

Benefit-cost analysis of Rhode Island Red chicken rearing in backyard on the basis of egg production performance

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Abstract

Aim: The aim of the present study was to analyze of the egg production features of backyard chicken rearing with an evaluation of production cost of an egg and there by benefit-cost analysis.

Materials and Methods: Study was conducted on 60000 chicken covering five different agroclimatic zones in the state West Bengal, India. Initially each farmer was provided day-old Rhode Island Red chicks, commercial ration upto pre-laying stage having CP of 17.23% and 12.32% in chick and grower mash respectively along with common management support system for backyard poultry rearing viz. separate poultry night shelter and brooding facilities, deworming and vaccination and regular health check up system, later farmers were allowed to use the supplemented feed made by the locally available resources having various crude protein content.

Results: It was observed that there was no significant variation in respect of total egg production under various supplemented crude protein containing feed, whereas significantly higher egg production feature is observed in Coastal and Old Alluvial zones.

Conclusion: The study concluded that more profit was occurred to those farmers who provided the supplemented feed with less crude protein content along with scavenging. This scope is more in new alluvial zone. It was also observed that profit started from 11 month onwards in each agro-climatic zone as well as in each category of supplemented feed.

Keywords: backyard, benefit-cost analysis, chicken, egg production, RIR.

Introduction

About 85% of chicken stock of India belongs to small sector which provides 50% of total egg production [1-3]. Family chicken through the International Network on Family Poultry Development (INFPD) was also committed by the Food and Agriculture Organization (FAO) as a Special Programme for Food Security (SPFS) in the developing countries including India where backyard chicken production system has been encouraged [4]. Rural farmers were motivated for backyard chicken production under the largest Poultry Distribution Scheme of world in the West Bengal state [5]. But, basic data related to egg production performance and benefit-cost analysis of the distributing chickens, the Rhode Island Red (RIR), at the backyard was not standardized.

On this background, an attempt was made to standardize the basic egg production data in respect to backyard chicken rearing at various agro-climatic zones of West Bengal viz. age of maturity, weekly hen day, laying period, total egg production. These egg

production features were also analysed on the basis of various supplemented feed provided by the farmers. Attempt was also made to analyze the production cost of an egg and there by benefit-cost analysis. The study may help the farmers and planners to evaluate the backyard chicken rearing system in rural areas and to take suitable programme thereof.

Materials and Methods

Ethical approval: Adequate measures were taken viz. good transportation system during transportation of chickens, well ventilated houses, proper sanitary and hygienic measures and provision of sufficient water and run space etc. to minimize pain or discomfort in accordance with the International Animal Ethics Committee. The study was approved by the University level committee framed for such research. During the study, the researchers explained the objective and methodology of the study to all farmers.

Study area and chickens: Study was conducted on 60000 RIR chickens in the year 2010 to 2013 covering five different agroclimatic zones viz. terai, old alluvial, new alluvial, red and laterite and coastal in the state West Bengal, India. Chickens were reared by the 1500 experienced women farmers who were belong to 150

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Table-1: Ration formulated by the farmers for backyard rearing RIR chickens in different agro-climatic zones of West Bengal, India using local resources with its cost.

Ingredients used [(in kg) per 100 kg of feed]	Various CP grades						Overall	Agro-climatic zones				
	1	2	3	4	5	6		Terai	New Alluvial	Red Laterite	Old	Coastal
1. Unpolished rice	0	1	1	1	1	1	1	0	1	2	1.5	0
2. Wheat (broken)	5	23	15	17	16	17	17	21	17.9	18.8	19	12
3. Maize (broken)	1	9.9	13	13	10	10.9	11	13	15	11	7	11
4. Commercial layer feed	0	5	9.9	14	16	14	11	14	11	11	5.2	12
5. Rice (broken)	49	31	26	24	23	18	26	21	24	22	31	29.8
6. Rice bran	11	8	8	7.9	11	17	9	9	8	11	7	10
7. Boiled rice	14	14	18	13	14	12	14.9	11	14	12	18	17
8. Paddy	14	5	7	8	8	9	8	10	7	9	9	7
9. Fish	0	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.2	0.3	0.2
10. Snail	6	3	2	2	1	1	2	1	2	3	2	1
Total	100	100	100	100	100	100	100	100	100	100	100	100
Intake protein** (gram/bird/day)	0.69 ^f	2.11 ^e	3.99 ^d	6.23 ^c	8.73 ^b	11.31 ^a	4.47	5.36 ^a	3.37 ^c	3.70 ^c	4.30 ^b	4.95 ^b
Mixed ration provided (gram/bird)	27.80	38.13	49.91	60.23	70.58	86.50	51.07	46.25	31.93	43.29	58.57	48.40
Green vegetables provided (gram/bird)	±5.12	±4.78	±8.04	±10.45	±7.21	±11.43	±8.78	±2.02	±1.09	±2.44	±1.97	±2.32
Total amount of feed provided (gram / bird)	38.80	52.83	68.92	77.25	84.88	106.70	67.62	56.16	51.42	61.45	91.11	65.01
Feed cost (Rs./Kg)	5.72	5.93	5.69	6.52	7.16	7.11	6.08	7.83	6.03	6.67	5.49	7.38
Feed cost** (Rs./bird/day)	0.22 ^d	0.31 ^{cd}	0.39 ^c	0.50 ^b	0.61 ^b	0.76 ^a	0.41	0.44 ^b	0.31 ^c	0.41 ^b	0.50 ^a	0.48 ^a
	±0.01	±0.01	±0.01	±0.02	±0.34	±0.04	±0.02	±0.02	±0.01	±0.02	±0.02	±0.02

** P≤0.01 Means in the same row having common alphabet within various CP grades / agro-climatic zones does not differ significantly.

self help groups (SHGs). The area of the study was selected randomly within a zone and the SHGs were selected equal numbers in each zone on the basis of survey conducted exclusively for this study, which had early experience of backyard indigenous and upgraded chicken rearing.

Service and support provided: Each farmer was provided 40 RIR day-old chicks in two lots with uniform night shelter and brooding facilities. The chickens were maintained by the common health care management schedule at free range system in the backyard of the farmers. Initially all the farmers were also provided 1.39 kg chick mash having crude protein (CP) of 17.23% upto 10 weeks and 2.8 kg grower mash having CP of 12.32% for the period of 11 – 20 weeks following the schedule as per Barua *et al.* [6]. Total cost of the initial feed was INR 119.71 per chicken. After 20 weeks, the chickens were provided variable types of supplemented feed produced by the farmers using local resources as farming practices. The ingredients used for preparing 100 kg feed and amount provided to each chicken with feed cost are presented in Table-1. Weekly egg production and other related records were collected from the farmers' register. The register was provided exclusively for this study before input supply and checked regularly.

Analysis of feed: CP % is presented in the form of total protein intake per chicken per day and amount of supplemented feed provided to the chickens by the farmers. The CP % of the feed was assessed following method AOAC 976.05 [7]. Depending upon CP intake on the basis of total quantity of protein provided from the supplemented feed was grouped into 6 types as CP

grade 1-6 and ranked as 1, 2, 3, 4, 5 and 6 where protein intake was upto 1.00 gm/chicken/day (0.69 ± 0.03) marked as 1, 1.01-3.00 gm/chicken/day (2.11 ± 0.05) marked as 2, 3.01-5.00 gm/chicken/day (3.99 ± 0.04) marked as 3, 5.01-8.00 gm/chicken/day (6.23 ± 0.07) marked as 4, 8.01-10.00 gm/chicken/day (8.73 ± 0.10) marked as 5 and 10.01-15.00 gm/chicken/day (11.31 ± 0.23) marked as 6 with an overall mean of (4.47 ± 0.11) gm CP intake per day per chicken (Table-1).

Statistical analysis: The mean and standard deviation of the egg production performance *viz.* age of puberty, weekly hen day, total egg produced and production period was statistically analyzed in respect to CP grade *i.e.* source of variance on the basis of farmers' record upto 18th month age of chicken. Mean of all the characters were further compared with CP grade following one-way analysis of variance techniques along with Duncan's test at 5% level of significance [8]. Main effect mean of CP grade if found significant, was displayed along with small alphabets where similar alphabets denote homogeneous means due to Duncan's test (P<0.05).

Considering the usual backyard farming practice, egg was considered as only source of income and all the produced eggs were considered as table egg for calculating benefit–cost analysis which was INR 3.88 as per farmers' record. Feed cost and cost of all other expenditures *viz.* health care management cost, electricity / fuel cost, other contingency expenditures was calculated from the farmers' record which was considered as 70:30 at any particular time. The benefit – cost ratio (B:C) was then calculated month wise from 5th month onwards.

Table-2: Egg production features of RIR chickens reared at backyard obtained by using initial commercial feed followed by various supplemented feed used in farming practices in different agro-climatic zones of West Bengal, India.

Parameter	Various CP grades						Overall	Agro-climatic zones				
	1	2	3	4	5	6		Terai	New Alluvial	Red Laterite	Old	Coastal
Age of maturity** (week)	24.23 ^a ±3.06	24.57 ^a ±2.92	23.08 ^{ab} ±2.32	23.15 ^{ab} ±2.23	23.49 ^{ab} ±3.28	22.13 ^b ±2.80	23.56 ±2.69	23.45 ^b ±1.96	24.25 ^c ±2.27	24.90 ^d ±2.96	21.82 ^a ±2.80	23.38 ^b ±2.34
Average weekly hen day**	3.17 ^b ±0.55	3.18 ^b ±0.58	3.23 ^{ab} ±0.42	3.33 ^{ab} ±0.47	3.20 ^{ab} ±0.46	3.43 ^{ab} ±0.36	3.24 ±0.50	3.24 ^b ±0.24	3.16 ^b ±0.48	3.13 ^b ±0.66	3.24 ^b ±0.45	3.45 ^a ±0.35
Total egg produced** (No./chicken)	148.83 ^{ab} ±28.82	138.41 ^b ±36.16	152.69 ^{ab} ±28.89	158.85 ^{ab} ±28.48	153.76 ^{ab} ±26.84	168.36 ^a ±24.87	150.72 ±31.99	146.76 ^b ±31.43	142.12 ^b ±34.20	144.43 ^b ±36.92	159.75 ^a ±28.02	160.56 ^a ±23.12
Production period** (week)	46.93 ^{ab} ±4.29	43.44 ^b ±8.66	47.25 ^{ab} ±6.31	47.69 ^{ab} ±5.31	47.94 ^{ab} ±5.09	49.09 ^a ±4.48	46.38 ±6.88	45.23 ^b ±7.88	44.86 ^b ±8.49	46.07 ^b ±6.26	49.18 ^a ±4.61	46.59 ^b ±5.64

** P≤0.01 Means in the same row having common alphabet within various CP grades / agro-climatic zones does not differ significantly.

Table-3: Age wise egg production performance of RIR reared at backyard in different agro-climatic zones of West Bengal, India using initial supplied feed followed by feed used in farming practices.

Age of chicken (week/month)	Various CP grades						Overall	Agro-climatic zones				
	1	2	3	4	5	6		Terai	New Alluvial	Red Laterite	Old	Coastal
20 / 5	0.07	0.04	0.07	0.10	0.00	0.41	0.08	0.07	0.06	0.08	0.55	0.12
24 / 6	3.36	3.22	3.64	2.98	2.39	5.43	3.36	1.90	1.01	1.32	7.19	2.98
28 / 7	13.60	14.06	14.51	12.65	12.52	16.49	13.81	10.51	8.71	7.29	22.81	12.15
32 / 8	28.36	29.75	30.04	27.48	27.17	31.25	29.05	24.54	22.85	19.00	41.55	25.66
36 / 9	45.61	45.71	47.10	44.42	45.08	49.79	45.97	41.03	39.52	34.58	58.98	42.59
40 / 10	64.20	62.83	64.81	61.05	63.92	67.75	63.36	57.86	56.54	50.18	75.85	60.73
44 / 11	80.58	78.39	81.61	78.33	84.28	85.03	80.26	74.35	71.63	64.86	90.84	78.83
48 / 12	98.71	92.24	94.62	93.51	102.27	102.68	94.82	89.64	84.33	78.61	104.21	96.54
52 / 13	112.78	104.60	106.40	106.71	116.07	116.36	107.45	103.20	95.97	91.38	116.02	112.18
56 / 14	124.97	115.02	117.88	119.20	126.67	127.95	118.98	115.62	106.91	103.92	126.89	124.78
60 / 15	135.12	124.16	128.00	129.67	137.63	141.51	129.20	125.13	117.52	115.61	136.82	135.64
64 / 16	145.69	132.69	137.34	139.14	147.36	154.27	138.65	133.56	127.26	126.09	145.84	145.66
68 / 17	147.21	136.54	146.32	148.25	150.35	161.74	147.45	141.07	135.10	135.96	154.17	154.45
72 / 18	148.83	138.41	152.69	158.85	153.76	168.36	150.72	146.74	142.19	144.63	159.72	160.61

Results

Major egg production performances viz. age of maturity, average weekly hen day, total egg production and production period in different agro-climatic zones and on the basis of various supplemented feed provided by the farmers were presented in Table-2. It appeared that overall laying period had been started from the age of 23.56 ± 2.69 weeks (165 days). In the study it was also appeared that average weekly hen day was 3.24 ± 0.50 and produced 150.72 ± 31.99 eggs per chicken per year within 46.38 ± 6.88 weeks laying period. The chickens reared under CP 1 and 2 graded feed also showed comparatively less hen day. On the contrary, the chickens reared under CP 6 graded feed showed earliest maturity, highest average weekly hen day (3.43 ± 0.36) and maximum laying period (49.09 ± 4.48 weeks) with highest egg production performance (168.36 ± 24.87 eggs per bird per year). Agro-climatic zone comparison feature showed that early maturity (21.82 ± 2.80 weeks), highest egg production performance (159.75 ± 28.02 eggs per bird per year) and maximum laying period (49.18 ± 4.61 weeks) was happened in old alluvial zone, where coastal zone also showed highest egg production performance along with highest average weekly hen day (3.45 ± 0.35).

Age wise egg production performance under various CP graded feed and in different agro-climatic

zones has been presented in Table-3.

Table-4 showed the benefit cost ratio (B:C) in respect of egg production. It was appeared that profit started from 9th month under CP grade 1 and 2 and in old alluvial zone, from 10th month in overall and in all other CP graded feed except CP grade 6 and also in all other zones except red laterite zone. Profit started and continued in all graded feed as well as all agro-climatic zones of West Bengal including CP grade 6 and in red laterite zone from 11th month onwards. It was also appeared that maximum profit and least production cost for producing an egg was occurred in CP grade 1 and in new alluvial zone; where least profit with maximum egg production cost was occurred in CP graded 6 and in terai and old alluvial zone. It was noticed that rate of feeding of aquatic snail was highest in CP grade 1 feed and decreased gradually in subsequent CP graded feed.

Discussion

The age of maturity of the present finding was corroborated with the age of maturity of Vanaraja and Gramapriya breed reared at backyard [9]. In overall study, the average weekly hen day and total egg produced per chicken per year was similar whereas profitable egg laying period was found to be higher than the previous report of Sonaiya *et al.* [10].

Table-4: Benefit-Cost analysis (B:C) of RIR chickens reared at backyard in different agro-climatic zones of West Bengal in respect of egg production.

Week (month)	Parameter	Various CP grades						Overall	Agro-climatic zones				
		1	2	3	4	5	6		Terai Alluvial	New Laterite	Red	Old	Coastal
20(5th)	Value of Table egg	0.22	0.10	0.29	0.00	0.00	1.55	0.29	0.27	0.23	0.31	2.14	0.47
	Total cost	119.71	119.71	119.71	119.71	119.71	119.71	119.71	119.71	119.71	119.71	119.71	119.71
	B:C	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.02	0.02
24(6th)	Value of Table egg	13.07	12.50	14.17	11.60	9.27	21.15	13.06	7.391	3.93	5.14	27.97	11.59
	Total cost	129.14	133.00	136.43	141.14	145.86	152.29	137.29	137.31	132.11	136.11	139.71	138.91
	B:C	0.10	0.09	0.10	0.08	0.06	0.14	0.10	0.05	0.03	0.04	0.20	0.08
28(7th)	Value of Table egg	52.99	54.81	56.56	49.30	48.78	64.27	53.82	40.88	33.88	28.36	88.73	47.26
	Total cost	138.57	146.29	153.14	162.57	172.00	184.86	154.86	154.91	144.51	152.51	159.71	158.11
	B:C	0.38	0.37	0.37	0.30	0.28	0.35	0.35	0.26	0.24	0.19	0.56	0.30
32 (8th)	Value of Table egg	110.57	115.97	117.12	107.12	105.93	121.85	113.24	95.46	88.89	73.91	161.63	99.82
	Total cost	148.00	159.57	169.86	184.00	198.14	217.43	172.43	172.51	156.91	168.91	179.71	177.31
	B:C	0.75	0.73	0.69	0.58	0.53	0.56	0.66	0.55	0.57	0.44	0.90	0.56
36 (9th)	Value of Table egg	177.84	178.24	183.65	173.21	175.75	194.16	179.25	159.61	153.73	134.52	229.43	165.68
	Total cost	157.43	172.86	186.57	205.43	224.29	250.00	190.00	190.11	169.31	185.31	199.71	196.51
	B:C	1.13	1.03	0.98	0.84	0.78	0.78	0.94	0.84	0.91	0.73	1.15	0.84
40(10th)	Value of Table egg	250.35	245.02	252.73	238.06	249.24	264.18	247.07	225.08	219.94	195.20	295.06	236.24
	Total cost	166.86	186.14	203.29	226.86	250.43	282.57	207.57	207.71	181.71	201.71	219.71	215.71
	B:C	1.50	1.32	1.24	1.05	1.00	0.93	1.19	1.08	1.21	0.97	1.34	1.10
44(11th)	Value of Table egg	314.22	305.69	318.24	305.45	328.66	331.59	312.98	289.22	278.64	252.31	353.37	306.65
	Total cost	176.29	199.43	220.00	248.29	276.57	315.14	225.14	225.31	194.11	218.11	239.71	234.91
	B:C	1.78	1.53	1.45	1.23	1.19	1.05	1.39	1.28	1.44	1.16	1.47	1.31
48(12th)	Value of Table egg	384.92	359.69	368.99	364.64	398.81	400.42	369.77	348.70	328.04	305.79	405.38	375.54
	Total cost	185.71	212.71	236.71	269.71	302.71	347.71	242.71	242.91	206.51	234.51	259.71	254.11
	B:C	2.07	1.69	1.56	1.35	1.32	1.15	1.52	1.44	1.59	1.31	1.56	1.48
52(13th)	Value of Table egg	439.81	407.92	414.93	416.15	452.62	453.76	419.03	401.448	373.323	355.472	451.32	436.38
	Total cost	195.14	226.00	253.43	291.14	328.86	380.29	260.29	260.51	218.91	250.91	279.71	273.31
	B:C	2.25	1.80	1.64	1.43	1.38	1.19	1.61	1.54	1.71	1.42	1.62	1.59
56(14th)	Value of Table egg	487.34	448.55	459.71	464.84	493.97	498.97	463.98	449.76	415.88	404.25	493.60	485.39
	Total cost	204.57	239.29	270.14	312.57	355.00	412.86	277.86	278.11	231.31	267.31	299.71	292.51
	B:C	2.38	1.87	1.70	1.49	1.39	1.21	1.67	1.617	1.798	1.51	1.65	1.66
60(15th)	Value of Table egg	526.92	484.17	499.14	505.66	536.72	551.83	503.86	486.76	457.15	449.72	532.23	527.64
	Total cost	214.00	252.57	286.86	334.00	381.14	445.43	295.43	295.71	243.71	283.71	319.71	311.71
	B:C	2.46	1.92	1.74	1.51	1.41	1.24	1.71	1.646	1.8758	1.585	1.67	1.69
64(16th)	Value of Table egg	568.16	517.43	535.58	542.62	574.66	601.61	540.70	519.55	495.04	490.49	567.32	566.62
	Total cost	223.43	265.86	303.57	355.43	407.29	478.00	313.00	313.31	256.11	300.11	339.71	330.91
	B:C	2.54	1.95	1.76	1.53	1.41	1.26	1.73	1.658	1.94	1.63	1.67	1.71
68(17th)	Value of Table egg	598.81	545.42	570.62	578.13	610.49	652.84	575.02	548.76	525.54	528.88	599.72	600.81
	Total cost	232.86	279.14	320.29	376.86	433.43	510.57	330.57	330.91	268.51	316.51	359.71	350.11
	B:C	2.57	1.95	1.78	1.53	1.41	1.28	1.74	1.658	1.96	1.67	1.67	1.72
72(18th)	Value of Table egg	625.93	571.09	598.21	606.52	640.61	687.76	602.92	570.82	553.12	562.61	621.31	624.77
	Total cost	242.29	292.43	337.00	398.29	459.57	543.14	348.14	348.51	280.91	332.91	379.71	369.31
	B:C	2.58	1.95	1.78	1.52	1.39	1.27	1.73	1.64	1.97	1.69	1.64	1.69
Production cost for a egg		1.51	2.00	2.20	2.56	2.80	3.08	2.25	2.38	1.98	2.30	2.38	2.30

Significantly delayed onset of maturity (nearly 1 week) was observed to the birds reared under CP 1 and 2 grade feed and in both new alluvial and red and laterite zones; but this finding was better than the earlier report [6] where age of maturity was observed at 37 weeks in RIR. This might be due to supplementation of good quality feed at the chicks and growing stage [11].

The chickens reared under CP 1 though showed less hen day but its egg production performance was similar with the other grade feed. Chickens reared under CP 2 grade feed was also showed comparatively less hen day might be due to less availability of protein of their feed [12]. Whereas, the chickens reared under CP 6 graded feed showed earliest maturity, highest average weekly hen day and maximum laying period which might be due to continuous supply of more protein containing feed contributing highest egg production performance. In various agro-climatic zones, comparatively low egg production performance was observed in terai, new alluvial and red and laterite zones. This

might be due to less hen day average; as a result their total production period was reduced also. Old alluvial and coastal zone showed significantly higher egg production performance was probably due to supply of more quantity of feed to the chickens.

Overall egg production rate of the present study was higher than the earlier report of backyard RIR at 9th week and comparable at 10th week of the chickens reared at farm [13]. Result showed that though there was significant variation occurred in various grade feed cost, but no significant variation persisted in respect of total egg production, except production performance of CP 2 graded feed which may be due to total less production performance. Hence, it would be better to rear the chickens under that CP grade feed which had less production cost and more return i.e. more the value of benefit cost ratio (B:C).

Result of B:C showed that maximum profit as well as least production cost for producing an egg was occurred in CP grade 1 and in new alluvial zone, whereas, least profit with maximum egg production

cost was in CP grade 6 and in terai and old alluvial zones. It might be due to availability of cheapest and good quality protein intake in CP grade 1 feed and in new alluvial zone by which the requirement of key indispensable amino acids were made available [14]. Hence, quantity of protein intake through supplemented feed by CP grade 1 and in new alluvial zone though was far below than the earlier observation [15] and also below than the other category of feed and zones respectively, yet produced equivalent quantities of eggs which made the backyard poultry farming more profitable when compared with other graded feed and zones. Further, higher egg production performance at backyard may not be an important criterion considering its benefit-cost analysis.

Conclusion

Thus, it can be concluded that the basic egg production features along with production cost of an egg of backyard chickens under various level of supplemented feed has been standardized. The benefit-cost analysis has also been calculated.

- So, it can be concluded that under scavenging system at backyard, profit will continue from 11 month onwards irrespective of protein supplementation available at various agro-climatic zones of West Bengal.

- In this system more protein as well as more quantity of supplemented feed may influence to produce more eggs but there is a scope of least profit due to higher egg production cost; rather supplementation of minimum protein through additional feed may causes more profit due to least production cost for producing an egg.

So, the rural poor farmers may follow this model for backyard chicken farming where a minimum support of initial feed upto pre-laying stage is to be provided.

Authors' contributions

PKD planned the study and supervised the entire work. PRG and SP drafted and reviewed the manuscript and monitored the work. BR analyzed the feed and reviewed the manuscript. DM analyzed the data and reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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