Swedish Deep-Straw Farrowing

Background

The Swedish deep-straw farrowing system was developed in Sweden as a response to stricter animal welfare and environmental protection laws and a ban on sub-therapeutic antibiotics. This system is getting attention in the Upper Midwest because of its low-odor and cost-saving features.

◆ Swedish type farrowing boxes. Group housing improves the well-being of the animals.

The Swedish deep-straw farrowing system is based on the animals' natural behavior and involves carefully planned production, maintenance of sows in stable groups, longer nursing periods, and deep-straw beds for the sows during nursing and weaning (Halverson et al., 1997). Successive groups of sows move through the system in a continuous process.

The system requires only simple buildings with added temporary pens for individual sows during farrowing and rooms for group gestation and lactation. While the simplicity reduces costs, the system also requires close observation and pro-active management (to tweak the system when necessary). To succeed with this system, a farmer must have a thorough understanding of hog behavior and husbandry (Honeyman and Kent, 1996).

In the Upper Midwest, this system relies on an environment that mimics the sow's natural environment. Large amounts of straw bedding (two tons per sow per year) keep animals comfortable and reduce stress by giving the pigs something to do, while at the same time absorbing most odors.

Housing

A variety of buildings can be used in the Swedish deep-straw system, including old hog houses, barns or even hoop structures. Older buildings should be well insulated and must be well ventilated and well lit, using both natural and artificial light, to help ensure that pigs respond to the light cycles of day and night.

Deep-bedded housing can be used for housing groups of gestating sows. The sows are fed daily in individual, lockable feeding stalls. Various types of buildings can be used for gestation housing, including hoop structures (Brumm et al., 1999). The sows do not go outside but live on the bedding pack where they spend time rooting and foraging.

The buildings include a group nursing room in which temporary farrowing boxes measuring 6 feet by 8 feet are installed (Halverson et al., 1997). Sows build straw nests and farrow in these boxes. Group housing stimulates estrus and allows social hierarchy to develop (Honeyman and Kent, 1996). This is consistent with hogs' natural herd instincts and improves the animals' comfort and well being. Piglets are kept in the farrowing boxes for their first seven to ten days, allowing them to bond with their mother. Then the farrowing boxes are removed and the sows and litters are allowed to mingle (Halverson et al., 1997). During this period, they have free access to a common area that includes feed and water on a raised platform. After weaning, the sows are taken to a breeding barn or room while the pigs stay in the nursing room. After 11 to 12 weeks, the pigs are moved to the farm's finishing unit or sold to a finisher (Halverson et al., 1997).

For a nursing room with eight to ten sows, a farmer spreads two 750-pound round bales of straw before animals enter the area. The farmer adds another 750-pound bale of straw to the room every week and places fresh straw over wet spots daily. Peat is sometimes used beneath the straw to absorb moisture. Farmers must monitor the straw bed closely. Fresh straw is added on a regular basis to absorb moisture and limit odor. In addition to keeping the animals comfortable, this also maintains a favorable carbon-to-nitrogen ratio, which prevents the emission of ammonia (Halverson et al., 1997).

Composting straw can be beneficial in that it keeps sows warm during the winter, it can limit disease by killing pathogens, and the fresh straw helps to keep the animals clean. However, the heat generated by the composting bedding can be a disadvantage during a hot summer. Many producers install sprinkler systems to wet down both the bedding and the hogs. The bedding is allowed to become more saturated to minimize composting activity and hence reduce the heat generated (Larson et al., 2000).

The minimum amount of space needed for this system is about 27 square feet per sow during gestation and mating phases and 81 square feet per sow and litter during nursing (Halverson et al., 1997). Although this amount of space per sow may seem high, it allows sufficient space for dunging and wastewater absorption, which is essential for good animal health and productivity.

In winter, most of the heat is generated by the sows and the composting straw and manure bedding. In summer, large windows and end doors give natural ventilation. Ventilation systems are designed to exchange large volumes of air at low speeds to allow for the efficient release of the heat, air moisture and carbon dioxide generated by the straw beds (Halverson et al., 1997). A well-insulated building, small group size and a quiet ventilation system allow for clear vocal communication between a sow and her piglets. This communication reduces pig deaths caused by crushing when the sow lies on the litter, and allows piglets to hear and respond to the sow's vocal cues about feeding. Fans are located close to the roof to keep noise on the ground level below 45 decibels (Halverson et al., 1997).

Feed

Feed and water are provided on a concrete platform that is raised 12 to 18 inches above the ground to keep straw or other bedding off the feeding area (Halverson et al., 1997). Many American farmers using Swedish deep-bed systems use standard feed without antibiotics. Sows eat some straw bedding, perhaps as a source of roughage.

Farrowing

Throughout the farrowing process, sows are maintained in groups of 8 to 12, and sows within a group are bred to farrow within five days of one another to minimize size differences among their piglets. Generally, there are two different methods of farrowing used in Swedish deep-bedded systems. One version allows the sows to farrow in boxes and still interact as a group. The farrowing boxes are removed 7 to 10 days after farrowing, allowing the pigs and sows to co-mingle. In the second version, the sows farrow in individual pens, and at 14 to 21 days the pigs and sows are moved to a group nursery setting.

◆ A raised feeding platform and creep area keeps straw and other bedding off the feeding area.

Animal Health

Because antibiotics are generally not used except as needed on a case-by-

case basis, greater attention to hygiene is needed to keep the production area clean and to minimize the pigs' stress. Producers must be good observers and have a strong working knowledge of pig biology and behavior in order to successfully replace antibiotics as a disease-preventing measure.

The composting component of this system is key to good animal health. The manure and urine from pigs is mixed with 1.7 to 2.2 tons of straw per sow per year (Halverson et al., 1997). The straw is kept clean and dry to avoid sow ingestion of molds and other toxins that can lower immunity levels and lead to stillbirths and abortions. Wet spots are covered with fresh straw daily to minimize ammonia volatilization and keep the beds composting. The straw beds compost year round, stabilizing the nutrients and reducing total volume.

A ventilation system that doesn't rely on fans in the summer makes the buildings less susceptible to power failures that may lead to pig mortality (a potential problem for conventional confinement farmers during hot summers).

Performance

In Sweden, sow longevity is between six and seven farrowings compared with about three farrowings for hogs raised in confinement in the United States (Halverson et al., 1997). Increased sow longevity means fewer replacement sows and reduced costs. The larger litters that older sows successfully farrow and wean also improve the bottom line. However, when farrowing in the cubicles, pre-wean mortality can be high. Iowa reported 27 percent pre-wean mortality in a 30-month demonstration (Honeyman and Kent, 2000).

Scale

Based on the Swedish experience, optimum herd size for this system would be 120 to 150 sows for a family-sized operation that relies on hired labor at busy times of the year (Halverson et al., 1997).

Labor

The greatest amount of labor is required during mating, farrowing, piglet processing and bedding management. Breeding takes labor time since sows are both hand-mated and artificially inseminated. During farrowing, some sows must be guided to farrowing boxes. Piglet processing chores include castration, teeth clipping and standard shots of iron.

In this system, more time and effort is spent observing hogs and practicing good animal husbandry skills than is spent repairing equipment, cleaning and medicating animals.

In Sweden, deep-straw bed farrowing operations require an average of 18 hours of labor per sow per year (Halverson et al., 1997). A new producer can expect to put in more hours as both producer and hogs learn how to operate in this new system.

Environmental and Social Considerations

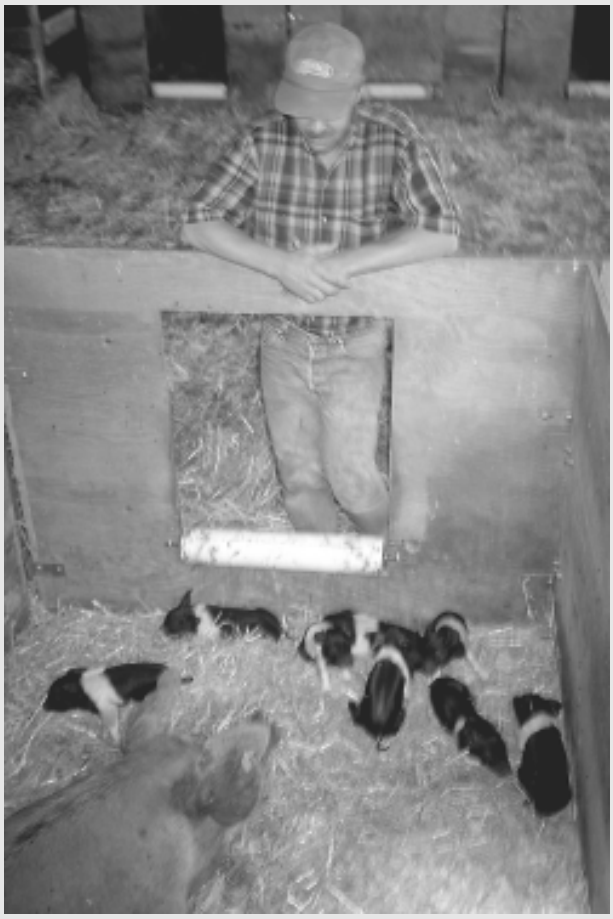
The manure and urine from pigs in this system is mixed with large amounts of carbonaceous material at a minimum carbon-to-nitrogen ratio of 30:1 and a moisture level of 40 to 60 percent. The bedding composts year round, stabilizing nutrients and reducing the total volume of wastes. Because the manure is in a stabilized, solid form, the danger of run-off and other sources of water pollution is reduced. Odor is minimized, if not totally eliminated.

Financial Risk

A retrofitted existing building or a new building can be used in this type of farrowing system. The structure's high ceiling and insulation lends the building to multiple uses, including machinery repair and storage. This flexibility lets the farmer limit financial risk by putting these assets to more profitable uses when hog market prices are low.

Nolan Jungclaus
Lake Lillian, Minnesota

To Nolan Jungclaus, the Swedish deep-straw system seemed like a flexible, low-cost way to explore hog production. He and his wife, Susan, wanted to add income to their 800-acre cash crop operation by diversifying into livestock production. Without prior animal husbandry experience, they started out in 1995 "literally raising [hogs] by the book" and settled on the Swedish system for year-round farrowing because of its relatively cheap start-up costs. "Our banker asked a lot of questions since the Swedish system is so low-input, but he liked the fact that there wasn't a lot of [capital] risk," says Nolan. "This is cheaper than a confinement system." Nolan also liked the relatively low annual payments. "We figured at $2,400 per year we could afford to try it out and still repay the loan if we didn't like raising hogs."



◆ Nolan Jungclaus watches a sow and her litter. Deep-straw farrowing requires keen observation and good husbandry skills. Nolan and Susan check the boxes every day.

Housing

Nolan and Susan started out small, buying 15 sows (which eventually increased to 29) and remodeling an existing pole shed for farrowing. Together, they retrofitted the shed with large windows and an insulated folding door wide enough to remove manure/bedding packs with a skid-steer loader. The walls are insulated with a six-inch layer of fiberglass while a small propane heater supplements heat generated by the sows and the composting straw beds during winter farrowing.

In the remodeled shed, Nolan constructed 5- by 7-foot boxes from treated three-quarter-inch plywood for farrowing and lined each box with a standard square bale of straw. "We line the boxes very heavily with straw to encourage [sows] to lie down in there," Nolan explains. "The sows just need enough straw to make a nest." One week before farrowing, a group of 10 to 12 gestating sows is brought into the barn and allowed to choose their own farrowing boxes. Nolan and Susan check the boxes every day, adding straw when necessary to keep the sows and litter clean during and after farrowing. Ten days after farrowing, Nolan removes the boxes, and sows and their litters mingle. Pigs are weaned at five weeks, and at two months are moved on for finishing to a standard confinement barn that Nolan rents from his brother-in-law.

Animal Health, Performance and Feed

Nolan's pigs are healthy and have performed well in the Swedish deep-straw farrowing system. He credits their low-stress environment, a combination of open pens (allowing for more communication among sows and piglets) and plenty of straw. "One of the critical things about this

system is that your groups must be [bred to farrow] tight," Nolan says. "If the group is not tight, you will have starve-outs [greater mortality among the younger litters]."

In this low-stress environment, Nolan has farrowed sows up to six times (many of which he still considers "good producers") and has weaned about 8.0 pigs on average per sow-litter during his first three years in hog production.

Feed rate conversion has been good. The Jungclauses buy a standard ration mix of feed that does not contain antibiotics or laxatives from a local elevator. "The sows eat straw which acts as fiber," Nolan explains. "That way they don't need the laxatives [to prevent constipation when they're lactating]." Composting straw beds and manure keep the pigs warm during the winter and limit disease by killing pathogens and keeping hogs clean, thus far eliminating the need for antibiotics. "Right now our hogs appear disease free," Nolan says. "We haven't had any mastitis or other problems."

◆ Greater attention to hygiene is needed if antibiotics are not used. Nolan's pigs are healthy and have performed well.

Labor

The Swedish system also provides a low-stress environment for its operators. So far, Nolan says, "The management as far as physical labor is not too intense." It takes him approximately two hours to clean out the barn every three months after each farrowing group. Otherwise, he says, most of the family's labor consists of "general husbandry work." As new hog producers, Nolan and Susan spend about one hour each day checking their animals, spreading clean straw and monitoring the beds to make sure they're not too warm (to avoid over-composting and excessive ammonia emissions).

Manure handling and animal husbandry work loads are compatible with the Jungclauses' cropping operation demands, although Nolan expects that as they expand the hog operation in the future, work loads may compete during spring planting and fall harvesting periods. Nolan and Susan plan to expand their operation (currently at 29 sows). "The optimum size for our farm would be about 96 sows," explains Nolan. "That's as many as I think we could handle with the labor of my immediate family." Nolan is considering switching to smaller farrowing groups within a larger overall operation to reduce the spring and fall labor demands.

Finances

The Jungclauses invested a total of $24,000 to establish their 30-sow capacity hog operation. Upon applying for the loan, Nolan and Susan calculated that they could make a $2,400 per year loan repayment from crop sales should they decide to liquidate their herd temporarily (during slumped hog markets) or permanently (in pursuit of other goals).

After three years, Nolan and Susan not only remained in hog production, but expanded sooner than planned. Just two months after setting up their operation with 15 sows, Nolan and Susan acquired an additional 14 bred sows. They paid off $10,000 in debt during their first year,

maintaining a positive cash flow and profit during the following two years of hog production. Beginning in 1998, however, as hog prices fell, Nolan and Susan began "cleaning out"—selling down some of their herd and taking advantage of the Swedish system's low fixed cost flexibility. "That's part of what I like about the Swedish system," Nolan explains. "We don't have to produce hogs when the market drops just to recover some of our fixed costs."

Environment and Community

Because of the small size of Nolan's hog operation, he and Susan were not required to apply with a public committee for their operating permit. However, living only one mile from the local town center, he and Susan were concerned about diversifying into hogs. "The prevailing winds could carry our smell right into town," Nolan explains. So far, however, Nolan says neighbors have been "very supportive" of his operation. "The neighbors and the town haven't smelled my pigs," he says. "This (Swedish system) is a good option to diversify your farm when you live in close proximity to a town."

Conclusion

Using the Swedish deep-straw farrowing system, Nolan and Susan have successfully diversified their farm income at relatively low financial risk while getting started in animal husbandry. Satisfied with their success thus far and with the financial flexibility of the low-input hog farrowing system, Nolan and Susan are preparing to construct hoop houses in the fall of 1998 to finish hogs on their own farm.

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Nolan did build a hoop structure in the fall of 1998, which is now used to finish hogs on their own farm. His hogs have continued to be healthy using the Swedish deep-straw method, and he has had no disease outbreaks. However, as hog prices continued to decline in late 1998 and early 1999, they did choose to shut down their hog operation temporarily. "I always said that when hogs went under $40, I would sell all the sows, and shut down for a while." He kept back a small group of eight gilts, to breed when prices recovered. For Nolan, having low capital investment enabled him to last through the price downturn, and he is now back to 30 breeding sows.

Nolan says that if he were to expand, he would go up to eight groups of eight sows or so, breeding every three weeks, instead of every two to three months. Shorter intervals would increase efficiency, since sows that didn't conceive would only need to be carried three weeks, then could be included in the next group. He would also use a pen farrowing system, both to decrease piglet mortality due to being laid on, as well as to make it easier to introduce new gilts into the group. Adding the gilts after moving the sows from their pens to a group nursery would decrease fighting.

Nolan finds himself spending more time on marketing these days. He is on the Board of Directors for a new small farm cooperative, and is writing a grant to help develop markets for the cooperative. Since most of the farmers in the cooperative are antibiotic-free, they hope to be able to move into producing for that market niche.

All in all, Nolan is pleased with his choice of the Swedish deep-straw system. He enjoys working with the hogs in this environment, and appreciates the flexibility of not having a lot of money tied up in buildings.

Dwight Ault
Austin, Minnesota

◆ Dwight Ault near sow in pasture hut.

Dwight Ault faced an important management decision in 1994—one that would affect his labor requirements, financial debt load and quality of life. He needed to either replace 26-year-old rusting crates, mats, and gates used in his winter farrowing confinement system or consider switching to a summer-only farrowing program in his existing pasture. What he came up with addresses both options.

"Replacing the existing equipment was [financially] not an option," Dwight says, estimating new equipment costs at $10,000. "And I really didn't want to give up winter farrowing." As an alternative, Dwight decided to experiment with his own version of a Swedish deep-straw system to winter-farrow 60 sows (a technique he learned about first-hand after a trip to Sweden in 1994). Dwight correctly estimated that it would cost approximately $3,000 to remodel and insulate an existing 40- by 60-foot barn for deep-straw farrowing, less than one-third the cost of replacing the worn-out confinement equipment.

Several characteristics of the Swedish deep-straw system appealed to Dwight, including the low conversion costs to remodel his barn and the system's compatibility with his existing pasture farrowing and overall hog management program. "I didn't have to change my breeding and gestating program, only the method of winter farrowing," Dwight explains. He also liked the idea of healthier, more enjoyable working conditions. "I was sick and tired of the ammonia and heavy smell [in our old, poorly ventilated, confinement farrowing system]," he says. "I figured that the enjoyment of raising hogs would be enhanced, and it certainly has been."

Finally, Dwight viewed the switch to Swedish deep-straw farrowing as part of an operational transition into "natural" pork production that could create financial flexibility through marketing opportunities.

Housing

During the fall of 1996, between grain harvesting, Dwight worked with his son, Grant, and a hired helper to clean and remodel a typical hip-roof 40- by 60-foot dairy barn for a 30-sow capacity. They removed crates, mats, gates and worn-out riser pads and then covered windows and the lower half of the barn with a foam insulation, sealing the windows and other seams with expandable polyurethane. This was covered with tin, to keep the hogs from chewing on the insulation. Dwight originally used

◆ Dairy barn retrofitted for Swedish-style farrowing.

presswood (oriented strandboard) to create 23 farrowing pens (8 feet by 4 feet). However, those tended to rot at the bottom from exposure to the manure bedding, and only lasted a few years. He has since used three-quarter-inch treated plywood to build new pens.

Dwight was able to use some of the old risers and mats from his confinement system in place of a poured concrete slab (as is common with this system) to build a common feeding area for sows and piglets in the retrofitted barn. He also retained self-feeders, metal troughs and the existing chimney and the old 1914 duct ventilation system. The ventilation system is therefore not as quiet as is required by true Swedish deep-bedded systems, which is one reason Dwight calls his a variation of the Swedish system. Dwight does not use supplemental heating, saving him approximately $500 per winter in fuel cost alone, and eliminating a potential fire hazard. The barn stays at about 51° F throughout the winter.

◆ Sow with pigs inside retrofitted dairy barn.

Farrowing

Dwight breeds a total of 60 sows for indoor farrowing; one group of 30 at the end of February, and a second group of 30 at the end of March. Sows within a group are bred to farrow within three days to two weeks of one another. Farrowing sows are restricted to their straw-bedded pens until piglets are two weeks old; then they are given access to a common feeding area. Dwight removes the plywood pens within 14 to 18 days after farrowing. Piglets remain in a common nursery with the sows for about six weeks before weaning. Weaned pigs are separated from sows and moved to a deep bedded conventional pole building or a 1974-built slat confinement building for finishing. Gestating sows are held back inside the remodeled barn until farrowing when they are moved out to pasture in June.

Dwight's decision to convert to the Swedish deep-straw system for winter farrowing doesn't affect his summer (June and August) pasture farrowing program. As he's done for nearly 40 years, before farrowing Dwight shifts a group of 30 breeding females to temporary paddocks that range in size from four acres to eight acres. Gestating and lactating sows are divided into separate paddocks by an electric fence. Dwight beds Port-a-Huts™ with about one-fourth to one-third of a bale of straw at the beginning of the pasture season, but eventually adds up to three-fourths of a bale. "It is critical that you plan on using three-fourths of a bale of straw [per sow] in an average season," he advises. "You don't want to be stingy on straw."

◆ A sow grazes on pasture while nursing her litter on the Ault farm near Austin, Minnesota.

Animal Health and Performance

Dwight hasn't noticed a significant change in sows' performance when moved from pasture to indoors for winter farrowing with either the conventional confinement or Swedish deep-straw systems. On average, sows farrow twice per year and wean eight piglets per litter, but litter sizes vary a little more on pasture than with the indoor farrowing. During his second season using the Swedish deep-straw farrowing methods in 1997-98, Dwight had "never had better performance" from pigs farrowed indoors.

Dwight does not use sub-therapeutic antibiotics or hormones or clip tails under either the Swedish deep-straw or pasture farrowing systems. Based on his experience, Dwight says that the hogs are generally more healthy when on pasture than when housed indoors. "You have the time and sun elements to break [disease] cycles," Dwight explains, noting that his sows have had mastitis only once in his 37 years of pasture farrowing.

Labor

As a hog producer for nearly 40 years, Dwight has well-developed animal husbandry skills and, therefore, has enjoyed his switch to a slightly more labor-intensive winter farrowing program. "It's wonderfully productive, it gives me more time with the hogs and a chance to observe," he says. During the winter when sows are farrowed indoors using the deep-straw system, Dwight spends approximately one hour per day spreading fresh straw in the mornings and filling feeders each evening. By comparison, labor requirements averaged approximately 45 minutes per day when Dwight farrowed in confinement using crates and risers.

In addition to shifts in daily work loads, Dwight says his monthly manure handling schedule and methods have altered under the Swedish deep-straw system. The volume of manure handling has increased with the use of straw bedding. However, the timing and amount of manure cleanup has shifted from a monthly scrape-and-haul routine to an end-of-season task that uses a small skid-steer loader. In time, Dwight expects that the solid manure handling will require no more time than monthly liquid removal. Currently, manure handling under the deep-straw system is a little more labor-intensive. "I think we just need a little more practice with the manure pack handling," Dwight explains. "We've been handling liquid manure for 25 years." After removal, Dwight stockpiles the manure pack for composting and eventually spreads it as fertilizer on his crop fields.

On pasture, labor and feed requirements are less demanding compared to both the Swedish deep-straw and standard confinement indoor farrowing systems. Dwight's labor time is cut by 30 to 50 percent when he moves the sows and gilts outdoors. "On pasture, you don't have to spend time spreading straw as often or checking on sows," he explains. On average, Dwight devotes 30 minutes daily to general husbandry work with 60 sows on pasture.

Based on his own experience, Dwight feels an individual could reasonably manage 30

◆ Sows are fed a ration in addition to forage.

or fewer farrowing sows during the first year. “I think [the Swedish and pasture systems] are wonderfully adaptive,” he says. Depending upon the desires of the individuals, he thinks a farm family could gradually expand from 30 sows to 200 sows using the Swedish deep-straw and outdoor pasture farrowing systems, yet still maintain reasonable workloads and profitability. “I would say that 200 sows would be the upper limit,” Dwight advises.

Feed

Indoors, beginning in October, sows are fed a standard ration of four pounds of mixed corn and soybean meal each per day. The feed is purchased because Dwight's fields are planted to organic grains for which he receives a price premium. Winter feed also is supplemented with ground alfalfa, a forage that the sows are used to during the spring, summer and fall on pasture. Once gestating sows are on pasture in the spring, Dwight reduces their feed from approximately four pounds per head to two pounds per head each day, “if they are on good alfalfa.”

In the future, Dwight may consider using organic feed grains from his fields in order to gain access to new niche markets.

Finances

Based on two years' experience, Dwight says the indoor Swedish deep-straw system is profitable and “fully cost-effective” when compared with his crate confinement history. “The deep-straw system is just as efficient as crates in terms of feed efficiency and rates of gain,” Dwight says. “My son and I are very optimistic financially.”

Healthy animals combined with lower fixed costs outweigh the added labor time necessary to check animals and spread straw each day. Likewise, Dwight's 37 years of pasture farrowing experience have taught him that reduced feed costs associated with pasture farrowing can lead to a higher net profit. Dwight estimates, for example, that he saves close to $1,100 each year in feed by moving his pigs out on pasture, a little more than he would earn from planting the temporary pastures with grain crops.

Moreover, the Swedish deep-straw system has created more production flexibility, and hence financial flexibility, by opening up new and alternative markets. In 1998, Dwight took advantage of premiums in the “natural” food industry under a new pork label, “Niman Ranch Pork Company.” Under the Niman label, hogs must be on straw-beds and/or pasture from “birth to market” without the use of antibiotics. Niman Ranch markets to up-scale restaurants and grocery stores on the East and West Coast. Dwight eventually hopes to “take more profit with fewer numbers” by marketing to health-conscious consumers. Moreover, Dwight can adapt the deep-straw barn for other purposes during financially tight hog markets, further increasing his financial flexibility.

Environment

Finances were not the only factor motivating Dwight's switch to a Swedish deep-straw system. “That was just one of the things,” Dwight recalls. One of the other reasons for his switch was “the smell.” Daily working conditions were not healthy in the old confinement system, Dwight says, because of the ammonia generated by the liquid manure. “The old barn smelled and was not pleasant to go into.” Dwight says. “Now, there is no [liquid] manure and straw-bedding absorbs the smell. The Swedish system is so decent and so much better. We would never go back to the old [crate confinement] system.”

Words of Advice

The Swedish deep-straw system, thus far, has been a good fit with Dwight's breeding and gestation schedule, outdoor pasture farrowing program, husbandry experience and lifestyle goals. At low cost, he has been able to continue indoor winter farrowing and retain a two-litter operation, while transitioning into what he hopes will be a financially profitable "natural" food market. "It's a symbiotic relationship. When my pigs are in trouble, then I am in trouble," Dwight points out. "I think that I understand hogs well enough that I can make [the Swedish deep-straw system] work—and I think that it is a much more enjoyable way to spend the winter."

Dwight's optimism stretches beyond his own operation. "I think that there are a lot of barns in this country that would make excellent deep-bed systems with only a few minor modifications," he says. He advises beginning hog producers or producers interested in experimenting with this system, to start with a small farrowing group of 10 to 15 sows. "Experiment at first," Dwight advises. "Visit some other farms that are using deep-straw systems and then figure out what works for you."

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Dwight continues to farrow two times on summer pasture and two times in the barn, producing 700 to 1,000 pigs per year with 60 sows. In the fall of 1998 they constructed a 30- by 80-foot hoop structure. This has enabled them to now finish all pigs on deep-bedded straw, up to market weight (270 pounds). They have further plans to convert an old pole barn and an old slatted-floor confinement building into buildings to accomodate deep-bedded straw.

Dwight now markets almost all of his pigs through Niman Ranch, a company that requires that the pigs be raised on deep-bedded straw, be antibiotic free, not clipped, and be castrated with 10 days of birth. He figures that the premium he gets amounts to an extra $4.00 per hundredweight.

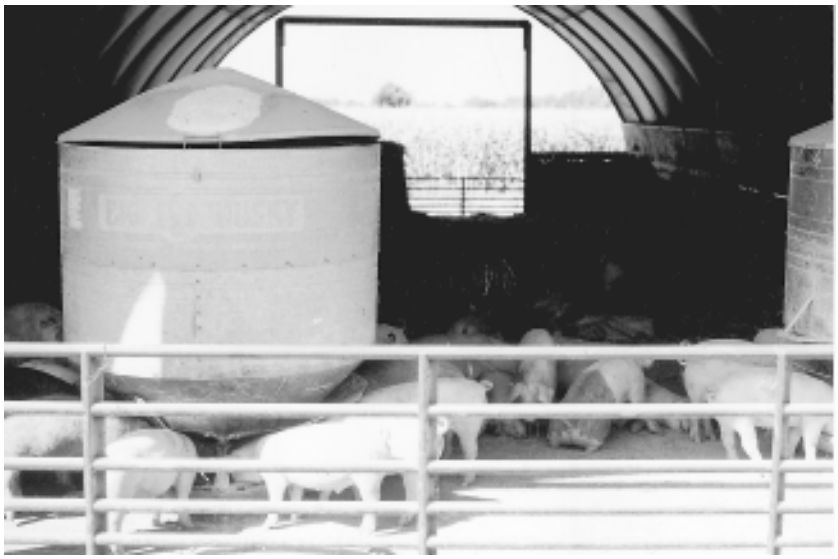
Dwight feels that, overall, the health of his herd has been excellent. He feels that the sows are much "stronger" coming out of farrowing in the deep bedded system than they were coming out of farrowing in total confinement. Dwight feels there is "something therapeutic about the straw." He notices that he has far fewer abscesses and cases of mastitis than he used to have in his old system. A recent carcass inspection in Sioux Center by a vet showed "one of the cleanest groups of pigs he'd ever seen." There were some liver scars from roundworm—Dwight says that he's done little worming for the past thirty years. He has had a few viral outbreaks. His herd contracted a virus in 1998 that resulted in a poor conception rate for one cycle, and had a PRRS (porcine reproductive and respiratory syndrome) outbreak in 1999. They vaccinated and now are back to good production.

Dwight is downright evangelistic about the deep-bedded straw system. Clearly, he has found a system that works well for him. He thoroughly enjoys what he does. He confesses to not be "big on record-keeping," but figures as long as he's not losing money and is able to make a living, he'll continue to raise hogs with this system.

Deep-Straw Hoop Structure System

Background

Producers in Canada and the United States who want a low-cost, low-maintenance alternative to confinement structures are building hoop structures for their hog finishing and, in some cases, farrowing operations. Hoop structures are arched or curved pipes covered with a polyethylene fabric tarp. The ends of the buildings are left open most of the year, but are closed during extreme winter weather. Three-quarters of the floor is covered with deep straw bedding. The remaining portion is a raised feeding and watering platform.



◆ A 30' x 72' hoop structure can accommodate more than 180 hogs.

Hoop structures generally cost less and require less maintenance than more traditional confinement structures. They are quick and easy to build and can be used for other things when hog prices are down. Because the manure generated in hoop structures is in a solid form, the potential for odor and water contamination are minimized.

Housing

Most hoop structures used in the Midwest are 30 feet by 72 feet and house 180 finishing pigs (Brumm et al., 1997).However , they can be adapted to be almost any size, and larger hoop structures, accomodating greater numbers of hogs, are found in other countries. They are built on a lime or gravel base, slightly above grade, and sloped away from the feeding and watering area. Treated wood posts are set into the ground four to six feet apart and the holes are filled with crushed lime. Weather-treated tongue-and-groove lumber is nailed to the posts to create four- to six-foot high walls. Galvanized tubular steel hoops are anchored to the tops of the wooden posts. A multi-layer polyethylene fabric cover is stretched over the hoops and secured to the wall with rope lashing or adjustable straps and buckles.

The structures are usually placed in a north-south orientation to improve airflow. Removable tarp or wood ends are in place during the winter months. Natural ventilation is provided through the continuous space where the walls and cover meet and through the open spaces at both ends.

Eight big round bales (approximately 1,200 pounds each) of straw or cornstalk bedding are put down and one or two 1,200-pound bales are added each week (Brumm et al., 1997). It is important to have enough bedding material and to cover wet spots. The deep straw bed provides enough heat to keep the material composting, which neutralizes pathogens, protects animal health and minimizes ammonia volatilization. The mix of straw, manure and urine composts throughout the

◆ Hoops are built on a lime or gravel base and sloped away from the feeding area.

year, providing heat and comfortable bedding for the pigs. Large amounts of bedding are needed with hoop structures. One Iowa study found that the amount of straw bedding required for a standard hoop structure varies from 18,600 pounds in the summer to 39,600 pounds in the winter (Brumm et al., 1997).Cycling continuous groups of 180 pigs through this system requires approximately 100 large bales of straw or corn stalks per year per hoop.

Building costs, including cement and waterers, range from $9,000 to $16,200, depending on the manufacturer and how much work is hired out. At $50 to $90 per pig space, this represents approximately one-quarter to one-half the cost per pig space of standard confinement facilities (Brumm et al., 1997).

◆ Hoop structure closed up during below-zero weather.

Feed

Pigs finished in hoop structures are generally fed a grain diet, *ad libitum*, similar to those finished in confinement. Antibiotics are used only as needed. Since the only heat is supplied by the composting manure, pigs usually require more feed in hoop structures than in confinement buildings during the coldest months of the year. The rest of the year the feed conversion rates (pound of feed per pound of weight gained) are about the same. An Iowa study found that feed conversion rates in hoop structures are 3.3 to 3.5, which is comparable to the rates for pigs in confinement (Brumm et al., 1997).

Farrowing

Most research focuses on using hoop structures for the finishing phase of hog operations. However, producers and researchers have recently begun looking at the use of hoop structures for gestating sows and farrowing. Preliminary results indicate that the reproductive performance (number of live pigs per litter and birth weight) of sows from hoop structures and confinement were comparable (Honeyman and Kent, 2000). However, cooling systems are especially important in hoop systems, since gestating sows in hoop structures may be more susceptible to heat stress (Honeyman and Kent, 2000). In addition, experts caution that managing bred sows in group housing requires good animal husbandry skills, to avoid fighting (Brumm et al., 2000).

Animal Health

The combination of the building and the bedding allow a producer to maintain healthy temperature levels in the hoop house. In the winter, the pigs' own heat, the composting bedding and the deep straw keep the building warm enough, even on days when the temperature drops far below zero. The pigs bury themselves in the straw where the composting bedding generates heat.In the summer , the open ends and other vents help cool the structure. Since the hoop houses do not need fans, the buildings are less susceptible to the summer power failures that can lead to pig mortality in conventional buildings.

Canadian researchers found that 94 percent of hogs raised in hoop houses exhibited normal lungs, compared with 70 percent of the hogs reared in confinement. On the other hand, some health problems could develop since it is not possible to totally disinfect the building, and parasites or roundworms could be trapped in the manure pack (Connor et al., 1994).

Performance

Average daily gain for hoop-housed pigs is as good as that of confinement pigs, and may be greater (Brumm et al., 1997). Research has shown that feed efficiency drops during the winter. Because of

increased feed intake, carcass back fat may be higher than in pigs finished in confinement facilities (Brumm et al., 1997). This may lower their market price. However, the low building and maintenance costs of hoop houses improve their profitability.

◆ Hoops can be used on any scale, from a single unit to large multi-unit facilities.

Scale

A typical hoop structure can accommodate approximately 180 hogs or more, and a farmer may have any number of these structures. Larger hoop structures are more common in other countries. The size of the operation is limited by labor, bedding and feed requirements, and the ability to handle the amount of manure generated by the system.

Labor

While labor is highly variable depending on farm size, experience of the manager, etc., some studies show that the hoop house system requires slightly more labor (0.1 hour per pig) than confinement systems (Duffy and Honeyman, 2000). With hoop structures, more time is spent checking pigs, moving and arranging large bales of bedding, and loading and hauling solid manure (Honeyman et al., 2000).More time is needed for observation and monitoring of conditions such as temperature and bedding level (Honeyman et al., 2000).

Environmental and Social Considerations

With the hoop structure system, manure and urine are mixed with large amounts of carbonaceous material and composted year-round. The composting process stabilizes the nutrients and reduces the volume of wastes. Because the manure is in a stabilized solid form, the danger of run-off and other environmental hazards can be reduced, although there may be some concern about nitrogen leaching from manure packs which are stored outdoors until they can be spread, especially during high rainfall periods (Richard et al., 1997). Odor is also minimized, if not totally eliminated. Ventilation from the buildings' open ends and vents provides cleaner air inside the structures (Brumm et al., 1997).

Financial Risk

Hoop structures give producers some insurance against periods of low hog prices, which reduces risk. The structures can be used to house other livestock, to store grain or machinery or for seasonal storage of recreational vehicles or boats.

Because building and fixed costs are lower than for confinement systems, financial risk can be lower (Gegner, 1997). In many cases, taxes and insurance rates for the hoop structures are lower than for other structures (Gegner, 1997).

Hoop structures do not have the problems with heavy snow loads that cause failures of standard farm buildings. Snow does not accumulate as much on the structure's curved roof, and heat from the pigs and composting bedding causes snow to slide off. Also, any ice formed on the roof can be cleared from the ground level.

Mark Moulton
Rush City, Minnesota

◆ The Moulton family in front of one of their hoop structures.

Like most farmers starting out 20 years ago, Mark Moulton borrowed money at high interest rates with expectations of growing markets and profitability. "When I started out in 1978, common wisdom was to borrow money," Mark recalls. "The inflation rate was actually higher than the interest rate. You could make money borrowing money." Over the years, however, as markets changed, Mark says he managed to make his loan payments on time, but "it was a real struggle" at 20 percent interest rates.

Mark's goal is to run a low-stress and debt-free operation by the year 2003 and to create more free time to spend with his family. "I've been in debt since I was 18 and I'm tired of it," he says. "I'm not going to borrow money for expensive confinement barns that [within a short time period] aren't worth 50 cents on the dollar. My goal is to be debt-free and to make money on the farm as a family."

Despite some skepticism, Mark decided to experiment with hoop structures in 1995 as a low-cost way to work toward his goals. He has since built two other hoop structures in which he finishes a total of 540 hogs. He has had several years to compare the hoop structure system with the standard confinement and Cargill™ open-front finishing systems already used in his operation.

Housing

Mark's initial skepticism about using the hoop structures came from concerns about temperature fluctuation—how would the structures perform during hot summers and cold winters? After three years of hoop structure finishing, Mark says his concerns have been alleviated. During the winter, Mark uses a four-piece tarp to close up the ends of the hoop structure. Although bedding freezes along the wall edges, composting manure and straw prevent the center from freezing and keeps hogs warm. Mark adds straw every two to three days during the winter. Bedding consists of whatever is available from Mark's fields—mostly corn stalks and canary grass, although he prefers wheat straw because it is more absorbent and is easier to break up when cleaning out the bedding pack. In

◆ Inside a properly bedded hoop structure at –25°F, the temperature is about +30°F at pig shoulder height.

summer, Mark adds less straw and opens the tarp ends to provide natural ventilation. He plans to add a sprinkler system to cool hogs during extreme heat.

Animal Health and Performance

Mark has found no difference in animal health between the confinement and hoop structure systems, although he says it's too soon to see significant differences. Mark farrows each sow several times and aims for 20 pigs per sow per year. He weans pigs at 21 to 24 days and moves hogs out of the confinement nursery to a hoop structure for winter and summer finishing when they weigh 60 to 70 pounds.

In each hoop structure, Mark finishes 180 hogs, although at first he was concerned that the group size would be too large for efficient feed conversion. During his first winter using the hoop structure, feed conversion was down compared to his hogs raised in confinement, though he says that the pigs weighed 110 pounds on average going into the hoop structure. In subsequent seasons, however, hogs finished in the hoop structures are showing rates of gain nearly equal to hogs finished out in the slatted floor barn and, Mark says, "a lot better than the Cargill™ floor, especially in the winter."

Inputs: Feed and Labor

Corn and other small grains grown in Mark's fields are used in a mixed ration for feed. "I don't usually have corn to sell," Mark says. "I make money on [corn] running it through the hogs." He also runs antibiotics through the feed for approximately 10 days when first moving hogs from indoor nurseries to the hoop structures for finishing. "I try to boost their resistance during stressful times," Mark explains.

Because the hoop structure system reduces exposure to weather, Mark finds it is less stressful for the hogs and operator than his Cargill™ open-front system. "We don't have to deal with wind, rain or snow [in the hoop structures]," he says. In contrast, snow drifts that accumulate in the Cargill™ system make it necessary to clean out the pens often to avoid ice packs. "If there's a storm, I've got to get the snow out of all of those pen—or else you're not going to have any fence left to keep your pigs separated," Mark explains.

Mark has found that the hoop structures make manure handling easier. "I load [hogs] up and then clean," he says, eliminating the need for weekly or monthly scrape and haul routines. Mark cleans out the manure pack once every three months following each finishing group, stacking the pack for compost using a skid-steer and gravel fork. "Pretty nice fertilizer is made from the many pigs that come in and out of here," Mark adds.

◆ A skid-steer is an essential piece of equipment for efficient manure removal in a hoop set-up.

Finances

The composted manure Mark spreads on his fields reduces

input costs and produces higher yields. Mark says his crop yields have increased 15 to 20 bushels per acre on average over the past three years using the composted manure in place of commercial fertilizers.

◆ Adjustable ratchet tensioners connected to a pipe allow growers to keep hoop cover tight.

In addition to increased crop revenue, the hoop structure system has given Mark more financial flexibility in hog production—moving him closer to his economic and personal goals. Each hoop structure cost approximately $10,000 to build and set up with feeders and other equipment. That is one-third of the cost of a similar-capacity finishing barn that Mark built in 1996. Mark estimates that his fixed costs for the hoop structure system total approximately $1,350 per year (including building depreciation and opportunity costs). "If I choose not to raise pigs it's going to cost me $1,350 a year," Mark explains. "I don't [need to] borrow money." In 1996, Mark held back his gilts until market prices recovered to $0.40 per pound from lows of $0.17–$0.18 per pound. "If I choose not to put pigs in here it's really not costing me an arm and a leg," he says. "I can remain flexible and wait for a better [price]."

Environment and Community

Environmentally "there's no comparison" between the hoop structure and confinement systems, Mark says. "[With hoop structures,] there's no runoff; there's no lagoons and no gases," he explains. "The smell doesn't compare. In the hoop structure you don't have that terrible hydrogen sulfide or ammonia smell." Outside the hoops, Mark says, the composting manure packs don't smell until they're broken up for spreading. "I think that the smell gets locked up in the pack," he says. Mark makes sure the odor is minimized during manure spreading by plowing in the manure quickly once it's been spread.

◆ In 1996 the Moultons hosted a picnic just 10 feet from their hoop structure and composting manure packs.

"My neighbors, who pasture cattle, were really concerned when I put up the hoops for finishing," he says. "They didn't want to see their quality of life eroded by the smell [of manure]." Over the past three years, however, Mark's neighbors and other community members have become accepting of the hoop structure system. He's had more than 100 farmers out to visit his farm and in 1996, Mark hosted a picnic for approximately 65 people just 10 feet from his hoop structure and composting manure packs. "You couldn't smell a thing," he says. "I felt like an asset to the community."

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Mark's wife, Nancy, began working off the farm in 1998, during the low hog prices. They continue to raise the same number of pigs, but Mark has changed his methods somewhat to concentrate labor requirements to periods when his family can help (weekends and evenings). Rather than having a steady stream of sows farrowing, he is farrowing in larger groups (30 to 50 at a time), six to seven weeks apart. He has eliminated early weaning at 10 days, and now removes sows from the crates at 25 days, leaving the pigs in the crate another week. They then go directly to the hoop structures for finishing. This eliminates the extra time required to care for very young pigs and clean weaning tubs.

He is working with the Natural Resources Conservation Service (NRCS) on a cost-share construction of a 30- by 100-foot cement slab with three-foot side walls that will be connected to the back ends of his three hoops with ramps. This will be used to store the manure/straw pack (up to six months worth) until he is ready to spread it, and will eliminate the possibility of leaching into the groundwater.

He now bales his own corn stalks, so that he doesn't have to purchase bedding. The bales are small enough that he can roll them out in the barns by hand (four feet by five feet).

He continues to finish pigs on both the Cargill™ floors and hoop structures. During the summer the weight gains and health are about the same, but during the colder weather the hoops are better. He has noticed some arthritis in some of the straw-bedded pigs, particularly during busy seasons (planting and harvesting) when he's short on time and perhaps not bedding them as much as he'd like. He has also had some parasite buildup, so he now worms the pigs before they go into the hoop structures and about a month later.

Mark is happy with his system. Having low debt payments enabled him to stay in business these past two years, when many small producers were forced out of business. He built his first hoop structure five years ago. He says that the only thing he would add to his system would be a few more hoops!

Roger Hubmer
Mankato, Minnesota

Following a series of expansions, Roger Hubmer was looking for a low-cost way to increase his finishing capacity. "For us, [hoop structures] have been our answer," Roger says. "We couldn't really afford to put extra money into a $70,000 or $100,000 barn." Roger first learned about hoop structures in 1994 at the World Pork Exposition. As the first producer in his area to use hoop structures, Roger spent two years asking questions, contacting dealers and researching literature to learn more about how hoop structures could be used for finishing.

When Roger showed up at his local zoning and planning meeting in 1996 to apply for a hoop structure building permit, he was surprised to find the planning committee had prepared a slide show illustrating his plans for hoop structures and composting. "Most of the group hadn't seen hoops before and just really liked the concept of this," Roger explains. "They showed layouts and overheads of my [hoop] barns."

Before putting up the hoop structures, Roger finished two-thirds of his hogs in Lester™ and standard finishing barns on the farmstead and hired out the rest of his finishing work to a neighboring producer five miles away. "I was spending a lot of time and money to finish out those hogs [five miles away]," Roger recalls. Roger now has five finishing locations, including the two Lester™ barns, a partial-slat finishing barn, and two hoop structures. "The [hoop structures] kind of freed us up so we didn't have to be so pushed with the other barns," he explains. "We just needed the addition of space to make our whole flow work."

Housing

Roger began construction of two hoop structures in the winter of 1996. He hired someone with a backhoe to clear a level area and to drill footing holes. It took Roger, a hired carpenter and several local college students the equivalent of 100 hours to construct two hoop structures. Roger engineered the hoops (measuring 37 feet by 70 feet as opposed to conventional 30 feet by 72 feet) to create a taller peak to accommodate machinery should he decide to use the hoops for storage in the future. "I like building stuff," Roger explains. "I like copying designs and building it myself rather than buying a lot of stuff."

The hoop structures are weathertight. "A little bit of snow comes mixed in with the air," Roger says. "But as far as blowing through the cracks, this building is pressurized and there is no way it could come in." Roger relies on composting straw and manure to keep his hogs warm throughout the winter. Despite the cold temperatures, Roger's hogs have performed very well.

Animal Performance and Health

Based on two years of hoop structure finishing experience, hogs raised in the hoop structures have out-performed those finished in Roger's Lester™ barns in terms of feed efficiency and growth. "This [hoop structure] was way ahead of the other barn as far as performance goes," Roger says. "The pigs coming out of [the hoop structures] averaged 26 pounds heavier than what I was used to at that same age, and on less feed, too." At 29 to 30 weeks, Roger markets his hoop-finished hogs at an average of 270 pounds and says their grade is similar to hogs finished in other buildings.

Although his hogs have performed well and are generally healthy, Roger has noticed that hogs from the hoop structures are more susceptible to worms than hogs from the Lester™ and partial-slat barns.

Inputs: Labor and Equipment

"Healthier hogs mean less labor," Roger says, remembering his first season with the hoop structure. "We spent a lot of time just observing and watching for changes in the hogs' behavior." Over the past two years, however, Roger's experience (combined with sorting and other innovations) reduced his labor to an amount comparable with time spent in his other buildings.

Based on the recommendations of animal scientist Dr. Temple Grandin (Colorado Springs), Roger developed a "squeeze gate" sorting system through which hogs are quickly funneled and sorted. Despite handling the hogs twice, Roger and two hired helpers are able to sort at a rate of one hog per 30 seconds. Roger also purchased equipment and experimented with management techniques to reduce his labor time. A skid-steer loader, fitted by Roger with a bale spear, is used to load and drop 50-inch straw bales in the hoop structures. From there, Roger rolls the bales into place by hand for bedding. On the advice of a northern Minnesota farmer, Roger leaves his end tarps open during the winter, as well as the summer, to freeze the manure and keep the straw bedding dry. This reduces the need for adding straw bedding in the winter. It takes Roger a couple of hours every four months to clean out the manure pack using his skid-steer loader. The manure pack is stacked for composting and then spread on his crops.

Environment and Community

Roger has noticed a change in the nutrient content of his composted manure compared with the liquid manure that comes from his lagoon. "The corn-stalk bedding has lower nitrogen levels and higher phosphorus," he says, adding that he now spreads the composted manure across his crops based on the phosphorus rating. According to a manure analysis of samples taken from Roger's farm, the composted manure exhibited 5 pounds of nitrogen, 23 pounds of phosphorus and 7 pounds of potassium per ton of manure, compared to almost 6 pounds of nitrogen, 1-1/2 pounds of phosphorus and 3 pounds of potassium per ton of liquid manure.

Roger has also noticed a change in the odor emitted from composted manure compared to the liquid manure stored in his lagoons. "It may sound funny, but the composted manure that comes out of the hoops is almost sweet smelling," he says. "I just signed up to participate in a manure odor monitoring project by National Pork Producers," Roger says. "I think it will help me in my operation. I'll have a chance to find out how the systems really compare."

Finances and Conclusion

In addition to environmental and performance gains, Roger says that hoop structure finishing has been a financial success, adding value to his operation while holding down construction costs and building liquid assets. Roger spent approximately $30,000 on new equipment in addition to "sweat equity" and hoop structure construction costs. The equipment—a bobcat, manure spreader and gooseneck trailer—make Roger's hoop structure system easier to operate, while creating liquid assets. "That's part of why I went with the hoop system," Roger says. "With the hoops you may need to buy extra equipment, but at least it's liquid. If you need to, you can sell it. It's different than putting equity into a permanent building."

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Two years later, Roger is still quite happy with this system. Having lower capital costs has been an advantage, and he feels that as they gain experience, there is not much extra labor involved.

They are now producing about 180 hogs a month. As they have become more comfortable with this system, Roger and Dawn have learned to adapt their practices to save labor. They add more straw at greater intervals and let the pigs do more of the work of spreading out the straw bale. They now leave some manure pack along the edges when cleaning out after one group. This keeps the new group from rooting out and getting out of the building. They have tried several different bedding types—corn stalks, wheat straw, soybean straw. They all work, but Roger prefers corn stalks because they are more durable and don't disintegrate and pack down as quickly. They are able to move their portable sorting gate and chute from one building to another, and that has reduced labor requirements.

Roger says that pigs in the hoops do well; they grow fast, and gain seems the same as in a conventional building. He has noticed that the pigs on dirt and straw seem more susceptible to worms, but they are wormed on the same schedule as the hogs in conventional buildings.

Dave Struthers
Collins, Iowa

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Some pork producers, both big and small, view alternative systems such as hoops, pasture, and Swedish deep-bedded as production systems for "the smaller producers." There are producers, however, who demonstrate that "alternative" systems are equally adaptable to larger hog production operations.

One such person is Dave Struthers, a partner in a family farm corporation near Ames, Iowa. Struthers, along with his dad and brother, own and operate a 900-sow, farrow-to-finish hog farm. They grow about 800 acres of crops, with high-oil corn accounting for 75 percent of the production. The rest is in soybeans, with about 15 acres in oats and hay. Their 60 ewes eat the oats and hay.

In 1996, when Dave's sister expressed interest in farming with the family, the Struthers first considered erecting two 1,100-head confinement units with pits or lagoons. The Struthers' lender expressed concern about the potential environmental impact and it became "too much of a hassle" to go the conventional route, Dave said. The family then began thinking about hoops as a low-cost method of expanding production. The neighbors' opinions and the farm's proximity to town were also considerations in the decision to build hoop barns.

Housing

The Struthers use a remodeled building as a 140-crate confinement farrowing facility. The sows are also in confinement during gestation. The pigs are finished in both hoop structures and confinement, with 9,000 to 10,000 hogs moving through the hoops annually. The remaining pigs are in slatted- or partially slatted-floor confinement buildings. Pigs enter the hoop structures at 45-60 pounds of weight.

The Struthers bought six hoop barns in 1996 and added seven more in 1998. Of the 13 hoop barns, one stores large round bales for bedding. Dave says the multi-use hoop barns could work for a variety of farm needs—sow gestation or other livestock cover, hay and bedding storage, etc. He also cites "no powerwashing, which needs to be done well," as an important feature. He feels that the labor requirements between hoops and confinement are about equal.

The 1,800 large, round bales they harvested last year will supply ample bedding due to the mild winter. From December through January, each barn requires four bales every ten days. The bedding use depends on pig size and bedding quality. They utilize both corn stalk and bean stubble bedding. Bedding management in summer is more difficult because it heats up. "We have to use sprinklers to cool on humid, still days, but also must add dry bedding to keep the pigs away from the heat pack," he says.

Animal Performance and Health

"There seem to be fewer respiratory problems, especially less coughing in hoops. There is less dysentery as well. One of the key factors is to keep plenty of bedding and the hogs will stay healthier. The hogs also seem happier, or at least they keep more occupied," he says. "They have a larger area in which to roam. They root in and chew on the corn stalks."

This is the third year the Struthers will plant high-oil corn. The higher energy content in the corn increases the rate of gain in finishing hogs, reduces dust in the facilities and results in more milk from sows during farrowing and lactation. The family buys additional corn from the elevator to meet their livestock feeding needs.

Dave lists good pig growth, fresh air from natural ventilation and less dust as positive hoop barn attributes that contribute to the health and performance of his hogs. However, Dave believes that hogs raised in hoop structures have lower feed conversions when compared to more modern confinement systems. But the Struthers' 1970's confinement buildings aren't as efficient as today's tunnel ventilated or double-curtain sided confinement buildings, so feed conversion is about equal to the hoop structures. Another downside is that the bedding requires handling, and is another crop to manage. It is also harder to treat individual animals when they are sick.

Manure Management

The Struthers find that the solid manure from hoop barns doesn't incorporate as well into soil and has inconsistent nutrient levels when compared to liquid swine manure from pits. The Struthers apply nitrogen fertilizer to land where manure from the hoops is applied because solid manure has lower nitrogen content. The solid manure provides adequate potash and phosphorus levels. The family is taking part in an Iowa State University research project on hoop barn manure values and effects on crop yield.

Environment and Community

When they were discussing their expansion options, people in the community "were more receptive to the idea of hoops than a conventional facility, because they viewed hoops as environmentally and community friendly," Dave said. Comments from the Struthers' neighbors about the hoop structures are positive and there seem to be fewer bothersome odors. Occasional odor complaints occur from the confinement units, especially when hauling manure. There was also an odor complaint in the fall of 1998 from manure (from the hoop manure pack) that wasn't incorporated during fall tillage. "There is even some smell still in the springtime from the manure pack applied in the fall when spring fieldwork begins. However, it doesn't seem to be as strong a smell as from the liquid manure," Dave says. The Struthers are pleased with their hoop structures and recommend them to other pork producers. Dave notes that hoop structures require that producers are comfortable as livestock managers, but they also address odor concerns and environmental challenges facing the industry.

Pasture Farrowing and Finishing System

Background

The low fixed costs of pasture production systems, also known as outdoor or grazing systems, appeal to many farmers who want to expand their hog operations without making large capital investments. While pasture farrowing systems usually have lower weaned pig rates and poorer feed efficiency, they offer easier manure management, less odor, reduced soil erosion and water contamination (because forage crops are planted versus row crops), and better air quality. The natural environment is enjoyed by both the sows and the producers.

◆ In outdoor farrowing systems, portable houses are spread out over several acres.

Housing

Outdoor, or pasture, farrowing systems need portable housing, feeders, watering systems and, usually, electric fencing. The portable houses are spread out over several acres and the animals distribute manure naturally.

Several types of pasture huts are available, including Quonset huts, wood and plastic A-frames, modified A-frames, plastic and plywood pig-savers, and English-style huts. An Iowa study found that huts with larger floor space and areas that protected the piglets from the sows, had lower pig crushing losses (Honeyman and Roush, 1996).

Farmers looking at housing systems should think about the structure's ability to moderate temperature extremes, keep pigs dry and out of drafts, and minimize piglet crushing by the sow. How easy is it for the sow, the litter and the farmer to get in and out? Consider portability for moving, placement and storage, maintenance and repair needs, and cost (Honeyman and Weber, 1996).

◆ Traditional A-frame farrowing huts.

In cold, wet or muddy conditions, bedding in the huts helps keep pigs dry and away from drafts. Producers can use low-quality grass hay, whole or ground corn cobs, baled cornstalks, straw or shredded newspaper for bedding. Large round bales can be used in larger pig shelters. Bales should be placed on their flat end to avoid burying small pigs as the bale settles. Small bales of straw can be used in smaller huts, but it requires hand labor, and may be expensive or unavailable (Honeyman and Weber, 1996). Whole or ground corn cobs are cheap and are not as dusty as straw, but they can be difficult to place and may be too abrasive for small pigs. Shredded newspaper is a dust free, absorbent low-cost option that makes a suitable bed for pigs, but it loses its integrity when wet (Honeyman and Weber, 1996).

Fencing

Electric fencing is often used in pasture farrowing because it is easy to install, remove and store. Fencing can divide a pasture into groups of sows with pigs the same age, which is advantageous during group lactation (Honeyman and Weber, 1996).

New Zealand-style fences provide a higher voltage shock for a shorter duration. This is a good deterrent and is less of a health risk to the operator and livestock. Using braided poly-stainless steel wire on spools makes it easier to install and remove fences. In most cases, pastures can be established or removed in less than an hour. These technologies give producers control over livestock without the extensive fence maintenance of older woven-wire hog fences. Since these high-voltage fences train animals quickly, only one or two wires are needed to successfully control both sows and pigs.

◆ Gestating sows grazing an alfalfa-brome grass pasture.

Feed

In a pasture system, feed accounts for 60 to 70 percent of the total cost of producing hogs farrow to finish (Honeyman and Weber, 1996). A study of Iowa farm records from 1989 to 1993 found that outdoor farrowing herds required 20.6 pounds more feed per hundred-weight of live gain (or 51.5 pounds more feed per 250-pound pig marketed) than indoor farrowing herds. The lower rate might be caused by outdoor producers farrowing and feeding their animals in large groups, greater internal parasite infestation of pigs on dirt, crowding of pigs, high winter consumption of feed and higher feed wastage from wind, spoilage and consumption by birds or rodents (Honeyman and Penner, 1995).

In one Iowa study, mid-gestation gilts grazing alfalfa needed 1.5 to 2 pounds of corn per day, plus phosphorus and salt, to match the gains of gestating gilts in drylot fed 4 pounds per day of a standard corn-soybean meal diet. Overall, feed costs of drylot and grazed gilts were similar, but keeping gilts on pasture meant less purchased feed inputs, less feed to handle and the inclusion of alfalfa in the crop rotation (Honeyman and Roush, 1995).

Alfalfa in a corn-soybean rotation helps control crop pests and adds nitrogen to the soil, reducing commercial fertilizer costs. The alfalfa hay can also be fed to swine with good results (Honeyman and Weber, 1996).

Farrowing

In pasture farrowing, each acre typically has 7 to 15 sows and litters. Producers use either the one-litter (or all-gilt) system or the two-litter system. In the one-litter system, gilts are farrowed once, usually during the summer, and then sold. Gilt pigs from the one-litter system are then raised and bred to farrow one year later. Since boars are used for insemination, all-gilt systems require new boars every year. In the two-litter system, sows farrow in spring and fall and produce two litters per year, avoiding the extreme summer and winter weather (Honeyman and Weber, 1996).

Animal Health

One of the best things about the pasture system is the healthy environment it offers both animals and producers. Respiratory diseases, rhinitis and foot and leg problems are minimized in hogs allowed

outside (Gegner, 1992).Sows enjoy a natural environment and the chance to move around. Producers using pasture farrowing often have lower swine health expenses than producers using confinement systems, because less disease is transmitted in open spaces (Honeyman and Weber, 1996).

Because rotating pastures and hog lots cannot eliminate parasites, rigorous parasite control programs are needed. Iron injections may not be needed since the pigs can get enough iron from the soil (Honeyman and Weber, 1996). As with all production systems where hogs are in groups, it is important to have good animal husbandry skills and a thorough understanding of hog social behavior in groups, in order to prevent fighting and other problems.

Performance

Iowa farm records from 1989 to 1993 show that farrow-to-finish operations using outdoor farrowing weaned fewer pigs both per litter and per sow per year. They also had a poorer whole herd feed efficiency rate. Year-to-year variability was greater in the outdoor systems (Honeyman and Penner, 1995). However, these operations did have lower fixed costs and overall lower costs of production (or lower break-even price), which outweighed the reduced litter size and lower feed efficiency.

This same study of Iowa producers found that the total production cost, or break-even price, for producing a market pig was $4.88 less for outdoor herds than for indoor herds (Honeyman and Penner, 1995). With intensive management, the low capitalization costs, reduced purchased feed costs and low-to-moderate labor requirements can make pasture systems profitable.

The pasture system has challenges. Pigs gain slightly less weight and feed efficiency rates are poorer with outdoor feeding than with confinement rearing. The weaning performance of outdoor herds is usually more variable than that of herds weaned indoors. Piglet mortality is often higher in outdoor farrowing systems than in indoor farrowing systems. This is partially related to the size and shape of the farrowing hut. One study found that crushing death rates were higher in huts with less floor space but were not affected by hut building materials (Honeyman and Roush, 1996). Piglet health is also vulnerable to adverse weather conditions in this system.

Scale

Stocking rates depend on soil type, slope, vegetation, pest considerations and producer preference. The scale of an operation will be based largely on the availability of labor and land.

Labor Requirements

Labor in pasture farrowing systems is more seasonal than in confinement systems. According to a study of Iowa farmers, farrowing is the busiest period. Labor needed during other months is considerably lower. Producers noted that even though the peak labor demand for pasture farrowing was during crop season, there was not a major conflict between the two activities. Most planting was done before the June farrowing began (Honeyman and Duffy, 1991).

◆ A hydraulic pig mover is essential for a pasture-based pig enterprise.

Labor needs are difficult to tally and identify because they differ so greatly among individual producers. Some published work estimates that the labor required for pasture farrowing is ten to thirteen hours per litter, and about seven hours per litter with confinement systems (Honeyman and Duffy, 1991). However, in one study, three Iowa hog producers spent an average of three hours of labor per litter until weaning for pasture farrowing, compared with seven hours per litter for confinement systems. (Honeyman and Duffy, 1991).

Environmental and Social Considerations

Properly managed pasture systems can be environmentally sound. Rotational grazing on different paddocks provides an even distribution of manure at low loading rates. Waste products are broken down by hoof action, weather and soil organisms. This means less odor and fewer flies.

The pasture system can reduce soil erosion by replacing erosive row crop protein sources (such as soybeans) with forage protein sources. The system saves the fuel usually involved in planting, cultivating, harvesting and manure handling. However, with pasture systems it is important to maintain vegetative cover on the pasture to prevent erosion. Stock density and duration, soil type, slope, vegetation type and climate all interact to determine vegetative cover (Honeyman and Weber, 1996).

The low level of odor emissions associated with moderate-sized outdoor swine operations is appreciated by neighbors and other community members. Neighbors may join forces or a producer may hire extra labor to set up pig pastures; place huts, shelters and water lines; and round up pigs for weaning or castration (Honeyman and Weber, 1996).

Financial Risk

Pasture systems are a low-cost way to enter hog production or expand an operation. Low-cost farrowing huts and high-impedance electric fencing make this system inexpensive to adopt. Pasture systems have lower fixed costs than confinement operations and provide a lower break-even price. If the market drops, the system can be discontinued fairly easily and the pasture put into crop production. All these factors lower this system's financial risk. However, there is more variability from year to year, which may increase risk (Honeyman and Penner, 1995).

Jim Van Der Pol
Kerkhoven, Minnesota

◆ Josh Van Der Pol provides straw bedding for sows in a hoop structure.

After more than 16 years farming and raising hogs in standard farrow-to-feeder confinement, Jim and LeeAnn Van Der Pol "wanted to try something else." They wanted to enhance the quality and enjoyment of daily farming, while providing a viable income to support their family and that of their son, daughter-in-law and grandchildren, who had moved to the farm.

In 1993, the Van Der Pols' confinement hog operation was profitable, yet Jim did not enjoy raising hogs. "I was about ready to quit at that point," Jim explains. "I was tired of having to face that [confinement] building every morning." But, he adds, "We didn't feel like we could quit the pigs as we needed the income."

That same year, Jim began considering pasture farrowing, a management alternative that would be compatible with his personal and farming goals—like spending more time outdoors and generating work and income to support the two families. He first heard about pasture farrowing at a Land Stewardship Project workshop in 1993. Shortly thereafter, the Van Der Pols applied for and received a grant from the Minnesota Department of Agriculture to explore pasture farrowing for 21 of their 60 sows. In 1995, they received another grant from the Federal Sustainable Agriculture Research and Education (SARE) program to finance a switch from winter farrowing in standard confinement to winter hoop house farrowing and finishing.

Since 1995, hog production has quickly become the Van Der Pols' "main business." They tripled the size of their farrowing operation between 1996 and 1998 from 60 to 175 litters annually and expanded into finishing using two hoop structures.

◆ Early spring farrowing with pasture huts in a hoop structure.

Operation Management and Housing

Combining the hoop structure and pasture management, Jim farrows sows three times annually. Sows, bred over the winter, are farrowed in late March and April in two hoop structures. Inside each hoop, 4- by 7-foot Port-A-Huts™ are set up adjacent to one another for spring farrowing. From this farrowing, approximately 100 replacement gilts are chosen and marked for the

following year's farrowings. After the spring-farrowed sows finish in the hoop structure, gilts selected the year before are farrowed in pastures in June. After the June farrowing, Jim retains only the best performers, usually a total of 50 to 55 sows, for a September and October pasture farrowing. This group is then bred over the winter for a final spring farrowing in the hoop structure, completing the farrowing cycle.

For the March-April farrowing, Port-A-Huts™ are assembled inside the hoops. Sows choose their own Port-A-Hut™ during gestation, and Jim and his son Josh surround the huts with straw that sows can walk on before and after farrowing. Two weeks after farrowing, the huts are removed and two to three 1,800-pound round bales of straw are added to create a deep-bedded group nursery. Jim adds straw to the hoop structure as necessary until the sows are moved out on pasture, usually five to six weeks after farrowing. "At five to six weeks we open the gates," Jim says. "The sows walk out of the building directly to the pasture."

◆ Sow and litter in pasture hut.

On pasture, Jim and Josh set up 70 Port-A-Huts™ (moved from the hoops) in each of four different four- to five-acre paddocks to accommodate June and September-October farrowing sows. Huts are spaced 50 feet apart with 10 to 11 sows stocked per acre. "That's enough social confusion," Jim says referring to the stocking rate. "I wouldn't recommend ever putting more than 11 sows and litters per acre."

Jim finishes out two groups of pigs each year on pasture and in two hoop structures (one Biotech™ and one Cover-All™ building). After several years of use, Jim prefers the hoop structures to confinement finishing facilities "because there is such movement of air through it" and more light. Since putting up his first hoop, Jim has added another similar-capacity Cover-All™ hoop structure. He chose the Cover-All™ hoop instead of a second Biotech™ because of its thicker tarps, more secure end-closures and smaller doorway (16 feet). Although the Cover-All™ hoop structure cost $10,500 to put up, Jim says he prefers this "tighter" system.

Spring pigs that were born in the hoop structures in March and April are also finished inside the hoop structures. The June pasture-born pigs are finished in a section of the pasture that is rotated with crops. Pigs are usually brought up closer to the yard by Thanksgiving and are generally marketed by the end of the year. The fall-born pasture pigs (approximately 350 to 400 head) are moved to the hoop structures for finishing over the winter. The replacement gilts, which are marked from the spring hoop farrowing, are raised with the rest of their farrowing group, but are sorted out in August and are grazed on pasture and grain until they are bred in January and February. Breeding takes place in an old farrowing house on the farmstead.

Labor

Labor is one of the most critical components of the Van Der Pols' operation. Jim's general management philosophy is to utilize labor resources within the family to maximize the

operation's "return to labor." Based on Jim's daily workload, he says the return to labor is stabilizing after an initial dip when the family first switched to pasture farrowing.

After pigs from the March-April farrowing are finished out inside the hoop structures, Jim and Josh spend approximately one day, or a total of 16 hours, cleaning out the hoops and spreading manure on their cropland. They use a front-end loader attached to a utility tractor to clean hoops and load manure for spreading. "The front-end loader is not as fast as a skid-steer loader," Jim explains. "But it works and by the time we get rid of [the March-April farrowed] pigs and get them to market, we can clean the building and bring the pasture-farrowed pigs in here to finish."

The initial conversion from a farrow-to-feeder confinement system to a combined hoop and pasture farrow-to-finish system required more seasonal and daily labor than the Van Der Pols originally anticipated. "We wound up with a lot of labor tied up in the hoop structures, which we constructed ourselves, and in fencing," Jim explains. "The fences and gating and that stuff takes quite some time (to erect)." However, with the expansion close to completion, Jim says the workloads are more reasonable. "Now we are just managing the farm," he says.

Each season, it takes Jim and Josh a full day to set up the paddocks for farrowing. Duties include installing fences, moving huts and adding drinkers. Daily workloads are about equal to time spent raising fewer hogs in confinement. Jim and Josh have split daily hog management equally between themselves according to the tasks they each prefer, and now are maintaining a "reasonable" workload. Every morning in the summer they each spend about one hour checking pigs and sheep, observing forage grasses, filling feeders and moving sows, if necessary. In the winter, they spend more time bedding pigs. Once their morning work is complete, Jim and Josh move on to fieldwork, equipment maintenance or other livestock duties. "I farrowed for 15 years in confinement with crates," Jim says. "And even though I don't have [return to labor] numbers to prove it, I know that pasture farrowing requires no more labor than confinement farrowing. I've lived through it."

Pasture Management and Feed

Fifty-five of 160 acres on the Van Der Pols' farm are devoted to permanent pasture—low-lying land that Jim says was usually too wet to farm. "We'd get our tractor stuck every year during planting and harvesting because it was so wet," Jim says. Instead, he found the land was perfect for raising lightweight livestock, such as pigs, sheep and stocker cattle, that don't "punch through the soil." The pasture land also is situated adjacent to Jim's farmstead, making daily livestock-related chores more convenient and less time-consuming.

The pasture land is divided into four one- to three-acre paddocks that vary in size according to "the lay of the land." Paddocks are rotated among sows, sheep and calves annually to prevent overgrazing of individual plant species and to limit disease throughout the summer. The paddocks are fenced using high-tensile polywire on reels, and stocked with eight to eleven gestating sows per acre.

Jim seeds the exceptionally low areas to Alsike clover and the remaining pasture areas to alfalfa in early spring. Otherwise, Jim says, his pastures consist mainly of quack grass, brome, Kentucky bluegrass and orchard grass. He supplements the sows' pasture grass with shelled corn and adds no other nutrients. "[The sows] are expected to get their protein and minerals from the grazing," Jim says. He is considering providing some or all of his winter sow feed in

the form of grass and clover silage. He currently finishes pigs on a standard corn and soybean ration, and feeds sows a mix of oats, barley and baled alfalfa harvested from his fields.

Animal Performance

Upon first moving his sows outdoors, Jim noticed a significant drop in productivity due mainly to piglet mortality. He lost approximately 30 percent of his pigs per farrowing group (21 litters) during his first year using the combined pasture and hoop structure farrowing systems. After a few years, however, he says sows are "used to their environment" and performing well. "My production numbers are now as good, or better, than when I was operating in confinement," Jim says. The sows, a cross of Hampshire and White-York breeds as well as full-blood Berkshires, wean between seven and nine pigs per litter, weighing 15 to 20 pounds each at five to six weeks. "Our litter rates vary a lot because of the sow's own genetics and the weather," Jim says. "We generally average close to nine pigs per litter." At 20 to 24 weeks, pigs finish out weighing 250 pounds.

Jim has not administered iron shots, vaccines or subtherapeutic antibiotics since moving his sows outdoors. "We only treat sick animals," he explains. "We don't use feed antibiotics as standard practice." In fact, he says, "herd health overall is better" than when raised in confinement. By eliminating antibiotics, Jim also now has access to niche health food markets that he says are beginning to show financial promise.

Finances

Like most producers, the "bottom line" is important to Jim—he wants to manage profitably. For this reason, his first few years farrowing on pasture and in the hoop structures were financially disappointing . Despite low building costs (an average of $10,000 for each hoop structure), net profits were down during the first three years, due partly to expansion costs and to high litter mortality. Based on Jim's first three years of pasture farrowing experience, he estimates that pastures provided a return of $300 per grazed acre.

Despite this initial drop in profit after the switch, Jim says his farm now "has a lot better return," with enough income to support both Jim's and Josh's families. The cost of production in 1997 totaled 30 cents per pound for pigs from sows farrowed in the hoops and slightly lower for those from sows farrowed on pasture. Jim explains that the "sow herd is much more used to their environment," reducing pig mortality and improving overall animal performance.

Beginning in 1996-97, Jim borrowed $10,500 to build his second hoop and add more capacity to his sow herd. "Our projected return on investment was 30 percent, compared to a typical 5 percent return for confinement capital investments," he says. "So far, during our first year, we are right on target to pay off our expansion in three years' time." The 30 percent return on investment is a function of more labor and less capital, Jim says. "By using less capital, our return is better, which means we are meeting goals to maximize labor and lower input costs."

Regardless of how significantly production costs are cut, Jim speaks from experience in warning that seasonal farrowing will expose operators to more financial risk than year-round farrowing. "The lowest hog prices of the year are right at the time your spring farrowed pigs are ready for the market," Jim explains. "You need to be creative and manage your markets well to make money." Toward this end, Jim is beginning to direct-market hogs to local customers and explore niche markets.

Conclusion and Words of Advice

Looking back after five years of raising hogs on pasture and in the hoop houses, Jim says he is glad his family made the decision to hold on to their hogs. "I would have missed the pigs," he says. Jim has fulfilled personal as well as business goals by spending more time outside with his animals, building an operation that can be managed by and support two families, and making good use of wet soil that was difficult to farm with crops.

Based on his experience, Jim recommends seasonal pasture farrowing in Minnesota, but advises producers who are planning to put confinement sows on pasture to "let them get used to looser conditions" before turning them out on pasture. "You can't expect to take sows straight out of confinement, put them in an open space, and expect them to know what to do," he advises. "Close down your confinement operation a bit at a time and let the sows get used to new conditions over their lifetime."

Summer 2000 Update

Jim's system continues to give him the flexibility he wants. He is currently producing fewer pigs, due to a depressed hog market and because he has diversified, and is now also grazing replacement dairy heifers. He discontinued his spring feeding group on pasture, and is now raising all feeder hogs in the hoops. He is selling more feeder pigs to people who direct market hogs. He feels that he has gained a good reputation, and hogs from his farm sell well. He had problems with high piglet mortality due to PRRS, but has vaccinated and his herd is now back up to speed.

Jim feels, too, that "our low costs were the only thing that brought us through 1998." And, like many other small producers, he feels that the key to the future is niche marketing. The Van Der Pols are attempting to move away from the commodity market entirely. Since 1999 they have been direct marketing under their Pasture-A-Plenty label. They have monthly delivery routes and sell at farmer's markets. They also sell to Niman Ranch (grass-raised, antibiotic-free) and sell hogs into the Berkshire program for export. Jim expects to keep producing hogs with this system. "We have no intention of quitting with the hogs."

Tom Frantzen
New Hampton, Iowa

◆ Tom Frantzen describes his hog operation to visitors during a field day.

Pasture farrowing is not new to Tom Frantzen. He has seasonally farrowed part of his sow herd for 17 years using a unique pasture system that corresponds with his soil management and cropping plan. Until 1992, Tom also has winter-farrowed sows in a crate confinement system. Nursery and feeder pigs have been finished out in slatted-floor and Cargill™-type finisher facilities since 1974. When Tom's nursery and grower crates began wearing out, he started thinking about a different way to farm. Tom had grown tired of the confinement system over the years and believed animal conditions could be improved. "We wanted to change the way we raised hogs to be compatible with the way we wanted to live life," Tom recalls.

The Frantzen family went through the Holistic Resource Management (HRM) goal-setting process in 1992, identifying a long-term future vision that included a more ecologically sound system, financial stability and more time working outdoors. Tom felt these goals could be met through a seasonal pasture farrowing and hoop house finishing system.

Now, Tom farrows his entire sow herd of 80 to 100 sows on pasture strips in the warm season and in huts in heated buildings during the winter. The hoops also are used for finishing. Gestating sows are grazed in permanent pastures during late spring and summer. After harvest, the sows are regularly allowed to glean corn stubble and soybean stubble.

Looking back at his indoor farrowing experience, Tom says, "Working conditions for myself weren't nearly as good as working outdoors. The health of the animals wasn't good either. You could almost see the stress on the sows in the [indoor] farrowing crates, which I don't see anymore. Now, they seem to enjoy life, and so do I."

Pasture Management

Tom uses a combination of permanent pastures, rotating strip pastures and cropland to farrow and graze his hogs. Gestating sows and gilts are grazed in permanent paddocks in combination with stock cows. Farrowing sows are grazed in managed pasture strips that are rotated every three years with corn, oats and clover. In the fall, sows, gilts and feeder pigs are turned out to graze "the whole farm" in mature corn fields and soybean stubble.

Pasture management begins in the spring, when gestating sows are moved from a straw-bedded metal cattle shed, where they are housed during the winter, to 30 half-acre paddocks that are rotated with cattle. Tom rotates gestating sows and cattle through the 20 acres of permanent pasture three or four times each year. Paddocks are given a three- to four-week rest period in the spring and a four- to six-week rest period during summer to avoid overgrazing and to break parasite cycles. Occasionally, Tom lets his pastures "get out of condition" to bring back natural grasses, which improves forage quality and builds soil structure. He does this by extending the rest period for two grazings for that year.

PASTURE FARROWING

Two weeks before farrowing, sows are moved to a designated 15-acre area that is divided into six sets of three strips: one strip of corn, one of pasture, and a third of oats and red clover. In other words, Tom always has one strip of pasture available for farrowing, another strip of oats where young clover is developing, and a third strip with corn that is maturing for fall harvest by hogs. Pasture strips are always bordered by corn, which acts as a windbreak during cool weather and as a shade during hot temperatures. "It's the little management practices that have been the most successful," Tom says.

◆ Sows and litters grazing on red clover pasture between strips of corn and trees.

Farrowing huts are lined up in the pasture strip to correspond with cropping patterns. "I want the houses and wheel tracks in a row," he explains. "I drive in the same tracks so you don't have unnecessary loss of cover." Piglets are left with sows in the pasture strip until they weigh 25 to 40 pounds, at which point they are weaned and moved off the pasture to straw-bedded hoop houses for finishing.

In early summer, Tom harvests oats from one strip, leaving the clover stand to mature for the following season's pasture. Oats and clover are seeded directly into tilled corn stubble. In the fall, all of Tom's hogs (sows, gilts and feeder pigs) are used to "hog-down" the strip of mature corn and allowed to occasionally glean soybean stubble in nearby fields. Each spring, pasture strips are planted with sixteen 500-foot long rows of corn. In the future, Tom plans to harvest the corn stubble for use as cattle bedding, and replace the stalks in his fields with composted bedding packs from the hoop houses.

Overall, Tom's rotation system has worked well for "places on the farm that are more ecologically suited for it—anywhere that we can grow a good crop."

◆ Electric fencing is used to contain sows on pasture.

Fencing

Tom uses Turbo Wire™ electric fencing attached to plastic posts every 30 feet to contain gestating and farrowing sows. Turbo Wire™ is a white cord wire that "weighs less, carries the same strength, delivers a good shock and has superior visibility," compared to the old Maxi Shock™ system he used to use. Tom also uses a digital voltage fence tester to monitor voltage levels and to ensure that sows remain contained in pastures. "Anyone interested in raising pigs on pasture should have a fence tester," says Tom, speaking from experience. "Otherwise, you'll run into problems if the sows don't respect the fence."

Housing

Housing is critical to animal performance, something Tom has learned over the years while comparing the confinement systems. "I've found that pigs need a space that can accommodate group sizes under 10 or over 100," Tom says. He explains that a healthy social hierarchy can be established with groups under 10, while aggression is reduced in groups larger than 100. "In the Cargill™-finisher, hogs are grouped 60 to a pen. It just doesn't work." Tom now stocks sows on pasture in groups of six, and uses the 2,160 square-foot hoop structures, each of which can accommodate more than 100 hogs.

Until recently, Tom has used 50-square-foot A-frame farrowing huts constructed from plywood. In 1997, Tom replaced the older huts with modified plywood "Henry County, Illinois" design A-frame farrowing huts, which he converted from 39 square feet to 47 square feet. "You need close to 50 square feet," he says, adding that 75 square feet would be even better to accommodate sows during farrowing. He chose the slightly smaller Henry County A-frame design for two reasons. First, the smaller design would reduce plywood cost, and second, the modified design has excellent water-shedding ability while keeping sows cool during summer and warm during spring and fall. Each hut is lined with one-and-a-half to three standard square bales of straw, depending on the weather. "If you have a lot of rainy weather, you can go through three bales per hut per farrowing" Tom explains; "in dry weather, probably a bale and a half per hut."

During the winter, replacement gilts are moved to a metal cattle shed bedded with straw. Tom houses between 100 and 150 finishing hogs in each of three newly-constructed standard hoop structures that have 2,160 square feet each. The hoop structures are bedded with straw and have provided a superior environment to that of the Cargill™-finishers. "The primary advantage to these [hoop structures], in addition to space, is that they use a limestone base instead of cement," Tom says. In the Cargill™-finisher units, the sloped cement floor made it difficult to maintain adequate straw cover. Once the finishing group moves out, pasture huts are moved into the hoop structures for spring farrowing and bedded with straw.

Farrowing

Tom farrows 80 to 100 sows twice annually—once in a cattle shed equipped with straw-bedded pens during the spring and again in pasture strips during the fall. On pasture, six sows are stocked per six-tenths of an acre during farrowing. Gilts from fall farrowings are bred over winter for March-May farrowings and again for August-September farrowings.

Tom has used a different breed of boar every year to build stock diversity. The breeds include the Tamworth, Yorkshire, Hampshire and Black Poland breeds. Tom's liked the Tamworth breed because of their foraging abilities and hardiness. He also found that the Tamworths are less prone to sunburn because of their all-dark coloring. In 1998, however, Tom began selling his hogs to organic and "free-range" markets which required Berkshire and Farmers' Hybrid breeding stock, respectively, so he no longer uses any Tamworth or Yorkshire stock.

Feed

Sows and gilts have access to "all the pasture they want," Tom says. The pasture features a mix of red clover, seeded alfalfa and orchard grass—forages sows and gilts prefer, according to Tom's observation. In order to maintain forage quality, Tom seeds clover into corn stubble for the pasture strips and rotates cattle with the gestating sows in each pasture. "The cows shift plant compositions in beneficial directions," Tom explains. The cows were added to the farm

specifically "to fill an ecological loop." The cows make use of the lower-quality forages and therefore will eat a wider range of plants to maintain more even cover in the pastures.

Tom monitors his pastures "while doing chores" to ensure sows receive adequate feed based on the quality and availability of pasture forage. If sows aren't getting enough protein from their forage, he supplements their diet with a standard ration containing three to four pounds of shelled corn, or a mix of oats, wheat, barley and peas ground with additional protein and minerals. Corn is added to the feed ration once sows begin lactating.

In the fall, Tom allows his sows to "hog down" corn in adjacent fields and occasionally moves them out to forage on soybean stubble. During winter he feeds replacement gilts high-lysine ear corn, explaining that it is a "more uniform feed source." He believes the high-lysine variety ear corn is more palatable than processed feed. "They eat the cob [of high lysine corn]," he says. "They won't eat the cob of conventional corn."

Animal Health and Performance

"The sows look excellent," Tom says, drawing on more than 20 years of livestock experience. He has noticed fewer disease outbreaks, which reduces or eliminates the need to vaccinate. This is in contrast to his previous confinement farrowing experience. "I used to have to vaccinate for your usual diseases and I don't do as much of that anymore," he says. Tom rotates his pasture frequently to reduce sows' exposure to parasites. "I try not to have the hogs out on the same ground for more than two farrowings," he explains. Moreover, since contracting with "free-range" and organic processors, Tom has eliminated his open-front finishing program, and with it, his use of antibiotics, by switching to hoop structures.

Litters average seven to eight pigs—slightly fewer than the consistent eight pigs that sows bore on Tom's farm with the winter confinement farrowing system. Piglet mortality hasn't been a problem, although Tom says some deaths occurred when sows laid down on the piglets inside the huts. "I think [the deaths] are more due to poor hut design that doesn't allow enough room," Tom says. Farrowing huts used in Tom's pasture have varied between 47 square feet and 50 square feet. "Seventy-five square feet would be better" to accommodate sows during farrowing and prevent crushing, Tom says.

Labor

Challenging the common myth that pasture farrowing requires more labor, Tom put a stop-watch to his work, timing the hours and minutes that it took him to raise seven litters of pigs from farrow-to-finish in 1995. "We raised seven litters in a total of 7.5 hours, or about one hour per litter," he says. These results are consistent with his general observations that there is less labor when sows are on pasture. Tom checks sows and litters only once per day on pasture instead of the several times a day required with the confinement system.

Tom's labor savings are the result of healthier sows on pasture and the use of several "essential" time-saving technologies. In order to make fence installation easier, for example, Tom uses two pieces of equipment: a forage harvester and a power wire winder. Using a Brady Hay-Maker™ forage harvester, it takes Tom and his 10-year-old son approximately two hours to clear a swath and install fencing around new grazing strips. The harvester offers two advantages: It makes laying fence easier by creating a cleared swath; and it retains cleared clover and corn for use as cattle feed and bedding. "This is an incredible piece of equipment that I

would never go without," he says. Another piece of equipment, a power winder, is used to unroll and roll fencing wire "in minutes."

Moreover, in 1992, after years of hauling water to his pasture, Tom hired a contractor to install a pressurized water system with lines running to each of his fields. "I don't think this [pasture farrowing] system could work efficiently without it," Tom says. "Now I hook into the water system out in my fields and it takes 15 to 20 minutes to water." The water lines were installed 18 inches below the ground on grade so that they can be drained in the fall to prevent winter freezing damage.

Finally, Tom says that by using ear corn in the winter he saves labor that would otherwise be spent combining, hauling, drying, transferring and storing shelled corn.

Finances

Tom's switch to a seasonal farrowing system has been a financial success, thanks to lower input costs and market premiums paid for his free-range and antibiotic-free hogs. These improvements, combined with the sale of some confinement equipment to partially finance hoop structure construction, are beginning to make up for the Frantzens' lost winter farrowing production.

Input costs to raise a 30- to 40-pound feeder pig on pasture average about half the cost of feed in confinement. "Protein, feed and manure spreading costs are all cut on pasture," Tom explains. It costs Tom $15 on average to produce a 30-pound feeder pig, based on two years' data.

Tom also "saves" money by lowering his exposure to feed and hog market price risks. "Anytime I [feed] out on pasture I have lowered my risk because I am spending less money—I've inherently increased my management alternatives because I can allow for some disasters to happen without leaping to the newest, latest-technology intervention." Most of Tom's pasture farrowing equipment—fencing, feed wagon, water tanks and even farrowing huts—can be used for cattle production throughout the year and during poor hog markets.

In addition to reducing production costs, Tom has improved his profit margin by gaining access to niche markets. "The key to producing in an alternative fashion is learning to market in an alternative fashion as well."

Environment

Tom monitors his fields' biodiversity and soil cover through constant observation. Walking his pastures regularly, he checks groundcover and forage quality. He has also begun more formal monitoring using a soil quality kit produced by the Land Stewardship Project. Based on his own observation and the results of periodic soil testing, Tom believes that the practice of alternating hogs and cattle on the same paddocks has produced excellent results. "Either one of the livestock groups on their own would make it hard to manage the groundcover," Tom says. "But I've noticed that when rotated through the same pastures, hogs and cattle will eat a wider range of plants and improve soil stability."

Conclusion

After a few years of experience with the new system, Tom thinks he made the right decision to switch. The seasonal pasture farrowing and hoop house finishing system have helped him meet the goals he originally set in 1992: employ a more ecologically sound system, achieve financial stability, and spend more time working outdoors.

Summer 2000 Update

Tom has added another 40- by 80-foot hoop structure to his operation; wider and taller than a standard hoop, it provides better ventilation. The biggest change in his production system is that he now has all 125 sows entirely in organic production. Tom describes the switch to organic as a "major time commitment, with a steep learning curve." As a result, he has developed an extensive list of new contacts who are valuable information resources. Tom says he "just climbed out of the stone age a year ago, but now I couldn't live without my internet access!" He has on-line partners to discuss various topics: organic diet and effects on digestion and fermentation in small pigs, designs to improve different sow wood huts for humane farrowing, and discussions about seeking organic approval of herbal products that work against internal parasites. He uses the Practical Farmers of Iowa website for sharing information (www.pfi.iastate.edu). Because of organic requirements, he now has a terminal cross program—Berkshire boars breed Chester White-Duroc-Farmer's Hybrid sows to produce market hogs. Sometimes he uses Durocs and Chester Whites to produce replacement gilts.

Overall, his herd has been healthy. He has battled a viral problem that strikes suddenly and causes problems, but he has also dealt with something similar in the past. He expected to see higher parasite loads with his switch to organic, but so far has not seen an increase.

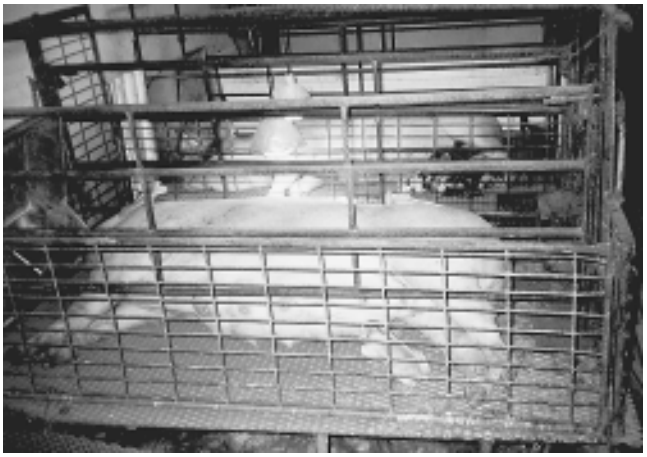
Tom survived the low hog prices by avoiding the commodity market—he hasn't sold a hog on the open market since March of 1999. He markets his organic hogs through CROPP Organic Valley Cooperative, which uses a set price determined once a year by cooperative members. He has also marketed a small number of hogs through Niman Ranch.

Tom is very optimistic about his future in organic hog production. In fact, he is expanding as rapidly as possible in order to meet demand. He fully expects demand for organic hogs to continue to increase rapidly in the coming years and is very satisfied with his production system. His advice to a farmer thinking about using an alternative production system is to develop a network of contacts—"networking with other farmers who have similar interests and goals is critical to success."

Confinement Farrowing and Finishing Systems

Background

Confinement systems were developed and introduced in the 1950s for poultry production. Since then they have been adapted to improve labor and hog production efficiencies in Europe and the United States (Donham, 1998). Confinement equipment and buildings may vary from farm to farm as the result of constant innovation, but production management is similar.



◆ Farrowing crate with sow and nursing piglet.

In confinement systems, production conditions are standardized to reduce variations in animal performance and make the operation more labor efficient. Specialized buildings and equipment, such as self-cleaning or slatted floors, automatic ventilation and liquid manure pits are needed because hogs are indoors 24 hours a day throughout all phases of production. The amount of land needed to operate these actual systems is small. However, a larger land base is necessary to spread the manure ecologically, and this must also be considered.

After years of relatively successful use, both the public and farmers have recently raised concerns about the risks of the confinement system. Financial risk is increased by the need for highly-automated buildings and equipment (Thu and Durrenberger, 1998). Manure handling can create poor working conditions and cause environmental hazards. Gases from manure handling and storage create odor as well as human and animal health risks (Donham, 1998). Liquid manure spills and nitrogen leaching can erode water and soil quality.

While each farm must weigh the benefits and risks of confinement production, the National Pork Producers Council says the system is best suited for farms where:

- operators have a long-term commitment to hog production,
- hog production is the farm's major enterprise,
- more than one person is available to perform work, and
- farmland is highly productive for crop use (Bache and Foster, 1996)

Scale

The need for high returns on capital investments means most confinement operations are run on a large scale and at full capacity. Operators keep buildings full by housing more hogs than alternative management systems. Depending on the facility size and farrowing schedule, confinement operations typically handle 500 or more sows and/or a minimum of 2,000 to 5,000 hogs in specialized finishing operations (Jacobson, 1998), although small- and medium-sized farrow-to-finish operations of approximately 250 sows are also common (Donham, 1998).

Housing

Confinement facilities range from state-of-the-art, highly mechanized new buildings to remodeled, older barns. Newer facilities typically consist of long, low-lying metal buildings constructed on a concrete foundation (Thu and Durrenberger, 1998).

Regardless of the type of confinement building used, all facilities emphasize a controlled environment to reduce temperature and humidity fluctuations and, consequently, hog stress and disease. Temperatures are regulated with circulating fans and drip-system coolers or misters in the summer, and automatic heaters in the winter. Heaters are important to control temperatures since bedding is not used in most confinement systems. In farrowing areas, supplemental heat is provided for piglets from heat lamps, electric radiant heaters, heating pads, mats and hot water floor heaters.

Both mechanical and natural ventilation can be used in confinement facilities, although mechanical ventilation generally does a better job of controlling the air-exchange rate in enclosed, insulated buildings located in cold climates (Anon., 1996). Ventilation is extremely important to regulate moisture and odor levels. Gases produced in underfloor pits by liquid manure can harm and even kill humans and animals (Miner and Barth, 1988). For these reasons, ventilation fans, used in either the natural or mechanical system, must be kept running continuously. Automatic warning systems are common to notify producers of a power failure or malfunction (Anon., 1997b).

Most confinement buildings have “self-cleaning” or slatted floors made of non-abrasive, non-porous and slip-resistant materials, such as woven metal, plastic coated metal, metal bars, and/or concrete (Anon., 1996). In all phases of production, hogs work manure through slatted floors to temporary or permanent underground storage pits that are located two to eight feet underground (Stanislaw and Muehling, 1997). Manure is usually flushed from shallow underfloor pits to outdoor treatment and storage lagoons, although underfloor deep pits with longer storage capacity are becoming more common, since they tend to reduce odor in comparison to the shallow pit-earthen lagoon system (Jackson, 1998). The size of the underfloor pit storage area determines how long manure can be stored before emptying for land application (Stanislaw and Muehling, 1997).

Liquid manure systems operate by the periodic removal of liquid manure from underfloor pits to vented outdoor settling basins or storage lagoons, or to fields for land application. Mechanical scrapers, pumps, gravity systems or flushing techniques are used to remove manure (Anon., 1996). When lagoons are used to store and treat manure, producers are usually required to install a liner, particularly when the unit is on highly-permeable soil. Liners can be made from compacted clay or a non-permeable synthetic material.

Bred sows are housed in rows either individually or in groups. Individual stall housing may be used to protect sows from group mate aggression, although it keeps them from natural social interaction. Individual stalls allow close observation of each sow during gestation. During farrowing, sows are confined to crates or stalls which allow a sow to stand, lie, eat and drink but prevent her from turning around. This is intended to reduce piglet crushing and mortality (Anon., 1996). Typically, heated creep areas alongside stalls attract piglets away from the sow except when nursing (Stanislaw and Muehling, 1997). A typical farrowing pen measures five feet by seven feet, but when stalls or farrowing crates are used, the sow is confined to a two-foot by seven-foot area within the pen.

Weaned pigs aged 18 to 21 days are moved into a separate indoor nursery area. Nursery areas can be in the same farrowing building, but for improved biosecurity (disease prevention) reasons, are usually in a different building. In the nursery, 10 to 20 piglets are kept in pens on slatted floors above an underfloor tank or shallow flush gutter. Nursery pens provide a per-pig space ranging from 1.7 square feet for 12- to 30-pound pigs to four square feet for 30- to 60-pound pigs.

After leaving the nursery at eight to ten weeks, pigs are moved to group finishing areas in specialized buildings. Each finishing building has rows of rectangular fully- or partially-slatted floor pens that can

hold between 15 and 40 hogs. As in the farrowing buildings, pen rows are usually separated by concrete alleys. Concrete-slatted floors and sturdy penning materials are recommended to withstand rooting and chewing (Anon., 1996). Some producers will use specialized finishing buildings (wean to finish) that house pigs from the time of weaning (18-21 days) until they reach market weight, thus eliminating the need for a separate nursery facility.

◆ Bulk feeder tanks are mounted to the outside of confinement facilities.

Feed

Elevated bulk feeder tanks are mounted to the outside of modern confinement facilities. Mechanical augers move feed from the tank indoors through ceiling pipes to feeder troughs in each pen or stall (Thu and Durrenberger, 1998). As with most Midwest non-pasture systems, confinement operations use a feeding program in which the feed ration balance is altered throughout the weaning and growth stages for maximum feed efficiency (Luce et al., 1996). A typical swine diet includes corn for an energy source and oilseed meals (mainly from soybeans) for protein. Premixed vitamin-mineral supplements, which include trace minerals, salt, calcium and phosphorus are used to supplement feed when needed. Antibiotics can also be added to the feed. Most subtherapeutic antibiotics are added during the nursery stage and into the first finishing stage to manage subclinical disease and thereby promote growth.

Management, Labor and Human Health

In many large scale high-intensity confinement systems, ownership, overall management and daily labor often become separated (Stanislaw et al., 1990). Employees or family members who work with the animals usually perform regular, specialized tasks in this highly-automated system. However, it should be noted that smaller, single-owner confinement operations can also be successful. The automated technology and the specialization of work are designed to reduce the time spent per pig unit in confinement compared with other management systems, with the goal that one person should be able to handle more sows and/or hogs (Stanislaw and Muehling, 1997).

For the owner and/or manager, daily workloads focus on equipment maintenance and repair, as well as financial management, scheduling, recordkeeping and human resource management. Because these systems are highly dependent on the smooth operation of automated equipment, the Pork Industry Handbook says producers considering confinement facilities should have “considerable mechanical skill” (Bache and Foster, 1976). When hired labor is necessary, a significant portion of time is spent managing and scheduling employees.

According to the Pork Industry Handbook, labor per sow unit in a farrow-to-finish operation varies from 15 to 22 hours annually. This does not include time spent planning, maintaining records or maintaining equipment, which can add up to 25 percent more time to the production of each hog (Bache and Foster, 1976). A Minnesota producer survey found that labor finishing requirements average approximately 12 minutes per marketed hog in a two-unit 1,000 head finishing facility, or one-and-a-half hours per day per 1,000 hogs (Koehler et al., 1996).

The most time-consuming functions of confinement production are:

- farrowing and handling pigs at and before weaning,
- periodic emptying and scrubbing of farrowing units,
- loading and selling market hogs, and
- pumping manure pits.

In confinement systems, the majority of time is spent indoors. Workers are often required to shower on-site before entering the gestation, farrowing, nursery or finishing buildings as a biosecurity measure.

Workers in the enclosed confinement system can be exposed to bioaerosol particles (dust, hair and dander) and gases (ammonia, methane, carbon dioxide, hydrogen sulfate and carbon monoxide). It is not uncommon for individuals working in confinement buildings to suffer one or more chronic respiratory illnesses as a result (Donham, 1990). Health hazards may occur when workers spend more than two to four hours per day for six days in enclosed buildings, particularly during winter and when agitating and pumping manure pits. During winter, bioaerosols and gases increase when ventilation rates are reduced to conserve heat (Donham, 1998).

Environmental and Social Considerations

Confinement operations concentrate larger volumes of manure for handling (Geyer and Findley, 1993). Improperly handled liquid manure can damage air and water quality. Consequently, local and state permits are required in Minnesota and other states for all feedlot or confinement-type housing units, manure storage and manure handling (Minnesota Rules, 1999).

Confinement operations must submit a building and operating application to either the Minnesota Pollution Control Agency or a local county feedlot officer, depending on the size of the operation (Anon., 1997a). Factors considered in local or state permit applications include the number of animals, soil type, topography, proximity to a town and neighbors, and the watershed. Larger manure storage facilities with a unit storage capacity greater than 500,000 gallons require an engineered site and manure storage plan. A public hearing is needed when local zoning or conditional use permits are considered. Operations near a town or neighboring farm are often required to take extra precautions to protect water and air quality since all livestock facilities are subject to regulations under the federal Clean Water Act and the federal Clean Air Act (Geyer and Findley, 1993).

Although odor from manure in underfloor pits, lagoons and cropland application can be managed with biological and mechanical techniques (Anon., 1996), producers can expect some exposure to ammonia, hydrogen sulfide and other gases created by liquid manure on a seasonal and periodic basis. For example, “objectionable” odors may occur during lagoon turnover in the spring. This temporary overloading is a result of decreased biological decomposition activity the previous winter. (Safely et al., 1993).

Animal Performance and Health

One of the primary benefits of an enclosed confinement system is the ability to control the hogs' environment. A constant environment, regardless of weather, is expected to result in more efficient production, whereas uncontrolled temperature fluctuations can lower feed conversion and farrowing rates, and ultimately meat quality (Harmon and Lawrence, 1995). A study by the University of Missouri found that pig performance during winter improved in environmentally controlled, enclosed systems compared with open facilities. On average, however, studies reviewed by Iowa State University have shown “essentially no difference in the yearly average pig performance of open compared to an enclosed swine housing” (Harmon and Lawrence, 1995).

General performance guidelines published by the National Pork Producers Council for farrow-to-finish confinement operations are listed in Table 1.

Because of the scale of investment and concentration of animals, biosecurity (control of animal disease) must be a part of any confinement operating plan. To reduce disease outbreaks and limit herd susceptibility, confinement operators often provide showers and sterilized clothing for workers, practice segregated early weaning and "all-in-all-out" technology, and often include antibiotics in the feed for pigs during early growth.

Table 1: Performance Measures for Confinement Operations

Performance Measure	Unit	Attainable Goal
Pregnancy rate	*Percent*	
Gilts		90
Sows		95
Farrowing Rate	*Percent*	
Gilts		85
Sows		95
Average no. live pigs born/litter	*Number*	
Gilts		11
Sows		12
Average no. pigs born dead/litter	*Number*	0.5
Average birth rate	*Pounds*	3.5
Pigs weaned/litter farrowed	*Number*	
Gilts		10
Sows		11
Average daily gain:	*Pounds*	
Birth-to-market		1.38
40-pounds-to-market		1.7
Age at 230 pounds	*Days*	165

Source: National Pork Producers Council. Pork Industry Handbook. PIH-100. January 1991. p. 5.

Finances

Confinement system producers need to devote a significant amount of time to financial business management (Bache and Foster, 1976). Because of operation size and specialized equipment, high-intensity confinement facilities usually require much more start-up capital than most other management systems. In general, a manure pit and building shell make up approximately 50 percent of total capital investment in an environmentally controlled facility. The other half of the initial capital investment consists of slatted-floor construction, ventilation systems, heating systems and feeding and watering equipment. Based on research by University of Minnesota agricultural economist Bill Lazarus and bioengineer Larry Jacobson, total building and equipment costs for a 1,400 sow farrow-to-finish operation average $900–$1,000 per sow farrowing space; $100–$120 per nursery pig space; and $160–$170 per finishing pig space. Daily operating costs, such as energy, are typically higher in confinement versus alternative facilities as a result of the required heating, ventilation, manure pumps and aerators (Harmon and Lawrence, 1995).

Once livestock, land, and operating input expenses are added to the building and equipment costs, Lazarus estimates that confinement operation investments for 1,400 sow farrow-to-finish operations total close to $5.1 million as shown in Table 2.

Table 2: Confinement Facility and Operating Investments for a 1,400 Sow Farrow-to-Finish Operation*

Investment Required	Farrow	Nursery	Finish	Total
Sow or pig spaces	1,400	4,800	9,600	
Facilities, equipment and land	$1,284,000	$533,000	$1,594,000	$3,411,000
Breeding herd	$ 390,084			$ 390,084
Operating inputs	$ 263,388	$ 59,237	$ 431,967	$ 754,591
Weaned pig/feeder pig purchases		$103,155	$ 409,651	$ 512,807
Total	$1,937,472	$695,392	$2,435,618	$5,068,482

Source: Bob Koehler, Bill Lazarus and Brian Buhr. *Swine Production Networks in Minnesota: Resources for Decision Making.* Murray County Extension Service and the University of Minnesota. December 1996. Page 17.

* Investment includes opportunity cost on interest rate at 8.0 percent, insurance at 0.65 percent and property taxes at 0.6 percent on the original construction cost of facilities and equipment. Facilities are assumed to have a 15-year life with no salvage value.

When capital is limited, producers may consider retrofitting older facilities to a partial-confinement system and substituting some additional labor for equipment while building their operations (Harmon and Lawrence, 1995). To finance new facilities investments and to minimize the financial risks associated with market price fluctuations, more operators are entering into producer networks and/or production contracts with other producers and/or processors.

In theory, the size advantage of confinement systems offers producers an opportunity to generate higher long-term profits, but producers must consider their feelings about financial risk, their access to capital, health and work-place issues, manure utilization and their desire to run their operation at full capacity.

Larry Liepold
Okabena, Minnesota

◆ Larry's barn remodeled for confinement operation.

Larry Liepold is an example of a small-scale producer who has been successful using the confinement system. He grew up on a farm just a few miles away from where he now lives. His current operation has been in the family of Jill Liepold, his wife, since the early 1900s. Larry began farming on the site in 1984 and moved to the 160-acre farm with his family in 1988. The Liepold family has four children and Larry would like to see them all come back to agriculture. In addition to the 153 tillable acres on his own farm, Larry also owns another 74 acres and farms that as well as 144 acres of his father's land for a total of 371 tillable acres.

Larry produces broiler chickens to be direct marketed (around 300 of them), but the hog operation is his primary focus. He began with 25 sows in 1988 and worked up to 173 sows divided between two sites. This proved burdensome, and so, in 1999, Larry scaled back to the current number of 130 sows, all of which are located on his farm. He currently has breeding, gestation, farrowing and nursery stages of production on his site, but has used an off-site nursery in the past.

The confinement system appeals to Larry because he feels that his system requires fewer hours to handle manure and bedding, has a better environment for the hogs, and is less prone to disease problems than the facility he worked with prior to having his own operation.

Investment and Buildings

Larry spent $9,000 for the original 25 bred sows ($360/head). When Larry decided to raise hogs, he spent $25,000 remodeling an existing barn by installing risers, manure gutters and a manure storage pit. In 1994, he expanded by building an adjoining barn at a cost of $64,000. Nearly everything within the buildings is constructed of durable, non-corrosive materials such as concrete, stainless steel and durable plastics, materials that Larry says last well and can withstand constant exposure to the animals better than other materials such as wood or iron. The walls themselves are made of wood, but are covered with durable fiberglass sheeting.

Feed

An interesting component of Larry's operation is a computerized feeding system. Each sow is given an ear tag (he plans on moving from ear tags to subdermal transmitter implants in the near future) with a unique code that is recognized by the feeder each time the sow enters the feeding stall. The feeder then delivers the proper amount of feed to the animal. The entrance and exit to the feeding stall are also computer controlled and keep the animal from remaining in the stall longer than necessary, preventing more aggressive feeders from depriving passive animals of time at the feeder. The stall can also be used for sorting the animals. The system is controlled by a PC in Larry's house and operates 24 hours a day, enabling each sow to eat on

demand. The entire system cost $18,000 ($550/sow space), a discounted price based on Larry's willingness to allow other farmers interested in the system to come to his farm and see it in operation. Had he gone with stalls and an alleyway, the same building that now contains 130 sows would have had a reduced capacity of 76 sows. Constructing the stall system instead of the electronic feeder system would have cost $585/sow space—an increase in construction cost per sow space and reduced overall production capacity. The system's efficiency also creates substantial feed cost savings.

◆ Computerized feeding system insures correct amount of feed for each sow.

Currently, the sows in the farrowing barn are fed by hand. However, Larry is looking into purchasing a $150/crate automated feeding system that would be operated by the same computer that controls the automated system in the gestation and breeding barn.

◆ Sows with ear tags.

The two adjoining barns are both conventional, fully insulated stick-built buildings. There are 24 farrowing crates in the 24- by 50-foot farrowing barn. The gestation and breeding barn is one large room with dimensions of 41 feet by 45 feet. The barns have mechanized waterers. The gestation and breeding barn has the computerized feeding system and the farrowing barn has drip coolers over each crate.

Labor

Larry estimates the labor requirement of the operation to be around 1.5 workers/day. He has a part-time herdsman who works four hours a day, five days a week doing most of the work in the barns. Larry does the management and crop harvesting work. Larry would like to create more farm work so as to increase the herdsman time to a full time position.

Larry feels the work is "definitely enjoyable," especially when compared to the barn he worked in prior to having his own operation. He enjoys working with the pigs, and likes the business side as well. The hired herdsman has indicated that he enjoys working in the facility as well.

Pig Development and Rations

For breeding, Larry has moved away from traditional methods. He currently uses two old boars for heat detection and artificially inseminates the sows. In the confinement barn, Larry says, "It's very easy to adapt to new technology" such as artificial insemination. Larry tries to have each group of sows farrow within three days. The pigs are weaned at 18 to 21 days. They then spend six weeks in the nursery. From there, they spend 90 days in the finishing stage and are sold at a weight of around 260 pounds. The total time from birth to market weight is between

150 and 170 days. Larry's operation averages nine pigs per litter and 19-20 pigs per sow per year.

The pigs are first introduced to solid food at 14 days when they are fed small amounts of pellet-based feed. At 18 days they begin receiving a pellet-based ration that replaces milk-based protein with plant-based protein, which is later replaced by a grind-in mix. All of the feed comes from a local elevator. Larry delivers his corn to this elevator and participates in a feed bank program. Larry estimates that the feed-to-animal-weight conversion is about 3.5 pounds of feed/pound of animal weight gain. Average gain/day varies from 1.5 to 2.25 pounds.

Animal Health

The sows receive routine vaccinations for *e. coli*, rota virus and other pathogens that could be passed on to the pigs. They also receive routine worming and anti-parasite medications, but they only receive antibiotics if needed. The pigs receive iron, mycoplasma pneumonia vaccine and routine antibiotics at three days of age to boost pig survival rates.

◆ Gestation and breeding area.

Larry uses feed-grade antibiotics and growth promotants. The first two pellet-based rations and the nursery rations are medicated with Tylan™ or Mecadox™ to protect lungs or gut. All feed grade antibiotics and growth promotants are absent in finishing rations at present, but he feels that by introducing these additives to the finishing ration he will be able to shorten the number of days needed to grow pigs to 260 pounds and increase uniformity within each group of pigs. However, he would like to find a way into the antibiotic-free market. He has been in contact with a buyer in Worthington, but they have not received enough farmer interest to start an antibiotic-free marketing strategy.

All equipment is washed daily. Crates are washed between litters. "We do our best to minimize interaction between buildings." Larry is the only person who goes into both the barns on his site and the other finishing location's barn. He changes clothes and showers in/showers out when going between barns.

Despite the technology installed in the barns to regulate the internal environment, maintaining ideal conditions inside can still be a challenge. In the mornings, the barns heat up quickly, the fans come on early, and cool, moist, morning air is drawn over the pigs, creating a draft. The pigs can be uncomfortable until outside air coming in is warmer. This may put stress on the pigs, and at times leads to scours.

Environmental Concerns

During humid, calm days, odor can be a problem, especially from 9 p.m. until 7 a.m. However, the cornfield seems to contain the smell to the building site and the neighbors have not complained. There are no "sensitive areas" nearby. In order to ensure that odor does not become an issue, Larry is planting a buffer line of evergreens around the barn to curb any odors that may otherwise reach his neighbors.

The facility has a six-month holding capacity for manure, since the storage system was built before full-year regulations came into effect. Larry applies the manure to nearby fields every spring and fall via injection. Larry says that with the use of his hog manure, he has no need to apply commercial potassium or phosphorus and the crops do very well on lands receiving the manure.

Larry feels that there is no pressure to change manner of production since, with only one exception, all other hog producers in the area use confinement operations.

Scale

Larry produces about 2,500 pigs per year and says production contracts are available for producers of his size if one looks for them. Although he does not currently have a contract, he is considering that option as a way to protect his operation from future low price situations. Instead, he is currently involved with exploring other economic opportunities such as joining Pork America, a new nationwide hog cooperative, and buying shares in a new local soybean processing plant. Larry also gives the market's current upswing as another reason why he is not looking into acquiring a contract at this time.

Larry feels it is important for each producer to "handle the scale that they're comfortable with." Right now his investment situation is comfortable at 130 sows. However, he feels that 130 sows at a 35-cent market level are not enough to provide a sufficient, steady income for his family and that every producer needs a system that can provide a steady source of income.

Larry also feels that it is no easier for a small operation like his own to withstand low market periods than it is for a large operation with millions of dollars invested. He believes that it is possible to make a comfortable living with an operation his size, so long as "you are watching things and you plan ahead, you can ride out the tough times. . . . If you look at the tough times, they are actually shorter than the good times."

Given his extensive knowledge and practical experience in the hog industry, Larry believes that the industry is going to become more consolidated. "There's just no way to stop it," unless laws are written to do so. "As long as the margins stay as tight as they are, you are going to have to get bigger to survive. I honestly am . . . looking at 1,200 sows." He plans on expanding to his father's site in the next five to ten years, requiring an investment of around $3.3 million in 1999 dollars. He plans to finance his expansion from a combination of bank loans, cooperatives and, hopefully, a production contract.

When considering the environmental implications of such an expansion, Larry believes that large-scale operations are no more of a strain on the environment than a multitude of smaller ones. If anything, the large operations have a better opportunity to control manure storage and application. As for social implications, Larry feels that since a large-scale operation employs several people, it does not necessarily force people away from rural communities. He says that six small producers with 200 sows each or one large 1,200-sow operation that employs five people plus the owner demonstrates that larger production systems do not have to correlate to fewer people on the land.

Larry fervently believes that one ought to "do something for the industry, rather than stand on the outside and criticize." Besides managing his farm, Larry is also active in organizations related to the industry. He is vice president of the Minnesota Pork Producers Association (MPPA). He is active in several other pork-related local and national organizations and has

served on and taken leadership roles in many MPPA committees. He has gone to Washington, D.C. numerous times since 1992 to visit Congress. He believes that "if you don't speak up for what you believe in, and want to do something about the way your business is run, somebody else is going to do it for you." Larry has had a front seat for many of the changes taking place in the industry and says, "It's a dynamic, changing industry and that's part of my attraction to it."

Concluding Advice

Larry holds that it is important for everyone interested in beginning their own operation to "make sure [they] can ensure [themselves] a steady source of capital" and "keep a good relationship with people providing capital." This is, according to Larry, part of managing your business well. Another component is "thinking outside the box." when designing an operation. He warns against simply copying what others have done. Instead, he suggests that each individual tailor the facility to what will be best for the style of operation he/she is interested in. "Try different things; don't confine yourself to popular trends and conventional ways of doing things." He stresses that it is vital for producers to "listen to your customer. That's not the packer; that's the consumer." As a final bit of advice, Larry stated, "It's your industry, take care of it. It's your environment, take care of it. It's your job, your vocation, your life, take care of it."

Scott Hislop
Mapleton, Minnesota

◆ Scott Hislop manages his family's 132-year-old farm.

Scott Hislop is part of a 132-year-old tradition. He manages a 1,400-acre crop farm and an 800-sow confinement farrowing operation on land that has been in family since 1866. "This became a century farm the year I was born," says Scott, who took over full-time operation of the farm in 1986 upon graduating from a local technical college. "That brings a lot of pride and a lot of pressure. All of the generations before me were successful and I don't want to be the one to screw it up."

Like most Midwest farms, the Hislop farm traditionally produced cash crops and raised a relatively small number of beef cattle, hogs and poultry for family consumption and additional cash sales. Production management shifted from year to year, but, in general, the operation's focus remained the same for more than 100 years—to earn a living from a diversified farm.

Beginning in 1986, however, Scott began reconfiguring the operation in response to changes he saw in the industry and marketplace. Fresh out of school during the heart of the economic farm crisis, Scott began studying the farm's financial records. Crop sales, he found, were not as financially profitable as hog production.

That same year, the Hislop family formed a general partnership called "Hislop Farms." Partners included Scott, his parents and his wife, Michelle. Together they began a series of gradual expansions into full-time pork production, which has become the main focus of their operation.

Today, the Hislop Farms partnership is a fine-tuned, capital-intensive operation that relies on daily financial and animal performance analysis as well as monthly visits with financial consultants and veterinarians. Over the years, the partnership has experimented with on-farm farrowing, nursery and finishing production and has expanded several times. In 1998 they increased their operation from 800 to 1,500 sows. All breeding and farrowing is performed on-site, while nursery and finishing work is contracted out to six local growers.*

Scale

Hislop Farm's general management philosophy is to operate on a large enough scale to take advantage of economic benefits while retaining ownership and a large share of management within the family.

By most confinement standards, Hislop Farms was about average in terms of production capacity until the fall of 1998. At that time they increased farrowing capacity from 800 sows to 1,500 sows and began marketing 30,000 to 34,000 hogs annually. To accommodate the on-site increase in gestation and farrowing capacity, Hislop Farms arranged nursery and finishing off-site with contracted growers in facilities that range in size from 1,200 to 3,600 head.

(* Although Hislop Farms further expanded to 5,500 sows in 1999, the information in this section is based on Hislop Farms' 1998 operation practices.)

"The unique part about our farm with 1,500 sows and farrowing in a group system is that we have the same pig flow as a 5,000-sow farm, because we wean more pigs at one time of the same age," Scott says, "so we can use bigger finishing barns and provide a larger, more uniform group of pigs. That's really important for animal health and economic efficiency."

Hislop Farms uses a nine-week group farrowing and finishing system. Pigs are in the nursery for nine weeks and in finishing facilities for two nine-week periods or a total of 27 weeks. "With the nine-week system, we are selling a 280-pound pig," Scott says. At this larger weight they are able to sell more total pounds of pork at a higher value.

Based on his previous experience, Scott believes their 1,500-sow farrowing operation is the minimum competitive size for Hislop Farms to take advantage of scale economies through lower per-sow production costs. "Every farm has a different level of maximum efficiency due to size based on their equity position," Scott says.

Housing

In 1998, for gestation and farrowing, Hislop Farms used a mix of six confinement buildings connected by a covered walkway. Some are older breeding and finishing barns that have been retrofitted for farrowing. Others are newer facilities constructed from the ground up, beginning in 1990. All facilities are situated on concrete foundations with self-cleaning floors and exterior, elevated bulk feed tanks.

Farrowing barns contain 5- by 7-foot farrowing units with 24-inch-wide farrowing crates. Pens and crates are elevated two feet above shallow manure pits on a raised deck of three-gauge wire. Heated creep mats are along the side of each farrowing crate where piglets have access to feed and water as well as overhead heat lamps. All farrowing buildings are power-ventilated and insulated using Lester™ panels, with a fiberglass-laminated plywood layer on the inside wall, insulation, more plywood and vinyl sheathing on the outside wall.

Scott has moved most gestation to two new 60- by 160-foot confinement barns that house 500 sows each. At the same time, existing gestation barns were converted into farrowing facilities. Inside each new gestation building, six rows were set up to accommodate 84 7-foot by 22-inch gestation stalls per row. Automatic feed drops and waterers line concrete alleys between each row. Natural ventilation with temperature-activated curtains is used in the new buildings, as in Hislop Farm's current gestation facilities. Pit fans draw air through the floor slats and outside, cutting down on gases and odor.

New and existing gestation and farrowing facilities are equipped with automated propane heaters and an overhead drip system to control temperatures inside the buildings. The heaters have worked very well during winter, Scott says, while the drip system has done a fairly good job of regulating summer heat despite slight productivity dips during extreme heat. In the new gestation barns, he plans to place overhead circulating fans behind the drippers to distribute the mist more evenly throughout the building. The heating and cooling systems are monitored and controlled by Scott remotely from his computer.

All piglet and sow mortalities are composted in a hoop house that Hislop Farms erected in 1995 for this purpose. They use purchased wood shavings as a base for the compost, to which Scott adds liquid manure as a nitrogen source and water before disposing of the carcasses and afterbirths each day. Wood shavings are added again on top of the carcasses, so that piles are gradually built within the hoop house. "We were one of the first ones in the state to have a composting facility," Scott says. "Before adding the hoop, we always had a mess. It always

◆ Hislop Farms constructed a hoop house for composting mortalities.

stunk, there were flies and plus there was the biosecurity concern of the rendering truck coming on the farm."

Gestation and Farrowing

Before the 1998 expansion, Hislop Farms bred and farrowed 800 sows using a group system. Artificial insemination was used to breed sow groups, with a breeding window of 10 to 14 days. Hislop Farms uses PIC (Pig Improvement Company) genetics, one of the Midwest's largest swine breeders. With the completion of their fall 1998, expansion, Hislop Farms breeds a total of 1,500 sows. Using this herd size, 1,800 piglets are weaned every three weeks. The largest 1,200 pigs are moved to one unit and the smallest 600 left for another week. This allows Hislop Farms to wean more pigs of uniform age and size.

Manure Management

Hislop Farms uses two manure management systems. One is a shallow pit two feet below farrowing crates that must be drained regularly to an outdoor 500,000-gallon capacity clay-lined earthen basin. Manure is flushed from the shallow pits into the earthen basin once every three months using grey water. The second system, installed in their new gestation facilities, has eight-foot-deep storage pits that can hold up to 500,000 gallons each for one year.

◆ 1,800 piglets are weaned every three weeks.

Traditionally, manure from the Hislop's earthen lagoon had been pumped and hauled to the fields one load at a time. This meant regular pumping and hauling to the fields over several months during the spring and fall, something Hislop Farms discontinued in the spring of 1998 when they began hiring semitrucks to haul more manure at less frequent intervals. Hislop Farms made the decision to hire out the hauling for three reasons: (1) to increase transportation distance to fields that need manure the most; (2) to improve community safety by reducing time spent on the road with their honeywagon, which travels at 18 to 20 mph; and (3) to reduce the amount of time spent on the road hauling. "If you keep the

◆ Hislop Farms has a 500,000 gallon clay-lined earthen basin for manure.

hauling time period short, in contrast to continuous hauling, it is appreciated by the community." Scott says that "the key to successful manure management is to view the manure as a valuable nutrient resource."

◆ Scott spends a lot of time in the office, analyzing data.

Labor

Hislop Farms relies heavily on eight permanent employees and a range of professional consultants. Five of the employees work full time as managers of office administration and bookkeeping, breeding, farrowing, crops/maintenance and nursery/finishing. Three part-time employees, including one of Hislop Farm's contracted finishers, are hired throughout the year as nursery/finishing representatives and sow unit technicians. Moreover, Scott regularly works with consultants such as an accountant, agronomist, veterinarian and financial consultant. "I think that the secret to success is to hire people that are smarter than you," Scott advises. "A vet consultant fits in that category. We have two vets; one works in the farrowing units with the staff and another meets with us monthly to look at records."

While staff perform the day-to-day swine management and bookkeeping work, Scott spends nearly all of his time analyzing financial and animal performance numbers, communicating with staff, ordering production inputs and overseeing the construction of new facilities. "I spend most of my time in the office," he says. "We have really good staff, employees and contract growers that we work with. I turn a lot of responsibility over to them and that has allowed me a lot more latitude to focus on budgets and profitability and on making changes in the operation." Although he would prefer to "drive a tractor or work with the animals," Scott says that the most productive place for him to manage Hislop Farms is in the office full time.

Feed

Corn raised on 700 of the Hislop's 1,400 acres supplies about 25 to 30 percent of all feed used in the gestation, farrowing and finishing stages. The remainder of feed, including supplements and a standard ration that changes in nutrient density throughout the growth and finishing process, is purchased from outside suppliers. Antibiotics are added to the feed to promote growth during weaning, nursery and the first finishing stage.

Animal Health and Performance

Animal health and performance are constantly monitored on Hislop Farms by veterinary consultants, who analyze pig feed consumption and growth rates. "We keep track of cumulative feed and water consumption on a daily basis," Scott says. "Our goal, as of last year (1997), is to analyze the group in progress rather than just by looking at close-outs. That way, if we notice something, we can change it and improve that group's performance."

Hislop Farms uses custom-designed software to develop feed budgets for each group of pigs upon entering the finishing stage. Contracted growers and staff weigh the pigs weekly and submit their results to Scott. "I do all of the feed ordering," Scott says. "So growers call me when they need feed and I look at the data to see if their average feed consumption and weight gain is where it should be, to see if we should continue to follow the budget or not and what

type of ration to order next." Feed orders are placed on a daily basis from Scott's office to a supplier.

As a result of this intense monitoring and regular meetings with a veterinary consultant, Hislop Farm's pigs have performed well with few biosecurity concerns. On average, 23 pigs are weaned per sow each year.

Hislop Farms uses Segregated Early Weaning (SEW) techniques as a biosecurity measure where pigs are weaned at 16 to 17 days of age (approximately 10 pounds). Pre-weaning mortality rates are about 10 percent based on May 1997 to April 1998 data. Feed conversion measures 3.0 to 3.1 for the entire herd and approximately 2.8 for finished hogs. In addition to SEW, Hislop Farms uses other biosecurity measures such as the nine-week group system and the "shower-in, shower-out" policy for workers at all facilities. "Most viruses survive about six weeks," Scott explains. "By moving groups at nine-week intervals, we make sure that most diseases are no longer active in the buildings." Sows and piglets are treated for disease only as necessary.

Finances

Financial management is at the heart of the Hislop operation. "In the past five years we've had to make dramatic changes to stay competitive," Scott says. "The changes involve capital purchases, which means working with a large volume of dollars." Capital costs, split roughly 50-50 between buildings and other equipment, total several million dollars. The 1,000-sow confinement gestation facility, for example, cost close to $600,000. Likewise, a 3,600-head nursery-finishing building constructed by one of the Hislop Farms' contract growers totaled $625,000 in 1997.

The partnership's financial strategy is based on the "Agro-Rule" where net profits are divided four ways to meet family living needs and business expansion. "We try to put 25 percent of profits toward interest, 25 percent toward principal payments, 25 percent toward family living expenses and the remaining 25 percent is used to grow our business," Scott explains. This financial management strategy has worked fairly well for Hislop Farms, although Scott says they had to take on new debt to finance the partnership's latest expansion. As a result, it has been important strategically for Hislop Farms to use a bank that is familiar with high-intensity confinement production, and sign marketing contracts to manage risk as much as possible.

"We meet with our financial consultant monthly," Scott says. "We go through our cash flow and a budget and look at our operating efficiency for all of the costs and all of the profit centers. He understands very well what we do." This understanding, Scott explains, has been critical to his expansion through the creation of more financial flexibility and a chance to acquire more capital with less equity.

Owing to these large capital investments, Scott has worked hard to manage market risk by using marketing contracts. "Our philosophy is probably a lot different than a lot of producers," Scott says. "I'm willing to fiddle for a smaller [marginal] profit and not risk the up-and-down roller coaster [of fluctuating market prices]. The contracts have worked pretty well." Scott says that annual marketing contracts signed with Hormel provide a consistent, steady income above costs of production, insulating against low hog prices while foregoing the opportunity to reap higher profits during good hog markets. Marketing contracts have, in turn, "reduced the risks associated with fluctuating markets, and lowered the financial risks of local contract growers who play a vital role in our operation."

Hislop Farms' gross annual sales were about $4.5 million with the 1998 expansion.

◆ Shallow injection of liquid manure.

Environment and Social Considerations

Water and air quality are important considerations with an operation the size of Hislop Farms. The Hislop farm is located just one-half mile from the town of Beauford on land that drains into the Cobb River and ultimately the Minnesota River. Consequently, Hislop Farms has taken active steps to control odor and to mitigate soil run-off and nitrate leaching. Out in the fields, Scott uses the latest techniques to control soil erosion and has developed a rapid, shallow-injection system to ensure maximum absorption at agronomic rates of the liquid manure application. "We make more quick passes over the same area to spread a lot of thin layers," Scott explains. "We never have standing puddles [of liquid manure]." At the farmstead, Scott admits that the lagoon does emit a strong odor "on hot days," but he has not received any complaints from neighbors. Scott feels that Hislop Farms is an asset to the community. "The scale of the operation provides good jobs and contract growing opportunities to people who are active in our communities"

Conclusion

The family members who make up Hislop Farms have worked together through many operational changes in order to respond to industry changes. They are devoted to careful management and, like many other farmers who experiment with alternative systems, they consider themselves "leaders" who are willing to adopt new management plans and technologies. All of Hislop Farm's business decisions are based on extensive research and planning, owing in part to the scale and goals of the operation, but also due to their overall business philosophy and a desire to keep their farm in the family. As stated in Hislop Farms' business plan, they are "committed to work together to remain competitive in the pork industry." Hislop Farms does not have specific further expansion plans. But Scott says that they will "change as the industry dictates, and as opportunities arise, in order to remain a viable business for future generations."

Summer 2000 Update

Scott continues to be pleased with their confinement hog production system. In 1999, when the opportunity arose to expand more, they acquired a new farm and have merged that into their present system, increasing their herd to 5,500 sows. Scott has been busy merging the two operations. They have been able to do well despite low commodity prices due to the contracts they have with Hormel, which assures them a stable income.

The health of Scott's herd has been good. Scott emphasizes that what makes this type of a system work is the hard, careful work of employees. "People are what makes it happen...both employees and contract growers. . . . [Modern] facilities don't matter if you don't have good quality people."