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Model for Backyard Poultry Farming in West Bengal, India

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Abstract: Family poultry is presently considered as a Special Programme for Food Security particularly at the developing countries in the world. In this outset, a study was conducted on 60000 Rhode Island Red (RIR) birds by twenty four major treatment types to identify the best combination of major inputs viz. age of birds, initial supply of concentrated feed upto grower stage followed by supplementation of ration produced by the farmers using locally available ingredients along with run space to develop a model on backyard poultry production system under scavenging at five agroclimatic zones in West Bengal, India where largest Poultry Distribution Scheme of world were implemented. Twenty one variables under three major criteria viz. production and physiological, economical and adoption of technology were considered as vital effect using factor analysis and linear indexing technique. The result showed that 21 day old bird may to be selected for sustainable backyard poultry farming through Rhode Island Red breed at all agroclimatic zone under study. It was shown that a run space of above 20 sq ft per bird with the provision of 50% quantity of commercial poultry ration as per their requirement before laying followed by supplementary feed having 10.01-15.00 g crude protein per day ranked first among 24 treatment groups. The best agroclimatic zone for backyard poultry farming is coastal zone. The best possible combination of input and supportive factor for economic backyard poultry farming at farmers' doorstep of various agroclimatic zones was also analyzed.

Key words: Backyard poultry, Rhode Island Red (RIR) birds, coastal zone, West Bengal

INTRODUCTION

Globally, poultry plays an important role providing supply of animal protein as meat and egg (Sonaiya *et al*., 2012). The target of egg production in India on 2030 is 501-1000 kg eggs per square kilometer and in West Bengal (a state of India) which ranks third in poultry population and first considering the density with India, the average egg production per layer is only 128 per year and the per capita availability of egg is only 45 numbers in 2010-11 (Das, 2008 and BAHS, 2012).

The Food and Agriculture Organization (FAO) committed to develop family poultry through the International Network on Family Poultry Development (INFPD) as a Special Programme for Food Security (SPFS) where backyard poultry production system has been encouraged. Backyard poultry under scavenging production systems having very limited application of management interventions viz feed, overnight housing, water supplementation etc., provides about 65% egg in the West Bengal (Dana and Ogole, 2002; GoWB, 2005 and Das *et al*., 2011). To facilitate the backyard poultry production, the breed up gradation programme with scientific poultry rearing practices were already implemented in West Bengal under the largest Poultry Distribution Scheme of world (GoWB, 2005; Pica-Ciamarra and Dhawan, 2009).

In backyard poultry production system evaluation of major inputs as chicks, supply of concentrated ration along with scavenging and factors viz. scavenging area were sporadically carried out (NPCMT, 2012; Poultry Facts, 2012; Poultry Hub, 2012a, b). In this background, a comprehensive study considering larger sample size with variation of major inputs and factor viz. age of chicks, quality and quantity of supplemented feed along with scavenging and scavenging area in different agroclimatic zones of West Bengal were studied to develop a model on backyard poultry production system. All types of possibilities for providing inputs and factors were considered in experimental design of the study to develop a sustainable model for the rural farmers of a developing country.

MATERIALS AND METHODS

Study was conducted in 2010 to 2012 on 60000 Rhode Island Red (RIR) birds reared at backyard by the experienced 150 women Self Help Groups (SHGs) having 10 farmers in each SHG at 5 agro-climatic zones viz. tarai, new alluvial, red laterite, old alluvial and coastal (Table 1). Each farmer was provided scientifically designed poultry night shelter and forty chicks in two lots in the month of September and April. Replicated data involving two types of birds (21 days old chicks and day old chicks, DOC) brought up by support of four different type of feed schedule upto 20 weeks followed by supplementary feed with three allowed level of run space were subjected to data reduction technique

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Table 1: Location and meteorological data of the study area

Zone	Latitude	Longitude	Temperature (°C) Maximum	Temperature (°C) Minimum	Relative humidity (%)	Rain fall (mm)
Tarai	26°16"N to 27'0" N	88°4" and 89°53" E	33.92±0.44	17.08±0.67	81.33±19.52	230.88±74.70
New alluvial	20°20" N to 22°06" S	88°20" E to 88°60" W	35.02±0.37	18.71±0.77	82.17±15.94	108.04±37.77
Red laterite	22°15'N	87°39'E	35.27±0.53	18.67±0.70	76.50±22.29	111.02±33.19
Old alluvial	25°10'55" N to 26°35'15"N	89°00'30"E and 87°48'37" E	33.70±0.71	19.50±0.92	81.13±17.91	161.59±48.07
Coastal	21°33'60"N	88°15'70" E	35.27±0.37	17.71±0.70	80.08±9.15	138.08±36.94

Table 2: Experimental design for development of a model for backyard poultry faring in West Bengal, India dividing the stakeholders (SHGs) into 24 experimental groups depending upon types of chicks, initial feed supply and run space available

Run space (sq. ft./bird)	21 days old chicks (1) Initial feed (upto 18 weeks) 4 (30%)	3 (40%)	2 (50%)	1 (60%)	Day old chicks (2) Initial feed (upto 18 weeks) 4 (30%)	3 (40%)	2 (50%)	1 (60%)
<10 (1)	G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8
10-20 (2)	G-9	G-10	G-11	G-12	G-13	G-14	G-15	G-16
>20 (3)	G-17	G-18	G-19	G-20	G-21	G-22	G-23	G-24

Table 3: List of variables observed for model evaluation for backyard poultry faring in West Bengal, India

Production and Physiological	Economical	Adoption of technology
(i) Protein intake (CP) per bird	(i) Egg produced per bird per year	(i) Whether maintained up to 72 week
(ii) Age of puberty	(ii) Weight of egg at 1st laying	
(iii) Percentage of hen in production	(iii) Egg produced at 52nd week	
(iv) Weekly hen day	(iv) Hen day at 39th week	
(v) Average egg weight	(v) Percentage of hen in production at 39th week	
(vi) Body weight at 10th week	(vi) Total laying period upto 72 week of age	
(vii) Body weight at 20th week		
(viii) Body weight at 30th week	(vii) Body weight of DOC	
(ix) Body weight at 40th week	(viii) Protein mass produced	
(x) Body weight at 50th week		
(xi) Body weight at 60th week		
(xii) Body weight at 72nd week		

to develop a model for sustainable backyard poultry farming in West Bengal, India. Twenty four major treatment types nourished by corresponding SHGs studied are listed in Table 2.

Four types of initial poultry feed upto 20 weeks (upto 8 weeks chick mash having 17.23 CP% followed by grower mash having 12.32 CP%) was provided as 30, 40, 50 and 60% of standard ration (Hossain, 1992; Daghir, 1995; Barua *et al*., 1998 and Yasmin, 2002). Birds were maintained in common rural management practice under the guidance of veterinarian and skilled personnel. All the birds were allowed to free range scavenging with supplementary feeding of concentrate mixture prepared by the locally available feed resources having a total intake of Crude Protein (CP) from below 1 to above 15 g per day per bird and ranked as 1, 2, 3, 4, 5, 6 and 7 for below 1.00, 1.01-3.00, 3.01-5.00, 5.01-8.00, 8.01-10.00, 10.01-15.00 and above 15.01 g CP per day per bird, respectively.

Twenty one variables studied under three major criteria viz. (a) Production and Physiological (b) Economical and (c) Adoption of technology for this investigation are included in Table 3. Factor analysis was attempted to identify underlying variables, or factors, that explained the pattern of correlations within a set of observed variables. Factor analysis was often used in data reduction to identify a small number of factors that explained most of the variance observed in a much larger number of manifested variables. Variance came into play because factor analysis attempted to identify factors that explained as much of the common variance within a set of variables as possible. All of the variances in a set of variables can be explained if there were as many factors as variables. Factor analysis was attempted to explain as much of the variance as possible with the least amount of variables. Uniqueness, on the other hand, was the variance specific to a particular variable. Part of the variance, however, was unique to the specific factor and cannot be explained by the component variables. Uniqueness measured the variance that was reflected in a single variable alone. It was assumed to be uncorrelated with the component factors or with other unique factors. In the present study, the varimax rotation technique was used to extract the orthogonal factors and this attempt to minimize the number of variables that have high loadings on a factor. Each extracted factor would explain a percentage of total accounted for variance only corresponding to eigen values more than 1 and the highly loaded variables in each factor were only contributing such variability explanation. On search

of indicator variables or key variables were further marked the variable which had maximum of the maximum loadings within each factor. Linear indexing technique was further used keeping the economic importance of such indicator variables and mean resultant indices were subjected to stacked bar for ranking all the main effect of any desired treatment or any level of treatment interaction depending upon the altitude of respective columns.

RESULTS

Analysis of result of 21 dependent variables for development of a model for backyard poultry farming in different agroclimatic zones of West Bengal are presented through rotated component matrix with variable loadings of the extracted factors corresponding to eigen values more than 1 (Table 4). Seven factors were extracted after 6 iterations explaining 85% of total accounted for variance of the total study and resultant seven indicator variables were body weight at 40th week, egg weight at 52nd week, average egg weight, week on which production starts, hen day of 39th week, whether maintained up to 72 week and body weight at 10th week. These seven variables dominate over expressions of remaining variables' character. Afterwards linear indexing was done considering the importance of selected variables where all variables were linearly transformed with the logic 'higher value is good' except for the variable 'age of puberty or week on which production starts', where 'lower value is good' logic was followed.

Stacked bars were drawn with the calculated mean linear indices (Fig. 1) for ranking all the main effect of all the treatments under study. Similar bars can also be drawn to rank any level of treatment interaction depending upon the altitude of respective columns.

It was appeared that 21 day old bird, above 20 sq ft run space per bird, 50% type initial poultry feed, supplementary feed having CP grade 6 and coastal zone was the best unit considering isolated independent variable. The best combination of independent variables within each zone was presented in Table 5. At best zone

Table 4: Rotated component matrix for development of a model for backyard poultry farming in West Bengal, India

	Component						
Variable	1	2	3	4	5	6	7
Intake protein (CP)	0.016	0.089	-0.282	-0.282	0.199	0.088	0.265
Percentage of hen in production	0.029	0.975	-0.05	-0.014	0.192	-0.038	0.017
Egg produced per bird per year	0.004	0.748	0.008	-0.359	0.189	0.495	-0.041
Weekly hen day	0.029	0.975	-0.05	-0.014	0.192	-0.038	0.017
Egg produced at 52nd week	0.029	0.975	-0.05	-0.014	0.192	-0.038	0.017
Total laying period upto 72 week of age	-0.019	0.05	0.101	-0.54	0.085	0.789	-0.069
Whether maintained up to 72 week	0.052	-0.042	0.026	0.08	0.066	0.933	0.108
Age of puberty	0.032	-0.107	0.031	0.879	-0.045	-0.107	-0.045
Hen day at 39th week	-0.002	0.323	-0.015	-0.035	0.935	0.077	0.038
Percentage of hen in production at 39th week	-0.002	0.323	-0.015	-0.035	0.935	0.077	0.038
Average egg weight	-0.007	-0.042	0.966	0.123	0.005	0.048	0.035
Weight of egg at 1st laying	0.091	-0.042	0.437	0.719	0.049	-0.024	-0.122
Protein mass produced	-0.027	-0.046	0.961	0.079	-0.016	0.064	0.04
Body weight of DOC	-0.03	0.049	-0.044	0.126	-0.049	-0.008	-0.877
Body weight at 10th week	0.413	0.214	0.027	0.429	-0.054	0.16	0.475
Body weight at 20th week	0.869	0.074	0.006	0.065	0.018	0.043	0.23
Body weight at 30th week	0.811	0.016	-0.068	0.093	-0.018	0.092	-0.226
Body weight at 40th week	0.937	0.109	0.005	0.088	-0.004	0.061	0.011
Body weight at 50th week	0.933	0.061	0.009	0.062	-0.003	-0.002	0.042
Body weight at 60th week	0.9	-0.104	0.059	-0.013	-0.027	-0.065	0.051
Body weight at 72nd week	0.858	-0.056	-0.044	-0.096	0.04	-0.06	0.048
Eigen value	4.896	3.734	2.161	2.055	1.96	1.827	1.217
Variance (%)	23.312	17.783	10.292	9.784	9.332	8.702	5.794
Cumulative (%)	23.312	41.095	51.388	61.172	70.503	79.206	0.85

Table 5: Best combination of independent variables in each zone for rearing of backyard poultry in West Bengal, India

Zone	Experimental group	Bird type	Run space	Initial Feed	Supplementary feed intake
Coastal	G-7	Day old chick	Less than 10 sq. ft per bird	50%	CP grade 4
New alluvial	G-20	21 day chick	Above 20 sq. ft per bird	60%	CP grade 4
Red laterite	G-1	21 day chick	Less than 10 sq. ft per bird	30%	CP grade 3
Terai	G-17	21 day chick	Above 20 sq. ft per bird	30%	CP grade 4
Old alluvial	G-4	21 day chick	Less than 10 sq. ft per bird	60%	CP grade 6

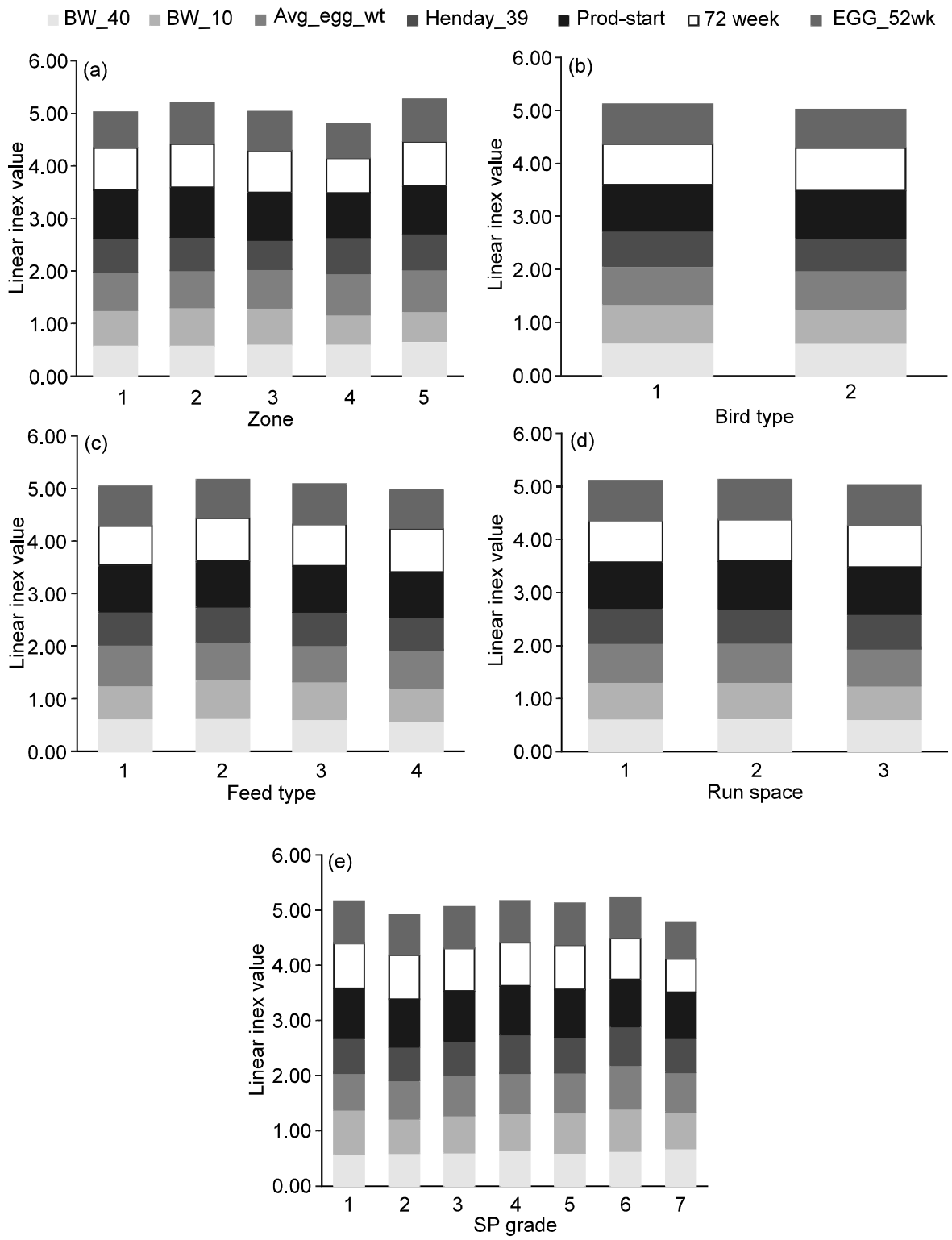

Fig. 1(a-e): Stacked bars with the calculated mean linear indices for main effect of (a) Zone, (b) Bird type, (c) Feed type, (d) Run space and (e) Supplemented feed (CP grade)

i.e., in coastal zone was the G-7 experimental group where Day Old Chick (DOC) reared in less than 10 sq ft per bird run space with 50% initial feed type followed by supplementary feed of CP grade 4.

DISCUSSION

The chick survivability was strongly correlated with growth rates (George *et al*., 1976); hence rearing of 21 day old bird showed better performance than Day Old Chick (DOC) in the present study which might be due to less brooding care at farmers' house to the DOC causing stress during early period of bird and supported by Farooq *et al*. (2004).

The best performance of the bird reared above 20 sq ft run space per bird resulted from the experiment was probably due to the more scope to scavenge at backyard. This observation is corroborated with the opinion of 'How to raise chickens' (2012) and more than as suggested by Miao (2012).

Present study also showed 50% initial concentrate feed with scavenging produced best performance compared to the birds reared in 30, 40 and 60% type of initial feed as supported by the findings of Mussaddeq (2002) and Kingori *et al*. (2007). Supply of less quantity of initial concentrated feed might affect performance probably for poor growth during developing stage. Over feeding at 60% initial feed level also negatively influenced overall performance due to fattening (Zanusso, 2003).

Supplementary feed after 20 weeks of bird having total crude protein intake 10.01-15.00 g per bird per day (CP grade 6) showed best performance throughout the laying period. These findings are similar with the estimation of daily protein requirement for laying hen made by NRC (1994) and supported by Dutta *et al*. (2012).

Among the zones the coastal zone was the best suitable zone for rearing of backyard poultry in West Bengal, India considering all independent variables under study. This may be due to most favourable weather having less fluctuation of temperature and humidity throughout the year (Allaby, 1995). The minimum variation of weather throughout the year resulted better survivability of DOC during brooding stage than 21 day old chick which was reverse to the observation found in other zone. Similar trend of opposite result were also found for run space and supplementary feed intake at coastal zone. Chance of more availability of waste sea animal protein (Mark, 2011 and FAO, 2012) probably reduced run space requirement at 10 sq ft per bird and less supplementation of crude protein, 5.01-8.00 g CP per bird per day (CP grade 4) at the zone.

The natural availability of protein through scavenging and run space are variable in various zones viz. red laterite, old alluvial, tarai and new alluvial; hence, the birds in different zones showed best performance rearing at various run space with suitable initial feed amount followed by different quantities and qualities of supplementary feed available at that zone.

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