Factors Affecting Reproductive Performance in the Nepalese Pakhribas Pig: Effects of Nutrition and Housing during Gilt Rearing

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ABSTRACT : The effects of housing and nutrition on the performance of growing gilts of the Nepalese Pakhribas breed were investigated. A total of 36 pigs were allocated according to a factorial design with 3 levels of nutrition, provided to achieve a target growth rate of 200, 300 or 400 g/day, and two types of housing, traditional or improved. The growth rate and body composition were monitored during the growing period and subsequent pregnancy. There was a significantly higher growth rate ($p<0.01$), greater P_2 backfat thickness ($p<0.01$), and greater eye muscle depth ($p<0.01$) at service in pigs given the higher level of nutrition. Similarly, there was a significantly higher growth rate ($p<0.05$), and greater eye muscle depth ($p<0.10$) with improved housing but no significant difference in P_2 backfat thickness. The conception rate was 90% at first service, with no difference between treatments. Gilts from the high plane of rearing produced a mean litter size of one piglet greater than those on the low plane, but this was not significant with the limited numbers. However, both improved plane of nutrition and reduced climatic penalty by improving housing resulted in increased birthweight of piglets ($p<0.05$). It is concluded that improvement in housing can give benefits equivalent to at least a 7% improvement in efficiency of feed use under traditional Nepalese circumstances for pig rearing. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 1 : 72-78)***

Key Words : Gilt, Nepal, Nutrition, Housing, Growth Rate, Body Composition

INTRODUCTION

The Pakhribas pig was developed in a Nepalese breed improvement scheme for traditional village pig rearing. However, whilst this breed has benefited performance of the growing pigs, problems have been experienced with reproductive performance of the sows (Shrestha and Ghimire, 1993; Gatenby et al., 1990). Pigs in Nepal are mostly fed with rice bran, brewery residues and a very small supplementation of green weeds and grasses. Since the Pakhribas pig has a greater mature body size than the local breeds, its feed requirement for maintenance is higher. If not given additional food to take account of this, it will lose body condition rapidly. It has been widely demonstrated in improved Western genotypes that animals which have poor body condition exhibit reproductive problems, and there is extensive evidence that underfeeding can delay puberty, suppress return to oestrous and impair conception rate and litter size (Aherne and Kirkwood, 1985; Edwards, 1993, 1994; English, 1992). Undernutrition may thus be a major contributory factor to the reproductive problems in improved Pakhribas pigs in Nepal. Since these problems seem to occur equally on farms of different socio-economic category (Shrestha, 2000), it would seem that lack of awareness of appropriate nutrition, rather than inability to afford feed, may be the the major problem.

However, in circumstances where food supply may be limiting, alternative approaches to maintaining body condition may be more cost-effectively applied. The housing conditions of traditionally kept Nepalese pigs are generally poor (Kshatri, 1994; Shrestha, 2000). When pigs suffer a climatic penalty, some of their food has to be used for heat production in order to maintain normal body temperature, and less is therefore available for productive purposes. Food is most efficiently utilized when pigs are maintained in a climatic environment above their Lower Critical Temperature (LCT) (Bruce and Clark, 1979). The climatic factors which adversely affect the pig are low environmental temperature, high wind speed and wet floor. Other factors which make the pig more liable to suffer a climatic penalty are lower live weight, being housed singly rather than in a group and lower energy intake (Robertson and Clark, 1985). All of these factors typically occur in traditional Nepalese pig housing. The climatic environment of the pig can be readily improved by dry floors, the provision of plentiful amounts of dry bedding in the lying area, provision of a kennel or micro-environment which helps to contain the pig's own body heat production, improved insulation of the house and reduced air currents. Kshatri (1994) conducted simulation studies of a range of climatic environments in Nepal at various altitudes and calculated that very considerable economies in feed costs could be achieved by maintaining pigs above their LCT using appropriate technologies and locally available materials such as sloping floors, bedding, micro-environments and reduced air flow.

Thus inadequate housing could be a significant

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contributing factor to the undernutrition of breeding sows in Nepal, since much of the already inadequate food allowance needs to be utilized for maintenance of body temperature rather than productive purposes. This experiment was therefore designed in order to investigate the relative role of nutrition and housing during gilt rearing on the body condition attained by animals at the start of their breeding life and their subsequent reproductive performance.

MATERIALS AND METHODS

Experimental design

The experimental design was a 3×2 factorial, with three levels of nutrition and two levels of housing quality.

Levels of nutrition were calculated using equations derived from ARC (1981). Ration for each nutrition treatments was calculated using additional allowances for target growth rate above maintenance.

1. Ration designed to allow 200 g/d growth rate (Treatment L: a negative control equivalent to the growth rate recorded under village conditions).
2. Ration designed to allow 300 g/d growth rate (Treatment M: the growth rate typically attained at the Pakhribas research station where reproductive performance of this breed has been consistently good).
3. Ration designed to allow 400 g/d growth rate (Treatment H: elevated growth rate to promote a high level of body reserves in breeding animals).

Levels of housing quality were:

1. Traditional housing (Treatment T: no bedding and open fronted lying area providing no protection from wind draught).
2. Improved housing (Treatment I: straw bedding and fully enclosed lying area to provide a microclimate and protection from draught).

Each treatment combination was replicated 6 times with individually housed pigs.

Housing

Thirty six new, individual pig houses were constructed at the Pakhribas Agricultural Centre (PAC). These were representative of the local pig houses generally made for rearing breeding sows in the eastern hills of Nepal. Out of 36 pig houses, 18 pig houses (improved housing) were built in which the sty was divided into two areas, having an indoor sleeping area (1.82 m × 1.82 m) fully enclosed by mud stone walls with the exception of a small doorway (1.06 m × 0.9 m) and an open exercise area outside (2.43 m × 1.82 m) with fencing of bamboo poles. The floor was pointed with stone inside the lying area and was bedded with rice straw to a depth of about 6 cm in each improved pig house. The other 18 houses (traditional housing) were built with no separate division between the roofed sleeping and unroofed exercise area, leaving the whole pen open without any provision for wind protection. The floor was left without any pointing and without any bedding materials. Each pig was housed singly, as is typical in traditional farms. A total of 6 blocks of pig housing was constructed in three terraces. The first terrace had only one block, the second terrace had two blocks and the third terrace had three blocks of pig houses. In each block, one replicate of each treatment was allocated randomly. All together, three blocks were south facing, two blocks were north facing and one block was northeast facing. Breeding boars were reared separately, one at the top of the terrace and the other at the end of the terrace.

Animals and general management

Piglets of the Nepalese Pakhribas breed were weaned at eight weeks of age and maintained at the PAC main piggery unit. They were offered a standard diet to achieve 300 g growth rate per day for three months after weaning before transferring into the new housing. All the piglets were transferred simultaneously on 21 June 1997 to the individual pig houses. Piglets were grouped into six blocks based on their body weight and allocated randomly to treatment within these weight blocks. An acclimatisation period to the new house of seven days was given before dietary treatments began.

All piglets in the group were drenched against internal parasites using a broad spectrum anthelmintic (albendazol) before the start of the experiment. Subsequently, routine fecal examinations were carried out and pigs treated, if required, with appropriate anthelmintic. Vaccination was carried out against swine fever in August 1997 using a vaccine made by the National Veterinary Company, Saigon (Ho Chi Minh), Vietnam and imported through the Central Veterinary Laboratory, Kathmandu.

Body weight and composition measurement

Body weight was recorded using a platform scale and locally designed weighing box. For two consecutive occasions each pig was weighed biweekly. After the third weighing, each pig was weighed at monthly intervals. Body Condition Score (BCS) was measured at each weighing, on a 0-5 scale with half units, according to standard procedures involving visual observation and palpation of the individual pig (rib, spine tailhead) (Lightfoot, 1979). Subcutaneous backfat thickness at the P_2 position was recorded ultrasonically at each occasion (Meritronics Livestock Grader, Meritronics Limited, Faversham, UK). After the second weighing, at an age of 6.5 months, eye muscle depth (linear and area measurements of the cross section of the eye muscle measured at the point where the carcass is cut at right angles to the backbone at the level of the posterior adge of the head of the last rib) measurement was also recorded using the same equipment. It had proved impossible to obtain a reliable reading for eye muscle depth (EMD) of the gilt at an earlier age.

Feeding

After each weighing during the growing phase, the feed level for each pig was calculated using a computer spreadsheet developed to predict nutrient requirements for a given rate of growth using equations for energy and ideal protein requirements for maintenance and tissue deposition from ARC (1981). No allowance was made for thermoregulatory requirement in this calculation, since this formed part of the housing treatment effect. All nutritional treatments were based on the same balanced diet, which was manufactured by a local feed compounder Kamdhenu Feed Industry, Terai. The composition and feed ingredients used by the compounder are shown in table 1, together with the proximate analysis analysed at PAC (Pakhribas Agricultural Center) laboratory of the diet. All pigs were fed twice daily, with feed given as dry meal mixed with water in a wooden trough.

The pregnancy feed level was standardized for all treatments and calculated to allow 20 kg maternal live weight during pregnancy, making allowance for the differential liveweight at mating of the different treatments. Calculations were again based on the equations provided by ARC (1981) suing similar diet provided during rearing.

Table 1. Composition and chemical analysis of the experimental diet

Ingredients	Amount (%)	Chemical analysis (% DM), Analysed	
Corn	40.0	Dry Matter	89.7
Rice bran	10.0	Crude protein	18.8
Rice bran extraction	16.0	Ether extract	2.4
Fish meal	5.0	Crude fibre	7.0
Deoiled ground nut cake	6.0	Total Ash	9.4
Deoiled coconut cake	7.0	Nitrogen free extract	62.3
Deoiled sesame	5.0	Phosphorus	1.7
Soya bean extraction	4.0	Potassium	1.7
Mustard cake expelled	5.0	DE Value*	13.6 MJ ME/kg
Calcite powder	0.5		
Salt	0.5		
Mineral mixture	1.0		
Total	100.0		

* Calculated based from the result of proximate analysis (MAFF, 1991)

Environmental monitoring

The LCT value for each individual pig during rearing at the time of introduction in May, and at one month intervals in June and July, was calculated according to the model of Bruce and Clark (1975), based on their feed intake and housing conditions at each weighing. The amount of time each pig spent per day below LCT was calculated by difference between LCT and daily mean temperature values from meteorigical data recorded at PAC site. Total time per month was described as °C hours. The food cost of exposure to temperatures below LCT was derived from total °C hours below LCT and the feed increment cost given by the model of Bruce and Clark (1975). The hourly air temperature was recorded in the lying area of each individual pen in turn at 6 cm above the floor for 12 h at night time (18:00 h to 06:00 h), when the temperature was lowest.

Statistical analyses

Data were analysed by two-way analysis of variance (Minitab, release 12), using nutrition and housing as the treatment factors. There was no effect of terrace on the result when used as block factors in the analysis and it was therefore not included in any final analysis.

RESULTS

The full data for treatment combinations are given in the tables, and details of important main effects are presented in the text.

Live weight and body composition

Due to delays in construction of the experimental housing, gilts were older than planned at the start of the experiment (mean of 158 days of age at introduction). The initial weight at introduction was 33.9, 33.2 and 33.8 kg for L, M and H respectively (sem 1.55, NS), and 34.3 and 33.0 kg for T and I respectively (sem 1.27, NS). Treatments were therefore balanced for initial weight. Similarly, there were no intial treatment differences in body condition score (BCS) or ultrasonic backfat thickness (P_2).

There was no difference in the live weight at 67 days after treatments commenced between the two different housing treatments, but a difference had developed in response to the nutritional treatments (table 2). The mean weight at 67 days after treatments were imposed was 53.8, 55.3, and 61.8 kg for L, M and H, respectively (sem 1.55, p<0.05), and 56.8 and 57.2 kg for T and I respectively (sem 1.2, NS). The mean growth rates in the first 67 days were therefore 297, 329, and 416 g/day for L, M and H, respectively (sem 10.0, p<0.01), and 335 and 360 g/day for

Table 2. The live weight and body condition of gilts after 67 days of rearing under three levels of nutrition treatment and two levels of housing treatment

Target Growth (g/day)	200		300		400		Significance		
	Traditional	Improved	Traditional	Improved	Traditional	Improved	N	H	N × H
Housing									
Weight at 67 day	52.3±1.83	55.2±1.38	55.0±1.7	55.5±3.16	62.9±2.8	60.8±1.68	*	NS	NS
Average daily gain up to 67 day (g/day)	289±10.8	306±13.1	313±20.4	344±19.2	404 ±7.4	429±8.4	**	*	NS
Body Condition Score at 67 day	2.6±0.227	3.2±085	2.9±0.164	3.0±0.239	3.2±0.139	3.2±0.239	NS	*	NS
P_2 (mm) at 67 day	13.4±0.15	15.4±0.843	14.8±0.792	19.4±0.955	21.2±1.37	19.0±1.87	**	NS	*
P_2 (mm) change at 67 day	-0.83±1.38	-.0.50±0.70	1.0±0.81	4.6±0.55	4.3±1.82	2.7±1.20	*	NS	(p<0.10)
Eye muscle depth at 67 day (mm)	45.5±3.15	54.3±2.60	53.8±2.06	55.7±2.67	60.7±1.36	60.7±2.80	**	(p<0.10)	NS
Feed intake (kg/day)	1.56±0.06	1.60±0.02	1.84±0.02	1.77±0.05	2.23±0.04	2.18±0.02	**	NS	NS
Gain: Feed ratio (kg feed/kg gain)	5.4±0.22	5.3±0.13	6.0±0.40	5.2±0.22	5.5±0.25	5.1±0.25	NS	*	NS

Key: N=Nutrition treatment, H=Housing treatment, The mean is followed by ± the standard error of the mean for each value.
* p<0.05, ** p<0.01, NS: p>0.05.

T and I, respectively (sem 8.0, p<0.05). The growth rates were thus close to the target for M and H, although higher than target for L.

Body Condition Scores after 67 days did not differ between dietary treatments, but it was higher for pigs in Improved housing; 2.9 and 3.2 for T and I respectively (sem 0.07, p<0.05). However the mean P_2 at this time was not affected by a nutritional treatments although the housing response was not significant; 14.3, 17.0 and 20.0 mm for L, M and H, respectively (sem 0.88, p<0.01), and 16.4 and 17.9 mm for T and I respectively (sem 0.71, NS). There was a significant interaction effect of nutrition and housing on P_2 level (sem 1.23, p<0.05), indicating that P_2 backfat thickness was more affected by poor housing for piglets reared under a low plane of nutrition. The mean eye muscle depth (EMD) of the piglets at 67 days also showed both nutrition and housing responses; 49.9, 54.7 and 60.7 mm for L, M and H respectively (sem 1.79, p<0.01), and 53.3 and 56.9 mm for T and I respectively (sem 1.46, p<0.10). The feed intake per pig for each nutritional treatment (L, M and H) over this period was 106.2, 121.4 and 148.0 kg (sem 2.14, p<0.01) and the Gain:Feed ratio was 5.37, 5.62 and 5.32 (sem 0.19, NS) respectively. Similarly, the feed intake per pig for each housing treatment (T and I) was 126.0 kg and 124.4 kg (sem 1.74, p<0.05) and FCR was 5.6 and 5.2 (sem 0.16, p<0.05) respectively.

Service information

The mean age at first service (254 days) did not differ between dietary or housing treatments (table 3). The time on experiment before service showed a tendency to be higher for animals in Traditional housing; 105.2 and 80.6 days for T and I respectively (sem 9.3, p<0.10). A total of four sows returned to service; two sows from treatment H and two sows from treatment L, consisting of one in each housing type. Three of these sows conceived at second service, whereas the sow under treatment L with traditional housing only conceived at third service. This indicates that no nutrient or housing treatment during rearing resulted in significantly better conception performance of the gilt.

The weight of the gilt at first service was 62.4, 66.2 and 74.7 kg for L, M and H respectively (sem 3.88, p<0.10). When age at service was used as a covariate, it significantly (p<0.01) reduced variance, and revealed a significant effect of nutrition treatments (p<0.05). The daily weight gain from treatment allocation to service showed similar treatment differentials to those seen at 67 days. Both P_2 (16.2, 18.9 and 21.9 mm for L, M and H respectively, sem 1.10, p<0.05) and EMD (52.0, 58.0 and 61.0 mm, sem 1.27, p<0.05) differed between nutritional treatments at first service, but there was no housing treatment difference in liveweight, P_2 or EMD. The later service of the T gilts cancelled out any contemporary treatment differences.

Farrowing information

There was no significant difference in the gestation length between rearing treatments or housing treatments.

The mean weight of the sows at farrowing did not differ significantly between treatments; 94.0, 96.9 and 104.8 kg for L, M and H respectively (sem 4.55, NS), 101.1 and 96.0 kg for T and I (sem 3.71, NS). The mean total maternal weight gain during pregnancy was 30.8 kg (sem, 1.31) with no treatment differences. The standard feeding during gestation therefore equalized growth, but the weight gain was higher than the 20 kg predicted from application of

Table 3. The live weight and body condition at service/farrowing for gilts reared under three nutrition treatments and two levels of housing treatment

Target Growth (g/day)	200		300		400		Significance		
	Traditional	Improved	Traditional	Improved	Traditional	Improved	N	H	N × H
Housing									
Weight at service (kg)	62.0±4.91	62.8±3.68	72.5±6.03	60.0±7.97	76.7±7.41	72.7±4.52	(p<0.10)	NS	NS
Average daily gain to service (g/day)	299±17.0	321±17.0	374±17.0	337±18.0	388±18.0	427±17.0	**	NS	NS
Age at service (days)	248.0±17.4	248.0±14.3	264.0±20.4	233.2±23.1	279.0±15.9	253.3±11.0	NS	NS	NS
BCS at service	2.8±0.10	2.9±0.083	3.0±0.183	2.8±0.16	3.2±0.21	3.2±0.17	(p<0.10)	NS	NS
Backfat thickness P_2 at service (mm P_2)	16.2±.83	16.3±0.88	17.2±1.19	20.7±1.80	23.0±2.07	20.7±1.56	*	NS	NS
Eye muscle depth at service (mm)	52.0±2.62	53.0±3.60	61.0±2.72	55.0±3.76	64.0±3.90	58.0±4.00	*	NS	NS
Eye muscle depth at farrowing (mm)	59.8±3.34	70.2±4.38	63.0±2.98	66.5±2.81	66.3±5.23	70.2±3.65	NS	(p<0.10)	NS
Gestetation period (d)	112.8±0.7	112.2±0.6	113.2±0.7	112.2±0.6	111.8±0.7	113.8±0.7	NS	NS	(p<0.10)

Key: N=Nutrition treatment, H=Housing treatment, The mean is followed by ± the standard error of the mean for each value.
* p<0.05, ** p<0.01, NS: p>0.05.

ARC (1981) principles. The absence of any significant treatment effects on BCS, P_2 or EMD indicated that differences in body reserves generated by differential gilt rearing had been reduced by the time of farrowing.

The mean total number of piglets born at first farrowing was 7.0, 7.4 and 8.0 for L, M and H respectively (sem 0.75, NS), and 7.3 and 7.6 for T and I (sem 0.57, NS). Two sows gave birth to only a single piglet at first farrowing. Substitution of a missing value for these animals reduced variance but did not alter the trends observed; 7.4, 7.4 and 8.6 for L, M and H respectively (sem 0.59, NS), 7.7 and 7.9 for T and I respectively (sem 0.50, NS). The mean piglet weight at birth was influenced by both nutritional and housing treatments; 850, 949 and 904 g for L, M and H respectively (sem 21.5, p<0.05), 872 and 930 g for T and I respectively (sem 16.3, p<0.05).

Comparison of the calculated LCT for each of the pigs with contemporary meteorological data indicated that there was no climatic penalty for pigs which were reared in good housing conditions or on the high level of rearing nutrition treatment. The mean temperature recorded at PAC station during May and July was 20.9°C, and June was 20.6°C. The average wind speed recorded for May, June and July was 1.5 m/sec, 1.4 m/sec and 0.9 m/sec respectively. The details of the estimated penalty incurred by the other treatments are shown in table 4.

Similarly, the LCT of each individual pig after the time of service was calculated. From the overnight temperature data recorded in each pig pen, the estimated number of total °C hours below LCT was 2942, 2899 and 2805 per month for L, M and H respectively (sem 63.6, NS) during the pregnancy period, when they received standard feeding. However, there was a major housing effect; the mean total °C hours below LCT was 4509 and 1256 per month for T and I respectively (sem 51.9, p<0.001).

DISCUSSION

Treatment effects during gilt rearing

The average daily gain (ADG) monitored up to day 67 was significantly higher (416 g/day) for the 400 g/day target growth rate, as would be expected. However, the recorded growth rate was higher (297 g/day) for the 200 g/day target growth rate group than predicted. There may be number of reasons for this discrepancy, but the most likely one is that the estimation of partitioning between lean and fat deposition was not accurate for this genotype, for which no good information on genetic growth potential exists. At the time of service, gilts were consequently both heavier and fatter as a result of the additional feed inputs. When comparing the responses to additional feed with those achieved by improvement in housing, it was seen that the improvement in ADG resulting from improved housing at the lowest plane of nutrition approached that achieved by input of an additional 200 g of feed/day. Similarly, the improvement in backfat deposition for gilts in improved housing at the medium plane of nutrition was similar to that achieved by input of an additional 400 g of feed/day. Lack of major growth improvement with improved housing for high plane gilts reflects the fact that these animals were calculated as being above their LCT during the experimental period. The effect of improved housing would

Table 4. The estimated mean total °C hours below LCT and equivalent food cost per pig of gilts reared under different planes of nutrition and conditions of housing in each month of the experiment

Treatment	Month					
	May		June		July	
	Total °C hours below LCT	Total food cost (kg)	Total °C hours below LCT	Total food cost (kg)	Total °C hours below LCT	Total food cost (kg)
LT	2,255	4.7	2,245	4.6	2,442	5.4
MT	1,290	2.6	1,261	2.5	1,052	2.1
HT	0	0	0	0	0	0

Key: LT=Low feed level under traditional housing, MT=medium feed level under traditional housing.

probably have been more apparent if the animals had been exposed to their treatment immediately after weaning at eight weeks of age during the winter period. There are several reports which indicate that smaller animals exposed to draughty weather conditions would experience a more serious effect on their growth (Holmes and Close, 1985; Robertson and Clark, 1985). The delayed treatment start therefore unfortunately tended to reduce the potential measurable benefits associated with an improved housing strategy.

Consequences of rearing treatments on subsequent performance

The age at first service ranged from 248 to 266 days for all the experimental gilts. The mean age at first service reported previously for Pakhribas pig in the PAC herd was 241 days (Aryal et al., 1992). There was no significant difference in the age at first service among the nutrition treatments, whereas a tendency (Sem 9.3, $p<0.10$) for a difference between housing treatments was observed.

There are several reports which state that undernutrition delays puberty in gilts (King, 1989; Van Lunen and Aherne, 1987; Kirkwood et al., 1987). Similarly, Den Hartog and Noordewier (1984) found that gilts which received increased food intake during rearing reached pubertal oestrus at a younger age than those receiving restricted food intake. Dourmad et al. (1990) found that high energy intake during growth reduced age at puberty and increased body fat content. Booth (1990) suggested that the onset of puberty is linked to the attainment of a critical body weight, a minimum lean to fat ratio and to a minimum percentage of body fat. Body weight and fatness has significant effects on steroid metabolism which may be of importance during puberty (Kirkwood and Aherne, 1985). However, in this present study, the higher level of nutrition (416 g/day growth rate) did not give a significantly lower age at first service despite a higher level of P_2 backfat thickness, body condition score and eye muscle depth at service.

The conception rate was 90% at first service followed by a further 80% at second service and 100% at third service. The conception rate in this present study is found to be higher than other reports available for this breed (Shrestha and Ghimire, 1993; Rai and Kshatri, 1994), and was again unaffected by treatments.

There were no significant differences in age, body condition score, or live weight at farrowing between nutrition and housing treatments, although eye muscle depth showed a tendency towards significance at $p<0.10$. Thus treatments differences generated during the rearing phase were subsequently reduced as found in other studies (Simmins, Edwards and Spechter, 1994).

The estimated target growth during pregnancy was 20 kg, but the mean maternal weight gain during pregnancy was 29.8 kg irrespective of treatment effects. The gilts thus had a higher maternal growth during pregnancy than the estimated target growth. Thus, as with the gilts on the low plane of nutritional rearing plane, either the animals utilised their feed more efficiently than we estimated or the estimated maintenance requirement in the equation was too high for Pakhribas pigs. The most likely reason for apparently better efficiency was that the DE value of the diet used in calculation of feed allowances was 9 MJ/kg dry matter derived from the proximate analyses using the equation published by Morgan et al. (1975). This low value may well have been an underestimate of the true energy content, resulting in the feeding of a higher calculated amount of feed than actually needed. Subsequent recalculation of DE from the same proximate analysis using a more recently validated prediction equation (MAFF, 1991) suggested that the DE of the diet was actually 13.6 MJ/kg dry matter. When the new energy value was used in the spreadsheet for the calculation of feed requirements during pregnancy, the amount of feed offered was much closer to that predicted for the weight gain achieved during pregnancy. However, a difference between calculated and actual energy inputs suggested that some energy was still being utilised for compensating for climatic penalty.

There was no significant difference between treatments in the litter size at birth, but there was a significant effect on piglet weight at birth between nutrition treatments and housing treatments, indicating that a climatic penalty had reduced energy available for fetal tissue deposition (Pluske et al., 1995). Although the differences in number of piglets born alive were not statistically significant between nutrition treatments, there was a difference of one piglet between the lower level of nutrition and higher level of nutrition. If we consider a repeatable difference of one piglet between the treatments, this would be of great economic importance for the Nepalese village farmers. However, a much greater sample size would be required in order to determine whether this is a true or chance effect. We therefore calculated an appropriate sample size under Nepalese conditions based on the standard error of the mean for nutrition treatments and housing treatments obtained in this experiment (Roberts, 1983). This showed that there should be at least 59 sows in each treatment to obtain a significant difference statistically of one piglet per litter. If such an experiment is conducted in the future, this should be the minimum target sample size. However, given the nature of traditional Nepalese pig keeping systems this scale of experiment will be difficult to achieve.

CONCLUSION

Improvement in housing provides a cost effective way to improve growth rate and body condition of breeding gilts under traditional Nepalese conditions without the need to supply extra feed. Improved growth rate during gilt rearing and reduction in climatic penalty during pregnancy can increase piglet birth weight. There may also be a beneficial effect on litter size, but a very substantial experiment (>59 sows/treatment) would be required to confirm this.

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