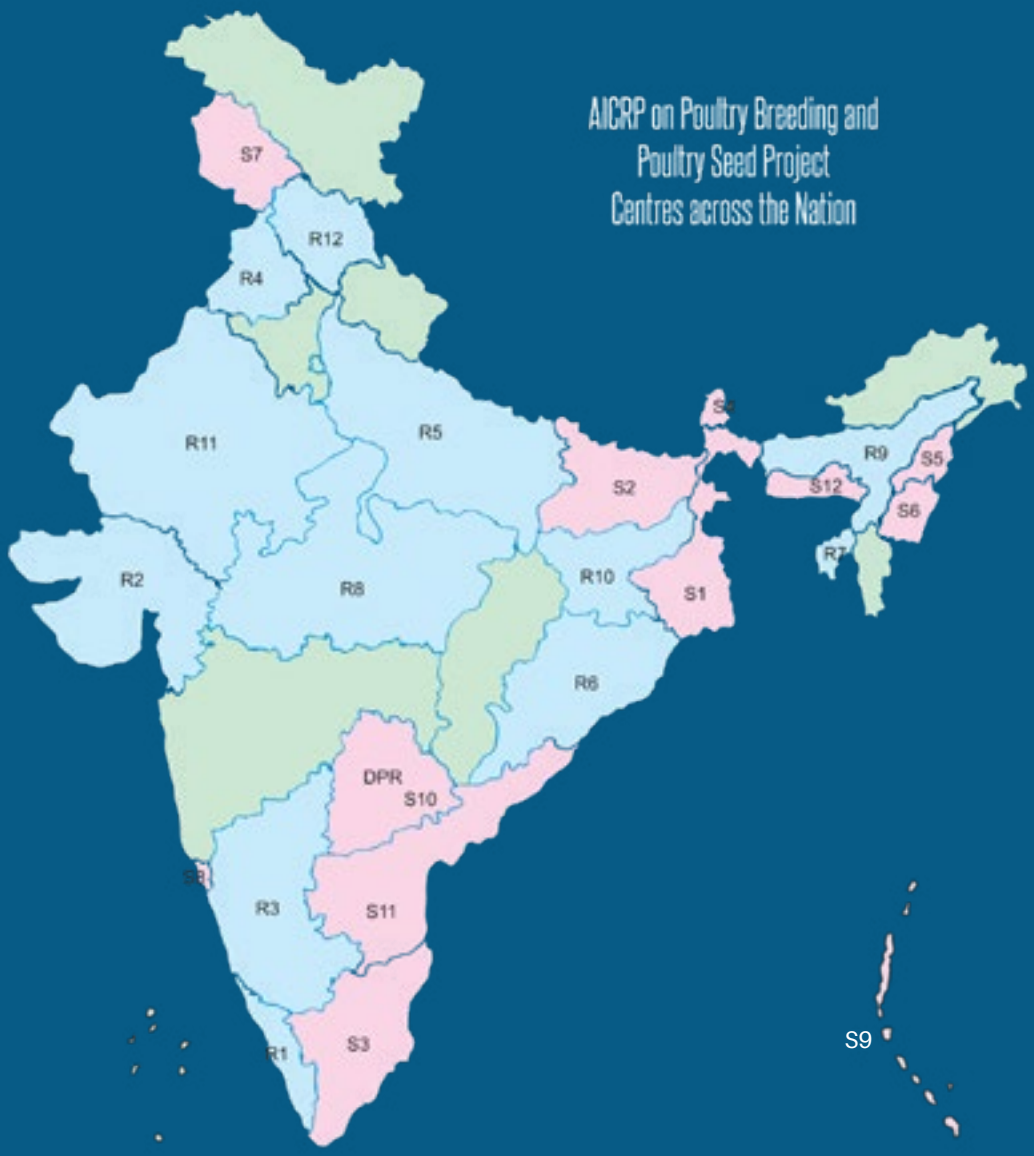
ANNUAL REPORT 2021

भाकृअनुप- कुक्कुट अनुसंधान निदेशालय

ICAR - Directorate of Poultry Research

ISO 9001:2015

Rajendranagar, Hyderabad - 500 030 India



ICAR-DPR

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R2	AAU, Anand
R3	KVAFSU, Bengaluru
R4	GADVASU, Ludhiana
R5	ICAR-CARI, Izatnagar
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R12	CSKHPKVV, Palampur

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S9	ICAR-CIARI, Port Blair
S10	PVNRTVU, Warangal
S11	SVVU, Tirupati
S12	ICAR-RC for NEHR, Barapani

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Adult Nicobari male

Inside Front Cover

Location of AICRP on Poultry Breeding and Poultry Seed Project centres

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ICAR-DPR publications

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Birds under moringa integration

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Preface

I am happy to present the Annual Report of ICAR-Directorate of Poultry Research, Hyderabad for the year 2021. The Directorate effectively carried out the mandated research work of the Institute in spite of the challenges and difficulties posed by the COVID-19 pandemic. The improved chicken germplasm was supplied throughout the country for fulfilling the needs of various stake holders. 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 pedigreed populations of different pure lines and native chicken germplasm are being maintained and improved for various economic traits of interest. During the period, Aseel crosses developed for meat purpose were evaluated at farmers' field. Furthermore, four two-way crosses and a three-way cross of layers were produced and are being evaluated at the institute. Editing of exon1 of inhibin α gene through CRISPR/Cas9 technology enhanced egg production in Nicobari native chicken. Human interferon alpha 2b was purified from the eggs of transgenic chicken expressing human interferon. A dual-purpose cross of chicken was developed by crossing improved control broiler birds that were selected through marker assisted selection (MAS). Other studies explored different parameters at genomic level. Research in other areas of nutrition, health and physiology aided in the realization of genetic potential of the pedigreed populations. The Directorate worked on a wide expanse in chicken in these allied areas, to mention a few, experiments were conducted on gut microbiome and antibiotic-free growth promoters, utilization of Black Soldier Fly larvae meal in chicken diet, production and use of nano minerals, hormone and amino acid expression after organic selenium supplementation and semen cryopreservation. Conversion of poultry litter to useful vermicompost with other carbon sources was done. The different neoplastic conditions prevailing in the Directorate farm was documented. The research findings at the Directorate were widely disseminated through different extension methodologies.

The Regional Station of the Directorate mandated to work on duck species has made noteworthy progress in various aspects of duck farming through development and evaluation of a cross, nutritional interventions, and integrated farming.

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

The Directorate is the nodal agency for coordinating the All India Coordinated Research Project on Poultry Breeding, which has 12 centres maintaining elite layer, broiler and rural germplasm. Further, the Directorate monitored the 12 Poultry Seed Project centres spread all over the country and supplied the improved germplasm to the farmers. It is heartening to share that one technology developed at this Directorate having commercial value and practical application in poultry industry was approved and submitted to Agrinnovate India Limited, New Delhi, for commercialization.

The Directorate has organized several meetings and training programmes under DAPSC, STC, and Skill development programmes. The institute showcased the technologies developed by participating in exhibitions, melas, and farmers field programmes. A total of 1.4 lakhs germplasm including 5031 parents were distributed by the Directorate to various beneficiaries. A total of Rs. 205.93 lakhs revenue was generated during the year. The AICRP centres and PSP centres supplied 6.80 and 4.28 lakhs germplasm, respectively, with a revenue generation of Rs. 200.8 lakhs and Rs. 151.15 lakhs, respectively.

I am extremely grateful and indebted to Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for the unstinted 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), Dr. Vineet Bhasin, Principal Scientist (AG&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 am sure that with continuous cooperation and efforts, we will be able to successfully move ahead to achieve the mandated objectives of this Directorate. I congratulate the editorial team for the commendable job in bringing out this Annual report in an appreciable manner.

(**R.N. Chatterjee**)

Director

Date: 30 November 2022

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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)
GP	Glutathione Peroxidase
GR	Glutathione Reductase
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
NAIP	National Agricultural Innovation Project
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
PDP	Project Directorate on Poultry
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 2021 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 least squares means for body weight at 4 and 6 weeks of age were 392.53±1.47 and 851.0±3.15 g in PD-1. The six weeks shank length and body weight in PD-1 line increased significantly compared to last generation. The genetic and phenotypic response in shank length at 6 weeks (SL6) was 0.83 and 0.72 mm per generation over the last 15 generations.

In PD-6 line, the ASM, 20-week body weight, and egg weights at 28, 32, 36 and 40 weeks of age were 189.9±0.09 days, 1888±0.82, 50.14±0.01, 52.80±0.01, 55.31±0.04 and 55.53±0.02g, respectively. The egg production up to 40 weeks was 64.57±0.20 eggs. In S-11 generation, a total of 2202 chicks were produced by mating 50 sires and 250 dams In PD-2 line, the ASM was 166.5±0.08 days, while egg weight, egg production and egg mass at 52 weeks were 55.88±0.04g 130.6±0.98 and 7373±4.05g, respectively. In S-18 generation, a total of 1836 chicks were produced by random mating. The body weight at 4 and 6 weeks of age was 368.8±0.04 and 701.7±4.98g, respectively and shank length at 6 weeks of age was 77.32±0.001 mm. The shank length showed marginal improvement of 0.90mm.

In PD-3 line, the ASM was 154.3±0.01 days. The egg weight at 40 weeks was 58.58 g. The part period egg production up to 40, 52 and 64 weeks of age was 100.4±1.91, 160.9±2.77 and 204.0±3.99 eggs, respectively. The 40 weeks egg production increased significantly from previous generation (93 eggs). The egg mass at 40, 52 and 64 weeks of age was 5547±1.74, 9419±2.64 and 12369±4.06 g, respectively. The egg mass at 40 weeks of age increased significantly from the last generation. The annual egg production up to 72 weeks of age was 243 eggs. The genetic and phenotypic response for egg mass at 40 weeks was 611 and 739g, respectively over the last 9 generations. In S-10 generation, a total of 4302 chicks of PD-3 line were produced by pedigreed mating of 50 sires and 250.

Native chicken populations

In the S-12 generation of *Vanashree*, (evolved from Aseel, PD-4), a total of 1358 good chicks were hatched by mating 50 sires with 150 dams. The selection differential and intensity of selection for 12 weeks body weight was 69.1g and 0.42σ, respectively. Those for 40 weeks egg production were 2.00 eggs and 0.098σ, respectively. Effective population size and rate of inbreeding were 145.05 and 0.00345, respectively as 50 sires and 132 dams contributed progenies to the S-12 generation. There was an improvement of 19.2 g in 8 weeks body weight and 1.09 mm in 8 weeks shank length over the generations on phenotypic scale. The body weight and shank length of pullets at 20 weeks of age were 1660±11.6 g and 106.1±0.51 mm, respectively while those of cockerels were 2304±20.6 g and 131.9±0.97 mm, respectively. Body weight of males and females at 20 weeks increased by 123 and 190 g, respectively.

The age at sexual maturity, age at 50% production and age at peak production (83.02%) in Vanashree were 174.9±0.87, 178 and 195 days, respectively. Hen housed and hen day egg production up to 40 weeks of age were 58.87±1.79 and 60.36, respectively. Egg weights at 28 and 40 weeks were 45.37±0.30 and 50.47±0.37 g, respectively. Body weight of hens at 40 weeks was 2126±32.8g with the liveability of 96.61%.

In Ghagus population (S-3 generation) egg weights at 28 and 40 weeks of age increased by 1.51 and 3.06 g, respectively. In the first hatch of S-4 generation of Ghagus, age at sexual maturity, age at 50% production and age at peak production (73.53%) were 167.4±0.87, 166 and 180 days, respectively. Hen housed, survivors' and hen day egg production up to 40 weeks of age were 56.00±2.07, 56.51±2.08 and 57.00, respectively. Significant improvement in egg production was seen in this breed. Egg weight at 28 and 40 weeks was 43.65±0.43 and 48.88±0.53 g, respectively. Excellent liveability was observed in males (98.11%) and females (97.09%) during 21-40 weeks of age.

In the 2nd and 3rd hatches, a total of 929 good chicks of Ghagus were hatched by random mating. Body weights at day old, 4, 6 and 8 weeks were 32.93, 208.9, 335.1 and 557.7g, respectively while the shank length at 6 weeks of age was 60.14 mm. Body weight at 4 weeks of age improved by 26.7 g. Body weight of male and female birds at 20 weeks of age was 2329±22.1 and 1593±14.3 g, respectively, while the shank length was 128.6±0.78 and 103.5±0.51 mm, respectively. There was an improvement of 84 g and 1.4 mm in 20 weeks' body weight and shank length of males, respectively in this generation.

In the G-8 generation of Nicobari, the heritability estimates of growth traits recorded up to 20 weeks, estimated for the first time in this breed were moderate to high for most of the growth traits on sire component of variance indicating the presence of adequate additive genetic variance for growth traits in this breed. A total of 144 good chicks were hatched in 2nd hatch of G-8 generation. The age at sexual maturity was 171.9±2.32 days and egg weight at 28 and 40 weeks was 42.80±0.46, and 48.17±0.43 g, respectively. Survivors' egg production up to 40 weeks of age was 75.71±2.93 eggs. The body weight and shank length of hens at 40 weeks were 1658±39.4 g and 91.2±0.72 mm, respectively.

In Kadaknath (G-1 generation), egg production up to 64 and 72 weeks of age was 149.2±1.67 and 177.0±2.97 eggs, respectively. Body weight at 64 weeks of age was 2359 g in males and 1661 g in female birds. A total of 988 good chicks of Kadaknath in G-2 generation were produced by pedigreed random mating of 33 sires and 66 dams. There was an improvement in body weights over the previous generation. Liveability during 0-8 weeks and 9-18 weeks was 95.75 and 95.67%, respectively. Body weight at 20 weeks was 1,811±18.81 g in males and 1,213±12.22 g in females. There is an improvement in body weight at 20 weeks in females. The ASM was 173.2±0.66 days, which was reduced in comparison to previous generation (176.2 days).

A total of 1,155 chicks of Aseel were produced in G-8 generation randomly and evaluated up to 40 weeks of age. The body weight at 40 weeks was 1,906 and 3,191 g in hens and cocks, respectively. The egg production up to 40 weeks of age was 19.53 eggs and egg weight at 40 weeks of age was 44.96 g.

Aseel crosses developed for meat purpose were evaluated both at the institute and under field conditions in Telangana with full feeding using commercial broiler feed. The body weight at 12 weeks of age was 1716±64.10 g at institute and 1661±18.58 g in farmer's field under intensive system of management. The economics analysis of rearing these crossbred chicken varieties indicated their suitability to establish a small-scale unit of 200 birds with an additional income of Rs. 64,000 and profit margin of Rs. 30,000 per cycle.

Broiler populations

The S-1 generation of PB-1 was evaluated for juvenile growth traits. Body weight at day old, 4, 5 and 6 weeks of age were 42.01±0.10, 649±3.69, 1081±4.25 and 1382±5.54 g, respectively. The shank length and breast angle at 5 weeks were 83.05±0.17 mm and 77.81±0.18 ^{0}, respectively. A total of 302 good chicks of PB-1 were produced by random mating in a special hatch. The average body weight of male and female birds at 20 weeks was 3,691±41.5 and 2,631±26.6 g, respectively. The ASM was 164.04±1.64 days. Egg weights at 28 and 32 weeks were 51.14±0.48 and 55.08±0.49g, respectively. In the G-19 generation of control broiler line, body weight at day old, 4, 5, 6 weeks was 40.12±0.11, 561.1±4.33, 787.7±4.12 and 1056±5.29g, respectively. The shank length and breast angle at 5 weeks were 76.12±0.18 mm and 74.46±0.14 ^{o} respectively. The average body weight of male and female birds at 20 weeks was 4,070±32.9 and 2,535±22.1g, respectively. The ASM was 173.61±1.33 days. Egg weights at 28 and 32 weeks were 47.44±0.34 and 50.65±0.31g, respectively.

A total of 1758 good chicks of PB-2 line in S-1 generation were hatched by mating 50 sires and 250 dams. Effective number was 166.66 and the rate of inbreeding was 0.003. Average selection differential for 5-week body weight was 158g and intensity of selection was 1.30. Juvenile body weights at 4, 5 and 6 weeks and shank length at 5 weeks, respectively were 718±0.92, 1088±2.35 and 1391±2.47g, and 83.87±0.12 mm. ASM, body weight at 20 weeks, egg weights at 28 and 32 weeks respectively were 159days, 2360, 51.22 and 55.44 g.

The S-18 generations of naked neck (717 chicks) and dwarf (715 chicks) gene lines were produced by mating 30 sires and 90 dams. Body weight at 4 and 6 weeks and shank length at 6 weeks, respectively in naked neck were 570±1.28, 1042±2.13g, and 88.64±0.62 mm. The corresponding values in dwarf were 465±1.39, 799±2.60g and 79.38±0.71 mm. The ASM, 20 weeks body weight, 28-week egg weight, 32-week egg weight, respectively in naked neck were 157 days, 2271, 49.11 and 51.23g. The corresponding values in dwarf were 158 days, 2096, 48.25 and 50.54g.

Layer populations

Three elite lines viz., IWH, IWI and IWK are under selection for higher egg numbers up to 64 weeks of age, whereas IWD, IWF and Layer Control (LC) are under random breeding programme. The production traits were evaluated from 40 to 72 weeks of age. Regeneration of the six lines of WLH (S-16 of IWK and LC, S-8 of IWH and IWI, G-3 of IWD and IWF) was completed. Evaluation of three different two-way crosses; Kadaknath x IWH (KxH), IWFxIWH (F x H) and IWHxIWF (H x F) was completed. Hatching eggs of two new WLH lines i.e., IWN and IWP were procured from AICRP centre, Mannuthy and chicks

were hatched and raised at the Directorate as resource population. A three-way cross, DKH [(PD-3) x (KxH)] was produced and is under evaluation. Four two-way crosses viz., CHx (PD-1 x IWH), VHx (PD-2 x IWH), KxH (Kadaknath x IWH) and DRxH (DR x IWH) were produced and are under evaluation.

Duck production

Ducks of S-1 generation of Kuzi were evaluated for egg production up to 80 weeks of age. The egg production up to 72 and 80 weeks of age was 218±5 and 239±5 eggs, respectively. The egg weight at 60 and 72 weeks of age was 65.19±0.27 and 71.29±0.30, g, respectively. In the S-2 generation Kuzi ducks and Kuzi X Khaki Campbell (DK) and Khaki Campbell X Kuzi (KD), there was an increase of 125 g in 8 weeks body weight as compared to S-1 generation. The shank length, keel length and bill length of KD recorded at 8 weeks of age were 69.28±0.51, 129.5±1.01 and 63.68±0.44 mm, respectively. Corresponding shank length, keel length and bill length in DK were 71.80±0.43, 125.8±0.82 and 65.45±0.43 mm, respectively. The eviscerated yield was numerically higher in Kuzi followed by KD and DK. Back cut was the highest amongst the different cuts followed by breast, leg, wing and neck in all the three genetic groups.

The growing period body weight at 16 weeks of age in Kuzi, KD and DK female were 1637±8, 1555±19 and 1542±18 g, respectively. Corresponding body weight at 20 weeks of age were 1732±9, 1642±17, 1650±23 g. Body weight recorded at 40 weeks in Kuzi, KD and DK were 1642±10, 1566±18 and 1534± 24 g, respectively. Age at first egg in the flock was 101, 103 and 104 days in Kuzi, KD and DK, respectively. Corresponding age at 50% duck house egg production (DHEP) was 133, 124 and 123 days. Age at 80 % DHEP in Kuzi, KD and DK were 178, 156 and 136 days respectively. DHEP % at 20 and 40 weeks of age in Kuzi, KD and DK were 64.60, 72.46, 83.02 and 72.37, 76.81 and 87.54 %, respectively. Egg production up to 40 weeks of age in Kuzi, KD and DK were 110.2, 123.4 and 130.6 eggs, respectively.

Breeding for development of mycotoxin tolerant meat type ducks

The Pekin duck breeders post epigenetic-sensitization, were used as the parents for raising the current-generation of ducklings. A total of 12 hatches of Pekins were raised using above parents and evaluated versus random control (Non-sensitized to aflatoxin B1 (AFB1) (50-100ppb). The hatchability was low to moderate (19.1 to 47.2%) through these 12 hatches. Egg-production data of Pekin-layers over 5 annual-egg production cycles (2013-20) were analyzed and the results revealed huge fluctuation in duck-day egg production throughout the 5 generations (range: 57-159 eggs/bird/year), for which both year-effects and feed's natural AFB1-levels (range: 2.1 to 97ppb) emerged as the significant most influencing factor.

Molecular genetics

The inhibin alpha gene was edited by CRISPR/Cas in Nicobari breed to analyse the effect of editing on egg production. The efficiency of production of transgenic birds was 21.7 and 7.6% for exon1 and exon2, respectively while efficiency of production of inhibin alpha edited birds was 13% for exon1 only. The exon1 sequence of inhibin alpha gene was edited by Cas9 enzyme creating substitution and addition of nucleotides in the sgRNA corresponding sequences in the inhibin alpha gene. The egg production up to 72 weeks of age was significantly higher by 103.9% in edited birds as compared to the control birds (261 vs 128 eggs). The number of pause days was lower in the edited birds as compared to that of control ones (100.5 *vs* 224 days) indicating higher persistency of egg production in edited birds compared to that of control ones (0.7 *vs* 0.4eggs/day). Haugh unit and yolk colour index was 19.8 and 17.5% higher, respectively in the edited birds as compared to the control hens. The follicular stimulating hormone, luteinizing hormone and oestrogen levels were 66.6, 20.6 and 98.1% higher in the edited birds as compared to the control birds. But, the progesterone level was 29.3% lower in the edited birds.

Transgenic chickens were produced through sperm mediated gene transfer (SMGT) method with the efficiency of 5.4%. In the transgenic birds, human interferon alpha 2b gene was introduced at the germ line stage for which ovalbumin promoter based transgenic cassette was developed, transferred and integrated in the chicken genome. Up to 45 weeks of age, transgenic hens laid 132 eggs. On an average, 30-40 mg interferon alpha 2b protein was isolated from each egg laid by transgenic birds.

A dual-purpose cross of chicken was developed by crossing improved control broiler birds selected through marker assisted selection (MAS) for 4 generations with Vanashree (PD-4) birds. The body weights of birds at 8, 10 and 12 weeks of age were 1002, 1389 and 1647 g, respectively. The age at first lay was 137.5 days. The hens laid 99.6, and 226.2 eggs up to 40 and 72 weeks of age, respectively. The egg weight at 40 weeks of age was 53.5g.

A PGC bank was established for conservation of native chickens. The PGCs of 4 native chicken breeds, Nicobari, Ghagus, Kadaknath and Aseel have been cryo-preserved.

Genome wide association study in Indigenous poultry breeds

A total of 10 Indian native chicken breeds, Aseel, Ghagus, Kadaknath, Nicobari Hansli, Ankleswar, Mewari, Punjab Brown, Tellicherry and Haringhata black and 2 improved chicken breeds namely, PB-1 and IWH were analysed for identification SNPs present in the genome. The total SNPs across the breeds varied from around 41 lakhs in

Ankeleshwar to 70 lakhs in Aseel. Around 1/4th of the total SNPs were detected in the intron region of the genome while around 1.3 to 1.5% of the total SNPs lies on exon region of which 70% of the SNPs were non-synonymous types changing amino acids due to SNP variabilities. In addition, upstream and downstream regions of the gene harbors around 20% of the total SNPs across the breeds. By annotating the SNPs across the breeds, the breed-specific SNPs and the breed signature were developed.

Development of bio-fortified chicken varieties

A total of 21 pure line chickens reared at the institute were evaluated for mineral profile in eggs. The average Fe and Cu contents in eggs were 1.70mg and 0.05mg/100g egg, respectively. The top 9 lines for egg Fe and Cu contents were selected and crossed in different combinations. A total of 12 crosses were developed and their egg Fe and Cu contents will be measured to select the top performing ones.

Genome wide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs

The genetic polymorphism study in the male and female gonads of 19th day incubated fertile Kadaknath chicken indicated that the relative expression of DMRT1 in the right testis was 3.83 and 3.78 folds higher than left and right ovaries, respectively and the relative expression of FOXL2 in the left ovaries was 12.65 and 2.14 folds higher than the right testes and right ovaries, respectively. Both DMRT1 and FOXL2 genes were found to be polymorphic.

Whole genome assembly of Kadaknath chicken

The high-quality reads were utilized for downstream analysis. Hisat2, a splice aware aligner was used to align the reads against the *Gallus gallus* (GRCg7) genome from ENSEMBL database. When aligned with *Gallus gallus* (GRCg7) genome, a total of 64584 transcripts were arranged in Kadaknath chicken transcriptome assembly. The highest number (8511) of transcripts belongs to chromosome No. 1. Different number of transcripts were present for all the 39 chromosome and also the sex chromosome (W and Z). A total of 780 transcripts remained unlined.

Epigenetic methylation and miRNA mediated gene regulation of transcellular calcium transport genes

Total number of miRNAs were identified in IU-218, KU-180. Common miRNAs in two lines were 162. Total number of novel miRNAs identified IU-14, KU-28. Total number of miRNAs that were involved in calcium metabolism identified in both the lines were 177. These 177 miRNAs were related to a total of 688 genes that were in turn involved in calcium homeostasis as well partly influenced by the calcium. Of these 177 miRNAs, a total of 9 highly differentially expressed genes related to calcium homeostasis were identified for further validation by *in vitro* cell culture method.

Nutrition

Alternatives for antibiotic growth promoters in feed

Marigold phenols (MP), marigold lutein (ML) and oregano extract (OE) were included in broiler diet at 250 g/ton. The body weight gain (BWG) and feed intake (FI) at both 21 and 39 d of age were not affected. The FE in broilers fed ML was higher than those fed the PC, while the FE in OE was similar to those fed the PC and higher than the NC. Coated sodium butyrate (CSB) was tested at 500 g/Ton feed. BWG and FI were not affected by inclusion of either AGP or CSB in broiler diet. However, the FE at both 21 and 42 d of age reduced in groups fed the AGP-free NC diet. Supplementation of CSB to the NC significantly improved the FE over the NC group and was similar to those fed the PC diet. Inclusion of sodium butyrate event at the lower concentrations tested (250 mg/kg) was adequate to replace AGP in broiler diet with an advantage of higher feed efficiency compared to the AGP-fed birds.

Feed emulsifier (combination of lecithins, glyceryl polyethylene glycol ricinoleate, glyceryl monostearate and polyoxyethylene sorbitan monooleate) in four different combinations of the emulsifier in pre-starter, starter and finisher diets. During 1-21 d of age, the FE improved by including all the combinations of emulsifiers compared to the NC group and the efficiency was similar to the PC group. At the end of experiment (1-42d), the BWG in broilers received 250, 250 and 500 g or 250, 500 and 500 g emulsifier, respectively in pre starter, starter and finisher diets was significantly higher than the NC groups and similar to those fed the AGP supplemented PC group. Similarly, the FE in broilers fed all the combinations of emulsifier improved compared to the NC and similar to those fed the PC, except those fed diets with 500 g emulsifier whose FE was inferior to PC but higher than the NC group. Protease, phytase, xylanase were supplemented either individually or in combination in diets without AGP. During the entire experimental period, except protease, all other enzymes or combination of enzymes significantly improved the FE compared to the NC group. The FE in broilers fed the combination was similar to those fed the PC.

Black soldier fly larva meal in chick diet

Black soldier fly larva meal (BSFLM) could be safely used upto 5% in the diet of broiler chicks with beneficial effects on growth during the initial few weeks of life. Body weight of broilers was significantly higher in the groups fed BSFLM in comparison to the control group during the early life of 0-3 weeks of age. BSFLM inclusion in diet upto 12% showed no adverse effect on the performance of Vanaraja chicks (body weight gain, feed intake and FCR) during 0-6 weeks of age. Instead, during the first 2 weeks

of life of the chicks, beneficial effects on body weight gain were recorded in the groups fed BSFLM at graded levels.

Low-phytate maize in diet

Low-phytate maize was about 71% lower in phytate content compared to that of normal maize. The threonine, lysine, methionine and tryptophan concentration was higher in low-phytate maize compared to that of normal maize. Feeding diet with low-phyate maize is advantageous over the diets with normal maize as improved body weight gain, feed conversion ratio and higher bone breaking strength were recorded in the present study in Gramapriya birds.

Green biosynthesis of nano-minerals and their feeding

Green biosynthesis of nano minerals using plant extracts was pursued. Six plants, namely, leaves of moringa, neem, mango, red sandalwood, guava and aloe vera gel showed promising results, while neem leaf extract produced the maximum yield. The biosynthesised zinc nano particles (NPs) were characterised 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). The SEM and TEM analysis also showed that most of the particles were in the range of 10-100 nm and the average particle size was 10.84 nm. By feeding nano zinc, the zinc dose could be reduced (upto 25% of the requirement) in Vanaraja chicks. The particle size analysis of copper NPs biosynthesized using neem leaf extract showed that average particle size was 9.62 nm. The diameter of most of the NPs of copper oxide was in the range of 50-100 nm. Nano copper improved immunity without affecting performance in Vanaraja chicks even at 25% of requirement.

Duck nutrition

For white Pekin ducks during grower stage (8-16 wks), the diet containing 2600 kcal ME/kg diet was sufficient to meet the energy requirements when tested with 2450, 2600 and 2750 kcal /kg levels. During, 20 to 40 weeks (layer stage) of age, the diet containing 2700 kcal ME/kg diet was sufficient to meet the energy requirements of White Pekin ducks. Further, the effect of feeding broken rice (BR) replacing wheat at 50 and 100% was studied in White Pekin ducks during first phase of laying (from 165 days till 40 weeks). Wheat could be completely replaced by broken rice, however, mixture of wheat and broken rice in equal ratio increased the metabolisability of nutrients. During mid phase of laying (41-52 weeks), the ducks could be raised on different cereal based diets under intensive rearing system, however, mixture of wheat and broken rice in equal ratio increased the performance and was economical. The replacement of fish meal by soybean meal with amino acid (lysine and methionine) supplementation improved the egg quality, i.e. shape index, albumen index, yolk index and Haugh unit without any adverse effect on the nutrient utilization in Khaki Campbell laying ducks (for 100 days from 35 weeks).

Physiology

Plasma levels of melatonin, ghrelin, progesterone and estradiol were estimated in Ghagus and Nicobari breeds during early laying period (24-28 weeks, EP) and mid laying period (32-36 weeks, MP. The mean concentration of melatonin in Ghagus breed was higher during EP than in MP. Supplementation of Se (@ 0.05g of product/kg feed) did not affect during EP but increased the hormone concentration during MP. Where as in Nicobari, the mean concentration of melatonin was less in the EP when compared to MP. Supplementation of Se increased the concentration during EP without any significant effect during MP. The concentration of ghrelin was not different between EP and MP. Supplementation of Se increased the plasma hormone concentration in Ghagus only during EP whereas no effect was observed in Nicobari. The mean level of estradiol was higher in EP when compared to MP in Ghagus and vice versa was the case in Nicobari. The level of progesterone was higher in both the breeds during EP when compared to MP. Treatment with Se decreased progesterone concentration during both EP and MP in Ghagus, but only during EP in Nicobari. In Ghagus, egg production and egg weight increased upon treatment with Se only during EP, whereas in Nicobari no effect was observed.

Semen cryopreservation protocol for Kadaknath chicken was explored. Semen was cryopreserved using 8% ethylene glycol (EG) in Sasaki diluent (SD), Lake and Ravie diluent (LR) or Red Fowl Extender (RFE) and the maximum post-thaw fertility (8.8%) was obtained from 8% EG SD. Further, semen was cryopreserved using 8% EG in SD, 4% dimethyl sulfoxide (DMSO) in SD or 4% DMSO in LR and the maximum post-taw fertility (14.5%) was obtained from 4% DMSO SD group. Supplementing raffinose at 10mM along with 4% DMSO during semen cryopreservation improved the post-thaw semen fertility.

Vermicompost of poultry litter was prepared with saw chips or rice hulls at C/N ratios of 35:1, 30:1 and 25:1. in a duration of 98 days. The vermicompost thus produced was evaluated in the field as bio-fertilizer for green gram. Several beneficial effects on the agronomic characteristics of the crop including seed yield and stover yield were observed with the application of poultry litter vermicompost. In addition, an integrated farming system was simulated by experimental feeding of Gramapriya hens with moringa leaves and earthworms. A vermicompost production facility for the culture of earthworms was created.

The floor space requirement of Khaki Campbell ducks during growing, adult and laying period (up to 40 wk age) was evaluated and found that 625, 1200 and 1800 sq cm/duck as night shelter and run space, respectively were optimum. Furthermore, fertility and hatchability

were optimum for the ducks maintained at 1500 sq cm per duck as night shelter and run space during day time. The presence of drakes in a flock had no beneficial effect on the initiation of egg laying in the flock. Earth worm production in cement concrete rings (diameter-3ft, height-2ft) was standardised. From each ring, 2.5-3.0 kg of earthworm was harvested after a period of 70-80 days. Earthworm meal contained 55.76 % crude protein, 5.68 % ether extract, 11.32 % crude fibre, 13.73 % total ash, 6.19 % acid insoluble ash and 13.51 % nitrogen free extract.

Health

Neoplastic growth was observed in various organs in 2.1% of the birds examined. The status of avian leukosis subgroup E loci was determined in native breeds by locus specific PCR assay. 100% of the birds in Kadaknath, Ghagus, White Leghorn and 72% of the birds in Aseel had dominant homozygous TVBS1 allele (S1S1) and remaining 28% of the Aseel birds had heterozygous TVB S1 allele (S1S3).

FMolecular confirmation of the E. coli isolates from the field samples was done using Pentaplex PCR for detection of uidA (β-D-galctosidase), lacZ (β-D-galctosidase), lacY (lactose permease), cyd (cytochrome bd complex) and phoA (bacterial alkaline phosphatase). Antibiotic sensitivity test for the confirmed E. coli isolates indicated highest resistance for Ampicillin. Among cephems, higher cefoxitin resistance was noticed.

Liver and kidney dysfunction were observed in White Pekin grower ducks with 30ppm arsenic, whereas supplementation of 2g garlic powder/kg of feed ameliorated these toxic effects.

Extension

Contribution of ICAR-DPR and AICRP germplasm in Indian poultry population was estimated on the basis of number of supply of fertile eggs, day old chicks, grownup birds and parent to different stakeholders. On an average, 38.7 lakh chickens were distributed to farmers and other stakeholders every year in the last ten years. The average annual contribution was estimated about Rs 205.64 crore in last ten years from ICAR-DPR and AICRP, which ranged from Rs 162.45 to 277.06 crore. Vanaraja has been propagated in different agroclimatic regions of India for the past 3 decades. There was continuous increment in the economic contribution by the variety. The average annual contribution of revenue from Vanaraja chicken to the Indian economy was estimated as Rs. 0.76 billion during the period 2017-2020. During the year due to COVID 19 pandemic, farmers interested in duck farming were provided advice through telephonically or via e-mail on different aspects of duck farming. Tribal farmers in NEH were provided training on backyard poultry farming and inputs distributed.

Regional Station, Bhubaneswar

Kuzi ducks and its crosses (Kuzi X Khaki Campbell (DK) and Khaki Campbell X Kuzi (KD)) were evaluated growth and egg production traits up to 80 weeks of age. The heritability estimates varied from 0.22 to 0.44 for different juvenile body weights. Different carcass quality traits were measured at 12 weeks of age in Kuzi, KD and DK ducks. Back cut as % of eviscerated weight was highest amongst the different cuts followed by breast, leg, wing and neck in all the three genetic groups. The body weight at 16 weeks of age in Kuzi, KD and DK female were 1637±8, 1555±19 and 1542±18 g, respectively. Corresponding body weight at 20 weeks of age was 1732±9, 1642±17, 1650±23 g. Body weights were significantly ($p<0.05$) higher in Kuzi compared to the crosses. Body weight recorded at 40 weeks in Kuzi, KD and DK were 1642±10, 1566±18 and 1534± 24 g, respectively. Age at first egg in the flock was 101, 103 and 104 days in Kuzi, KD and DK, respectively. Corresponding age at 50% duck house egg production (DHEP) was 133, 124 and 123 days. Age at 80 % DHEP in Kuzi, KD and DK was 178, 156 and 136 days respectively. Egg production up to 40 weeks of age in Kuzi, KD and DK were 110.2, 123.4 and 130.6 eggs, respectively. The crossbreds produced more number of eggs than Kuzi ducks, however their body weight was lower than the Kuzi ducks.

Through breeding programme mycotoxin tolerant meat type duck development was undertaken. The egg-production data of Pekin-layers over 5 annual-egg production cycles (2013-20) were analyzed for their impacts along with ambient temperature and relative humidity (RH) information. The study concluded that for managing sound egg production, the most important factor to be considered is minimizing natural-build-up of AFB1 in duck-diets. The ambient-temperature, RH level and seasonal effects proved as secondary factors influencing duck husbandry under coastal ecosystems.

The optimum level of metabolizable energy requirement of White Pekin ducks during grower stage was evaluated with three experimental rations containing three levels of metabolizable energy, i.e. 2450, 2600 and 2750 k cal / kg diet. No significant differences among the groups with respect to DM, OM, CP, CF and EE metabolizability were observed. It was concluded that the diet containing 2600 k cal ME/kg diet was sufficient to meet the energy requirements during grower stage. To determine the ideal level of ME in layer ducks three levels of ME, i.e. 2550, 2700 and 2850 kcal/kg were evaluated. The experiment was conducted from 20 to 40 weeks of age. It was concluded that the diet containing 2700 kcal ME/ kg diet was sufficient to meet the energy requirements of White Pekin ducks during layer stage.

The effect of feeding broken rice (BR) replacing wheat on nutrients metabolisability and egg production in White Pekin ducks during first phase of laying in intensive rearing system was studied. Three experimental diets without (BR-0) and with BR, replacing 50 (BR-50) and 100 (BR-100) percent wheat were evaluated. There was no significant difference in the dry matter intake and N balance (g/d) among the groups. The total egg production during the period of study was similar. In conclusion,

wheat can be completely replaced by broken rice in the diets of white Pekin ducks during first phase of laying in intensive rearing system; however, mixture of wheat and broken rice in equal ratio increases the metabolisability of the nutrients of the feed.

A study was conducted to find out the performance of White Pekin ducks during mid phase of laying on different cereal-based diets under intensive rearing system. Three types of diets without (BR-0) and with BR, replacing 50 (BR-50) and 100 (BR-100) percent of wheat were prepared and offered randomly to the above three groups till the ducks attained 52 weeks. The total egg production (dozen) and duck day egg production (DDEP) % were higher in BR-50 group (4.51 and 64.44) than the BR-100 group (3.85 and 55.00); however, both were similar to BR-0 group (4.09 and 58.49). The mean value of total feed intake was similar among the groups. The cost (Rs.) per kg feed in BR-0, BR-50 and BR-100 groups was 32.50, 31.95 and 31.56, respectively and decreased with the inclusion of broken rice by replacing wheat. The egg weight in BR-50 group (76.61g) was higher than the BR-0 group (75.42 g); however, both were similar with BR-100 group (76.19 g). It was concluded that White Pekin ducks during mid phase of laying can be raised on different cereal-based diets under intensive rearing system; however, mixture of wheat and broken rice in equal ratio increased the performance and was economical.

The effect of replacing fish meal by soybean meal on the performance of Khaki Campbell (KC) laying ducks was studied. Three experimental diets with fish meal (Control, T1), without fish meal replacing fish meal completely by Soybean meal (T2) and T2+addition of Lysine and Methionine 50 % more than control diet (T3) were evaluated for a period of 100 days. The results indicated that digestibility of organic matter was significantly better for the amino acid supplemented group (T3). The egg quality characteristics were significantly higher for ducks fed diet where fish meal was completely replaced by soybean meal with addition of lysine and methionine. It is concluded that replacement of fish meal by soybean meal with amino acid i.e. lysine and methionine supplementation improved the egg quality without any adverse effect on the nutrient utilization in KC laying ducks.

Earthworm production in cement concrete rings was standardized. Earthworm (Eisenia foetida) culture was introduced in the cement rings with dung and other biomass. From each ring, 2.5-3.0 kg of earthworm was harvested after a period of 70-80 days. The composition of earthworm meal was analyzed and found to contain 19.76 % DM, 55.76 % CP, 5.68 % EE, 11.32 % CF, 13.73 % total ash, 6.19 % acid insoluble ash and 13.51 % NFE.

In the rice-fish-duck integrated model for better economic benefit to farmers Khaki Campbell ducks were introduced in the model unit after 15 days of plantation of saplings. Fish fingerlings (Indian carps) were also added to the model. The growth of birds, fishes and rice plants along with insect and weed control were studied. At the end of the experiment, the detailed economics of the model was calculated, which was found to be much beneficial to the farmer in comparison to the monocropping with rice only.

Field performances of backyard chicken and ducks were studied through farmer first approach. During the period in addition to previously adopted farmers, new farmers (22 nos for backyard poultry units and 8 nos for duck units) were added and were briefed about brooding of day old chicks & ducklings, rearing, feeding and vaccination procedures through on-farm training programme. Day old chicks and ducklings were supplied to the farmers with other necessary critical inputs. Monitoring the health and survivability of birds were done and data were recorded from farmers field. It was observed that farmers not having own ponds are not interested for duck rearing. More farmers are interested for Kadaknath chicken due to the high market price of the birds.

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, two elite layer germplasm (IWN and IWP) and four elite broiler germplasm (PB-1, PB-2, CSML and CSFL) have been maintained.

At Mannuthy centre, egg production up to 40 weeks of age in S-6 generation of native chicken germplasm was 77.11 eggs. A three-way cross has been produced and its evaluation is under progress. The centre has bagged the ICAR-NBAGR, Breed Conservation Award 2021 under institution category for conserving *Tellichery* chicken breed. At AAU, Anand centre, 40 weeks egg production of *Ankleshwar* was 82 eggs. The 72 weeks egg production was 307 and 310 eggs in IWN and IWP strains (S-1) respectively. Egg production of IWD and IWK strains (S-9 gen.) up to 64 weeks of age was 234 and 223 eggs, respectively.

At Bengaluru centre, the five-week body weight was 956.2 and 947.2 g in PB-1 and PB-2 lines. At GADVASU, Ludhiana centre, the body weight at 5 weeks was 1172, 1078 and 806 g in PB-1, PB-2 and control broiler, respectively. The average egg production up to 36 weeks of age in PB-1, PB-2, and control broiler was 58, 61 and 57 eggs, respectively. The body weight in *Punjab Brown* at 4, 8, 16, 20 and 40 weeks of age was 483, 693, 1424, 1986 and 2685 g, respectively.

At Bhubaneswar centre, the body weight of *Hansli* native chicken at day-old and 8 and 20 weeks of age was 30.2,

447.9 and 1534 g, respectively. At ICAR-CARI, Izatnagar centre, development and improvement of dual purpose backyard cross was continued. At Udaipur centre, the hen day egg production up to 72 weeks in *Mewari* and *Pratapdhan* was 98.29 and 158.2, respectively. At Jabalpur centre, Jabalpur colour (JBC) females matured at 155 days and produced 152 eggs up to 52 weeks of age. The body weight of *Kadaknath* females at 6, 20 and 40 weeks of age was 398, 1045 and 1453g, respectively. *Kadaknath* females matured at 168 days and produced 87.6 eggs up to 52 weeks of age. *Narmadanidhi* birds attained 8 week body weight of 765g in males and 625.5g in females under field condition. Egg production up to 40 and 52 weeks was 47.5 and 88.7, respectively.

At Guwahati centre, a total of 1208, 96, 469 and 1518 good chicks of *Daothigir*, PB-2, BN cross and *Dahlem Red* were produced and performance was evaluated. At Palampur centre, the HHEP at 40 weeks and 52 weeks was 48.75 and 81.58 eggs, respectively in native chicken. The 64 weeks HDEP was 165.53 eggs in *Dahlem Red*. The HDEP up to 40 weeks was 75.2 eggs in *Himasamridhi* under farm condition.

At Ranchi centre, the HDEP of native chickens was 78.19 (G-9) at 52 weeks of age. The body weight at day old and 4 weeks of age was 28.12 and 167.4 g in native chickens (G-10). The hen day egg production in *Jharsim* was 82.72 eggs up to 52 weeks of age. The ASM was 164 days. At Tripura centre, the 72 week-egg production of BND cross (E4) was 170.13 and 142.13 under farm and field conditions, respectively. The age at first egg of BND cross at Institute farm and farmers' fields was 132.6 and 145 days, respectively.

During the year, a total of 6,80,184 chicken germplasm was distributed to 4,747 farmers/beneficiaries from different centres. An amount of Rs. 200.80 lakhs revenue was generated through sale of the improved chicken germplasm during the year.

Poultry Seed Project

The Poultry Seed Project (PSP) was initiated during the XI Five-year Plan with the main objective of 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, supplied parent chicks and co-ordinated, and monitored 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 2021 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 4,28,531 improved chicken varieties were distributed in their respective regions/states with a revenue receipt of Rs. 151.15 lakhs during the year.

Technologies transferred

The technologies and varieties developed at the institute were propagated despite the constraints of the pandemic. One contract research project was under operation during the period. One technology having commercial value and practical application in poultry industry was submitted to Agrinnovate India Limited, New Delhi, for commercialization.

A total of 28,311 hatching eggs, 94,127 day-old chicks, and 2,050 grown-up birds of Vanaraja, Gramapriya, Srinidhi, Vanashree, Krishibro, native chickens, etc. were supplied to the farmers and different organizations including Government agencies across the country. In addition, 20,602 parent chicks of different varieties were also supplied. From the AICRP and Poultry Seed Project centres, another 6,80,184 and 4,28,531 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.

The Development Action Plan for SC (DAPSC) was implemented in Telangana, West Bengal and Andhra Pradesh during the year by conducting three on-field training programs for 300 farmer families on different aspects of backyard poultry farming and four input distribution programs. Besides, improved chicken varieties and native chickens alongwith inputs like night shelters, feeders and waterers were distributed under the Scheduled Tribe Component Program with an aim to improve the economic and living standards of tribal farmers In Telangana.

Other activities

During the year, a total of 55 research papers, 5 review papers, 7 popular articles and 2 brochures/leaflets were published by the scientists of the institute. In addition, 14 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. 2961.06 lakhs and at AICRP and Poultry Seed Project centers, Rs. 824.83 and Rs. 718.38 lakhs, respectively were utilized. A total revenue of Rs. 590.54 lakhs (DPR-205.93, AICRP- 207.16 and PSP-177.45 lakhs Rs.) was generated during the year 2021.

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	2961.06	2961.06	205.93
AICRP	824.83	824.83	207.16*
Seed Project	718.38	718.38	177.45*

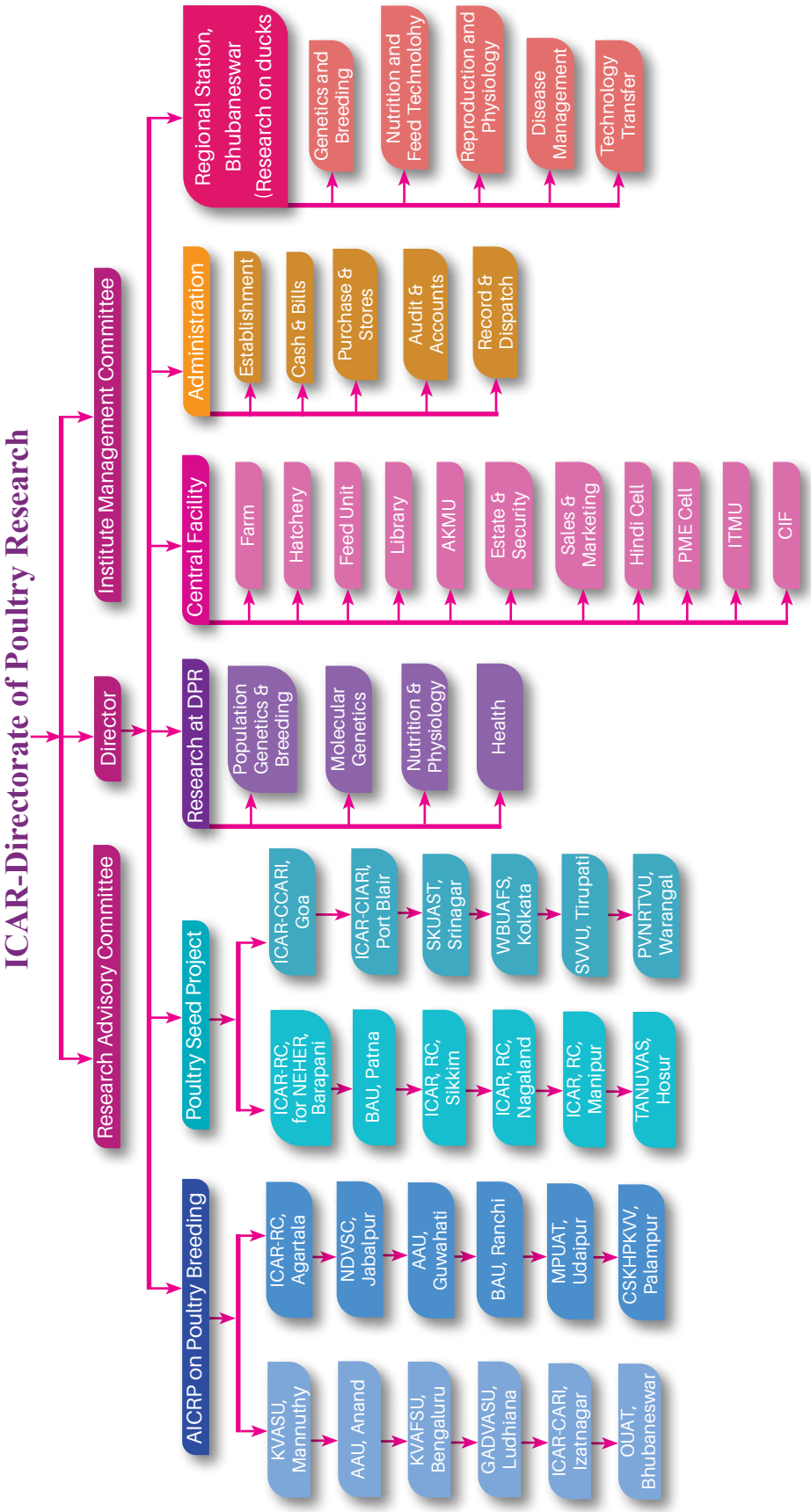
The Budget allocation is as per the financial year. However, the above figures are calculated proportionately from the allocations for the year 2020-21 and 2021-22.

*Receipts are for the financial year 2021-22.

Staff position (as on December 31, 2021)

	Head Quarter, Hyderabad		RS. Bhubaneswar		Total	
Cadre	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

2 Research Achievements

Genetics and Breeding

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

Male lines

PD-1 line (*Vanaraja* Male Line)

U. Rajkumar, M. Niranjan, S. Haunshi, L.L.L. Prince, M.R. Reddy, Vijay Kumar, B. Prakash, S. Jayakumar

PD-1 line was evaluated for growth and production traits up to 40 weeks of age in S-15 generation during the reporting period.

Juvenile performance (S-15)

PD-1 population was evaluated for juvenile traits in S-15 generation. The least squares means for body weight at 4 and 6 weeks of age were 392.5±1.47 and 851.0±3.15 g in PD-1. The shank length at 4 and 6 weeks was 60.61 ±0.15 and 83.65±0.04 mm, respectively. The six week shank length and body weight increased significantly compared to last generation. The genetic and phenotypic response in shank length at 6 weeks (SL6) was 0.83 and 0.72 mm per generation over the last 15 generations (Fig 1).

Regeneration

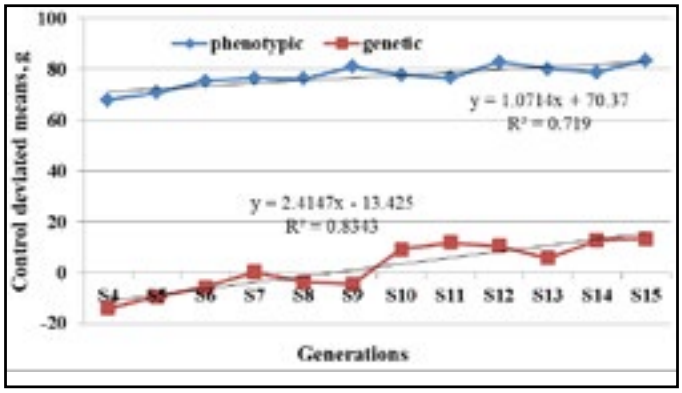


Fig 1. Selection response for 6-week shank length in PD-1 over the last 12 generations

PD-1 population was regenerated using random mating to improve the variability in the population. The pedigreed mating and selection for higher shank length and body weight will be employed from next generation with index selection.

Construction of selection index

The selection index was constructed utilizing the seven generations data of PD-1 line for body weight and shank length at 6 weeks of age. The variance and covariance estimated for both the traits and heritability estimate of 7 generations data were considered. The economic value for each trait was given based on the market value of per kg chicken meat. The data was rationalized for both body weight and shank length. 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 as follows.

I= 0.2260∗BW6(g) + 0.7717∗SL6(mm)

The above index will be utilized for selection in the PD-1 population from next generation onwards.

PD-6 (*Gramapriya* Male Line)

M. Niranjan, U. Rajkumar, K.S. Rajaravindra, T.R. Kannaki

The PD-6 line is developed from the PD-2 line. The PD-6 line is being used as male parent line of *Gramapriya* variety. The selection criterion practiced in this line is higher shank length at 6 weeks age. During the S-10 generation the production traits were recorded up to 40 weeks of age. The ASM, 20-week body weight, and egg weights at 28, 32, 36 and 40 weeks of age were 189.9±0.09 days, 1888±0.82, 50.14±0.01, 52.8±0.01, 55.31±0.04 and 55.53±0.02g, respectively. The egg production up to 40 weeks of age was 64.57±0.20 eggs.

The S-11 generation was reproduced utilizing 50 sires and 250 dams. The fertility was 93.06% and hatchability on total and fertile eggs set was 82.97% and 89.15%. Total number of chicks produced were 2202. Recording of juvenile traits is in progress.

PD-2 line

M. Niranjan, U. Rajkumar, K.S. Rajaravindra, T.R. Kannaki

PD-2 line is developed from coloured random bred control population. This line is being used as female parent for production of *Vanaraja* chicks. The selection criterion employed in this line is higher egg mass to 52 weeks. The production traits were recorded up to 52 weeks of age during S-17 generation. The means with standard error for ASM, body weight, egg weight, egg production and egg mass up to 52 weeks of age were presented in Table 1.

The S-18 generation was produced by random mating. The fertility was 86.04% and hatchability on total and fertile eggs set was 80.16% and 93.16%. Total number chicks produced were 1836. Among the juvenile traits, the body weight at 4 and 6 weeks of age was 368.8±0.04 and 701.7±4.98g, respectively and shank length at 6 weeks of age was 77.32±0.001 mm. The shank length showed marginal improvement of 0.90 mm.

Table 1. Least square means of juvenile traits in PD-2 line (S-17) and rural control (RC)

Traits	PD-2	Rural control
ASM (d)	166.5±0.08	195.3
Body weight (g)		
20 wks	2076±0.93	1966
40 wks	2423±0.87	-
52 wks	2645±0.97	2405
Egg weight (g)		
28 wks	50.20±0.01	47.98
32 wks	53.10±0.02	52.04
36 wks	54.10±0.01	53.09
40 wks	54.50±0.02	53.43
52 wks	55.88±0.04	54.79
Egg Prod. (Nos.)		
40 wks	84.5±0.87	72.3
52 wks	130.6±0.98	120.1
Egg mass (g) 52 wks	7373±4.05	6483

PD-3 line (*Gramapriya* Female line)

U. Rajkumar, M.Niranjan, S.Haunshi, L.L.L.Prince, M.R.Reddy, Vijay Kumar, B.Prakash, S. Jayakumar

The PD-3 line is being selected for higher 40-week egg mass. The line was evaluated for production traits during S-9 generation.

Production performance (S-9)

The selected population of 619 hens was evaluated for growth and production performance up to 72 weeks of age during S-9 generation. The ASM was 154.3±0.01 days, which reduced in compared to the previous generation. The least squares mean for body weight at 20 and 40 weeks were 1540 and 1733 g, respectively. The egg weight at 40 weeks was 58.58 g. The part period egg production up to 40, 52 and 64 weeks of age was 100.4±1.91, 160.9±2.77 and 204.0±3.99 eggs, respectively. The 40 weeks egg production increased significantly from previous generation (93 eggs). The egg mass at 40, 52 and 64 weeks of age was 5547±1.74, 9419±2.64 and 12369±4.06 g, respectively. The egg mass at 40 weeks of age increased significantly from the last generation. The annual egg production up to 72 weeks of age was 243 eggs in PD-3 line. The heritability estimates for production traits were low to high from sire & dam components variance (Table 2). The genetic and phenotypic response for egg mass and egg production are presented in Fig 2 and 3, respectively. The genetic and phenotypic response for EM 40 was 611 and 739 g, respectively over the last 9 generations.

Table 2. Heritability estimates for production traits in PD-3 Chicken

Traits	h^2_S	h^2_D	h^2_{S+D}
BW 20	0.451±0.145	0.234±0.161	0.343±0.117
BW 40	0.459±0.144	0.251±0.131	0.314±0.101
EP 40	0.148±0.143	0.322±0.163	0.235±0.110
EP 52	0.275±0.136	0.399±0.175	0.307±0.113
EP 64	0.253±0.167	0.328±0.167	0.291±0.120
EW 28	0.605±0.204	0.544±0.176	0.575±0.153
EW 40	0.731±0.212	0.187±0.146	0.459±0.140
EW 52	0.729±0.221	0.414±0.162	0.571±0.149
EM 40	0.255±0.127	0.209±0.167	0.232±0.108
EM 52	0.139±0.105	0.178±0.170	0.159±0.103
EM 64	0.400±0.156	0.281±0.166	0.341±0.116

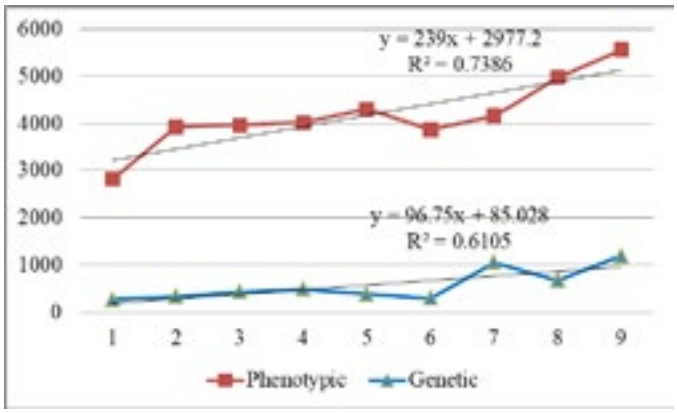


Fig 2. Selection response for egg mass at 40 weeks of age in PD-3 line

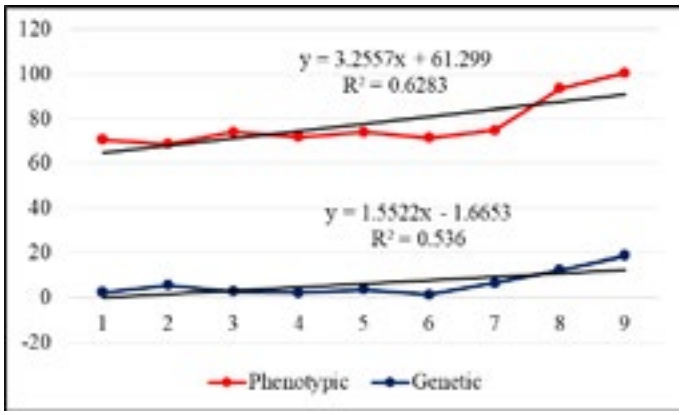


Fig 3. *Correlated response for egg production at 40 weeks of age in PD-3 line*

Regeneration of PD-3 line

S-10 generation of PD-3 line was regenerated using 50 sires and 250 dams in a pedigreed mating. A total of 4302 chicks were produced in this generation. The fertility was 87.3% and hatchability on fertile egg set (FES) was 87.3 and on total egg set (TES) was 76.2%. The hatchability has shown the increasing trend from 8th generation on-wards (Fig 4).

Egg quality traits

The important external and internal egg quality traits were studied in PD-3 line (Table 3). The age of the bird had significant effect on the egg quality traits. The shape index was better at early age. The average HU score was 83.49 indicating the desirable albumen quality of the egg. The shell thickness and shell weight was similar at all ages without any significant variation.

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

Parameter	Mean±S.E.		
	40 wks	52 wks	64 wks
Egg weight (g)	55.11±4.3^{b}	59.27±5.6^{a}	59.80±4.6^{a}
Shape index	97.9±0.94^{a}	74.6±0.80^{b}	74.9±0.44^{b}
Albumin height (mm)	6.40±0.15^{b}	7.31±0.13^{a}	7.17±0.15^{a}
Haugh unit	79.8±1.14^{b}	86.6±0.81^{a}	84.6±1.06^{a}
Yolk height (mm)	16.7±0.11^{c}	17.5±0.10^{b}	18.9±0.16^{a}
Albumin weight (g)	21.9±0.40^{c}	23.4±0.43^{b}	25.1±0.43^{a}
Yolk weight (g)	15.5±0.12^{c}	15.3±0.14^{bc}	16.4±0.14^{ab}
Yolk colour	7.3±0.14^{c}	7.5±0.12^{bc}	7.8±0.12^{ab}
Shell weight (g)	5.2±0.04^{b}	5.5±0.05^{a}	5.4±0.05^{a}
Shell thickness (mm)	0.38±0.002	0.38±0.003	0.38±0.002

Means with same superscripts do not differ significantly (P≤0.05) within the row

Slaughter parameters

A total of 55 birds (25 male and 30 female) were slaughtered at 15 weeks of age for evaluating the slaughter parameters. The sex had significant effect on live weight, dressing percentage, breast, legs and abdominal fat (Table 4).

Table 4. Slaughter parameters in PD-3 line

Traits	Male	Female	Overall
N	25	30	55
Live weight (g)	1552±30.9^{a}	1165±20.6^{b}	1341±31.7
Dressing (%)	73.4±0.29^{a}	73.7±0.44^{b}	73.6±0.27
Feather (%)	14.5±0.34	15.3±0.25	14.9±0.21
Breast (%)	14.6±0.39^{b}	16.3±0.30^{a}	15.5±0.26
Legs (%)	19.4±0.41^{a}	19.2±0.13	19.3±0.15
Wings (%)	10.4±0.23	10.0±0.13	10.2±0.12
Back (%)	22.2±0.56	21.8±0.40	22.0±0.33
Blood (%)	4.6±0.30	3.39±0.17	3.94±0.18
Heart (%)	0.4±0.00	0.42±0.01	0.45±0.08
Liver (%)	2.0±0.04	2.0±0.04	2.0±0.02
Gizzard (%)	2.2±0.07	2.3±0.06	2.3±0.04
Bursa (%)	0.10±0.01	0.10±0.01	0.10±0.01
Spleen %	0.19±0.00^{b}	0.24±0.01^{a}	0.21±0.00
Fat %	0.62±0.01^{b}	0.73±0.10^{a}	0.67±0.07

Means with same superscripts do not differ significantly (P≤0.05) within the row

Genetic improvement and evaluation of native chicken breeds

Santosh Haunshi, L.L.L. Prince, U. Rajkumar, T. R. Kannaki, Suresh Devatkal

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. In the S-12 generation, a total of 1358 good chicks were hatched in two hatches by mating 50 sires with 150 dams in a 1 : 3 ratio. The fertility was 89.86% while hatchability on fertile and total eggs set was 87.71 and 78.82%, respectively. Fertility improved by 3.5% while hatchability on FES and TES improved by 1.94 and 4.66%, respectively as compared to the previous generation. The selection differential and intensity of selection for 12 weeks body weight was 69.1 g and 0.42 σ, respectively. Those for 40 weeks egg production were 2.00 eggs and 0.098 σ, respectively. Effective population size and rate of inbreeding were 145.05 and 0.00345, respectively as 50 sires and 132 dams contributed progenies to the S-12 generation.

Growth traits : Least square means and heritability estimates of juvenile growth traits of *Vanashree* in the S-12 generation are presented in Table 5. Heritability estimates of juvenile growth traits on sire component of variance were high (except for 8 weeks shank length) indicating that there is high additive genetic variance in the Vanashree population for these traits. There was an improvement of 19.2 g in 8 weeks body weight and 1.09 mm in 8 weeks shank length over the generations on phenotypic scale. The body weight and shank length of pullets at 20 weeks of age were 1660±11.6 g and 106.1±0.51 mm, respectively while those of cockerels were 2304±20.6 g and 131.9±0.97 mm, respectively. Body weight of males and females at 20 weeks increased by 123 and 190 g, respectively. Liveability observed during 0-8 (92.84%) and 9-20 (99.06%) weeks of age increased considerably as compared to the previous generation. The age at sexual maturity, age at 50% production and age at peak production (83.02%) was 174.9±0.87, 178 and 195 days, respectively. Hen housed and hen day egg production up to 40 weeks of age was 58.87±1.79 and 60.36, respectively. Egg weights at 28, 32, 36 and 40 weeks were 45.37±0.30, 46.62±0.33, 48.10±0.48, 50.47±0.37 g, respectively. Body weight of hens at 40 weeks was 2126±32.8g with the liveability of 96.61%.

Table 5. Juvenile growth traits (Mean±S.E.) of *Vanashree* (S-12)

Traits	Hatch 1 & 2	h^2 (Sire)	Hatch 4 & 5
Body weight (g)			
0 day	36.54±0.09	0.34±0.19	35.84±0.32
4 wks	206.6±1.40	0.30±0.14	207.9±1.90
6 wks	372.5±2.25	0.42±0.15	377.4±3.29
8 wks	580.3±6.40	0.45±0.16	575.5±4.73
Shank length (mm)			
6 wks	63.66±0.17	0.45±0.16	62.55±0.32
8 wks	78.21±0.40	0.25±0.12	-

Ghagus

S-3 generation : Ghagus, an indigenous chicken breed is being selected for higher body weight at 8 weeks of age. The production performance of the S-3 generation evaluated up to 40 weeks of age is presented in Table 6. There was decline in egg production in this generation. However, there was significant increase in egg weights recorded at different ages up to 40 weeks. Egg weights at respective age increased by 1.51, 0.26, 2.15 and 3.06 g, respectively as compared to the previous generation. Better liveability was observed in males (96.15%) as compared to hens (91.50%) during 21-40 weeks of age.

Table 6. Production traits of Ghagus breed (S-3)

Traits	Mean±S.E.
ASM (d)	163.0±0.75
Age at peak production (d)	182 (50.0%)
Egg production 40 wks (Nos.)	
Survivors'	35.24±1.29
HHEP	33.97±1.97
HDEP	35.61
Egg mass 40 wks (g)	1682±61.99
Egg weight (g)	
28 wks	45.06±0.37
32 wks	46.18±0.39
36 wks	48.07±0.43
40 wks	49.52±0.50

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

S-4 generation : A total of 298 good chicks of Ghagus in I-hatch were hatched along with common hatch of all other pure lines on 19th April 2021 with the fertility of 73.12% and hatchability of 87.63 and 64.09% on FES and TES, respectively. The production performance of first hatch of Ghagus was evaluated up to 40 weeks of age. Age at sexual maturity, age at 50% production and age at peak production (73.53%) were 167.4±0.87, 166 and 180 days, respectively. Hen housed, survivors' and hen day egg production up to 40 weeks of age was 56.00±2.07, 56.51±2.08 and 57.00, respectively. So, far this is the highest egg production recorded in this breed. Egg weight at 28, 32, 36 and 40 weeks was 43.65±0.43, 45.83±0.44, 47.44±0.48, 48.88±0.53 g, respectively. Body weight of hens and cocks at 40 weeks was 1920±43.13 and 3093±52.5g, respectively. The shank length of hens and cocks at 40 weeks was 103.9±0.58 and 134.8±1.27 mm, respectively. Excellent liveability was observed in males (98.11%) and females (97.09%) during 21-40 weeks of age.

A total of 929 good chicks were hatched by random mating using pooled semen with the fertility of 87.07% and hatchability of 92.23 and 80.30%, respectively on FES and TES. Fertility improved by 1.81% in this generation.

Growth traits : Evaluation of these two hatches of S-4 generation was completed up to 20 weeks of age during the reporting period. Body weights at day old, four, six and eight weeks of age were 32.93, 208.9, 335.1 and 557.7g, respectively while the shank length at six weeks of age was 60.14 mm. Body weight at four weeks of age improved by 26.7 g. Body weight of male and female birds at 20 weeks of age was 2329±22.1 and 1593±14.3 g, respectively. Shank length of male and female birds at 20 weeks of age was 128.6±0.78 and 103.5±0.51 mm, respectively. There was an improvement of 84 g and 1.4 mm in 20 week's body weight and shank length of males, respectively in this generation.

Liveability : Liveability during 0-8, 9-20 and 0-20 weeks of age was 97.63, 99.23 and 96.88%, respectively during S-4 generation. Liveability during different stages of growth was higher in this generation as compared to that observed in the previous generation.

Nicobari

Nicobari, an important indigenous breed of chicken is being evaluated and conserved as a purebred random mating population at the Institute. The G-8 generation was evaluated for growth and production traits from 8 to 20 weeks of age. The least-square means and heritability estimates of growth traits of Nicobari on pooled sex are presented in Table 7. The heritability estimates of growth traits recorded up to 20 weeks estimated for the first time in this breed were moderate to high for most of the growth traits on sire component of variance indicating the presence of adequate additive genetic variance for growth traits in this breed.

Table 7. Growth performance of Nicobari breed on pooled sex (G- 8)

Age	Mean±S.E.	h^2 (Sire)
Body weight (g)		
10 wks	592.5±6.0	0.38±0.14
12 wks	811±7.85	0.21±0.13
14 wks	973±9.35	0.36±0.15
16 wks	1103±10.2	0.23±0.14
19 wks	1208±13.2	0.26±0.17
20 wks	1330±16.8	0.39±0.24
Shank length (mm)		
20 wks	92.4±0.78	0.45±0.23

Body weight and shank length of male and female birds recorded at 20 weeks of age were presented in Table 8.

Table 8. Sex wise growth traits of Nicobari breed (G-8)

Growth traits	Males	Females
Body weight at 19 wks (g)	1469±17.7	1106±28.5
Body weight at 20 wks (g)	1582±19.1	1150 ±10.7
Shank length at 20 wks (mm)	102.5±0.97	85.45±0.55

The second hatch of G-8 generation of Nicobari was produced using pooled semen (random mating) at the parents' age of 78 weeks. A total of 144 good chicks were hatched in one hatch with the fertility of 76.89% and hatchability of 88.34 and 67.92%, respectively on FES and TES. These birds were evaluated for production traits up to 40 weeks of age. The age at sexual maturity was 171.9±2.32 days and egg weight at 28, 32, 36 and 40 weeks was 42.8±0.46, 44.31±0.47, 47.6±0.43, 48.17±0.43 g, respectively. Survivors' egg production up to 40 weeks of age was 75.71±2.93 eggs. Body weight of hens recorded at 20 weeks was 1226±30.4 g. The body weight and shank length of hens at 40 weeks were 1658±39.4 g and 91.2±0.72 mm, respectively.

Kadaknath

Kadaknath, an indigenous chicken breed was evaluated for egg production performance up to 72 weeks of age in the G-1 generation. Egg production up to 64 and 72 weeks of age was 149.2±1.67 and 177.0±2.97 eggs, respectively. Body weight at 64 weeks of age was 2359 g in males and 1661 g in female birds.

The G-2 generation of Kadaknath was produced by pedigreed random mating of 33 sires and 66 dams which were tested negative for ALV. About 1111 eggs were set and 988 good chicks were produced in 3 hatches. Fertility was 95.77%. Hatchability on total egg set and fertile egg set was 89.83 and 93.80%, receptively. Improved fertility and hatchability parameters were observed compared to the previous generation.

The growth performance of Kadaknath breed during G-2 generation is presented in Table 9. There was an improvement in body weights over the previous generation. Livability during juvenile stage (0-8 weeks) was 95.75% and during grower stage (8-18 weeks) it was 95.67%.

Table 9. Growth performance of Kadaknath (G-2 gen.)

Traits	Mean±S.E
Body weight (g)	
0 day	30.29±0.14 (478)
9 wks	422.3±4.26 (667)
10 wks	526.8±4.29 (877)
12 wks	695.8±5.14 (874)
16 wks	1038±7.51(867)
16 wks : Male	1237±9.84 (331)
16 wks : Female	915.5±6.06 (536)
Shank Length (mm)	
10 wks	77.24±0.46 (247)
12 wks	86.40±0.59 (244)

About 500 pullets were housed for performance evaluation. Body weight at 20 weeks of age was 1,811±18.81 g in male and 1,213±12.22 g in female. There is an improvement in body weight at 20 weeks in female compared to the previous generation (1,111 g). The ASM was 173.2±0.66 days and there is reduction in comparison to previous generation (176.2 days). Egg production up to 32 weeks was 38.25±1.20 eggs with average egg weight of 44.68±0.27 g.

Aseel

The Aseel population was regenerated in G-8 generation randomly. A total of 1155 chicks were produced in three hatches. The fertility was 80.29% and hatchability was 81.62% (FES) and 65.55% (TES). The fertility and hatchability on FES were maintained but there was a reduction in hatchability on total eggs set. Aseel birds were evaluated up to 40 weeks of age for growth and production traits in G-8 generation. The adult Aseel hen and cock body weight at 40 weeks was 1906 and 3191 g, respectively. The egg production up to 40 weeks of age was 19.53 eggs which reduced from the previous generation. The egg weight at 40 weeks of age was 44.96 g.

Economic evaluation of Aseel crosses for meat purpose

A total of 10 farmers from Telangana were provided with Aseel crosses developed for meat purpose as an alternative to native chicken farming. Each farmer was provided with 100 chicks and advised to rear under full feeding with commercial broiler feed. The body weight at 12 weeks of age was 1716±64.10 g in farm and 1661±18.58 g in farmer's field under intensive system of management.

The economics of rearing the crossbred chicken variety are presented in Table 10. The input expenditure involved was cost of feed, cost of chicks and other rearing expenses. The output was the income from the sale of chicken meat and live birds. The income levels varied among individual farmers. The expenditure per 100 birds ranged from Rs. 15,000 to 19,500 among the farmers with an average of Rs. 17,200. On an average, a total of 21 cocks were sold by each farmer at the rate Rs. 358 per bird earning Rs. 7,518. The average bulk sale by each farmer was 145 kg live weight @ Rs. 169/kg with an average income of Rs. 24,505. The average total income earned by each farmer including cocks and bulk sales was Rs. 32,023 by rearing 100 Aseel crossbred birds for 3 to 4 months. The net profit was Rs. 14,823 per farmer. However, the profit varied among the farmers from Rs. 13,140 to 18,025 based on their inputs, market price and management. In the present study, productivity ratio (cost benefit ratio) was 1.86, it means that with the investment of Rs.1.00 the farmer got Rs.1.86 as returns. The return on investment (ROI) was calculated to be 86.2%.

A small-scale unit of 200 birds was a viable unit with an additional income of Rs. 64,000 and profit margin of Rs. 30,000 per cycle. A farmer can rear at least 3 to 4 cycles per annum with a net profit of Rs. 90,000 to 1,20,000 per annum. This income was in addition to his / her regular income from other agricultural and livestock sources. However, the prices may vary based on the market demand and price fluctuations.

Table 10. Economics of Aseel x PD-1 cross under farmers field conditions

No. of Farmers			5
Average No of birds/Framer			100
Rearing period			4 months
Average variable cost		**Average output**	
Quantity of Feed purchased (Kg)	400	Cocks sold (Nos.)	21
Feed cost (Rs.)	12000	Price/bird	358
Cost of Household grains (Rs.)	3200	Income Rs.	7518
Chick Cost @Rs.20	2000	Bulk sales (Kg)	145
Gross variable cost (Rs)	17200	Price/Kg (Rs)	169
		Income (Rs)	24505
		Gross income (Rs)	32023
Net Income			
Net profit per farmer (Rs)			14823
Return over variable cost (ROVC)			14823
Return on investment (ROI)			86.2 %
Cost of production per bird (CP), (Rs)			172
Net income per bird (Rs.)			148
Net income per month (Rs.)			3708
Cost Benefit ratio (CBR)			1 : 1.86

Coloured broiler populations for intensive and semi intensive broiler farming

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

L. Leslie Leo Prince, K.S. Rajaravindra, T.K. Bhattacharya, U. Rajkumar, B.L.N. Reddy, M. Niranjan

Performance of Juvenile traits in S-1 generation

During the period under report, the S-1 generation of PB-1 was evaluated for juvenile growth traits. Average body weights at day old, 4, 5, 6 weeks of age were 42.01±0.10 (1733), 649±3.69 (1066), 1081±4.25 (1623) and 1382±5.54 (1628) g, respectively. The shank length and breast angle at 5 weeks of age was 83.05±0.17 mm and 77.81±0.18^0 respectively.

Regeneration and performance evaluation of PB-1

A special setting to regenerate the PB-1 lines was done and a total of 504 fertile eggs, produced by random mating, were set. A total of 302 good chicks were obtained. About 75 adult female birds of PB-1 were housed and egg production was evaluated. The average body weight of male and female PB-1 line birds at 20 weeks was 3,691±41.5 (83) and 2,631±26.6 (75) g, respectively. The ASM was 164.04±1.64 (74) days. Egg weights at 28 and 32 weeks of age were 51.14±0.48 (59) and 55.08±0.49 (59) g, respectively. Egg production up to 32 weeks of age was 37.91±1.71 (68) eggs.

Regeneration and strengthening of the PB-1 flock

Available adult females were mated with pooled semen and regeneration was started. To add variability and to strengthen the flock size, hatching eggs were procured from Ludhiana centre of AICRP on Poultry Breeding and set for hatching. A total of 1500 fertile eggs were received and 1439 were set.

Pedigreed random bred broiler control line

Performance of Juvenile traits (G-19)

During the period under report, the G-19 generation of control broiler line was evaluated for juvenile growth traits. Average body weights at day old, 4, 5, 6 weeks of age were 40.12±0.11 (1204), 561.1±4.33 (551), 787.7±4.12 (1115) and 1056±5.29 (1112) g, respectively. The shank length and breast angle at 5 weeks of age was 76.12±0.18 mm and 74.46±0.14 ° respectively.

Regeneration and performance evaluation of Control broiler line

L. Leslie Leo Prince, K.S. Rajaravindra, T.K. Bhattacharya, U. Rajkumar, B.L.N. Reddy, M. Niranjan

A special setting to regenerate the Control broiler line was done and a total of 595 fertile eggs, produced by random mating, were set. A total of 336 good chicks were obtained. About 102 adult females were housed and egg production was evaluated. The average body weight of male and female birds at 20 weeks was 4,070±32.9 (154) and 2,535±22.1 (102) g, respectively. The ASM was 173.61±1.33 (101) days. Egg weights at 28 and 32 weeks of age were 47.44±0.34 (89) and 50.65±0.31 (97) g, respectively. Egg production up to 32 weeks of age was 37.34±1.25 (100) eggs.

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

B.L.N. Reddy, U. Rajkumar, L.L.L. Prince

S-1 generation of PB-2 was regenerated with 50 sires and 250 dams. Effective number was 166.66 and the rate of inbreeding was 0.003. Average selection differential for 5-week body weight was 158g and intensity of selection was 1.30. A total of 3011 eggs were set and 1758 good chicks were hatched. Fertility, hatchability on total eggs set and on fertile eggs, respectively were 75.70, 60.41 and 86.82%. Juvenile body weights at 4, 5 and 6 weeks and shank length at 5 weeks, respectively were 718±0.92, 1088±2.35 and 1391±2.47g, and 83.87±0.12 mm. Production traits up to 32 weeks were recorded.

ASM, body weight at 20 weeks, egg weights at 28 and 32 weeks and egg production up to 32 weeks of age, respectively were 159days, 2360, 51.22 and 55.44 g, and 43.46 eggs. As compared to last generation, production traits are more or less similar.

Maintenance of naked neck (Na) and Dwarf (Dw) gene lines

B.L.N. Reddy, U. Rajkumar, L.L.L. Prince

S-18 generation of naked neck and dwarf gene lines were regenerated with 30 sires and 90 dams in 3 hatches. Fertility, hatchability on total eggs set and on fertile eggs, respectively in Naked neck were 92.73, 79.15 and 85.35%. The corresponding values respectively in dwarf were 76.79, 70.56 and 91.88%. Number of good chicks in naked neck were 717 and in dwarf were 715. Juvenile traits like body weight at 4 and 6 weeks and shank length at 6 weeks, respectively in naked neck were 570±1.28, 1042±2.13g, and 88.64±0.62 mm. The corresponding values, respectively in dwarf were 465±1.39, 799±2.60g and 79.38±0.71 mm. Production traits up to 32 weeks were recorded in naked neck and dwarf gene lines. ASM, 20 weeks body weights, 28-week egg weight, 32-week egg weight and 32-week egg production, respectively in naked neck were 157 days, 2271, 49.11 and 51.23g, and 41.40eggs. The corresponding values in dwarf were 158days, 2096, 48.25 and 50.54g, and 45.57eggs. As compared to last generation these values were more or less similar.

Improvement and maintenance of elite layer germplasm

K.S. Raja Ravindra, R.N. Chatterjee, T.K. Bhattacharya, M. Niranjan, U. Rajkumar, S. Haunshi, L.L.L. Prince

Under the layer project, three elite lines viz., IWH, IWI and IWK are under selection for higher egg numbers up to 64 weeks of age, whereas IWD, IWF and Layer Control (LC) are under random breeding programme. During the reporting period, the production traits were evaluated from 40 to 72 weeks of age. Regeneration of the six lines of WLH (S-16 of IWK and LC, S-8 of IWH and IWI, G-3 of IWD and IWF) was completed. Evaluation of three different two-way crosses Kadaknath x IWH (KxH), IWF x IWH (F x H) and IWH x IWF (H x F) was completed. Hatching eggs of two new WLH lines i.e., IWN and IWP were procured from AICRP centre, Mannuthy and chicks were hatched and raised at the Directorate as resource population. A three-way cross, DKH [(PD-3) x (KxH)] is produced and is under evaluation. Four two-way crosses viz., CHx (PD-1 x IWH), VHx (PD-2 x IWH), K x H (Kadaknath x IWH) and DR x H (DR x IWH) are produced and are under evaluation. The growth and production traits of the pure lines and their crosses are presented in Table 11. The fertility and hatchability of each line and crosses are given in Table 12. The Table 13 shows the comparison of various economic traits between the two-way cross KxH with its parental lines, Kadaknath and IWH.

Table 11. Least square means and SE of body weights and egg production traits in layer lines

Line	BW40 (g)	EW40 (g)	EP40, Nos.	BW52 (g)	EW52 (g)	EP52 (Nos.)	EP64 (Nos.)	EW72 (g)	EP72 (Nos.)
IWH (S-7)	1427±9.5	52.41±0.18	119.7±1.13	1501±10.7	53.54±0.21	189.1±1.09	241.9±1.65	--	285.3±2.58
IWI (S-7)	1437±8.9	52.60±0.17	110.5±0.92	1488±11.2	54.96±0.20	173.2±1.34	227.6±2.01	56.16±0.33	261.2±2.04
IWK (S-15)	1509±13.9	55.76±0.25	94.6±1.50	1567±14.8	58.33±0.28	157.2±1.94	204.6±2.81	59.00±0.41	242.8±2.37
LC (S-15)	1585±11.5	55.48±0.17	90.5±1.22	1681±27.2	55.58±0.51	141.7±2.04	189.9±2.51	57.26±0.45	239.6±2.94
IWD (G-2)	1469±11.9	51.27±0.22	115.9±0.99	1549±14.0	53.49±0.20	182.1±1.42	233.4±2.54	55.08±0.30	266.9±3.24
IWF (G-2)	1451±12.6	51.29±0.24	111.2±0.93	1547±15.4	54.03±0.23	176.8±1.33	231.7±2.43	55.70±0.43	258.9±3.06
K x H	1524±22.6	49.89±0.26	93.5±1.33	1548±30.2	52.63±0.29	149.3±1.89	199.0±2.95	51.48±0.41	227.7±3.25
IWF x IWH	--	53.21±0.25	119.0±1.65	--	--	184.7±1.96	248.0±2.33	--	283.4±3.84
IWH x IWF	--	53.84±0.31	111.3±2.04	--	--	178.4±2.72	237.9±4.04	--	273.7±4.71

Table 12. Fertility and hatchability traits of elite layer lines and their crosses

Group	Line/ cross	Fertility (%)	Hatchability (%)		Good chicks (Nos.)
			TES	FES	
Pure lines	IWH	78.64	67.93	86.37	970
	IWI	73.57	66.49	90.37	629
	IWK	84.01	76.44	90.98	545
	LC	78.04	62.12	79.60	843
	IWD	79.04	78.41	89.21	494
	IWF	80.21	74.44	88.24	469
	IWN	49.02	5.04	10.29	36
	IWP	40.05	7.65	19.10	55
Two way crosses	KxH	79.45	77.21	90.18	225
	CHx	81.60	66.83	82.13	262
	VHx	80.89	70.47	87.12	284
	DRxH	81.54	79.52	85.28	215
Three way cross	DKH	88.01	82.30	93.51	865

KxH : Kadaknath x IWH, CHx : PD-1 x IWH, VHx : PD-2 x IWH, DRxH : DR x IWH, DKH : (PD-3) x(KxH)

Table 13. Performance comparison of KxH vis-à-vis Kadaknath and IWH

Trait	Kadaknath	IWH	KxH
16 wks BW (g)	960.9±5.41	1086±6.4	1069±17.7
20 wks BW (g)	1111±6.39	1151±6.5	1094±9.9
40 wks BW (g)	1485±9.58	1427±9.5	1524±22.6
ASM, days	176.2±0.74	139.4±0.54	158.7±0.69
EW28 (g)	40.61±0.14	47.75±0.14	45.83±0.20
EW40 (g)	45.78±0.16	52.41±0.18	49.89±0.26
EP40	76.3±0.84	119.7±1.13	93.5±1.33
EP52	113.5±2.05	189.1±1.09	149.3±1.9
EP64	149.2±1.67	241.9±1.65	199.0±2.9
EP72	177.0±2.97	285.3±2.58	227.7±3.2

Editing inhibin alpha gene by CRISPR/Cas for improving egg production in Nicobari indigenous chicken of India (SERB)

T.K. Bhattacharya

Inhibin alpha plays significant role to inhibit synthesis of FSH in the pituitary gland and consequently, affects follicular growth eventually required for initiating ovulation to release eggs leading to egg laying in chicken. Genome editing has been one of the major tools to minimize the activity of protein. In this study, inhibin alpha gene has been edited by CRISPR/Cas in Nicobari breed to analyse effect of editing on egg production. Two exons viz. exon1 and exon2 have been targeted for which sgRNA molecules have been designed, synthesized and cloned in zsGreen1 vector, and the recombinant clones were transfected to the sperm by the sperm mediated gene transfer technique to the host genome. The efficiency of production of transgenic birds were 21.7 and 7.6% for exon1 and exon2, respectively while efficiency of production of inhibin alpha edited birds was 13% for exon1 only. The exon1 sequence of inhibin alpha gene was edited by Cas9 enzyme creating substitution and addition of nucleotides in the sgRNA corresponding sequences in the inhibin alpha gene. Due to such changes, amino acid substitution and frameshift mutation have been happened by creating changes in amino acid sequence of the inhibin alpha protein.

The egg production up to 72 weeks of age was significantly higher by 103.9% in edited birds as compared to the control birds (261 vs 128 eggs). The number of pause days was lower in the edited birds as compared to that of control ones (100.5 *vs* 224 days) indicating higher persistency of egg production in edited birds compared to that of control ones (0.7 *vs* 0.4 eggs/day). Internal egg quality parameters were analysed of which Haugh unit and yolk colour index was 19.8 and 17.5% higher, respectively in the edited birds as compared to the control hens. The hematological parameters were assessed in both edited and control birds at 30 weeks of age. The RBC count and ESR significantly differed between two groups of birds. In case of RBC count, 11.5% more number of RBCs was found in the edited birds as compared to the control ones. In case of ESR, 22.2% lower magnitude was observed in the edited birds compared to the control birds. However, there were no significant differences in Hb%, PCV, MCV, MCH and MCHC between these two groups of birds. In case of differential count, 19.4 and 20% more lymphocytes and monocytes percentages, respectively were found in the edited birds. But, eosinophil and platelet counts were 20 and 31.2% lower in the edited birds compared to the control ones. Other counts such as total WBC, neutrophils and basophil percentages did not differ significantly between the edited and control birds.

In addition, blood urea, creatinine, uric acid, albumin, cholesterol, HDL, LDL and triglycerides in serum of the edited and control birds were analysed at 30 weeks of age. Blood urea, triglycerides and LDL contents were 15.1, 25.2 and 55.3% higher, respectively in the edited birds, while serum creatinine and serum albumin were 27.7 and 14.9% lower, respectively in the edited group as compared to the control group. Other parameters did not differ significantly (P<0.05) between the edited and control groups. Besides, four reproductive hormones (FSH, LH, progesterone and oestrogen) were also estimated in plasma of both the edited and control birds. The FSH level was 66.6% higher (P<0.05) in the edited birds as compared to the control birds. The LH level was 20.6% higher in the edited birds than the control ones. But, the progesterone level was 29.3% lower in the edited birds than that of control ones. The estrogen level was 98.1% higher in the edited birds than that of control ones. It is concluded that the editing of exon1 of inhibin alpha gene enhances egg production by 41% in genome edited Nicobari chicken. The editing of exon1 of inhibin alpha gene enhances egg production, and affects Haugh unit in Nicobari native chicken of India.

Inhibin alpha edited Nicobari chicken

Development of transgenic chicken as bioreactor for production of therapeutics (DBT)

T.K. Bhattacharya

Transgenic chickens were produced through sperm mediated gene transfer (SMGT) method and the efficiency of producing the transgenic bird through this method was 5.4%. In the transgenic birds, human interferon alpha 2b gene was introduced at the germ line stage for which ovalbumin promoter based transgenic cassette was developed, transferred and integrated in the chicken genome. Up to 45 weeks of age, transgenic hens laid 132 eggs. The average egg weight, albumen index, yolk index, Haugh unit, albumen%, yolk%, shell%, shell thickness and shape index in the transgenic birds at 42 weeks of age were 41.0g, 0.26, 0.45, 90.4, 62%, 29.3%, 8.7%, 0.32mm and 77.3, respectively. The protocol of purification of interferon alpha 2b protein from egg white through column chromatography was established for which eggs were collected and albumen separated from yolk. Egg albumen was diluted 1:4 in PBS buffer and stirred at room temperature for 10 min. The diluted egg albumen was centrifuged at 25,000g for 45min at 10°C. The supernatant was collected and adjusted to pH 7 and centrifuged again at 25,000g for 45 min at 10 °C. The supernatant was charged in Ni-NTA column and the column was washed and finally, protein was eluted with elution buffer. The purified interferon alpha 2b was quantified through Bradford assay. The linear regression equation established from value of OD595 and quantity of BSA protein through Bradford assay was Y=2460.9x-946.5. The accuracy of estimation of protein quantity was 95.7%. Average 30-40 mg interferon alpha 2b protein was isolated from each egg of transgenic birds. The purified interferon alpha 2b was detected through Western blotting, ELISA and MALDI-MS and the protein size was of 22 kDa.

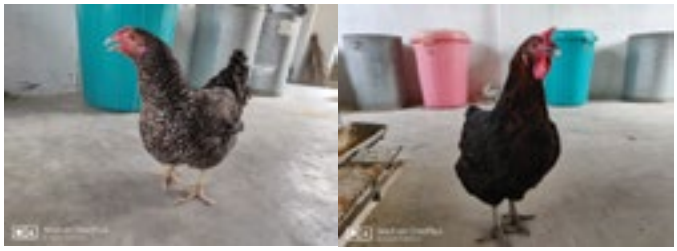
Transgenic IWH layer male and female birds. Hens laying eggs containing human interferon alpha 2b

National Fellow Project

Dual purpose colour chicken cross developed for backyard poultry by crossing Vanashree (PD-4) female with control broiler males improved through MAS (NF)

T.K. Bhattacharya

A dual-purpose cross of chicken was developed by crossing improved control broiler birds selected through marker assisted selection (MAS) for 4 generations with Vanashree (PD-4) birds. The feather colours of the birds were mostly black with brown and barred. The body weights of birds at 8, 10 and 12 weeks of age were 1002, 1389 and 1647 g, respectively. The age at first lay was 137.5 days. The hens laid 99.6, 154.6, 198.4 and 226.2 eggs up to 40, 52, 64 and 72 weeks of age, respectively under farm condition. The egg weight at 40 weeks of age was 53.5g. The shell colour of the egg was light brown. This cross may be used as potential dual purpose chicken cross suitable for backyard and intensive poultry farming.



A pair of birds of the dual purpose cross

Established PGC bank of Indigenous native chicken breeds for conservation of native chickens (CRP on Agro-biodiversity)

T.K. Bhattacharya, M. Shanmugam, S. Jayakumar

For conserving chicken breeds/lines/strains under *ex-situ* condition, one of the important approaches is cryo-preservation of primordial germ cells (PGCs) of chicken. In this regard, we have cryo-preserved PGCs of 4 native chicken breeds namely, Nicobari, Ghagus, Kadaknath and Aseel at the Institute.

Genome wide association study in Indigenous poultry breeds/varieties (ILRI)

Chicken PGCs of Nicobari native chicken breed

T.K. Bhattacharya, R.N. Chatterjee, S.P. Yadav, L.L.L. Prince

A total of 10 Indian native chicken breeds namely, Aseel, Ghagus, Kadaknath, Nicobari Hansli, Ankeleswar, Mewari, Punjab Brown, Tellicherry and Haringhata black and 2 improved chicken breeds namely, PB-1 and IWH were analysed for identification of SNPs present in the genome. The whole genomes of all these breeds were explored at 10-18x coverage under Illumina Novaseq platform. The total SNPs across the breeds varied from around 41 lakhs in Ankeleshwar to 70 lakhs in Aseel. Around 1/4th of the total SNPs were detected in the intron region of the genome, while around 1.3 to 1.5% of the total SNPs lies on exon region of which 70% of the SNPs were non-synonymous types changing amino acids due to SNP variabilities. In addition, upstream and downstream regions of the gene harbours around 20% of the total SNPs across the breeds. The overall proportion of average heterozygotes was 0.29, while average minor allele frequency was 0.18. We observed nucleotide diversity within the breeds, which depicts the informativeness of the population. The nucleotide diversity in terms of ϖ/bp and Tajima D were 0.41, 0.36, 0.44, 0.42, 0.43, 0.41, 0.45, 0.39, 0.41, 0.44, 0.42 and 0.46, and 0.87, 0.09, 1.19, 1.04, 1.04, 0.79, 1.36, 0.98, 1.01, 1.23, 1.15 and 0.87 in Aseel, Ghagus, Hansli, Kadaknath, Nicobari, IWH, PB-1, Mewari, Tellicherry, Punjab brown, Haringhata black and Ankeleshwar breeds, respectively.

By annotating the SNPs across the breeds, we detected 4 (Aseel), 4 (Ankeleshwar), 5 (Ghagus), 8 (Haringhata black), 11 (Hansli), 7 (Punjab brown), 1 (Tellicherry), 4 (Kadaknath), 3 (Mewari), 1 (Nicobari), 5 (PB-1) and 9 (IWH) breed specific SNPs and the breed signature was developed. Further, 1,22,579 SNPs, which were present on at least 100 bp apart across all the chromosomes of all the breeds have been included in the SNP array. These arrays are being used to develop a medium density native chicken specific SNP array for further selection and diversity analysis of chicken breeds.

Development of bio-fortified chicken variety enriched with minerals in eggs

T.K. Bhattacharya, R.N. Chatterjee, M.R. Reddy, M. Niranjan, U. Rajkumar, Santosh Haunshi, L.Leslie Leo Prince, B. Prakash , M. Shanmugam, Vijay Kumar, S.K. Bhanja

Egg is the rich source of trace elements including iron and copper. Enrichment of the trace elements in eggs may be one of the most important options for minimizing hidden hunger or micro-nutrient malnutrition of human being globally. In this study, we target to enrich egg with Fe and Cu for minimizing anaemia in human. A total of 21 pure line chicken was included in the study. The Fe and Cu contents in eggs were estimated by iCAP7200 ICP OES in all the lines. The average Fe and Cu contents in eggs were 1.70mg/100g egg and 0.05mg/100g egg, respectively. Top 9 lines for egg Fe and Cu contents were selected and crossed in different combinations. A total of 12 crosses were developed where the body weights at 15 weeks of age were 1041, 1157, 1181, 1138, 1788, 1865, 2067, 1845, 2151, 1173, 1927 and 1476 g in IWDxIWF, IWIxIWF, CLxIWF, IWHxIWF, IWFxGML, Nicobari x GML, Ghagus x GML, IWKxGML, PD4xGML, Nicobari x IWF, GMLxIWF and PD4xIWF, respectively. The egg Fe and Cu contents will be measured in all these crosses to select top performing crosses.

GhagusxGML ***IWKxGML*** ***PD4xGML***

Genome wide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs during the asymmetric ovarian development of chicken

S. Jayakumar, U. Rajkumar, M. Shanmugam, T. K. Bhattacharya, S.P. Yadav

The present research was undertaken to study the differential expression of DMRT1 and FOXL2 genes and to identify the genetic polymorphism in the male and female gonads of 19th day incubated fertile Kadaknath chicken. RT-PCR analysis showed that the relative expression of DMRT1 in the right testis was 3.83 and 3.78 folds higher than left and right ovaries respectively and the relative expression of FOXL2 in the left ovaries was 12.65 and 2.14 folds higher than the right testes and right ovaries, respectively. To identify the genetic

polymorphism of FOXL2 and DMRT1 genes, both the ovaries and right testes were sequenced and analyzed. Two SNPs were detected i.e., one SNP was found in one of the samples of left ovaries (c.289C>G) at 289th position of ORF of FOXL2 (Fig 5) and it was a nonsynonymous substitution (Histidine to Aspartic acid) and the second SNP was noticed in all the samples of right testes, a G→A transition located outside the coding sequence (CDS) at 51st position of exon 6 of DMRT1 (Fig 6). The study suggests that DMRT1 has higher expression in males compared to females and FOXL2 expression was higher in females than males. Both DMRT1 and FOXL2 genes were found to be polymorphic.

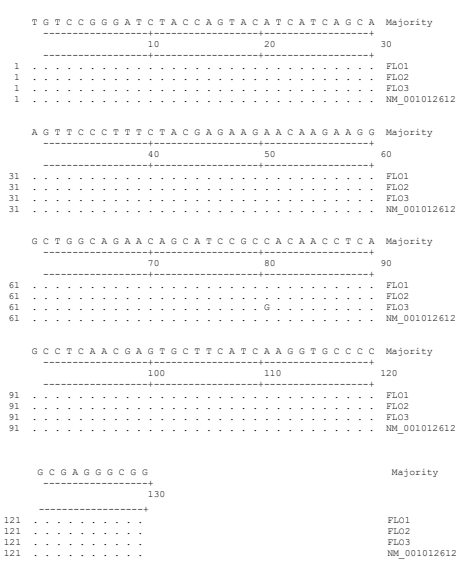


Fig 5. Nucleotide sequence alignment of FOXL2 gene in left ovary

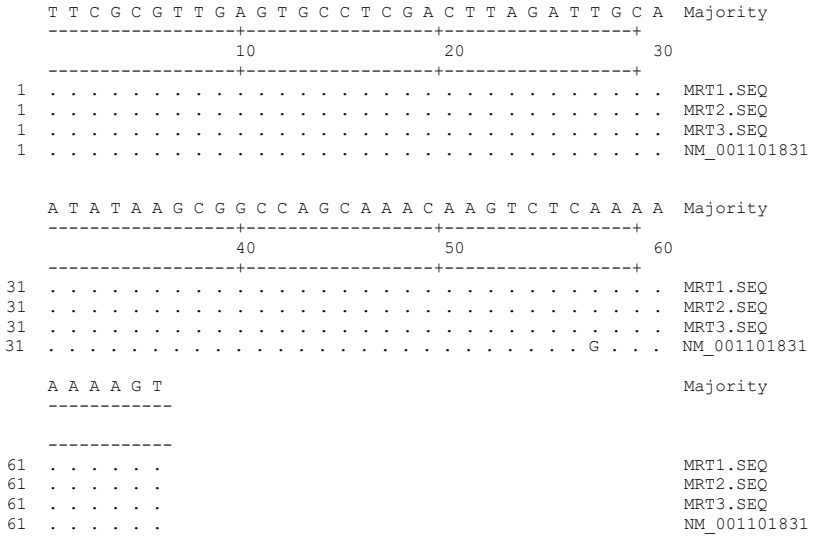


Fig 6. Nucleotide sequence alignment of DMRT1 gene in right testis

Generation of whole genome assembly of native Kadaknath chicken and its annotation Transcriptome analysis and variant identification

S.P. Yadav, S.S. Paul, R.N. Chatterjee, T.K. Bhattacharya, S. Jayakumar

Fastp (v0.20.0) was used for quality filtering and adapter trimming of the raw data. The high-quality reads were utilized for downstream analysis. Hisat2, a splice aware aligner was used to align the reads against the Gallus gallus (GRCg7) genome from ENSEMBL database. The transcriptome was assembled and quantified from the aligned reads for each sample using Stringtie. Functional annotation of the assembled transcripts with gene ontology terms was done with ENSEMBL biomart function. When aligned with Gallus gallus (GRCg7) genome a total of 64584 transcripts were arranged in Kadaknath chicken transcriptome assembly (12 tissues). The highest number (8511) of transcripts belongs to chromosome No. 1. Different number of transcripts were present for all the 39 chromosome and also the sex chromosome (W and Z). A total of 780 transcripts were remain unlined.

The filtered reads were aligned against the Gallus gallus (GRCg7) genome using hisat2 aligner. Samtools fixmate was used to correct any flaw in read-pairing and samtools markdup was used to remove potential PCR duplicates and reads aligning to identical coordinates in the genome. Variants (SNPs) were detected from the data using VarScan (v2.3.9). SnpEff was used to determine their functional effect and annotation. In order to increase the confidence of the variant calls, minimum read depth and minimum supporting reads at each position was set to 10 for a variant call and minimum base quality for the base was set at 20. Highest number of SNP and Indels were observed in Ovarian tissue 325254 and 24051, respectively.

Understanding the epigenetic methylation and miRNA mediated gene regulation of transcellular calcium transport genes in avian uterus during egg calcification (SERB)

M. Shanmugam, R.N. Chatterjee

Tissue samples from uterus of IWI and IWK lines at 64 weeks of age were collected and processed for extraction of RNA. The cDNA library was prepared, ligated with 3' and 5' ligators and sent for deep small RNA sequencing on Hiseq 2000 Illumina platform. The raw sequenced data was processed and the cleaned data after removing adaptors were aligned to Gallus gallus reference genome for differential expression of miRNA. Total number of miRNAs identified in IU-218, KU-180. Common miRNAs in the two lines were 162. Total number of novel miRNAs identified IU-14, KU-28. Total number of miRNAs that were involved in calcium metabolism identified in both the lines were 177. These 177 miRNAs were related to a total of 688 genes that were in turn involved in calcium homeostasis

as well partly influenced by the calcium. Of these 177 miRNAs, a total of 9 highly differentially expressed genes related to calcium homeostasis were identified for further validation by in vitro cell culture method.

Nutrition

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

S.V. Rama Rao and S.S. Paul

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, testing and identification of potential alternatives for anti-biotic growth promoters (AGP) were focussed during the year. Five experiments were conducted utilizing certain herbal extracts (Marigold polyphenols, marigold lutein and oregano extract – experiment 1), coated butyric acid at two different concentrations (experiments 2 and 3), feed emulsifier (experiment 4) and microbial enzymes (experiment 5). In all the experiments, a positive control with BMD (PC) and a negative control (NC) without BMD or test product 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 10-12 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.

Experiment 1 : *Effect of supplementing marigold phenols, oregano extract and marigold lutein on broiler chicken fed diets without antibiotic growth promoters*

Marigold phenols (MP), marigold lutein (ML) and oregano extract (OE) were included in broiler diet at the rate of 250 g/ton feed. The results indicated that the body weight gain (BWG) and feed intake (FI) at both 21 and 39 d of age were not affected by the treatments employed (Table 14). However, the feed efficiency (FE – FI/BWG) was significantly reduced at day 21 in NC diet fed broilers. The FE in broilers fed ML or MP was similar to those fed the AGP included PC diet. At the end of experiment (39 d of age), the FE in broilers fed ML was significantly higher than those fed the PC (Fig 7), while the FE in OE was similar to those fed the PC and higher than the NC.

Table 14. Performance of broilers fed various herbal extracts as alternatives to AGP

Herbal	0-21 d	0-39 d				
extract	BWG (g)	FI (g)	FI/BWG	BWG (g)	FI (g)	FI/BWG
PC	810.1	1035	1.279B	2206	3370	1.529AB
NC	802.1	1034	1.290A	2199	3373	1.534A
MP	824.0	1052	1.276B	2200	3344	1.520ABC
ML	827.6	1053	1.273B	2212	3335	1.507C
OE	817.1	1050	1.286A	2205	3338	1.514BC
P	0.477	0.765	0.000	0.998	0.938	0.006
N	12	12	12	12	12	12
SEM	4.890	6.002	0.001	12.38	17.69	0.003

BWG body weight gain; FI fed intake; PC positive control (with BMD), NC negative control (without BMD), P probability; N number of replications; SEM standard error mean,

[ABC] means having common superscript in a column did not differ (P<005).

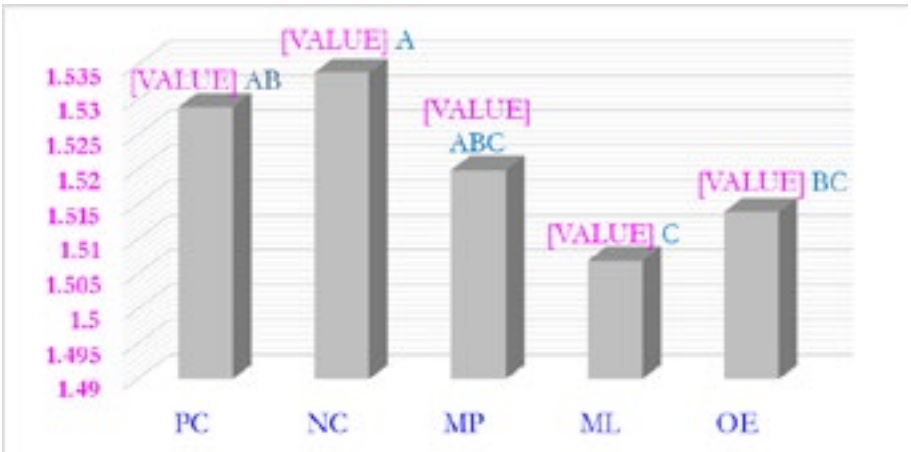


Fig 7. EF in broilers fed different herbal extracts vis a vis AGP

Table 15. Effect of supplementing coated sodium butyrate on performance and slaughter variables in broilers chicks reared on controlled challenging conditions

Treat	1-21 d	1-42 d				
	BWG, g	FI, g	FI/BWG	BWG, g	FI, g	FI/BWG
BMD	887.8	1201	1.354B	2339	3835	1.639B
NC	880.8	1207	1.370A	2302	3821	1.660A
CSB	884.3	1188	1.344B	2343	3824	1.633B
P	0.927	0.669	0.001	0.265	0.941	0.001
N	10	10	10	10	10	10
SEM	7.029	8.668	0.003	11.07	15.86	0.003

BWG body weight gain; FI fed intake; PC positive control (with BMD), NC negative control (without BMD), CSB sodium butyrate (500g/T feed); P probability; N number of replications; SEM standard error mean,

^{ABC} means having common superscript in a column did not differ (P<005).

Experiment 2 : Effect of supplementing coated sodium butyrate on performance and gut microbiota in broilers fed AGP- free diet

Coated sodium butyrate (CSB) was tested at 500 g / Ton feed. The data suggested that BWG and FI were not affected by inclusion of either AGP or CSB in broiler diet (Table 15). However, the FE at both 21 and 42 d of age reduced significantly (P<0.05) in groups fed the AGP-free NC diet. Supplementation of CSB to the NC significantly improved the FE over the NC group and was similar to those fed the PC diet.

Experiment 3 : Effect of supplementing graded concentration of coated sodium butyrate on performance and slaughter variables in broiler chicken

In the subsequent experiment, an attempt was made to find out the beneficial effects of including lower levels of CSB (250 g/Ton diet) compared to the level tested in the previous experiment (500 g/Ton diet). The results of starter phase indicated that except the FE, the performance variables were not affected (P>0.05) during starter phase (Table 17). The FE at day 21 showed a trend of reduction in broilers fed AGP-free diet compared to the PC group. The FE in broilers fed CSB was significantly (P<0.05) better at both the concentrations compared to those fed the NC. The FE in broilers fed CSB at 500 mg/kg was significantly better than those fed the AGP fed broilers.

At the end of experiment, both BWG and FI were not affected (P>0.05) by supplementation of diets with either AGP or CSB at both the concentrations (Table 16). However, the FE reduced (P<0.05) in broilers fed AGP-free NC diet compared to the CD. Supplementation of CSB at both the concentrations significantly improved the FE better than both groups fed diets with AGP or without the growth promoter.

Carcass variables, except the abdominal fat were not affected (P>0.05) (Table 17). Deposition of fat in abdominal area reduced (P<0.05) in NC compared to those fed the PC diet. However, inclusion of CSB at 500 mg/kg diet improved the fat deposition which was intermediate between the PC and NC groups.

Table 16. Performance of broiler chicken fed sodium butyrate as an alternative to AGP (BMD)

Treat	1-21 d	1-42 d				
	BWG (g)	FI (g)	FI/BWG	BWG (g)	FI (g)	FI/BWG
PC	897.1	1147	1.279AB	2459	3895	1.584B
NC	896.8	1149	1.282A	2448	3930	1.606A
CSB 250	909.5	1157	1.272BC	2492	3900	1.565C
CSB 500	909.8	1156	1.270C	2497	3900	1.562C
P	0.573	0.923	0.014	0.287	0.878	0.000
N	10	10	10	10	10	10
SEM	4.379	5.678	0.002	10.80	16.60	0.003

BWG body weight gain; FI fed intake; PC positive control (with BMD), NC negative control (without BMD), CSB sodium butyrate (250g and 500g/T feed); P probability; N number of replications; SEM standard error mean,

^{ABC} means having common superscript in a column did not differ (P<005).

Table 17. Carcass variables (g/kg live weight) of broiler chicken fed coated sodium butyrate as an alternative to AGP (BMD)

Treat	RTC	Breast	Abdfat	Liver
PC	761.8	264.8	11.83A	18.60
NC	767.9	271.8	9.297B	18.36
CSB 250	766.6	266.1	9.516B	17.36
CSB 500	762.2	267.2	10.38AB	18.45
P	0.836	0.761	0.028	0.492
N	10	10	10	10
SEM	2.821	2.384	0.339	0.310

RTC ready to cook yield, Abdfat abdominal fat; PC positive control (with BMD), NC negative control (without BMD), CSB sodium butyrate (250g and 500g/T feed); P probability; N number of replications; SEM standard error mean

^{AB} means having common superscript in a column did not differ (P<005).

Based on the results, it is concluded that inclusion of sodium butyrate event at the lower concentrations tested (250 mg/kg) was adequate to replace AGP in broiler diet with an advantage of higher feed efficiency compared to the AGP fed birds.

Experiment 4 : Effect of supplementing different concentrations of feed emulsifier on performance, gut microbiota and nutrient digestibility in broiler chicken fed AGP free diet

Feed emulsifier is known to improve the feed utilization by improving the nutrient digestibility in chicken intestine and therefore lower concentrations of undigested nutrients are available for microbial utilization in posterior portion of intestine. Therefore, inclusion of feed emulsifier may reduce the pathogen load in chicken gut and can be considered as a probable alternative for AGP in broiler diet. An experiment was conducted by utilizing a feed emulsifier (combination of lecithins, glyceryl polyethylene glycol ricinoleate, glyceryl monostearate and polyoxyethylene sorbitan monooleate) in four different combinations of the emulsifier in pre-starter, starter and finisher diets. The results during 1-21 d of age indicated that the BWG and FI were not affected (P>0.05) (Table 18). Feeding the NC significantly (P<005) reduced the FE compared to those fed the AGP-free NC diet. The FE improved by including all the combinations of emulsifiers compared to the NC group and the efficiency was similar to the PC group. At the end of experiment (1-42d), the BWG in broilers received 250, 250 and 500 g or 250, 500 and 500 g emulsifier, respectively in pre starter, starter and finisher diets was significantly higher than the NC groups and similar to those fed the AGP supplemented PC group (Fig 8). Similarly, the FE in broilers fed all the combinations of emulsifier improved compared to the NC and similar to those fed the PC, except those fed diets with 500 g emulsifier whose FE was inferior to PC but higher than the NC group.

Table 18. Performance of broiler chicken fed graded concentrations of feed emulsifier in diets containing no added AGP

Treat	1-3wk				1-6wk	
	BWG (g)	FI (g)	FI/BWG	BWG (g)	FI (g)	FI/BWG
PC	831.1	1166	1.403B	2484AB	4103	1.652C
NC	783.1	1117	1.429A	2422B	4081	1.686A
EK(250/250/250)	831.2	1165	1.402B	2497AB	4117	1.649C
EK(250/250/500)	823.3	1158	1.408B	2518A	4140	1.645C
EK(250/500/500)	832.9	1165	1.399B	2523A	4138	1.640C
EK(500/500/500)	833.0	1164	1.397B	2480AB	4141	1.670B
P	0.270	0.546	0.037	0.078	0.879	0.000
N	10	10	10	10	10	10
SEM	7.073	8.578	0.003	10.75	16.39	0.003

BWG body weight gain; FI fed intake; PC positive control (with BMD), NC negative control (without BMD), EK emulsifier dose; P probability; N number of replications; SEM standard error mean,

^{ABC} means having common superscript in a column did not differ (P<005).

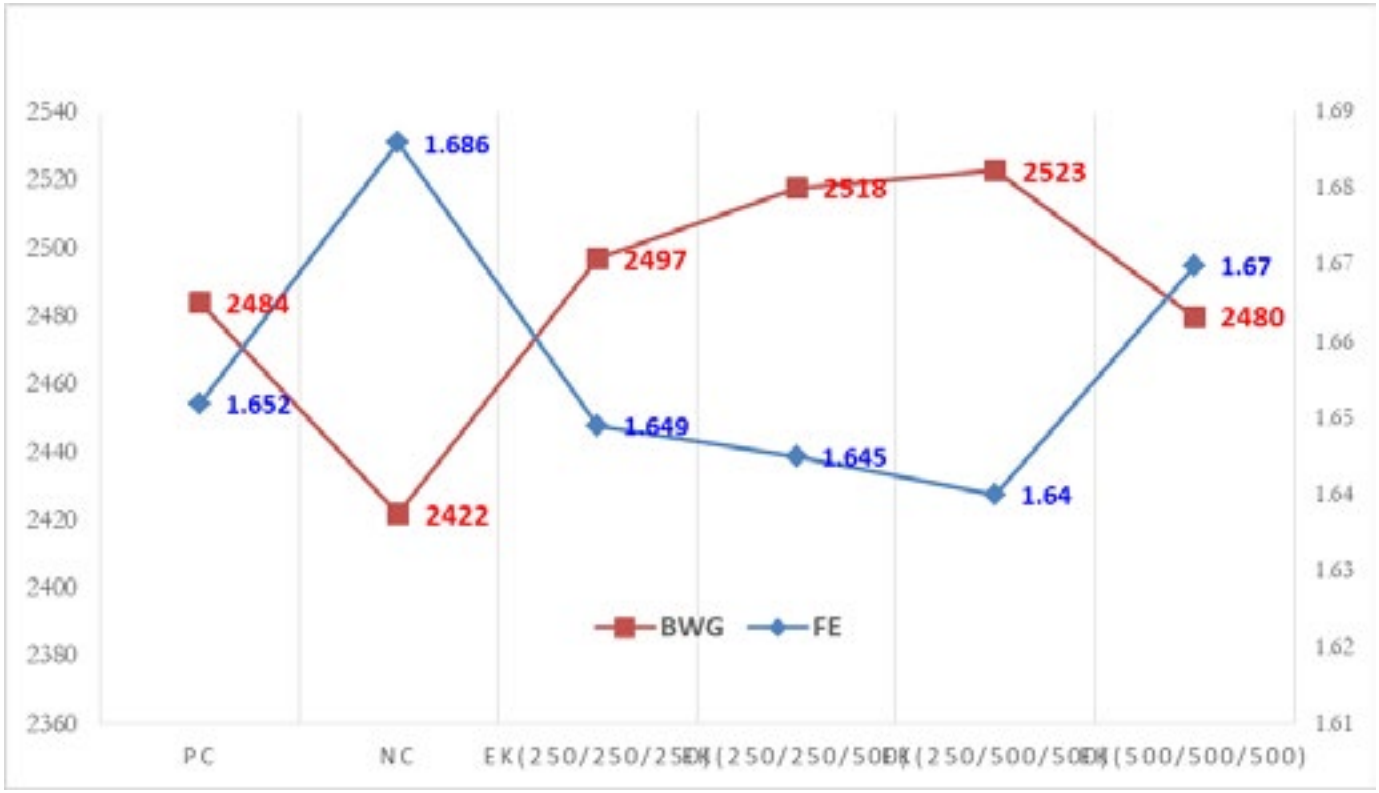


Fig 8. Feed emulsifier as alternate to AGP

Slaughter variables (RTC yield, relative weight of breast meat, abdominal fat, liver and gizzard) were not affected (P>0.05) (Table 19).

Table 19. Slaughter variables in broiler chicken fed graded concentrations of feed emulsifier in diets containing no added AGP

Treat	RTC	Breast	Abd.fat	Liver	Gizzard
PC	701.4	251.8	11.47	19.15	15.47
NC	714.1	269.0	10.44	19.28	14.65
EK(250/250/250)	723.6	255.1	13.17	18.80	14.94
EK(250/250/500)	729.9	246.7	12.95	21.15	15.93
EK(250/500/500)	718.2	261.4	14.38	19.55	15.18
EK(500/500/500)	723.2	252.6	12.12	20.77	15.35
P	0.332	0.114	0.177	0.122	0.833
N	10	10	10	10	10
SEM	3.755	2.451	0.458	0.296	0.272

RTC ready to cook yield, Abd.fat abdominal fat; PC positive control (with BMD), NC negative control (without BMD), EK emulsifier dose; P probability; N number of replications; SEM standard error mean

Experiment 5 : Possibility of replacing AGP with various microbial enzymes in broiler chicken diet

Similar to the emulsifier, the microbial enzymes are known to breakdown complex nutrient molecules in to simple nutrients which will be readily absorbed from the gut and less nutrients are available for gut pathogens and thereby dietary requirement of AGP can be avoided. The fifth experiment was conducted by individually supplementing protease, phytase, xylanase and their equal combination in diets without AGP. During 1-14d of age, the BWG and FE were reduced significantly by feeding NC compared to those fed the PC (Table 20). Feeding the diets containing xylanase or combination of enzymes improved the BWG similar to those fed the PC. The FE improved with the enzymes supplementation compared to those fed the NC diet. Among the enzymes, combination of enzymes improved the FE similar to the PC group. The FI during 1-14 d and BWG and FI during 1-35 d were not affected (P>0.05). During the entire experimental period, except protease all other enzymes or combination of enzymes significantly improved the FE compared to the NC group (Fig 9). The FE in broilers fed the combination was similar to those fed the PC.

Table 20. Performance of broilers fed different microbial enzymes in place of antibiotic growth promoter in diet

Treatment	1-14 d	1-35 d				
	BWG (g)	FI (g)	FI/BWG	BWG (g)	FI (g)	FI/BWG
PC	457.0A	542.8	1.188E	2073	3259	1.572E
NC	440.6C	538.6	1.223A	2019	3226	1.598A
Phytase	442.4C	534.7	1.209B	2028	3216	1.586BC
Protease	444.2BC	535.6	1.206BC	2020	3219	1.593AB
Xylanase	450.2ABC	539.3	1.198CD	2035	3217	1.581CD
Phy+Prot+Xylanas	455.2AB	542.8	1.193DE	2046	3225	1.576DE
P value	0.025	0.756	0.000	0.170	0.819	0.000
No	12	12	12	12	12	12
SEM	1.793	1.915	0.002	6.650	9.782	0.001

BWG body weight gain; FI fed intake; PC positive control (with BMD), NC negative control (without BMD), P probability; N number of replications; SEM standard error mean,

ABCDE means having common superscript in a column did not differ (P<005).

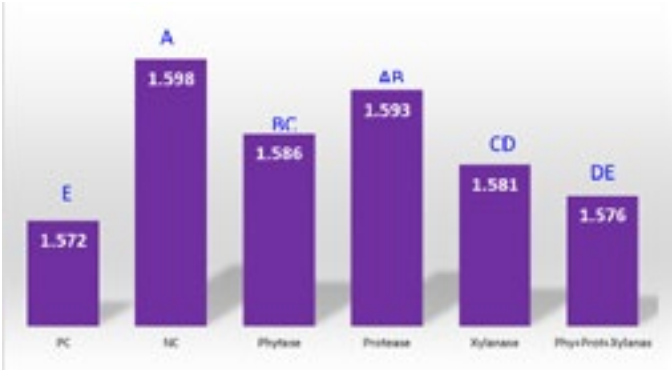


Fig 9. Feed efficiency in broilers fed enzymes vis a vis AGP

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

M.V.L.N. Raju, S.V. Rama Rao, S.S. Paul, B. Prakash, A. Kannan, M. Shanmugam, M.R. Reddy

Insect protein has been considered of late as an effective and sustainable source of animal protein in the diet of poultry. The larva of Black soldier fly (BSF) (Hermetia illucens) is being currently viewed as an important raw material in this regard for its versatility, sustainability and practical feasibility. Research efforts were initiated at the Directorate for exploring the feeding value of BSF larval meal in poultry diet.

Dried Black soldier fly larvae

BSF larva meal in the diet of broiler chickens

A pilot scale feeding trial was conducted to evaluate the response of commercial broiler chickens to dietary inclusion of BSF larva meal from a source (Gandhinagar, Gujarat) at 2.5 and 5.0% levels on iso-caloric and iso-nitrogenous basis. A total of 216 day-old commercial broiler chicks were divided into 3 groups with 12 replicates of 6 chicks each and housed in raised wire floor SS battery brooders in an open sided poultry house. The diets were fed ad libitum from 0 day of age till 6 weeks. Body weight, feed intake and FCR were recorded at weekly intervals. At 35 days of age, blood was collected from one bird per replicate (n=12/treatment group), serum was separated and analysed for the concentration of total protein, albumin and total cholesterol using reagent kits. The cell mediated immune (CMI) response was assessed using phytohemagglutinin lectin from Phaseolus vulgaris (PHAP). At the end of the trial, representative number (12/treatment) of birds were slaughtered by cervical dislocation and data on dressing yields and weights of visceral and lymphoid organs were collected.

Body weight of broilers was significantly higher in the groups fed BSF larva meal in comparison to the control group during the early life of 0-3 weeks of age (Table 21). However, no such difference was observed during the subsequent period of 4-6 weeks of age where the body weight was similar among the groups. Feed intake showed a trend of increase with dietary inclusion of BSF meal, whereas FCR was largely unaffected, except during 3rd week, where highest FCR was recorded with 5% BSF meal. Other parameters like slaughter yields, organ weights, serum biochemical profile and PHA-P response (cellular immunity) were not affected by BSF meal in diet (Table 22). The results of this pilot study thus indicated that BSF larva meal could be safely used upto 5% in the diet of broiler chicks with beneficial effects on growth during the initial few weeks of life.

BSF larva meal in the diet of Vanaraja chicks

Another feeding experiment was conducted to evaluate the sample of BSF larva meal (BSFLM) obtained from Karnataka in the diet of Vanaraja chicks at graded levels. A total of 420 day-old Vanaraja chicks were divided at random into 5 treatment groups with 14 replicates of 6 chicks each. Experimental diets containing BSFLM at 0, 3, 6, 9 and 12% were compounded on iso-caloric and iso-nitrogenous basis and fed ad libitum to the chicks from 0 to 6 weeks of age. The response of chicks was assessed in terms of performance (body weight, feed intake and FCR) at weekly intervals. Blood was collected at the end of 6 weeks of age from one bird from each replicate and evaluated for the profile of liver enzymes (SGOT and SGPT activities). The immune response of chicks to the test diets was also assessed for ND titres and PHA-P response during the 6th week. At the end, one bird from each replicate was slaughtered and data were collected in collaboration with ICAR-NRC on Meat, Hyderabad on dressing yields, organ weights, abdominal fat content, carcass cut-up parts and meat quality.

BSF larva meal

The results indicated that BSFLM inclusion in diet upto 12% showed no adverse effect on the performance of Vanaraja chicks (body weight gain, feed intake and FCR) during 0-6 weeks of age (Table 23). Instead, during the first 2 weeks of life of the chicks, beneficial effects on body weight gain were recorded in the groups fed BSFLM at graded levels. Humoral immune response (ND titres) was higher at the lower levels of BSFLM in comparison to control, while cellular immune response (PHA-P response) was not affected. Serum concentration of SGPT increased significantly at the higher levels of 9 and 12% BSFLM and that of SGOT decreased at the highest level of 12% BSFLM in diet. The slaughter data indicated that dressing yields, organ weights, intestine weight, carcass cutup parts, meat quality including sensory traits were not affected by BSFLM inclusion in diet (Tables 24 and 25). The overall results thus indicated that BSFLM could be safely included upto 12% in the diet of Vanaraja chicks during 0-6 weeks of age without any adverse effects.

Table 21. Performance of broiler chicken as affected by dietary inclusion of BSF larva meal

	Body wt. (g)		Feed intake (g)		FCR	
Insect meal (%)	Wk 3	Wk 6	0-3 wks	0-6 wks	0-3 wks	0-6 wks
0	621.0b	2027.6	764.9b	3187.4b	1.35b	1.63
2.5	663.2a	2051.3	849.0a	3293.7ab	1.38b	1.66
5.0	673.2a	2177.0	886.4a	3358.0a	1.42a	1.58
P-Value	0.016	0.110	0.0001	0.017	0.002	0.182
N	12	12	12	12	12	12
SEM	8.107	31.31	12.25	25.36	0.009	0.017

Means bearing common superscripts do not differ significantly (P<0.05)

Table 22. Slaughter variables (g/kg live wt.) and PHA-P response as affected by BSF meal in the diet of broiler chicken at 6 weeks

Insect meal, %	RTC	Breast	Liver	Giblets	Abd.fat	PHA-P
0	806.0	235.7	17.6	39.6	14.6	114.6
2.5	800.4	213.9	18.2	41.2	12.4	110.7
5.0	802.0	217.3	16.9	41.5	12.6	116.9
P- Value	0.36	0.10	0.74	0.44	0.23	0.66
N	12	12	12	12	12	12
SEM	1.603	4.518	0.682	0.659	0.593	2.779

Means bearing common superscripts do not differ significantly (P<0.05)

Table 23. Influence of dietary BSF larva meal (BSFLM) level on performance of Vanaraja chicks

BSFLM in diet (%)	Body wt. gain/b (g)				FCR	
	0-1wk	0-2 wks	0-3 wks	0-6 wks	0-3 wks	0-6 wks
0	58.86b	159.4b	302.0	811.1	1.87	2.29
3	61.32ab	167.0ab	307.5	805.0	1.93	2.36
6	62.23ab	167.1ab	312.9	819.8	1.90	2.32
9	64.50a	169.8a	310.5	826.9	1.89	2.32
12	64.02a	166.3ab	306.5	805.5	1.87	2.32
P – Value	0.010	0.067	0.593	0.599	0.795	0.545
N	14	14	14	14	14	14
SEM	0.570	1.186	2.185	5.041	0.016	0.013

Table 24. Influence of dietary BSF larva meal (BSFLM) level on slaughter variables (g/kg live wt.) of Vanaraja chicks

BSFLM in diet (%)	Carcass Wt.	Liver	Abd. Fat	Gizzard + Intestine	Spleen	Heart
	650.5	23.03	7.99	103.7	2.06	5.14
0	646.7	21.45	7.71	107.3	2.27	5.26
3	637.9	23.52	6.53	109.3	2.21	4.90
6	640.3	23.23	6.57	101.3	2.04	4.98
9	645.7	23.60	7.46	109.6	2.31	4.96
P – Value	0.471	0.625	0.716	0.901	0.881	0.793
N	14	14	14	14	14	14
SEM	2.385	0.480	0.405	3.106	0.098	0.101

Table 25. Influence of dietary BSF larva meal (BSFLM) level on meat characteristics of Vanaraja chicks

BSFLM in diet (%)	WHC (%)	Shear force (N)	pH	Sensory attributes*				
				Appearance / color	Flavor	Juiciness	Texture	Overall acceptability
0	22.14	6.37	6.31	7.06	7.06	7.06	6.89	6.97
3	23.57	6.18	6.35	7.08	7.14	7.22	7.11	7.14
6	22.71	6.16	6.30	6.97	7.03	7.11	7.00	7.08
9	22.14	6.24	6.29	7.06	6.89	6.75	6.72	6.75
12	23.57	6.27	6.31	7.00	6.89	7.00	6.89	6.97
P – Value	0.84	0.87	0.635	0.920	0.523	0.188	0.366	0.267
N	7	7	14	18	18	18	18	18
SEM	0.519	0.064	0.013	0.042	0.054	0.063	0.062	0.058

WHC : water holding capacity; *score from 0-10 (lowest to highest)

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

S.S. Paul, U. Rajkumar, L.L.L. Prince, S.V. Rama Rao, S. Jayakumar, M.V.L.N. Raju, S.P. Yadav, B. Prakash

The project was initiated during the end of the year with the objectives of identifying, annotating and classifying SNPs related to residual feed intake in colour broiler chicken; identifying candidate genes modulating RFI from differential expression of genes in colour broiler chickens with high and low residual feed intake; and analysing difference in gut microbiome and expression of gut immunity and porosity genes in high and low RFI coloured broiler chickens. Optimization of qRTPCR for feed efficiency, gut immunity and gut porosity related genes and liver GH, IGH, IFNG and CGHR genes was initiated during the period.

Effect of feeding low phytate maize with varying dietary concentrations of phosphorous on performance and bone breaking strength in Gramapriya birds

B. Prakash, S.V. Rama Rao, M.V.L.N. Raju

Phytic acid content was determined in normal maize and low-phytate maize and it was about 71% lower in low-phytate maize compared to that of normal maize. The amino acid profile of the normal maize and low-phytate maize revealed that the threonine, lysine, methionine and

tryptophan were higher in low-phytate maize compared to that of normal maize (Fig 10).

Further, an experiment was conducted to assess the feeding value of low-phytate maize with varying levels

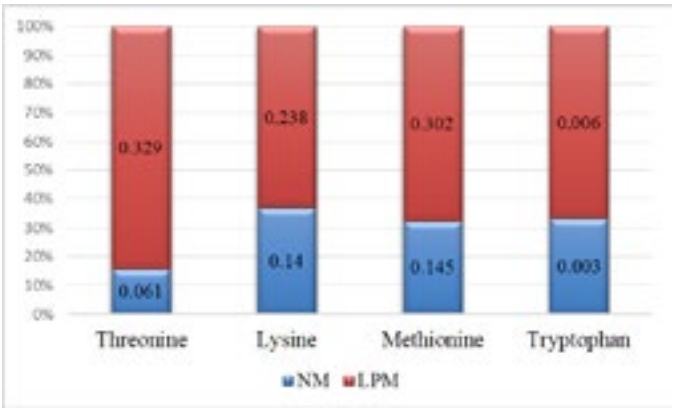


Fig 10. Normal maize (NM) Vs Low Phytate Maize (LPM)

of dietary P concertation on performance, slaughter variables and bone breaking strength in Gramapriya birds. For the purpose, Gramapriya birds (day-old age; n=432) were randomly distributed to 6 dietary treatments having 12 replicates with 6 birds in each replicate. Three diets with normal maize with varying concentrations of P (0.25, 0.33 and 0.40%) and three diets with low-phytate maize with varying concentrations of P (0.25, 0.33 and 0.40%) were computed and fed to the experimental birds up to 6 weeks of age. Body weight gain (BWG) during the first week did not vary significantly. However, feed conversion ratio (FCR) was better (P<0.03) in group fed normal maize + 0.40% P and low-phytate maize + 0.40% P compared to other groups (Table 26).

BWG during 3 and 6 weeks was higher (P<0.01) in groups fed low-phytate maize (with different P contents) compared to those groups fed normal maize. Similarly, the FCR during 3 weeks did not vary among different groups but during 6 weeks, the FCR improved (P<0.02) significantly among groups fed normal maize or low-phyate maize with 0.33% P compared to those groups fed normal maize + 0.40% P. Feeding low-phytate maize did not affect slaughter variables in the present study (Table 27). Bone breaking strength (compressive strength N/mm2) was higher (P<0.02) among the groups fed low-phyate maize + P 0.40% compared to other groups (Table 28). Therefore, it is concluded that feeding diet with low-phyate maize is advantageous over the diets with normal maize as improved body weight gain, feed conversion ratio and higher bone breaking strength were recorded in the present study in Gramapriya birds.

Table 26. Effect of feeding low-phytate maize with varying levels of P supplementation on performance of Gramapriya chicks

Maize	P (%)	0-1 wk		0-3 wks		0-6 wks	
		BWG	FCR	BWG	FCR	BWG	FCR
Maize	0.25%	37.25	1.704ab	193.0b	1.990	533.5b	2.388bc
	0.33%	38.89	1.583ab	209.8a	1.879	574.3a	2.302c
	0.40%	42.86	1.489b	215.5a	1.958	510.0b	2.677a
LPM	0.25%	41.09	1.783a	213.7a	2.021	579.4a	2.424b
	0.33%	41.55	1.735a	215.4a	1.994	594.3a	2.302c
	0.40%	42.03	1.628ab	225.8a	1.961	604.0a	2.331bc
SEM		0.792	0.031	2.543	0.017	6.01	0.021
P Value		0.316	0.061	0.006	0.213	0.00	0.00

LPM : Low-Phytate Maize

Table 27. Effect of feeding low-phytate maize with varying levels of P supplementation on carcass parameters (g/kg live wt.) in Gramapriya chicks

Treatment	P (%)	Breast	Liver	Fat	Gizzard	Spleen	Heart	Bursa	Giblet
Maize	0.25%	111.3	24.83	3.256	24.24	2.422	5.578	1.489	54.68
	0.33%	111.5	24.16	7.500	25.77	2.544	4.911	1.700	54.82
	0.40%	113.3	24.10	12.444	25.39	2.244	5.522	1.489	55.02
LPM	0.25%	115.1	24.20	8.156	23.58	2.433	5.200	1.433	52.97
	0.33%	112.8	23.80	8.256	24.56	1.856	4.544	1.956	52.90
	0.40%	108.1	25.78	6.400	24.33	2.356	5.122	1.767	55.23
SEM		1.540	0.289	0.731	0.395	0.087	0.132	0.109	0.509
P Value		0.864	0.406	0.010	0.652	0.268	0.211	0.733	0.632

Table 28. Effect of feeding low-phytate maize with varying levels of P supplementation on bone breaking strength (N) in Gramapriya chicks

Treatment	P (%)	Peak Load (N)	Compressive Strength (N/mm2)
Maize	0.25	96.7b	0.703b
	0.33	103.8ab	0.755ab
	0.40	88.3b	0.643b
LPM	0.25	93.9b	0.683b
	0.33	104.1ab	0.757ab
	0.40	114.9a	0.836a
SEM		2.389	0.017
P Value		0.022	0.021

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

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Plant mediated green synthesis of zinc nano particles

Twenty different plants were selected based on the presence of different phytochemicals with functional groups having potential to act as reducing and capping agents for green biosynthesis of zinc nano particles (NP). Out of these plants, only six plants, namely, leaves of moringa, neem, mango, red sandalwood, guava and aloe vera gel showed promising results. Initially, nanoparticles were biosynthesised in small quantities and slowly the protocols were modified to produce in bulk quantity. Neem leaf extract produced the maximum yield and these extracts were standardised for producing zinc nanoparticles in bulk quantity. In brief, for Zinc nano particle synthesis, 500ml of the neem plant extract was taken in 1 litre beaker and heated to 75 oC under constant stirring and fixed quantity of Zinc nitrate crystals were added, and heated for one hour. The residue (liquid) was collected and kept in hot air oven at 105 oC for overnight. The dried residue was incinerated in muffle furnace at 550 oC for an hour to obtain nanoparticles. The zinc NPs biosynthesised were white in color with low bulk density (Fig 11).

Characterization of biosynthesised zinc nano particles

The biosynthesised zinc NPs were characterised 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. The absorption peaks of green synthesized zinc oxide NPs were around 330-380 nm in UV-Vis spectroscopy analysis, and the average particle size was 10.84 nm (Fig 12) in a particle size analyser. The SEM and TEM analysis also showed that most of the particles were in the range of 10-100 nm (Fig 13). The FTIR spectrum (Fig 14) was developed in the wavelength range of 500 nm to 4000 nm to identify different functional groups and the spectrum indicated the presence of different functional groups of neem, i.e. phenolic –OH group, amino group, C=C- stretch, aldehydic -C-H stretching, organic phosphate group attached to oxygen, C-N vibrations etc. These functional groups worked as reducing and stabilising agents during biosynthesis of zinc nano particles.

Fig 11. Zinc nanoparticles

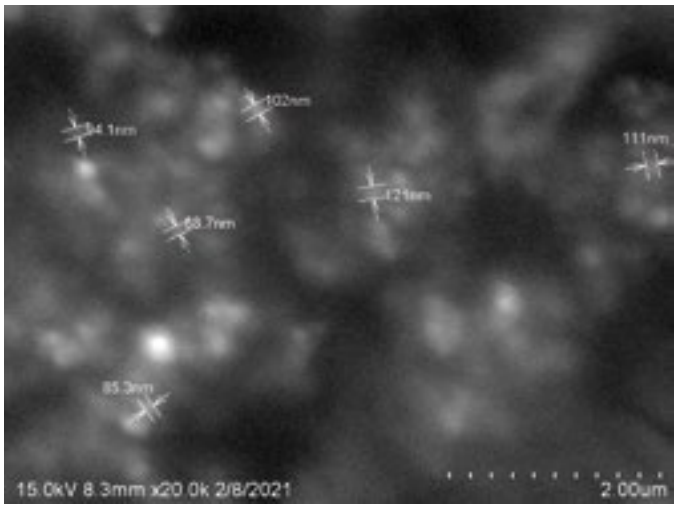


Fig 12. Zinc nanoparticles (Scanning electron microscopy)

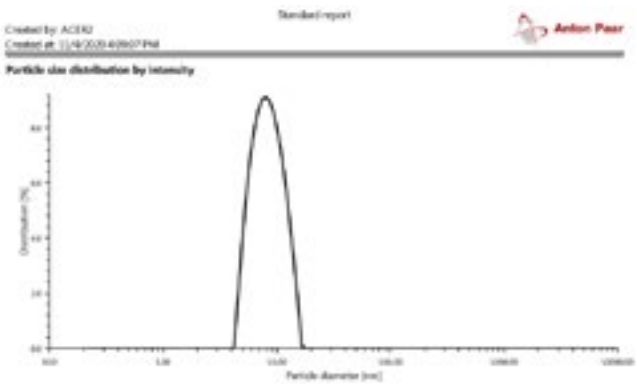


Fig 13. Particle size analysis of nano zinc

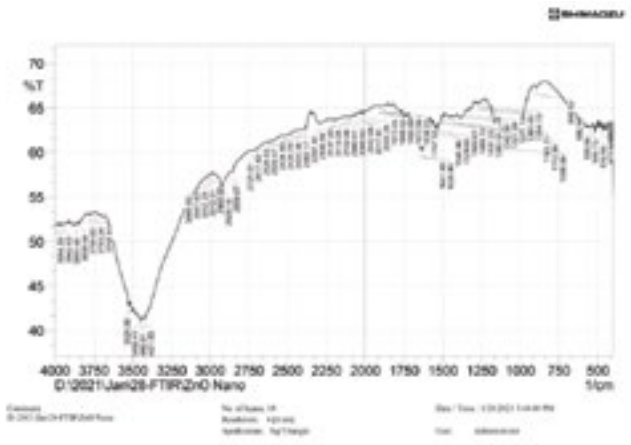


Fig 14. FTIR Spectra of nano zinc

Effect of feeding biosynthesised nano zinc on performance of Vanaraja chicken

An experiment was conducted to investigate the effect of feeding reduced dose levels of nano zinc relative to inorganic zinc in Vanaraja chicks. A total of 324 chicks were divided into six groups, each with 9 replicates and five birds per replicate. One group was control with no added zinc. In the 2nd group, zinc sulphate was added @ 60mg/kg diet. In the third to sixth group, nano zinc was fed at 25, 50, 75 and 100 percent of zinc requirement, respectively. The positive control group and all the four nano zinc fed groups had shown significantly (P<0.05) better performance in terms of growth and FCR. The serum biochemical parameters (glucose, protein, albumin, globulin, cholesterol, triglycerides), serum enzymes (SGOT, SGPT, ALP) and antioxidant parameters (LP, GPX, GRX, SOD) remained unaffected indicating that there was no harmful effect due to feeding of biosynthesised zinc NPs in chicken. The carcass traits and meat quality characteristics were also comparable among the groups. Feeding nano zinc also significantly (P<0.05) improved humoral immune response and bone zinc concentrations in Vanaraja chicken. The overall results indicated that by feeding nano zinc, the zinc dose can be reduced, which may lead to a reduction in environmental pollution.

Biosynthesis of copper nano particles

For green biosynthesis of copper nano particles, four plants were tried and the yield was maximum for neem leaf and the biosynthesis procedure using neem leaf was standardised for bulk biosynthesis. Initial identification of NPs formation was done by visual assessment of colour change. At the end point, the solution changes to dark green indicating the formation of copper NPs and this was confirmed by U-V Visible spectroscopy. The residue should be dried in a hot air oven overnight to obtain copper oxide NPs. Copper oxide NPs appear as brownish black powder (Fig 15). The particle size analysis of copper NPs biosynthesized using neem leaf extract showed that average particle size was 9.62 nm (Fig 16). Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) revealed that the diameter of most of the NPs of copper oxide was in the range of 50-100 nm (Fig 17). Involvement of phytochemicals of neem in copper NPs formation was evident from the presence of organic functional groups detected in FTIR spectrum.

Effect of feeding biosynthesised nano copper on performance of Vanaraja chicken

Fig 15. Copper oxide nano particles

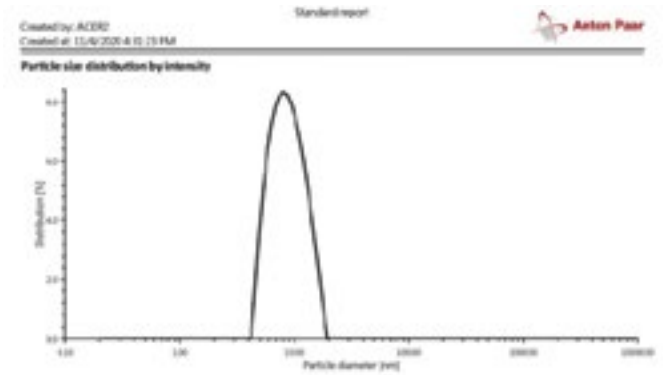


Fig 16. Particle size analysis of copper oxide nano particles

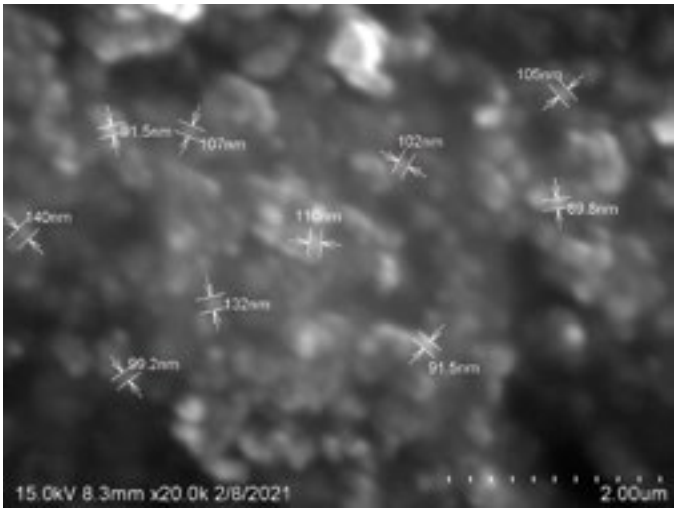


Fig 17. Copper oxide nanoparticles (Scanning electron microscopy)

A feeding trial was conducted to evaluate the effect of biosynthesised copper NPs on performance of Vanaraja chicken. A total of 324 chicks were randomly assigned to six treatments with nine replicates with six birds per replicate. The control group was fed a maize –soybean basal diet with no added copper. In the 2nd group, copper sulphate was added at 12mg/kg. In the third to sixth groups, copper NPs were fed at 25, 50, 75 and 100 per cent of the copper requirement, i.e. 3, 6, 9 and

12mg copper NP/kg diet, respectively. The feed intake, growth and FCR were comparable among the groups. The antioxidant parameters, the serum biochemicals, and serum enzymes also remained unaffected among the groups indicating that the copper oxide NPs were not harmful at the dose level studied in the chicken. The carcass traits and meat quality were also comparable among the groups. However, feeding nano copper had significantly (P<0.05) increased the antibody titres against Newcastle disease. The overall results indicated that nano copper may improve immunity without affecting performance in chicken. More studies are needed especially in commercial broilers and layers to evaluate the effect of nano copper in chicken.

Physiology

Comparative studies on different factors influencing egg production in chickens

Anand Laxmi, R.K. Mahapatra, M. Shanmugam

Ghagus and Nicobari chicken were selected at 22 weeks of age for conducting a study during early laying period (24-28 weeks, EP) and mid laying period (32-36 weeks, MP). During the two periods, plasma levels of melatonin, ghrelin, progesterone and estradiol were estimated. The birds were sacrificed at 26 and 34 weeks of age for collecting jejunum and magnum tissue samples. The samples were processed for extraction of RNA and that were further processed for production of cDNA. Gene expression studies for hormones melatonin, ghrelin receptors and amino acid transporters BAT, CAT, LAT2 and LAT4 were carried by Real Time PCR using SYBR Green. Selenium was supplemented @ 0.05g of product/kg feed. The mean concentration of melatonin in Ghagus was higher (P<0.01) during EP when compared to MP. Supplementation of Se (T) did not have significant effect during EP but increased (P<0.01) the hormone concentration during MP. Where as in Nicobari, the mean concentration of melatonin was less (P<0.01) in the EP when compared to MP. Supplementation of Se increased the concentration of melatonin (P<0.05) during EP without any significant effect during MP (Table 29). When comparison was made between control groups of respective breeds and laying periods, the concentration of melatonin in Ghagus was higher during both the EP (P<0.01) and MP (P<0.05) laying periods (Table 30).

Supplementation of Se increased (P<0.05) the plasma hormone concentration only during EP in Ghagus where as in Nicobari, supplementation of Se did not cause significant change in the concentration of hormone, at either of the laying periods (Table 29). When compared between the control groups, of respective breeds and laying periods, the difference in the hormone levels was not significant at either of the laying periods (Table 30).

The mean level of estradiol hormone was higher in EP when compared to MP in Ghagus and vice versa in Nicobari. Supplementation of Se did not have any significant effect at any of the laying periods in both the breeds (Table 29). When compared between the control groups of both the breeds during respective laying periods, concentration of plasma esrtadiol was higher (P<0.05) in Ghagus during EP and the same was observed to be higher during MP in Nicobari, but was not significant (Table 30).

The mean level of progesterone hormone when compared between C groups was higher in both Ghagus (P<0.05) and Nicobari (P<0.01) during EP when compared to MP. Treatment with Se significantly (P<0.01) decreased concentration at EP and MP in Ghagus, but in Nicobari only at EP (Table 29). When compared between the control groups of respective breeds, the concentration of hormone was higher in Ghagus at both EP (P<0.05) and MP (P<0.01) of the laying periods (Table 30). In Ghagus, egg production (P<0.01) and egg weight (P<0.05) increased significantly upon treatment with Se only during EP. In Nicobari, treatment with Se did not cause significant change in any of the egg parameters.

Table 29. Effect of treatment of organic Selenium on plasma level of melatonin, ghrelin, estradiol progesterone hormones and egg production parameters during early (EP) and mid (MP) laying periods within Ghagus and Nicobari breeds.

	Ghagus				Nicobari			
Hormones	**EPC**	**EPT**	**MPC**	**MPT**	**EPC**	**EPT**	**MPC**	**MPT**
Melatonin								
(pg/ml)	317a±11.9	321±18	214±13.9	320**±12	80a±8.6	104.5**±10	188±9	201±14.02
Ghrelin								
(ug/ml)	19.6±1.9	29*±1.9	25.2a±2.3	29.4±2.5	23.9±3	26.9±4.1	23.6±2.4	30.1±2.1
Estradiol								
(pg/ml)	24.8a±2.1	24.6±1.9	16.7±1.8	16.3±1.4	13.8±1.2	14±0.8	21.5a ±1.5	26.17±1.4
Progesterone								
(ng/ml)	7.35a±0.2	5.23*±0.47	5.23a±0.17	2.6**±0.05	5.16a±0.16	2.7**±0.1	2.7±0.23	3±0.3
Egg parameters N=15								
Egg (%)	43.5±2	57.5**±1.8	40.5±1.5	41±1	62.2±2.8	62.3±2.5	78.77±1.2	80.3±1.5
Ewt. (g)	40.25±0.5	42.5*±0.7	47.6±0.5	48.5±0.9	42±0.5	43.5±1	47±0.5	47.5±1.5

Superscripts given in alphabets denote the significant difference (P<0.05) between the Control groups (C) of EP and MP within a breed.

** denotes the significant difference between the mean values of Control and Treatment (T) groups with in EP and MP phases of Ghagus and Nicobari breeds respectively.* P<0.05, **P<0.01 . N=6, for hormones.

Selenium was supplemented @0.05gof product/kg feed.

Table 30. Comparison between plasma level of melatonin, ghrelin, estradiol and progesterone hormones between Control (C) groups of Ghagus and Nicobari at respective EP and MP phase of laying periods upon treatment with organic Selenium

Hormones	Ghagus	Nicobari	Ghagus	Nicobari
	EPC	EPC	MPC	MPC
Melatonin	317**±11.9	80±8.6	214*±13.9	188±9
Ghrelin	19.6±1.9	23.9±3	25.2±2.3	23.6±2.4
Estradiol	24.8**±2.1	13.8±1.2	16.7±1.8	21.5±1.5
Progesterone	7.35*±0.2	5.16±0.16	5.23**±0.17	2.7±0.23

** denotes the significant difference between the mean values of Control and Treatment groups with in EP and MP phases of Ghagus and Nicobari breeds respectively. * P<0.05, **P<0.01

Evaluation and standardization of protocol for cryopreserving semen of DPR pure lines

M. Shanmugam, N. Anand Laxmi, R.K. Mahapatra

Cryopreservation of Kadaknath semen

An experiment was conducted to develop semen cryopreservation protocol for Kadaknath chicken. In experiment 1, semen from adult Kadaknath roosters was cryopreserved using 8% ethylene glycol (EG) in Sasaki diluent (SD), Lake and Ravie diluent (LR) or Red Fowl Extender (RFE). In experiment 2, semen was cryopreserved using 8% ethylene glycol (EG) in SD, 4% dimethyl sulfoxide (DMSO) in SD or 4% DMSO in LR. The cryopreserved semen in 0.5ml French straws were thawed at 5°C for 100 sec or 37°C for 30 sec and assessed for different in vitro semen parameters and fertility. The post-thaw sperm motility, live sperm and acrosome intact sperm were significantly lower (P<0.05) in cryopreserved semen in both the experiments (Table 31). In experiment 1, the maximum post-thaw fertility (8.8%) was obtained from 8% EG SD group but fertility result could not be repeated. In experiment 2, the maximum post-taw fertility (14.5%) was obtained from 4% DMSO SD group and results could be repeated. In conclusion, Kadaknath chicken semen may be cryopreserved using 4% DMSO SD and thawed at 5°C for 100 sec for obtaining fertility.

Effect of inclusion of raffinose during cryopreservation of Kadaknath semen on post-thaw semen quality and fertility

Inclusion of raffinose, a non-penetrating cryoprotectant, along with dimethyl sulphoxide (DMSO) was evaluated during Kadaknath chicken semen cryopreservation on post-thaw semen parameters and fertility. Adult Kadaknath (28 weeks age) semen was cryopreserved using 4% DMSO in Sasaki diluent (SD). In the semen cryomixture, raffinose (1, 5 and 10 mM) was added at final concentrations. The semen cryomixtures were cryopreserved in 0.5 ml French straws. The semen straws were thawed at 5°C for 100 sec and semen evaluated for sperm motility, live, abnormal and acrosome intact sperm. Lipid peroxidation in the seminal plasma was evaluated. Fertilizing potential of the cryopreserved sperm was evaluated by inseminating in the Kadaknath hens. The post-thaw sperm parameters were significantly (P<0.05) lower in the cryopreserved groups, except for the percent abnormal sperm that was significantly (P<0.05) higher in the cryopreserved groups. There was no difference in the lipid peroxidation level between the different groups. The fertility in all the cryopreserved semen inseminated groups was significantly (P<0.05) lower compared to fresh semen inseminated group. The fertility from 10mM raffinose supplemented semen group was 33.95% and was significantly (P<0.05) higher compared to DMSO alone group (4.02%). In conclusion, inclusion of 10mM raffinose along with 4% DMSO during Kadaknath chicken semen cryopreservation improves the post-thaw semen fertility.

Sustainable Poultry Waste Management through composting

R.K. Mahapatra, N. Anand Laxmi, M. Shanmugam, S.K. Bhanja, B. Prakash, P.K. Pankaj (CRIDA), Md. Osman (CRIDA)

One of the major issues the poultry industry currently facing is the accumulation of large amount of wastes, especially manure and litter, generated by intensive production, which is causing major environmental problems if disposed off in the field without any treatment. This problem can be solved by utilizing the litter for productive purposes by converting poultry litter (Waste) to vermicompost (Wealth). The poultry litter generated, could be successfully converted into compost by mixing with saw chips in proper ratio of carbon to nitrogen (C/N ratio) content present in the litter as well as in saw chips. Finally, vermicompost was prepared from the compost by introducing earthworms into the pile of compost.

I Vermicompost with poultry litter and saw chips

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 saw chips having relative humidity 50%, pH 5.0 and temperature 340C. 15 Kg of litter was mixed with 48 Kg of saw chips. The humidity was maintained at around 50%. The temperature was

changing due to the growth of the microbes inside the pile. The compost was ready on 70th 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 80th day after introduction of earthworms. The relative humidity was 30%, pH was 6.0 and temperature was 250C on 80th day.

Vermicompost with C/N ratio of 35 :1

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 saw chips as supplement having relative humidity 50%, pH 5.0 and temperature 340C. 18 Kg of litter was mixed with 42 Kg of saw chips. The compost was ready on 70th day. Once the compost was ready, earthworms were introduced into the pile of compost for converting it into vermicompost. The vermicompost was ready on 80th day after introduction of earthworms. The relative humidity was 35%, pH was 6.0 and temperature of the pile was 250C on the final day.

Saw chips

Compost 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 saw chips as supplement having relative humidity 50%, pH 5.0 and temperature 250C. 25 Kg of litter was mixed with 36 Kg of saw chips. The compost was ready on 70th day. After the compost was ready, earthworms were introduced into the pile for converting it into vermicompost. The vermicompost was ready on 80th day after introduction of earthworms. The relative humidity was 35%, pH was 6.0 and temperature was 250C on the final day of vermicompost formation.

II Compost and Vermicompost with poultry litter and rice hull

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

The compost was prepared having C/N ratio of 35 :1 by mixing poultry litter with rice hulls having relative humidity 45%, pH 5.5 and temperature 390C. 35 Kg of litter was mixed with 84 Kg of rice hulls. The humidity was maintained at around 45 to 50%. The rice hull was properly mixed with poultry litter. The temperature was changing due to the growth of the microbes inside the pile. The compost was ready on 98th day.

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

The compost was prepared having C/N ratio of 30 :1 by mixing litter with rice hulls as supplement having relative humidity 47%, pH 5.5 and temperature 400C. 51 Kg of litter was mixed with 84.15 Kg of rice hulls. The rice hull was properly mixed with poultry litter. With the passage of time, temperature of the pile was kept on changing due to growth of the microbes. The compost was ready on 98th day.

Table 31. Effect of ethylene glycol and DMSO on post-thaw semen parameters in Kadaknath chicken

Parameters	Control (Fresh semen)	8% EG - SD	4% DMSO - SD	4% DMSO – LR
Sperm motility (%)	63.3 ± 3.07a	25.0 ± 1.29b	15.8 ± 1.54b	14.2 ± 1.53b
Live sperm (%)	75.5 ± 3.19a	43.03 ± 3.89b	28.0 ± 1.41b	27.5 ± 1.31b
Abnormal sperm (%)	2.1 ± 0.26	1.6 ± 0.28	1.7 ± 0.34	1.68 ± 0.27
Acrosome intact sperm (%)	96.0 ± 0.37a	89.2 ± 1.67b	87.5 ± 1.95b	80.5 ± 2.54b

Compost with C/N ratio of 35 :1

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

The compost was prepared having C/N ratio of 25 :1 by mixing litter with rice hulls as supplement having relative humidity 48%, pH 5.5 and temperature 420C during initial days. The temperature kept on changing due to multiplication of the microbes in the pile. For making compost 84 Kg of litter was mixed with 84 Kg of rice hulls. The compost was ready on 98thday.

Compost with C/N ratio of 30 :1

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 rice hulls having relative humidity 45%, pH 5.5 and temperature 390C. 35 Kg of litter was mixed with 84 Kg of rice hulls. The humidity was maintained at around 45 to 50%. The rice hull was properly mixed with poultry litter. The temperature was changing due to the growth of the microbes inside the pile. The compost was ready on 98th day. Once the compost was ready, earthworms were introduced into the pile of compost for converting it into vermicompost. The vermicompost was ready on 116th day after introduction of earthworms. The relative humidity was 50%, pH was 5.5 and temperature was 250C on 80th day.

Compost with C/N ratio of 25:1

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 rice hulls as supplement having relative humidity 47%, pH 5.5 and temperature 400C. 51 Kg of litter was mixed with 84.15 Kg of rice hulls. The rice hull was properly mixed with poultry litter. With the passage of time, temperature of the pile was kept on changing due to growth of the microbes. The compost was ready on 98th 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 116th day after introduction of earthworms. The relative humidity was 50%, pH was 5.5 and temperature of the pile was 240C on the final day.

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 rice hulls as supplement having relative humidity 48%, pH 5.5 and temperature 420C during initial days. The temperature kept on changing due to multiplication of the microbes in the pile. For making compost 84 Kg of litter was mixed with 84 Kg of rice hulls. The compost was ready on 98thday. After the compost was ready, earthworms were introduced into the pile for converting it into vermicompost. The vermicompost was ready on 116th day after introduction of earthworms. The relative humidity was 50%, pH was 5.5 and temperature was 250C on the final day of vermicompost formation.

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 dry leaves compost and vermicompost having Carbon to Nitrogen ratio 30 :1, poultry litter with wood chips vermicompost with Carbon to Nitrogen ratios 35 :1, 30 :1, 25 :1 and poultry litter with rice hulls compost and vermicompost having Carbon to Nitrogen ratios 35 :1, 30 :1, 25 :1 were applied to the field at the village Devenoniguga, Vikarabad, Telangana.

The green gram variety WGG-45 was taken for the study. The date of sowing was 3rd July, 2021 and the crop was harvested on 5th September, 2021. The total duration of the crop was 65 days and spacing between the plants was 45x10 cm. The plant population was 22 per m2. Along with the control, recycled derived fertilizer, met from 18 kg urea and 125 kg SSP, was also applied to the field 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.

Group no.	Product	C/N ratio
C	Control	
RDF	Recycled Derived fertilizer	
1.	Poultry litter with dry leaves vermicompost	30 :1
2.	Poultry litter with dry leaves compost	30 :1
3.	Poultry litter with wood chips vermicompost	35 :1
4.	Poultry litter with wood chips vermicompost	30 :1
5.	Poultry litter with wood chips vermicompost	25 :1
6.	Poultry litter with rice hulls vermicompost	35 :1
7.	Poultry litter with rice hulls vermicompost	30 :1
8.	Poultry litter with rice hulls vermicompost	25 :1
9.	Poultry litter with rice hulls compost	35 :1
10	Poultry litter with rice hulls compost	30 :1
11.	Poultry litter with rice hulls compost	25 :1

Effect of bio-fertilizers on plant height

The maximum plant height was achieved in the group where poultry litter with rice hulls vermicompost was applied. The plant height reached to the height of 48.65 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 10.25 and 32.60 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. At the time of maturity, the plant heights remained almost same in poultry litter with wood chips vermicompost having C/N ratios 35 :1, 30 :1 and 25 :1 and poultry litter with rice hulls vermicompost having C/N ratios 35 :1 and 30 :1. The plants height was found to be 44.36 and 44.77 cm at maturity in case of poultry litter with dry leaves vermicompost and compost having C/N ratios 30 :1. In rice hulls compost groups, it was observed that the plants height didn't differ significantly in 30 :1 and 25 :1 C/N ratio groups; however, the growth was significantly less in 35 :1 C/N ratio group which was found to be 41.13 cm as compared to other groups of the bio-fertilizers. Overall, it has been observed that the growth of plants in Control and RDF groups in terms of plant heights were 36.16 and 38.91cm, 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

The maximum number of branches was achieved in the group where poultry litter with rice hulls vermicompost was applied. The number of branches reached to 6.67 at the time of harvest. The number of branches 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 2.61 and 3.33, respectively. 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. At the time of maturity, the number of branches remained almost same in poultry litter with wood chips vermicompost having C/N ratios 35 :1, 30 :1 and 25 :1and poultry litter with rice hulls vermicompost having C/N ratios 35 :1. The number of branches was found to be 3.66 and 3.94 at maturity in case of poultry litter with dry leaves vermicompost and compost having C/N ratios 30 :1. In rice hulls compost groups, it was observed that the number of branches didn't differ significantly in 30 :1 and 25 :1 C/N ratio groups; however, the growth was significantly less in 35 :1 C/N ratio group which was found to be 4.10 as compared to other groups of the bio-fertilizers. Overall, it has been observed that the growth of plants in Control and RDF groups in terms of number of branches was 3.66 and 3.94, respectively which were significantly less at the time of harvest as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on 50% maturity

A 50% maturity was attained fast in all the bio-fertilizers groups except in Control and RDF groups. Maximum growth was observed in poultry litter with wood chips vermicompost and rice hulls vermicompost with poultry litter 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 39-40 days. However, there was no significant difference observed between the poultry litter with dry leaves compost and vermicompost having C/N ratios 30 :1

Table 32. Effect of different types of bio-fertilizers on plant height at different stages of growth in green gram

	Plant Height (cm)												
Intervals	C	RDF	1	2	3	4	5	6	7	8	9	10	11
30 DAS	6.63	7.10	9.20	9.36	9.40	9.60	10.20	8.89	9.36	10.25	8.63	8.92	9.20
45 DAS	20.12	23.21	30.12	27.54	28.53	29.60	31.60	27.50	28.60	32.60	26.30	27.50	27.90
At harvest	36.16	38.91	44.36	44.77	46.23	46.68	47.15	47.10	47.70	48.65	41.13	42.15	42.60

Table 33. Effect of different types of bio-fertilizers on number of branches per plant at different stages of growth in green gram

No. of branches per plant													
Intervals	**C**	**RDF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
30 DAS	1.45	1.68	2.31	2.33	2.45	2.5	2.43	2.51	2.6	2.61	1.98	2.01	2.23
45 DAS	2.13	2.23	2.45	2.41	2.56	2.60	2.80	2.91	3.12	3.33	2.33	2.50	2.45
At harvest	3.66	3.94	5.10	4.60	5.20	5.50	5.52	5.61	6.12	6.67	4.10	4.30	4.40

Table 34. Effect of different types of bio-fertilizers on age to 50% maturity (days) at different stages of growth in green gram

C	**RDF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	
Avg. age to 50% maturity (days)	40.23	39.12	38.16	38.14	37.15	37.20	36.60	36.45	36.27	36.14	39.10	38.20	38.00

and the groups of the bio-fertilizers rice hulls with poultry litter compost having C/N ratios 30 :1 and 25 :1.

Effect of bio-fertilizers on pod characteristics

The observations on pod characteristics include average number of pods per plant, pod length and number of seeds per pod. It has been observed that maximum production in terms of pod characteristics was achieved in the group where poultry litter with rice hulls vermicompost (where the C/N ratios were 35 :1, 30 :1 and 25 :1) was applied. The average number of pods per plant, pod length and number of seeds per pod reached to12.30, 8.30 cm and 10.30, respectively at the time of harvest. The pod characteristics were significantly different from all other groups of bio-fertilizers applied to the field. At the time of maturity, the average number of pods per plant remained almost same without any significant difference in poultry litter with wood chips vermicompost having C/N ratios 35 :1, 30 :1 and 25 :1 and poultry litter with rice hulls vermicompost having C/N ratios 35 :1 however, this particular characteristic is significantly different from bio-fertilizer groups of rice hull with poultry litter compost where it was observed that it was significantly less. Average number of pods per plant was significantly higher in dry leaves with poultry vermicompost (C/N ratio 30 :1) as compared to the rice hulls with poultry litter compost having C/N ratios of 35 :1, 30 :1 and 25 :1. Similar trend was observed in other two pod characteristics viz. Pod length and number of seeds per pod. Overall, the growth of plants in Control and RDF groups in terms of plant heights were 36.16 and 38.91cm, respectively which were significantly less at the time of harvest as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on seed index

The seed index showed high in all the bio-fertilizers groups except in Control and RDF groups. The grain weight was observed in poultry litter with wood chips vermicompost having C/N ratios of 35 :1, 30 :1 and 25 :1 as 3.90, 4.00 and 3.98, respectively and rice hulls vermicompost with poultry litter groups as 4.00, 4.50 and 4.70 respectively. The best seed index was observed in rice hulls with poultry litter vermicompost when the C/N ratio was 25 :1. This observation was significantly different from all the bio-fertilizer groups. There was no significant difference observed in vermicompost and compost with dry leaves, wood chips with poultry litter vermicompost and rice hulls with poultry litter vermicompost having C/N ratio of 35 :1 and 30 :1. Overall the seed index was less in Control and RDF groups as compared to all other bio-fertilizer groups except rice hulls with poultry litter group having C/N ratio 35 :1 which is comparable.

Effect of bio-fertilizers on average stover yield

The stover yield showed high in all the bio-fertilizers groups except in Control and RDF groups. The stover yield was observed in poultry litter with wood chips vermicompost having C/N ratios of 35 :1, 30 :1 and 25 :1 as 37.50, 37.40 and 38.12 q/ha, respectively and rice hulls vermicompost with poultry litter groups as 39.10, 39.20 and 40.12, respectively. The best stover yield was observed in rice hulls with poultry litter vermicompost when the C/N ratio was 25 :1. This observation was significantly different from all the bio-fertilizer groups. There was no significant difference observed in vermicompost and compost with dry leaves, wood chips with poultry litter vermicompost and rice hulls with poultry litter vermicompost having C/N ratio of 35 :1 and 30 :1. The stover yield was slightly higher in rice hulls with poultry litter compost groups having C/N ratios of 30 :1 and 25 :1 as compared to rice hulls with poultry compost having C/N ratio of 5 :1. Overall, the stover yield was less in Control and RDF groups as compared to all other bio-fertilizer groups.

Effect of bio-fertilizers on average seed yield

The seed yield was high in all the bio-fertilizers groups except in Control and RDF groups. The seed yield was observed in poultry litter with wood chips vermicompost

Table 35. Effect of different types of bio-fertilizers on pod characteristics in green gram

Pod characteristics													
Particulars	**C**	**RDF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Avg. no. of pods per plant	7.45	8.12	10.10	9.30	10.50	10.90	11.30	11.10	11.60	12.30	8.90	9.10	9.10
Pod length (cm)	4.2	4.56	6.20	5.80	6.60	6.90	7.30	7.40	8.10	8.30	5.10	5.60	5.30
No. of seeds per pod	5.69	6.10	8.10	7.80	8.30	8.40	8.70	8.90	9.60	10.30	6.60	7.10	7.30

having C/N ratios of 35 :1, 30 :1 and 25 :1 as 9.60, 10.20 and 10.10, respectively and rice hulls vermicompost with poultry litter groups as 10.60, 12.20 and 12.80, respectively. The best seed yield was observed in rice hulls with poultry litter vermicompost when the C/N ratio was 25 :1. This observation was significantly different from all the bio-fertilizer groups. There was no significant difference observed in vermicompost and compost with dry leaves and wood chips with poultry litter vermicompost. The production of seed in the rice hulls with poultry litter vermicompost is significantly higher than the vermicompost of wood chips with poultry litter in all the C/N ratios groups. Overall the seed yield was 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

R.K. Mahapatra, S.K.Bhanja, B.Prakash, M.R.Reddy

Harvesting stage of crop

Application of compost in the field

Major concerns in poultry industry is the feed cost due to high prices of protein and energy sources and development of antibiotic resistant pathogens due to unwise and excessive use of antibiotics. To overcome these problems, we need to look for cheap and safe alternative sources of protein and energy. Moringa oliefera leaves have many qualities like it is a good source of protein and energy. It has got antimicrobial property and antioxidant effects.

Infrastructure for conducting feeding trials have been developed. Partitioning of moringa farm for free scavenging of the birds in the farm is completed. Night shelters construction was also completed. Facilities were created for vermicomposting for production of earthworms to feed the birds. Gramapriya birds have been housed and are being reared for the initiation of feeding trials.

Partitioning of night shelters for housing for feeding trials

Model project and demonstration unit for backyard poultry, livestock, vermifarming and moringa integration (DAHD)

R.K. Mahapatra, S.K. Bhanja, B.Prakash

Infrastructure development

Boundary wall (linked chain mesh) was erected over one-foot brick wall on around one acre land. The total area of the entire moringa field is 63,000 sq. ft. Entry passages and gates were also provided.

Plantation of moringa plants

The jungle was cleared and rocks were removed from the field. Land levelling, ploughing and land preparation were also completed. Ridge cutting was done for seed

Table 36. Effect of different types of bio-fertilizers on seed index, stover yield and seed yield green gram

C	RDF	1	2	3	4	5	6	7	8	9	10	11	
Seed index or 100 grain wt. (g)	2.56	2.89	3.80	3.70	3.90	4.00	3.98	4.00	4.50	4.70	2.99	3.20	3.30
Average stover yield (q ha-1)	22.69	26.59	36.80	36.50	37.50	37.40	38.12	39.10	39.20	40.12	31.20	33.60	35.10
Avg. seed yield (q ha-1)	6.94	7.86	9.30	9.20	9.60	10.20	10.10	10.60	12.20	12.80	8.12	8.60	9.10

sowing. Moringa seeds were sown and water sprinklers established.

Shed construction

The night shelter construction for birds was completed. A total of 7 night shelters were constructed with an area of 3502 sq. ft. and area of each night shelter is about 18 ft. X 10 ft. = 180 sq. ft.

Vermicompost shed for the culture of earthworms is completed. Vermicompost with Jaigopal breed of earthworms has been established in the vermicompost shed.

Night shelters for birds in Moringa farm

Birds housed in night shelters

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

S. C. Giri, M.K.Padhi, S.K.Sahoo

Floor space requirement of ducks (Khaki Campbell) during growing, adult and laying period (up to 40 wk age)

A total of 804 (5wks old) Khaki Campbell (KC) growing ducks were randomly divided into six groups and reared separately in a duck house with different floor space provisions i.e. 500 (Gr 1), 525 (Gr 2), 550 (Gr 3), 575 (Gr 4), 600 (Gr 5) and 625 (Gr 6) sq cm per bird as shelter space. They were reared upto 8th wk of age. Standard management practices with rice husk as litter material and soaked (ad lib) duck mash (CP : 20 percent and ME : 2900 K cal/g) along with sufficient clean drinking water were offered. It was observed that floor space provision of 625 sq cm/duck as night shelter and run space is ideal for Khaki Campbell ducks between 6-8 wks of age.

Between 9-16th wks of age, the floor space provision was increased to 1200 (Gr 1), 1300 (Gr 2), 1400 (Gr 3), 1500 (Gr 4), 1600 (Gr 5) and 1700 (Gr 6) sq cm per duck as

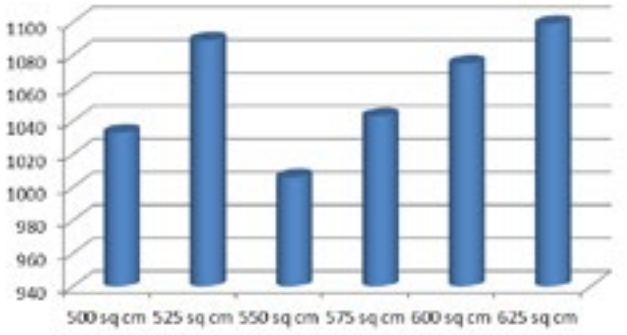


Fig 18. Body weight (g) of KC ducks at 8th week reared under different floor space conditions

shelter space and equal amount of area as run-space with provision of water channel. Observations with respect to growth and survivability of birds suggests that 1200 sq cm floor space for night shelter as well as run-space during day time is optimum. The feed consumption was normal for all the groups.

From 18 wks onwards, all the ducks under experiment (six groups) were again reared with floor space provision of 1500, 1600, 1700, 1800, 1900 and 2000 sq cm per

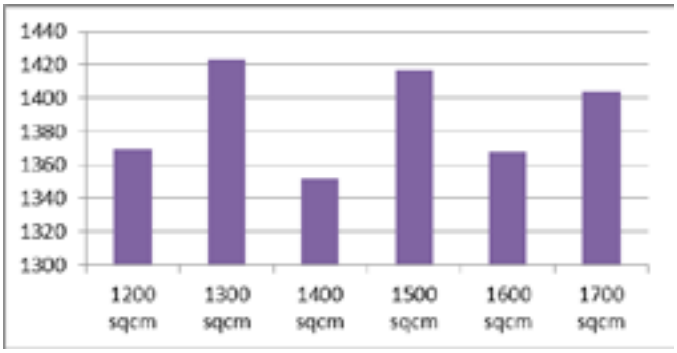


Fig 19. Body weight (g) of KC ducks at 16th week reared under different floor space conditions

bird respectively as night shelter as well as run-space during day time. Duck layer mash (CP :18 percent, ME : 2650 Kcl/g) was offered to all ducks under experiment. Growth, egg production upto 40th wks, egg weight and mortality were recorded. Precautions were taken for optimum hygiene and sanitation during the experiment period. Observation revealed that at 1800 sq cm floor space provision per adult duck, the growth performance was ideal. Growth (body weight), mortality rate and feed consumption were recorded to study the effect of floor space provision on performance of birds.

Production parameters : Under the above floor space provision for laying ducks, the age at sexual maturity, weight at first egg, duck house egg production and egg

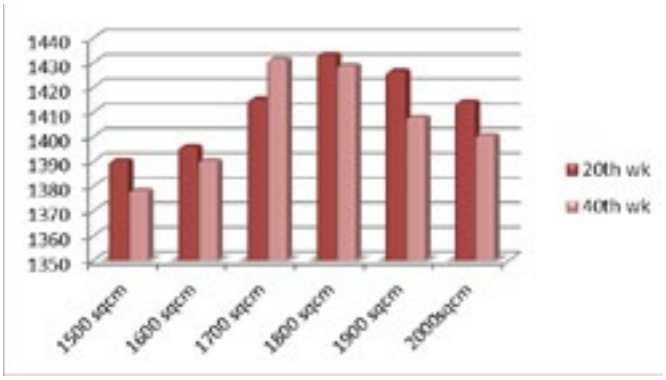


Fig 20. Body weight (g) of KC ducks at 20th and 40th weeks reared under different floor space conditions

weight were recorded upto the age of 40 wks age. It was observed that age and weight at first egg were optimum for the ducks reared with 1700 sq cm floor space whereas duck house (number) and duck day (%) egg production were highest for the birds reared with maximum floor space i.e 2000 sq cm. However, egg weight is significantly higher for the ducks reared with 1900 sq cm floor space at 28th, 32nd and 36th wks of age.

Reproduction parameters : The Khaki Campbell ducks for experiment under various floor space provision were maintained with 1 :3 : : M : F sex ratio. The eggs

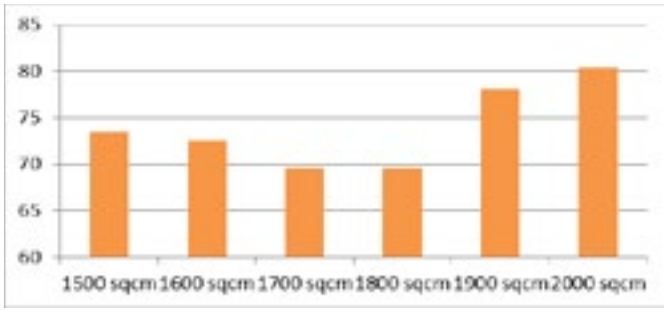


Fig 21. Duck day egg production (%) upto 40 wks of age for the KC ducks maintained at different floor space conditions

collected were subjected for incubation and hatching with standard hatchery management practice. It was observed that percent fertility and hatchability were ideal for the ducks maintained with 1500 sq cm floor space provision as night shelter and run space during day time.

Study of attaining sexual maturity in ducks in presence / absence of Drakes in the flock

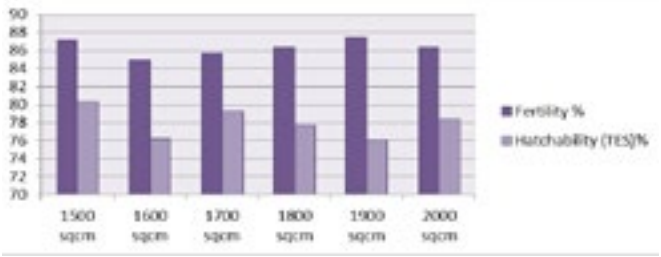


Fig 22. Fertility and hatchability (TES) for the KC ducks maintained at different floor space conditions

A total of 360 female ducks (KC; 12th wks age) were randomly distributed in to 3 groups with 3 replicates (40 ducks in each pen) and maintained under standard management protocol. At 14th wks of age, 10 ducks in each of 3 pens of were replaced by 10 drakes (Gr-1). At 16th wks of age 10 ducks in each of another 3 pens were replaced by 10 drakes (Gr–2). No drakes were introduced to last 3 pens (Gr-3). Age at first egg in the group, body weight of female ducks on the day of first egg, biochemical parameters in blood serum such as total protein and total cholesterol at 20th wks of age were estimated. It was observed that presence of drakes in a flock has no beneficial effect on initiation of egg laying in the flock.

Health

Disease Monitoring, Surveillance and Control in Chicken Populations of DPR

M.R. Reddy, D.S. Sena, T.R. Kannaki, S.K. Bhanja

prevalence of neoplastic conditions

Among 4195 birds examined, 90 birds had neoplastic growth in various organs with the prevalence rate of 2.1% (90/4195). Gross examination of the birds with neoplasms revealed that 71.1% of the birds were severely emaciated (64/90) and the tumor lesions were recorded in 86.6% of liver (78/90), 68.8% of spleen (62/90), 60% of kidney (54/90), 14.4% of heart (13/90), 18.8% of proventriculus (17/90), 17.7% of lungs (16/90), 38.8% of intestine (26/90),

Parameters	Group -1 Male introduced at 14th wks age	Group -2 Male introduced at 16th wks age	Group -3 No male ducks
Age at 1st egg (days)	140	143	144
Avg B.Wt (g) of females on day of 1st egg in flock	1372.50 ± 18.67	1373.60 ± 17.04	1393.60 ± 24.97
Serum protein (mg/dl)	4.20 ± 0.21	4.99 ± 0.32	4.60 ± 0.163
Serum total Choresterol (mg/dl)	160.36 ± 24.41	153.25 ± 14.42	145.08 ± 7.07

10% of ovary (9/ 90), 2.2% of oviduct (2/90), 3.3% of bursa (3/90), 3.3% of testis (3/90), 10% of mesentery (10/90), 5.5% of pancreas (5/90), 3.3% of bones (3/90) (Fig 23), 3.3% of trachea (3/90), 1.1% of skin (1/90), 1.1% of gizzard (1/90) and 1.1% of the brain (1/90). Of these 90 birds with tumor lesions, 55.5% of the birds were from adults (layer/ breeder) (50/90), 41.1% of the birds were from grower (47/90) and 3.3% of the birds were from chicks (3/90).

Histopathological examination of the collected tissue samples revealed that 13.5% of the samples were myeloid leukosis, 25.2% of the samples were lymphoid leukosis, 20.3% of the samples were histiocytic sarcoma and 40.7% of the samples were Marek's disease. Myeloid leukosis was characterized by the infiltration of large myeloid cells with eccentrically placed nucleus and eosinophilic granules in the cytoplasm (Fig 24). In case of lymphoid leukosis large lymphoid cells of uniform size with large nucleus and scanty cytoplasm was noticed. Histiocytic sarcoma was characterized by the infiltration of spindle or polygonal shaped cells with or without vacuolation whereas as in Marek's disease infiltration of pleomorphic lymphoid cells were noticed. Histologically the normal parenchyma of the organs was replaced by the severe infiltration of tumor cells. Histopathological examination revealed 53% of the birds had only one type of tumor cells whereas 47% of the birds had infiltration of multiple type of tumor cells in various organs.

A total of 588 Kadaknath birds including 413 females and 175 males were screened for ALV by Ag ELISA. The overall ALV positive percentage was 58.5 which include 65.61% in females and 41.71% in males.

Avian leukosis ev loci and TVB locus in native breeds of chicken

The status of avian leukosis subgroup E loci such as ev3, ev6, ev9 and ev21 was determined in Kadaknath (n=30), Ghagus (n=19), Aseel (n=7) and White Leghorn (n=25) by locus specific PCR assay. Among the ev loci, only ev 6 locus was observed in 10% of Kadaknath and 15.7% of Ghagus, whereas ev3, ev6 and ev21 loci were absent in all the breeds tested. PCR RFLP assay was performed to detect the SNP which determine allele of TVB locus. Results indicate that 100% of the birds in Kadaknath, Ghagus, White Leghorn and 72% of the birds in Aseel were having dominant homozygous TVBS1 allele (S1S1) and remaining 28% of the Aseel birds were having heterozygous TVB S1 allele (S1S3). Further nucleotide sequencing of TVB gene from Aseel which has TVB S1*S3 allele and other birds (Kadaknath, Ghagus and White Leghorn) revealed the presence of SNP at 184th nucleotide position in Aseel (T/G) which is responsible for the conversion of S1 allele to S3 allele.

Fig 23. Cut section of the breast muscle showing hard white neoplastic growth originated from bone marrow

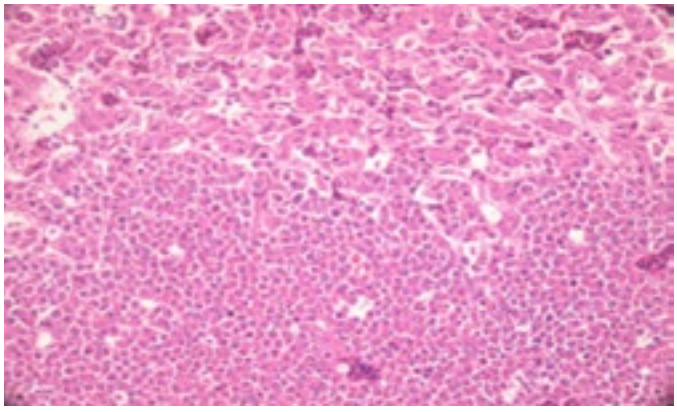


Fig 24. Myeloid leukosis. Section of liver showing infiltration of large myeloid cells with eccentrically placed nucleus and eosinophilic granules in the cytoplasm

INFAAR (Indian Network for Fisheries and Animal Anticmicrobial Resistance)

D. Suchitra Sena, M.R. Reddy, S.K. Bhanja, T.R. Kannaki

A total of 40 milk samples each from cows and buffaloes, 20 rectal swabs each from sheep and goat and 30 cloacal swabs from poultry were collected from different villages of Rangareddy, Mahaboobnagar, Medak and Nalgonda districts of Telangana state. During the July-September quarter, percent E. coli isolated were 65% in cattle, 68 % in buffaloes, 100 % in sheep and goat and 97 % in poultry.

Isolation and identification of E. coli isolates

The samples were processed as per the SOP's and on Eosin Methylene Blue (EMB) agar metallic sheen colonies were identified as E. coli. Gram staining revealed gram negative bacilli. Biochemical tests revealed oxidase

negative, indole positive, methyl red positive, Voges-proskaeur negative, citrate negative, urease negative. catalase positive, producing acid and gas from glucose and are motile.

Molecular confirmation of the E. coli isolates was done using Pentaplex PCR for detection of uidA (β-D-galctosidase), lacZ (β-D-galctosidase), lacY (lactose permease), cyd (cytochrome bd complex) and phoA (bacterial alkaline phosphatase) (Fig 25).

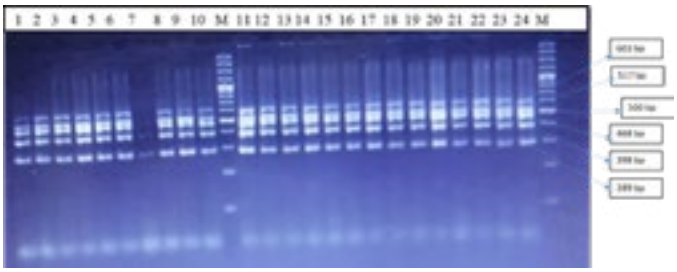


Fig 25. Molecular identification of E.coli isolates from poultry samples

Antibiotic sensitivity test for E. coli isolates

Antibiotic sensitivity test (AST) was performed for the confirmed E. coli isolates using different classes of antibiotics. The percent sensitivity pattern of Amikacin (AK), Amoxyclav (AMC), Ampicillin (AMP), Chloramphenicol (C), Enrofloxacin (EX), Nalidixic acid (NA), Imipenem (IPM), Tetracycline (TE), Trimethoprim and Sulfamethoxazole (COT) in cattle, buffalo, sheep, goat and poultry (Fig 26). The Cephems viz., Cefpodoxime (CPD), Aztreonam (AT), Ceftriaxone (CTR), Ceftazidime (CAZ), Cefotaxime (CTX), Cefoxitin (CX) sensitivity was performed on E. coli isolates. The antibiotic sensitivity pattern for Cephems on E. coli isolates were represented in Fig 27. Phenotypically for E. coli isolates, highest resistance was noticed for Ampicillin antibiotic in cattle, buffalo, sheep, goat and poultry. Among cephems, higher cefoxitin resistance was noticed in cattle, buffalo, sheep, goat and poultry.

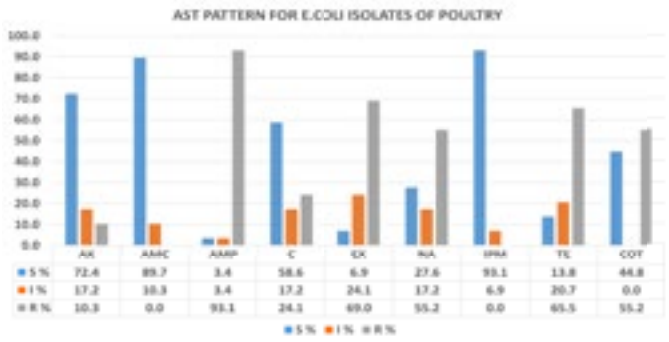


Fig 26. AST pattern for E. coli isolates

Arsenic toxicity and its amelioration with some herbs in ducks

D. Kumar, P.K. Naik, S. K. Mishra, B.K. Swain

Effect of Garlic powder was observed in arsenic induced subchronic toxicity on body weight, haematological, biochemical and oxidative parameters along with gross and histopathological changes in white Pekin grower ducks. To study the subchronic arsenic toxicity, 90 grower ducks of eight weeks of age were divided into 4 groups. Each group had 3 replicates containing 6 grower

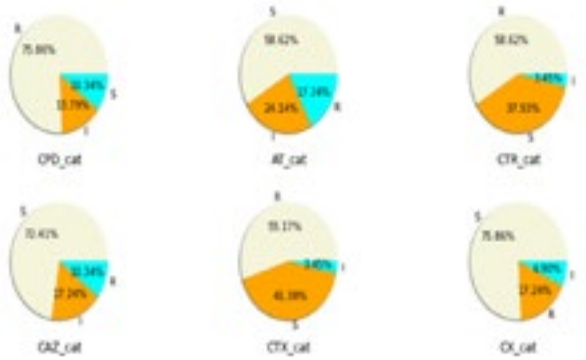


Fig 27. AST pattern for CEPHEMS on E. coli isolates of Poultry

ducks in each replicate. Group I (control) was given arsenic free water and Group II was administered Sodium Arsenite (30 ppm arsenic) and Group III, IV & V were given Arsenic @ 30ppm in water along with garlic powder @ 500mg, 1g and 2 g per kg of feed, respectively.

Administration of arsenic @ 30ppm over a period of 90 days lead to reduced feed intake and body weight, depression and dullness, watery diarrhoea, pale comb, discoloration of beak, excessive scaling of the legs, ruffled feathers, which were very significant. The above signs were also observed in all the garlic treated groups except in birds with supplementation of 2g garlic powder/ kg of feed where symptoms were less pronounced. There was significant reduction in mean body, absolute and relative organ weights with 30ppm arsenic and with supplementation of 2g garlic powder/kg of feed, there was significant increase in mean body, relative and absolute organ weights. Macrocytic hypochromic anaemia was evident indicating adverse effects of arsenic at 30ppm on mean levels of Hb, TEC, TLC and these effects were partially ameliorated with supplementation of 2g garlic /kg of feed. There was significant increase in levels of ALT, AST, ALP and uric acid indicating liver and kidney dysfunction with 30ppm arsenic whereas with supplementation of 2g garlic powder/kg of feed these effects were ameliorated significantly. The increase in levels of LPO, superoxide and marked reduction in levels of reduced glutathione in various tissues like liver, kidney and spleen indicate the oxidative stress induced with arsenic 30ppm and with supplementation of 1g & 2g garlic powder/kg of feed the oxidative changes were reversed significantly. Thus it can be concluded that garlic powder @2 g/Kg of feed can work as adjunct therapy during chronic arsenic toxicity.

Surveillance and monitoring of duck diseases and their biosecurity measures

D. Kumar, P.K. Naik, S. K. Mishra, B.K. Swain

The total Number of birds reared at the Regional Centre were 2880 birds/ month which includes 700 WP

ducks/ Month, 830 Khaki/ month, 1200 desi/ month and Muscovy 150/ month. A total of 1823 ducks were reported to have died during this period (Jan to Dec 2021). The average mortality of duck revealed to be approx. 5.17% (previously 0.72 %). Month-wise highest mortality was in July, 2021 (382, 12.76%) and minimum mortality was reported in Sep, 2020 (35, 1.31%). Highest cause of mortalitywas due to Septicaemia (756, 41.47%), followed by other major mortalities due to Hepatitis (439, 24.08%), omphalitis (109, 5.98 %), inanition (101, 5.54%), egg bound (100, 5.49%) gout/nephritis (80, 4.39%), nephritis (69, 3.78%), drowning (30, 1.65%), cannibalism (18, 0.99%), aspergillosis (5, 0.27%), huddling (5, 0.27%), ascitis (4,0.22%), enteritis (3,0.16%), egg peritonitis (2, 0.11%), aflatoxicosis (2, 0.11%), pericarditis (2, 0.11%), peritonitis (1, 0.05%). Age wise highest mortality was found in ducklings (1094) followed by adult (681) and least in grower (42). Breed-wise highest mortality was observed in White Pekin (1087), followed by Khaki Campbell (512), Desi-Pati (211), and Muscovy Moti (13). Health care and prophylactic measures (vaccination and preventive therapy) were provided on regular baisis to different breeds of duck.

Extension

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

Vijay Kumar, S.K. Bhanja, M. Niranjan, S.V. Rama Rao

Contribution of ICAR-DPR and AICRP birds in Indian Poultry Population and economy

Contribution of ICAR-DPR and AICRP germplasm in Indian poultry population was estimated on the basis of number of supply of fertile eggs, day old chicks, grownup birds and parent to different stakeholders. Certain assumptions were considered while calculating the economics of rearing these improved chicken varieties as backyard farming model. Hatchability (75%), mortality (20%) and other factors (chicks produced from pair of Vanaraja parents- 80, Gramapriya parents -120, Srinidhi parents - 100 and parents of others - 70). The estimated income from male of all varieties Rs. 210, female of Vanaraja and other varieties Rs. 765 and female of Gramapriya Rs. 975 were used to estimate the economic contribution (Table 37).

Minimum supply (30.85 lakh) was recorded in 2014-15 and maximum supply (51.35lakh) was noticed in 2011-12. On an average, 38.7 lakh chickens were distributed to farmers and other stakeholders every year in the last ten years. The average annual contribution was estimated about Rs 205.64 crore in last ten years from ICAR-DPR and AICRP, which ranged from Rs 162.45 to 277.06 crore. The share of these birds in Indian fowl population is given below in Fig 28.

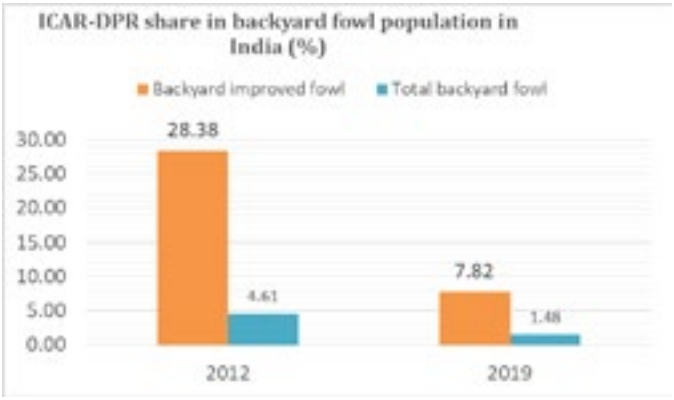


Fig 28. ICAR-DPR share in backyard fowl population in India

Impact of Vanaraja chicken variety in Indian poultry sector

Vanaraja, a dual-purpose backyard chicken variety developed by the Directorate, has been propagated in different agroclimatic regions of India for the past 3 decades. The data from 1992-2020 of Vanaraja propagation in different parts of the country was used to find their impact. Propagation of Vanaraja was in three dimensional from ICAR-DPR, Hyderabad (14.3%), Poultry Seed Project (PSP) centres (9.14%) and other

Table 37. Estimated chicken population contribution and economic contribution of ICAR-DPR and AICRP germplasm

Year	Chicken germplasm supplied (Lakh)	Estimation of economic contribution (Rs. crore)
2010-11	40.17	215.63
2011-12	51.36	277.07
2012-13	43.15	236.66
2013-14	34.05	179.62
2014-15	30.86	162.45
2015-16	41.86	229.13
2016-17	34.28	179.94
2017-18	32.00	165.22
2018-19	41.60	217.86
2019-20	37.75	192.83
Total	**387.07**	**2056.41**

organisations (76.56%). During the period, major portion of the birds were distributed in southern (30.31%) followed by eastern (27.6%), central (18.59%) and western (10.1%) regions of India. As many as 4.14 lakh stakeholders reared the improved chicken variety and majority of them benefited from other organizations (92.2%) followed by PSP centers (4.1%) and ICAR-DPR (3.7%). During the 15th livestock census, share of Vanaraja birds was estimated as 0.0007% that reached to 0.228% of total Indian chicken population in 20th livestock census and on indices it has grown from 100 to 89,240, whereas country chicken reached from 100 to 244 indices points. There was continuous increment in the economic contribution and it was found to be Rs. 0.02 billion in Eighth Plan that reached to Rs 3.64 billion in Eleventh Plan. In three-years period of 2017-2020, the contribution of the improved varieties was calculated to be Rs 2.28 billion. The average annual contribution of revenue from Vanaraja chicken to the Indian economy was estimated as Rs. 0.76 billion (i.e, Rs 76 Crore/year) during the period 2017-2020.

Extension activities at RC, Bhubaneswar

During the year due to COVID 19 pandemic, many farmers interested in duck farming were not able to visit the centre. However, more than 100 farmers visited the centre personally and more than 100 have contacted telephonically or via e-mail to enquire about different aspects of duck farming including, housing, management, profit, marketing, feed, suitable ducklings for egg and meat, availability of ducklings, integrated farming, disease, vaccination as well institutional financial support given, if any. The farmers/entrepreneurs were being counselled about different aspects of duck farming and if need arises they were being requested to meet the subject expert on feed, health, management etc. Most of the farmers were interested for the egg type ducklings and for integrated farming. Many farmers were interested to start duck farming by keeping 200 to 500 ducklings however; few farmers were interested for 1000 to 5000 ducklings. However, availability of ducklings from the centre in large number was a constraint.

Women farmers visiting the RC

Project : Empowering Tribal Farmers through Backyard Poultry Farming in NEH Region

Training and input distribution : The programme was implemented in three states of NEH region, viz. Meghalaya, Arunachal Pradesh and Mizoram. A total of 450 farmers covering 150 farmers from each state were selected and 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 waterers, veterinary medicines and vaccines.

Training and input distribution : The programme was implemented in three states of NEH region, viz. Meghalaya, Arunachal Pradesh and Mizoram. A total of 450 farmers covering 150 farmers from each state were selected and 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 waterers, veterinary medicines and vaccines.

Monitoring of performance of birds at farmers' field

The monitoring and technical inputs were provided along with data collection on the performance of birds in the farmers' fields.

Meghalaya

The Launching Programme of the collaborative project entitled "Empowering tribal farmer through backyard poultry farming in NEH Region" was held on 16th March, 2021 at ICAR Research Complex for NEH Region, Umiam, Meghalaya. The program was graced by

Dr. V. K. Mishra, Director of the Institute and Dr. R. N. Chatterjee, Director, ICAR-DPR along with other Heads of the Divisions, Scientists from both the Institutes and the farmers. A training manual on "Empowering tribal farmer through backyard poultry farming in NEH Region", prepared under the project was also released on the occasion.

Under the project, two-days training programme was also organised on 16th and 17th March, 2021 covering 150 tribal farmers selected from different villages of Ri-Bhoi and East Khasi Hills districts of Meghalaya. The farmers were imparted training on scientific management of backyard poultry through theoretical and practical demonstration. After successful completion of the training, the farmers were provided with 20 numbers of one month old Vanaraja chicks, waterer, feeder and feed.

Launching program

Input distribution

Birds at farmers field

The data on average body weight and mortality of Vanaraja birds in the farmers' fields up to 20 weeks of age are given in Table 38.

Table 38. Average body weight of Vanaraja birds in the farmers' field in Meghalaya

Age (wks)	Average body weight (g)	Mortality (%)
4	109.3±2.66	0.00±0.00
6	318.2±2.92	1.05±0.47
8	578.6±7.04	4.56±1.40
10	765.2±10.65	5.61±1.41
12	1025.1±14.26	1.40±0.80
14	1390.1±27.25	0.53±0.53
16	1690.4±34.25	0.00±0.00
18	2185.2±66.99	1.40±0.80
20	2287.8±87.41	0.88±0.62

Arunachal Pradesh

Under the project, a total of 150 farmers were selected from two circles i.e. Daring and Basar in Arunachal Pradesh and were imparted training. After successful completion of training, they were provided inputs in the presence of Shri Tage Taki, Honourable Minister for Agri-Horti-Vety-Fishery, Govt. of Arunachal Pradesh, Shri Gokar Basar, Hon'ble MLA, Basar, Directors of agri-allied, DC and SP Leparada covering Daring, Basar circles. Each farmer was provided 20 numbers of one month-old chicks of Kalinga brown variety along with feed, waterer and feeder.

The farmers were advised to rear the 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. Followed up activity was conducted by the Scientist of ICAR Arunachal Pradesh Centre in some nearby villages covering 30 farmers. The bodyweight of birds at 12 and 16 weeks of age was 816.2 ±22.09 g and 1374.5 ±27.98 g respectively in males, whereas in females they were 634.2±17.12 and 843.8± 20.09 g. The overall mortality was 8.32%.

Distribution of inputs by Shri Tage Taki, Hon'ble Minister for Agri-Horti-Vety-Fishery, Govt. of Arunachal Pradesh in presence of Shri Gokar Basar, local MLA and birds under farmers field conditions

Mizoram

The ICAR Mizoram Centre, Kolasib conducted two days training on "Backyard poultry farming for socio-economic upliftment of tribal farmers in Mizoram" during 11-12 March 2021 under this project. The training was inaugurated by the Deputy Commissioner,

Dr. Lalthlangliana, Kolasib district in the presence of Dr. I. Shakuntala, Joint Director, ICAR Mizoram Centre, Kolasib, Dr. Engkunga Chhangte, District Veterinary

Officer, Kolasib, Dr. Hmingthanzuala, DIPRO, Kolasib, Scientists from ICAR Mizoram Centre, other officials and farmers from Aizawl, Kolasib and Mamit districts of Mizoram.

A total of 150 farmers from three districts (Aizawl, Kolasib and Mamit) participated in the training and several inputs including 3000 chicks, 15 quintals of poultry feed, feeder and waterer, medicines and vaccines were distributed to the farmers during the training programme. The average body weight of female birds was 2.30 kg, while the males attained average body weight of 3.5 kg at 5 months of age.

Release of training Manual

Distribution of inputs

Regional Station, Bhubaneswar

Genetic up-breeding of duck production to strengthen livelihood security in NER of India by converging conventional and molecular techniques.

M.K. Padhi, S.K. Sahoo, S.C. Giri

Ducks of S-1 generation of Kuzi were evaluated for egg production up to 80 weeks of age. The egg production up to 72 and 80 weeks of age was 218±5 and 239±5 eggs, respectively. The egg weight at 60 and 72 weeks of age was 65.19±0.27 and 71.29±0.30, g, respectively. The S-2 generation Kuzi ducks and Kuzi X Khaki Campbell (DK) and Khaki Campbell X Kuzi (KD) hatched in last year were evaluated for growth and egg production traits. The least square means for juvenile growth traits are presented in Table 39. The primary trait of selection in the Kuzi ducks is higher body weight at 8 weeks of age. There was an increase of 125 g in 8 weeks body weight in this generation as compared to S-1 generation. The heritability estimates varied from 0.22 to 0.44 for different juvenile body weights. The heritability estimate of 8 weeks body weight was 0.22±0.09, whereas body weight at other ages was moderate to high in magnitude (Table 39). Genetic correlations among various juvenile growth traits were high in magnitude among body weights.

Multi-colour plumage was found to be dominant in Kuzi and Kuzi X Khaki Campbell (DK) and Khaki Campbell X Kuzi (KD). Bluish pink colour bill was dominant in all the three genetic groups. Brown and pink colour shank was more in all the three genetic groups compared to other colour. The juvenile body weights were lower than the Kuzi after 6 weeks of age in both the crosses (Fig 29). The shank length, keel length and bill length of KD recorded at 8 weeks of age were 69.28±0.51, 129.5±1.01 and 63.68±0.44 mm, respectively. Corresponding shank length, keel length and bill length in DK were 71.80±0.43, 125.8±0.82 and 65.45±0.43 mm, respectively. Significant ($p<0.05$) difference between keel length and bill length were recorded between two crosses.

Different carcass quality traits were measured at 12 weeks of age in Kuzi, KD and DK ducks by sacrificing three drakes and three ducks. Eviscerated yield % was numerically higher in Kuzi followed by KD and DK. Back cut as % of eviscerated weight was highest amongst the different cuts followed by breast, leg, wing and neck in all the three genetic groups (Table 40). Meat to bone ratios in two prime cuts breast and leg did not differ significantly between the genetic groups.

The body weight at 16 weeks of age in Kuzi, KD and DK female were 1637±8, 1555±19 and 1542±18 g, respectively. Corresponding body weight at 20 weeks of age was 1732±9, 1642±17, 1650±23 g. Body weights were significantly ($p<0.05$) higher in Kuzi compared to the crosses. Body weight recorded at 40 weeks in Kuzi, KD and DK were 1642±10, 1566±18 and 1534± 24 g, respectively. Body weight at 40 weeks of age was lower in all the three genetic groups compared to the weight recorded at 20 weeks of age. This may be due to higher egg production during the period. Age at first egg in the flock was 101, 103 and 104 days in Kuzi, KD and DK, respectively. Corresponding age at 50% duck house egg production (DHEP) was 133, 124 and 123 days. Age at 80 % DHEP in Kuzi, KD and DK was 178, 156 and 136 days respectively. DHEP % at 20 and 40 weeks of age in Kuzi, KD and DK were 64.60, 72.46, 83.02 and 72.37, 76.81 and 87.54 %, respectively. Egg production up to

40 weeks of age in Kuzi, KD and DK were 110.2, 123.4 and 130.6 eggs, respectively. The crossbreds produced more number of eggs than Kuzi ducks, however their body weight was lower than the Kuzi ducks. The egg weights recorded at different weeks of age are presented in Table 41. The mortality % between different periods in all the three genetic groups was within the acceptable range. During the period, a total of 27,687 Kuzi ducklings were supplied to the farmers for duck farming. Besides this, 915 crossbreds having one parent as Kuzi were also supplied to the farmers for popularization of duck farming in the country.

Adult Khaki Campbell X Kuzi KD Birds

Adult Kuzi X Khaki Campbell (DK) Birds

Adult Kuzi Ducks

Table 39. Least square means and heritability estimates of different juvenile traits of Kuzi ducks (S-2 gen)

Traits	Male	Female	Pooled sex	h2± SE
Body weight (g)	(N=423)	(N=452)	(N=875)	
Day old	41.16±0.20	41.08±0.20	41.12±0.14	0.43±0.14
1 wk	105.6±0.75	105.6±0.73	105.6±0.53	-
2 wks	266.7±2.02	265.7±1.97	266.2±1.43	0.29±0.10
3 wks	463.1±3.46	459.9±3.37	461.5±2.45	0.31±0.11
4 wks	674.2±4.14	668.0±4.04	671.1±2.93	0.28±0.10
5 wks	922.2a±5.09	904.4b±4.97	913.3±3.61	0.28±0.11
6 wks	1120a±5.68	1091b±5.54	1106±4.02	0.44±0.14
7 wks	1327a±6.10	1264b±5.94	1296±4.32	0.45±0.14
8 wks	1474a±6.95	1384b±6.77	1429±4.92	0.22±0.09
10 wks	1607a±7.62	1465b±7.43	1536±5.40	0.25±0.09
SL 8 wks (mm)	74.18a±0.19	71.37b±0.19	72.78±0.14	-
KL 8 wks (mm)	121.1a±0.34	116.3b±0.33	118.7±0.24	-
BL 8 wks (mm)	66.86a±0.18	64.41b±0.17	65.64±0.13	0.20±0.09

SL=Shank length, KL= keel length, BL= bill length, N in first row indicates no of birds

Estimates showing different superscript for a particular trait between male and female differ significantly (p<0.05).

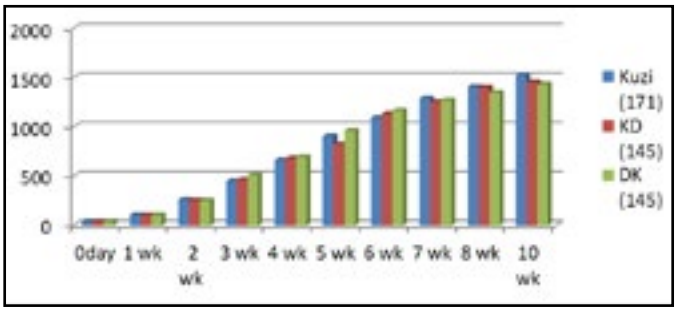


Fig 29. Comparative juvenile body weight in Kuzi (D), Khaki Campbell (K)XD and DK

Table 40. Carcass quality traits at 12 weeks of age in Kuzi duck of Odisha and its two crosses with Khaki Campbell

Parameters	Kuzi	KXD	DXK
Pre-fasting body wt. (g)	1616±122	1528±61	1422±64
Body wt. before slaughter (g)	1532±112	1467±60	1367±62
Traits as % of live weight			
Fasting loss	5.17±0.42a	3.99±0.39b	3.89±0.17b
Blood	4.08±0.41	4.86±0.36	4.47±0.48
Feather	5.15±0.35	4.63±0.12	4.54±0.34
Head	6.07±0.43	5.67±0.12	6.27±0.12
Shank+feet	2.75±0.07	2.91±0.06	2.93±0.09
Liver	1.81±0.12	1.63±0.09	1.81±0.09
Gizzard	3.19±0.06a	2.95±0.08b	2.86±0.07b
Heart	0.91±0.07a	0.75±0.03b	0.83±0.02ab
Eviscerated yield	72.2±0.72	71.9±1.18	69.9±0.72
Giblet	5.91±0.15a	5.32±0.09b	5.49±0.11ab
Cut up parts as % of eviscerated carcass weight			
Leg	18.46±0.64	19.60±0.72	19.87±0.40
Breast	26.01±0.25	25.54±0.61	26.41±0.34
Back	29.41±0.40a	29.54±0.34a	27.86±0.41b
Neck	12.00±0.52	12.09±0.25	11.83±0.53
Wing	13.60±0.56	12.75±0.35	13.60±0.54
Cutting loss	0.57±0.26	0.47±0.16	0.48±0.17
Meat to bone ratio of prime cuts			
Breast	3.57±0.32	4.21±0.41	3.43±0.31
Leg	4.05±0.32	4.12±0.26	3.92±0.09
Meat + Skin Bone of prime cuts			
Breast	4.68±0.43	5.29±0.52	4.65±0.36
Leg	5.22±0.43	5.22±0.43	5.35±0.15

Means having one common superscript in a row do not differ significantly (P<0.05)

Table 41. Egg weight at different weeks of age in Kuzi, KD and DK

Age (wks)	Kuzi	Khaki X Kuzi (KD)	Kuzi X Khaki (DK)
16	48.05±0.52	48.35±2.48	47.67±0.78
20	60.37±0.30	57.30±0.88	57.35±0.60
24	62.85±0.23	60.2±0.33	59.88±0.36
28	66.61±0.23	62.23±0.44	62.61±0.46
32	67.98±0.20	65.76±0.87	64.58±0.40
36	70.73±0.17	69.65±0.42	70.18±0.34
40	71.23±0.16	68.61±0.45	67.68±0.28
44	72.47±0.15	70.68±0.36	70.48±0.34
48	72.16±0.16	72.66±0.37	71.65±0.25
52	72.27±0.14	71.23±0.32	70.25±0.31

Breeding for Development of Mycotoxin Tolerant Meat Type ducks

S.K. Mishra, C. K. Beura, P. K. Naik, B.K. Swain, D. Kumar, Rajlaxmi Behera

Pekin duck breeders raised from the NASF project post epigenetic-sensitization, were used as the parents for raising the current-generation of ducklings. As per the mandate of the current project, a section of white Pekin population was to be raised through feeding of experimental diets, which by design, were to be spiked with aflatoxin B1 (AFB1) at sub-clinical dosages, i.e. range of 50 to 100 ppb, for infusing tolerance into resultant Pekin progeny. Further, a mass selection for high 6th-week live body weight (BW6) were to be superimposed on above Pekin ducklings, entailing purported selection of QTLs favouring both growth rate and AFB1 tolerance.

Incidentally, throughout bulk of 2021, as many as 12 hatches of Pekins were raised during Jan to Sep 21 period, using above parents (NASF output breeders) versus random control (Non-sensitized to AFB1), where most of the lots experienced very- higher rates of mortality during juvenile ages (0-6 wks of age) with cumulative-mortality percentages varying from 7.8 to 77.4%, where no significant aetiology could be established, including major mycotoxins. The levels of AFB1 and Ochratoxin, (OTA) in duck feed, during the period varied from 4 to 20 ppb and 8 to 26 ppb, respectively.

Most survivors raised from above hatches exhibited very minimal growth, i.e. mean BW6 varying from 457 to 1103g, through these 12 hatches coupled with highly variable (non-uniform) growth with standard deviation (S.D) for BW6 ranging from 137.4 to 406.2 over hatches. The hatchability (against eggs-set basis) of Pekins too continued to be low to moderate, i.e. varying between 19.1% and 47.2% through these 12 hatches, which were drawn during the Jan-Sep period of 2021. Though, the necropsy examination of most mortalities coupled with laboratory analyses for mycotoxins (AFB1 & OTA) did not

hint any strong roles of the AFB1 or OTA to precipitate such heavy mortalities in above flocks, the surmises hinted that : similar growth-depressions in ducklings; wide standard deviations and mediocre fitness (fertility, hatchabilities, etc.) were conventionally held as hallmarks of chronic biotic stresses (including mycotoxins as possible stressors or predisposing factors).

Keeping the above (trend), as a manifested-trigger of possible biotic stress in performance of Pekins, a detailed analysis was undertaken for our Pekin flock for 2013-2020 period, aiming a detailed profiling of some selected biotic and abiotic factors in determining significance of their roles in impacting productivity of Pekins.

For the above, egg-production data of Pekin-layers over 5 annual-egg production cycles (2013-20) were analyzed for their impacts, besides those of abiotic factors : ambient temperature (low/high) and relative humidity (RH). The impacts of 4 seasons of year (summer, rains, autumn, winter) and 4 natural production-peaks (early, mid, late, declining production-peaks) were also analyzed. Data of adult layers (N=200/Year) across 21 to 72 weeks of age were included in the study. The analysis assumed the health care and management practices to be uniform through the years, with major nutritional components of layer-diets to be uniform over the years (isocaloric with range : 2650-2750 ME kcal/kg and iso-proteinous : 18.0% CP with standard Ca : P ratios). Statistical significance of various factors was determined using SAS's GLM Procedure. The mycotoxins (AFB1/OTA) were determined using high-precision Fluorometer facilities (available nearby using Kits from Vicam® Inc, USA). The results revealed huge fluctuation in duck-day egg production throughout, the 5 generations (range : 57-159 eggs/bird/year), for which both year-effects and feed's natural AFB1-levels (range : 2.1 to 97ppb) emerged as the significant most influencing factor ($P<0.05$), with most other factors as non-significant or secondary in impact on egg production. However, the impacts of numerically-fluctuating OTA levels, (3-76 ppb range), across seasons, remained statistically non-significant on production. The egg-weight's variation (40 wks) too was non-significantly impacted across both biotic and abiotic factors. The study concluded that for managing sound egg production, a moderate duck-management sector, the most important factor emerges as : minimizing natural-build-up of AFB1 in duck-diets, while ambient-temperatures, RH levels, seasonal effects proved as secondary factors influencing duck husbandry under coastal ecosystems.

Determination of optimum level of Metabolizable Energy (ME) for White Pekin ducks during grower stage

S.K. Sahoo, B.K. Swain, P.K. Naik, S.C. Giri

To determine the optimum level of metabolizable energy requirement of White Pekin ducks during grower stage, an experiment was conducted on 162 ducks of 7 weeks of age. All the ducks were randomly divided into three groups having 6 replicates in each group with 9 ducks in each replicate. All the three groups were provided with three experimental rations containing three levels of metabolizable energy, i.e. 2450, 2600 and 2750 k cal /kg diet. All the diets were iso-nitrogenous. All the birds were in deep litter system. Daily feed intake and bi-weekly body weight were recorded upto 16th week. Blood samples were collected at 16th week to study the effect on various blood parameters. No significant differences among the groups were observed in body weight at 16 weeks of age (Table 42). At the end of 16th week, a metabolism trial was conducted to study the nutrient availability in different groups. No significant differences among the groups with respect to DM, OM, CP, CF and EE metabolizability were observed.

The differences among the groups in daily feed intake were not statistically significant. Various blood parameters like total protein, albumin, globulin, cholesterol, triglycerides, urea, creatinine, calcium and phosphorus were estimated in different treatment groups. However, similar values were observed without any significant differences among the groups. From this experiment, it is concluded that the diet containing 2600 k cal ME/kg diet was sufficient to meet the energy requirements of white Pekin ducks during grower stage.

Experiment 2 : - Study of the performance of White Pekin ducks during layer stage

To determine the ideal level of Metabolizable Energy (ME) in layer ducks, 144 ducks of 20 weeks of age were taken and divided into three groups. Each group had six replicates and eight No. of birds (2 males and 6 females) were kept in each replicate. Three experimental rations were prepared having three levels of ME, i.e. 2550, 2700 and 2850 kcal/kg. The experiment was conducted from 20 to 40 weeks of age. During this period, daily feed intake, egg production and egg weight were recorded. Various blood parameters and egg quality parameters were also studied. Significantly ($p<0.05$) higher egg production was observed in ME-2700 group than the other two groups (Table 43). No significant differences among the groups with respect to fertility, hatchability, egg quality and various blood parameters were observed. From this experiment, it is concluded that the diet containing 2700 kcal ME/kg diet was sufficient to meet the energy requirements of White Pekin ducks during layer stage.

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

P.K. Naik, B.K. Swain, S.K. Sahoo, S.K. Mishra, D. Kumar

Effect of feeding broken rice replacing wheat on nutrients metabolisability and egg production & quality in White Pekin ducks during first phase of laying in intensive rearing system

A study was conducted to find out the effect of feeding broken rice (BR) replacing wheat on nutrients metabolisability and egg production in White Pekin ducks during first phase of laying in intensive rearing system. White Pekin ducks (45) in first phase of laying (165 days) were divided into three groups with three replicates in each group and each replicate had five ducks. Three experimental diets without (BR-0) and with BR, replacing 50 (BR-50) and 100 (BR-100) percent wheat were prepared. The above diets were offered randomly to the above groups for a period of 115 days till the birds attained 40 weeks. At the end of the feeding trial, a metabolic trial of 4-d collection period was conducted on six birds from each group (two birds from each replicate) in individual cages. All the diets were iso-nitrogenous (18.31-18.70, %CP) and iso-caloric (2610-2660, ME, Kcal/kg).

There was no significant difference in the dry matter intake (g/d)) of the White Pekin ducks among the groups and ranged from 151.17 to 157.57. The dry matter (DM) and organic matter (OM) metabolisability (%) in BR-50 (74.81 and 75.75) was similar with BR-0 (73.97 and 74.35) and both were higher (P<0.05) than BR-100 (68.98 and 70.19). The crude protein (CP) metabolisability was significantly (P<0.05) higher in the ducks fed 50% BR (72.18), which was similar to BR-0 (70.73), but higher than BR-100 (66.41). The metabolisabilities (%) of ether extracts (EE) and crude fibre (CF) were also similar in BR-0 (78.49 and 55.98) and BR-50 (82.30 and 51.72); which were higher than BR-100 (73.31 and 45.02). The nitrogen (N) intake (g/d) was significantly lower (P<0.05) in BR-0 (3.80) than BR-50 (4.38) and BR-100 (4.36), which were similar. However, the N outgo (g/d) in groups BR-0 (1.11) and BR-50 (1.21) were similar and higher than BR-100 (1.46). There was no significant difference in N balance (g/d) among the groups and ranged from 2.69 to 3.17. The N balance as % N intake in BR-50 was 72.18, which was similar to BR-0, but higher than BR-100 (66.41).

The total egg production in dozen during the period of study ranged from 6.29 to 7.02 and were similar. Similarly, there was no difference (P<0.05) in the duck day egg production (DDEP) percentage among the groups and the values ranged from 65.11 to 72.63. The feed conversion ratio was similar among the groups and ranged from 2.62 to 2.79. The external egg quality (egg weight and egg shape index) and internal egg quality (albumen index, yolk index, Haugh unit, % albumen weight, % yolk weight, % shell weight, shell thickness with & without membrane) were similar among the groups. In conclusion, wheat can be completely replaced by broken rice in the diets of white Pekin ducks during first phase of laying in intensive rearing system; however, mixture of wheat and broken rice in equal ratio increases the metabolisability of the nutrients of the feed.

Performance of White Pekin ducks during mid phase of laying on different cereal based diets under intensive rearing system

White Pekin ducks can be reared under intensive rearing system for meat and egg production. Depending upon the availability, duck farmers use different types of cereals for feeding their ducks. A study was conducted to find out the performance of White Pekin ducks during mid phase of laying on different cereal based diets under intensive rearing system. White Pekin laying ducks (45; 41 weeks) were divided into three groups. Three types of diets without (BR-0) and with BR, replacing 50 (BR-50) and 100 (BR-100) percent of wheat were prepared and offered randomly to the above three groups till the ducks attained 52 weeks, maintaining standard feeding and management practices. Standard analytical and statistical procedures were also followed for proper interpretation of the data. The total egg production (dozen) and duck day egg production (DDEP) % were higher in BR-50 group (4.51 and 64.44) than the BR-100 group (3.85 and 55.00); however, both were similar to BR-0 group (4.09 and 58.49).

The mean value of total feed intake (12.55-13.80, kg) was similar among the groups. The feed conversion ratio (feed consumed in kg per dozen eggs produced) in BR-50 group (2.93) was non-significantly better than the BR-0 (3.07) and BR-100 (3.31) groups. The cost (Rs.) per kg feed in BR-0, BR-50 and BR-100 groups was 32.50, 31.95 and 31.56, respectively and decreased with the inclusion

Table 42. Body weight and feed intake in White Pekin ducks during grower stage fed with different metabolizable energy feed

Particulars	ME-2450	ME-2600	ME-2750	P	SEM	N
Initial body wt.	2250.81 ±22.62	2213.28 ±42.73	2240.54 ±26.06	0.694	6034.43	6
Final body Wt.	2675.96 +36.55	2735.02 +40.45	2636.37 +38.39	0.199	8209.92	6
Avg. daily feed intake	307.21 ±7.88	306.11 ±9.92	297.13 ±11.69	0.738	594.3	6
FCR	45.88 +1.86	38.29 +3.91	48.99 +4.36	0.126	76.221	6

Table 43. Egg production and fertility parameters in White Pekin ducks during layer stage

Age (wks)	ME (kcal/kg)		
Overall duck housed egg prodn *	65.35ab±1.41	68.28a±1.26	61.00b±1.36
Overall duck day egg prodn. *	66.16b±1.47	68.28a±1.26	62.65b±1.43
Total eggs/bird			
(20-40th week)	94.79±3.59	100.61±3.14	90.28±5.84
Total feed Intake (kg)	30.34±0.88	28.82±0.69	29.19±0.85
Hatchability % on FES	45.40±3.36	52.36±2.53	48.85±2.00
Hatchability % on TES	31.81±2.91	35.16±2.55	29.04±1.14
Total feed intake (kg)	30.34±0.88	28.82±0.69	29.19±0.85
Avg daily feed intake (g/d)	205.00±5.97	194.72±4.63	197.21±5.71
Feed per egg production (g/egg)	321.90±12.81	287.35±8.18	328.80±19.16

of broken rice by replacing wheat. The cost (Rs.) per egg was non-significantly lower in BR-50 group (7.79) than the BR-0 group (8.32) and BR-100 group (8.71). The egg weight in BR-50 group (76.61g) was higher than the BR-0 group (75.42 g); however, both were similar with BR-100 group (76.19 g). There was no significant difference in the mean values of egg shape index (68.22-69.69) among the groups.

The albumen index (0.13-0.14) and yolk index (0.42-0.44) were similar among the groups; however, the Haugh unit in BR-100 groups (87.32) was lower than BR-0 group (89.90); but both were similar with BR-50 group (89.56). There were no significant differences in the percentage of albumen (55.09-55.71), yolk (31.75-32.38) and shell (12.45-12.63) among the groups. Similarly, the shell thickness with membrane (0.50-0.52, mm) and without membrane (0.43-0.44, mm) were also similar among the groups. It can be concluded that White Pekin ducks during mid phase of laying can be raised on different cereal based diets under intensive rearing system; however, mixture of wheat and broken rice in equal ratio increased the performance and was economical.

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

A study was conducted to find out the effect of replacing fish meal by soybean meal on the performance of Khaki Campbell (KC) laying ducks. Seventy two (72) numbers of Khaki Campbell laying ducks (35 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, T1), without fish meal replacing fish meal completely by Soybean meal (T2) and T2+addition of Lysine and Methionine 50 % more than control diet (T3) were prepared. All the diets were made isonitrogenous and isocaloric. The above diets were offered randomly to the experimental groups for a period of 100 days. 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 metabolizability of nutrients and nitrogen balance were similar for all the groups. However, the digestibility of organic matter was significantly better for the amino acid supplemented group (T3). The egg quality characteristics viz., shape index, yolk index, albumen index and Haugh unit score were significantly ($P<0.05$) higher for ducks fed diet where fish meal was completely replaced by soybean meal with addition of lysine and methionine. It is concluded that replacement of fish meal by soybean meal with amino acid i.e. lysine and methionine supplementation improved the egg quality, i.e. shape index, albumen index, yolk index and Haugh unit without any adverse effect on the nutrient utilization in KC laying ducks.

Production and utilization of earthworm-based feed in White Pekin ducks

B.K. Swain, P.K. Naik, S.K. Sahoo, S.K. Mishra, D. Kumar and C.K. Beura

Standardization of Earthworm production in cement concrete rings

Cement concrete rings (Diameter-3ft, Height-2ft) were fixed on cement concrete floor. Shade was provided 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 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 8 inch depth in three layers. Each ring was inoculated with 500 g of earthworm (Eisenia foetida) culture. From each ring, 2.5-3.0 kg of earthworm was harvested after a period of 70-80 days.

Chemical composition of Earthworm meal

Earthworm meal contained 19.76 % DM, 55.76 % CP, 5.68 % EE, 11.32 % CF, 13.73 % Total ash, 6.19 % Acid insoluble ash and 13.51 % NFE.

Diversified rice based farming system for livelihood improvement of small and marginal farmers : (Lead centre : ICAR-NRRI, Cuttack).

A. Poonam (NRRI, Cuttack) S.C.Giri (RS, DPR, Bhubaneswar)

Rice-Fish-Duck integrated Model : ICAR-NRRI Cuttack

Studies on adaptability of ducks (Khaki Campbell) in Rice-Fish-Duck Integrated model for better economic benefit.

Khaki Campbell ducks (100 nos) were introduced to the Rice-Fish-Duck integrated model unit after 15 days of plantation of saplings. Fish fingerlings (Indian carps 4000 nos) were also added to the model at the same time. No fertilizers were applied to the rice after fish and ducks were introduced. Water level of 6 inches and above was maintained in the peripheral deeper portion always. The growth of birds, fishes and rice plants along with insect and weed control were studied. Adult ducks were kept confined within netting for some days during harvest of rice so that the fall of rice on water was checked. At the end of the experiment, the detailed economics of the model was calculated, which was found to be much beneficial to the farmer in comparison to the monocropping with rice only.

Increasing productivity and sustaining the rice-based production system through Farmer FIRST approach (Co.PI S. C. Giri) (Externally Funded Project : Lead centre : ICAR-NRRI, Cuttack)

Vanaraja unit

Training to farmers

Duck (KC) unit

Field performances of backyard chicken and ducks

During 2021, new farmers (22 nos for backyard poultry units and 8 nos for duck units) were added to the previously adopted farmers. The new farmers were briefed about brooding of day old chicks & ducklings, rearing, feeding and vaccination procedures through on-farm training programme. A total of 1200 day old chicks (Vanaraja, RIR and Kadaknath variety from CPDO, Bhubaneswar) and 240 Khaki Campbell ducklings were supplied to the farmers with other necessary critical inputs. Monitoring the health and survivability of birds were done and data were recorded from farmers field. It was observed that farmers not having own ponds are not interested for duck rearing. More farmers are interested for Kadaknath chicken due to the high market price of the birds. However, all the farmers were benefited through backyard poultry and duck rearing.

3 Technologies Assessed and Transferred

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, Farmers' days, etc. across the country. The scientists delivered TV and Radio talks 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.

Germpalsm supply

A total of 12,49,234 improved chicken germplasm was distributed to the farmers and other stake holders across the country during 2021 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 1,40,519 improved chicken germplasm during the year, out of which, 5,031 were the parents of improved chicken varieties. From the centres of AICRP and PSP, a total of 6,80,184 and 4,28,531 improved chicken germplasm, respectively was supplied during the year.

Table 1. Germ plasm supplied during 2021

S. No	Particulars	Number
A.	**Hatching Eggs**	
	Krishibro	149
	Vanaraja	10,203
	Gramapriya	12,462
	Srinidhi	1,244
	Aseel	1,619
	Vanashree	1,056
	Ghagus	1,137
	Kadaknath	4,757
	Layer	1,120
	Layer Control	630
	Broiler Control	393
	Nicobari	524
	Embryonated eggs	3,017
	Total	**38,311**
B.	**Day Old Chicks**	
	Vanaraja	25,475
	Gramapriya	35,094
	Srinidhi	4,209
	Aseel	4,495
	Vanashree	3,311
	Ghagus	4,637
	Kadaknath	15,814
	Layer	985
	Nicobari	107
	Total	94,127
C	**Parents**	
	Vanaraja	1,110
	Gramapriya	3,201
	Srinidhi	720
	Total	**5,031**
D	**Grownup birds supplied in STC, DAPSC and at DPR**	3,050
	Net Total	1,40,519
	Supply to DPR pure line & commercial farms	43,120
	Total feed supply in Kg	3,651
	Revenue Generated (Rupees)	
1	Germplasm Supply (Hatchery)	72,42,113
2	TOT Supply (Sales)	37,98,795
	Total Revenue Generated (Rs.)	**1,10,40,908**

Schedule Tribe Component/ TSP Program

ICAR-DPR distributes inputs for backyard poultry rearing to tribal farmers of Adilabad district, Telangana

The Directorate distributed improved backyard chicken varieties (Vanaraja and Gramapriya) to Gond tribes of Tummaguda village (Indervalli Mandal), Adilabad district (Telangana) on 25th September 2021 under the DAPSTC 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 grown-up birds (825), night shelters (100), feeders (100), waterers (100) and feed (1600kgs) were distributed to 100 farmers to establish a small backyard unit as a subsidiary income provider. Dr. R.N. Chatterjee, Director, ICAR-DPR addressed the farmers and explained about the role of backyard poultry in sustainable rural livelihoods and doubling farmers income by 2022.

Distribution of inputs for backyard poultry farming under TSP program by Dr. R.N. Chatterjee, Director and Scientists

Peoples' representatives from local bodies actively participated in the programme and appreciated the efforts taken by the Directorate for the upliftment of the tribal farmers. The programme was attended by 200 tribal farmers including women in large numbers. Wearing masks, maintaining social distancing and SOP as per COVID guidelines were followed. The team of Scientists from the Directorate interacted with tribal beneficiaries and elaborated about scientific rearing of rural improved chicken varieties to obtain maximum benefit from the birds. Dr. M.V.L.N. Raju, Dr. U. Rajkumar, Dr. L.L.L. Prince, Dr. B. Prakash, Dr. K.S. Rajaravindra and Dr. S. Jayakumar from the Directorate participated in the programme. The programme was organized and coordinated by the STC cell of the Directorate.

Shri Soyam Babu Rao, Hon'ble Member of Parliament (Lok Sabha) participated in TSP program organized at Heerapur village, Adilabad, Telangana

The Directorate organized backyard poultry distribution programme at Heerapur village of Adilabad district of Telangana under the Development Action Plan for Scheduled Tribes (TSP) on 24th December 2021. Seventy-six farmers were given poultry birds, night shelter, feeder, waterer and medicine kit. The farmers were given demonstration and hands on training on scientific rearing of poultry. They were also appraised about the additional benefits of rearing the improved chicken varieties like Vanaraja, Gramapriya and Srinidhi before the input distribution.

Shri Soyam Babu Rao, Hon'ble Member of Parliament (Lok Sabha) participated in the program as the Chief Guest. He highlighted the importance of poultry and livestock sector in making agriculture profitable. He narrated the vision of Prime Minster in doubling the farmers income and the role of poultry towards achieving the goal. He appreciated the efforts of ICAR-DPR in popularizing backyard poultry in the tribal district of Adilabad and urged the Director to cover more number of villages in future. Dr. R.N. Chatterjee, Director, ICAR-DPR presided over the programme and emphasized the role of the institute in livelihood and income generation through backyard poultry in the country. Dr. U. Rajkumar, Pr. Scientist & In charge, TSP programme explained about the objective and implementation of the TSP program in Adilabad district. The Sarpanch and MPTC of Heerapur village, other representatives of local bodies from Indravelli Mandal, officials from ITDA, Utnoor and team of scientists from ICAR-DPR participated in the program. Dr. B. Prakash, Pr. Scientist, ICAR-DPR, Hyderabad proposed vote of thanks.

Shri Soyam Babu Rao, Hon'ble Member of Parliament (Lok Sabha) distributing inputs

Distribution of night shelters at Yapalguda Village

ICAR-DPR distributed a total of 74 numbers night shelters to 74 tribal beneficiaries of Yapalguda Village, Neradigonda (Mandal), Adilabad district, Telangana on 23rd December 2021. The tribal farmers were explained about the benefits of backyard farming and its management practices under free range backyard system.

Feedback and Impact analysis of TSP programme

ICAR-DPR has been continuously working with the tribal community of Adilabad district of Telangana through backyard poultry. The major emphasis was to create an alternative and supportive source of income, food security especially enhancing the animal protein consumption in diet and employment generation. In the last two years, the income through poultry has increased by 204% and the major contributor was flock size (increased by 174.7%) and reduced mortality by predators (300%). The increased flock inventory also contributed to increased egg consumption by 179.2% (weekly basis/household) and chicken meat consumption by 230% (monthly basis/household). Most of the women members were involved in taking care of these birds and there was about 1 man-day extra employment created in the household.

Development Action Plan for Scheduled Caste

ICAR-DPR implemented the Development Action Plan for SC (DAPSC) work in Andhra Pradesh, Telangana and West Bengal during the period. The Directorate has also signed a MOU with YFA - Krishi Vigyan Kendra, Wanaparthy, Mahabubnagar on September 02, 2021 for implementation of the DAPSC programme among SC families of Telangana.

Andhra Pradesh

In Andhra Pradesh, two field trainings and input distribution programmes were organised at Mulpuru and Inturu villages of Amruthalur Mandal, Guntur district, in association with Department of Animal Husbandry, Andhra Pradesh. A total of 200 SC families were trained on backyard poultry farming and 1254 grownup birds, 1200 kg of feed, 100 temporary night shelters, 200 feeders and waterers and 200 packets of medicine and vitamins, and pamphlets on backyard chicken farming were distributed to start backyard poultry farming. A base line data survey was also conducted to evaluate the living standards of the beneficiaries.

Telangana

During the period, in association with Department of Animal Husbandry, Telangana, one on field training cum input distribution programme was organised in Shedpally and Sankarapur villages of Kottapalle mandal, Mancherial district in Telangana. A total of 100 SC families were trained on backyard poultry farming and a total of 492 grownup birds, 600 kgs of feed, 100 temporary night shelters, 100 feeders and 100 waterers and 100 packets of medicine and vitamin, and pamphlets on backyard chicken farming were distributed to start backyard poultry farming.

West Bengal

In West Bengal, as per the MoU signed between the Directorate and ICAR-Central Institute of subtropical Horticulture, Krishi Vigyan Kendra, Malda (CISH- KVK), the DAPSC programme is being implemented by CISH -KVK, Malda. Ten community poultry brooding units were established in Malda district for nursery rearing of chicks up to 4 weeks. After nursery rearing in brooding centres, these grown up chicks are distributed to SC families to start back yard poultry farming. A total of 5562 grown up chicks, 255 feeders, 255 waterers and other inputs were provided to 401 SC families to start backyard poultry farming in West Bengal during the period.

ICAR-DPR implemented the Development Action Plan for SC (DAPSC) work in Andhra Pradesh, Telangana and West Bengal during the period. The Directorate has also signed a MOU with YFA - Krishi Vigyan Kendra, Wanaparthy, Mahabubnagar on September 02, 2021 for implementation of the DAPSC programme among SC families of Telangana.

On-field training and input distribution programme under DAPSC at Inturu village, Andhra Pradesh

On-field training and input distribution programme under DAPSC at Sankarpur village, Telangana

Backyard poultry units in West Bengal

Technologies Assessed and Transferred at RS- Bhubaneswar

In a television programme Dr M. K.Padhi participated in discussion on Avian farming for Atma Nirbhar on Naxatra news, a 24X7 Multilingual satellite news channel on Special program (DISHA) on science and technology of CSIR/ICAR/DBT/ICMR/IIT. This program is aiming to popularize the innovation of scientist among the people of India for societal development. The recorded programme was telecasted on 22nd July, 2021 at 9.30 PM.

Trainings imparted

Sl no	Date	Place	No farmers	Organizer	Remarks
1.	10.02.21	Nabarangpur	51	ICAR –CHES Bhubaneswar	Trained in different aspects of duck farming
2.	28.02.21	KVK, Khurda	65	KVK, Khurda	Backyard poultry and duck production
3.	27.03.21	Village Satyabhamapur, Cuttack	42	ICAR-NRRI, Cuttack	Training on livestock production under Farmers First project

4 Training and Capacity Building

In the training programmes organized by different organizations, staff of the Directorate participated to update and gather knowledge in different aspects including science and technology, administration and financial management. The details of training programmes attended by the staff have been stated in the following Table.

S.No.	Particulars of training	Official(s)	Duration	Organiser/Venue
1	Online Training Programme on Time Series Data Analysis	Dr. Vijay Kumar, Sr. Scientist	4-9 January 2021	ICAR-NAARM, Hyderabad
2	Generic Online Training in Cyber Security	Dr. L. Leslie Leo Prince, Pr. Scientist	21 January 2021	ISEA, Ministry of Electronics and Information Technology
3	Online Training on Accrual Accounting by Council	Sri. R. Sudarshan, AFAO	19-21 January 2021	ICAR- NRRI Cuttack
4	Virtual Online Training Programme on "Administration and Financial Issues"	Sri. A.V.G.K. Murthy, AO Smt. R.T. Nirmala Veronica, AAO Smt. T.R. Vijaya Lakshmi, Asst. Sri. Rajesh Parashar, UDC Sri R. Ganesh, LDC	15-17 February 2021	ICAR-IIHR, Bengaluru
5	NABL Assessor Training Programme	Dr. T.K. Bhatttacharya, National Fellow Dr. M. Shanmugam, Sr. Scientist Dr. K.S. Rajaravindra, Sr. Scientist	10-12 March 2021	NABL, Gurgoan
6	Online Training on "Advance course on preventive vigilance"	Dr. M.V.L.N. Raju, Pr. Scientist	6 -7 July 2021	National Productivity Council, New Delhi
7	Online Training Program on Transcriptomic Data Analysis	Dr. S. Jayakumar, Sr. Scientist	28-30 September 2021	CABIN, ICAR-IASRI, New Delhi
8	Training programme on data analysis in social sciences research (online)	Dr. Vijay Kumar, Sr. Scientist	4-8 October 2021.	ICAR-NAARM, Hyderabad
9	Onsite Training programme on Laboratory Assessors Course organized by National Accreditation Board for Testing and Calibration Laboratories (NABL)	Dr. M. Shanmugam, Sr. Scientist Dr. K.S. Rajravindra, Sr. Scientist	21-23 October 2021	NABL, Bengaluru
10	Virtual Regional Training Course on Bioinformatics data analysis for biodiversity and genome-wide association studies in livestock	Dr. S. Jayakumar, Sr. Scientist	15 -26 November 2021	FAO/IAEA and RIAH, Mongolia
11	Training programme on Impact Assessment of Agricultural Research and Technology (online)	Dr. Vijay Kumar, Sr. Scientist	18-22 December 2021	ICAR-NAARM, Hyderabad

5 Awards and Recognitions

- Dr. T.K. Bhattacharya, Pr. Scientist was awarded the Fellowship of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) (Fellow-SOCDAB), which was conferred by the Society for Conservation of Domestic Animal Biodiversity (SOCDAB), Karnal, Haryana.
- Dr. S.S. Paul, Pr. Scientist was awarded the Distinguished Scientist award 2021 by Indian Society for Buffalo Development (a registered professional Society).
- Dr. U. Rajkumar, Pr. Scientist was conferred with C.K. Rao Trust award for the Best Poultry Scientist for the year 2021 for outstanding contribution to the Poultry sector development in Telangana.
- Dr. U. Rajkumar, Pr. Scientist was awarded the Padmasri Prof I.V. Subba Rao Rythu Nestham award for the year 2021 for outstanding contribution for the development and welfare of farmers in the field of poultry farming.

Best Ph.D. Thesis Award

Dr. N.K. Dharanesha (supervised by Dr. M.R. Reddy, Principal Scientist, ICAR DPR) received the IAVP Best Ph.D. thesis award during the virtual International Veterinary Pathology Congress organised by RAJUVAS, Bikaner, Rajasthan during 17-19 December 2021.

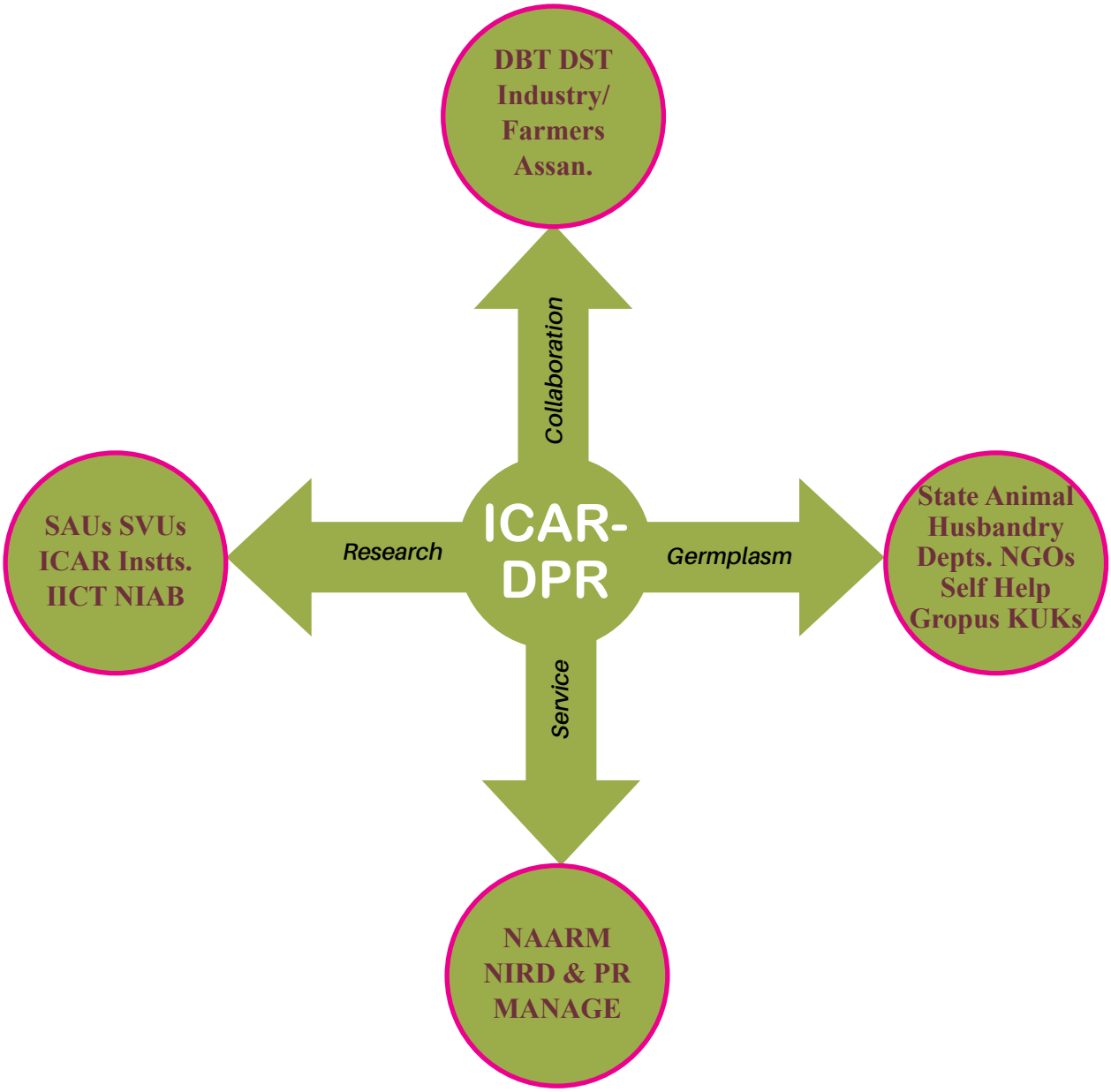
Best Poster Awards

- S. Sruthi, M. R. Reddy, M. Asok Kumar, S. K. Latheef, S. Vishnu and K. S. Prasanna were awarded the Best Poster presentation award-2021 during the virtual International Veterinary Pathology Congress organised by RAJUVAS, Bikaner, Rajasthan during 17-19 December 2021.
- S. Sruthi, M. R. Reddy, M. Asok Kumar, S. Vishnu and K. S. Prasanna were awarded the Best Poster (2nd Prize) presentation award-2021 during Kerala Veterinary Science Congress organized by Indian Veterinary Association at College of Veterinary Science and Animal Sciences, Mannuthy, Thrissur, Kerala during 13-14 November 2021.
- Shanmugam M. and R.K. Mahapatra were awarded with third prize for their e-poster during the XVIII Annual Convention and National Webinar of Society for Conservation of Domestic Animal Biodiversity organised during 11-12 February 2021.

Dr. U. Rajkumar receiving the CK Rao Trust award and Rythu Nestham award

6 Linkages and Collaborations

The 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 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 6,80,184 chicken germplasm was distributed to 4,747 farmers/beneficiaries from different centres. An amount of Rs. 200.80 lakhs revenue was generated through sale of the improved chicken germplasm during the year.

The AICRP on Poultry Breeding, Mannuthy centre has evaluated the S-6 generation of native chicken germplasm up to 40 weeks of age during the calendar year 2021. Egg production of native chicken germplasm up to 40 weeks of age was 77.11. Egg production and egg weight remained the same as compared to the previous generation. Hen-housed egg production up to 72 weeks of age was 292.94 in IWN and 278.89 in IWP lines. The values of hen-day and survivors' egg production up to 72 weeks of age were 301.82 and 302.05 respectively in IWN and 293.61 and 293.02, respectively in IWP lines in S-32 generation. A three-way cross has been produced and its evaluation is under progress. The center has bagged the prestigious ICAR-NBAGR, Breed Conservation Award 2021 under institution category for conserving *Tellichery* chicken breed. The centre distributed a total of 30,416 number of germplasm to 221 beneficiaries and generated revenue of Rs. 13.21 lakhs.

The AAU, Anand centre evaluated native chicken, i.e. "*Ankleshwar*" and White Leghorn strains (IWN, IWP, IWD and IWK) during the year 2021. The egg production up to 40 weeks of age was 82 eggs in the present generation of "*Ankleshwar*" chicken, which was higher as compared to last generation (76). Egg production up to 72 weeks of age was 307 and 310 eggs in IWN and IWP strains (S-1) and egg production up to 40 weeks of age was 127 and 125 eggs in IWN and IWP strains (S-2), respectively. Egg production up to 64 weeks of age was 234 and 223 eggs in IWD and IWK strains (S-9 gen.), respectively. The centre has supplied a total of 77,365 chicken germplasm to 1487 beneficiaries during the year 2021. The centre has generated revenue of Rs. 31.11 lakhs.

The Bengaluru centre evaluated PB-1 and PB-2 coloured broiler lines. Raja II (the commercial strain with 1.90 kg body weight at 7th week and 2.10 FCR) chicks were distributed to the farmers. The five week body weight was 956.2 and 947.2 g in PB-1 and PB-2 lines. The body weight of native chicken at 8 and 40 weeks was 25535 and 1481 g, respectively. The centre has supplied 1,99,309 chicken germplasm to the farmers during the year 2021 with a total revenue of Rs 54.02 lakhs. A total of 330 farmers benefitted during the period.

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 1172, 1078 and 806 g in PB-1, PB-2 and control broiler, respectively. The average egg production up to 36 weeks of age in PB-1, PB-2, and control broiler was 58, 61 and 57 eggs, respectively. The body weight in *Punjab Brown* at 4, 8, 16, 20 and 40 weeks of age was 483, 693, 1424, 1986 and 2685 g, respectively. The average egg production up to 36 weeks for *Punjab Brown* was 67.5 eggs. A total of 95,463 germplasm were supplied during the reporting period to 360 farmers. The revenue generation was around Rs.22 lakhs during 2021.

The Bhubaneswar centre maintained *Hansli*, CSML, CSFL and their crosses during the year. *Hansli* birds were procured from the native tract to re-establish the flock in the farm. The body weight of *Hansli* at day-old and 8 and 20 weeks of age was 30.2, 447.9 and 1534 g, respectively. Preliminary studies on phenotypic characterization and production traits of native *Vezaguda* and *Phulbani* chickens have been carried out in their native tract.

The ICAR-CARI, Izatnagar centre evaluated the local native chicken, CSML and CSFL during the year 2021. Development and improvement of dual purpose backyard cross was continued. The good chicks produced in CSML, CSFL and native were 3163 and 3518 and 1280, respectively. The fertility percentage was 72.4 and the hatchability percentage based on TES and FES were 64.8 and 89.6, respectively in CSML. Corresponding values in CSFL were 72.9, 65.6 and 90.0 percent, respectively. The germplasm supply was 55,241 with revenue of Rs. 3.64 lakhs. A total of 54 farmers were benefited.

The Udaipur centre evaluated *Mewari,* RIR, CSFL and *Pratapdhan* populations during the year. The hen day egg production up to 72 weeks of age in *Mewari* and *Pratapdhan* was 98.29 and 158.2 respectively. The evaluation of meat type chicken variety both at farm and under field conditions was carried out. The pooled body weight at 12 weeks of age under farm and field conditions was 1665 and 1537g, respectively. The centre supplied 19,686 germplasm to 506 farmers and generated revenue of Rs 5.33 lakhs during the period.

The Jabalpur centre evaluated *Kadaknath,* Jabalpur colour (JBC) and *Narmadanidhi* populations during the year. JBC females matured at 155 days and produced 152 eggs up to 52 weeks of age. The body weight of *Kadaknath* females at 6, 20 and 40 weeks of age was 398, 1045 and 1453g, respectively. *Kadaknath* females matured at 168 days and produced 87.6 eggs up to 52 weeks of age. *Narmadanidhi* birds were evaluated under field condition and attained 8 week body weight of 765g in males and 625.5g in females. Egg production up to 40 and 52 weeks was 47.5 and 88.7, respectively. Under TSP and SCSP components, a total of 8 trainings were conducted and 4000 grownup birds, feed and equipment were distributed to 160 beneficiaries. During the year, a total of 40,052 germplasm was distributed to 328 farmers with a revenue generation of Rs. 21.29 lakhs.

The Guwahati centre evaluated *Daothigir*, *Dahlem Red*, PB-2 and BN populations. Initially 80 numbers of *Daothigir* birds were procured from Kokrajhar district and the population was raised to 875. A total of 1208, 96, 469 and 1518 good chicks of *Daothigir*, PB-2, BN cross and *Dahlem Red* were produced and performance was evaluated. The centre supplied a total of 39,181 numbers of germplasm to 187 farmers with a revenue receipt of Rs. 7.36 lakhs during the year.

The Palampur centre evaluated native chicken, *Dahlem Red*, DN cross and *Himsamridhi* during the year. The hen housed egg production at 40 weeks and 52 weeks was 48.75 and 81.58 eggs, respectively in native chicken. The 64 weeks HDEP was 165.53 eggs in *Dahlem Red*. In DN cross, the HHEP at 40 weeks and 52 weeks was 69.85 and 110.88 eggs, respectively. The HDEP up to 40 weeks was 75.2 eggs in *Himasamridhi* under farm condition. A total of 66,193 germplasm was distributed to 585 farmers of Himachal hill region. An amount of Rs. 18.37 lakhs revenue was generated during the year.

The Ranchi centre evaluated native chicken, *Dahlem Red*, PB-2 and *Jharsim* populations. The hen day egg production of native chickens was 78.19 (G-9) at 52 weeks of age. The body weight at day old and 4 weeks of age was 28.12 and 167.4 g in native chickens (G-10). The hen day egg production in *Jharsim* was 82.72 eggs up to 52 weeks of age. The ASM was 164 days. The centre supplied 30,656 germplasm among 192 farmers, NGOs, KVKs and other agencies. The revenue receipt was Rs. 7.01 lakhs.

The Tripura centre evaluated *Tripura Black*, *Dahlem Red*, broiler dam line and their crosses during the year. The 72 week-egg production of BND cross (E4) was 170.13 and 142.13 under farm and field conditions, respectively. The age at first egg of BND cross at Institute farm and farmers' fields was 132.6 and 145 days, respectively. During the period, a total of 26,622 chicks were supplied to 497 farmers of Tripura with a revenue receipt of Rs. 17.46 Lakhs.

Table 1. Germplasm distribution, farmers benefited and revenue generation during 2021

Centre	Germplasm (Nos.)	Farmers (Nos.)	Revenue (Rs. in Lakhs)
KVASU, Mannuthy	30,416	221	13.21
AAU, Anand	77,365	1,487	31.11
KVAFSU, Bengaluru	1,99,309	330	54.02
GADVASU, Ludhiana	95,463	360	22.00
OUAT, Bhubaneswar	-	-	-
ICAR-CARI, Izatnagar	55,241	54	3.64
MPUAT, Udaipur	19,686	506	5.33
NDVSU, Jabalpur	40,052	328	21.29
AAU, Guwahati	39,181	187	7.36
CSKHPKVV, Palampur	66,193	585	18.37
BAU, Ranchi	30,656	192	7.01
ICAR-RC NEH, Agartala	26,622	497	17.46
Total	**6,80,184**	**4,747**	**200.80**

8 Poultry Seed Project

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 2021 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 4,28,531 improved chicken varieties have been distributed in their respective regions/states with a revenue receipt of Rs. 151.15 lakhs during the year.

The Patna centre reared one batch of Vanaraja parents. A total of 49,042 Vanaraja chicken germplasm was distributed to 1088 numbers of farmers in Bihar during the year 2021 with an amount of Rs. 21.49 lakhs revenue. One batch each of Vanaraja and Srinidhi were in position at Jharnapani centre. A total of 52,444 numbers of germplasm were supplied to 856 tribal farmers of Nagaland and neighbouring states during the year 2021. A total of Rs. 25.14 lakhs revenue was generated at the Jharnapani Centre.

Three batches of Vanaraja parents were reared at ICAR-NOFRI, Gangtok, Sikkim. A total of 71,445 improved chicken germplasm of Vanaraja were distributed to 2,302 farmers covering 348 village habitats in Sikkim with an amount of Rs. 29.34 lakhs revenue. One batch each of Vanaraja and Srinidhi parents were reared at the Manipur Centre during the year. A total 10,432 improved chicken germplasm were distributed to 92 farmers in Manipur. The Centre has generated Rs. 4.11 lakhs of revenue during the year.

A total of 1,04,119 improved rural chicken (Vanaraja and Gramapriya) germplasm were distributed to 1,635 farmers in Tamil Nadu by Hosur Centre during the reporting period. The Centre has generated total revenue of Rs. 28.4 lakhs during the year. One batch each of Vanaraja and Krishibro parents were reared at Goa centre during the year. A total of 36,379 improved chicken germplasm were distributed to 1,216 farmers in Goa with revenue generation of Rs. 7.4 lakhs.

One batch of Nicobari parents was reared under deep litter system at Port Blair. A total 3,000 chicken germplasm were distributed to 55 farmers in Andaman & Nicobar Islands with revenue of Rs. 37878/- during the year. One batch of Vanaraja parents was reared at ICAR RC for NEH Region, Umiam, Meghalaya. A total 10,052 improved chicken germplasm were distributed to the farmers in Meghalaya with an amount of Rs. 11.64 lakhs of revenue during the year 2021.

One batch of Vanaraja parents was maintained at SVVU, Tirupati, Andhra Pradesh. A total of 26,276 chicks were supplied to 402 farmers and generated Rs.3.18 lakhs as revenue by sale of chicks and eggs during the year. Four batches of parents of Gramapriya, three batches each of Vanashree and Aseel, and one batch each of Kadaknath and Ghagus were reared at PVNRTVU, Warangal, Telangana during the year. A total of 50,537 improved rural chicken germplasm was distributed to 173 farmers. The centre has generated total revenue of Rs. 12.36 lakhs during the year. The Srinagar centre reared two batches of Vanaraja parents during the year. A total of 14,805 chicks were distributed to 1,467 farmers. An amount of Rs. 7.72 lakhs revenue was realized during year.

Table 1. Centre-wise distribution of germplasm under Poultry Seed Project during 2021

Sl. No.	Centre	Germplasm (Nos.)	Revenue (Rs. in lakhs)
1	BASU, Patna	49,042	21.49
2	ICAR-RC, Jharnapani	52,444	25.14
3	ICAR-RC, Gangtok	71,445	29.34
4	ICAR-RC, Imphal	10,432	4.11
5	TANUVAS, Hosur	1,04,119	28.4
6	ICAR-CCARI, Goa	36,379	7.4
7	ICAR-CIARI, Port Blair	3,000	0.37
8	SKUAST, Srinagar	14,805	7.72
9	ICAR-RC for NEHR, Umiam	10,052	11.64
10	PVNRTVU, Warangal	50,537	12.36
11	SVVU, Tirupati	26,276	3.18
12	WBUAFS, Kolkata	-	-
Total		**4,28,531**	**151.15**

9 Publications

I. Headquarters, Hyderabad

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Anand Laxmi, N. 2021. Keynote paper : Comparative Studies on Differential Regulation of Different Physiological Parameters Influencing Egg production in Vanaraja and Aseel hens and Effect of Supplementation of Selenium During Early Laying Period during 12-13 October 2021 in the webinar conducted by VetCong-2021 at Hanoi, Vietnam.

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10 Research Projects in Operation

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
DPR, Hyderabad				
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. Santosh 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 (NRC Meat)	2020-25
4	Improvement and maintenance of elite layer germplasm (Project No. ANSCDPRSIL202000500075)	Dr. K.S. Rajaravindra	Dr. R.N. Chatterjee Dr. T.K. Bhattacharya Dr. M. Niranjan Dr. U. Rajkumar Dr. Santosh 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 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 Dr. S. Jaya Kumar	2020-22
8	Development of bio-fortified chicken variety enriched with minerals in eggs	Dr. T.K. Bhattacharya	Dr. R.N. Chatterjee Dr. M.R. Reddy Dr. M. Niranjan Dr. U. Rajkumar Dr. Santosh Haunshi Dr. L. Leslie Leo Prince Dr. B. Prakash Dr. M. Shanmugam Dr. Vijay Kumar Dr. S.K. Bhanja	2021-23
9	Exploration of Genomic architecture of the Indian native ducks using whole genome sequencing and transcriptome analysis	Dr. T.K. Bhattacharya	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 Dr. D.C. Mishra-IASRI, New Delhi	2021-23

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
10	Genome wide profiling of long intergenic non-coding RNAs, miRNAs and mRNAs during the asymmetric ovarian development of Chicken	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 exploit its 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.R. Reddy Dr. M. Shanmugam	2020-23
13	Identification and characterization of residual feed intake specific SNPs and candidate genes in coloured broiler	Dr. S.S. Paul	Dr. U. Rajkumar Dr. L.L. Prince Dr. S.V. Rama Rao Dr. S. Jayakumar Dr. M.V.L.N. Raju Dr. S.P. 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
16	Exploring medicinal plants as alternative to antibiotic growth promoters (AGP) in broiler production (Project No. – ANSCDPRSIL201500700056)	Dr. D. Suchitra Sena	Dr. B. Prakash	2015-22
17	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. Santosh Haunshi Dr. S.P. Yadav	2019-22
18	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
19	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
20	Poultry rearing with moringa and other feed base - an Integrated Farming System (Project No. ANSCDPRSIL202001200082)	Dr. R.K. Mahapatra	Dr. S.K. Bhanja Dr. B. Prakash Dr. M.R. Reddy	2020-24
21	Cryopreservation of blastodermal cells and production of chicken chimera	Dr. M. Shanmugam	Dr. N. Anand Laxmi Dr. T.K. Bhattacharya	2021-24
22	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

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
B. Externally Funded Research Projects				
1	Life cycle assessment of broiler 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	2018-2023
3	Chicken or egg : Drivers of antimicrobial resistance in poultry in India (DBT)	Dr. S.V. Rama Rao	Dr. S.S. Paul	2018-22
4	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
5	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
6	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
7	INFAAR (Indian Network of Fisheries and Animal Antimicrobial Resistance) (Network project)	Dr. D. Suchitra Sena	Dr. M.R. Reddy Dr. S.K. Bhanja Dr. T.R. Kannaki	2020-24
8	Model Project and Demonstration Unit for Backyard Poultry, Livestock Vermifarming and Moringa Integration (DAHD)	Dr. R.K. Mahapatra	Dr. S.K. Bhanja Dr. B. Prakash	2020-23
9	Consortium Research Platform (CRP) on Agro-biodiversity	Dr. T.K. Bhattacharya	Dr. M. Shanmugam Dr. S. Jayakumar	2021-26
List of projects completed during 2021				
Institute Funded Projects				
1.	Evaluation and standardization of protocol for cryopreserving semen of DPR pure lines	Dr. M. Shanmugam	Dr. N. Anand Laxmi Dr. R.K. Mahapatra	2018-21
2.	Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry (National Fellow)	Dr. T.K. Bhattacharya		2016-21
3.	Development of transgeneic chicken for production of human interferon alpha 2b:A therapeutic for treatment of viral diseases in human (DBT)	Dr. T.K. Bhattacharya	Dr. R.N. Chatterjee	2018-21

DPR, Bhubaneswar				
A. Institute Funded Projects				
1.	Nutrient requirements of White Pekin ducks	Dr. S.K. Sahoo	Dr. B. K. Swain Dr. P. K. Naik Dr. S. C. Giri	2020-23
2.	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	2018-23
3.	Production and utilization of earthworm based feed in White Pekin ducks	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

Sl. No.	Project Title	PI	Name of Co-PIs	Project Duration
4.	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
5.	Arsenic toxicity and its amelioration with some herbs in ducks.	Dr. D. Kumar	Dr. P. K. Naik Dr. S. K. Mishra Dr. B.K. Swain	2018-21
6.	Surveillance and monitoring of common duck diseases of Odisha.	Dr. D. Kumar	Dr. P. K. Naik Dr. S. K. Mishra Dr. B.K. Swain	2017-21
7.	Aflatoxin-tolerant duck production through genetic and epigenetic approaches	Dr. S. K. Mishra	Dr. P. K. Naik Dr. B.K. Swain Dr. D. Kumar	2017-21
8.	Breeding for Development of Mycotoxin Tolerant Meat Type ducks	Dr. S. K. Mishra	Dr. C. K. Beura Dr. P. K. Naik Dr. B.K. Swain Dr. D. Kumar Dr. Rajalaxmi Behera	2021-25
B. Externally Funded Projects				
1.	Genetic up-breeding of duck production to strengthen livelihood security in NER of India by converging conventional and molecular techniques (DBT).	Dr. M.K. Padhi	Dr. S.K. Sahoo Dr S.C. Giri	2018-21
C. Inter-institutional Projects				
1.	Diversified rice based farming system for livelihood improvement of small and marginal farmers : (Lead centre : ICAR-NRRI, Cuttack)	Dr A. Poonam-PI (ICAR-NRRI, Cuttack)	Dr. S. C. Giri	2016-24
2.	Increasing productivity and sustaining the rice based production system through Farmer FIRST approach. (Externally Funded Project : Lead centre : ICAR-NRRI, Cuttack)	Dr S. K. Mishra PI (ICAR-NRRI, Cuttack)	Dr. S. C. Giri	2019-23
List of projects completed during 2021				
Institute Funded Projects				
1.	Aflatoxin-tolerant duck production through genetic and epigenetic approaches	Dr. S. K. Mishra	Dr. P. K. Naik Dr. B.K. Swain Dr. D. Kumar	2017-21
Externally Funded Projects				
1.	Farm based S&T Interventions for Socio-economic Development in the Aspirational District of Nabarangpur, Odisha (RKVY).	Dr. M.K. Padhi	Dr. R.K.S. Bais Dr. K.V.H. Sastry Dr. S.K. Sahoo Dr S.C. Giri	2019-21
2.	Surveillance and monitoring of common diseases in ducks of Odisha (RKVY).	Dr. D. Kumar	Dr. P.K. Naik Dr. S.K. Mishra Dr. B.K. Swain	2017-21

11 Consultancy, Contract Research and Commercialization of Technologies

Institute Technology Management Unit (ITMU)

Institute Technology Management Unit at ICAR-DPR is managed by Institute Technology Management Committee (ITMC). The 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. The ITMC is chaired by the Director of the Institute.

ITMC Meetings Conducted

The ITMC meetings were conducted thrice during the year on 30th January, 27th April and 21st September 2021. The meetings were held to examine patent applications for their novelty and commercial applicability, to review Trademarks application of feed additive "Oxycure" and evaluation of technologies developed at this Directorate for commercialization.

Technologies Approved for Commercialization

One technology developed at this Directorate having commercial value and practical application in poultry industry was approved and submitted to Agrinnovate India Limited, New Delhi, for commercialization to reach the end users and benefit them. Details are provided in Table 1.

Table 1. Technology approved for commercialization

S.No.	Technologies Developed	Inventor
1	Kit for gender determination in birds	Dr.T.K. Bhattacharya

Request for Examination of Patents

The details of requests for examination of patents received during the year 2021 are given in Table 2.

Request for Examination of Trademarks (2021)

The details of requests for examination of Trademarks received during the year 2021 are given in Table 3.

Contract Research

The facilities of the Directorate were extended for the benefit of poultry industry through the contract research mode of ICAR. One project was in operation during the year, viz. "Evaluation of sea plant extracts as alternative to antibiotic growth promoters in broilers chickens" for M/s Sea6 Energy Private Ltd., Bellary road, Bengaluru for 12 months from September 2020 (Rs. 15.81 lakhs).

Table 2. List of requests received for examination of patents during 2021

S.No	Name of innovation	Date of filing	Application no.	FER/Hearing notice issued on	FER submitted/ Hearing attended on
1	A simple method of detection of protein(s) by using a paper-dip assay kit	25th July 2018	TEMP/E-1/30619/2018-CHE	FER issued on 19th May 2021	Hearing attended on 4th June 2021
2	Primers and method for detection of haplotypes on promoter of a gene and its use in poultry	27th March 2013	1365/ CHE/2013	Hearing notice issued on 3rd May 2021	Hearing attended on 9th June 2021

Table 3. List of requests received for examination of Trademarks during 2021

S. No	Trademarks	Date of filing Application	Application Number	FER/Hearing notice issued on	FER submitted/Hearing attended on
1	VANASHREE	24th February 2021	4877929 Class 29/31	Hearing notice issued on 11th March 2022	Hearing will be attended on 4th April 2022
2	SRINIDHI	24th February 2021	4877930 Class 29/31	Hearing notice issued on 11th March 2022	Hearing will be attended on 4th April 2022

Research Project Proposal (RPP)

With the aim of human resource development of the Scheduled Caste and promotion of free-range back yard poultry farming utilizing the potential of *Vanaraja*, *Gramapriya*, *Srinidhi*, Aseel, Kadaknath etc. in the rural areas, ICAR-DPR entered into the following agreements with the objective of empowering tribal farmers through backyard poultry (Table 4).

Contract Service project

Under contract service of ICAR-Professional service functions, a total revenue of Rs. 1,58,787/- has been generated by providing diagnostic services including PCR, serology and bacteriological services on cost basis. An MoU was signed with M/s Sree Ramadootha Poultry Research Farm Pvt. Ltd., Hyderabad and Indbro Research and Breeding Farms Pvt. Ltd., Hyderabad for providing diagnostic services.

Table 4. List of MoUs entered during 2021

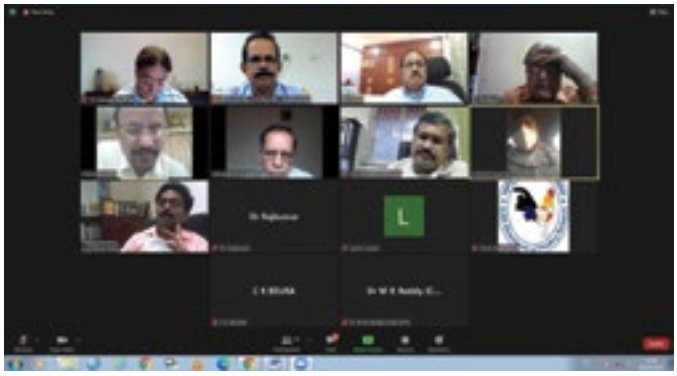
S.No.	Organization with whom MOU signed	Mode	Title of the Project	Date of Agreement	Date of completion
1	ICAR – National Research Center on Yak, Dirang, Arunachal Pradesh (ICAR-NRCY)	RPP	Empowering tribal yak farmers through backyard poultry farming in NEH region	18.10.2021	18.10.2022
2	College of Veterinary Sciences & Animal Husbandry, Central Agricultural university, Imphal	RPP	Empowering tribal farmers through backyard poultry farming in NEH region and improving their livelihood through small scale poultry processing and value addition in NEH region	30.8.2021	30.8.2024
3	ICAR Research Complex for NEH Region, Umiam, Meghalaya (ICAR-NEH)	RPP	Empowering tribal farmers through backyard poultry farming in NEH region	27.01.2021	27.01.2022

12 Committees

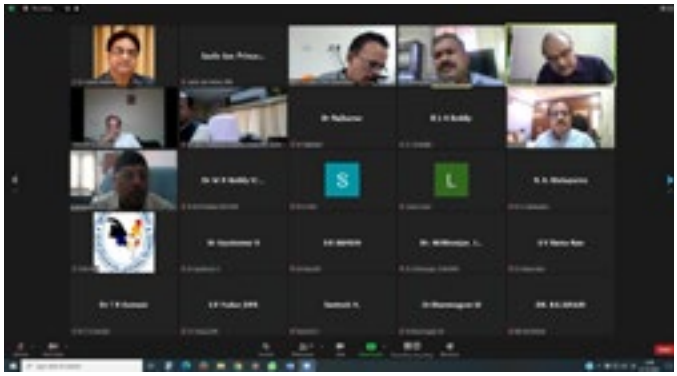
Research Advisory Committee

The meeting of Research Advisory Committee was held in virtual mode on 28th September 2021 and 27th October 2021 (in two phases). Prof. B.B. Mallick, Chairman, RAC chaired the 1st meeting on 28th September 2021 wherein all the RAC members including the ADG (AP&B), ICAR participated. Prof. Mallick in his opening remarks said that the varieties developed by ICAR-DPR have become extremely popular at the pan India level and contributing immensely to the poultry production in the country with promising upward trend over the past few decades. Dr. R.N. Chatterjee, Director presented a brief overview of the research progress during the year 2020. The committee was informed that a total of 15.7 lakh germplasm was supplied covering all the components, besides 33,000 parents. Dr. M.V.L.N. Raju, Member Secretary presented the Action Taken Report for the recommendations of previous RAC meeting.

In the subsequent meeting held on 27th October 2021, the research progress in different sections at the head quarter and at the RS, Bhubaneswar was reviewed. Dr. K.T. Sampath, former Director, ICAR-NIANP and Member, RAC chaired the meeting in the absence of Prof. B.B. Mallick. The RAC expressed satisfaction with the good research progress at the institute and publications in high impact journals, and recorded recommendations for further research pursuance.



RAC meeting (virtual) held on 28.09.2021



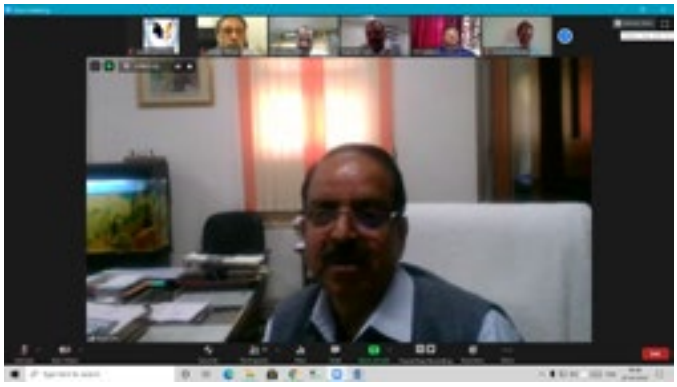
RAC meeting (virtual) held on 27.10.2021

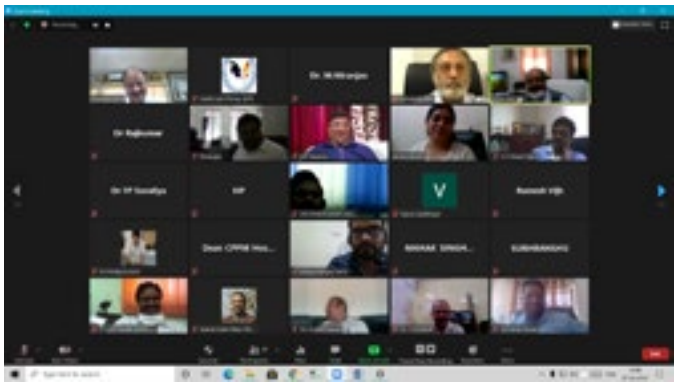
Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project

The Annual Review Meeting of All India Coordinated Research Project (AICRP) on Poultry Breeding and Poultry Seed Project (PSP) was held on 7th April, 2021 through online meeting. Dr. B.N. Tripathi, Deputy Director General (Animal Science) chaired the meeting. He appreciated the contribution of AICRP on Poultry Breeding for development of poultry sector in India over the last 50 years. He emphasized to further increase the contribution of backyard poultry to total poultry production. He also stressed the need to concentrate on climate resilient poultry and health management of backyard poultry. Dr. V.K. Saxena, ADG (AP&B), ICAR, New Delhi appreciated the good work carried out by AICRP on poultry breeding. He emphasized on the need of conservation of indigenous chicken breeds and large-scale dissemination of superior backyard poultry. Dr. Vineet Bhasin, Principal Scientist, AS Division, ICAR suggested to work on chicken variety suitable for high altitude regions.

Dr. R. N. Chatterjee, Director, ICAR-DPR, appraised about the genesis of project and its salient achievements made during last 50 years. He also presented the action taken report and the action plan for the next five years. Annual Progress made during 2019-20 for the twelve AICRP and twelve PSP Centres was reviewed and suitable suggestions were offered for improvement of the scheme.

Dr. R.K. Vijh, Director, NBAGR participated in the review meeting. Earlier, Dr. S.V. Rama Rao, Pr. Scientist welcomed the dignitaries and participants. The centre In-charges of 12 AICRP-PB and 12 Poultry Seed Project centres covering different states of the country and scientists from ICAR-DPR, Hyderabad participated in the review meeting.





Institute Joint Staff Council

The Institute Joint Staff Council meeting of the Directorate was held on 21st December 2021.

Institutional Animal Ethics Committee

The Institutional Animal Ethics Committee meetings of ICAR-DPR were conducted on 23rd July 2021 and 27th December 2021 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 both the meetings. Annual inspection of the animal house facility was also done by the committee on 27th December 2021.

IAEC meeting in progress

Annual inspection of the facility by committee members

Institute Biosafety Committee

The 12th IBSC meeting of ICAR-DPR was held on 21st September 2021 under the chairmanship of Dr. R.N. Chatterjee, Director, ICAR-DPR. Dr. K. Thangaraj, Director, CDFD, Hyderabad and DBT nominee participated in the meeting online. Dr. M. Sujatha, Director IIOR, Hyderabad (outside expert), Dr. T.K. Bhattacharya, Dr. M.R. Reddy and Dr. S.P. Yadav, Principal Scientists of ICAR-DPR also participated in the meeting.

13 Participation of Scientists in Seminars, Conferences, Workshops, etc.

Sl. No.	Particulars of Seminars/conferences/workshops	Official(s)	Schedule	Venue/ Organised by
1	Virtual International Conference on Promising genetic and genomic technologies- Frontier in selection and animal improvement	Dr. L.L.L. Prince, Pr. Scientist	27-28 January 2021	Jointly organized by TANUVAS & KVASU
2	International Conference on Agricultural librarians and users' community	Sri. J. Srinivas Rao	25-26 February 2021	UAS, Bengaluru
3	National Webinar on Bio-fortified Maize Prospectus in Poultry Industry	Dr. R.K. Mahapatra, Pr. Scientist Dr. A. Kannan, Pr. Scientist	12 March 2021	ICAR-DPR, Hyderabad
4	Strategy Workshop (online) on Potential of Transgenic Poultry for Biopharming	Dr. L.L.L. Prince, Pr. Scientist	15 March 2021	National Academy of Agricultural Sciences
5	II International Conference on Veterinary and Livestock	Dr. N. Anand Laxmi, Pr. Scientist Dr. Suchitra Sena Pr. Scientist	19-20 March 2021	Conference Mind, Goa
6	Virtual Meeting of FAD 05 of Bureau of Indian Standards	Dr. M.V.L.N. Raju, Pr. Scientist	5 April 2021	BIS, New Delhi
7	Knowledge Day 2021, Online Technical Webinar	Dr. M.V.L.N. Raju, Pr. Scientist	16 April 2021	Poultry India, Hyderabad
8	Panel discussion in Network Meeting for Reinforcing Indigenous Medicine (Online meeting)	Dr. Santosh Haunshi Pr. Scientist	20 April 2021	Veterinary College, Hassan (KVAFSU),
9	Virtual Meeting of Expert Panel for review of BIS Poultry feeds Specification (as Convenor)	Dr. M.V.L.N. Raju, Pr. Scientist	4 June 2021	BIS, New Delhi
10	Online International Workshop on Scientific writing	Dr. L.L.L. Prince, Pr. Scientist Dr. K. S. Rajaravindra, Sr Scientist	23-24 June 2021	IDP-NAHEP, ICAR-NDRI, Karnal
11	International Webinar on Impact of oxidative stress on male and female reproduction	Dr. K.S. Rajaravindra Sr Scientist	1 July 2021	ICAR-NDRI, Karnal
12	Virtual International Symposium on Harnessing the potentials of genome editing tools to augment the productivity and health of farm animals	Dr. Shanmugam M. Sr. Scientist	19 - 20 July 2021	ICAR-NDRI, Karnal
13	Webinar on Shelf life management of feed	Dr. M.V.L.N. Raju, Pr. Scientist	5 August 2021	Trouw Nutrition, India
14	Webinar on How mycotoxins disrupt poultry immune response	Dr. M.V.L.N. Raju, Pr. Scientist	6 August 2021	Trouw Nutrition, India
15	Workshop on Mission towards Zero Non-Descript AnGR of India (Virtual Mode)	Dr. L.L.L. Prince, Pr. Scientist	11 August 2021	ICAR-NBAGR, Karnal.
16	Virtual Meeting of Expert Panel for review of BIS Poultry feeds Specification (as Convenor)	Dr. M.V.L.N. Raju, Pr. Scientist	17 August 2021	BIS, New Delhi

Sl. No.	Particulars of Seminars/conferences/workshops	Official(s)	Schedule	Venue/ Organised by
17	National Webinar on Recent advances in Animal Genetics for Improving Poultry Productivity	Dr. L.L.L. Prince, Pr. Scientist Dr. Shanmugam M., Sr Scientist Dr. K.S. Rajravindra, Sr Scientist	28 August 2021	ICAR-RCER, Patna
18	The Asia Oceania Regional Animal Biotech Virtual Workshop science and opportunities of animal biotechnology for food and agriculture International Service for the Acquisition of Agri-biotech Applications (ISAAA)	Dr. S.P. Yadav, Pr. Scientist	31 August - 1 September 2021	Khush Hall, IRRI, Philippines
19	III Annual Conference of Animal Physiologists Association (APA) and National Symposium on Physiological Interventions for the Augmentation of Sustainable Animal Production	Dr. N. Anand Laxmi, Pr. Scientist	24-25 September 2021	C.V. Sc. and A. H., DUVASU, Mathura
20	परीक्षण अभिकल्पना के अनुप्रयोग - ऑनलाइन हिन्दी कार्यशाला	Dr. S.P. Yadav, Pr. Scientist Dr.R.K.Mahapatra Pr. Scientist	28-30 September 2021	ICAR-IASRI, New Delhi
21	3rd Veterinary and Livestock conference	Dr. Suchitra Sena Pr. Scientist	4-5 October 2021	Online
22	Online Conference Veterinary Congress 2021	Dr. N. Anand Laxmi Pr. Scientist	12-13 October 2021	Online
23	National Webinar on "Entrepreneurship in Livestock & Poultry Sector : Opportunities & Approach and Innovation & Livestock Products"	Dr. Shanmugam M. Sr. Scientist	18 October 2021	ICAR-CIPHET, Ludhiana
24	National Workshop on Meat Traceability and Recall ः From Concept to Practice	Dr. S.P. Yadav, Pr. Scientist Dr. L.L.L. Prince, Pr. Scientist	22 October 2021	ICAR-DPR and organized by ICAR-NRC Meat
25	International webinar on Fighting the Hunger using Smart Technology	Dr. L.L.L. Prince, Pr. Scientist	26 October 2021	ICAR-Indian Institute of Oil Palm Research
26	Scope of Insect meal in India (as expert panellist) (Webinar)	Dr. M.V.L.N. Raju, Pr. Scientist	29 October 2021	Benison Media, Karnal
27	Webinar on Emerging managerial opportunities in ALPF : Industry-Academia perspective	Dr. Vijay Kumar Sr. Scientist	10 November 2021	Indian Institute of Plantation Management, Bengaluru
28	Indian Veterinary Association- Lady Vets Convention, Shakti-2021	Dr. Suchitra Sena Pr. Scientist	13-14 November 2021	----
29	XV Agricultural Science Congress	Dr. T.K. Bhattacharya National Fellow Dr. R.K. Mahapatra, Pr. Scientist Dr. C.K. Beura Pr. Scientist Dr. S. K. Mishra Pr. Scientist	13-16 November 2021	BHU, Varanasi, UP
30	Online Interface Meet on Characterization and Documentation of Animal Genetic Resources of Rajasthan State A Mission towards Zero Non-Descript Population	Dr. L.L.L. Prince, Pr. Scientist	16 November 2021	ICAR-NBAGR
31	Online Orientation workshop for all Nodal Officers of DRIVE & National S7T Survey 2020-21	Dr. K.S. Rajaravindra, Sr. Scientist	27 November 2021	ICAR- NAARM, Hyderabad

Sl. No.	Particulars of Seminars/conferences/workshops	Official(s)	Schedule	Venue/ Organised by
32	National Conference on क्षेत्रीय राजभाषा सम्मेलन, दक्षिण एवं दक्षिण पश्चिम आयोजन	Dr. R.K. Mahapatra, Pr. Scientist Dr. S.P. Yadav, Pr. Scientist Sri. J. Srinivas Rao, ACTO	4 December 2021	Nuclear Fuel Complex, Hyderabad.
33	Indian Society for Buffalo Development (ISBD) Conference	Dr. S.S. Paul, Pr. Scientist	10-11 December 2021	GADVASU, Ludhiana
34	National Conference on Animal Breeding Strategies in the Era of Genomics and Phenomics and XV Annual Convention of ISAGB through Online mode	Dr. T.K. Bhattacharya National Fellow Dr. L.L.L. Prince, Pr. Scientist Dr. K.S. Rajravindra, Sr. Scientist	17-18 December 2021	ICAR-NBAGR, Karnal
35	Online International Veterinary Pathology Congress on Advances in Veterinary Pathology for Diagnosis and Control of Emerging and Re-emerging Diseases of Livestock, Wild Animals and Poultry	Dr. M.R. Reddy Pr. Scientist	17-19 December 2021	C.V.Sc. and Animal Science, RUVAS, Bikaner, Rajasthan

14 Distinguished Visitors

- Dr. B.N. Tripathi, DDG (Animal Science), ICAR, New Delhi
- Dr. A.K. Srivastav, Member, ASRB, New Delhi
- Dr. Praveen Mallick, A.H. Commissioner, DAH&D, Govt. of India, New Delhi
- Dr. V. Ravinder Reddy, Vice-Chancellor, PVNRTVU, Hyderabad
- Dr. K.M. Bujarbaruah, Former Vice Chancellor, AAU, Assam
- Dr. A.C. Varshney, Former Vice Chancellor, DUVASU, Mathura
- Dr. V.K. Saxena, ADG (AP&B), ICAR, New Delhi
- Dr. A.K. Tyagi, ADG (AN&P), ICAR, New Delhi
- Dr. (Mrs.) Hema Tripathi, National Coordinator, NAHEP, New Delhi
- Dr. B.S. Barbudhe, Director, ICAR-NRC on Meat, Hyderabad
- Dr. M. Sujatha, Director, ICAR-IIOR, Hyderabad
- Dr. A. Padma Raju, Former Vice Chancellor, ANGRAU, Hyderabad
- Dr. D. Rama Rao, Former Director, ICAR-NAARM, Hyderabad
- Dr. N.P. Singh, Former Director, ICAR-CCARI, Goa

15 Personnel

Headquarters, Hyderabad

RESEARCH & MANAGEMENT POSITION

1. 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. N. Anand Laxmi, Pr. Scientist
5. Dr. Shyam Sundar Paul, Pr. Scientist
6. Dr. M.R. Reddy, Pr. Scientist
7. Dr. M. Niranjan, Pr. Scientist
8. Dr. U. Rajkumar, Pr. Scientist
9. Dr. R.K. Mahapatra, Pr. Scientist
10. Dr. T.K. Bhattacharya, Pr. Scientist
11. Dr. D. Suchitra Sena, Pr. Scientist
12. Dr. Santosh Haunshi, Pr. Scientist
13. Dr. L. Leslie Leo 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. Jayakumar, 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.
3. Smt. Minakshi Dange, C.T.O.
4. Sri D. Pratap, A.C.T.O.
5. Sri J. Srinivas Rao, A.C.T.O.
6. Sri A. Ravi Kumar, Tech. Officer
7. Sri G. Rajeshwar Goud, Tech. Officer
8. Sri Md. Maqbul, Tech. Officer (Driver)
9. Sri G. Madhukar, Tech. Officer (T-5)
10. Sri Md. Yousufuddin, Sr. Tech. Asst. (Driver)
11. Sri P. Santosh Phani Kumar, Tech. Asst. (T-3)
12. Sri D. Ashok Kumar, Technician (T-1)

ADMINISTRATION

1. Sri A.V.G.K. Murthy, S.A.O.
2. Sri S. Bala Kamesh, F. & A.O.
3. Smt. O. Suneeta, P.S.
4. Smt. T.R. Vijaya Lakshmi, A.A.O.
5. Smt. M. Kamala, A.A.O.
6. Sri Rajesh Parashar, U.D.C.
7. Sri L.V.B. Prasad, U.D.C.
8. Smt. N. Siva Dharani, L.D.C.
9. Sri R. Ganesh, L.D.C.

SKILLED SUPPORT STAFF

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

Regional Station, Bhubaneswar

SCIENTIFIC

1. Dr. C.K. Buera,
   I/c Head & Pr. Scientist
2. Dr. S.K. Mishra, Pr. Scientist
3. Dr. S.K. Sahoo, Pr. Scientist
4. Dr. M.K. Padhi, Pr. Scientist
5. Dr. P.K. Naik, Pr. Scientist
6. Dr. B.K. Swain, Pr. Scientist
7. Dr. S.C. Giri, Pr. Scientist
8. Dr. Dhirendra Kumar, 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

- Dr. B. Prakash, Sr. Scientist has been promoted to the next higher grade of Pr. Scientist w.e.f. 01.01.2020.
- Dr. M. Shanmugam, Sr. Scientist (RGP- 8000) has been promoted to the next higher grade (RGP- 9000) of Sr. Scientist w.e.f. 07.01.2020.
- Sri A.V.G.K. Murthy has been promoted to the post of Senior Administrative Officer w.e.f. 13.10.2021 (A.N).
- Smt. T.R. Vijaya Lakshmi has been promoted to the post of Assistant Administrative Officer w.e.f. 20.07.2021(A.N).
- Smt. M. Kamala has been promoted to the post of the Assistant Administrative Officer w.e.f. 02.09.2021 (F.N).

NEW JOININGS

- Sri Bala Kamesh, Finance and Accounts Officer has joined on 09.11.2021 on promotion from ICAR-ATARI-Zone X, Hyderabad.
- Dr. Raja Laxmi Behera, Scientist has joined on 04.10.2021 at ICAR-DPR, RS Bhubaneswar on transfer from ICAR-NDRI, ERS Kalyani, West Bengal.

RETIREMENT

1. Sri M. Pantulu, Sr. Tech. Asst. (Driver) has retired on superannuation on 31.07.2021.
2. Smt. R.T. Nirmala Veronica, A.A.O. has retired on V.R.S. on 01.09.2021.

TRANSFER

- Sri R. Sudarshan, A.F.A.O. has been transferred from ICAR-DPR to ICAR-CRIDA on inter-institutional transfer on 04.12.2021.

16 Other Relevant Information

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 2021, a total of 38,311 hatching eggs, 94,127 day old chicks, 5,031 parents and 3,050 grown up birds were sold/ supplied to the farmers and Govt agencies across the country. A total of 3,017 embryonated eggs were supplied to different organizations for research on diagnosis and vaccine production.

Experimental Farm

The experimental poultry farm with state of art facilities is located inside the campus and has two units, Pureline and Commercial Units. The pureline farm is for carrying out research whereas the commercial one is for supplying germplasm to different stakeholders and farmers. During the period under report, the average livestock reared at the farm was 21,371 per month. A total of 11,55,421 eggs were produced out of which 3,45,645 were hatching eggs and the remaining were table eggs. An integrated farm structure with moringa was developed in half acre of land and an isolation unit of 350 sq.ft was constructed.

Feed Processing Unit

The Feed Compounding Unit served as the Central Facility for supplying compounded feed for the various purelines, 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, shell 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 birds. During the year, a total quantity of 983.4 MT of feed was compounded and supplied.

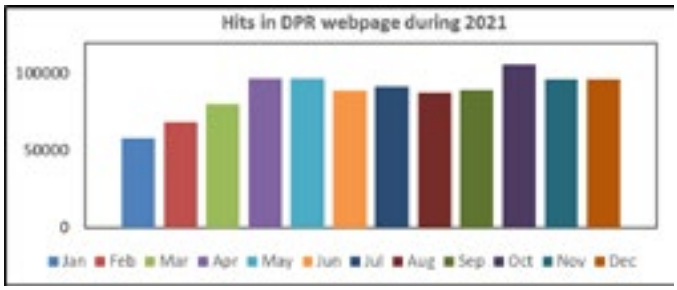
Sales and Marketing Unit

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.

Agricultural Knowledge Management Unit (AKMU)

Internet Connectivity under NKN : Internet leased line connectivity of 100Mbps under National Knowledge Network (NKN) has been maintained with suitable firewall hardware for security. Backup connectivity with BSNL leased line is also maintained for connectivity without interruption. 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 10.57 lakh hits during 2021 with an average of 2,900 visits per day. Payment gateway link has been maintained in DPR webpage and facilitates online payment through State Bank Collect on "Booking or purchase of germplasm" and "Payment by DPR staff".



ICAR-DPR Mobile App : An Android mobile App in English named "ICAR DPR" is maintained. This app provides information about institute, chicken germplasm, AICPR on Poultry Breeding, Poultry Seed Project, germplasm availability, etc. About 830 users downloaded this app during 2021. Average rating given by 28 users was 4.5 out of 5. A total of 3,425 users download the mobile app since its launch.

ICAR-DPR Poultry YouTube channel : DPR Profile and several informative videos are available in https ://www.youtube.com/channel/UCDL2gnmjtzabrxX39waOITA. A total of 99,934 people viewed different informative videos during Jan to Dec 2021.

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 resourceful 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 also utilized these resource materials available at the institute library.

The library has been subscribing various 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 subjects. The institute is also utilizing the Cera consortia services. The library also subscribes daily newspapers in Hindi, Telugu and English for our regular readers. All the institute's publications were also digitalized (such as annual reports, newsletters, un-priced books).

Hindi Implementation Activities

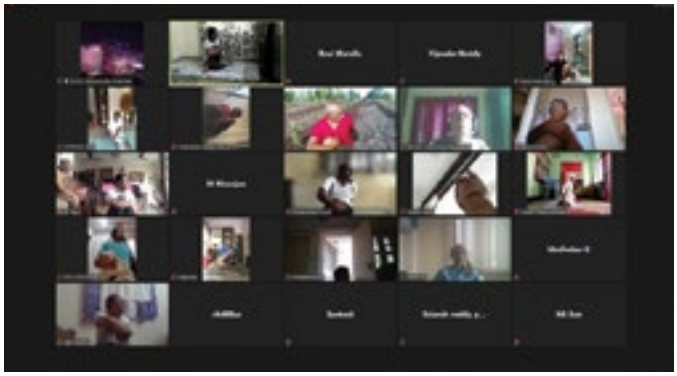
The Directorate conducted four quarterly meetings of Official Language Implementation Committee on 30.03.2021, 29.06.2021, 18.08.2021 and 21.12.2021, in which different issues related to effective implementation of Hindi Language in office were discussed. The Directorate also conducted four Virtual Hindi workshops, i.e. on 12.03.2021, 16.06.2021, 14.09.2021 and 28.12.2021 for employees to upgrade their Hindi language skills as official language, which were very much informative and useful to the staff for their routine works.

The Directorate also celebrated Hindi Fortnight celebrations during 1-15 September 2021 and Hindi Day on 14 September 2021. During these celebrations, different literary competitions were conducted for the staff members. Dr. R.N. Chatterjee, Director highlighted the importance of Hindi language and its vast usage throughout the country. The Director wished the participants and presented cash awards and certificates to all winners.

The Regional conference of South and South-west was attended by Dr. R.K. Mahapatra, Principal Scientist, Dr. S.P. Yadav. Principal Scientist and Sri. J. Srinivas Rao, ACTO at NFC, Hyderabad on 04.12.2021. TOLIC meeting was attended on 02.12.2021 at NIRDPR, Rajendranagar, Hyderabad. During this period Dr. S. Jayakumar, Sr. Scientist and Sri. G. Madhukar, Technical Officer successfully completed Hindi Pragya Course, which was conducted by Central Hindi Teaching Scheme, Hyderabad.

ICAR-DPR celebrated 7th International Day of Yoga-2021

The Director and staff of the Directorate actively participated in the online Yoga session organized by ICAR-National Academy of Agricultural Research Management, Hyderabad commemorating the 7th International Day of yoga on 21 June 2021. Dr. A. Debnath, Medical officer and Yoga tutor explained about the goodness of Yoga and especially its benefits during these Covid days. He taught some important Pranayamas and asanas which was practiced online by the staff at their homes.



Directorate celebrated tree plantation campaign on ICAR Foundation Day

The Director and staff of the Directorate enthusiastically participated in the Nation-wide campaign on tree plantation and awareness on the occasion of ICAR's Foundation Day celebrations on 16th July 2021 with the theme "Har Med Par Ped" as part of our celebration of India @75- Azadi Ka Amrut Mahotsav. Different species of plants were planted by the Director and the Staff of the Directorate. The tree plantation campaign was organized at both the main campus and the new campus of the Directorate.

Dr. R.N.Chatterjee, Director planting a sapling

Mega Campaign on Nutri garden organized at the Directorate

A mega campaign on Nutri garden and tree plantation drive was organized on 17th September 2021 on the occasion of International Year of Millets 2023. Several fruit bearing plants were planted inside the campus by the Director and staff. Twenty eight girl students from Cherish Foundation, Kismatpur, Hyderabad and twenty two women farmers participated in the programme. A lecture

on Nutricereals and their importance was delivered by Dr. K.S. Rajaravindra, Senior Scientist of this Directorate. Fruit bearing saplings and seed packets of different vegetable crops were distributed to the participants.

Mega campaign on Nutri garden celebrations

Swachh Bharat Activities

A Special Swachtha Campaign was conducted during 02-31 October 2021 to celebrate the 152nd Birth Anniversary of Shri Mahatma Gandhiji, the father of our Nation. During the period, ten different programmes related to sanitation and cleanliness was organized at the directorate as well as in the adopted and nearby villages to create awareness. Mahila Kisan Diwas and World Food Day were also organized on 15 and 16 October, respectively, as part of the celebrations.

A Swatchtha Pakwada Program was organized at the Directorate from 16-31 December 2021 in order to create awareness among the children, youth and general public about the importance of cleanliness in our day to day life. Awareness was created about reuse of waste water for kitchen gardening, no open defecation, no littering with plastics and non-biodegradable waste in public places, segregation of waste at household level, composting and vermin composting, promoting green and sustainable technologies, organic farming, no use of single use plastic and water harvesting. The Rashtriya Kisan Diwas was also celebrated on 23rd December by inviting women farmers to the Directorate. Seeds of vegetable plants were distributed on the occasion and the women were emphasised to adopt organic farming of these plants and also use the waste water from the household for growing these plants. Various Swachtha activities/programs undertaken by the central government were explained in detail to the beneficiaries in the adopted villages, nearby tourist spot and public areas. Wide publicity of the event was given through the mass media so that more number of people will be educated and the cleanliness drive becomes more and more successful in making our nation a clean and green India.

Constitution Day celebration at ICAR-DPR

The Constitution Day was celebrated on 26 November 2021. The Director, staff of the Directorate and the School children from nearby schools participated and read the Preamble of the constitution along with the Honourable President of India Shri. Ramnath Kovind ji (online). The programme organized for the Constitution of India celebrations was watched live by all the staff and school children.

Constitution Day celebrations

World Soil Day celebration

The World Soil day was celebrated on 5 December 2021. Fruit bearing plants were planted in the Moringa integrated farm unit and Vermicompost was applied to other plants and saplings to enhance the soil quality and their growth.

World Soil Day celebrations

Republic Day and Independence Day

The Directorate celebrated the Republic Day on 26 January 2021 and the Independence Day on 15 August 2021. Dr. R.N. Chatterjee, Director hoisted the National Flag and addressed the staff of the institute and their families.

Institute Foundation Day

The ICAR-Directorate of Poultry Research, Hyderabad celebrated its 34th Foundation Day and National Science Day on 1 March 2021. Dr. V.K. Saxena, Assistant Director General (Animal Production and Breeding), ICAR, New Delhi graced the occasion as the Chief Guest. The ADG (AP&B) appreciated the significant contributions made in the improvement of poultry production, particularly the backyard poultry production through the dissemination of improved chicken varieties. He also emphasized to raise beyond comfort zones to achieve the targeted objectives of the poultry sector. On this occasion, he released a bulletin entitled "Multiplex PCR for simultaneous and differential detection of tumor viral diseases of chicken" authored by Dr. T.R. Kannaki and co-workers. He also distributed the prizes to winners of the games and sports competitions organized for the staff of the Institute.

Dr. V.K. Saxena, ADG addressing the staff

Dr. R.N. Chatterjee, Director addressing the staff

Dr. R. N. Chatterjee, Director, ICAR-DPR presided over the function and highlighted the contribution of ICAR-DPR through its germplasm, technologies and extension activities. He also narrated the significance of celebrating the National Science Day programme in the Country highlighting the research work conducted by Sir C.V. Raman which led to the discovery of the Raman Effect. Earlier, Dr. M.V.L.N. Raju, Principal Scientist presented the research activities of the Institute at the august gathering. Dr. U. Rajkumar, Principal Scientist and Chairman Organizing committee welcomed the dignitaries. Poultry farmers, officials from Veterinary University and scientists from local ICAR Institutes and Regional Station, Bhubaneswar participated in this programme. At the end, Dr. L. Leslie Leo Prince, Principal Scientist proposed the vote of thanks.

Dr. V.K. Saxena, ADG releasing the bulletin

DDG (Animal Science) visits ICAR-DPR

Dr. B. N. Tripathi, Deputy Director General (Animal Science), ICAR, New Delhi visited the Directorate on 22 October 2021. During his interaction with scientists, DDG lauded the contribution of ICAR-DPR in the improvement of poultry production in the country, particularly the backyard poultry production through the dissemination of improved chicken varieties throughout the country. Dr. Tripathi opined that everyone must be ready for accepting the challenges of the present-day poultry sector and meet the stakeholders' expectations. He identified 10 actionable points that need to be given priority in the coming five years. The DDG (AS) advised to conduct regular interface meetings with the industry and formulate the projects based on the industry needs. He also advised to take up collaborative projects with industry and other Institutions. Earlier Dr. B. N. Tripathi, DDG (AS) inaugurated the Bioinformatics laboratory building of this Directorate. Dr. Praveen Malik, Animal Husbandry Commissioner, DAHD, Dr. A.K. Tyagi, ADG (ANP), Dr. S.B. Barbuddhe, Director, ICAR–NRC Meat and other dignitaries graced the occasion. The dignitaries also participated in the special Swachtha campaign on the occasion of the 152nd Birth Anniversary of the Father of the Nation and planted fruit trees in the campus. Dr. A. K. Tyagi, ADG (ANP) appreciated the contribution of the institute to the poultry sector. Dr. R.N. Chatterjee, Director, ICAR-DPR highlighted the research achievements of the institute. He also narrated the future thrust areas for which the Institute has prepared the road map in the EFC.

Dr. B.N. Tripathi, DDG (AS) inaugurating the Bioinformatics Lab

International Women's Day celebrated

The International Women's Day was organized on 8 March 2021 on the theme "Empowerment of Women as Entrepreneurs".

Live streaming of Hon'ble PM's Program on Natural Farming

Live streaming of Hon'ble PM's Program on National Conference on "Natural Farming (Zero Budget Natural Farming)" during Pre-Vibrant Gujarat Summit 2021 was web telecasted at the Directorate and Regional Centre, Bhubaneswar on 16 December 2021. The staff participated in the program. Information on this important event was posted on institute Twitter and Facebook pages for wider publicity and coverage.

The Directorate also organized the live streaming program in MGMG adopted village and a total of 75 farmers of Bavoji Tanda, a tribal village of Mahabubnagar (dist.), Telangana have participated and viewed the Hon'ble PM'S Program on Natural Farming. Scientist-Farmer interaction was organized and 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 was explained to the farmers. The farmers were briefed about the benefits of organic farming and the conversion of waste into wealth. The importance of using toilets in combating several food and water-borne diseases was explained. The need for the segregation of waste into recyclable and non-recyclable categories was also emphasized for the protection of the environment.

Health management of birds was explained and birds were vaccinated with ND Lasota vaccine. Vitamin supplements were also provided. Information on the nutritional benefits of eggs was explained and boiled eggs were distributed to the farmers. Farmers were also provided with Vermipoul, vermicompost, developed at the institute from poultry litter. A team of scientists comprising Drs. M.R. Reddy, R.K. Mahapatra, T. K. Bhattacharya, L. Leslie Leo Prince, B. Prakash and S. Jayakumar (Coordinator) participated in the program and elaborated on the various activities of the Directorate and the importance of the MGMG program in the village.

Live streaming of Hon'ble PM's Program on Natural Farming

Live streaming of Hon'ble PM's Program on Natural Farming at Village

Scientist- Farmer interaction

Video on Integrated farming of chicken with Moringa prepared

- One video on "Integrated farming of chicken with Moringa" was prepared for the benefit of the farmers.
- Another video on "Moringa aur murgion kee akeekrit kheti" is available in Hindi on YouTube for the viewers

Two folders on Moringa Integrated Farming System were released by DDG (Animal Sciences), Animal Husbandry Commissioner, ADG (Animal Sciences) and Director, NRC-Meat along with Director, ICAR-DPR.

Release of folder on IFS

Inauguration of Renovated Duck Shed under DBT Project

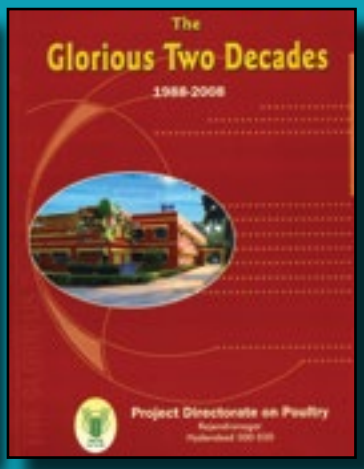
A duck shed, renovated under the DBT project at Regional station, Bhubaneswar, was opened by Dr. R. N. Chatterjee, Director, ICAR-DPR.

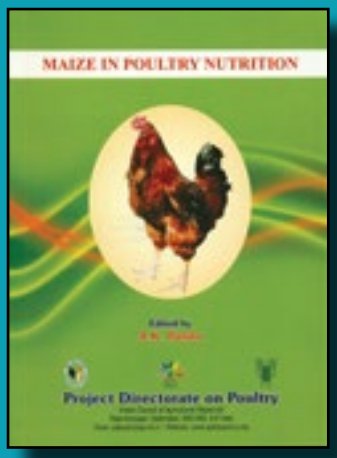
NOTES

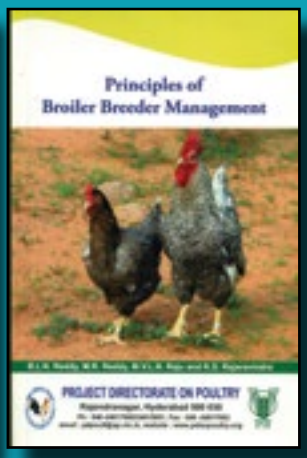

25
IN THE SERVICE OF NATION
PROJECT DIRECTORATE ON POULTRY

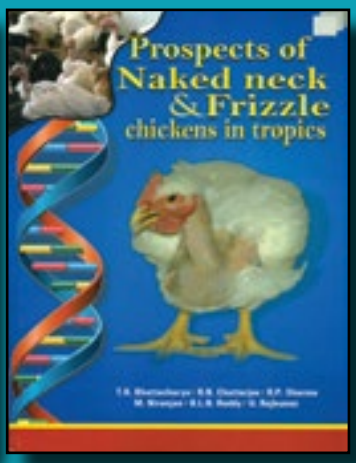

AN OVERVIEW OF DPR LIBRARY RESOURCES
DIRECTORATE OF POULTRY RESEARCH

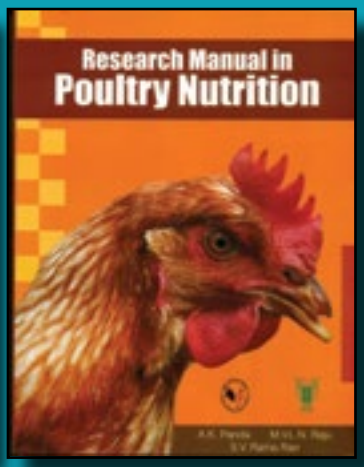

Appropriate Poultry for Adverse Environment
SOUVENIR

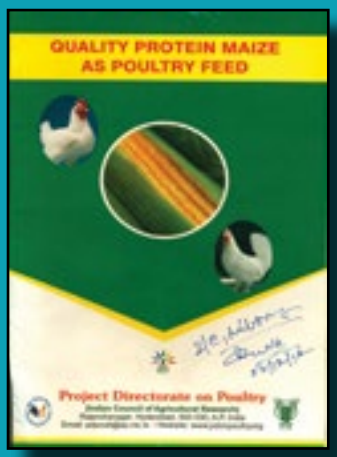

The
Glorious Two Decades
1988-2008
Project Directorate on Poultry

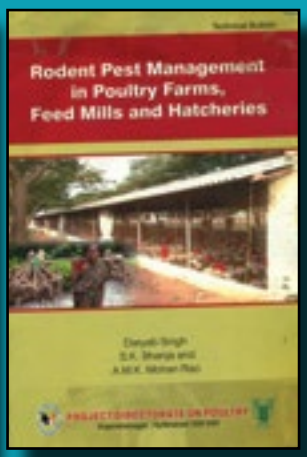

MAIZE IN POULTRY NUTRITION
Project Directorate on Poultry

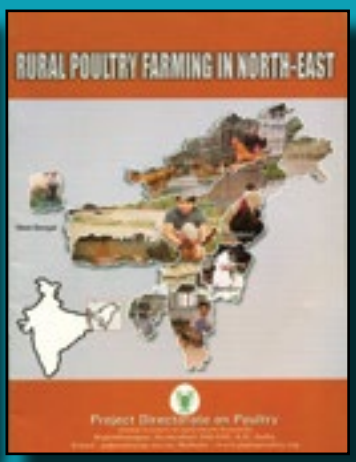

Principles of
Broiler Breeder Management
PROJECT DIRECTORATE ON POULTRY

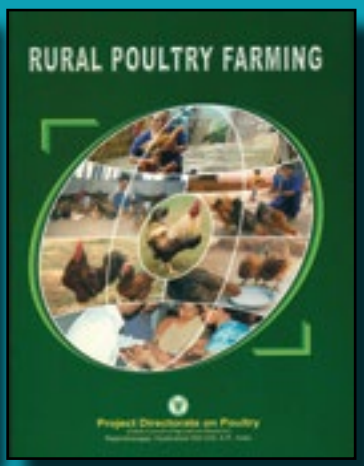

Prospects of
Naked neck
&Frizzle
chickens in tropics

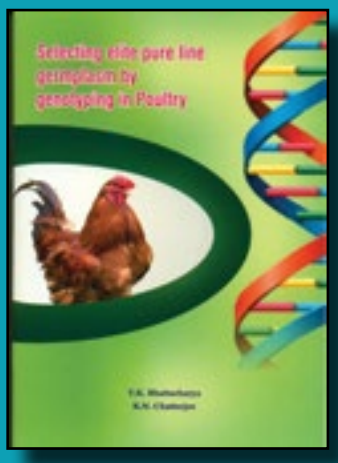

Research Manual in
Poultry Nutrition

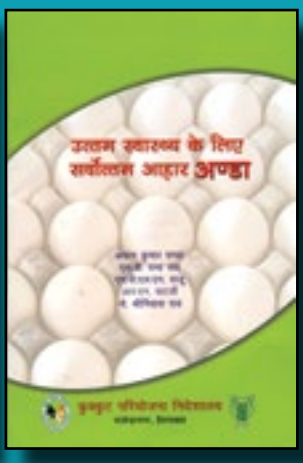

QUALITY PROTEIN MAIZE
AS POULTRY FEED
Project Directorate on Poultry

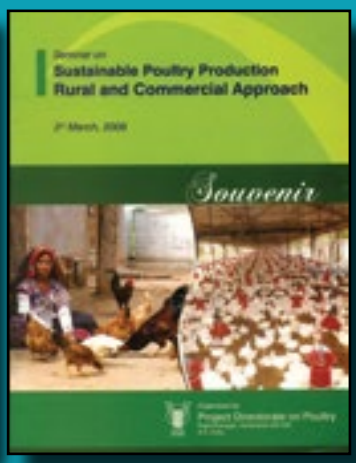

Rodent Pest Management
in Poultry Farms,
Feed Mills and Hatcheries


RURAL POULTRY FARMING IN NORTH-EAST


RURAL POULTRY FARMING


Stretching elite pure line germplasm by genotyping in Poultry


उत्तम स्वास्थ्य के लिए
सर्वोत्तम आहार अण्डा


Sustainable Poultry Production
Rural and Commercial Approach
Souvenir

भाकृअनुप- कुक्कुट अनुसंधान निदेशालय

ICAR - Directorate of Poultry Research

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