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The Economics of Adopting Alternatives to Gestation Crate Confinement of Sows

The Humane Society of the United States

An HSUS Report: The Economics of Adopting Alternatives to Gestation Crate Confinement of Sows

Gestation crate confinement of sows

Gestation crates are individual stalls with metal bars and concrete floors that confine pregnant pigs in the commercial pork production industry. Gestation crates measure 0.6-0.7 m (2.0-2.3 ft) by 2.0-2.1 m (6.6-6.9 ft), only slightly larger than the animals themselves, and restrict movement so severely that the sows are unable to turn around.[1] In typical pig production facilities, gestation crates are placed side by side in long rows. They are primarily used on large-scale industrialized pig production operations, where thousands of pigs are produced annually in warehouse-like buildings.


Sows in gestation crates.
Photo by Humane Society of the United States

There are a number of significant animal welfare concerns associated with gestation crates for sows,[*] including tangible physical and psychological consequences. Studies document a decrease in muscle weight, bone density, and bone strength due to movement restriction and lack of exercise.[2,3] Unable to engage in natural rooting and foraging behavior, crated sows often engage in "stereotypic" bar-biting, an abnormal behavior characterized by repeated mouthing movements on the metal rails of the crate.[4,5,6,7,8,9] Crated sows also suffer from health problems associated with confinement including a higher rate of urinary tract infections as compared to uncrated sows.[10] Continuous close confinement is a topic of serious ethical deliberation, and gestation crates have been banned in eight states in the United States,[†] Tasmania,[11] New Zealand,[12] and all 27 members of the European Union.[13]

Alternative systems

Alternative systems that do not rely on gestation crate confinement have the potential to greatly improve the welfare of sows. The most basic alternative is simply to move the sows out of gestation crates and into group housing pens. Group housing designs vary by pen layout, group size, and method of feed presentation. The way that feed is offered is important, because competition between sows can lead to aggression, especially in a floor feeding system where the feed is simply dropped into the pen. To overcome this problem, farmers have developed trickle feeding systems, individual feeding stalls, and Electronic Sow Feeding (ESF) equipment, all of which reduce feed-associated fighting among sows. In trickle feeding systems, sows are fed either on the floor or in short stalls that protect their head and shoulders while the feed ration is gradually released into a trough at the head of each stall. The feed is 'trickled' into the trough at a rate that the slowest animal can

[*] For more detailed information, see: "An HSUS Report: Welfare Issues with Gestation Crates for Pregnant Sows" at www.humanesociety.org/assets/pdfs/farm/HSUS-Report-on-Gestation-Crates-for-Pregnant-Sows.pdf and "An HSUS Report: The Welfare of Sows Used for Breeding in the Pig Industry" at www.humanesociety.org/assets/pdfs/farm/welfare_breeding_sows.pdf.
[†] For more information, see: "An HSUS Report: Welfare Issues with Gestation Crates for Pregnant Sows" at www.humanesociety.org/assets/pdfs/farm/HSUS-Report-on-Gestation-Crates-for-Pregnant-Sows.pdf

consume, thus preventing the accumulation of feed that sows might fight over. In systems with individual feeding stalls (also called free-access stalls), sows are completely separated at feeding time. Sows enter the stall and the back gate closes behind them until they are finished eating. Thin sows can be given additional feed by hand. In the ESF system, sows are also fed individually. The ESF is an enclosed stall with separate, computer-controlled entrance and exit gates. Several group housed sows take turns using one ESF throughout the day. Each sow is fitted with an electronic identification transponder in an ear tag that is read by the computer. The animal is identified by the transponder and her daily ration is released inside the ESF where she consumes her feed without interference from other sows.[14]

A variety of other, usually more modest size, alternative systems are also available. These not only address animal welfare concerns but can also have environmental and sustainability benefits as well. These include indoor group housing in deep-bedded, Swedish-style systems and simple hoop barn structures—both of which house sows on straw or another bedding material—and outdoor pasture-based systems with small huts for shelter. Some producers using these alternative housing systems combine their pig production enterprise with additional animals and plant crops, diversifying the farm and diffusing the pig population over a greater land area, which reduces the environmental burden of concentrated pig production and has advantages for rural communities and farmers' quality of life.[15]

Producers may be concerned about the costs of switching to group housing or the profitability of a less intensive system, and consumers may be concerned about the price of pork at the retail level when purchasing from an alternative system. The remainder of this review addresses the economic impacts of adopting more welfare-friendly systems.

Production costs to farmers

Investment costs (or capital costs) are expenses associated with constructing new buildings or switching to an alternative system. Conventional confinement buildings are capital intensive, therefore producers will often spread out the cost over many animals by confining a large number of individuals together under one roof.[16] The capital costs of alternative systems for group housing sows vary widely depending on the housing structure, the type of feeding system used, and the building space required.[17]

In an existing building, production costs can be divided into two types: fixed costs and operating costs. Fixed costs depend on the value of the facility and occur independently of how the building is used, and include interest payments on loans for farm buildings, insurance, taxes, depreciation, and repairs. Operating costs (or variable costs) are the costs of running the system, and include expenses such as utilities, feed, and labor.[18]

Economic analyses comparing the expenses of building or converting to group housing systems are few,[19] and the results of existing studies vary considerably. Because the published studies often do not report all details of the cost calculations or the housing system examined, comparing and summarizing studies may leave contrasting results unexplained. Costs will also differ depending on geographical location, local conditions, and environmental regulations. Construction supply availability and pricing will obviously differ depending on the country and region in which the facility is built.

Group housing in confinement buildings

Due to the high cost of steel needed to build individual gestation crates,[20] estimates of construction costs for group housing sows often show that it is less expensive to build a group housing facility for sows. However, cost differences depend on the amount of space provided to each sow and the complexity of the group housing pen. An economic comparison in Canada found that the capital costs per sow space of a group housing facility for 1000 sows providing 18ft^2 (1.7 m^2) per sow were 30% lower than the costs of construction of conventional gestation crate housing, but when the group housing facility provided more space per sow (26ft^2; 2.4 m^2) and wall dividers within the pens, the cost was just 4% lower.[21] In a report for the European Commission, data presented by the Scientific Veterinary Committee using Dutch farm and price conditions showed that every 5.4

ft^2 ($0.5m^2$) increase in space per sow resulted in an approximately 1% increase in investment and housing costs and a 0.3% increase in total costs per piglet sold.[22]

In other cases, the particular scenario examined shows contrasting results, with greater costs for group housing. Using software developed in the United States by the National Pork Board, Lacey Seibert and Bailey Norwood working in the Department of Agricultural Economics at Oklahoma State University concluded that the construction costs for new group pen and gestation stall production facilities would be identical.[23] This is supported by studies in Canada in economic comparisons prepared for the Alberta Livestock Industry.[24] However, Seibert and Norwood determined that because the group housing facility in the scenario they examined would hold 18% fewer sows, the fixed costs would be $26.88 per finished pig in the confinement-stall system and $32.78 in the group housing system. They also assumed that labor costs would be higher because group housed sows may be temporarily moved into individual stalls for care and breeding, which requires more work. They reported an overall cost increase of $8.94 per finished pig for group housing. When the costs of converting from gestation crates to group housing prior to the end of the depreciation period on current facilities were included in the final figure, the cost was $10.09 more per pig.[25]

Group housing with Electronic Sow Feeding (ESF) system (left).
Photo credit: Tom Parsons, DVM, University of Pennsylvania

The type of feeding system used in the group housing system can also make a substantial difference in the overall economic analysis. A study conducted in the Netherlands comparing conventional and free-access stalls, trickle feeding, and ESF group housing systems, found that investment costs were highest for free-access feeding stalls and trickle feeding systems. Like gestation crates, these systems require construction of enclosed or partially enclosed individual feeding spaces. Investment costs for the ESF system, however, were *lower* than that of gestation crates.[26,27]

In addition to differences in labor requirements, the amount of feed sows consume also differs between group housing systems. In the study conducted in the Netherlands, feed intake for sows in their first pregnancy was higher in the free access stalls and the trickle feeding system compared to the conventional crates and the ESF system, and for multiparous sows (those in their second pregnancy or beyond) feed intake was lowest in the ESF system. Records of the amount of labor needed in each system showed that working time was less in the ESF system, however this difference accounted for only 3% of the total time, because working with the dry (non-lactating) sows made up less than 10% of the total working time on the sow farm.[28]

Table 1 summarizes the three economic studies that report figures for investment, feed, labor and total costs between different types of group housing systems as compared to conventional gestation crates. While some group housing systems cost more than gestation crate facilities, the studies available show that those with ESF stations actually cost about the same or even less. Additionally, productivity between systems is comparable or better in alternative systems,[29,30,31] although lameness and fighting can be a concern.[32] In total, the data indicate that the costs associated with group housing can be as low as the costs associated with gestation crates, but in cases where group housing is more expensive, the differences are not prohibitive, and they are less than consumer willingness to pay estimates, discussed below.

TABLE 1. RELATIVE COST CHANGE IN GROUP HOUSING AS COMPARED TO GESTATION CRATE HOUSING (% DIFFERENCE)					
STUDY	FEED SYSTEM TYPE	CAPITAL INVESTMENT COSTS	FEED COSTS	LABOR COSTS	TOTAL COSTS
Seibert and Norwood[a]	NOT SPECIFIED	0	0	+22	+7.5 to +8.4
Backus, Vermeer and Roelofs et al.[b]	TRICKLE FEEDING	+4.3	0	+0.2	NA
	INDIVIDUAL FEED STALLS	+28.7	0	-0.07	NA
	ELECTRONIC SOW FEEDER	-2.1	-3.6	-2.6	NA
SVC[c]	ELECTRONIC SOW FEEDER	-0.2	NA	NA	-0.6

a. Based on figures of cost per finished pig provided in Seibert L and Norwood FB. 2011. Production costs and animal welfare for four stylized hog production systems. Journal of Applied Animal Welfare Science 14:1-17
b. Calculated from investments costs per sow, feed figures for a multiparous sow, and labor for the whole experimental farm in Backus GBC, Vermeer HM, Roelofs, et al. 1997. Comparison of Four Housing Systems for Non-lactating Sows. Research Institute for Pig Husbandry, Netherlands, Report P5.1. http://edepot.wur.nl/120583.
c. Based on figures from table 6.5 of the Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997. http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf.
NA = data not available

Buildings and equipment have a finite life, and must be updated and refurbished at regular intervals, no matter what the housing system. Economic estimates assume that the lifetime of buildings and equipment is 20 years.[33] While the costs of constructing a new group housing facility may be similar to the costs of building a new gestation crate facility, Seibert and Norwood point out that producers may have to convert from gestation crates to group housing in an already existing facility before gestation crate equipment wears out. They determined that the cost of converting gestation stalls to group pens would be $1.15 per finished pig, if the original facility was ten years old.[34] However, the extra investment costs would be higher in recently built facilities, as depreciation would not have yet decreased the value of the earlier investment.[35] Conversely, if the conversion is made at the end of the reasonable lifetime period of the gestation crate facility, the cost calculation per finished pig would decrease.

The costs of renovating a gestation crate facility to a group housing system include the depreciated cost of the existing building, the cost of new equipment (minus the salvage cost of old equipment), and the labor required to remove the old equipment and install new equipment. In a typical gestation crate facility, approximately 30% of the floor space is dedicated to the access areas for stockpersons, and are therefore not used by the sow. An economical way to convert from gestation crates to group housing is to utilize this extra space, by removing the back of the crates to permit open access. Group housing systems can thus save space by partitioning more of the access areas to the sows. In an ESF system space can be used efficiently by providing 95% of the building floor area to the sows, instead of the 70% typical in conventional gestation crate housing.[36]

Because each individual situation is different, producers may need information that fits the economic conditions for the geographical location and resources available at their own production site. The National Pork Board in the United States has created an on-line tool called the “sow housing calculator” that producers can use to determine the expenses for their own particular set of circumstances.[37,38]

Group housing in hoop barns

Hoop barns are simple structures made of steel arches attached to wooden sidewalls and covered with polyvinyl fabric. The ends of the hoop structure are open most of the year, but can be closed or partially closed in cold winter months. The floor is typically dirt covered with bedding, usually straw, corn stalks, or sometimes sand.

The capital costs of hoop barns are much less than conventional confinement facilities. As part of a long-term research project on alternative pig production facilities conducted at Iowa State University, it was determined that hoop barns can be built for 30% less than the cost of a conventional confinement facility with gestation crates. General contractors working in agricultural construction and equipment and materials suppliers were surveyed for the study. Materials for the conventional gestation crate facility were based on a 78.74 by 449.5 ft (24 by 137 m) building holding 1,700 sows and with mechanical ventilation, totally slatted flooring, and a manure flush system below. For the hoop barns, materials were based on 29.9 by 89.9 ft (9.1 by 27.4 m) facilities each housing 52 sows. Because hoop barns provide more space per sow, land costs are higher, but the building structure, ventilation system, flooring, manure storage, and feed and water systems are all significantly less. For facilities housing a total of 1,700 sows, construction costs were estimated at $820.00 per sow space in a confinement building with gestation crates and only $570.00 per sow space in the hoop barn.[39]

Deep bedded hoop barn, University of Minnesota at Morris
Photo credit: Marlene Halverson

Operating costs also differed: mechanical ventilation in confinement buildings cost more to run than utility use in hoop barns. However, bedding is an expense in hoop barns that is absent in typical confinement facilities. Feed costs are also higher in hoop barns, because sows eat more during winter months if the temperature is not controlled.[40] Productivity, including pre-weaning mortality of piglets and weaning weight, is comparable between hoop barns and confinement facilities with gestation crates.[41] The Iowa State researchers found that the overall cost per pig weaned is 3% less in hoop barns compared to those produced in individual stall gestation systems. If prolificacy in hoop barns is increased, as previous work suggests that it could be, then production costs can be as much as 10% lower.[42] The authors concluded that in the geographic location of the study, optimally managed deep-bedded hoop barns can produce weaned pigs at a lower cost than typical gestation crate confinement facilities.[43]

Group housing in deep-bedded, indoor, Swedish systems

The Swedish system for group housing gestating sows on deep straw with individual feeding stalls—one for each sow in the group—is economically competitive on modest-sized farms (100 to 500 sows) and has generated interest in other countries. The system was developed by a farmer near Stockholm in the 1970s and quickly spread to other farms in the country as farmers found that it was the best way to feed and maintain healthy sows.[44,45] In this system, sows are housed indoors in groups on a deep bed of straw. The sows are fed individually in free-stalls and this allows the producer to adjust the diet of each sow individually, reduces fighting, and eases management for administering vaccinations, sorting, or performing artificial insemination. As compared to typical confinement operations, sow

Swedish deep-bedded gestation housing
Photo credit: Marlene Halverson

mortality is low and sow longevity is better.[46] Soiled bedding is removed with skid loaders that enter through large doors at the side of the building,[47] while the sows are temporarily confined to their feeding stalls.[48]

Ongoing research in the United States, at the University of Minnesota, in the Morris "Swedish" gestation housing system project, continues to operate and produce successful results.[49] The pre-weaning mortality rate of piglets has continued to decline as the system has been studied and as barn staff has become more familiar with and adjusted management practices.[50]

Few economic analyses are available, but labor demand has been calculated at 18 hours/sow/year and includes repairs, cleaning, medicating, moving sows, and providing assistance at farrowing. These requirements are thought to be lower than conventional operations, but labor needs are higher in the Swedish system for observation, management, and planning.[51]

Group housing in pasture-based systems

A renewed interest in outdoor pig production has expanded internationally including in North America, parts of Europe, and in South Africa. Outdoor pig farms can range considerably in size, from very small (10 sows or less) to very large farms with 10,000 sows.[52] In pasture-based pig production, sows gestate and sometimes give birth outdoors in small huts. The huts are bedded with straw and are portable by tractor so they can be rotated to fresh pasture. Huts may be insulted for winter farrowing[53] or farrowing may be seasonal.[54] Electric, low-cost fences are used to contain the pigs, and the stocking density may be 7-15 sows per acre. These farms often diversify by including a crop production enterprise in addition to the pigs. The freedom of movement and natural environment offer animal welfare benefits, but these operations also provide employment in rural areas, distribute the farmer's financial risk, and support the local economy. The system is sustainable, as crops can be used to feed pigs and pig manure can be utilized to fertilize cropland in a small enough quantity that the land can absorb it.[55] Outdoor pig production is becoming more popular in the United States, especially in geographical areas that are not traditionally areas of highly concentrated swine production, such as Oklahoma and Colorado.[56]

Gestating sows on pasture
Photo credit: Diane and Marlene Halverson

Pasture-based pig production is a low-input enterprise. Investigations show that these systems have lower initial, fixed, and annual capital improvements costs. When pigs are kept on pasture, there are no manure hauling requirements and studies in Iowa have reported excellent herd health. There are also lower energy costs, and fewer odor problems. However, pastured pigs have slightly lower weight gain and feed efficiency, and slightly higher feed costs. Pigs consume more during the winter months when energy is needed to maintain body heat. There is also a cost associated with the provision of bedding,[57,58] and there may be fewer pigs weaned per litter and per sow per year.[59] Producers can purchase "seed stock" from other outdoor producers in order to start with sows well-suited for pasture-based production.[60]

Total production costs for a "finished" pig in an outdoor system include feed, labor, utilities, health, repairs, and other fixed costs. A survey of "farrow-to-finish" outdoor operations in Iowa found that fixed costs were $3.33 less per weaned pig and the total production costs of a 250 lb. pig were $4.88 less than pigs housed in conventional indoor production operations, despite the fact that there were fewer pigs weaned per litter, fewer overall pigs per year, and lower feed efficiency.[61] A 2006 study of a variety of pig production systems in the U.K. found that the production costs per weaned pig were lowest for pasture systems (£22.39) and were substantially higher (£23.19 to 23.34) for indoor, crate-based systems.[62] Pasture-based systems have a high rate of return compared to the capital invested.[63]

The disadvantages of pasture-based systems are the greater potential for internal parasites and less environmental control to moderate temperature extremes. [64] Therefore it is vital producers use effective parasite control and that they take steps to protect their animals from the elements in order to ensure the welfare of their pigs. However, pastured pigs often have lower health expenses as compared to confinement systems, because the close proximity of pigs in crowded indoor facilities can increase the rate of disease transmission.[65]

Pasture-based systems are flexible and involve less financial risk,[66,67] which is a substantial economic benefit. They can be expanded or downsized in response to market conditions,[68] and the pay back period may be just three to five years.[69] The opportunity for low cost expansion makes pasture-based systems attractive to risk-aversive entrepreneurs.[70] Coupled with the animal welfare and environmental advantages, pasture-based systems have the potential to become more widespread in countries where discerning consumers are concerned about food production methods.

Retail prices for consumers

For consumers, the price increase associated with switching from gestation crates to group housing is small. Seibert and Norwood estimate that the cost of producing finished pork in a conventional system using gestation crates is $0.45 per pound. Assuming corn prices of $3.00 bushel, the cost of producing finished meat in an intensive system using group housing instead of gestation crates is $0.48–$0.49 per pound. In systems that provide more generous space allowances and bedding, costs would be $0.53–$0.65 per pound of finished meat. In pasture-based outdoor systems, costs would be $0.50–$0.55.[71] Since many of the other studies reviewed above find that costs may actually be lower in some alternative systems, these price changes represent a conservative estimate.

Retail prices do not accurately reflect production costs, because they also include the costs associated with bringing the animals to slaughter, packaging, distributing, marketing and the final retail mark-up. In the United States, only about 19 cents out of every dollar spent on food goes to the farmer while the other 81 cents is used for transforming the raw food inputs into salable products for grocery store shelves and other retail outlets.[72] The total cost of production breaks down as follows:

> 15% production
> 10% slaughtering
> 25% processing and packaging
> 20% distribution
> 30% retailing[73]

The monetary value that consumers are willing to pay for welfare improvements as expressed in surveys and experiments—even when involving real money and real pork purchases—are typically higher than grocery store prices for pork produced in alternative systems.[74] One 2011 study found that a complete ban on gestation crates in the United States would increase retail pork prices by 2-5%, depending on the alternative that replaces the conventional system.[75] This study found that the cost of banning gestation crates is lower than other estimates of consumers' willingness-to-pay. As explained by Seibert and Norwood:

> Suppose that all pork was initially produced under the confinement-stall system and then converted to the confinement-pen system. The cost of this transition would be modest—increasing costs at the farm level by 9% and the retail level by 2%—if all costs were passed on to the consumer. In absolute terms, this implies the retail price of pork would increase by a maximum of $0.065 per retail pound. Will consumers pay this price? Fortunately, studies have been conducted to answer this question. Consumer surveys have shown that the average American is willing to pay $0.34 per pound more for pork produced in a confinement-pen system than a confinement-crate system .... Thus, banning gestation crates creates an average value of $0.34 per pound but only costs an extra $0.065 per pound.[76]

Small- and medium-sized independent swine farms are finding that there is an expanding niche market for meat from pigs raised in an alternative system.[77] The price of some pork produced in pasture-based systems is often 200–300% higher than pork from conventional gestation crate systems sold at major food retailers. Seibert and Norwood point out that this premium is much higher than the increase in production costs of pasture-based systems.[78] Yet there is a sub-set of consumers who are willing to pay for meat that is produced in these more environmentally and socially sustainable systems.

Conclusions

Asking that pigs have the simple freedom of turning around is a modest request, yet compliance would make a substantial improvement in the lives of many animals. The costs of making a gradual transition are not trivial to producers, but can be reasonable with careful consideration and planning. Many alternatives are available, and the decision to engage in animal welfare reforms is very likely to be perceived favorably by consumers. The resulting costs at the retail level will be minimal. A subset of consumers will continue to pay a premium for meat produced in alternative systems that lead to even greater animal welfare improvements. Recognizing consumer concern and willingness to pay for improved welfare, some companies such as Smithfield and Maple Leaf have pledged to phase out the use of gestation crates in the United States and Canada,[79,80,81,82] and niche pork markets are continuing to expand.[83] Gestation crates are clearly no longer socially viable and given the current climate of animal welfare reform, further investment in new gestation crate systems is inadvisable.

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