factsheet
Pork Information Gateway

Management of large groups of growing pigs

Authors
Mike Ellis, University of Illinois
Jake DeDecker, University of Illinois

Reviewers
Kenneth Kephart, Penn State University
Mike Brumm, University of Nebraska

Introduction

Choice of appropriate group size is an important consideration when designing facilities, particularly for growing pigs (from weaning to slaughter) and for sows that are group housed during gestation. Small group sizes (around 10 pigs/pen) are used on some operations for growing pigs; particularly those that use litter segregation (keeping whole litters together in discreet groups from weaning to slaughter). Typical group sizes for commercial production are generally within the range of 20-30 pigs per group. Recently, there has been increased interest in the use of larger groups for growing pigs. Initially this interest focused on the potential to reduce costs and improve management in larger groups; however, more recently, the development of automatic sorting systems which are based on groups of between 500 and 1000 pigs has added a new dimension to the debate on optimum group sizes.

Objectives

- Compare the effects of small vs. large group size on growth performance and health/welfare
- Discuss facility design and management for large group sizes
- Evaluate the economics of group size

Background

"Large group size" is a relative term that can encompass the range from 50-1000 pigs per group, or even larger. Commercially, pigs are housed in group sizes ranging from individual animals (e.g., sow gestation crates) to, in certain cases, groups of several thousand animals. There is a substantial volume of research available relating to groups of up to 100 animals that can be used as a basis to develop recommendations. However, there is relatively little, if any, research information available on larger groups of 500-1000 animals that are being used on some facilities today. This paper will focus on the available research information which is largely based on groups of 100 pigs or less.

Considerations for choosing optimum group size

From a producers' perspective, there are a wide range of factors to consider when designing facilities and developing management systems for growing pigs in large groups. These include any impact of group size on the following aspects.

- Growth performance
- Health and welfare
- Facility design and management
- Economics

These aspects will be discussed in this paper.

Effect of group size on growth performance

A critical factor in any consideration of the optimum group size to use for growing pigs is any impact on growth performance. Historically, research in this area focused on relatively small groups of 30 pigs or less and there has been limited research carried out with what today would be considered large groups. In addition, in a number of studies, increases in group size were achieved by increasing the number of pigs per pen with a consequent decrease in floor space per pig. The results of such studies are notoriously difficult to interpret because it is not possible to separate any effect of increasing group size from that associated with reduced floor space.

Kornegay and Notter [1], in a classic paper that reviewed group size effects at the same floor space allowance, developed equations predicting the impact of increases in group size based on pooled data from a number of experiments which used groups of up to 35 pigs per pen. These prediction equations suggested that increases in group size were associated with a reduction in average daily gain and feed intake with the size of the effect being greater, both in absolute and relative terms, in nursery pigs than in growing finishing animals (predicted reductions in growth rate with increasing group size were -3.7, -1.9, and -1.2g/day/pig for weaners, growers, and finishers, respectively; predicted reductions in feed intake were -9.2, -2.5, and -3.2g/day/pig for weaners, growers, and finishers, respectively). Feed efficiency did not change with increasing group size. Since this work by Kornegay and Notter [1], the swine industry has undergone major changes including significant increases in slaughter live weight (currently averaging around 120 kg), considerable improvements in genetics, and major changes in production practices, including the emergence of wean-to-finish production. One of the consequences of this latter change is that the growth period from weaning to slaughter is considered as a whole rather than being split into two or three phases as historically was the case.

More recent studies, a number of which have been carried out at the University of Illinois, have used larger groups of 100 pigs per pen or more. Interestingly, these studies have generally led to the same general conclusion as Kornegay and Notter [1] that the impact of increasing group size is greatest in nursery pigs and decreases with weight. For example, Wolter et al. [2,3] conducted two studies in commercial nursery accommodations involving over 2000 pigs and found that the growth rate of newly weaned piglets between approximately 5 and 15kg in groups of 100 compared to 20 pigs was reduced by between 4.3 and 6.6% and that this reduction was in large part due to a lower feed intake in the large groups (average daily feed intake reduced by between 5.1 and 6.6% for groups of 100 compared to 20 pigs), with little effect of group size on feed conversion efficiency. However, in a study with growing-finishing pigs between 35 and 115kg liveweight, there was no effect of group sizes of 100 compared to 25 pigs on growth rate and feed intake and, surprisingly, gain:feed ratio was approximately 3% greater for the larger groups [4].

There have been a number of recent literature reviews evaluating the effects of group size on animal performance with one of the most extensive being that of Turner et al. [5]. These authors analyzed pooled data from 20 studies involving about 22,000 animals that evaluated group sizes of between 3 and 120 pigs. This analysis showed that average daily gain was reduced with each additional pig in the group in nursery pigs (weaning to 30kg) by 0.36g/pig/day and growing pigs (30-68kg) by 0.48g/pig/day, but not in finishers (>69kg), that showed a non-significant reduction in growth rate of 0.09 g/pig/day for each additional pig in the group. Interestingly, the reductions in growth rate with increasing group size reported by Turner et al. [5] are much lower than those found by Kornegay and Notter [1] previously reported in this paper. This suggests that the impact of increasing group size is much less under modern production conditions, perhaps reflecting changes in genetics, and housing and management conditions.

Overall, the effect of large group sizes on growth performance during the entire growth period is most easily observed in wean-to-finish production systems. In the study of Wolter et al. [4], pigs were grown in a wean-to-finish facility between 5-115kg liveweight in groups of 25, 50 or 100 pigs per pen. Growth rate

and feed efficiency were reduced in the nursery stage (5-35kg) for the larger groups; feed intake was not affected by group size. However, for the grower and finisher phases and the entire period from weaning to slaughter weight there was no effect of group size on growth rate or feed intake. In fact, in the growing-finishing period the growth rate of the pigs in the larger groups was numerically higher and feed efficiency was improved compared to those in the smaller groups resulting in a similar time to reach the slaughter weight of 115kg for the two group sizes (168 vs 166 days for the groups of 25 and 100 pigs, respectively). There has been little if any research evaluating the impact of group size on growth performance in a two-phase system (i.e., separate nursery and grow-finish facilities). However, it seems likely that results would be similar to those found in a wean-to-finish facility suggesting that the effect of group sizes of up to 100 pigs on growth performance from weaning to slaughter weight is minimal.

Why should the growth response of pigs to increasing group size vary with the weight of the animal? Research on the feeding behavior of pigs in response to increasing group size could shed some light on this question. Hyun and Ellis [6,7] compared group sizes of between 2 and 12 pigs during either the growing (26 to 48 kg liveweight) or finishing periods (84 to 112 kg liveweight) using automated feed intake recording equipment. These studies showed that finishing pigs showed marked changes in feeding behavior with increasing group size, particularly an increase in the rate of feed consumption, and consequently, there was no effect of group size on feed intake and growth rate. However, during the growing period, pigs showed little or no change in feed consumption rate with increasing group size and, growth rate and feed intake were reduced in the larger groups. Obviously, this research was carried out with much smaller group sizes than used in commercial practice, however, it does provide some potential insight into changes in feeding behavior that will impact growth performance. Larger pigs appear to have more capacity to change feeding behavior, particularly to increase eating speed, than small pigs and this may, in part at least, explain why the response to increasing group size declines with increasing size of pig.

The research discussed above was carried out with a group size of up to around 100 animals. Recent developments in the industry and particularly the adoption of autosort technology have resulted in the use of much larger groups (500-1000 pigs) on commercial operations. It is obviously difficult, if not impossible, to carry out controlled research with such large groups and the impact of these on growth performance has not been established. Several field reports have suggested that growth performance of pigs in groups of 500-1000 may be reduced compared to more conventional group sizes. Research is needed to establish the effect, if any, of extremely large groups on growth and to identify the cause(s) of any reduction in performance.

Health and welfare

There has been limited research investigating the impact of large groups on animal health and welfare. A number of studies have shown little or no effect of group sizes between 20 and 100 pigs on morbidity or mortality levels [2-3,8]. In fact, in one study [4] morbidity levels were actually reduced for groups of 50 and 100 compared to 25 pigs. However, another study [9] did report higher pig injury and morbidity in groups of 40 than in groups of 20 or 10 pigs per pen. Reports on the incidence of specific disease problems and on measures of immuno-competence have suggested no negative impact of large group sizes [10]. Some studies have shown that levels of aggression can be increased in larger groups [11,12], although research in this area is limited. The impact of large groups on pig welfare has not been clearly established.

Facility design and management

Large group systems often allow more flexibility to management practices and to facility design and utilization. Properly designing the facility to accommodate large groups is key in maximizing building and labor efficiency. Design features of the barn and pen as well as management and care of the animals will require some modifications from conventional models. A large degree of trial and error has occurred as producers and researchers alike continue to search for better ways to house and manage large group systems.

Structurally speaking, the dimensions of doorways, aisles, and in some situations the base of loading chutes may need to be wider compared to conventional barns to improve the movement of pigs in large groups. The method of how to sort pigs from larger pens is extremely important and needs to be evaluated on an individual facility basis. The pricing matrices employed by slaughter plants increasingly require more frequent and accurate sorting of animals. If manually sorting is used, facilities must be well

designed. Utilizing crowding gates or establishing a "hinged' gating system to move animals out of the pen into a narrower loading chute should make the process easier and require fewer people. It is best to move several small groups out separately, as large groups typically pile at the door or in the hallway and will require more people to move. Automated sorting systems are becoming more popular for use in very large groups. There are many unanswered questions to the proper management and design of these systems, but the technology has the potential to make a significant contribution to our ability to more effectively mange large group systems.

One of the biggest changes to management is the manner in which daily checks of animal health and facilities are carried out. Entering the pen is essential to appropriately inspect the animals as well as feeder and water function. In some situations it may be best for two or more persons to work together for adequate inspection of the animals and to ensure worker safety. Initially it may take additional time to check large pens of pigs in order to identify animals that require medical treatment. However, it has also been noted that ill or injured pigs may seek refuge in protected areas such as corners, thus making them easier to locate and treat [13]. In order to efficiently remove an animal from a group for isolation or treatment it is recommended that a small capture or hospital pen be included in the pen design.

The manner in which large groups interact with one another and with members of other unfamiliar groups differs from small groups and offers managerial benefits. Pigs in large groups (i.e., > 80-100 pigs) seem to be more tolerant when unfamiliar animals are introduced to the group. Market weight pigs from two large groups have been mixed in holding pens prior to loading with little or no aggressive behavior [13]. In addition, Turner et al., [14] combined unfamiliar pigs from small and large groups and found that pigs from large groups showed a marked reduction in aggression towards unfamiliar pigs. It has been suggested that the lack of aggression in pigs from large groups could be caused by either the inability of the animals to recognize one another in such large groups or the realization that if a structured social hierarchy was in place the energetic cost of reinforcing the hierarchy would outweigh the benefit [15]. This lack of aggression, when animals from unfamiliar groups are mixed, could reduce or eliminate the typical setbacks associated with combining pigs from different groups and can have practical benefits, particularly in multiple-stage systems and during transport for slaughter. Initially it was anticipated that certain behavioral vices or group segregation would occur, but in most cases these problems have not been observed.

There are certain aspects to consider when remodeling conventionally constructed barns to house larger groups of pigs when the facilities were designed to house smaller groups of pigs. One of the major considerations when remodeling for larger groups is the dunging patterns of pigs. Rooms designed for small groups have ventilation that encourages good dunging patterns. Managers of very large groups have reported that lying and dunging patterns are usually very consistent. Pigs often lie on the perimeter of the pen and dung in the center of the pen. Poor dunging patterns may become established early, resulting in high levels of ammonia and increased labor costs for cleaning. The differences in dunging patterns between small and large groups are obviously not important when total slatted floors are used. In partially slatted facilities, dunging on the solid floor areas will create dirty pens with higher levels of ammonia [16]. It is very difficult to remodel a partially slatted room for use in large group systems.

Economics of group size

The most appropriate group size to implement in a given system will largely be decided by economics. An advantage claimed for larger groups is lower facility or fixed costs per pig space resulting from both a reduction in pen partitions and improved use of facility space, thereby increasing the number of pigs housed per building. The specific economic impact of large groups will depend on the particular situation in question, with the stage of production question being one of the major factors. For example, Wolter et al. [17] performed an economic comparison of nursery systems based on group sizes of 20 or 100 pigs. Surprisingly, the results suggested that the most profitable approach was to house pigs in groups of 20 rather than 100 animals. This result was largely due to the reduction in growth rate observed during the nursery period for the larger groups. Moreover, the reduced facility cost associated with larger groups had a very limited effect on total production costs on a per pig basis. Obviously, if the entire growth period from weaning to slaughter is considered, where no impact on performance is expected, then the outcome of the economic analysis is likely to be different. This highlights the importance of a situation-specific analysis of the economic impact of managing large groups.

Summary

Rearing of growing pigs in large group sizes (80-100 pigs) presents unique opportunities to producers interested in improving floor space efficiency. Overall, studies suggest that large group sizes are not beneficial to nursery pigs. Conversely, pigs in the finishing phase see no reduction in performance. The recent development of autosort technology makes possible the use of extremely large group sizes (500-1000 pigs) in the finishing phase. Caution should be used when implementing such technology into a finishing system since some initial field reports suggest that there is reduction in growth performance. More research in needed to fully understand the effect of extremely large group sizes in the finishing phase.

Literature Cited

1. Kornegay ET, Notter DR. Effects of floor space and number of pigs per pen on performance. *Pig New Info* 1984;5:23-33.

2. Wolter BF, Ellis M, Curtis SE, Parr EN, Webel DM. Group size and floor-space allowance can affect weanling-pig performance. *J Anim Sci* 2000a;78:2062-2067.

3. Wolter BF, Ellis M, Curtis SE, Parr EN, Webel DM. Feeder location did not affect performance of weanling pigs in large groups. *J Anim Sci* 2000b;78:2784-2789.

4. Wolter BF, Ellis M, Curtis SE, Augspurger NR, Hamilton DN, Parr EN, Webel DM. Effect of group size on pig performance in a wean-to-finish production system. *J Anim Sci* 2001;79:1067-1073.

5. Turner SP, Allcroft DJ, Edwards SA. Housing pigs in large social groups: a reviw of implications for performance and other economic traits. *Livest Prod Sci* 2003;82:39-51.

6. Hyun Y, Ellis M. Effect of group size and feeder type on growth performance and feeding patterns in growing pigs. *J Anim Sci* 2001;79:803-810.

7. Hyun Y, Ellis M. Effect of group size and feeder type on growth performance and feeding patterns in finishing pigs. *J Anim Sci* 2002;80:568-574.

8. Schmolke SA, Gonyou HW. Effect of group sizes of 10, 20, 40, and 80 on productivity of grower-finisher pigs. *J Anim Sci* 2000;78 Suppl 2:38 (abstr).

9. McGlone JJ, Newby BE. Space requirements for finishing pigs in confinement: behaviour and performance while group size and space vary. *Appl Anim Behav Sci* 1994;39:331-338.

10. Turner SP, Ewen M, Rooke JA, Edwards SA. The effect of space allowance on performance, aggression and immune competence of growing pigs housed on straw deep-litter at different group sizes. *Livest Prod Sci* 2000;66:47-55.

11. Spoolder HAM, Edwards SA, Corning S. Effects of group size and feeder space allowance on welfare in finishing pigs. *J Anim Sci* 1999;69:481-489.

12. Turner SP, Edwards SA, Bland VC. The influence of drinker allocation and group size on the drinking behaviour, welfare and production of growing pigs. *J Anim Sci* 1999;68:617 624.

13. Gonyou H. Managing Large Grow-Finish Groups. Banff Pork Seminar. January 2004.

14. Turner SP, Horgan GW, Edwards SA. Effect of social grop size on aggressive behaviour between unacquainted domestic pigs. *App Anim Behav Sci* 2001;74:203-215.

15. Pagel M, Dawkins MS. Peck orders and group size in laying hens: 'futures contracts' for non aggression. *Behav Processes* 1997;40:13-25.

16. Gonyou H. 2003. Remodeling Barns for Large Groups [Online]. [2003] [Cited 2004 Apr 10]. Available from: URL: http://adminsrv.usask.ca/psci/WhatsNew/MAR03/RemodellingFinisher.htm.

17. Wolter BF, Ellis M, Curtis SE, Schnitkey GD, Parr EN, Webel DM. Group size and floor-space allowance affect the economic performance of a four week nursery system for weaning pigs. Proceedings of First Int. Swine Housing Conf. 2000c. American Society of Agricultural Engineers. St. Joseph, MI, USA. p. 205-213.

Information developed for the Pork Information Gateway, a project of the U.S. Pork Center of Excellence supported fully by USDA/Agricultural Research Service, USDA/Cooperative State Research, Education, and Extension Service, Pork Checkoff, NPPC, state pork associations from Iowa, Kentucky, Missouri, Mississippi, Tennessee, Pennsylvania, and Utah, and the Extension Services from several cooperating Land-Grant Institutions including Iowa State University, North Carolina State University, University of Minnesota, University of Illinois, University of Missouri, University of Nebraska, Purdue University, The Ohio State University, South Dakota State University, Kansas State University, Michigan State University, University of Wisconsin, Texas A & M University, Virginia Tech University, University of Tennessee, North Dakota State University, University of Georgia, University of Arkansas, and Colorado State University.