THE EFFECT OF DIFFERENT FLOOR SPACE ALLOCATIONS ON THE PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWING PIGS KEPT ON SOLID-FLOOR PENS

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ABSTRACT

The growth performance and carcass characteristics of 110 large White growing pigs assigned to varying floor space allocations were evaluated. There were 5 treatments with 2 replications each. The number of pigs per replicate pen varied from 5, 8, 11, 14, to 17, providing a floor space (FS) of 1.23, 0.77, 0.56, 0.45 and 0.41m^2 per pig to Treatment 1(FS_1), 2(FS_2), 3(FS_3), 4(FS_4) and 5(FS_5) respectively. Feed and water were provided ad libitum. Eighty percent of the pigs on each treatment were slaughtered at an average weight of 45kg for carcass analysis.

Daily feed intake and weight gains decreased ($P < 0.05$) with increasing number of pigs from Treatment FS_1 to FS_4; therefore, feed intake improved for the pigs on floor space of 0.41m^2 (FS_5).

FCE and Pen efficiency values recorded showed a curvilinear trend. Mortalities of 0, 0, 0, 7.1 and 11,8% ($P < 0.05$) were recorded for pigs on Treatments FS_1, FS_2, FS_3, FS_4 and FS_5 respectively. Postmortem examination attributed this to injuries

There were no significant differences ($P < 0.05$) between treatment means for all the carcass parameters measured.

Based on the results of this experiment, a floor space of 0.56m^2 per growing pig is recommended for producers in the humid tropics where pigs are mostly kept on solid floors.

Keywords: Growing pigs, Solid floors, Space, Performance, Carcass Characteristics, Humid tropics, Profit margin.

INTRODUCTION

Research on pig production in Ghana has in the past been concentrated on the nutrition and to some extent the health problems of pigs (1; 15; 16; 17; 4; 5).

However the importance of a suitable environment for the successful growth and development of pigs cannot be over-emphasized. In this respect, the provision of adequate floor space to pigs could have considerable significance. Menier-Salaun *et al* (13) observed that daily weight gain and feed efficiency of growing pigs declined significantly ($P < 0.05$) as the floor space allocation decreased from 1.52, 1.01 to 0.51 m^2. Jensen *et al* (10), Randolph *et al* (18) and Moser *et al* (14) had earlier reported similar results. These studies were however conducted on partially or fully slatted floors. According to Kornegay and Notter (11), pig specialists and producers have suggested

that there may be considerable variations in the floor space requirements of pigs kept on solid and slatted floors.

The objective of this work therefore was to investigate the effects of differing floor space allocations on certain biological and economic performance traits of growing pigs kept on solid floors in a humid tropical environment.

EXPERIMENTAL OUTLINE

Climatic Factors: The experiment was performed from 19th May to 25th July, 1987, Ghana. The prevailing climatic conditions during the experiment are shown in Table 1.

Housing: The experiment was undertaken in a 42 x 9m weaner barn oriented in an east-west direction. The 1.2m (4ft) dwarf walls were built with sandcrete blocks with the upper part left open for easy ventilation. The house is roofed with corrugated aluminium sheets. There are two rows of pens, one on each side of 0.63m (2ft) wide alley which allows easy access to all the pens. All the pens have concrete floors and gates made out of galvanised pipes. Each pen measured 3.66m x 2.09m (7.65m^2) and had concrete troughs for water and feod.

Experimental Design: Five floor area allocations (treatments) were evaluated using 110 Large White pigs. The differing floor space allocations were obtained by varying the number of pigs in the pens (11). The number of pigs per treatment, space allowed per pig and the feeder space available are shown in Table 2. There were 2 replications per treatment. Two or three movable concrete feed troughs were placed in some pen so as to obtain the feeder spaces indicated.

Group size and feeder space were kept constant throughout the experiment except in the FS_4 and FS_5 where mortalities occured. Pigs were randomised on the basis of weight, sex and litter origin with 10, 16, 22, 28 and 34 pigs each in treatments FS_1, FS_2, FS_3, FS_4 and FS_5 respectively. At the beginning of the study, pigs averaged 20 kg.

TABLE 1: CLIMATE FACTORS AT KUMASI (06° 43' N; 01° 36' N) DURING THE EXPERIMENTAL PERIOD.

Item	Experimental Months May	June	July	Average
Rainfall (mm)	154.8	268	176.3	199.7
Relative humidity (%)	60	68	69	65.7
Wind velocity (ms^{-1})	1.63	1.73	1.53	1.63
Temperature (°C) Max.	32.5	30.5	29.5	30.8
Min.	22.9	22.2	21.9	22.3

TABLE 2: EXPERIMENTAL OUTLINE.

Item	Treatments FS_1*	FS_2	FS_3	FS_4	FS_5
No. of replicates	2	2	2	2	2
No. of pigs/replicate	5	8	11	14	17
No. of pigs/treatment	10	16	22	28	34
Floor space allowed per pig (m^2)	1.23	0.77	0.56	0.45	0.41
Feeder space per pig (cm^2)	510	320	345	335	325

*FS= Floor Space

Commercial feed, containing 17.6% crude protein (Table 3) and water were offered *ad libitum*.

Data Collection: Individual pig weights and group feed consumption were measured fortnightly from the beginning of the experiment until an average slaughter weight of 45kg per replicate (pen) was attained. From these, average daily feed intake, weight gain, feed conversion efficiency (FCE) and pen efficiency (FCE: Floor space) were calculated. Behavioural characteristics such as fighting, eating and dunging patterns were qualitatively monitored. Mortality rates were also recorded.

Eighty percent of the pigs on each treatment were selected on equal sex basis and slaughtered by exsanguination after a 24hr fast at the end of the experiment. Carcass evaluation was done on warm carcasses. Dressing percentage, carcass length, loin eye area, mean backfat thickness and weight of the empty gastrointestinal tracts (GIT) were determined.

Statistical Analyses: All data obtained were subjected to analysis of variance, using the Completely Randomised Design (Steel and Torrie, 19) and significant differences were separated by the Duncan's Multiple Range Test.

TABLE 3. ANALYSED CHEMICAL COMPOSITION OF THE COMMERCIAL DIET.

Item	%
Protein	17.6
Oil	4.90
Crude fibre	6.03
Lysine	0.91
Methionine	0.87
Calcium	0.80
Phosphorous	0.74
ME, Kcal/kg	2,687

TABLE 4. BIOLOGICAL AND ECONOMIC PERFORMANCE OF PIGS ALLOWED VARYING FLOOR SPACES.

	Treatments					
Item	FS_1*	FS_2	FS_3	FS_4	FS_5	Significance
Floor space allowed per pig (m^2)	1.23	0.77	0.56	0.45	0.41	
No. of pigs	10	16	22	28	34	-
Initial weight (kg)	20.7	19.8	20.14	19.2	19.2	NS
Final weight (kg)	45.6	45.0	45.2	44.5	46.8	NS
Feed intake (kg pig^{-1} day^{-1})	2.32^a	1.90^b	1.82^{bc}	1.60^c	2.00^b	*
Weight gain (kg pig^{-1} day^{-1})	0.62^a	0.60^a	0.58^a	0.45^b	0.42^b	*
Days to slaughter	42^c	42^c	42^c	56^b	63^a	*
FCE	0.27^b	0.32^a	0.32^a	0.28^b	0.23^b	*
Cost of feed (¢000's) X	58.30	76.60	101.20	147.80	212.50	*
Income (¢000's) Y	56.10	90.10	126.20	159.50	178.80	-
Returns (¢000's)	-2.20	+ 13.50	+ 25.00	+ 11.70	-33.70	-
Pen efficiency	0.22^d	$.42^c$	$.57^{ab}$	$.62^a$	$.55^b$	*
Mortality (%)	0^c	0^c	0^c	7.1^b	11.8^a	*

X = 1kg of feed costs 60 cedis (¢) and 1 US dollar ($) is equivalent to 264 cedis.

Y = Based on sales from dressed carcasses.

Returns refer to differences of revenues from sales and feed cost.

* = a,b c. Means in the same row that do not have a common superscript differ ($P<0.05$)

RESULTS AND DISCUSSION

The effect of floor space allocation on feed intake, weight gain, PCE, pen efficiency and mortality are summarised in Table 4. With the exception of treatment FS5 there was a gradual but significant decrease in feed intake (P0.05) as floor space per pig decreased (Fig 1). This result is at variance

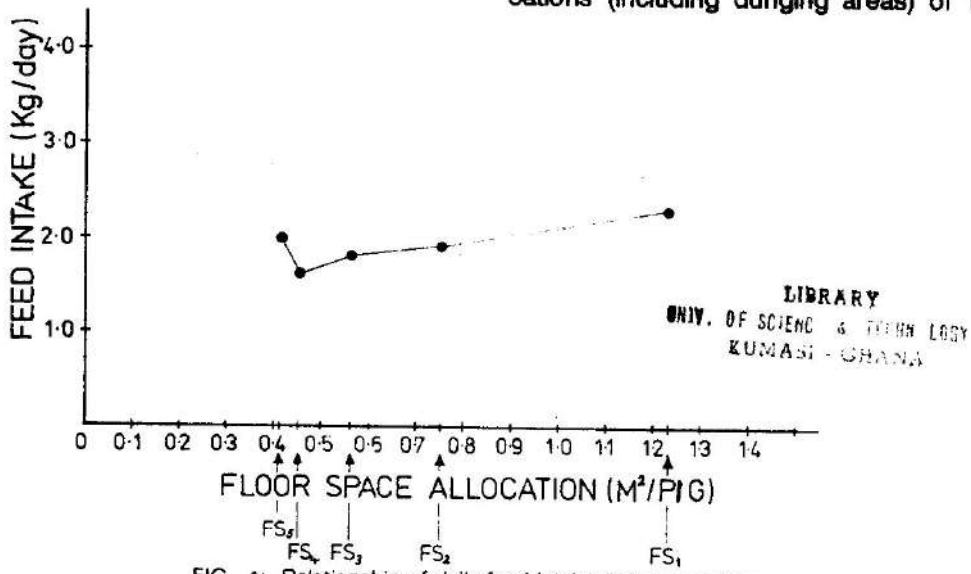

FIG. 1: Relationship of daily feed intake (kg) versus floor space (m) per pig.

with the observations of Randolph *et al* (18) and Moser *et al* (14). However, Menier-Salaun *et al* (13) did not observe any significant influence on daily feed intake with different floor space allocations. They recorded feed intakes of 2.06, 2.02 and 2.01 kg for pigs allowed 0.51, 1.01 and 1.52m^2 respectively. Bond *et al* (2) working in California reported decreasing daily feed intake values of 2.43, 2.43 and 2.37 kg with increasing space allowances of 0.45, 0.90 and 1.80m^2 per pig respectively.

Daily gains declined significantly (P< 0.05) from FS_1 to FS_5(Table 4 and Fig 2). This agrees with results obtained by Gehlback *et al* (7), Handlin *et al* (8), Jensen *et al* (10), Randolph *et al* (18), Moser *et al* (14) and Menier-Salaun *et al* (13). Gehlback *et al* (7) obtained decreasing rates of gain at higher stocking densities, which he attributed to lower feed consumption as a result of heat stress. Handlin *et al* (8) observed that as the number of pigs per pen increased from 10 to 16, the average daily gain decreased slightly as was obtained in this present experiment (Table 4). In recent investigation in France, Menier-Salaun *et al* (13) recorded similar results for growing pigs. Daily gain values obtained for growers were 0.68, 0.67 and 0.64 kg for space allocations (including dunging areas) of 1.42 (High), 1.01 (Medium) and 0.51m^2 (Low) per pig. These values were however, not significant (P> 0.05). Daily gain values of 0.78, 0.74 and 0.64 kg for High, Medium and Low treatments respectively were significantly (P < 0.01) different for finishing pigs in the same experiment.

The gain:Feed ratio determined are shown on Table 4. In similar studies Menier Salaun *et al* (13) recorded improved FCE with bigger space allowance per pig but Bond *et al* (2) had earlier obtained different results. In this experiment, the results showed a curvilinear trend (Fig. 2). Pen efficiency was best (P< 0.05) for treatment FS_4 and poorest for FS_1 (Table 4 and Fig 2). The poor value (0.22) obtained for FS_1, suggested an under-utilization of the pens.

No deaths were recorded for treatment FS_1, FS_2, and FS_3. In treatments FS_4 and FS_5, 7.1 and 11.8% (P< 0.05) mortalities were recorderd respectively. Menier-Salaun

et al (13) obtained mortalities ($P < 0.05$) of 2.50, 0 and 2.50% for 120 growing pigs given space allowances of 1.52, 1.01 and 0.52m^2 per pig respectively. In this study, post mortem results indicated the causes of death to be severe internal bleeding as a result of

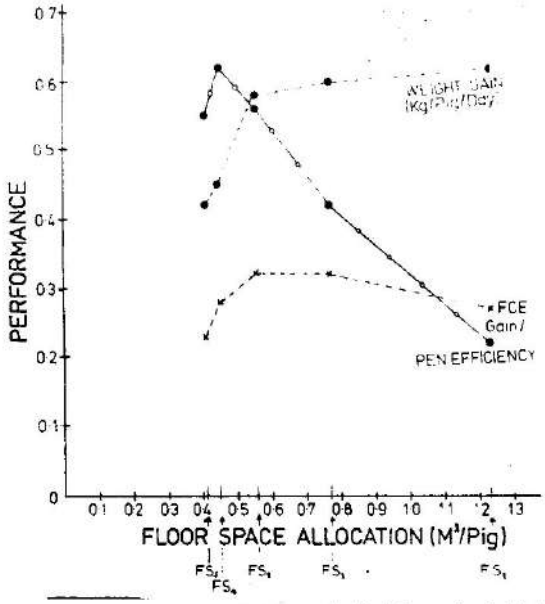

FIG. 2: Relationship of daily gain (kg) f.c.e. (gain/pig) and pen efficiency versus floor space (m) per pig.

fighting among the pigs on treatments FS_4 and FS_5 due perhaps to competition for lying area and feed. Decreasing the floor space allowance per pig led to abnormal behaviour patterns such as tail biting, cannibalism and increased aggressive behaviour patterns as has been observed in similar studies by Jensen (9) and Bryant and Ewbank (3).

The expenditure (on feed) and income (from sale of pork) values are also shown in Table 4. Profits were recorded for treatments FS_2, FS_3, and FS_4. The loss in treatment FS_1 may be to overfeeding whilst that of treatment FS_5 may be attributed to the inability of pigs to convert feed consumed into gain due to stressful environmental conditions. Pigs on treatment FS_1, FS_2 and FS_3 attained the slaughter weight of 45kg within the same number of days. However, FS_4 and FS_5 pigs attained this weight after 56 and 63 days respectively which could be due to the significantly poor daily gains (Table 4). Table 5 shows the results obtained for the carcass data. There were no significant differences ($P > 0.05$) between treatment means for all the parameters measured. However, this was not unexpected since all the animals were slaughtered at an average weight of 45kg.

The results confirm that growing pigs benefit quite markedly from a good floor space allowance and suggests that extremely dense stocking rates may retard the growth of pigs even though other environ-

TABLE 5. CARCASS DATA OF PIGS ALLOWED VARYING FLOOR SPACES.

Item	Treatments					Significance
	FS_1	FS_2	FS_3	FS_4	FS_5	
No. of pigs[a]	8	13	17	21	24	-
Av. slaughter weight (kg)	41.8	40.3	43.3	43.7	42.6	NS
Av. dressing (%)	63.2	63.5	63.1	63.8	63.6	NS
Av. ham weight	12.80	15.16	12.82	12.54	12.47	NS
Av. loin eye area (cm^2)	19.48	18.51	18.00	18.50	19.00	NS
Av. backfat thickness (cm)	1.67	2.05	1.45	1.70	1.66	NS
Av. carcass length (cm)	65.40	65.50	66.0	65.70	63.20	NS
Relative av. weight of empty GIT (kg)	11.68	10.74	10.55	8.55	9.23	NS

a = 80 percent of the pigs (on attainment of 45kg liveweight) were slaughtered for carcass analysis.

mental conditions may have been maintained at an optimum.

CONCLUSION

The importance of improved management practices including space allocation cannot be over-emphasized. Overcrowding or restricted space allocations was found to affect weight gains, FCE, cost of production and mortality whilst under-utilization of pens also resulted in poor pen efficiencies and lower returns. It is suggested that in humid tropics, growing pigs kept on solid floors should be allowed a space of 0.56m^2, since this yielded the higher profit margin. Future work in this area should examine animal performance during the finishing period.

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