Dr. Saroj Toppo

Principal Scientist

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Department	Fish Nutrition & Physiology
Institute/ University	Central Institute of Freshwater Aquaculture (*Indian Council of Agricultural Research*)
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Date of Birth	8th August 1958
Sex	Female
Discipline	Animal Nutrition
Date of award of degree	M. Phil ----------
	Ph. D 27.01.1995

Date of joining the ICAR	25.07.1994
Date of joining the Institute	13.08.2003
Date of joining in the post of Sr. Scientist In the grade pay of Rs. 9000	25.07.2003
Date of completion of three years In the grade pay of Rs. 9000	25.07.2006

Academic Qualification			
Examination/ Degree	**Board/ University**	**Subjects**	**Year**
Ph D (Animal Nutrition)	Indian Veterinary Research Institute, Izatnagar	Major sub- Animal Nutrition Minor sub- Poultry Nutrition, Physiology	1995
M.V.Sc (Animal Nutrition)	Birsa Agricultural University, Kanke, Ranchi	Major sub- Animal Nutrition Minor sub- Bio-chemistry, Physiology, Statistics	1989
B.V.Sc & A.H.	Birsa Agricultural University Kanke, Ranchi	All subject in B.V.Sc & A.H.	1986
Intermediate Science	Ranchi University	Hindi, English Physics, Chemistry, Biology	1979
Matriculation	Secondary School Examination Board	Hindi, English, Maths, Physics, Chemistry, Biology	1977

Particulars of employment			
Organization	**Designation on joining**	**Date of joining, leaving**	**Nature of Job**
State Govt. Animal Husbandary Deptt., Bihar	Asst. Poultry marketing Officer	02.05.1986 to 20.11.1987 & 05.10.1989 to 18.12.1989	Treatment & management
State Govt. Animal Husbandary Deptt., Bihar	Junior Research Officer	19.12.1989 to 09.09.1991	Analysis of feed samples
I.C.A.R, NAARM, Hydrabad	Scientist (Probation)	25.07.1991 to 22.07.1994	49th foundation course on agri. Research & Project management, field experience training

CARI, Izatnagar	Scientist	25.07.1995 to 26.07.1998 Up to 08.08.2003	Research, Teaching, Training & extension work
CARI, Izatnagar	Scientist (Sr. Scale)	27.7.1998 to 24.7.2003	Research, Teaching, Training & extension work
ICAR Research complex for NEH Region, Sikkim Centre, Tadong, Gangtok	Sr Scientist	25.7.2003 – 08.4.2012 Joined on 13.8.2003 in Sikkim Centre	Research
Central Institute of Freshwater Aquaculture	Sr Scientist	17.4.2012	

Participation in Refresher Courses/ Summer Institute

S. No.	*Title of the course*	*Duration*	*Name of the organizing Institute*
1.	Feed Microbiology	23rd Nov. 2000 to 22nd Dec. 2000	Centre of Advanced Studies in Animal Nutrition,IVRI, Izatnagar.
2.	Information technology in Agriculture	12th May 2002 to 2nd July 2002	NAARM, Hyderabad
3.	Aflatoxin Assay	16th Dec. 2002 to 25th Jan. 2003	Central Poultry Training Institute Hessarghatta, Bangalore

Participation in Seminar/ Symposia/ Workshop/ Conference etc.		
Sl. No.	***Name of the Seminar / Symposia/ Workshop / Conference***	***Organizing Institute***
1.	Indian Veterinary Congress & VI Annual Conference of IAAVR	Indian Veterinary Research Institute, Izatnagar, 18-19 Feb. 2000.
2.	Scientist-Industry Workshop on Recent Scientific Innovations for Advancement of Poultry Feed Industry	American Soybean Association and Central Avian Research Institute, Izatnagar, Aug. 9-10, 2001
3.	NATP-Workshop on Utilization of Course Cereals and by-products of oilseed based cropping system in poultry production	Central Avian Research Institute and Nutrition and Feed Technology Division, CARI, Izatnagar Feb. 26-27, 2002
4.	National workshop on Organic Animal Husbandry Standards	IVRI, Izatnagar, November 26-27,2002
5.	National Seminar on Red Jungle Fowl	CARI, Izatnagar, 10-11 March, 2003
6.	XX Conference and Symposium of IPSACON 2003	CARI, Izatnagar, March 27-28, 2003
7.	Second Annual Workshop of NATP	CARI, Izatnagar, March 29, 2003

Teaching	Being a member of PG Faculty in the discipline of Poultry Science of the Deemed University (IVRI), I am actively engaged in post graduate teaching programme to NPH and Ph.D. students in the following courses:- 1. NPH-401 Principles of Nutrition (T) 2. NPH-402 Principles of Nutrition (P) 3. NPH-410 Applied nutrition (P) 4. PSC-767 Energy utilization in poultry (T) 5. PSC-768 Energy utilization in poultry (P)
Corporate life	♦ **Feed analysis and quality control:** Sample of different feedstuffs received by the division as and when analyzed for their chemical composition which helped in the maintenance of quality control of poultry feed ingredients of Feed Unit of the Institute.

	♦ **Member of DPC Committee, CARI, Izatnagar:** Acted as a member of several DPC Committee for promotion of Administrative, Technical and Supporting staff of the Institute time to time. ♦ **Member of Selection Committee at CARI and IVRI, Izatnagar:** Acted as a member of several selection committees for selection of Research Associate, Senior Research Fellow, and Jr. Research Fellow under different projects running at CARI and IVRI time to time. ♦ **Research paper review:** Research articles were reviewed as and when received from the editor for the Journal of Animal Nutrition and Feed Technology. ♦ Member of Academic Council of IVRI (Poultry Science). ♦ Member of Student Advisory Committee.

Assignments	**Duties performed as**	**Period**
Institute Library	Scientist in charge	19.9.2006 to 2012
QRT,2006	Repporteur	03.11.2006
Annual Report editorial committee	Member	10.8.2009
Regional Agricultural Fair at Sikkim 2008	Treasurer	2008
5th Annual Scientist meet of AINP on GIP	Treasurer	May 22-24, 2009
Annual assessment report	Reporting Officer (01) (03) (01) (01) (02)	 01.4.2007 to 31.3.2008 01.4.2008 to 31.3.2009 01.4.2009 to 31.3.2010 01.4.2010 to 31.3.2011 01.4.2011 to 31.3.2012
Operation of Bank account of ICAR Sikkim Centre	Second Signatory	22.02.2007 to 28.02.2007 05.12.2007 to 27.12.2007 28.01.2008 to 28.02.2008

		02.01.2009 to 10.12.2009 28.4.2011 to 25.5.2011 27.6.2011 to 23.8.2011
Senior most Scientist/ Routine duties of Joint Director Current duties of Joint Director	16.3.2008 to 14.5.2009 to 16.5.2009 25.11.2009 to 21.02.2010 to 01.3.2010 08.8.2010 to 11.8.2010 23.8.2010 to 30.8.2010 07.9.2010 to 25.11.2010 to 5.12.2010 23.01.2011 to 27.01.2011 02.2.2011 to 13.02.2011 27.2.2011 to 03.3.2011 12.3.2011 to 17.3.2011 17.4.2011 to 20.4.2011 **29.4.2011 to 16.5.2011** 26.8.2011 to 05.9.2011 29.5.2011 to 16.6.2011 27.6.2011 to 04.7.2011 26.8.2011 to 10.9.2011 to 25.11.2011 16.12.2011 to	- 03 - 08 04 08 - 11 05 12 05 06 04 **18** 11 19 10 - 16
Physical verification of Library books &journals	Committee member	2008-09
Conducting Hindi week Programme	Chairperson /committee member	2009 -2011
Farm produce Price fixation committee	Member	19.5.2009 to 2011
Disposal of discarded stores of the	Chairperson	2009 to 2011
To conduct walk-in interview for selection of RA/SRF/JRF/ Inseminator/ Data operator/ Milk recorder under various projects	Member	20.7.2009 21.11.2009 09.4.2010 15.5.2010 25.5.2010 23.6.2010

		15.9.2010 20.01.2011 07.3.2011 22.3.2011

Institute projects

Project 1

Studies on energy efficient biodegradation and recycling of poultry Waste P-1/96/IAV/TOO/6000/3851/3862. *(Duration 1996-2001)* **As PI**

Salient Achievements:

- Aerobic decomposition is more suitable for decomposition of poultry droppings along with plant materials.
- The suitable depth for composting poultry manure will be 1.2 meter
- The ratio 2:1 of the poultry droppings and a mixture grasses + tree leaves is the best combination for preparation for poultry manure.
- The high alkaline p^H of poultry droppings can be reduced on composting them with fibrous plant materials.
- The poultry manure in 1.21 m deep pits were well decomposed and used as manure for cultivation of cereal crop i.e., wheat. Poultry manure was compared with farmyard manure and urea as control. The percent grain yield increased over control in T1 to T4 groups was 14.19, 24.24, 44.09 and 36.18 with aerobic manure and 6.08, 7.27, 13.95 and 10.25 for anaerobic type compost manure. The results indicated that aerobic fermentation is superior to the anaerobic and that the nutrient utilization from poultry manure is better when decomposed with fibrous plant materials.
- Results indicated that the manure value of poultry droppings be increased by composting with green or dry plant materials.
- Dried hatchery eggshell waste (HESW) can be included instead of lime stone (OS) plus shell grit (SG) and dicalcium phosphate (DCP). In a layer diet with fishmeal inclusion of HESW increased egg production and specific gravity without affecting feed intake. The replacement of 100% OS plus SG and 50 % DCP calcium increased egg production and maintained egg weight with an increase in feed intake but decreased egg quality in respect of specific gravity.

Project 2	
Dietary interrelationships of calcium phosphorus and vitamin D for poultry P-1/95/IAV/L 30/3755/6100. *(Duration 1995-2000)* **As Associate**	**Salient Achievements:** ♦ The overall performance studies suggested that egg type (WL) starting chickens could perform well on diets supplemented with 600 to 1200 IU vitamin D_3/kg. ♦ Cage layers performed well on diet containing 3.0% calcium and 1200 ICU vitamin D_3 per kg diet. ♦ Vegetable sources based layer ration containing at least 0.5% total phosphorus through dicalcium phosphate can maintained the internal quality of egg and eggshell of WLH laying hen. ♦ Ca and P utilization was better at low levels of dietary P as compared to higher levels dietary P in broiler chicks. ♦ Significantly higher intake and excretion of P at higher levels of P as compared to fed low level of dietary P in broiler chicks. ♦ The percent weight loss representing solubility of marble stone and oyster shell samples depended on their particle size and also the HCl concentration. ♦ A diet containing 1.0% calcium and 0.35% available phosphorus was optimum for optimum growth performance of CARI Debendra Strater chicks.
Project 3	
Augmentation of the nutritive value of poultry feeds through supplementation of feed additives. P-1/2000/IAV/L 30/3740/6000*(Duration 2000-2003)* **As Associate**	**Salient Achievements:** ♦ Addition of feed grade enzymes to conventional diets of quail layers was not beneficial. ♦ A dietary level of 2900 kcal ME/kg with ascorbic acid supplementation might be beneficial for optimum egg production performance and better survivability of quail layers during heat stress. ♦ Enzyme supplementation might be beneficial to improve utilization of finger millet based broiler starting and finishing diets. ♦ Enzyme supplementation might be beneficial to improve utilization of sunflower seed meal supplemented in maize-finger millet or maize-sorghum based broiler starting and finishing diets.

Project 4	
Optimizing energy protein needs of native and alien chicken employing feed techno-tenets**.** P-1/2000/IAV/L 30/6100/3730 *(Duration 2000-2003)* **As Associate**	**Salient Achievements*:*** ♦ Body weight, feed intake and FCR were non-significant between male and female chicks. The optimum energy and protein requirement for Cari Sonali is 2800 kcal/kg ME and 20% CP for the starting phase. ♦ The optimum energy and protein requirement of CARI Sonali growing chicks is 2600 kcal ME/kg with a minimum of 14% crude protein. ♦ For optimum production performance CARI Sonali laying hens require a diet with 2600 kcal ME /kg with a minimum of 14% Crude Protein during both first phase (20-36 weeks) and second phase (36-40 weeks) of laying period.
Project 5	
Quantitative estimation of some anti-nutritional factors in native forages of Sikkim (Duration 2003-07) **As PI**	**Salient Achievements*:*** • 42 tree fodder species and 50 grass species including few cultivated fodder constitute the forage resources of Sikkim. Some of the jungle grasses low in crude protein content (0.9 -6%) frequently occur and make 10-30% of the total biomass. The crude protein content in tree fodder ranged from 9 to 16%. Most of the samples collected during the month of August contained higher levels of total phenols and condensed tannin as compared to those collected during the month of January. • The tree fodders contained higher levels of total phenol (tannins) and condensed tannin as compared to jungle grasses. The higher oxalate values (4.04 to 6.54 %) were observed in some tree fodders. • Feeding of jungle grass, broom grass and commonly fed tree fodder Nevaro leaves (*Ficus hookerii*) to kids may help maintenance but for growth and production supplementation of concentrate mixture is necessary. • Feeding of Nevaro, Amlisho or Jungle grass to kids for 28 months depending on their availability (as practiced in Sikkim) along with concentrate mixture did not show any deleterious effect.

Project 6	
Effect of locally available legu-minous fodder supple-mentation on milk prod-uction per-formance of crossbred cows under existing silvi-pastoral system of Sikkim (Duration 2002-08) ***As Co PI***	• Supplementation of spent malt in rice bean based ration up to 20 kg increased nutrient utilization and milk production in cows. • Eco-friendly silage can be prepared in synthetic tank or poly bags that can be kept either on the ground or covered in pits. • The nutritive value of broccoli leaves is better than chuletro and oat-chilawne silage. Addition of chilawne leaves and twigs as a component of silage up to 25% with oat green reduced nitrogen availability to animals substantially. (Pease see details year wise under Annexure I)
Project 7	
Evaluation of feeds and fodders of Sikkim in terms of their anti-methanogenic activities (Duration 2007-2011) ***As PI***	**I**n vitro fermentation study was conducted to estimate volume of CO_2 and methane gas. A total 72 samples of commonly fed tree fodders, shrubs, creepers and various species of jungle grasses and other plant species of medicinal or aesthetic use, vegetative parts of spices crops of the region, aromatic plants, tree fruits having medicinal values and some commonly used species. **S**ample dried at low temperature was incubated with fresh cow dung, buffered and fortified with trace minerals. Volume of total gas liberated during fermentation was recorded at 6 hours time intervals upto 48 hours. The volume of carbon-dioxide and methane gas was estimated at the end of 96 hours of incubation period. **R**esults showed a wide variability in gas production among samples at different time intervals. Inoculums pH ranged from 8.21 to 8.51 differ significant ($P<0.01$) however, apparently could not affect the fermentation pattern. Total gas production in various samples differ significantly ($P< 0.05$) after 12, 24 and 96 hours of incubation period. The chemical composition of fodder samples could not be correlated with volume of total gas and methane. However, an increasing trend of methane production in fodders containing low ether extract content could be noted. During study 92.5% samples have a non significant methane production value. (Pease see details year wise under Annexure I)

Project 8	
Effect of incorporation of medicinal plants as components of different silage combinations on quality and utilization in sheep (Duration 2008-09) ***As CoPI***	• Silage containing chilawne (*Schima wallichii*) tree leaves have longer self-life than others containing malato, nevaro, elamey, banmara and titepatti. (Pease see details under Annexure I)
Project *9*	
Studies on reproductive disorder of bovines in Sikkim and their therapeutic management (Duration 2007-2009) ***Associated***	**T**he infertility in domestic livestock include genetic, infectious, hormonal and nutritional that causes economic loss to the farmers. To identify the various reproductive problems prevailing in Sikkim total 2425 cases were screened from different parts of the State. Out of this, breedable 61.15% and affected 33.28% have different reproductive disorder. The breed wise incidence was almost similar (49.28 and 45.03%) in Local and Jersey crossbred cattle, preferred by farming households. In HF crossbred, with progressive farmers the incidence of reproductive disorder was much less (5.69%). The major reproductive disorders were delayed maturity (27.76%) followed by repeat breeding (20.45%) and anoestrus (15.71%), abortion (8.69%), ROP (9.54%), dystocia (5.08%) and metritis (3.22%). Feed quantity as well as quality appears to be the major cause for reproductive disorder in livestock of the State.
Project 10	
Genetic improvement of Sikkim Local goat for litter size (2007-10) ***Associated***	Forty females of Sikkim local goats were selected for breeding and randomly divided into two feeding regime groups. The conception rate was slightly higher (89.5%) in well fed group (I) in comparison to that of group (II) local feeding practiced (87.5%) by the farming household at Sikkim. A total 31 kidding were obtained (2008-09) and overall incidence of twining and triplet were found to be 61.29 % and 3.23%, respectively. Litter size, birth weight and body weight at 3 months of age was high in group I. the gestation period and interkidding period was 145 ±2.44 and 231 ±22 days in group I and 146.7± 1.8 and 236.3± 37.3 days in group II. The pre weaning mortality rate was higher in group II. In second generation during 2009-10 total 19 kidding were obtained with overall conception rate 88.49%. The incidence of twining and triplets was found to be 42.11% and 10.53%, respectively.

External projects	
Project 1	
.Sustainable Utilization of Mountain Fisheries Resources – A Partnership Mode (Duration 2008-12) ***As Co PI***	**S**ikkim bestowed with plenty of water bodies in the form of lakes natural springs, along with myriads of tributaries situated at various altitudes ranging from 400 to 4600 masl. The state has two major rivers Teesta originating from the glaciers of North and Rangeet from lower hills in West district of Sikkim **I**t is difficult to reach and collect samples from all tributaries, river belt and water bodies present in the state. Hence, sampling sites were selected considering approach roads as well as confluence and fishing sites. Metrological data and representative water samples were collected from various streams and small rivers of varying altitude. Fish samples was collected through fishing with the help of hired fisher man and also procured from the local market. **T**he torrential streams of Sikkim have shallow clear cold water in the foothills. Depending upon altitude the water temperature varies from 3.9 to 19.8° C. The dominant fish species in Teesta and Rangit tributaries are Schizothorax *spp* (Asala) *Neolissocheilus spp* (Katley), *Garra spp* (Buduna), *Pseudecheneis spp* (Kabrey), *Barilius spp* (Chirkay), *Semiplotus spp* (Chepti). Ornamental species available are Barilius *bendelisis bendelisis*, *Barilius vagra*, *Danio aequipinnatus*, *Danio naganensis*, *Garra lamta*, *Noemacheilus scaturigina* and *Noemacheilus sikkimensis*. Depending upon water current the percent availability of different species varies from one stream to other. However a declining trend has been noted in fish gemplasm. The average catch fish is very low may be due to low productivity or destructive and over fishing. The water quality parameters i.e. air temperature (5.57-27.8° C), water temperature (3.9 -19.8° C), DO (5.0-9.9 mg/l), pH (6.2 -8.4), alkalinity (20– 25.2 mg/ l), TDS (24.4– 52.7mg /l), hardness (14– 24 mg /l) were found within the suitable range for cold water fishes. (Pease see details under Annexure I)
Project 2	
Poultry Seed Project (Duration 2009-12) ***As Co PI***	**Establishment, Production and dissemination of day old chicks at Sikkim**

The work on Poultry Seed Project initiated in a temporary shed where first batch of Vanaraja breed breeding stock day old chicks (300 nos) procured during December, 2009has been reared. From this flock a total of 26956 number of hen day eggs were produced during May 2010 to march 2011 (up to the age of 65 weeks). Out of which 7608 number of hatchable egg were sold for hatching purpose to state hatchery unit and interested farmers for hatching by broody hen. Approximately 5571 numbers of healthy day old chicks has been produced.. Day old chicks were distributed among beneficiaries in various villages by State Department. Apart from this Hatchable eggs availability at ICAR Sikkim Centre caption was telecast through local Television channel as advertisement. More than twenty farmers from various parts of Sikkim have taken more than 200 eggs for hatching through broody hens and most of them have reported 70 to 100% hatchability except few. Feedback received from beneficiaries in respect of body weight gain and mortality percentage Vanaraja breed is doing well without any special care under backyard rearing system. However, all hatch able eggs could not be hatched out due to unavoidable circumstances.

The second batch of day old chicks of Vanaraja and Gramapriya (600 nos) to replace old parent stock procured after one year in the month of December 2010, raised into newly constructed Brooder cum Grower house than shifted to layer shed.

The hatchery facilities have been developed and a total 13267 number of chicks have been produced from this flock during June to October 2011. The day old chicks produced are either sold or distributed under Tribal Sub plan to promote backyard poultry production in the region.

Performance of Vanaraja and Gramapriya birds

Sl. No.	Economic traits	Vanaraja	Gramapriya
1.	Body weight(g)		
	Six weeks	650-750	400-500
	At sexual maturity	2000-2200	1600-1800
2.	Egg weight(g)		

		28 weeks	42-44	52-53
		40 weeks	52-58	57-58
	3.	Age at first egg(days)	175-180	160-165
	4.	Egg production, no. up to 1.5years	100-110	200-230

Infrastructure developed at ICAR Sikkim Centre	1. Parent shed — Capacity 500 layers 2. Brooder cum grower shed — Capacity 1000 chicks 3. Hatchery Unit Chicken egg setter — 02 (capacity 15000 each) Hatcher — 01 Capacity 5000)
Achievements	➢ Project work was initiated during May, 2009 ➢ First batch of day old parent stock chicks (300 nos) were procured during December, 2009 and raised in a temporary shed ➢ Birds started laying egg in the month of May 2010 ➢ More than 26,000 nos (twenty six thousand) hatchable eggs have been produced ➢ State Deptt. Hatchery unit at Tokal Bermiok, 7700 nos of eggs were hatched and 5500 day old chicks have been produced ➢ The first test hatching was on 5th April 2011 and 800 nos of day old vanaraja chicks have been produced

*** At present the poultry unit at the ICAR Research Complex, Sikkim Centre is maintaining parent stock for continuous supply of hatch able eggs and supplying day old chicks.**

Project 3		
Livelihood Improvement and Empowerment of Rural Poor through Sustainable	***NAIP Sub Project 1***	
	Feed storage technology for availability of fodder round the year (Duration	• Lack of judicious use of available feed and fodder has been identified in Project implementation area. Hence, inputs in the form of chaff cutter machines (electricity-driven (6nos) has been procured and distributed to different Self-Help Groups (SHGs) at

Farming System in North East India (NAIP) 2008-12)	*2009 -12)* ***As PI***	Lingdong, Passingdong, Tingvong and Gor. Training cum demonstration was given to two persons of the project area at ICAR Sikkim for installation of chaff cutter machines. Small tools have also been provided to them. • Saplings of fodder trees and improved grasses planted and distributed among members of SHG. • A cattle demonstration shed was constructed and cows were kept. Participatory experiment was conducted and animal feed (spent malt) was provided during demonstration period. More than 30 farmers participated in feeding trial experiment to increase milk production. Increased milk production up to 51% has been reported by the beneficiaries by adopting balanced feeding practices to the dairy animals. The concentrate feeding in the form of spent malt (Brewers' waste) is followed by many dairy cattle owners. • In order to make them active participant and to increase milk production in the area an offer was given to procure dairy animal at the nominal rate 5% of the purchase price. On demand by the interested farmers two cow and nine heifers of which five cross bred Holstein cattle and seven Jersey heifers of about fifteen months of age were made available to seven SHGs of seven wards at the project site. • Livestock owners have been developing the concept of scientific / balanced feeding. Training cum demonstration has been conducted at institute as well as project site. To encourage fodder preservation Poly bags has been made available to them. Farmers are well aware of the fodder preservation technology and some of them are practicing.
	NAIP Sub Project 2	
	Composite fish culture in harvested water in sub temperate region (Duration 2009 12) ***As PI***	Farmers having old infrastructures for harvesting rain water and interested in fish farming in the project area were identified and selected. Financial support was provided to fifteen (15) farmers to renovate their existing water tank used for agricultural activities and fish farming.

		Awareness programme on integrated fish farming and aquaculture were imparted in collaboration of other projects. Ten thousand suitable fingerlings were procured from the neighboring state with the help of State fisheries department and distributed to the farmers for stocking in the month of June2010.
	NAIP Sub Project 3	
	Promotion of subsidiary enterprise for women to enhance household income (Duration 2008-12) ***As PI***	• Training cum demonstration on mushroom production, machine wool knitting, handloom and handicraft, poultry farming and value addition on farm produce have been imparted and organised in the project area. The training materials and all essential tools and minimum incentives were given to encourage and support during training period. • Inputs in the form of mushroom spawn, small implements for mushroom production, wool knitting machine, wool, sewing machine, day old broiler chicks, and chicks of Vanaraja, and Gram priya breeds to promote backyard poultry have been made available to them. • The women folk in the project area have acquired different skills and became aware of the benefits derived from mushroom cultivation in terms of nutritional security and an additional income. Some of the SHGs have initiated vermin compost production with spent mushroom beds. • The members of two SHGs received training on handloom and handicraft. These SHGs have made products like hand woven bags, bamboo crafts and utility items out of locally available materials. The earning they made from this activity was more of a moral boost. • The farmers have started low scale broiler farming. They are also trained for backyard poultry farming Vanaraja breeds of poultry. The outcome in terms of availability of egg and meat production has increased in the area. • The members from about ten SHGs who received short term trainings on machine wool knitting at the

		two sites of project area have been making woollen garments as per their requirements.
Innovative technologies developed (Technology modified)		
1. Small Scale Silage making (PI) *(IPR submitted during 2010)*		• Large permanent silo pits can be replaced with high-density polythene bags (Silpaulin-90) which is easily available in the market, convenient to use and economical. • This can be a part-time job for a family to fill a bag having size 7′ x 30″ with a capacity of 250 kg, sufficient to feed a cow for 20 days. • These bags can be used for three to four years if used carefully. • Ensiled bags can easily be stored anywhere in the premises. Minimum smell nuisance while opened for feeding. Easy to ensiled, increases self life of the silage. • A farmer can preserve green forage as per his requirement. • Forages of high moisture content can be ensiled with available crop residues. • There will be no effluent run off hence, no contamination of water resource • No run off nutrient loss.
2. Fabrication of Farmers Feed block making device (Co PI) *(IPR submitted during 2010)*		• User-friendly as the cost of the machine is cheap and suitable for small and marginal farmers. Easy to carry and operate by women, children and old persons. • Preparation of compacted complete feed block reduces feed loss as residues up to 90 to 100%. • Easy to supplement deficient nutrients to animals in right proportion • Increases efficiency of utilization of nutrients • It reduces scarcity of feeds during winter.

Expert system developed	
1.	Expert system developed on eco- friendly feed preservation
2.	To increase self life of silage
3.	Mushroom cultivation
4.	Back yard Poultry production and management

Research papers	1. **Toppo, S.**, Verma A.K., Dass R.S., Mehra U.K. (1996). Nutrient Utilization and rumen fermentation pattern in crossbred cattle fed different plane of nutrition supplemented with urea molasses mineral block. Animal Feed Science and Technology 64: 101-112. 2. Haque N., Shrivastava J.P., Verma A.K. and **Toppo, S.** (1996). Growth performance in broiler chicks feeding on a cake mixture of agro-forest by-products. Int. Anim. Sci. 11: 283-288. 3. **Toppo, S.,** Shrivastava H.P, Verma, S.V.S., Deo C. and Manorath R. (1998). Effect of particle size and acid strength on in vitro solubility of marble stone and oyster shell. Indian J. Poultry Sci. 33(1): 90-92. 4. **Toppo,S.,** Mehra Usha R. and. Dass R.S (1999). Effect of feeding groundnut cake and urea molasses mineral block to adult cattle Indian Journal of Animal Sciences **69**(10) : 853-855. 5. **Toppo, S.,** Mehra Usha R and Dass R.S. (2000) Effect of urea supplementation to urea molasses mineral block (UMMB) lick on nutrient utilization and rumen fermentation Pattern in crossbred cattle. Indian Journal of Animal Sciences 70(4): 415-418. 6. **Toppo, S**., Verma, A.K. Haque, N, and Gupta, B.S. (2000). Effect of feeding unconventional cakes supplemented with lysine and Methionine to broiler chicks. Int. J. Anim. Sci. 15(2) 267-271. 7. Shrivastava H.P., Deo **C., Toppo S.,** Verma S.V.S. and Chand S. (2001). Requirement of supplemental vitamin D3 in the diet of white leghorn chicks. Indian J. Poult. Sci. 36 (1): 63-67. 8. Chandra Deo**,** Shrivasava H.P., Singh N.B. and **Toppo S**. (2001). In-vitro evaluation of different phosphates as phosphorus source for poultry feeding. Indian J. Poult. Sci. 36 (3):248-251. 9. Chandra Deo**,** Shrivastava H.P., Singh N.B. and **Toppo S**. (2001). Morphometry and mineralization of tibia bone as influenced by dietary phosphorus in broilers. Indian J. Poult. Sci. 36 (3): 260-263.

10. Chandra Deo**,** Shrivastava H.P., Singh N.B., **Toppo S.** and Johri T.S. (2002). Effect of feeding different levels of dietary phosphorus on growth performance and blood biochemicals of broiler chicks. Indian J. Poult. Sci. 37 (2): 183-186.

11. Chandra Deo, Shrivastava H.P., Singh N.B., **Toppo S**. and Johri T.S. (2002). Morphometry and mineralization of tibiae bone as influenced by dietary phosphorus in broiler starting chicks. Indian J. Poult. Sci. 37 (3): 280-282.

12. Chandra Deo, Shrivastava H.P., Singh N.B. and **Toppo S.** (2002). Effect of feeding different sources and levels of dietary phosphorus on morphometry and minralization of tibia bone in broiler chickens. Accepted Xth International Congress of Asian- Australasian Association of Animal Production Societies, held at Ashok Hotel, New Delhi, India..

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