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COST BENEFIT APPROACH FOR OPTIMIZATION OF STOCKING DENSITY OF BROILER REARING IN A SMALL POULTRY HOUSE

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The study was performed to determine the optimum stocking density of poultry bird in small broiler rearing poultry house using the stocking densities 20, 25, 33, 50 and 100 birds poultry house^{-1} (equivalent to 2.5, 2.0, 1.5, 1.0 and 0.5 ft^2 space bird^{-1}). Growth and survival of bird were recorded at regular intervals. Production data was collected after rearing of 45 days. Data was analyzed statistically by ANOVA and LSD for separation of means ($p < 0.05$). The growth of poultry birds gradually decreased with increasing stocking density and showed maximum growth 2.25 Kg at SD_{20}. Total production of bird tended to rise as a direct function of the stocking density till the stocking density SD_{33}, further rise in stocking density resulted in 33 to 41% decline. Critical appraisal of the cost benefit data clearly showed the four levels of response to density of bird. Low growth of profit from SD_{20} to SD_{25}-low growth of profit density (LGPD), high growth of profit from >SD_{25} to SD_{33}-high growth of profit density (HGPD), reduced growth of profit from >SD_{33} to SD_{43}-reduced growth profit density (RGPD) and negative growth of profit or loss from >SD_{43} to SD_{100}-negative growth of profit density (NGPD). Examination of cost benefit ratio for production of broiler exhibiting the total revenue and profit being maximum at the density of bird 33(SD_{33}) and exhibiting zero profit at the stocking density of 43. Therefore, it can be concluded that stocking density 33 bird poultry house^{-1} (1.5ft^2 bird^{-1}) is cost benefit density as well as optimum in small broiler rearing poultry house.

Key words : Broiler, small poultry house, stocking density, cost benefit ratio.

INTRODUCTION

Poultry industry is one of the fastest growing segments of the agricultural sector of India playing an important role in the Indian Economy. Production of poultry primarily depends on the growth of bird rearing in the poultry, which in turn is regulated by various intrinsic and extrinsic factors. Stocking density of bird, nutrition, water, air, temperature, humidity, light, disease, social aspects, sound and wastes are the critical extrinsic factors directly influencing the growth of bird. Physical and social space requirements may cause an impact on animal behaviour. It has been proposed that body weight of bird decreased with increasing stocking density (Deaton *et al.*, 1968; Bolton *et al.*, 1972; Weaver *et al.*, 1973; Proudfoot *et al.*, 1979; Cravener *et al.*, 1992) and reduced activity level (Estevez & Arias, 1997). Reduced activity has also been implicated as a factor involved in the development of leg problems in broiler chickens (Haye & Simons, 1978; Newberry *et al.*, 1988; Kestin *et al.*, 1992). In many poultry species, stocking density has been shown to influence feeding, drinking, resting, locomotion and foraging and has been linked to increased competition for resources and aggression among conspecifies. In addition to providing birds with exercise, perches in the environments of broiler chickens may improve welfare by providing them with an opportunity to perform a natural behaviour and by allowing them to exert some control over their environment (Newberry, 1995). Perches also allowed for more efficient use of the vertical space in a house, which may decrease the impact of higher rearing densities (Newberry, 1995; Tablante *et al.*, 2003).

To gain competitiveness in the animal agriculture arena, the poultry industry must focus on increasing chick survivability, maximizing growth and reducing costs associated with feeding. Factors affecting growth in ostriches are similar to those affecting other avian species and include diet, rearing environment, genetic potential, and management and health status. Currently, ostriches are reared under a wide range of stocking densities, ranging from 16 to 40 m bird^{-1} (Verwoerd *et al.*, 1999). In other poultry species, amount of available space has been shown to alter bird behaviour (Lewis & Hurnik, 1990; Andrews *et al.*, 1997; Carmichael *et al.*, 1999) and influence health and performance of an individual (Proudfoot *et al.*, 1979; Shanawany, 1988). Focusing research on adequate requirements may lead to management charges that could help diminish stress and subsequently lead to improve survivability and growth of ostriches. Maximum densities of bird in a specific area at which maximum production gains by minimum cost without showing any adverse effect on bird environment as well as health that is optimum stocking density. The optimum stocking density can be useful tool to increase the production by maximizing weight gain, reducing feeding and other costs.

The purpose of the present study was to determine the optimum stocking density for maximum growth and production of broiler through cost benefit analysis of small broiler rearing poultry house.

MATERIALS AND METHODS

Experimental design : The experiment was performed using poultry house (10 x 5 ft^2) constructed with bamboo and wire net, which was the main constituents. Many farmers use small poultry house for short term production of broiler to avoid the economic loss due to management problem as well as more probability of disease infection. Fifteen poultry houses were prepared and arranged all facilities providing all equipment necessary for an ideal poultry house to avoid any kind of environment stresses and to lead a normal life of poultry bird.

The stocking density used in the study was 20, 25, 33, 50 and 100 bird per poultry house (herein called poultry houses SD_{20}, SD_{25}, SD_{33}, SD_{50} and SD_{100}) which is equivalent to 2.5, 2.0, 1.5, 1.0 and 0.5 ft^2 space bird^{-1}.

One day old broiler chicks (70 ± 3.5g) were collected from a local poultry farm and introduced at the rate as above mentioned and reared for 45 days production cycle. Prepared feed was collected from market and supplied to the bird according to normal feeding procedure. All birds were reared following the standard management practices of a poultry bird. Growth and survival of the bird were recorded at the regular intervals. Production data was collected at the final harvest.

Feed conversion index : Growth and feed consumption rate were collected at every five days interval. Feed conversion index (FCI) was determined according to the following method :

$$FCI\ (\%) = \frac{NWG}{TFC} \times 100$$

Where, NWG = Net weight gain
TFC = Total feed consumed

Cost benefit analysis : Cost benefit analysis (CBA) of production of bird performed using the method described by Jolly & Clont (1993) as follows :

$$Y = Y_1 - (ax_1 + bx_2 + cx_3 + dx_4)$$

where, Y = Net profit
Y_1 = Total revenue
x_1 = Stocking cost
x_2 = Rearing cost
x_3 = Land rent cost
x_4 = Interest on input costs

Statistical analysis : A one way ANOVA was used for data of production of bird. If the main effect was found significant, the ANOVA was followed by a LSD (least significance difference) test. All statistical tests were performed at a 5% ($p < 0.05$) probability level using statistical package EASE and M-STAT.

RESULTS

Growth : The average weight of bird ranged from 0.44 to 2.40 kg in all stocking densities. The average growth was maximum in SD_{20} (2.25 kg) followed by SD_{25}, SD_{33}, SD_{50} and SD_{100}. The daily growth rates varied between 0.09 and 0.049 g d^{-1} in different stocking densities employed. The daily growth rate was markedly higher in SD_{20} (Table I).

Survival : Survival of bird varied largely ranging from 85 to 100% in five stocking densities employed. No mortality was encountered when the stocking density remained between SD_{20} and SD_{33} but 90 and 85% survival were observed in SD_{50} and SD_{100}, respectively (Table I).

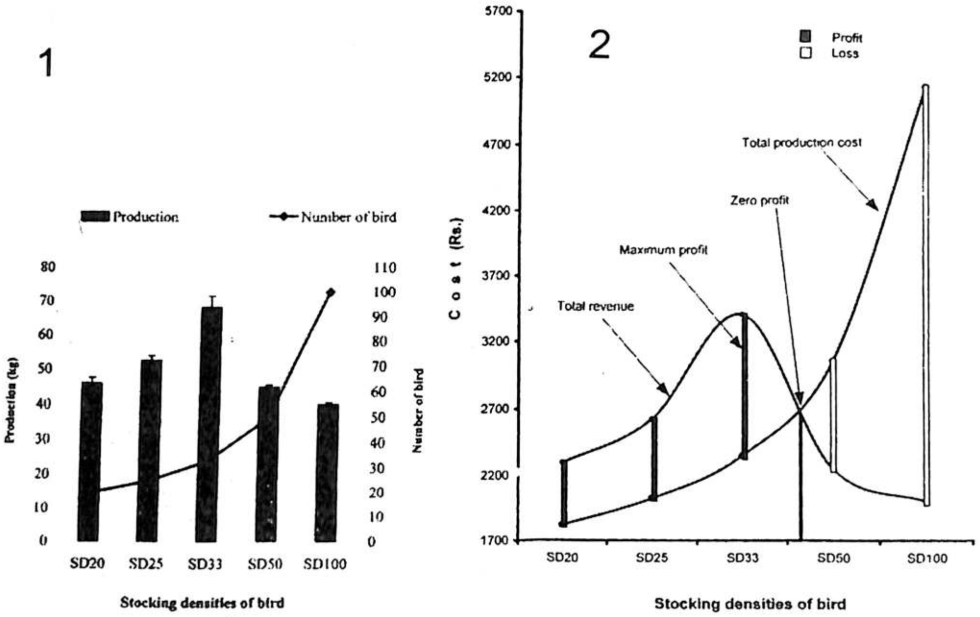
Production : Maximum production of bird (68 kg) obtained in the stocking density of SD_{33} was 29 to 47% higher than that observed in the lower stocking density (SD_{20} and SD_{25}) (Table I). Generally, production of bird tended to rise as a direct function of the stocking density till the density of SD_{33}, further rise in stocking density (SD_{55} and SD_{100}) resulted in 33 to 41% decline of bird production due to over density of bird population and mortality of bird (Fig. 1).

Feed convesion index (FCI) : The values of FCI for bird tended to decrease as the stocking density increased. The values ranged from 0.247 to 0.638 (Table I).

Table I : Mean (± S.E.) of growth and production criteria of bird in different stocking density employed. Same script among treatments (rows) revealed lack of significant difference.

Criteria	Stocking densities				
	SD_{20}	SD_{25}	SD_{33}	SD_{50}	SD_{100}
Initial weight (kg)	0.071 ± 0.0011	0.068 ± 0.0023	0.074 ± 0.0023	0.070 ± 0.0011	0.069 ± 0.0001
Final weight (kg)	2.3 ± 0.023^A	2.1 ± 0.028^A	2.06 ± 0.034^A	1.0 ± 0.11^B	0.47 ± 0.103^C
Daily growth rate (kg d^{-1})	0.049 ± 0.002^A	0.045 ± 0.001^A	0.044 ± 0.0017^B	0.021 ± 0.0017^C	0.009 ± 0.0011^D
Survival (%)	100	100	100	90	85
Feed conversion Index	0.638 ± 0.008^A	0.617 ± 0.002^B	0.614 ± 0.0023^B	0.434 ± 0.0023^C	0.247 ± 0.0017^D
Production (kg)	46.0 ± 1.7^{BC}	52.5 ± 1.44^B	68.0 ± 3.46^A	45.0 ± 0.06^C	39.95 ± 0.057^C

Cost benefit analysis of production : The conversion cost for poultry houses remained the same in all cases of stocking densities. The total production cost increased sharply from Rs. 1820 to 5100 (Rs 46/ US$) with increasing stocking density of bird. The total revenue, on the other hand, increased gradually till SD_{33} but declined sharply with further rise in density of bird, resulting in no revenue at SD_{50} and SD_{100} due to low growth rate and mortality (Fig. 2). As a consequence, net profit became maximum at SD_{33} but showed loss of profit at the next two higher rearing density of bird (SD_{50} and SD_{100}).



Figs. 1-2 : **1**. Relationship between production and stocking densities of bird employed; **2**. Cost benefit analysis in different stocking densities of broiler reared in small poultry house.

DISCUSSION

Result of the study clearly revealed that the maximum production was encountered in the SD_{33} (1.5 ft^2 $bird^{-1}$) density of bird for 45 days production cycle of broiler rearing (Fig. 1). This density of bird rearing appeared to be more realistic according to the working principle for carrying capacity and management of poultry farming because over population caused severe hazard to the environment of the poultry house affecting the health of bird. According to Cravener *et al.* (1992) the production of broiler varies with population density of bird. Perches in the environment of broiler chickens may improve space and welfare by providing them with an opportunity to perform a natural behaviour and by allowing them to exert some control over their environment (Newberry, 1995; Lewellen & Vessey, 1998; Tablante *et al.*, 2003).

The relationship of production of bird with daily growth rate and feed conversion index (FCI) indicated highest production at SD_{33} when daily growth rate and feed conversion index (FCI) remained 0.044 kg d^{-1} and 0.614, respectively, but growth of bird tended to decrease or mortality occurred with increasing density. Bolton *et al.* (1972) reported that growth performance is revealed with stocking density of bird.

Critical appraisal of the cost benefit data clearly showed the four levels of response to density of bird (Fig. 3). Low growth of profit from SD_{20} to SD_{25} - low growth of profit density (LGPD), high growth of profit from $>SD_{25}$ to SD_{33} - high growth of profit density (HGPD) reduced growth of profit from $>SD_{33}$ to SD_{43} - reduced growth of profit density (RGPD) and negative growth of profit or loss from $>SD_{43}$ to SD_{100} - negative growth of profit density (NGPD).

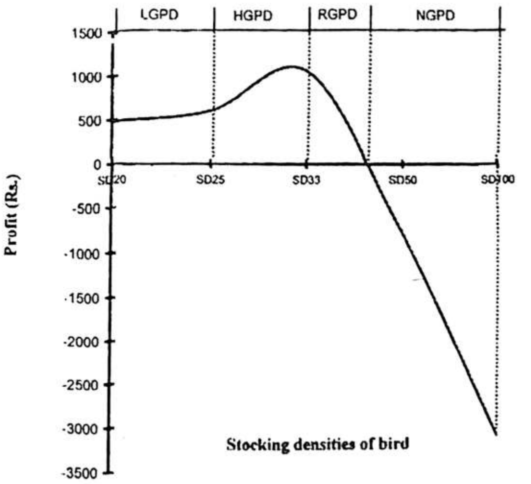


Fig. 3 : Profit curve showing the four levels of response for different stocking densities.

Basically the production function is stated as the relationship of a single product and a single resource describing the output level of input is varied (Jolly & Clont, 1993). Examination of cost benefit ratio for production of bird (Fig. 2) indicated linear increase in the total production cost of bird as a direct function of the density of bird, the total revenue and profit being maximum at the density of bird of 33 (SD_{33}). The profit after the level of 33 density of bird tended to reduce with increasing density of bird exhibiting zero profit at density of 43 birds and loss tended to mount steadily as the density of bird increased further (Fig. 2).

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