C. Giri	2022-24
4	Nutrient requirements of White Pekin ducks	Dr. S.K. Sahoo	Dr. B. K. Swain Dr. P. K. Naik Dr. S. C. Giri	2020-23
5	Evaluation of Broken Rice or Tuber Crops Based Feed Mixture Supplement in White Pekin Ducks in Semi-Intensive Rearing System	Dr. P. K. Naik	Dr. B.K. Swain Dr. S. K. Sahoo Dr. S. K. Mishra Dr. D. Kumar Dr. C. K. Beura	2018-23
6	Production and utilization of earthworm based feed in White Pekin ducks (Project No. ANSCDPRSIL202100600090_B)	Dr. B. K. Swain	Dr. P. K. Naik Dr. S.K. Sahoo Dr. S.K. Mishra Dr. D. Kumar Dr. C.K. Beura	2021-23
7	Duck Rearing management practices in farm condition for optimum productivity under changing climatic condition.	Dr. S. C. Giri	Dr M.K.Padhi Dr S.K.Sahoo	2020-23
8	Monitoring of duck diseases and their biosecurity measures	Dr. D. Kumar	Dr S K Mishra Dr. S. C. Giri	2017-23
9	Maintenance and Conservation of Kuttanad ducks (Project No. ANSCDPRSIL202200300093_B)	Dr. Rajalaxmi Behera	Dr. M. K.Padhi	2022-24
	Inter-Institutional Projects			
1	Diversified rice based farming system for livelihood improvement of small and marginal farmers: (Lead center: ICAR-NRRI, Cuttack)	Dr A. Poonam-PI (ICAR-NRRI)	Dr. S. C. Giri	2016-24
2	Increasing productivity and sustaining the rice based production system through Farmer FIRST approach. (Lead centre: ICAR-NRRI, Cuttack)	Dr S. K. Mishra PI (ICAR-NRRI)	Dr. S. C. Giri	2019-23

Institute Technology Management Unit at ICAR-DPR is managed by Institute Technology Management Committee (ITMC). ITMC is the highest body which takes important decisions for the intellectual property management at DPR viz., filing of patents, approval of the technology for commercialization, pricing of the technologies ready for commercialization etc. ITMC is chaired by the Director.

ITMC Meetings Conducted

ITMC meeting was conducted on 8.6.2022 to examine Patent applications for their novelty and commercial applicability, to review Trademarks application and evaluation of technologies developed at this Directorate for commercialization.

Patent Filed and Granted

Details of Patent applications filed during 2022 are given in Table 1. One patent filed from this directorate on 25th July 2018 entitled "A simple method of detection of protein(s) by using a paper-dip assay kit" was granted on 18th October 2022 with patent no 409212.

Table 1. Details of Patent applications filed during 2022

S. No.	Title of patent	Date of filing	Application number	Inventor
1	Non-viral method of producing human interferon alpha 2b in transgenic chicken eggs under the regulatory control of chicken ovalbumin promoter, poly A tail and histone gene-based construct" received from Dr. T.K Bhattacharya, Principal Scientist.	17th March 2022	TEMP/E-1/16905/2022-CHE	Dr. T. K. Bhattacharya
2	Composite feed additive for improved performance, immunity, and healthier gut microbiome	7th July 2022	TEMP/E-1/49050/2022-DEL	Dr. S. S. Paul
3	Producing organic selenium using milky mushroom (*Calocybeindica*), soyabean meal powder and aqueous extract of zinger through *Saccharomyces cerevisiae* (strain 050)	27th December 2022	202211076024	Dr. B. Prakash

Trademark Granted

The following two trademarks were granted during 2022 (Table 2).

Table 2. Details of the trademarks granted during 2022

S.No	Trademark	Date of filing	Registration No.	Class	Date of grant
1	VANASHREE	24th February 2021	4877929	29 &31	03rd October 2022
2	SRINIDHI	24th February 2021	4877930	29 &31	25th October 2022

Trademark Filed

One "word" Trademark **"OXYCURE"** for the technology developed at ICAR-DPR was filed with Indian Trademark office on 20th July 2022.

Technology Commercialized

One technology developed at this Directorate was commercialized (Table 3).

Table 3. Details of technology commercialized during 2022

Technology	Licensor	Licensee	Date of Licensing	License fee in Rs.	Duration
A kit for detection of protein(s) by using a paper-dip assay	ICAR- DPR	GCC India Pvt. Ltd	15th March 2022	1.5 lakhs + 18% GST	5 years

Contract Research

The facilities of the Directorate were extended for the benefit of poultry industry through the contract research mode of ICAR. Details of Contract research projects are given in Table 3.

Table 3. List of MoUs entered in Contract Research mode during 2022

S. No.	Organization with whom MOU signed	Title of the Project	Date of Agreement	Date of completion	Project PI	Total cost in Rs in Lakhs
1	Intervet India Pvt. Ltd, a division of MSD Animal Health, 6th floor, World Trade Center, Tower 5, Survey No 1, Kharadi, Pune-411014, Maharashtra	The Current status of Marek's Disease in chicken flocks of India	25.11.2022	25.11.2024	Dr. T.R Kannaki	56.83
2	Indbro Research & Breeding Farms Pvt. Ltd, 2-4-118/117, South Swaroop Nagar, Uppal, Hyderabad-500 039	Molecular screening of Slow feathering RIR line for exogenous and endogenous ALVs and association of *ev*21 Loci	17.10.2022	17.4.2023	Dr. M.R. Reddy	6.78
3	Biosint Nutraceuticals, 37 Krishna Nagar, KK Pudur 4th Street, Coimbatore, Tamilnadu-641038	Effect of ActiVin-M feed supplementation in layer male breeders on semen quality and fertility	7.10.2022	7.1.2023	Dr. M. Shanmugam	2.58

Consultancy Services

ICAR-Directorate of Poultry Research offers technical inputs to the poultry industries for the research and development. Advisory consultancy was extended to M/S Chalimeda Feeds Pvt. Ltd., 3-5-446, Gandhi Road, Karimnagar, Telangana on "Advisory Consultancy services on feed and disease related field issues in poultry". Memorandum of Understanding (MOU) was signed between ICAR-DPR and Chalimeda Feeds Pvt. Ltdon 20th April 2022 for the duration of 1 year. Total cost of the project was Rs.5, 20,306.

Contract Services

The Directorate renders contract services to external agencies. The details of Contract service provided are given in Table 4.

Table 4. Details of MoU entered under Contract Service mode during 2022

S. No.	Organization with whom MOU signed	Title of the Project	Date of Agreement	Date of completion	Project PI
1	M/S Chalimeda Feeds Pvt. Ltd., 3-5-446, Gandhi Road, Karimnagar, Telangana	Feed Analysis, Molecular diagnostics PCR, RT-PCR, serology, bacteriology etc	20.4.2022	2.4.2025	Dr. T.R Kannaki

Institute Research Committee

Half yearly IRC (Institute Research Committee) meeting

The half yearly IRC meeting was held on 4 and 5 January 2022 at the Directorate. The meetings were chaired by Dr. R.N. Chatterjee, Director and Dr. T.K. Bhattacharya acted as the Member Secretary. Principal Investigators presented the achievements (April to September 2021) of their respective projects. The Chairman, IRC suggested measures for overcoming the difficulties in achieving desired targets.

Annual IRC (Institute Research Committee) meeting

The Annual IRC meeting was held on 14-15 June and 23-24 July 2022 at the Directorate. The meetings were chaired by Dr. R.N. Chatterjee, Director and Dr. T.K. Bhattacharya acted as the Member Secretary. Principal Investigators presented the achievements (2021-22) of their respective projects. The Chairman, IRC suggested measures for overcoming the difficulties in achieving desired targets.

Research Advisory Committee

The first meeting of newly constituted Research Advisory Committee of ICAR-Directorate of Poultry Research, Hyderabad was held during 29-30 August 2022. Dr.R. Prabakaran, Chairman, RAC chaired the meeting that was attended by other committee members, Dr. Jalaluddin, Dr. P.K. Singh, Dr. S.K. Mukhopadhayay, Dr. V.K. Saxena, ADG (AP& B) and Sri. K. Ramakrishna Reddy. Other committee members Dr. C.Joshi, and Dr. M.M. Chawak joined the meeting virtually. Dr. R.N. Chatterjee, Director, DPR and all the I/Cs of different sections, Dr. C.K. Beura, I/c RS, Bhubaneswar and scientists attended the meeting, The progress of different research projects was discussed and suitable recommendations were made for further improving the research progress of the Institute

RAC Meeting is in progress

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

The Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project for the years 2020-21 and 2021-22 was organized at the College of Veterinary Sciences, SVVU, Tirupati on 8th and 9th September 2022. Dr. B.N. Tripahi, DDG (AS) graced the occasion as the Chief guest. The inaugural session started with the invocation by Dr. Adilakshmamma, Associate Dean, C.V.Sc. Tirupati. Dr. K. Sarjan Rao, Dean, C. V. Sc. Tirupati, welcomed the chief guest, other dignitaries and participants. In his opening remarks Dr. R.N. Chatterjee, Director, ICAR-DPR highlighted the contribution of the poultry sector to the Indian economy and the role played by the AICRP and PSP centres in making available the improved germplasm of the poultry throughout the country. Dr. V.K. Saxena, ADG (AP&B), ICAR lauded the contribution of AICRP on Poultry breeding during the last 50 years of its existence in meeting the needs of animal protein.

Honourable DDG (A.S.), ICAR, Dr. B.N. Tripathi congratulated the AICRP team for the successful completion of fifty years (golden jubilee) of its contribution. He suggested bringing out a document highlighting the achievements of AICRP during the last fifty years He stressed the need for quantifying the contribution of the AICRP towards the economy of the country. He suggested collaborating with agricultural economists to accomplish this task. He also suggested improving the productivity of native or improved chickens in order to increase the availability of eggs from the present 90 eggs to the recommended level of 180 eggs per person per year. He emphasized the need for the characterization of native chickens of the country to achieve the mission of zero non-descript birds. Dr. U. Rajkumar, In-charge, AICRP on Poultry Breeding and Dr. S.V. Rama Rao, In-charge, PSP presented the respective PC reports. Two technical sessions were conducted and the progress of the Centres was reviewed. Hon'ble DDG (AS) chaired all the sessions, while ADG (AP&B) and Director, ICAR-DPR, Hyderabad co-chaired. The officials

from the SVVU, Tirupati, a team of scientists from ICAR-DPR, Hyderabad and Principal Investigators of all the Centres participated in the meeting. The meeting ended with a vote of thanks from Dr. U. Rajkumar, Pr. Scientist.

Brain Storming Meet on "Duck Research in India – a Way Forward"

Regional Station, ICAR-DPR, Bhubaneswar organized a Brain Storming meeting on "Duck Research in India – a Way Forward" on 4.7.2022. The Deputy Director General (Animal Science), Dr. B.N. Tripathi was the Chief Guest and Dr. R.P. Singh, Director, ICAR-DFMD, Bhubaneswar was the Guest of Honor. Dr. R.N. Chatterjee, Director, ICAR-DPR presided over the function. Dr. R.N. Chatterjee, Director, ICAR-DPR welcomed the guest and emphasized the importance of duck species in the country and urged the eminent scientist to discuss the researchable issues and come up with recommendations to develop duck production in the country. Dr. C.K. Behura, In-charge, Regional Station presented the significant achievements and contribution of the centre in duck development. Dr. Mahesh P.S., Joint Commissioner & Director, CPDO, Bangalore and Dr. A. Jalaudeen,

Annual review meeting of AICRP on Poultry Breeding and PSP is in progress

Ex-Director of Academics & Research, KVASU, Kerala narrated the status of duck production in India and abroad and highlighted the researchable issues in different areas of duck production. Dr. B.N. Tripathi, DDG (AS) stressed on the importance of duck research in India. He suggested to develop a road map to improve the duck production to 40 million from 33 million in coming five years. He also emphasized for collaborative program with CPDO for effective extension and propagation of duck rearing. After the presentations, a Round table discussion was held inviting suggestions from all the experts and scientists. The program ended with vote of thanks from Dr. S.K. Sahoo, Pr Scientist. Experts from the different Government organizations, OUAT, entrepreneurs and scientists participated in the meeting.

ITMC

ITMC meeting was conducted on 8.6.2022 to examine Patent applications for their novelty and commercial applicability, to review Trademarks application and evaluation of technologies developed at this Directorate for commercialization.

Institute Joint Staff Council

3rd, 4th and 5th Meetings of Institute Joint Staff Council meeting was held at this Directorate on 17 March 2022, 8 July 2022 and 7 October 2022 respectively.

Brain Storming Meet on "Duck Research in India is underway

Institutional Animal Ethics Committee

The IAEC meeting of ICAR-DPR were conducted on 20th August, 2022 for the approval of experimental protocols of the research projects. The IAEC nominees of CPCSEA, Dr Ramavat Ravinder Naik, Dr Rajender Rao, Dr Uma Mahesh Yellisetti and Dr Krishnakumar attended the meeting.

IAEC Meeting is in progress

13. PARTICIPATION OF SCIENTISTS IN SEMINARS, CONFERENCES, WORKSHOPS, ETC.

Sl. No.	Particulars of Seminars/conferences/ workshops	Official(s)	Schedule	Venue/ Organised by
1	Online meeting on "Characterization and Documentation of Animal Genetic Resources of Telangana State: A Mission towards Zero Non-Descript Population"	Dr. LLL Prince, Pr. Scientist	10 January 2022	ICAR-NBAGR, Karnal
2	New (or alternative) feedstuffs in the time of increasing feed costs (Webinar)	Dr. M.V.L.N. Raju Pr. Scientist	March 8, 2022	Paris, France (Online) WPSA (French branch)
3	4th International Conference on Veterinary and Livestock	Dr. D. Suchitra Sena, Pr. Scientist	28-29 March 2022	Goa
4	International workshop on climate change and livestock production: Current scenario and way forward	Dr. M. Shanmugam, Sr. Scientist Dr. S. Jayakumar Sr. Scientist	11-13 April 2022	ICAR-NIANP, Bengaluru in collaboration with University of Melbourne, Australia
5	Town Official Language Implementation Committees (TOLIC) meeting	Dr. S. P. Yadav Pr. Scientist	27 April 2022	Software Technology Park of India (STPI), Hyderabad
6	National Seminar on "Revisiting poultry production and marketing systems for addressing the fast-changing consumer preferences"	Dr. R.K. Mahapatra Pr. Scientist Dr. S. Haunshi Pr. Scientist Dr. S. P. Yadav Pr. Scientist Dr. LLL Prince, Pr. Scientist	6 May 2022	ICAR-DPR, Hyderabad jointly organized by ICAR- DPR, Hyderabad and IPSA-Telangana and A.P., Chapter
7	Seminar on the theme "Feed ingredients: what goes up won't come down !"	Dr. M.V.L.N. Raju Pr. Scientist	May 7, 2022	Bengaluru, Institution of Veterinarians in Poultry Industry (IVPI)
8	National Symposium on self-reliant Coastal Agriculture	Dr. R.N. Chatterjee, Director Dr. U. Rajkumar, Pr. Scientist	11-12 May 2022	Goa
9	Brainstorming Workshop on Organic Farming	Dr. R.K. Mahapatra Pr. Scientist	June 10 2022	ICAR-NAARM, Hyderabad.
10	Town Official Language Implementation Committees (TOLIC) meeting	Dr. R.K. Mahapatra Pr. Scientist Dr. S. P. Yadav Pr. Scientist	13 June 2022	The Institute of Co-operative Management (ICM), Hyderabad

Sl. No.	Particulars of Seminars/conferences/ workshops	Official(s)	Schedule	Venue/ Organised by
11	20th Annual Convocation cum Scientific Convention of NAVS(I)	Dr. R.N. Chatterjee, Director Dr. U. Rajkumar, Pr. Scientist	20-21 June 2022	Nagpur
12	Brainstorming session on Impact of COVID-19 on livestock & Poultry Sector	Dr. Vijay Kumar, Sr. Scientist	24 June 2022	NAAS, New Delhi
13	Online National Workshop cum webinar on Genome Editing	Dr. S. Jayakumar, Sr. Scientist	27 June-03 July 2022	----
14	Virtual national workshop cum webinar on "Genome editing – Basic to advanced applications in agriculture, pharma and health sectors"	Dr. S. Jayakumar Sr. Scientist	27 June - 3 July 2022	Glostem and Indian National Young Academy of Sciences
15	2nd International Conference on "Integrative Biology Applied Genetics"	Dr. Anand Laxmi, N. Pr. Scientist Dr. S. Jayakumar, Sr. Scientist	20 -22 July 2022	Hyderabad
16	XXVI World's Poultry Congress of World's Poultry Science Association (Online)	Dr. M.V.L.N. Raju Prl. Scientist	7-11 August 2022	Paris, France WPSA (French branch)
17	National Workshop on Pathways for Effective Implementation of SC Sub-Plan Scheme in ICAR	Dr. Vijay Kumar, Sr. Scientist	18-19 August 2022	ICAR-NAARM, Hyderabad
18	National Conference on "Native Chicken Relevance of Climate Smart Traditional Farming Systems in the Era of Omics"	Dr. T.R. Kannaki, Sr. Scientist	22-23 September 2022	TANUVAS, Chennai
19	National Seminar on "Harnessing the Potential of Panchabhutas (tatvas) for sustainable climate Resilient Rainfed Agriculture" at CRIDA, Hyderabad	Dr. R.K. Mahapatra, Pr. Scientist Dr. Vijay Kumar, Sr. Scientist	28-29 September 2022	Hyderabad
20	TOLIC – 2 Hyderabad meeting	Dr. R.K. Mahapatra Pr. Scientist	21 October 2022	NFDB, Hyderabad
21	XXXVII Annual Conference of Indian Poultry Science Association-2022 (IPSACON-2022)	Dr. Anand Laxmi, Pr. Scientist Dr. K.S. Rajaravindra, Sr. Scientist Dr. Vijay Kumar, Sr. Scientist Dr. M. Niranjan, Pr. Scientist	04-06 November 2022	DUVASU, Mathura
22	Webinar on DDGS for Animal Feed: Opportunities and Challenges: Panel discussion on potential opportunities for using DDGS as a protein source by animal feed industry (Panellist)	Dr. M.V.L.N. Raju Pr. Scientist	11 November 2022	CLFMA, KPFBA, AIPBA, BCC and Biotech Consortium India Ltd.

Sl. No.	Particulars of Seminars/conferences/ workshops	Official(s)	Schedule	Venue/ Organised by
23	XVI Annual Convention of Indian Society of Animal Genetics and Breeding (ISAGBCON-2022) and National Conference on Innovations in Animal Genetics & Breeding for sustainable productivity of livestock and poultry	Dr. R.N. Chatterjee, Director Dr. S.V. Rama Rao, Pr. Scientist Dr. M.V.L.N Raju, Pr. Scientist Dr. B.L.N. Reddy, Pr. Scientist Dr. N. Anand Laxmi, Pr. Scientist Dr. S.S. Paul, Pr. Scientist Dr. M.R. Reddy, Pr. Scientist Dr. M. Niranjan, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist Dr. R.K. Mahapatra, Pr. Scientist. Dr. D. Suchitra Sena, Pr. Scientist Dr. Santosh Haunshi, Pr. Scientist Dr. L.L.L. Prince, Pr. Scientist Dr. S.P. Yadav, Pr. Scientist Dr. A. Kannan, Pr. Scientist Dr. B. Prakash, Pr. Scientist Dr. M. Shanmugam, Sr. Scientist Dr. T.R. Kannaki, Sr. Scientist Dr. K.S. Rajaravindra, Sr. Scientist Dr. S. Jaya Kumar, Sr Scientist Dr. Vijay Kumar, Sr. Scientist	02-03 December 2022	ICAR-DPR, Hyderabad
24	5th International Conference on Veterinary & Livestock	Dr. D. Suchitra Sena, Pr. Scientist	17-18 November 2022	----
25	International Veterinary Pathology Congress 2022. Symposium on Global challenges in rapid diagnosis and management of animal and poultry diseases for improved health and production conducted by IAVP	Dr. D. Suchitra Sena, Pr. Scientist Dr. T.R. Kannaki, Sr. Scientist Dr. S.K. Bhanja, CTO Dr. Diwakar Singh Rana, Sr.T.O	17-20 November 2022	PVNRTVU, Hyderabad

Sl. No.	Particulars of Seminars/conferences/ workshops	Official(s)	Schedule	Venue/ Organised by
26	Poultry Knowledge day Seminar by Poultry India	Dr. M.V.L.N. Raju, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist	22 November 2022	Poultry India, Hyderabad
27	Hindi Workshop	J. Srinivas Rao, ACTO	13 June 2022	ICM, Rajendranagar, Hyderabad
28	Cera National Workshop cum Awareness Program	J. Srinivas Rao, ACTO	21 November 2022	Virtual mode by ICAR, New Delhi

Regional station, Bhubaneshwar

Sl. No.	Particulars of Conference / Seminar / Workshop	Official (s)	Schedule	Venue / Organised by
1.	26th World's Poultry Congress	Dr. S.K. Mishra, Pr. Scientist	7-11 August 2022	Paris, France
2.	Annual Convention of National Academy of Veterinary Nutrition and Animal welfare and National Conference on 'Co-ordinated Nutrition, Health and Extension Approach for Sustainable Livestock Production'	Dr. P.K. Naik Pr. Scientist	21-22 September 2022	NDVSU, Jabalpur
3.	International Conference of Applied Zoologists Research Association (AZRA) on Advances in Applied Zoological Researches towards Food, Feed & Nutritional Security and Safer Environment'	Dr. C.K. Beura Pr. Scientist Dr. S.K. Mishra Pr. Scientist Dr. S.K. Sahoo Pr. Scientist Dr. B.K. Swain Pr. Scientist Dr. P.K. Naik, Pr. Scientist	10-12 November 2022	Hotel Suryansh, Bhubaneswar, Odisha
4.	XXXVII Indian Poultry Science association conference (IPSACON 2022) and National symposium on Recent advances in sustainable poultry production for livelihood and nutritional security	Dr. M.K. Padhi Pr. Scientist Dr. S.K. Sahoo Pr. Scientist Dr. B.K. Swain Pr. Scientist Dr. S.C. Giri Pr. Scientist	4-6 November 2022	DUVASU, Mathura
5.	19th Biennial International Conference of Animal Nutrition Society of India (ANSICON-2022) on 'Nutritional Technologies to Augment Livestock, Poultry, Canine and Fish Production for Global Competitiveness'	Dr. P.K. Naik Pr. Scientist	16-18 November 2022	GADVASU, Ludhiana
6.	XXII Annual Conference of Indian Society of Veterinary Pharmacology and Toxicology & International Symposium on 'New Horizons in Veterinary Pharmacology and Toxicology Research: Way Forward to Augment Livestock Health and Production'	Dr. D. Kumar Sr. Scientist	02-04 November 2022	Veterinary College and Research Institute, Namakkal

14. DISTINGUISHED VISITORS

- Shri. Giriraj Singh, Hon'ble Union Minister of Rural Development and Panchayati Raj, Govt. of India,
- Dr. G. Ranjith Reddy, Hon'ble Member of Parliament (Lok Sabha), Chevella Constituency, Telangana

- Dr. Himanshu Pathak, Secretary DARE and Director General ICAR, New Delhi
- Dr. B. N. Tripathi Deputy Director General (Animal Science) ICAR, New Delhi
- Dr. G. Narendra Kumar, IAS, Director General NRIDPR, Hyderabad
- Dr. N. Balasubramani, Director (CCA), MANAGE, Hyderabad
- Prof. V. Ravinder Reddy, Vice Chancellor, PVNRTVU, Hyderabad
- Dr. A.S. Ranade, Associate Dean, Mumbai Veterinary College and President, Indian Poultry Science Association
- Dr. H. Rahman, ILRI, Regional Repreentative, South Asia
- Dr. Olivier H, Chief Geneticist, ILRI, Nairobi, Ethiopia
- Dr. T. Kotaiah, MD, IndBro Research & Breeding Farms Pvt. Ltd., Hyderabad
- Dr. V. R. Reddy, Retired Professor, Hyderabad

15. PERSONNEL

ICAR-DPR, Head Quarters-Hyderabad

Research & Management Position:

Dr. R.N. Chatterjee, Director

SCIENTIFIC:

1. Dr. S.V. Rama Rao Pr. Scientist
2. Dr. M.V.L.N. Raju, Pr. Scientist
3. Dr. B.L.N. Reddy, Pr. Scientist
4. Dr. Anand Laxmi, Pr. Scientist
5. Dr. S.S. Paul, Pr. Scientist
6. Dr. M.R. Reddy, Pr. Scientist
7. Dr. M. Niranjan, Pr. Scientist
8. Dr. U. Rajkumar, Pr. Scientist
9. Dr. T.K. Bhattacharya, Pr. Scientist
10. Dr. R.K. Mahapatra, Pr. Scientist.
11. Dr. D. Suchitra Sena, Pr. Scientist
12. Dr. Santosh Haunshi, Pr. Scientist
13. Dr. L.L.L. Prince, Pr. Scientist
14. Dr. S.P. Yadav, Pr. Scientist
15. Dr. A. Kannan, Pr. Scientist
16. Dr. B. Prakash, Pr. Scientist
17. Dr. M. Shanmugam, Sr. Scientist
18. Dr. T.R. Kannaki, Sr.Scientist
19. Dr. K.S. Rajaravindra, Sr. Scientist
20. Dr. S. Jaya Kumar, Sr. Scientist
21. Dr. Vijay Kumar, Sr. Scientist

TECHNICAL:

1. Dr. S.K. Bhanja, C.T.O. (Farm Manager)
2. Sri V.V. Rao, C.T.O. (Computer Astt.)
3. Smt. Minakshi Dange, C.T.O. (Lab. Tech.)
4. Sri D. Pratap. A.C.T.O. (Field/Farm)
5. Sri J. Srinivasa Rao, A.C.T.O. (Hindi Translator)
6. Dr. Diwakar Singh Rana, Sr. T.O (Field/Farm)
7. Sri. A. Ravi Kumar, Tech. Officer (Field/Farm)
8. Sri G. Rajeshwar Goud, Tech. Officer (Field/Farm)
9. Smt. G. Madhukar, Tech. Officer (IT)
10. Sri Md. Maqbul, Tech. Officer (Driver)
11. Sri Md. Yousufuddin, Sr. Tech. Astt (Driver)
12. Sri P. Santosh Phani Kumar, Tech. Asst. (Field/Farm)
13. Sri D. Ashok Kumar, Technician- (Field/Farm)

ADMINISTRATIVE:

1. Sri. AVGK Murthy, Sr. A.O (Retired on Superannuation)
2. Sri S. Bala Kamesh, F. & A.O.
3. Smt. T.R. Vijaya Lakshmi, A.A.O.
4. Smt. M. Kamala, A.A.O.
5. Sri Rajesh Parashar, Asst.
6. Sri L.V.B. Prasad, Asst.
7. Smt. N. Siva Dharani, L.D.C.
8. Sri R. Ganesh, L.D.C.

SUPPORTING:

1. Sri Syed Mujtaba Ali, SSS
2. Sri N. Manyam, SSS
3. Sri K. Charles, SSS
4. Sri G. Narasimha, SSS
5. Sri Manzoor Ahmed, SSS
6. Sri D. Srinivas, SSS
7. Sri M. Narsing Rao, SSS
8. Sri V. Ravinder Reddy, SSS
9. Sri P. Shankaraiah, SSS
10. Sri K. Venkataiah, SSS
11. Sri D. Shiva Kumar, SSS
12. Smt. K. Vimala, SSS

ICAR-DPR, Regional Station, Bhubaneswar

SCIENTIFIC:

1. Dr. C.K. Buera, I/c Head & Principal Scientist
2. Dr. S.K. Mishra, Principal Scientist
3. Dr. S.K. Sahoo, Principal Scientist
4. Dr. M.K. Padhi, Principal Scientist
5. Dr. P.K. Naik, Principal Scientist
6. Dr. B.K. Swain, Principal Scientist

7. Dr. S.C. Giri, Principal Scientist
8. Dr. Dhirendra Kumar, Sr. Scientist
9. Dr. Rajalaxmi Behera, Scientist

TECHNICAL:

1. Sri. A.K. Nanda, Sr. Technical Officer
2. Sri. A.K. Jha, Technical Officer

ADMINISTRATIVE :

1. Sri Sukul Hansda, Assistant

SUPPORTING:

1. Sri Birendra Kumar Behra
2. Sri. Haresh Chandra Sahoo

PROMOTIONS:

- Sri. Rajesh Parashar has been promoted to the post of Assistant w.e.f. 18-08-2022(A.N)
- Sri. L.V.B. Prasad has been promoted to the post of Assistant w.e.f. 18-08-2022(A.N)

RETIREMENT:

Sri AVGK Murthy, Sr. A.O has retired on superannuation on 28/02/2022

Sri A. Ravi Kumar, Technical Officer has retired on superannuation on 30/09/2022

TRANSFERS:

- Dr. T.K. Bhattacharya, Principal Scientist has been transferred on Selection and appointment to the post of Director of ICAR-NRC on Equines, Hisar on 14-11-2022 (F.N)

Experimental Hatchery

The experimental hatchery of the Directorate has the state of art equipment and infrastructure to carry out pedigree hatching of pure line populations as well as hatching and supply of improved germplasm developed by the Directorate to farmers, NGOs, Govt. agencies and other stakeholders. The Unit has 4 setters of 15,000 eggs capacity each and 4 hatchers of 9000 capacity each, besides the facility for fumigating the hatching eggs upon receipt from the farm and a walk-in cold room with storage capacity of 40,000 eggs. The incubators have been fitted with data loggers to monitor and control humidity and temperature in the setters, hatchers and in cold room 24/7.

During the year 2022, a total of 1,41,967 hatching eggs, 1,91,635 day old chicks, 41, 829 parents and 6179 grown up birds were sold/supplied to the farmers and other stakeholders across the country. A total of 4349 embryonated eggs were supplied to different organizations for research on diagnosis and vaccine production.

Experimental Farm

The experimental poultry farm is located inside the Directorate premises which has two units distinctly discharging two separate mandates. The one pureline farm is utilized for only pureline research involving different native and rural poultry germplasm, whereas the other one is for commercial exploitation only catering to the needs of different stake holders. During the period under report, the average livestock reared at the farm was 27,160 per month. A total of 20,17,938 eggs were produced out of which 34% were hatching eggs and the rest ones are of table eggs. The annual average mortality was 3.5%.

Feed Processing Unit

The Feed Compounding Unit served as the Central Facility for supplying compounded feed for the various pure lines, commercial stocks and experimental birds of the Directorate. In addition, chick mash was supplied to the farmers and beneficiaries under TSP and SCSP programs. The raw materials, like maize, soyabean meal, DORB, stone grit, vitamins, minerals, additives etc. were procured and balanced rations were compounded for chick, grower and adult breeding stocks of layer, broiler and rural type of birds. During the year, a total quantity of 986.75 MT of feed was compounded and supplied.

Sales and Marketing Unit

The Sales and Marketing Unit was the core unit in coordinating and undertaking various activities related to sales and marketing of hatching eggs and day-old chicks of parent stock and terminal crosses of germplasm developed by the Directorate. The birds culled in the breeding programme, dressed birds and surplus eggs for table purpose were sold. The grownup birds of about 6 weeks age of rural germplasm were supplied to the farmers for rearing purpose.

Revenue generation from Jan 2022 - Dec 2022 from All sources of DPR (hatchery, TOT etc) was Rs. 1,87,22,664.

Agricultural Knowledge Management Unit

Internet Connectivity under NKN: Internet leased line connectivity of 100 Mbps under National Knowledge Network (NKN) has been maintained with a suitable firewall for security. Backup connectivity with BSNL leased line is also maintained. This high bandwidth connectivity was effectively utilized by the staff in conducting and participating in several online meetings and webinars.

Institute webpage with payment gateway: Institute webpage (http://www.pdonpoultry.org) was frequently updated and had about 12.64 lakh hits during 2022 with an average of 3,462 visits per day. A payment gateway link has been maintained on the DPR webpage and facility online payment through State Bank Collect on "Booking or purchase of germplasm" and "Payment by DPR staff" has been provided.

ICAR-DPR Mobile App: An Android mobile App in English named "ICAR DPR" is maintained and provides information about the institute, chicken germplasm, AICPR on Poultry Breeding, Poultry Seed Project, germplasm availability, etc. A total of 575 new users downloaded this app in 2022. The average rating given by 33 users was 4.5 out of 5.A total of 4,000 users download the mobile app since launching.

ICAR-DPR Poultry YouTube channel: DPR Profile, several informative videos and webinars are available at https://www.youtube.com/@IcarPoultry. A total of 50,665 views viewed different informative videos during the Jan to Dec 2022 period.

Information dissemination: Facebook page https://www.facebook.com/ICAR.DPR.Hyderabad and Twitter handle https://twitter.com/IcarPoultry were

maintained for effective dissemination of information to farmers and poultry entrepreneurs.

Library and Information Centre

The Directorate is having a small and well equipped resource full collection of books in library, which is very much useful to the readers like scientific, technical, administrative staff of the institute. Besides this the other users from veterinary universities and poultry industry people for their resource material available at institute library.

The library has been subscribing two foreign journals and Indian journals/magazines and having approximately about eight hundred reference books on different aspects of poultry science and livestock as well other general subject books. Institute also utilizing of Cera consortia services. The library also subscribe daily newspapers in Hindi, Telugu and English for our regular readers. We also digitalized all our publications (such as annual reports, newsletters, un-priced books). The facilities of this library is being utilizing by the institute scientist, scholars and students and faculty members of neighbor veterinary college as well from other parts of india.

Hindi Implementation Activities

The Directorate conducted four quarterly meetings of Official Language Implementation Committee on 22-03-2022, 07-07-2022, 19-08-2022 and 21-12-2022, in which different issues related to effective implementation of Hindi Language in office were discussed. The Directorate also conducted four Virtual Hindi workshops, i.e. on 26-03-2022, 25-06-2022, 07-09-2022 and 16-12-2022 for employees to upgrade their Hindi language skills as official language, these Hindi learning workshops are very much informative and useful to the staff for their routine works.

The Directorate also celebrated Hindi Fortnight celebrations during 1-15 September 2022 and Hindi Day on 14th September 2022, during these celebrations different literary competitions were conducted for the staff members. Dr. R.N. Chatterjee, Director heightened the importance of Hindi language and its vast usage in all parts of India. The Director presented cash awards and certificates to all winners and wishes them.

TOLIC meetings were attended on 27-04-2022 and 21-10-2022 at NIRDPR, Rajendranagar, Hyderabad

ICAR-DPR Organized Training Program on Certified Livestock Advisor on Poultry

A training program on "Certified Livestock Advisor on Poultry, Module – II" sponsored by MANAGE, Hyderabad was organized by ICAR–Directorate of Poultry Research Rajendranagar, Hyderabad, during 28 Dec 2021 to 11 Jan 2022. A total of 11 Animal Husbandry officers from 7 states/UT attended the programme. The trainees were exposed to various aspects of poultry production such as breeding, nutrition, management and health care. The training module included theory, practical demonstrations and hands on experience on farm and hatchery operations. A total of 35 lectures and 9 practical sessions were arranged during the training program. Apart from the Faculty members of Institute, several Industry experts also delivered lectures and provided inputs in commercial poultry farming. The participants were also taken to the adopted village to learn more about the backyard poultry farming as well to the other ICAR institutes to learn more about the value addition of products. On 11 Jan 2022, during the valedictory function, Dr. R. N. Chatterjee, Director, ICAR-DPR and Dr. N. Balasubramani, Director (CCA), MANAGE graced the occasion and distributed the certificates to the participants. The Director of ICAR-DPR interacted with the participants about the importance of the training program. The participants gave their feedback about the training program as very useful. Dr. S. S. Paul and Dr. S. Jayakumar coordinated the program.

ICAR-DPR, Hyderabad Celebrated National Girl Child Day-2022

National Girl Child Day- 2022 was celebrated by ICAR-Directorate of Poultry Research, Hyderabad on 24th January 2022. It is initiated by the Ministry of Women and Child Development, Government of India led by our beloved Prime Minister. This program was conducted to spread awareness about inequities that girls face in Indian society and the need for their development for a brighter tomorrow.

The program was organized under Azadi ka Amrut Mahotsav. Fifteen girls studying in different schools aged between 8-13 years, were participated in this function. They gave their opinion about the challenges faced by the girls in the 22nd century. They also gave their opinion on the need for girls' education, problems faced by girls in the society in the present scenario, and different roles played by girls throughout their life and hardships faced by the girls. Dr. R.N. Chatterjee, Director, DPR emphasized the need for empowering the girls for a better future in society. He also added that they should be given priority and should not be discriminated against. The program was followed by the felicitation of girls. The program was coordinated by Dr. N. Anand Laxmi, Principal Scientist of this Directorate.

ICAR-Directorate of Poultry Research, celebrated 35th Foundation Day

The ICAR-Directorate of Poultry Research, Hyderabad celebrated its 35th Foundation Day on 1st March 2022. Prof. V. Ravinder Reddy, Vice Chancellor, P. V. Narasimha Rao Telangana Veterinary University (PVNRTVU), Hyderabad graced the occasion as the Chief Guest and Dr. R. N. Chatterjee, Director, ICAR-DPR presided over the function. The foundation day programme of ICAR-DPR started with traditional invocation of Saraswati Vandana, lighting of lamp and honouring dignitaries.

Prof. V. Ravinder Reddy, Vice Chancellor, PVNRTVU, Hyderabad during his address to the august gathering appreciated the contribution of ICAR-DPR in the growth and development of poultry production in the country particularly the backyard poultry production through its varieties development, dissemination of improved chicken varieties, germplasm supply, technology development and extension activities throughout the country by the institute. During this occasion, he released a booklet entitled "Cryo-preservation of PGCs: An efficient method for *ex situ* conservation of chicken breeds" authored by Dr. T. K. Bhattacharya, Dr. R. N. Chatterjee, Dr. M. S. Tantia, Minakshi Dange, Dr. S. Jayakumar and Dr. M. Shanmugam. He also distributed the prizes to winners of the sports competitions organized for the staff of the Institute.

Dr. R. N. Chatterjee, Director, ICAR-DPR presided over the function and highlighted the role and contribution of ICAR-DPR in the poultry sector of the country through its various activities. He also appraised the house about the long association of ICAR-DPR with the Veterinary University and elaborated the evolution of ICAR-DPR as well as its present status with well-furnished labs and a regional centre at Bhubaneswar. He also appraised the house about the additional mandate of the institute on capacity building as well as involvement of the Institute in disease diagnosis and vaccine development for poultry. He appreciated the recent identification of breed specific SNPs in the different chicken breeds of the country.

Dr. T.K. Bhattacharya, Principal Scientist and Chairman of the organizing committee welcomed the

dignitaries. During his address he appraised the house about the research achievements of the institute of the various disciplines as well about the development of region specific chicken varieties, area specific mineral mixtures, Bio-fortified eggs, semen cryopreservation, etc. He also highlighted the role of the institute in the different flagship programs such as AICRP and PSP.

The programme was ended with the formal vote of thanks proposed by Dr. U. Rajkumar, Principal Scientist of the Institute. Around 81 participants were present in the programme.

ICAR-DPR Celebrated National Science Day

The ICAR-Directorate of Poultry Research, Hyderabad celebrated the "National Science Day" on 28th February 2022, Hyderabad to commemorate the great contribution of Nobel Laureate, Sir C.V. Raman and creating awareness on Science in the society.

The Chief Guest, Padma Bhusan Dr. Anil Prakash Joshi, noted Environmentalist, Scientist & Founder of Himalayan Environmental Studies and Conservation Organization (HESCO) delivered Science Day lecture on the theme of the programme "Integrated approach in science and technology for a sustainable future". He emphasized about the Rural- urban divide in terms of Science, technology and information and the need to fulfill the gap. He deliberated many science and technologies including agricultural technologies involved in upliftment of the socio-economic status of the rural people of the country. He mentioned about the benefit and curse of science and highlighted its judicious use for benefit of human being. He appreciated the efforts of ICAR and other scientific organizations to minimize the poverty of country people though adopting farmers-oriented technologies.

Dr. R.N. Chatterjee, Director, ICAR-DPR presided over the Science Day programme and inaugurated the exhibition stall. He also briefed about the salient achievements of the Institute including future flagship research programmes. He also narrated the significance of celebrating the National Science Day programme in the Country.

At the outset of National Science Day programme, Dr. S.V. Ramarao, Principal Scientist welcomed the honourable Guests and other delegates and mentioned about the activities of the Institute.

On the eve of National Science Day celebration, an exhibition was organized by the Institute to showcase new technologies and improved chicken and duck varieties developed at the Institute where about 120 participants including students of local schools and Engineering College participated. In the morning, school children participated in drawing competition on Science and its role in the society. Students also participated in the extempore programme on Science and significance of observing National Science day in the country. The winners of the various competitions were awarded with prizes during the occasion. College students also visited the research facilities of the Institute and they showed their keen interest about the modern advanced science being carried out at the Institute. Dr. B. Prakash, Principal Scientist proposed vote of thanks.

Visit of veterinary Students from North-Eastern states

An education tour of final year Veterinary students (45) led by Dr. Rajesh B. J. (Assistant Professor) of College of Veterinary Sciences & Animal Husbandry, Central Agricultural University, Aizawl, Mizoram visited ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad on 20th April 2022. Information on different chicken varieties developed and activities carried out by the Directorate were explained to the students. They interacted with

scientists to understand the different research programmes undertaken for poultry development in the country. Dr. Niranjan M, In-charge, ToT cell, apprised them about poultry production status, backyard and commercial poultry and different types of germplasm at the Exhibition point of the Directorate. Dr. Vijay Kumar, Sr Scientist coordinated the visit.

Awareness on Biofortification

ICAR-DPR, Hyderabad organized an awareness program on "Biofortification-Improving Nutrition for Reducing Malnutrition" under the ***Kisan Bhagidari Prathmikta Hamari*** campaign of ***Azadi Ka Amrit Mahotsav*** at the MGMG adopted village Bavoji Thanda, Mahbubnagar district of Telangana state on 28th April 2022. About 50 farmers' families and children of the village actively participated in the programme. Dr. T. K. Bhattacharyya, Pr. Scientist, explained about different biofortified poultry products and their importance on health and income. Dr. B. Prakash, Pr. Scientist, told them about poultry management and also replied to their queries on different aspects of poultry nutrition and management. Dr. Vijay Kumar, Sr. Scientist explained about different biofortified animal products and their effective use to eradicate malnutrition in society. The Program was coordinated by Dr. T. K. Bhattacharyya, Dr. Vijay Kumar and Dr. B. Prakash.

Biofortification Campaign at Bavoji Thanda Village, Telangana State

ICAR-DPR organized farmers training programs under "Annadata Devo Bhava" of Azadi ka Amrit Mahotsav

ICAR-DPR organized different farmers training programs under the "Annadata Devo Bhava" campaign of Azadi ka Amrit Mahotsav on 23 April 2022.

Training program on Backyard Poultry Farming for Small and Marginal Farmers

A training program on "Backyard Poultry Farming for Small and Marginal Farmers" was organized at the MGMG adopted village Bavoji Thanda, Balanagar Mandal, Mahboob Nagar District, Telangana. Forty farmers from the village actively participated and got benefitted from the training program. Dr. K. S. Rajaravindra, Sr. Scientist explained the importance of improved chicken varieties and their management practices. Dr. B. Prakash, Pr. Scientist focused on the feeding and health management of the birds in rural backyards and also replied to their queries on different aspects of rural poultry. Dr. Vijay Kumar, Sr. Scientist, apprised them about marketing channels and different governmental schemes in this sector. The Program was coordinated by Dr. Vijay Kumar and Dr. K. S. Rajaravindra.

Training program on Promotion of Natural and Organic Farming

A training program on "Promotion of natural and organic farming" was organized at ICAR-DPR, Hyderabad. A total of 25 participants from nearby villages in the Rangareddy District participated in the program. The farmers were explained about the role of backyard poultry and its importance in natural farming. The concept of poultry waste management and the advantages of making compost and vermicompost out of poultry litter were explained to the farmers. The farmers were briefed about the benefits of organic farming and the conversion of Waste into Wealth. The program was coordinated by Dr. S. P. Yadav and Dr. R. K. Mahapatra.

ICAR-DPR organized Entrepreneurship training program

A training programme on "*Creation of Entrepreneurship in Poultry Farming*" was organized by ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad on 20th April 2022 for young poultry farmers and M.V.Sc students of Veterinary College, Rajendranagar, Hyderabad. In his opening remarks, Mr. C. V. Rao, Chairman, Chalimeda Feed (P) Ltd and Chief Guest of today's programme, apprised the entrepreneurial opportunities in the livestock sector, especially in the animal feed sector and motivated participants to be an entrepreneur and provide jobs to others. Dr. R. N. Chatterjee, Director, ICAR-DPR outlined the entrepreneurial scope in the poultry sector and the scenario of poultry growth in India. Participants have attained a lecture by Dr. S. K. Bhanja, CTO on "Risk Associated for Beginners in Commercial Poultry Sector and their Solution". There was the active participation of all 30 participants. The programme is coordinated by Dr. S. V. Rama Rao, Dr. U. Rajkumar and Dr. Vijay Kumar.

Visit of Poultry-Tech students of CPPM, Hosur

Final year students of B. Tech (Poultry Technology) from College of Poultry Production and Management (Hosur), Tamil Nadu Veterinary and Animal Sciences University (TANUVAS)led by Dr. K. Rajendra Kumar (Assistant Professor) visited ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad on 11th May 2022 as part of an education tour. Information on different chicken varieties developed and activities carried out by the Directorate were explained to the students. They also interacted with scientists to understand the different research programmes carried out by this Directorate for poultry development in the country. Dr. Niranjan M, Incharge, ToT cell, apprised them about the status of poultry production, backyard and commercial poultry rearing and different types of germplasm at the Exhibition point of the Directorate. Dr. Vijay Kumar, Sr Scientist coordinated the visit.

ICAR-DPR organized a special training session for newly recruited faculty of PVNR Telangana Veterinary University

ICAR-DPR conducted a special training session on 'Importance of R & D activities in the Livestock and Poultry Sector' for the newly recruited young faculty of Veterinary and Fishery Sciences of PVNR Telangana Veterinary University undergoing Foundation Course at ICAR-NAARM on 24.05.2022. The objective of the session was to enhance the quality of veterinary education through building competencies related to teaching, research, and extension. Dr. R.N. Chatterjee, Director, welcomed the faculty and delivered a lecture on the Research and Development in the Livestock and Poultry sector. He gave an overall glimpse of the current status and scenario of the sector and its contribution to national income. He discussed the various strengths, weaknesses, opportunities and threats in the livestock sector and how they can be addressed successfully to benefit the farmers. He opined that the young faculty should focus on the present day problems of the farmers or stakeholders and plan their action plan accordingly to solve the issues. He also encouraged the young faculty to concentrate equally on imparting quality education to the veterinary graduates with recent advancements in science and also involve themselves in research activities by obtaining extramural research grants from ICAR, DBT, DST,

SERB, RKVY etc. He extended full cooperation, collaboration and support from the Directorate and its scientists for the benefit and overall development of the young faculty members. Young faculty also interacted with the scientists of the Directorate.

National seminar on poultry production and marketing systems organized at ICAR-DPR

ICAR-Directorate of Poultry Research, Hyderabad organized a one-day National Seminar in collaboration with Indian Poultry Science Association- Telangana and Andhra Pradesh Chapter on the topic "Revisiting poultry production and marketing systems for addressing the fast changing consumer preferences" on 6th May 2022. Dr. R.N. Chatterjee, Director welcomed the dignitaries and the participants to the seminar. He said that it is very delightful to organize the Seminar in the offline mode after a very long gap. He highlighted the role of Poultry industry and its contribution to the national economy. Dr. S.V. Rama Rao, Principal Scientist elaborated on the theme of the National Seminar and its high relevance during this pandemic era. Dr. V. Ravinder Reddy, Vice Chancellor, P.V. Narsimha Rao Telangana Veterinary University, Hyderabad, the Guest of Honour for the Seminar, emphasised the need to support the poultry farmers by providing the feed ingredients in time at a reasonable cost. He also opined that proper biosecurity and health measures should be taken to control the emerging and remerging poultry diseases.

The Chief Guest of the programme, Dr. G. Ranjith Reddy , Member of Parliament (Lok Sabha), Chevella Constituency, Telangana appreciated the efforts of the Directorate in organizing the Seminar at this crucial time when feed prices are skyrocketing and creating havoc for the poultry industry in the country. He said that the deliberations should focus on highlighting the health benefits of egg and chicken meat, and also convince the customers about the myths circulating in the social media about chicken and eggs. He advocated that the industry should stay strong in marketing, publicizing and advertising their products. He also encouraged the young Veterinary graduates to venture into the poultry sector as there are lot of opportunities. The dignitaries released a book on "Poultry Feed: Region specific" authored by Dr. S. V. Rama Rao, Dr. A. Kannan and Dr. M. V. L. N. Raju of the Directorate. They also released the Vermicompost "Vermipoul" developed by Dr. R. K. Mahapatra from poultry litter under the programme "Wealth from waste".

There were two technical sessions in which eight lectures were delivered by eminent speakers in the field of poultry. The plenary session was chaired by Dr. R. N. Chatterjee, Director, ICAR-DPR and Co-chaired by Dr. T. Kotaiah, MD, IndBro Research & Breeding Farms Pvt. Ltd., Hyderabad; Dr. V. R. Reddy, Retired Professor, Hyderabad, and Dr. A. S. Ranade, Associate Dean, Mumbai Veterinary College and President, Indian Poultry Science Association. The Seminar was attended by Scientists from DPR, Officials, staff and students from the Veterinary University, Poultry entrepreneurs and industry representatives from AP and Telangana (TS), officials from the AH Department and members of IPSA-TS and AP chapter. Dr. U. Rajkumar, Principal Scientist and Organizing Secretary proposed the vote of thanks.

Glimpses of Dr. C. M. Singh Birth Centenary Year Celebrations (30-11-2021 to 30-11- 2022) cum National Webinar on Advances of Veterinary Sciences during 75 Years of Indian Independence (1947-2022) organized on 30th March, 2022 by ICAR-Directorate of Poultry Research, Hyderabad, Telangana & Dr. C. M. Singh Endowment Trust, Bareilly, UP.

Dr. R. N. Chatterjee, Chairman, Organizing Committee cum Director, ICAR-DPR, Hyderabad, Telangana giving welcome address and Chairperson's remark

Dr. R. Somvanshi, Hony. Sec., CMSET, Bareilly, UP briefing about Achievements of Dr. C. M. Singh Endowment Trust

ICAR-DPR organized a special training session for newly recruited faculty of Odisha University of Agriculture & Technology

ICAR-DPR conducted a special training session on 'Importance of R & D activities in the Livestock and Poultry Sector' for the newly recruited young faculty of Veterinary and Agricultural Sciences of Odisha University of Agriculture & Technology (OUAT), Bhubaneswar (Odisha) undergoing Foundation Course at ICAR-NAARM on 27.06.2022. The objective of the session was to enhance the quality of veterinary and agriculture education through building competencies related to teaching, research, and extension. Dr. R. N. Chatterjee, Director, welcomed the faculty and delivered a lecture on the Research and Development in the Livestock and Poultry sector. He gave an overall glimpse of the current status and scenario of the sector and its contribution to national income. He discussed the various strengths, weaknesses, opportunities and threats in the livestock sector and how they can be addressed successfully to benefit the farmers. The faculty visited the farms and information on different chicken varieties developed and activities carried out by the Directorate were explained to the faculty by Dr. M. R. Reddy, Pr. Scientist. The program was coordinated by Dr. M. Balakrishnan, Pr. Scientist, ICAR-NAARM, Hyderabad.

Shri Giriraj Singhji, Honourable Minister of Rural Development and Panchayati Raj, Govt. Of India Inaugurated the Integrated Farming Unit of "Moringa and backyard Poultry" at ICAR-Directorate of Poultry Research, Hyderabad, Telangana

Hon'ble Union Minister of Rural Development and Panchayati Raj, Govt. of India, Shri. Giriraj Singh inaugurated the Integrated Farming Unit of "Moringa and backyard Poultry" at ICAR-Directorate of Poultry Research, Hyderabad, Telangana on 1st July, 2022. He inspected the newly developed facility at the directorate and appreciated the efforts in creating such a model facility to highlight the benefits of integrated farming. He appreciated the performance of the improved chicken germ plasm developed at this Directorate. He told that the Directorate is striving hard to develop suitable technologies for both commercial and backyard poultry and also in new frontier areas of Nutrition, Health and Biotechnology. During his address, he reiterated that Poultry farming is one of the most important ways to alleviate malnutrition in rural areas providing additional income to the poor families and nutritional security to the poor and landless farmers. He suggested that this model will help in reducing the feed cost and competitiveness for human food like maize and soybean. He emphasised that youth should be encouraged to take up this technology through start-ups. He also suggested exploring the possibility of branding and marketing

of moringa fed chicken egg and meat. He suggested developing a low cost model for entrepreneurship development in integrated farming system with Moringa and backyard poultry. He suggested developing a variety capable of producing about 200 eggs under free range system.

The Guest of Honour, Dr. G. Narendra Kumar, IAS, Director General NRIDPR appreciated the activities of the directorate and suggested for collaboration between the two organizations for the welfare and benefit of the farmers.

Earlier Dr. R. N. Chatterjee, Director ICAR-DPR welcomed the dignitaries and explained briefly about the various achievements and technologies developed at the directorate. He thanked the honourable minister for extending support in developing an integrated farming unit with Moringa and Chicken at this Directorate.

The officials from NIRD & PR, Hyderabad, State government, Telangana and staff of the directorate participated in the programme.

ICAR-Directorate of Poultry Research (Regional Station, Bhubaneshwar) organized Brain Storming Meet on "Duck Research in India – a Way Forward"

Regional Station, ICAR-DPR, Bhubaneswar organized a Brain Storming meeting on "Duck Research in India – a Way Forward" on 4.7.2022. The Deputy Director General (Animal Science), Dr. B. N. Tripathi was the Chief Guest and Dr. R. P. Singh, Director, ICAR-DFMD, Bhubaneswar was the Guest of Honor. Dr. R. N. Chatterjee, Director, ICAR-DPR presided over the function. Dr. R. N. Chatterjee, Director, ICAR-DPR welcomed the guest and emphasized the importance of duck species in the country and urged the eminent scientist to discuss the researchable issues and come up with recommendations to develop duck production in the country. Dr. C. K. Behura, In charge, Regional Station presented the significant achievements and contribution of the centre in duck development. Dr. Mahesh P.S., Joint Commissioner & Director, CPDO, Bangalore and Dr. A. Jalaudeen, Ex-Director of Academics & Research, KVASU, Kerala narrated the status of duck production in India and abroad and highlighted the researchable issues in different areas of duck production. Dr. B. N. Tripathi, DDG (AS) stressed on the importance of duck research in India. He suggested to develop a road map to improve the duck production to 40 millions from 33 millions in coming five years. He also emphasized for collaborative program with CPDO for effective extension and propagation of duck rearing. After the presentations, a Round table discussion was held inviting suggestions from all the experts and scientists. The program ended with vote of thanks from Dr. S. K. Sahoo, Pr. Scientist. Experts from the different Government organizations, OUAT, entrepreneurs and scientists participated in the meeting.

Annual Review Meeting of AICRP on Poultry Breeding organized at College of Veterinary Sciences, SVVU, Tirupati

The Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project for the years 2020-21 and 2021-22 was organized at the College of Veterinary Sciences, SVVU, Tirupati on 8th and 9th September 2022. Dr. B. N. Tripahi, DDG (AS) graced the occasion as the Chief guest. The inaugural session started with the invocation by Dr. Adilakshmamma, Associate Dean, C.V.Sc. Tirupati. Dr. K. Sarjan Rao, Dean, C. V. Sc. Tirupati, welcomed the chief guest, other dignitaries and participants. In his opening remarks Dr. R. N. Chatterjee, Director, ICAR-DPR highlighted the contribution of the poultry sector to the Indian economy and the role played by the AICRP and PSP centres in making available the improved germplasm of the poultry throughout the country. Dr. V. K. Saxen ADG (AP&B), ICAR lauded the contribution of AICRP on Poultry breeding during the last 50 years of its existence in meeting the needs of animal protein.

Honourable DDG (A.S.), ICAR, Dr. B. N. Tripathi congratulated the AICRP team for the successful completion of fifty years (golden jubilee) of its contribution. He suggested bringing out a document highlighting the achievements of AICRP during the last fifty years He stressed the need for quantifying the contribution of the AICRP towards the economy of the country. He suggested collaborating with agricultural economists to accomplish this task. He also suggested improving the productivity of native or improved chickens in order to increase the availability of eggs from the present 90 eggs to the recommended level of 180 eggs per person per year. He emphasized the need for the characterization of native chickens of the country to achieve the mission of zero non-descript birds. Dr. U. Rajkumar, Incharge, AICRP on Poultry Breeding and Dr. S. V. Rama Rao, Incharge, PSP presented the respective PC reports. Two technical sessions were conducted and the progress of the Centres was reviewed. Hon'ble DDG (AS) chaired all the sessions, while ADG (AP&B) and Director, ICAR-DPR, Hyderabad co-chaired. The officials from the SVVU, Tirupati, a team of scientists from ICAR-DPR, Hyderabad and Principal Investigators of all the Centres participated in the meeting. The meeting ended with a vote of thanks from Dr. U. Rajkumar, Pr. Scientist.

Deputy Director General (AS) inaugurated ILRI-ICAR Sponsored training program at ICAR-DPR, Hyderabad

Dr. B. N. Tripathi DDG (Animal Sciences) inaugurated the International Livestock Research Institute (ILRI) and ICAR-DPR collaborative five days hands on training program on "Advanced biotechnological approaches to augment productivity in poultry for ensuring food and nutritional security" on 20th September 2022 at ICAR-Directorate of Poultry Research, Hyderabad. Dr. B. N. Tripathi DDG (Animal Sciences), Chief Guest of the program appreciated the alliance between ILRI and ICAR and appreciated the progress made in different collaborative projects. He applauded the team for organizing this training programme for the young faculty members of the NARS system at this juncture where characterization of the livestock and poultry of the nation is taken up in a mission mode. He urged the participants to make use of their knowledge gained in this programme and utilize various biotechnological tools for the characterization and genetic improvement of livestock and poultry for various economic traits. He also emphasized that the faculty should propose external funding for their research and also commercialization of the technologies. He suggested formulating multi-disciplinary projects with a holistic approach to address the problems of the industry and farmers.

Dr. H. Rahman in his address elaborated on the long term association between ILRI and ICAR and its benefits to both organizations. He urged the

participants of the programme to be more proactive and learn as much as possible and benefit from this advanced biotechnological training programme. He also suggested for exchange of germplasm between Indian and African countries as both experience similar agro-climatic zones. He appreciated the efforts taken by the team in organizing this training programme. Dr. Olivier H, Chief Geneticist, ILRI described the commonality between India and Africa in livestock rearing patterns, breed characteristics and ecological terrains. He urged for strengthening the collaboration in the Poultry sector between the two organizations for high quality research, technology dissemination and sharing of genetic resources.

Earlier, Dr. R. N. Chatterjee, Director, DPR, welcomed the dignitaries and participants to the training programme. He briefed the various research, extension and capacity building activities being undertaken by the institute, He said that working in isolation will not fetch better returns and collaboration on a global scale is the need of the hour to achieve solutions for the common challenges. He opined that biotechnological approaches are the new paradigm to improve the productivity and performance of livestock and poultry as the traditional breeding approaches have almost reached a plateau. He urged young minds to make the best use of this opportunity. Dr. T. K. Bhattacharya, Course Coordinator of the program presented a glimpse of the various activities to be covered during the five day training program. He said that more emphasis was given to hands on training for the participants to learn the laboratory techniques. A total of 20 participants from 10 SAUs, 5 ICAR institutes belonging to 13 different states participated in the training programme The program was attended by the officials of ILRI, New Delhi, Hyderabad and scientists and staff of the Directorate.

Dr. Himanshu Pathak, Secretary (DARE) & DG (ICAR) interacted with the participants of an international training program jointly organized by ILRI-ICAR at DPR, Hyderabad

A five days hands on international training program on "Advanced biotechnological approaches to augment productivity in poultry for ensuring food and nutritional security" was organized jointly by International Livestock Research Institute (ILRI) and ICAR from 20-24 September 2022 at ICAR-Directorate of Poultry Research, Hyderabad. Dr. Himanshu Pathak, Secretary (DARE) & DG (ICAR) graced the valedictory function of the training programme at ICAR-DPR, Hyderabad.

Dr. Pathak, the chief guest of the valedictory program appreciated the organizers for conducting advanced training in cutting edge research areas for young faculty of ICAR and State Veterinary/Agricultural Universities. He emphasised that scientists should regularly upgrade their skills and knowledge as new technologies are continuously emerging globally at a faster pace. He applauded the CGIAR organizations like ILRI and others working hand in hand with ICAR to achieve common goals for the welfare of animals, crops and humans. He urged young minds to act as game changers by quickly developing and adopting newer technologies.

Dr. V. Ravinder Reddy, Vice Chancellor, P. V. Narasimha Rao Telangana Veterinary University, Hyderabad and Guest of Honour appreciated that the young faculty of the NARS will be highly benefitted by training in advanced technologies. Dr. H. Rahman, Regional Representative, ILRI South Asia, appreciated the sincerity of the trainees who learnt to learn and interacted with the faculties of the training. He congratulated the participants for successfully completing the training program.

Dr. R. N. Chatterjee, Director, DPR, earlier welcomed the Secretary (DARE) & DG (ICAR) on his maiden visit to the Directorate and other dignitaries and participants for the valedictory function. He made a brief presentation on the various research, extension

and capacity building activities being undertaken by the institute. He urged the young scientists to carry forward the knowledge gained in this training for the benefit of the farmers.

Dr. T. K. Bhattacharya, Course Coordinator presented a brief report of the training program. A total of 20 participants from 10 SAUs and 5 ICAR institutes belonging to 13 different states participated. The program was attended by the Directors of ICAR institutes in Hyderabad, officials of ILRI, New Delhi & Hyderabad and scientists and staff of the Directorate.

ICAR-Directorate of Poultry Research, Hyderabad Organized National Conference of ISAGB

ICAR - Directorate of Poultry Research organized XVI Annual Convention of Indian Society of Animal Genetics and Breeding (ISAGB) and National Conference on "Innovations in Animal Genetics & Breeding for sustainable productivity of livestock and poultry" on 2nd & 3rd December 2022. Dr. R.N Chatterjee, Director and Chairman organizing committee of ISAGBCON 2022 welcomed the Guests and delegates. He narrated the theme of the conference and explained overview of the Animal genetics and breeding research in the country.

Dr. Mangala Rai, Former Secretary, DARE & DG, ICAR, the Chief Guest of the inaugural program emphasized the importance of innovations in genetics and breeding for improving the productivity of livestock and poultry. He narrated the necessity of infrastructure creation for high end research in frontier areas of biotechnology and computing. He appreciated the efforts of animal scientists for their contribution towards the improved productivity of livestock and poultry and its contribution to GDP of India.

Dr. V. Ravinder Reddy, Vice Chancellor, PVNRTVU, Hyderabad and Dr. T. J. Rasool, Director, Camel Biotechnology Centre, UAE & Patron, ISAGB graced the occasion as the Guests of honour in the conference. Dr. B. P. Mishra, Director, ICAR-NBAGR, Karnal & President of the society and Dr. V. K. Saxena, Director of Research, BASU, Patna also graced the occasion. They narrated the activities of the society and need for further strengthening the society in dissemination of research findings to the farmers. The inaugural function concluded with the vote of thanks from Dr. U. Rajkumar, Organizing Secretary, ISAGBCON 2022.

Padmasri, Dr. SosammaIype, Professor, KVASU, Mannuthy was conferred with life time achievement award of the ISAGB society for her contribution to the conservation Vechure cattle breed. Dr. R. K. Sethi, Former Director CIRB was also conferred with life time achievement award. Dr. M. S. Tantia, Pr Sci. ICAR-NBAGR was conferred with the ISAGB fellowship. A key note address on "Innovations in Animal Genetics and Breeding for sustainable productivity of livestock and poultry" was delivered by Dr. T. J. Rasool, Director, Camel Biotechnology Centre, UAE and Former ADG (AP&B), ICAR.

During the conference a total three technical session on Innovative breeding technologies- Current trends and future scope, Genomics: phenotype variability and trait expression in animals and Trends in computational genetics and artificial intelligence in understanding genome complexity. A total 245 delegates participated in the conference out which 80 were on virtual mode. Overwhelming no of students (about 60) participated in the conference.

A total of 11 lead papers and 30 oral papers were presented in various aspects of Animal Genetics and Breeding during the technical sessions. Parallel to each technical session a poster session was organized and delegates presented their posters on various aspects of the breeding and genetics. Apart from the technical sessions a young research award session was conducted in which 12 students participated and presented their research findings. Dr. A. Rajendra Prasad, Asst Professor, CVSC, Mamnoor, Telangana was awarded with ISAGB Young Researcher award. A session on Scientist industry interface was organized

with experts from academia and industry participated.

The two days conference ended with a plenary cum Valedictory function in which Dr. K. M. L. Pathak, former DDG (AS) & former VC, DUVASU, Mathura participated and presented the awards to scientists and students. He narrated the importance of breeding in improving the productivity and providing the food to the human beings. Dr. S. S. Majumdar, VC, GBU, Gandhinagar and Dr. T. J Rasool, Director, Camel Biotechnology Centre, UAE were the guests of honours. Dr. B. P. Mishra, Director, ICAR-NBAGR & President, ISAGB, Dr. R. N. Chattrejee, Director, ICAR-DPR, Hyderabad & Chairman, ISAGBCON-2022 and Dr. U. Rajkumar, Pr. Sci., ICAR-DPR & Organizing Secretary, ISAGBCON 22 participated. The conference ended with a vote of thanks by Dr. M. Niranjan Principal Scientist, ICAR-DPR, Hyderabad.

ICAR-DPR Celebrated World Soil Day 2022

ICAR-DPR celebrated World Soil Day on 5th December 2022 with the theme "Soils: Where food begins". Vermicompost, made up of poultry manure and other natural carbon source, a natural fertilizer, was applied to all ornamental plants of the Moringa Farm Unit of the Directorate to boost the soil nutrients. Scientists, Technical, Administrative and other staff along with students were actively participated in the event. Programme was headed by Dr. R. N. Chatterjee, Director of the Institute and Coordinated by Dr. Vijay Kumar, Sr. Scientist.

World Veterinary Day at ICAR-DPR Regional Station, Bhubaneswar

Dr. C. K. Beura, Incharge, Regional Station, Bhubaneswar delivered a lecture on "Aflatoxicosis in Poultry" in World Veterinary Day programme organized by Chief District Veterinary Officer, Govt. of Odisha on 30.4.2022.

Celebration of Hindi Pakwada -ICAR-DPR Regional Station, Bhubaneswar

Hindi Diwas was celebrated on 14.9.2022 in Committee Room which was attended by all staff of Regional Station.

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भाकृअनुप – कुक्कुट अनुसंधान निदेशालय

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