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Decision-making for the lightweight pig

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Introduction

It has long been accepted that lightweight piglets at birth are lightweight at weaning.¹ Others have established that lightweight pigs at birth have higher mortality, grow slower, and so are a significant contributor to variation in slaughter weight and, as such, a major problem in assembling slaughter loads.² Given the economic incentives to produce and deliver similarly sized “cookie-cutter” types pigs to slaughter various techniques have been pursued to improve the profitability of lightweight pigs. Some have concluded that it is cheaper to euthanize them as soon as they are identified others have advocated special treatment including penning by size, special accommodation, and special diets (including liquid diets). The importance of product uniformity is illustrated by producers’ responses to the USDA’s National Animal Health Monitoring System (NAHMS) survey, which examined how pork producers sold their finished hogs in the Swine 1995 study. The survey showed that 64.2% of US operations always assembled a “uniform group based on weight.” Further illustrating the objective of providing what the packer wants, 61.8% never sold “all animals in pen or building.” Like most complex problems there is unlikely to be one solution and the optimal approach will likely vary by farm and the particular mix of genetics, nutrition, and overall stockmanship. In three-site production where the system rewards nursery managers for dispatching more pigs, there tends to be more pigs shipped than there should be. Conversely, finishing managers struggle with the issue of how to handle the underweight/disadvantaged pigs they are shipped.

Selecting the individual pigs for special treatment is not hard—simply select the lightest. It is more difficult to decide which should be euthanized because, on an individual pig basis, there is no room for error!

The advantages of culling the lightweights include:

- increased floor space for the remaining pigs;
- a market for the lightweights, such as the barbecue market in the Southeast;
- an increase in the throughput (turns) for the building; and

- a decrease in the risk of disease transmission.

Additional advantages for euthanizing the lightweights include:

- the antibiotic residue problem is avoided;
- no need for special housing or handling;
- no mixing problems post-accumulation;
- no marketing issues; and
- no cull trucks picking up lightweights from multiple farms.

The need to do something is compelling: A study by Azain, Jones, and Glaze³ at the University of Georgia demonstrated that lighter pigs at day 14 were also lighter at birth and at weaning (day 28). Also, they found that the growth rate of the heavier pigs was greater than the lighter. The magnitude of the difference in growth rate was greatest between birth and 14 days with the lighter pigs growing at 45% the rate of the heavier (122gm/day versus 223gm/day). Their efforts to assist the lighter pigs were unrewarding: they showed that piglets fed a liquid milk replacer had greater growth and dry matter intake; however, the benefit was not sustained through day 14 of the study. They were able to improve 21-day weights in pigs weaned at 7 days and fed liquid diets to day 21 (Azain et al., 1994).⁴ However, they stated that the obstacle preventing the use of liquid diets is in identifying a feasible means to automate the processes of mixing and dispensing of milk replacer and cleaning the equipment. Contributing to the difficulty in raising these young lightweight pigs may be their susceptibility to disease, especially of the enteric variety.⁵

It seems that one of the hardest jobs in pork production is deciding what to do with these lightweight or otherwise compromised pigs. Caretakers seem to be naturally programmed to care for even the most desperate cases even when a more judicious evaluation would indicate that they should be euthanized. Most caretakers seem to prefer to nurture the small piglets and it is disappointing that after years of cross-fostering, nurse sows, special diets, and liquid feed we still haven’t found the best management system. This is not surprising as even growth of normal-weight piglets is compromised after about 9 days of lac-

tation because of the limit to sows' milk production and it progressively worsens throughout lactation.⁶ The poor start that these lightweight pigs get only serves to further intensify the challenge of meeting the pig's requirements for preweaning growth and development.

Most researchers seem to agree that as litter size has increased over the years; so has the variation in litter size and that results in more lightweight piglets. If caretakers accept the challenge to rear them then they also must accept the fact that pigs are not capable of compensatory growth and so a lightweight pig will always weigh less than its heavier litter mate and will grow more slowly, likely taking an extra 2 weeks to reach slaughter weight.

The essence of a good replacement diet

Work on neonatal nutrition by Drs. Bob Harrell and Jack Odle⁷ at North Carolina State University indicates that young pigs can use either fat or carbohydrate equally well and it is not necessary to have a high (30% dry-weight basis) fat ration. Also, you can switch fat and carbohydrate as buying opportunities arise and thereby minimize costs. In addition, such high fat fed pigs may be accreting less muscle than pigs on a low fat diet, which has got to be an added bonus for the low-fat route. Harrell and Odle also think that if you are using milk diets then it is less important to acidify the diet but a pH of about 5 is good for its bactericidal activity. The addition of probiotics (bacteria and yeasts) is probably another important aspect; in trials they are unable to replace antibiotics but they may help in the mix.

Cabrera⁸ reported that by weaning piglets weighing on average about 1kg, raising them in their swine center and then taking them to nurseries where they were either commingled with their sow-reared littermates or reared separately they achieved a lifetime mortality of only 18% compared to 41% for comparable sow-reared piglets. This produced a profit of \$7/small pig placed compared to a loss of \$6/sow-reared small pig. They attributed their success to diet, feed delivery and system hygiene, palatability, minimal disease, and a dedicated team to run the center. In addition, in their system it seems that it is critical to have a separate flow for these privileged early-weaned pigs as they are very healthy and therefore suffer if reintroduced into the same flow as their non-early-weaned cohorts.

Most workers agree that to successfully raise these 1- to 7-day-old pigs you have to feed a liquid milk replacer and the best system is a cup feeder with a nipple. Interestingly Cabrera⁸ noted that, in their trials, the cup feeding system is improved when feed intake was restricted (milk use decreased 39%) to minimize waste. This small change resulted in a saving of \$5.03/pig. Improved cup delivery systems are under development and it will be interesting

to see how well they can handle the transition to delivering a gruel as the piglets grow.

One of the major factors that can erode potential profits and is not captured in relatively short-term scientific trials is the risk of a major disease outbreak that causes mortalities to soar and growth efficiency to plummet. For these low-probability events, management usually has to presume that they will "get it all right" and the impact of infrequent outbreaks will be minimal. Getting it wrong can be a financial disaster. Tailoring a vaccination and medication program specifically for the sites involved is critical and a good manager can often spot these impending disasters and sometimes head them off.

When considering the alternatives for lightweight piglets, managers usually resort to a very subjective assessment, often heavily weighted by the animals' perceived ability to return a profit with little thought to the welfare of these animals. Some farming systems have adopted specific protocols to help managers decide which animals to euthanize and which to keep. For example, the "two-strike" system (John Roberts, personal communication) has two criteria that must be fulfilled before a weaner pig is euthanized: being underweight (e.g., less than 8lb on a farm with 18-day weaning) and having a disability such as a rupture, navel illness, lameness, or poor body condition.

As part of a larger study looking at compromised pigs generally we studied lightweight pigs to help answer the question "Are lightweight pigs worth raising?" We conducted a trial in five commercial nursery sites (Farms 1–5) owned by four separate entities (A, B, C, and D) in North Carolina. Each farm was part of a three-site production system and regularly received nursery-aged pigs from their supplier. After growing for about six weeks the pigs were shipped to their respective finishing sites.

Treatments

Batches of pigs were assigned to treatment (heavy, medium, or light euthanasia regimes) before the pigs arrived on site (but at the convenience of the owners). Pigs within batches were screened upon entering the nursery and either euthanized, tagged, or penned normally depending on their condition and the assigned treatment. The heavy protocol triggered euthanasia for welfare conditions that were less severe (compromising) than the medium protocol, and the light protocol triggered euthanasia only for the most compromised pigs (Table 1). Pigs with conditions not severe enough to trigger immediate euthanasia were ear-tagged and monitored daily by farm staff for changes in their condition.

All five nurseries were in North Carolina; all were curtain-sided, naturally ventilated, with woven wire floors, concrete alleyways, and nipple drinkers. All pigs in all batches were sized and placed into pens with similarly

Table 1: Criteria for euthanasia by treatment protocol

Level	Condition	Euthanasia Action (By Protocol)		
A	<i>Lightweight</i> Less than 40% under normal barn average weight (don't tag)	No	No	No
B	40-49% under normal barn average weight	No	No	Yes
C	50-59% under normal barn average weight	No	Yes	Yes
D	More than 60% under normal barn average weight	Yes	Yes	Yes

sized pigs. Farms varied in where they housed tagged pigs and the status of porcine reproductive and respiratory disease (PRRS) in the herds supplying the nursery pigs:

Farm A/1

Tagged pigs were left in the pens they were found in. The pig flow was a known PRRS-positive flow with clinical problems. Two batches were processed and mean batch size was 3585 pigs. Two hundred pigs were euthanized and 80 tagged.

Farm B/2

Tagged pigs were grouped into set pens if small or lightweight, but were left in the pens where they were found if large or normal weight. The pig flow was known to be PRRS-positive but not a clinical problem at this time. Twelve batches were processed and mean batch size was 587 pigs.

Farm B/3

Tagged pigs were grouped into set pens if small or lightweight, but were left in their original pens if of normal weight or heavier. This practice was used to prevent heavier lame pigs from physically abusing small weak tagged pigs. The pig flow was known to be PRRS-positive but not a clinical problem at this time. Twelve batches were processed and mean batch size was 801 pigs.

Farm C/4

Tagged pigs were grouped into set pens. The pig flow was a healthy PRRS-free flow. Six batches were processed and mean batch size was 2207 pigs.

Farm D/5

Tagged pigs were grouped into set pens. The site was recently depopulated and the pig flow was a healthy PRRS-free flow. Fifteen batches were processed and mean batch size was 930 pigs.

Any pig requiring veterinary treatment was treated according to standard operating procedures on the study farms. The time taken to administer treatment was recorded, as was the amount, type, and cost of drugs administered. If more than one pig was treated at the same

time (e.g., injecting five pigs with an antibiotic) the time taken to treat the group was averaged and the mean cost in time assigned to individual pigs. Tagged pigs were euthanized if their condition progressed to a level that triggered euthanasia for their respective treatment group. The conditions monitored and the levels triggering euthanasia were decided in advance by consensus with the investigators and veterinarians responsible for the health of the pigs studied (Table 1). Pigs were euthanized according to standard operating procedures on the study farms and in accordance with current AVMA guidelines.

If pigs died they were weighed and the date was noted. All tagged pigs were weighed by people standing on bathroom scales (a pig's weight was obtained by subtracting the person's weight) when they were transferred to the finishing barn. In cases where there were no shipping weights they were estimated from the total load-out weight of the batch.

Value of pigs

The value of each lightweight (tagged) pig in each batch was established at shipping by partial budget (additional income+reduced expenses-reduced income-additional expenses). Additional income was calculated as the product of the animal's weight at shipping by the standardized value of \$0.80 per lb. If individual pig weights were not available the shipping weights were estimated from the shipping weights of contemporary pigs in the batch. The cost of drugs administered was set at a standard value per ml of \$0.563 ceftiofur sodium, \$0.04 tylosin, \$0.03 penicillin G, and \$0.05 long-acting oxytetracycline. Cost of time was set at \$10/hour. There were no reduced expenses or reduced income to consider. The value of the batch was the sum of the value of all casualty pigs in the batch.

For tagged pigs that died or were euthanized, the cost of feed consumed was charged against them (and therefore their batch). We assumed a starting pig weight of 5lb, feed consumption of 2lb/d, and feed cost of \$0.13/lb. We did not include the transfer (purchase price) costs in the economic model because it was assumed to be the same for all pigs.

At the time they were received at the nursery and each day thereafter, farm staff observed the pigs under their care and determined if they needed treatment, if euthanasia was warranted, and their condition (specifically if they changed levels in the physical condition they were experiencing). Conditions and levels were recorded for each pig. The welfare score (Table 2) assigned to pigs was the product of the assigned initial score for their condition and level and the number of days they experienced that condition, that is, until they recovered, died, were euthanized, or left the nursery to go to the finishing stage (e.g., a lightweight pig, level C, for 30 days would score 60 (2x30)). Thus, a low welfare score indicated fewer pigs were lightweight for less time and a high score indicated more pigs were lightweight for longer.

Data analysis

The model was of hierarchical design. For each dependent variable (value and welfare), we performed an analysis of co-variance (ANCOVA) in the GLM procedure of SAS (Version 8.01 for Windows98; Statistical Analysis Systems Institute Inc., Cary, North Carolina). The batch (one turn of a nursery room) was the experimental unit. The model included farm, protocol, barn, reason, and the level of reason as nominal (class) data. Barn was nested in farm and level nested in reason. The dependent variables were the value (\$) or welfare.

For sensitivity analysis on the economic value, welfare, cost of treatment, etc., a decision tree was constructed using the results from the mixed model ANOVA in Data 4.0, published by TreeAge Software (<http://www.treeage.com>)

The decision tree diagram represented, in chronological order, the alternative states for the pigs for the duration of their stay in the nursery. When pigs first entered the nursery they would be allocated to the treatment protocol (light, medium, or heavy euthanasia). Then pigs would be examined and determined whether they were in a well or compromised state. If compromised, the reason (state) was determined by clinical examination and a level (state) of severity was assigned. Depending on the protocol, reason, and level then the manager would determine if the pig was either euthanized immediately or tagged and observed daily.

Results

The percentage of deaths numerically increased as the level increased, lightweight/B 9.54% and lightweight/C 17.73% (Table 3). There was considerable variation in the reasons for which pigs were compromised among farms (e.g., 1100 lightweight compared with 41 damaged digits). The decision tree is illustrated in Figure 1.

Discussion:

This study provides economic and welfare-cost guidelines to help producers decide which nursery pigs to euthanize and when. The advantage to producers of adopting a policy to euthanize more casualty nursery pigs on arrival is that they can immediately improve the welfare status of their farm without incurring any capital costs.

The expected values of the chosen protocols (light, medium, heavy) are the average values of uncertainties and these are the result of probabilistic calculations enabling comparisons among the options available and with the stated probabilities. They represent the average values

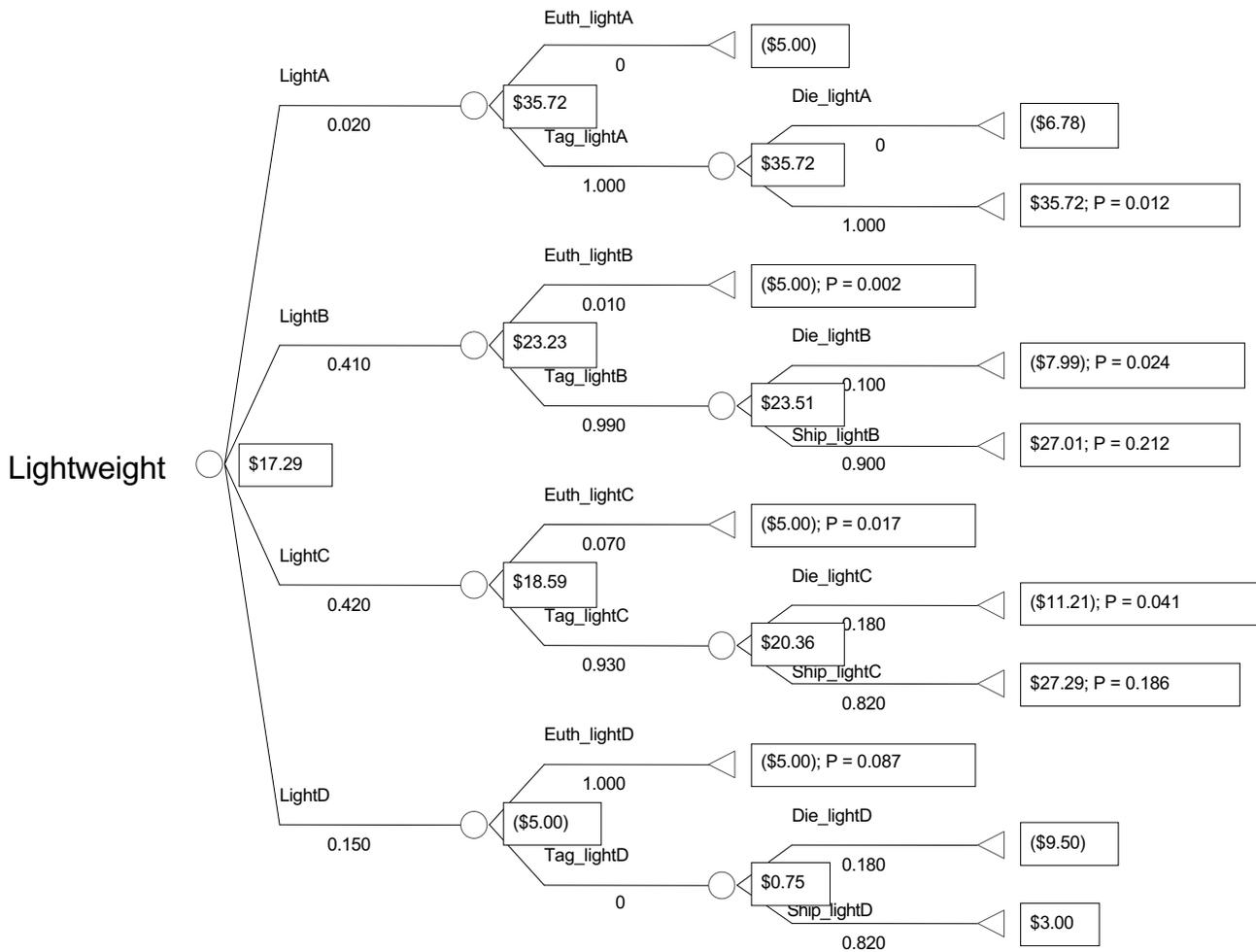
Table 2: Welfare score by condition and level

Level	Condition	Welfare Score
	<i>Lightweight</i>	
A	Less than 40% under normal barn average weight (don't tag)	0
B	40-49% under normal barn average weight	1
C	50-59% under normal barn average weight	2
D	More than 60% under normal barn average weight	3

Table 3: Final disposition of lightweight pigs by condition and level

Level	Euthanized On Entry (# Euthanized)	Tagged Pigs		
		# Tagged	# Died (As % Of Tagged)	# Shipped
A	5	14		14
B	131	325	31 (9.54)	294
C	317	141	25 (17.73)	116
D	167	0		

Figure 1: Decision tree for lightweight pigs



obtained if these treatments were repeated many times on similar pigs on similar farms. They are presented to enable managers to estimate the effect of adopting a protocol better suited to their circumstances by representing the situation on their farms regarding the prevalence of conditions, probabilities of death for the various conditions, and the cost of treatment. In interpreting these sensitivities remember that the proportions of all conditions must sum to 1 and so if the proportion of lightweight pigs increases then the proportion of other conditions must decrease to accommodate the change.

Lightweights have a mortality of 12% (level B and C) and as the proportion increases this decreases the economic value of lightweights across all three protocols. However, because lightweights have a low welfare score (level B=1, level C=2) as their proportion increases, the proportion of pigs with other conditions and higher scores are displaced and welfare improves (welfare score decreases).

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