RESEARCH REPORT
SWINE HEALTH

Title: Economic Impact of PRRS on the Cost of Pork Production – **NPB #02-223**

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Abstract: This study evaluates the cost of PRRS to the United States swine industry. PRRS can lead to reproductive and mortality losses in the breeding, gestation and farrowing phases of pig production. Additionally, losses can carry into the nursery and grow-finish phases of pig production through reduced feed efficiency, increased days to market, reduced average daily gain, increased death loss, etc. The cost analysis is structured to analyze the economic impact of a PRRS outbreak on the three segments of the pig production industry; breeding herd and farrowing, nursery, and grow-finish. Cost impacts are provided by these phases of production. Information for the analysis was obtained from three sources; a case study approach of ten swine production operations which had experienced a PRRS outbreak, the National Animal Health Monitoring System (NAHMS), and a Delphi-type survey of professionals familiar with PRRS and its impacts on pig production efficiency. The issue of the variability of impacts from PRRS is also evaluated. To do this, information from the individual case farms and the Delphi Survey were used to provide insight into the level of variability of PRRS impacts.

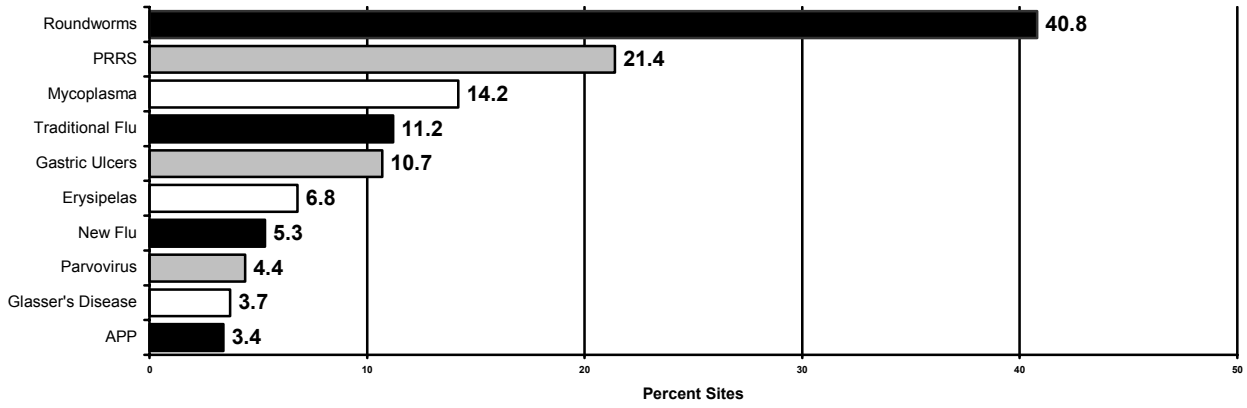
Case study results showed that the farrowing rate declined during PRRS outbreak periods by 10.92 points or from a farrowing rate of 79.36 pre-PRRS to 68.44 during the PRRS outbreak. The number of pigs weaned per litter declined by 1.5 pigs or from 9.13 pigs to 7.63 pigs per litter. Mortality level of nursery pigs increased by 10.65 percentage points (from 1.55 percent death loss to 12.2 percent death loss) during a PRRS outbreak. Mortality level in grow-finish pigs increased by 6.05 percentage points. Feed efficiency and average daily gain for nursery and grow-finish pigs were also impacted. Average daily gain declined by .21 pounds per day (25 percent decline) for the nursery pigs and .20 pounds per day (12 percent decline) for the grow-finish pigs.

Nursery pigs required .18 more pounds of feed (11.69 percent) per pound of gain while pigs in the grow-finish production phase required .24 more pounds of feed (7.57 percent) per pound of gain. The economic impact is as follows: $74.16 per litter in herds which have outbreaks in the gestation-farrowing phase; $6.01 per pig in positive nurseries; and $7.67 per pig in positive grow-finish facilities. The case study analysis shows the total economic impact on production costs to pig producers in the United States is projected to be $560.32 million annually.

The Delphi survey approach showed a greater economic impact than did the case study approach. Production efficiencies such as litter size and farrowing rate declined. Additionally, Delphi survey respondents indicated that weaned pig values were lower for PRRS positive weaned pigs. Their value declined by about 25 percent during the peak outbreak period and about 10 percent during the recovery phase. Mortality, feed efficiency, and average daily gain were impacted in the nursery and grow-finish phases of production for PRRS positive pigs as well. Additionally, Delphi survey respondents indicated that the level of lightweights and culls increased during PRRS outbreaks. There were 18.57 percent more lightweights/culls in the nursery phase during the peak outbreak period and five percent more lightweights/culls during the nursery recovery phase, on average 11.79 percent more lightweights/culls. The peak outbreak period is defined as the acute time of severe clinical signs and production losses. The recovery period is inclusive of moderate clinical signs. The level of veterinary medicine expense per pig was also higher for PRRS positive pigs. On average, it was $1.21 per pig higher. For the finishing phase there were, on average, 8.13 percent more lightweights/culls. Veterinary medicine cost was, on average, $1.49 higher per pig for PRRS positive pigs. The economic impact for the farrowing phase using Delphi survey information is as follows: $189.58 per litter during the peak outbreak period and $52.19 per litter during the recovery phase; $123.47 on average. The economic impact for the nursery phase is $11.68 per pig during the peak outbreak; $3.37 per pig during the recovery period; on average $7.30 per pig. The economic impact during the grow-finish phase is $15.39 per pig during the peak outbreak; $6.03 per pig during the recovery phase; an average $10.66 per pig. The total economic cost on production cost to pig producer is projected to be $761.8 million annually.

Introduction: The health status of pigs impact production efficiencies in the swine industry. This in turn can impact producer competition within the industry and the competitive position of the industry. A health event that has received much attention in the pork production industry for more than a decade is Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) more commonly referred to as PRRS. It is a disease that has been identified as causing severe endemic problems. In the recent National Animal Health Monitoring System (NAHMS) survey of pork production operations, PRRS was the second most often reported health problem in breeding herds (NAHMS-USDA-APHIS-VS, Part II). It was reported as a health problem in 21.4 percent of the breeding herds (Figure 1). The most frequent health problem was roundworms. PRRS was listed as a herd health problem by more respondents than health problems such as *Mycoplasma* pneumonia or the traditional flu (Swine Influenza virus H1N1). Moreover, it was reported that 53.5 percent of the breeding females received a vaccination for PRRS.

Figure 1. Disease Problems Present in Breeding Females during the Previous 12 Months



Source: NAHMS-USDA-APHIS-VS, Swine 2000 Part II.

The Porcine Reproductive and Respiratory Syndrome virus was first recognized in the late 1980's in the United States swine herd (Keffaber, 1989; Loula, 1991). Disease impacts included dramatic reproduction losses, increased pneumonia and reduced pig growth (Hill, 1990). A similar disease was concurrently spreading in the European swine industry (OIE, 1992: Plana Duran et al., 1992; Edwards et al., 1992; Robertson, 1992; Baron, et. al., 1992). By the late 1980's to early 1990's outbreaks were documented in Asia and Taiwan (Chang et al., 1993). It was during this time as well, that the disease was confirmed in Poland and the Czech Republic (Pejsak and Markowska-Daniel, 1996; Valicek et al., 1997). Retrospective studies using serum samples support these conclusions. Serum samples collected in 1980 in Canada showed PRRS antibodies were present (Carman et. al., 1995). Iowa serum samples showed that PRRS antibodies were not present in 1980 while PRRS antibodies were present in 1985 samples (Zimmerman et. al., 1997). The disease had spread throughout the swine production industry within a relatively short period of time.

The United States pig production industry has identified PRRS as one of the major disease problems being faced by producers. It has rapidly spread throughout the industry and has significant impacts on cost of pork production. Studies have provided insight into productivity losses from PRRS and associated disease events. Economic studies have been limited and most have found an economic impact on the breeding, gestation, and farrowing phases. Economic studies to determine the impact in the nursery and grow-finish production phases are even more limited.

During 2000, the National Animal Health Monitoring Systems (NAHMS) conducted a national survey of the United States pig production industry. The survey collected information on a broad range of factors including type of production systems in use, animal health management strategies, animal health issues and industry prevalence, and information on pig productivity. The NAHMS study surveyed 2,499 pig production site surveys conducted to obtain information on type of pig production operation, productivity, etc. The survey covered the December 1999-May 2000 production period. The distribution of surveyed sites by operation size is shown in Tables 1 and 2.

Table 1: Size of Pig Inventory for NAHMS Survey Respondents

Size of Site (Total Inventory)	Number Responding Sites	Percent of Sites
Less than 2,000	1,378	55.1
2,000 – 9,999	1,019	40.8
10,000 or more	102	4.1
Total	2,499	100

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part I, 2001.

Table 2: Size of Sow Inventory for NAHMS Survey Respondents

Size of Site (Total Inventory)	Number Responding Sites	Percent of Sites
Less than 250	1,948	77.9
250 – 499	227	9.1
500 or more	324	13.0
Total	2,499	100

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part I, 2001.

As seen in Table 1, 55 percent of the respondents had less than 2000 pigs in inventory; 41 percent had 2,000 to 9,999 pigs in inventory; while 4.1 percent had 10,000 or more pigs in inventory. Most respondents (78 percent) had less than 250 sows in inventory while 13 percent had 500 or more sows (Table 2). Information provided in Table 3 shows the type of production phases for the NAHMS survey respondents. About one-third of the respondents were farrow-to-finish producers while about four-in-ten were pig finishers.

PRRS in the United States

The initial NAHMS survey showed that 28.3 percent of the sites regularly used PRRS vaccinations (NAHMS-USDA-APHIS-VS, Part I, 2001). There was not a significant difference by size of producers; 27.3 percent, 33.5 percent, and 31.7 percent of the small, medium, and large producers, respectively, vaccinated for PRRS.

Table 3: Type of Production Phase for NAHMS Survey Respondents

Production Phase	Number Responding Sites	Percent of Sites
Farrow to finish	786	31.4
Feeder pig producer	124	5.0
Weaned pig producer	176	7.0
Nursery site	202	8.1
Finisher site	914	36.6
Nursery and finisher site	187	7.5
Other phase	110	4.4
Total	2,499	100

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part I, 2001.

NAHMS followed up the initial survey with a more detailed survey on swine health and health management in the United States pig production industry. This detailed survey involved 895 sites (NAHMS-USDA-APHIS-VS, Part II, 2002). The distribution of sites by pig inventory, sow inventory, and production phase was similar to the initial survey of 2,499 sites. The detailed survey showed that 21.4 percent of the sites indicated they had PRRS problems present in the breeding herd during the previous 12 months. Large producers were much more likely to indicate the presence of PRRS (Table 4). As shown in Figure 1, the only disease problem reported more frequently was roundworms. Disease events such as Mycoplasmal pneumonia and swine flu, were reported less frequently. Eighty percent of the time PRRS was reported as present in the pig operation, it was diagnosed by a veterinarian or laboratory. Thus, while the disease was reported by the operation respondent for the survey, most PRRS events were verified by a veterinarian and/or laboratory diagnoses.

Vaccination for PRRS was used as a management practice by producers. About half (53.5 percent) of the breeding females were located in sites that vaccinated against PRRS (NAHMS-USDA-APHIS-VS, Part II, 2002). More than one-third (37.7 percent) of the breeding females were vaccinated with a modified live vaccine. About one-in-ten (13.2 percent) were vaccinated with a killed vaccine while 5.6 percent were vaccinated with an autogenous PRRS vaccine. Information presented in Table 5 shows the percent of breeding herd sites using
PRRS vaccines.

Table 4: Percent of Sites Indicating the Presence of PRRS during Previous Twelve Months

Operation Size (Number of Sows)	Percent of Sites	Standard Error
Less than 250	15.1	3.4
250 – 499	39.8	7.0
500 or more	58.3	5.5
Total	21.4	3.1

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part II, 2002.

This shows that about 70 percent of the large operations vaccinated for PRRS while a much smaller percent of the smaller operations vaccinated for PRRS (30.6 percent). Slightly more than one-third (37.1 percent) of all sites vaccinated for PRRS. Of the sites that vaccinated for PRRS, 19 percent used more than one type or brand of vaccine. There was a strong tendency for medium size producers to use more than one brand of vaccine (38.2 percent) compared to 20.1 percent of the large sites and 14.3 percent of the small sites. About one-fifth of the PRRS vaccinated breeding herds received one vaccination. Timing of vaccine administration showed a wide variation. About 30 percent of the respondents indicated that they vaccinated at the time gilts entered the herd. Of those that vaccinated, most (80 percent) vaccinated at the time gilts entered the herd.

Table 5: Percent of Breeding Herd Sites that Vaccinated for PRRS during the Six Months Prior to Survey

	Size of Site (Sow and Gilt Inventory)			
	Small (Less than 250)	Medium (250-499)	Large (500 or More)	All Sites
Vaccine Type	Percent	Percent	Percent	Percent
Modified live vaccine	26.0	50.3	44.2	29.9
Killed vaccine	4.3	18.1	21.4	7.1
Autogenous PRRS vaccine	0.1	2.6	7.4	1.0
Any type of PRRS vaccine	30.6	60.8	69.4	37.14

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part II, 2002.

There were a wide variety of methods used by producers to control PRRS. The most common strategy was to use only PRRS negative boars or semen. Large and medium size producers were much more likely to use PRRS control strategies. For example, about half of the medium and large producers acclimatized gilts while only 8.8 percent of the small producers did so. About 90 percent of the large and medium size producers used PRRS control management strategies.

PRRS was not as prevalent in the suckling pig population as it was in the breeding herd. About one-in-ten sites (10.7 percent) reported that they had PRRS in the suckling pigs during the 12 months prior to the survey (NAHMS-USDA-APHIS-VS, Part II, 2002). The most prevalent disease problem in suckling pigs was *Escherichia coli* (45.2 percent of sites), followed by *Streptococcus suis* (29.8 percent) and greasy pig (25.9 percent). The larger operations reported PRRS more often in the suckling pigs; 22.2 percent of sites for large operations, 20.3 percent of medium size sites, and 8.2 percent of the smaller sites (Table 6). Similar to the breeding herd, the majority of the PRRS disease problems were diagnosed by a veterinarian or laboratory (58.5 percent).

Table 6: Percent of Sites Where PRRS was Present during the Previous 12 Months, By Size of Site

	Size of Site (Sow and Gilt Inventory)				
	Less than 250 - Small	250-499 Medium	1500 or More Large	All Sites	Veterinary or Laboratory Diagnosis
Production Phase	Percent	Percent	Percent	Percent	Percent
Breeding herd	15.1	39.8	58.3	21.4	76.7
Suckling pigs	8.2	20.3	22.2	10.7	58.5
Nursery pigs	13.4	33.8	58.0	17.5	67.8
Grow/finish pigs	12.7	32.4	50.7	16.6	75.2

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part II, 2002.

PRRS was a disease problem in nursery age pigs as well. About one-fifth (17.5 percent) of the sites reported PRRS as a problem during the previous 12 months (NAHMS-USDA-APHIS-VS, Part II, 2002). However, it was reported as a disease problem by about six-in-ten (58 percent) of the large operations; those with 10,000 or more pigs in inventory (Table 6). One-third of the medium size sites reported PRRS as

a disease problem while 13.4 percent of the small sites (less than 2,000 in inventory) reported PRRS disease. PRRS was the second most reported disease problem for nursing pigs for the large producers. A majority of the PRRS disease problems in nursery age pigs were diagnosed by a veterinarian or laboratory (67.8 percent).

PRRS disease was also a problem for the grow-finish phase of production. PRRS was reported by 16.6 percent of the sites (NAHMS-USDA-APHIS-VS, Part II, 2002). Again, as shown in Table 6, this was reported more frequently by the large operations (50.7 percent). It was reported as a disease problem by about one-third of the medium size operations and 12.7 percent of the small operations. Three out of four sites with PRRS reported in the grow-finish phase, indicated it was diagnosed by a veterinarian or laboratory.

Vaccines were not widely used for weaned pigs. Only 6.4 percent of weaned pigs were in sites that used vaccines in weaned pigs during the six months previous to the NAHMS survey (NAHMS-USDA-APHIS-VS, Part II, 2002). None of the large sites used PRRS vaccine in weaned pigs. Of the medium size sites, 8.2 percent used the vaccine in weaned pigs while 4.6 percent of the small sites used vaccines. The primary management strategy to control PRRS was a single source of weaned pigs. About 80 percent of the large operations used management strategies to control PRRS while about one-third of the small operations used strategies for PRRS control.

Productivity information for all the NAHMS survey respondents (both PRRS affected and non-PRRS affected farms) is provided in Table 7. This shows that, of the piglets born, 92 percent were born alive. Of those born alive, 11 percent died before weaning. Or, 89 percent were weaned. The total number born alive per litter increased as farm size increased. The large operations, those with 500 or more sows, had 10.2 pigs per litter born alive. This compared to 9.3 pigs born alive for the small operations, those with less than 250 sows. While the pre-weaning death loss increased as the sow herd size increased, the large operation weaned more pigs per litter. They weaned nine pigs per litter, as compared to 8.9 for the medium-sized operator and 8.5 for the small operator.

Table 7: Average Per Litter Productivity for NAHMS Survey Respondents

	Size of Site (Sow and Gilt Inventory)							
	Small (Less than 250)		Medium (250-499)		Large (500 or More)		All Sites	
Measure	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Stillbirths	0.9	8.4	0.9	7.9	0.9	7.9	0.9	8.0
Born Alive	9.3	91.6	10.00	92.1	10.2	92.2	10.0	92.0
Total Born	10.2	100.0	10.9	100.0	11.1	100.0	10.9	100
Pre-weaning deaths	0.8	9.0	1.1	11.1	1.2	11.6	1.1	11
Weaned	8.5	91.0	8.9	88.9	9.0	88.4	8.9	89
Total	9.3	100.0	10.0	100.0	10.2	100.0	10.0	100

Source: NAHMS-USDA-APHIS-VS, Swine 2000, Part II, 2002.

Impact on Pig Productivity

While PRRS leads to reduced pig production efficiency, the severity of the impact has been to vary greatly between farms. Mengeling et. al., 1994, 1996, 1998 and Park et. al., 1996, has shown significant differences in disease impacts. Some outbreaks are

severe leading to catastrophic reductions in productivity, while others are more subclinical with minimal losses. Halbur (1998) suggested that many factors may impact the disease virulence and impact. These include genetic differences of susceptibility of the pig, between farm environmental differences, variation in pig management, level of herd immunity to PRRS and presence of concurrent diseases.

Studies have shown that PRRS appears to attack the pigs immune system, leaving infected pigs more susceptible to secondary disease problems such as pneumonia, etc. (Chiou, 2000). Zeman (1996) has shown that more than 60 percent of pigs infected by PRRS also tested positive for respiratory infection. These can invade the lungs creating lung lesions (Halbur, 1997) and lead to a reduction in average daily gain and feed efficiency (Ciprian, et. al., 1988).

This variability leads to difficult producer decisions on strategies for PRRS control or prevention. Much remains to be discovered about the disease epidemiology and transmission. Additionally, little is known about disease severity and associated factors such as management style, type of production system etc. Thus, it is not possible to assign disease probability and it is quite difficult to assign potential disease impacts for individual farmers.

The intent of this research is to project the economic impact of PRRS for the U.S. pig production industry. The focus will be on the impact on cost of pig production. Due to the variability of production, individual farm case studies will be developed. This will show the effect of PRRS outbreaks respectively on operations and be used to determine the impact of the outbreak. The case study information will be used to project industry impacts as well as the variability of impacts between farms.

PRRS Management Strategies

There is no singular management strategy more successful than the rest. There is a wide array of strategies used. What is best will likely vary by operation. Alternative management strategies would include:

- Following, all-in/all-out production
- Isolation/acclimation of new animals
- Purchasing negative replacement gilts
- Purchasing negative boars/semen
- Follow thorough working/disinfecting
- Provide shower in-shower out facilities
- Prohibit employees from working in other swine herds
- Limit visitors
- Provide clean boots and coveralls
- Change clothes after market hogs
- Control rodents and stray animals
- Dispose of fetuses, placentas, etc. appropriately
- Wash and disinfect transport vehicles
- Whole herd exposure strategies
- Vaccines
- Separation of gilt progeny
- Internal gilt multiplication
- Depopulation/repopulation
- Herd closure
- Test and remove programs
- Segregated sources

The NAHMS 2000 swine survey showed that most sites (70.3 percent) isolated breeding females before adding them to the breeding herd. Thirty percent never isolated new breeding females (NAHMS-USDA-APHIS-VS Info Sheet, February 2003). Two-thirds of the small producers isolated new breeding females. This compared to 79 percent of the medium-sized operations and 84 percent of the large sites. Isolation percentages were similar for breeding males.

The 2000 survey found that 84.1 percent of the sites which isolated new breeding

stock vaccinated them during this time. Other methods used to acclimate gilts included exposure to cull females by about half the sites, feedback of feces from other swine by about one-fourth the sites; and feedback of mummies etc., and exposure to sick pigs (NAHMS-USDA-APHIS-VS, Part I, 2001). Most of the large sites with sows or gilts used artificial insemination (91.3 percent). Only 12.1 percent of the small sites used artificial insemination (NAHMS-USDA-APHIS-VS; VS Info Sheet, September 2002). Although some operations utilize purchased semen to reduce the risk of disease spread. PRRS is known to spread through semen from positive males.

Although not always structured due to health management (i.e. contract production), separate site production was listed as another method of animal health management. Pigs were moved to nurseries or grow-finish operations which were physically separated from other production phases. The large operations had a greater tendency to use this strategy. Segregated early weaning (SEW) was used by only 4.7 percent of the sites. However, most were the large operations and thus, about one-fifth of all the pigs weaned (21.4 percent) were raised using SEW.

Weaned pig source also impacts disease biosecurity and potential for spread. The largest source of weaned pigs came from units that belonged to the site (52.8 percent). Less than one percent comes from sale barns, auctions, or livestock markets. Most of the operations (76.1 percent) relied on only one site for their source of pigs. Another 16.3 percent received their pigs from two sites. All-in/all-out production was used by more than half the sites. The larger operations tended to use it more often. Thus, between 80 to 90 percent of the pigs were raised under all-in/all-out production. Production operations also restricted entry. About two-thirds (65.5 percent) of the sites only allowed employees to enter the facilities. Almost all large sites that allowed visitors (98.3 percent) required visitors to wear clean boots and coveralls when touring the facility. Additionally, most operations did not allow employees to have contact with swine not connected with their operation.

Over half the sites (56.8 percent) allowed trucks transporting livestock to enter the production site. Large sites were less restrictive than small sites. For the large sites, 86.8 percent allowed truck entry. However, large sites were much more likely to require truck disinfecting between pig shipments.

The most common method of dead pig disposal was through a renderer picking up the carcass. This accounted for about 40 percent of the pre-weaned pig carcasses and 55.9 percent of the weaned and older pig carcasses. However, only about 12 percent of the carcasses were picked up outside the operation perimeter. Bait was the most common form (88.5 percent of sites) of rodent control. About six-in-ten sites had cats for rodent control. Cats, while helping control rodents, can carry another problem – *toxoplasma gondii*, an intracellular parasite to be controlled in food animal production. Buildings were also constructed to limit rodent entry. About half the sites had feed storage facilities that kept out rats and mice. About six-in-ten storage facilities kept out cats.

Economic Impact of PRRS

Studies have shown that PRRS infection can impact pig production efficiency. These impacts can be manifested in reduced reproduction efficiency such as litter size and number of piglets born alive, pre-wean mortality, reduced breeding success and increased repeat breedings. Morbidity and mortality have increased. Additionally, the production efficiency of nursery and grow-finish pigs are impacted as well through increased levels of death, reduced feed efficiency, etc. Some of the impacts can be catastrophic in a swine herd.

A limited number of studies have addressed the economic impact of PRRS in a pig breeding herd. Hoefling (1992) evaluated four herds in Illinois and projected the economic impact "cost" of the initial outbreak of each herd to range from $100 to $510 per breeding female. The average was $302 per breeding female. Polson et. al. (1992) projected the cost for a four-month outbreak to be $236 per breeding female. The primary impact was from a reduced level of pigs produced. Pigs weaned per female per year declined by 3.8 pigs over baseline production levels. In 1997, Dee et al. projected loss levels at $228 per sow over the year of the PRRS outbreak. Losses included an increased level of mortality, reduced rate of growth, and increased costs of medication and vaccination. For these three studies the average cost per sow for a PRRS outbreak is $255.

In a recent report for the National Pork Board, Holck et. al. developed a model to evaluate economic impacts from reduced farrowing rates, reduced live born per litter, and increased percent pre-wean mortality. They developed some baseline scenarios for application of the model. They projected that a one percent decline in farrowing rate led to a loss ranging from $3.20 to $8.00 per mated female per year; the average was $5.60. A decrease in live birth of one pig per litter led to a loss ranging from $37.00 to $92.00 per mated female per year; the average was $64.00. If percent pre-wean mortality increased by one percent, projected losses ranged from $4.20 to $10.40 per mated female; the average was $7.30.

A recent study in Poland has shown that animal health prevention and treatment costs can increase dramatically during and following a PRRS outbreak (Pejsak et. al., 1997). The study showed that expenses related to post secondary infections increased 60 percent during the 12 months following the outbreak. Animal health expenses during the peak of the outbreak ran at levels four times greater than the levels prior to the PRRS outbreak. Animal health expenses a year after the outbreak remained above the pre-outbreak level.

The impact of PRRS on nursery-finishing pigs has received limited attention as well. A summary of the studies and projected economic impact is shown in Table 8. PRRS has been shown to weaken the pig, reducing its immune response and leading to other health problems such as *Mycoplasma hyopneumonia*, swine flu, etc. PRRS appears to lead to these other health problems and there is felt to be a direct association. Dee and Joo (1993) estimated an additional cost of $7.40 to $15.00 per pig marketed from groups infected with PRRS. They projected that it took 14 to 30 more days to reach market weight. There was also increased mortality and an increased number of non-marketable pigs. Kerkaert (1994) found profit in the nursery stage declined by about $5.00 per pig due to PRRS. Here again, mortality levels increased, feed efficiency was worse and growth rates declined. In a 1994 study Dee and Joo projected increased cost per pig due to an endemic problem of PRRS in the nursery ranged from $10.50 to $12.50 per pig marketed. This was $225 per sow per year. Polson et. al. 1994 developed a model that allowed average daily gain, mortality, and PRRS duration to vary in determining economic impact of PRRS in nursery pigs. The PRRS impact ranged from $.73 to $18.21 per pig placed on feed. The low projection reflected only a two percent increase in mortality while the high estimate involved a five percent reduction in average daily gain, a 12 percent increase in mortality, and a six-week duration of the outbreak.

Table 8: Summary of Economic Impacts of PRRS in Nursery-Finishing Pigs

Study Authors	Year Date	Projected PRRS Impact
Dee and Joo	1993	$7.50 to $15.00 per pig
Kerkaert	1994	$5.17 per feeder pig
Dee and Joo	1994	$10.50 to $12.50 per pig
Polson, Gorcyca & Morrison	1994	$0.73 to $18.21 per pig
Holck and Polson	2003	$4.59 to $15.89 per pig
Main	2003	$7.07 per pig

In a recent study, Main projected that the cost of a PRRS outbreak in the nursery and finisher was $7.07 per pig. Holck and Polson projected the economic impact of a low, moderate and higher impact resulting from a PRRS outbreak in the pig finishing state. The low impact scenario assumed a five percent decrease in average daily gain, a five percent increase in feed per pound of gain and a three percent decrease in percent marketable pigs. For the moderate impact scenario, the assumed changes were a 10 percent decrease in ADG; a 10 percent increase in F/G; and a five percent decrease in percent marketable pigs. The high impact scenario assumed a 15 percent decrease in ADG; a 15 percent increase in F/G; and a 10 percent decrease in percent marketable pigs. Feed cost as well as live hog prices were also varied. The range of economic impact was from $4.59 to $15.89 per pig.

Along with the production impacts from PRRS are the cost of intervention strategies, test costs and cost for any PRRS treatment. This can include items such as herd testing, costs of vaccine and labor for vaccination, and income impacts from herd closure as a control method. Holck et. al. (2003) projected the cost of herd testing for PRRS. The herd size was varied. It was also assumed that 30 breeding animals would be tested monthly and 15 pigs would be sampled from each nursery group and 15 pigs from each finisher group. The laboratory cost was $5.00 per sample. Given this information, the testing cost was $14.40 per sow ($.72 per pig) for an operation with 250 sows. The cost for a 4,000 sow operation was $.72 per sow ($0.36 per pig) if there was one pig flow. The cost for the 5,000 sow operation with four pig flows was $1.80 per sow or $.09 per pig.

Studies have projected economic impacts of PRRS outbreaks in other countries as well. The impact of an outbreak near Beijing, China in 1995 was projected to be about $73 million (USD) from mortalities alone (Cai et. al., 2000). Another study evaluated the cost of a PRRS control program as compared to the cost of a disease outbreak. This was done for the “Pays de la Loire” region of France (Le Potier et. al., 1997). The projected cost was one to two million euros for a control program. This compared to a projected cost of 18 million euros for a disease outbreak. A control program was concluded to be more cost effective than not doing anything until the disease was present in swine herds.

Objectives: The primary objective of this study is to evaluate the cost of PRRS to the United States swine industry. PRRS can lead to reproductive and mortality losses in the breeding, gestation and farrowing phases of pig production. Additionally, losses can carry on into the nursery and grow-finish phases of pig production through reduced feed efficiency, increased days to market, increased death loss, etc. The cost analysis will be structured to analyze the economic impact of a PRRS outbreak on the different segments of the pig production industry; breeding herd and farrowing, nursery, and grow-finish. Cost impacts will be provided by these phases of production.

Materials and Methods: Information on production impacts resulting from PRRS is necessary for the economic analysis. This includes impacts on such factors as breeding efficiency, abortions, farrowing rate, litter size and weight, sow death and cull rates, etc. for the breeding gestation and farrowing phases. It also includes pig death rates and associated weaning levels for the farrowing phase of production. Nursery production efficiencies include such factors as average daily gain, feed efficiency, death loss, etc. Similar factors would be important for the grow-finish phase of production. Information which would cut across the different production phases would include information on such factors as growth rate or average daily gain, days-to-market, etc.

Information for the analysis was obtained from three sources. The first was from information obtained in a case study of swine production operations which had experienced a PRRS outbreak. Detailed production information was obtained from ten farms which had a PRRS outbreak. Farms were selected based on size, type of organization, and type of production system. Production system types included farrow-to-finish weaned pig producer, and market pig finisher. They were also selected based on the availability of detailed production information that could be analyzed during the outbreak period as well as before and/or after the outbreak. This allows for analysis of changes in production efficiency during the outbreak period. Some producers had multiple production sites and/or multiple groups and had sites which were PRRS positive while others were PRRS negative.

This approach included producers representing various ranges of operation size. Production efficiencies are compared between pigs in herds (groups) which were impacted by PRRS to those not impacted by PRRS. For some operations it was possible to identify groups of pigs which were impacted by PRRS and groups not impacted. For these operations, which had multiple groups of pigs, the comparison was across the same time period. Moreover, the comparable groups were under the same management and were from identical genetics. With this approach, production efficiencies were compared between the groups which had a PRRS outbreak and those that did not. An advantage of this approach is that all groups are under the same management, same facility type, same ration, etc. and at a similar time period. For other operations, the comparison was across groups over time. This approach compared production efficiencies on a before, during, and after outbreak analysis. This allowed determination of production impacts during the outbreak time period. This approach allows inclusion of operations which are not of sufficient size that they have multiple groups being produced at the same time to be included in the analysis.

The length of the PRRS ‘outbreak’ period varied between producers. The high degree of disease impact variation and length of outbreak is representative of the industry. To identify and evaluate an outbreak impact for the PRRS infected herds, the first month of significant production losses was identified as the start of the outbreak period for each farm. In most cases this ‘outbreak’ period was verified by a PRRS test and the operations practicing veterinarian. Weekly and monthly production losses were monitored to determine when significant losses waned. The average value of the production parameters during the ‘outbreak’ period was compared to the average production values for the pre- and/or post-outbreak period. Clinical and/or viral PRRS was not present. Post-outbreak information was not used until it was clear that PRRS production losses were minimized or eliminated. Clearly evident in the case farms is that the degree of impact variability between farms. There does not appear to be what could be referred to as a ‘typical’ PRRS outbreak.

It is also important to note that not all production parameters were impacted for the same time period or duration for the case farms. For example, within the sow herd,

farrowing rate, abortions, stillborns, numbers weaned, etc. which were associated with PRRS, were impacted in different weeks/months (time periods). The case study analysis accounted for this.

The second information source is the National Animal Health Monitoring System (NAHMS). This system provides a broad base of information for the livestock industry. A survey of the pig production industry was completed in 2000 by NAHMS. Animal health information was included. This information included PRRS. The survey results show the percent of sows, pigs and farms reported as PRRS positive. This information is needed for developing an economic analysis on the cost of PRRS to the industry. The NAHMS survey results provides information for the breeding, gestation, and farrowing phase along with the nursery phase, and the finishing phase. This information on percent of the herds and pigs which are PRRS positive is used to link with production efficiency impacts reflected in the case study farms.

The third source of information is the result from a Delphi-type survey of personnel familiar with PRRS. The survey is used to obtain information on the respondent's insight into PRRS. Individuals surveyed were primarily veterinarians who are familiar with PRRS through working with their clients. All respondents serve as consulting veterinarians for pig producers. All had a large number of producers as clients. Information on production efficiency impacts, percent of herds impacted, outbreak duration, etc. was obtained from the respondents.

The issue of the variability of impacts from PRRS is also evaluated. To do this, information from the individual case farms and the Delphi Survey will be used to provide insight into the level of variability of PRRS impacts. The individual farm results are provided to show the potential range in production and economic impacts. Similarly, results from the Delphi survey can provide insight into the perceived variability of PRRS impacts.

Results

Cost of PRRS – Farm Case Study Approach

A. Production Efficiency Impacts

For the case study approach, ten pork producers were interviewed and detailed production information was obtained. The ten producers represented a broad range of type of producers. They ranged from independent family farmers to corporate operations. They included farrow-to-finish producers, weaned pig or feeder pig producers, and nursery and/or finish pig producers. The size of the operations ranged from 320 sows to more than 80,000 sows. The nursery and grow-finish groups represent close outs from 300 pigs to 750,000 pigs. Descriptive information is provided in Table 9. This provides information on operation size, duration of PRRS impact, and comparison groups. Production information was available for the farrowing, nursery, and finishing phases.

Table 9.

Description of Sow Farms In Case Study

Farm	Size	Duration of Impact	Comparison
A-1	3 units, 3400 sows each	28 months endemic	1 unit PRRS positive; 2 units PRRS negative of same size, management, genetics, nutrition & time period
A-2 (a)	same as A-1	10 months endemic	same as A-1
B-1	1400 sows	3 month outbreak	w/in farm; same time period pre-outbreak
B-2 (b)	1400 sows	2 month outbreak	w/in farm; same time period pre-outbreak
C	4000 sows	3 month outbreak	w/in farm; 8 months pre-outbreak & 1 month post-outbreak
D-1	475 sows	4 month outbreak	w/in farm; same time periods 1 & 2 years pre-outbreak
D-2 (c)	475 sows	12 month endemic	w/in farm; same time periods 1 & 2 years pre-outbreak
E	2800 sows	3-4 month outbreak	w/in farm; 7 months pre-outbreak & 2 months post-outbreak
F	1000 sows	3-4 month outbreak	w/in farm; 8-9 months pre-outbreak

Description of Nursery Farms in Case Study

Farm	Number of Groups	Number of Pigs	Comparison
A-2 (d)	40 positive; 105 negative	51,185 positive; 137,568 negative	simultaneous to PRRS negative pigs from other units
J	66 positive; 220 negative	220,049 positive; 531,159 negative	simultaneous to PRRS negative pigs from other units

Description of Grow-Finish Farms in Case Study

Farm	Number of Groups	Number of Pigs	Comparison
A-2 (d)	38 positive; 109 negative	44,358 positive; 140,127 negative	simultaneous to PRRS negative pigs from other units
G	2 positive; 12 negative	463 positive; 2568 negative	simultaneous, pre & post-PRRS groups
H	12 positive; 8 negative	5774 positive; 3441 negative	pre & post-PRRS groups
I	27 positive; 24 negative	9500 positive; 8400 negative	post-PRRS groups
J-1 (e)	325 positive; 178 negative	363,237 positive; 198,116 negative	simultaneous to PRRS negative pigs from other units
J-2 (f)	221 positive; 178 negative	233,281 positive; 198,116 negative	simultaneous to PRRS negative pigs from other units

(a) A-1 and A-2 are the same farm; A-1 is inclusive of A-2; A-2 is the last 10 months of A-1; A-2 corresponds with nursery and finish pigs represented by farm A-2
(b) B-1 and B-2 are the same farm; B-2 is a second outbreak of a new strain one year later
(c) D-1 and D-2 are the same farm; D-2 is inclusive of D-1; D-2 reveals the residual impacts
(d) A-2 nursery and finish pigs are 10 months of production from A sow farms
(e) J-1 positive represents pigs that were negative in the nursery
(f) J-2 positive represents pigs that were also positive in the nursery

Table 10. Farrowing Productivity Comparisons for Case Farms A and B

Item	Farm A-1 (a)				Farm A-2 (b)				Farm B-1 (c)			
	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference
Farrowing Rate	72.0	81.0	-9.0	-11.11%	70.0	78.0	-8.0	-10.26%	83.0	85.0	-2.0	-2.35%
Percent Rebreeds	18.0	13.0	5.0	38.46%	21.0	13.5	7.5	55.56%	15.43	13.97	1.46	10.45%
Litters Per Sow Per Year	2.2	2.40	-0.2	-8.33%	2.27	2.36	-0.09	-3.81%	2.18	2.11	0.07	3.32%
Total Pigs Born Per Litter	10.74	11.08	-0.34	-3.07%	10.56	10.87	-0.31	-2.85%	12.71	12.48	0.23	1.84%
Stillborn Pigs Per Litter	0.76	0.87	-0.11	-12.64%	0.80	0.92	-0.12	-13.04%	1.83	1.04	0.79	75.96%
Mummies Per Liter	0.18	0.12	0.06	50.00%	0.16	0.10	0.06	60.00%	1.04	0.19	0.85	447.37%
Pigs Born Alive Per Litter	9.80	10.1	-0.3	-2.97%	9.6	9.84	-0.24	-2.44%	9.84	11.25	-1.41	-12.53%
Percent Preweaning Mortality	13.81	10.66	3.15	29.55%	13.18	9.90	3.28	33.13%	26.67	7.00	19.67	281.00%
Pigs Weaned Per Sow Farrowed	8.4	9.10	-0.7	-7.69%	8.3	8.85	-0.55	-6.21%	7.51	10.46	-2.95	-28.20%
Pigs Weaned Per Sow Per Year	19.19	22.43	-3.24	-14.44%	19.5	21.45	-1.95	-9.09%	16.3	22.1	-5.8	-26.24%

(a) The outbreak time period was 28 months; December 1998-March 2001. The positive farrowing facilities are compared to the negative faciltiies.
(b) The outbreak time period was 10 months; June 2000-March 2001. The positive farrowing facilities are compared to the negative facilities.
(c) The outbreak time period was three months; March-May 2002. This is compared to production information for the same time period in 2001.

Table 11. Farrowing Productivity Comparisons for Case Farms B and D

Item	Farm B-2 (d)				Farm D-1 (e)				Farm D-2 (f)			
	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference
Farrowing Rate	71.0	91.0	-20.0	-21.98%	76.2	83.2	-7.0	-8.41%	79.6	83.2	-3.6	-4.33%
Percent Rebreeds	28.88	9.60	19.27	200.68%	14.2	8.70	5.5	63.22%	11.5	11.5	0.0	0.00%
Litters Per Sow Per Year	1.81	2.31	-0.5	-21.65%	2.25	2.47	-0.22	-8.91%	2.27	2.38	-0.11	-4.62%
Total Pigs Born Per Litter	12.44	12.75	-0.31	-2.43%	8.4	11.7	-3.3	-28.21%	10.1	11.5	-1.40	-12.17%
Stillborn Pigs Per Litter	2.46	0.97	1.49	153.61%	0.92	1.28	-0.36	-28.13%	1.05	1.78	-0.73	-41.07%
Mummies Per Liter	1.44	0.19	1.25	657.89%	0.08	0.12	-0.04	-33.33%	0.10	0.16	-0.06	-37.27%
Pigs Born Alive Per Litter	8.54	11.59	-3.05	-26.32%	9.4	10.3	-0.9	-8.74%	9.6	10.0	-0.4	-4.00%
Percent Preweaning Mortality	24.61	8.67	15.94	183.85%	16.5	10.9	5.6	51.38%	13.8	11.8	2.0	16.95%
Pigs Weaned Per Sow Farrowed	7.06	10.46	-3.41	-32.55%	7.8	9.10	-1.3	-14.29%	8.2	8.8	-0.6	-6.82%
Pig Weaned Per Sow Per Year	12.91	24.11	-11.2	-46.45%	17.6	22.4	-4.8	-21.43%	18.7	21	-2.3	-10.95%

(d) The outbreak time period was 2 months; February-March 2003. This information is compared to production during February, March 2001 & February 2002.
(e) The outbreak time period was 4 months; December 2001-March 2002. This information is compared to production in the same time period 1999/2000 and 2000/2001.
(f) The outbreak time period was 12 months; December 2001-November 2002. This information is compared to production in the 24 month period prior to the outbreak.

Table 12. Farrowing Productivity Comparisons for Case Farms C, E, and F

Item	Farm C (g)				Farm E (h)				Farm F (i)			
	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference	PRRS Outbreak	PRRS Non-Outbreak	Difference	Percent Difference
Farrowing Rate	56.7	70.1	-13.4	-19.12%	66.6	75.6	-9.0	-11.90%	40.9	67.1	-26.2	-39.05%
Percent Rebreeds	27.3	12.7	14.6	114.96%	28.1	16.2	11.9	73.46%	57.5	24.6	32.9	133.74%
Litters Per Sow Per Year	2.24	2.22	0.02	0.90%	2.25	2.32	-0.07	-2.83%	1.48	2.05	-0.57	-27.65%
Total Pigs Born Per Litter	11.27	11.37	-0.1	-0.88%	10.40	10.69	-0.29	-2.68%	9.97	10.47	-0.50	-4.78%
Stillborn Pigs Per Litter	1.27	0.87	0.4	45.98%	0.86	0.69	0.18	25.43%	0.87	0.75	0.12	16.30%
Mummies Per Liter	1.2	0.4	0.8	200.00%	0.41	0.14	0.27	181.10%	0.11	0.08	0.03	32.75%
Pigs Born Alive Per Litter	8.8	10.1	-1.3	-12.87%	9.1	9.8	-0.7	-7.14%	8.97	9.64	-0.68	-7.03%
Percent Preweaning Mortality	23.2	16.5	6.7	40.61%	14.0	9.9	4.1	41.41%	24.8	15.1	9.7	64.24%
Pigs Weaned Per Sow Farrowed	6.4	8.4	-2.0	-23.81%	8.0	8.9	-0.9	-10.11%	7.0	8.1	-1.1	-13.58%
Pig Weaned Per Sow Per Year	14.6	19.1	-4.5	-23.56%	17.8	20.1	-2.3	-11.44%	10.3	16.7	-6.4	-38.32%

(g) The outbreak time period was 3 months; December-February 2002-2003. This information is compared to production April-November 2002 and March 2003.
(h) The outbreak time period was for3-4 months; January-March 2002. The information is compared to production June-December 2001 and April-May 2002.
(i) The outbreak time period was for 3-4 months; October-December 2002. The information is compared to production January-September 2002.

Information in Tables 10, 11, and 12 shows farrowing productivity information by farm for the outbreak groups as compared to the non-outbreak groups. The pig producers along with their veterinarians helped identify the outbreak and non-outbreak groups. Detailed information is provided on a number of variables ranging from farrowing rate, litters per sow per year, pigs born and weaned per litter, and pigs weaned per sow per year.

The length or duration of PRRS outbreak was variable between operations. The normal duration for farrowing operations was about four months. Some are much longer than this as some appear to be a chronic infection, lingering for long periods of time. Although these analyses are for periods longer than the 'average' of three to four months, they are included in the outbreak assessment as the production losses never returned to pre-outbreak levels. The range is exhibited by operations A, B, and D. PRRS was a chronic problem for operation A. For B, there were two outbreaks; one was three months while the other was two months in duration. For operation D the acute outbreak was four months in duration. It was endemic for 12 months.

The farrowing rate for producer A-1 was 72 percent for the PRRS outbreak herd as compared to 81 percent (9 percentage points higher) for the PRRS negative herds. This difference persisted over a 28 month time period. Not only was the farrowing rate lower, the number of pigs weaned per litter was also lower; 8.4 pigs for the PRRS positive herd as compared to 9.1 pigs for the PRRS negative herds. Farrowing rate for producer B was not impacted as much for the first outbreak. The second outbreak lead to a greater impact on the farrowing rate. The number of stillborn and mummy pigs for operator B was higher during the PRRS outbreak periods. Pre-weaning mortality was also much higher during the PRRS outbreak for all operations, but especially operation B.

Table 13 provides a summary of the production impacts in the farrowing operation for the case study farms. Farrowing rate and pigs weaned per litter are two key variables. The farrowing rate links to the number of litters that will be produced per sow per year. Pigs weaned represents the number of pigs available after weaning. This would be the number of pigs available to go into the nursery or the number available for sale as weaned pigs.

The average farrowing rate for the PRRS negative groups was 79.36. This compared to a farrowing rate of 68.44 for the positive groups, a reduction of 10.92 percentage points in the farrowing rate. The farrowing rate decline ranged from only two percentage points for operation B-1 to 26 percentage points for operation F. The decline was almost a 40 percent decline for producer F (Table 12). The farrowing rate for operator F was under 50 percent during the outbreak. Litters per sow per year averaged 2.29 for the PRRS negative groups as compared to 2.09 for the PRRS positive groups; a difference of .20 litters. This difference ranged from a .02 reduction for producer C to a reduction of .5 for producer B-2. This is about a 22 percent reduction for producer B-2. Pigs weaned per litter averaged 9.13 pigs for the PRRS negative groups. This compared to 7.63 pigs for the PRRS positive groups, a reduction of 1.5 pigs per litter. This ranged from a reduction of .6 pigs for producer D-2 to 3.4 pigs for producer B-2.

Information in Table 14 shows the absolute, as well as percentage change in production efficiency between the PRRS negative and PRRS positive groups for each case farm. This provides information on the impact variability between producers. This shows the dramatic impacts experienced from a PRRS outbreak by some operators. For example, the farrowing rate declined by 39.05 percent during the PRRS outbreak for producer F. It only declined by 2.35 percent for producer B-1. Number of pigs weaned per sow per year declined by 46.45 percent for producer B-2 during the PRRS outbreak.

Table 13. Summary of Farrowing Pig Production Information for Case Farms

Farm	Farrowing Rate		Pigs Weaned Per Litter		Litters Per Sow Per Year	
	Negative Group	Positive Group	Negative Group	Positive Group	Negative Group	Positive Group
A-1	81.0	72.0	9.10	8.40	2.40	2.20
A-2	78.0	70.0	8.85	8.30	2.36	2.27
B-1	85.0	83.0	10.46	7.51	2.11	2.18
B-2	91.0	71.0	10.46	7.06	2.31	1.81
C	70.1	56.7	8.40	6.40	2.22	2.24
D-1	83.2	76.2	9.10	7.80	2.47	2.25
D-2	83.2	79.6	8.80	8.20	2.38	2.27
E	75.6	66.6	8.90	8.00	2.35	2.17
F	67.1	40.9	8.10	7.00	2.05	1.48
Average	**79.36**	**68.44**	**9.13**	**7.63**	**2.29**	**2.09**

Nursery productivity information for PRRS negative and positive groups is provided in Table 15. Two case farms (operations) had nursery productivity information. Nursery mortality was higher for the PRRS positive groups of pigs. However, it was dramatically different between the two operations. The increase in nursery mortality for producer A-2 increased by 17.91 percentage points to a mortality rate of almost 20 percent. It increased by 3.39 percentage points for operator J. The average increase in mortality was 10.65 percentage points (Table 16). Average daily gain declined by .21 pounds for each operator. However, the percentage change was different as producer A was more efficient than producer J. The average daily gain reduction was 28 percent for producer A-2 as compared to about 23 percent for producer J. Average daily feed intake also declined for the PRRS positive groups of nursery pigs. They ate about .2 fewer pounds of feed per pig per day. Feed efficiency declined by .19 pounds for operator A-2 and .17 pounds for operator J. On average, about .18 pounds more was needed per pound of gain for the PRRS positive pigs. This represents about a 12 percent increase.

Grow-finish mortality increases for PRRS positive pigs also exhibited variability. It ranged from an increase of 1.53 percentage points to 15.09 percentage points (Table 16 and 17). While an increase in the mortality rate of 1.53 percentage points does not appear to be large, it is an increase of about 50 percent over the PRRS negative groups. The average increase in percent mortality was 6.05 percentage points. Average daily gain and feed efficiency for the PRRS positive groups of pigs were also impacted in the grow-finish phase of production. This is shown in Tables 16 and 18. Average daily gain declined by about .20 pounds per day. This ranged from a high of .64 pounds per day for producer G to .03 pounds per day for producer I. Average daily gain declined, on average, by 12.03 percent. Feed efficiency declined, on average by 7.57 percent. Pounds of feed increased by about .24 pounds of feed per pound of gain. Two farms, J-1 and J-2 exhibited slightly improved feed conversion for the PRRS positive pigs. This is most likely due to suppressed appetite and decreased feed intake.

Table 14. Farrowing Productivity Differences for Case Farms: Comparison of PRRS Positive and Negative Groups

Case Farm	Farrowing Rate		Number Pigs Weaned Per Sow Farrowed		Number Pigs Weaned Per Sow Per Year	
	Difference (%)	Percent Difference	Difference (Number)	Percent Difference	Difference (Number)	Percent Difference
A-1 (a)	-9.00	-11.11	-.70	-7.69	-3.24	-14.44
A-2 (b)	-8.00	-10.26	-.55	-6.21	-1.95	-9.09
B-1 (c)	2.00	-2.35	-2.95	-28.20	-5.80	-26.24
B-2 (d)	-20.00	-21.98	-3.41	-32.55	-11.20	-46.45
C (e)	-13.40	-19.12	-2.20	-25.58	-4.50	-23.56
D-1	-7.00	-8.41	-1.30	-14.29	-4.80	-21.43
D-2	-3.60	-4.33	-.60	-6.82	-2.30	-10.95
E	-9.00	-11.90	-.90	-10.11	-2.30	-11.44
F	-26.20	-39.05	-1.10	-13.58	-6.40	-38.32
Average	**-10.92**	**-13.76**	**-1.50**	**-16.43**	**-4.72**	**-22.44**

(a) This is a 28-month outbreak time period: December 1998-March 2001. Some farrowing facilities were negative while others were positive.
(b) This is a 10-month outbreak time period: June 2000-March 2001. Some farrowing facilities were negative while others were positive.
(c) Outbreak period was three months: March-May 2002 production is compared to same period in 2001.
(d) Outbreak period was two months: February-March 2003. The February, March 2003 production is compared to February, March 2001 and February 2002 production.
(e) Outbreak period was three months: December 2002-February 2003.

Table 15. Nursery Pig Productivity Comparisons for Case Farms

	Farm A-2				Farm J			
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference
Percent Mortality	19.63	1.72	17.91	1041.28%	4.77	1.38	3.39	245.65%
Average Daily Gain	0.54	0.75	-0.21	-28.00%	0.72	0.93	-0.21	-22.58%
Average Daily Feed Intake	0.99	1.22	-0.23	-18.85%	1.17	1.35	-0.18	-13.33%
Feed Efficiency	1.81	1.62	0.19	11.73%	1.63	1.46	0.17	11.64%

B. Economic Impact on Cost of Production

The economic impact of PRRS was evaluated for three phases of production; the farrowing phase, the nursery phase, and the grow-finish phase. To determine United States industry level impacts, three items are needed. Production efficiency impacts are needed. These represent factors such as increased mortality level, reduced farrowing rate, reduced average daily gain, reduced feed efficiency, etc. Information on pig prices, feed prices, etc., are also needed to determine the economic cost of the reduced production efficiencies.

Table 17. Summary of Nursery and Grow-Finish Mortality Percent Changes between PRRS Positive and Negative Pig Groups for Case Farms

Farm	Percent Nursery Mortality		Percent Grow-Finish Mortality	
	Difference	Percent Difference	Difference	Percent Difference
A-2	17.91	1041	11.10	189
G			15.09	408
H			4.10	187
I			1.53	44
J	3.39	2.46		
J-1			1.56	59
J-2			2.90	109
Average	**10.65**	**644**	**6.05**	**166**

Table 16. Grow-Finish Pig Productivity Comparisons for Case Farms

	Farm A-2 (a)				Farm G				Farm H			
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference
Percent Mortality	16.96	5.86	11.10	189.42%	18.79	3.70	15.09	407.84%	6.40	2.30	4.10	178.26%
Average Daily Gain	1.52	1.69	-0.17	-10.06%	1.00	1.64	-0.64	-39.02%	1.36	1.55	-0.19	-12.26%
Average Daily Feed Intake	4.62	4.77	-0.15	-3.14%	4.36	5.21	-0.85	-16.31%	4.80	5.40	-0.60	-11.11%
Feed Efficiency	3.03	2.82	0.21	7.45%	4.36	3.18	1.18	37.11%	3.55	3.49	0.06	1.72%

	Farm I				Farm J-1(b)				Farm J-2(c)			
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference
Percent Mortality	5.0	3.47	1.53	44.09%	4.22	2.66	1.56	58.65%	5.56	2.66	2.90	109.02%
Average Daily Gain	1.5	1.53	-0.03	-1.96%	1.75	1.80	-0.05	-2.78%	1.69	1.80	-0.11	-6.11%
Average Daily Feed Intake	4.99	4.82	0.17	3.53%	4.74	4.95	-0.21	-4.24%	4.41	4.95	-0.54	-10.91%
Feed Efficiency	3.33	3.15	0.18	5.71%	2.71	2.75	-0.04	-1.45%	2.61	2.75	-0.14	-5.09%
Cull Percent					3.15	2.25	0.90	40.00%	4.58	2.25	2.33	103.56%
Cull Weight					194	201	-7	-3.48%	185	201	-16	-7.96%

(a) This represents the pigs from farm A-2 that were weaned during the 10 month outbreak shown in Table 9.
(b) PRRS positive represents pigs negative in the nursery and positive in the finisher.
(c) PRRS positive represents pigs positive in the nursery and positive in the finisher.

Table 18. Summary of PRRS Average Daily Gain and Feed Efficiency Impacts in the Nursery and Finishing Production Phase for Case Farms

Farm	Nursery Average Daily Gain		Nursery Feed Efficiency		Finish Average Daily Gain		Finish Feed Efficiency	
	Difference	Percent Difference	Difference	Percent Difference	Difference	Percent Difference	Difference	Percent Difference
A-2	-.21	-28.00	.19	11.73	-.17	-10.06	.21	7.45
G					-.64	-39.02	1.18	37.11
H					-.19	-12.26	.06	1.72
I					-.03	-1.96	.18	5.71
J-1					-.05	-2.78	-.04	-1.45
J-2	-.21	-22.58	.17	11.64	-.11	-6.11	-.14	-5.09
Average	**-.21**	**-25.29**	**.18**	**11.69**	**-.20**	**-12.03**	**.24**	**7.57**

The third item of information is the percent of the United States pig herd impacted by PRRS. The production efficiency information provided above for the case study farms, will be utilized for this analysis of economic impacts on the United States pork production industry. Pig price, feed prices, etc., information utilized is average historical prices for the United States. Prices utilized are as follows: weaner pig price = $30.00; feeder pig price = $50.00 for 50 pound pig; nursery feed price = $.13 per pound; grow-finish feed price = $.063 per pound; facility cost per day = $.10 per pig. Variable cost and fixed cost per litter is obtained from Iowa State University farrow-to-finish pig production budgets (May, et al. 2003).

The economic impact of an acute PRRS outbreak in the farrowing phase of a pig production operation is $45.00 lost revenue per litter and $29.16 per litter from reduced farrowing rate; or a total of $74.16 per litter. This is based on the above information and shown in Table 19. This would represent the loss level using the information from the case study farms. Number of pigs weaned per litter fell by 1.5 pigs per litter for the PRRS positive (7.63 pigs) group as compared to the PRRS negative (9.13 pigs) groups (Table 13).

Table 19. Economic Impact of PRRS Outbreak on Farrowing Phase of Production: Case Farms

Reduced Revenue from Reduced Number of Pigs

Number pigs weaned per litter for negative periods	9.13	
Number pigs weaned per litter for positive periods	7.63	
Reduced number of pigs weaned per litter	1.50	
Reduced number of pigs weaned per litter	1.50	
Value of weaned pig	$30.00	
Reduced revenue per litter		$45.00

Reduced Farrowing Rate

Farrowing rate for negative periods	79.36%	
Farrowing rate for positive periods	68.44%	
Farrowing rate difference	10.92%	
Variable cost per litter	$141.07	
Fixed cost per litter	$125.95	
Total cost per litter	$267.02	
Fixed cost per missed litter	$125.95	
Reduced farrowing rate	.1092	
Increased fixed cost per litter	$13.75	
Variable cost per litter	$141.07	
Reduced farrowing rate	.1092	
Increased variable cost per litter	$15.41	
Total increased cost per litter in positive herd from reduced farrowing rate		$29.16
Total economic impact per litter in positive herd		$74.16

Given the weaned pig value of $30.00 per pig, reduced revenue is $45.00 per litter. The farrowing rate for PRRS positive groups declined by 10.92 percentage points over the negative groups (79.36 percent vs. 68.44 percent). Reduced farrowing rate results in open spaces in the farrowing facility and increased breeding costs, etc. There are also females in breeding/gestation consuming feed that are not producing pigs. Thus, you have an economic impact of fixed cost for the open space and variable costs for the feed etc. the female is consuming. Iowa State University budgets show fixed costs of $125.95 per litter of weaned pigs.

Table 20. Economic Impact of PRRS Outbreak on Nursery Phase of Production: Case Farms

Cost of Increased Nursery Mortality

Increased percent death loss	10.65%
Value of weaner pig	$30.00
Cost of death loss per pig placed	$3.20
Cost of death loss per pig out of nursery (a)	$3.58

Cost of Reduced Feed Efficiency(b)

Normal pounds of feed per pig (12 to 50 lbs)	77.00
Feed efficiency impact (%)	11.69%
Increased pounds of feed fed	9.00
Nursery feed price (per lb)	$0.13
Increased nursery feed cost per pig	$1.17

Cost of Reduced Average Daily Gain(b)

Normal number of days (12 to 50 lbs)	50
Increased days on feed per pig (%)	25.29%
Increased number of days on feed	12.60
Facility, etc. cost per day	$0.10
Increased ADG cost per pig	$1.26

Increased Cost Impact per Nursery Pig

Mortality	$3.58
Reduced feed efficiency	$1.17
Reduced average daily gain	$1.26
Total increased cost per pig	$6.01

(a) This is the cost per head placed divided by the percent survivability ($3.20 ÷ .8945).
(b) PRRS negative pig is on feed for 50 days from 12 to 50 lbs.

Variable costs are $141.07 per litter of weaned pigs. Given this and the reduced farrowing rate of 10.92 percent, the increased cost per litter farrowed is $29.16, or fixed costs increase by $13.75 per litter and variable costs increase by $15.41 per litter.

The economic impact of an acute PRRS outbreak in the nursery phase of a pig production operation is $6.01 per pig (Table 20). This is comprised of increased mortality, reduced feed efficiency, and reduced average daily gain for PRRS positive

pigs. The increased death loss was 10.65 percentage points (Table 17). Given a weaner pig price of $30.00, the increased cost is $3.58 per pig out of the nursery. The feed efficiency was reduced by 11.69 percent (Table 18). Given a normal amount of feed consumed of 77 pounds for a pig growing from 12 to 50 pounds, it requires nine more pounds of feed per pig.

Table 21. Economic Impact of PRRS Outbreak on Grow-Finish Phase of Production: Case Farms

Cost of Increased Grow-Finish Mortality	
Increased percent death loss	6.05%
Value of feeder pig	$50.00
Cost of death loss per pig placed	$3.03
Cost of death loss per pig sold (a)	$3.23
Cost of Reduced Feed Efficiency (b)	
Normal pounds feed per pig (50 to 260 lbs)	630
Feed efficiency impact	7.57%
Increased pounds of feed fed	47.69
Finisher feed price (per lb)	$0.063
Increased grow-finish feed cost per pig	$3.00
Cost of Reduced Average Daily Gain (b)	
Normal number of days (50 to 200 lbs)	120
Increased days on feed per pig (%)	12.03%
Increased number of days on feed	14.4
Facility, etc. cost per day	$0.10
Increased ADG cost per pig	$1.44
Increased Cost Impact per Grow-Finish Pig	
Mortality	$3.23
Reduced feed efficiency	$3.00
Reduced average daily gain	$1.44
Total increased cost per pig	$7.67

(a) This is the cost per head placed divided by the percent survivability ($3.03 ÷ .9395).
(b) PRRS negative pig is on feed for 120 days from 50 to 260 lbs.

At a feed cost of $.13 per pound, the increased feed cost is $1.17 per pig. Average daily gain was reduced by, on average, 25.29 percent. With a normal feeding time of 50 days, the pig is on feed for 12.6 more days. With a facility cost of $.10 per day the increased cost from reduced average daily gain is $1.26 per pig.

Information on the economic impact of PRRS on the grow-finish production phase is provided in Table 21. The increased cost for a PRRS positive group of pigs is $7.67 per pig. Pig mortality increased by 6.05 (Table 17) percentage points leading to an increased cost of $3.23 per market hog sold.

Table 22. Projected Annual Cost of PRRS to the United States Swine Industry: Case Farms

Projected Annual Cost for Farrowing

Impact of Reduced Pigs Weaned per Litter

Number of breeding females	6 million
Percent in positive herd	15%
Number of litters impacted	0.9 million
Reduced revenue per litter impacted	x $45.00
Total reduced revenue	$40.50 million

Impact of Reduced Farrowing Rate

Increased fixed cost per litter impacted	$13.75
Number of litters impacted	x 0.9 million
Increased fixed costs for reduced farrowing rate	$12.38 million
Increased variable costs per litter impacted	$15.41
Number of litters impacted	x 0.9 million
Increased variable costs for reduced farrowing rate	$13.87 million
Total increased cost of reduced farrowing rate	$26.25 million

Projected Annual Cost for Nursery

Number of nursery pigs annually	104.16 million
Percent pigs in positive nursery	x 32.16%
Number of positive nursery pigs	33.50 million
Increased cost per pig in positive nursery	x $6.01
Total increased cost nursery phase	$201.34 million

Projected Annual Cost for Grow-Finisher

Number of grow-finish pigs annually	100 million
Percent pigs in positive grow-finish phase	x 38.10%
Number of positive grow-finish pigs	38.1 million
Increased cost per pig in positive finisher	x $7.67
Total increased cost grow/finish phase	$292.23 million
TOTAL ANNUAL COST	$560.32 million

Feed efficiency declined by 7.57 percent (Table 18) leading to increased feed costs of $3.00 per pig. The impact from reduced average daily gain was $1.44 per pig.

The annual economic impact of an acute PRRS outbreak on the U.S. swine industry is shown in Table 22. For this analysis, information on the size of the U.S. swine industry and percent of the pigs impacted by PRRS annually is needed. On average there are about 12 million litters farrowed annually in the U.S. (6 million sow herd). The 2000 National Animal Health Monitoring System (NAHMS) survey provided information on prevalence of PRRS in the U.S. industry. The NAHMS information showed that 44.91 percent of the females were in positive herds; 32.16 percent of the pigs were in positive nurseries, and 38.10 percent of the grow-finish pigs were in positive facilities.

Given this information, the impact of reduced litter size from PRRS is $40.50 million. This is based on a typical outbreak lasting four months. Considering the NAHMS information showed that 45 percent of the females were in PRRS positive herds, and that annual female replacement rates in U.S. breeding herds is estimated to be about 33 percent, we project that one-third of these (15 percent) will be in herds that experience an acute PRRS outbreak annually. The impact of reduced farrowing rate is $26.25 million, for a total of $66.75 million in the farrowing phase. The projected annual cost increase for the nursery phase is $201.34 million. This is based on 104.16 million nursery pigs annually and that 32.16 percent are in positive facilities as reflected in the NAHMS survey information. The 104.16 million nursery pigs is based on 100 million market hogs in a normal year and adjusted for a normal nursery death loss of four percent (100 million/.96 = 104.16 million). The normal level of market hogs produced annually in the United States is 100 million. The projected annual cost increase for the finishing phase is $292.23 million. This is based on the typical number of market hogs of 100 million. The NAHMS survey showed that 38.10 percent of the market hogs were in positive facilities.

Given the above information, the projected economic impact of PRRS on the United States swine industry is $560.32 million annually (Table 23). The projected impact is as follows: farrowing $66.75 million, nursery $201.34 million, and finishing $292.23 million.

C. Variability of PRRS Impact on Producers

This section will focus on the variability of PRRS impacts on individual producers. Information from the case study farms will be utilized to provide insight into the range of production and economic impacts experienced by the case study farms.

Table 23. Summary of Annual Cost of PRRS to the United States Swine Industry: Case Farms

Farrowing Losses	
Reduced pigs weaned	$ 40.50 million
Reduced Farrowing Rate	$ 26.25 million
Nursery Losses	$ 201.34 million
Finisher Losses	$ 292.23 million
TOTAL	$ 560.32 million

Information in Tables 10 thru 18 provides insight into this level of variability. Some producers experienced only minor reductions on production efficiency while others had dramatic drops in production efficiency. Additionally, the duration of the decline in production efficiency differed by producer. Some experienced impacts for as short of a period as two months, while others had severe chronic impacts that exceeded two years. The normal duration for sow herds was in the three to five months.

Information presented in Table 24 shows the variability of the economic impact of a PRRS outbreak in the farrowing phase of production. The economic projection of the cost of an outbreak is provided for each of the case study farms. The detailed calculations are provided in Appendix A. As shown in Table 24, the economic impact ranged from a high of $156.60 per litter during the outbreak period for farm B-2 to

$27.61 per litter for farm D-2. The severity of the impact exhibits a wide degree of variability. For some producers the impact was catastrophic. Moreover, the productivity item impacted varied between case farms as well. For example, reduced revenue per litter was $103.20 for farm B-2. It was $16.50 per litter for farm A-2. Increased variable cost per litter was the highest for farm F at $33.10 per litter. The increase in fixed cost per litter was the greatest for farm F at $36.96 per litter. Farm B-1 had the lowest impact on increased variable cost per litter, an increase in variable cost of $2.52 per litter and an increase in fixed cost of $2.82 per litter.

The overall economic impact of the PRRS outbreak is influenced by the duration of the outbreak as well. The outbreak duration also showed variability. Farm A-1 had a chronic PRRS problem in one of their sow operations. Production was low for 28 months when compared to their other identical sow herds. While the economic impact was at $45.04 per litter, the impact lasted for 28 months. At the other end of the spectrum is farm B-2. The economic impact was $156.60 per litter but the outbreak only lasted for two months. Production and economic impacts were severe but it was of short duration.

Variability information on PRRS impacts on the nursery phase of the production system is provided in Table 25. While there were only two case farms with information specifically on the nursery phase of the production, they represent multiple sites and close-outs. Farm A-2 represents nearly 200,000 head of nursery pig close-outs and Farm J represents 750,000 head. The increased cost per pig in the outbreak group was $9.12 for farm A and $3.35 for farm J. While there are a limited number of observations, they point to a high degree of variability in the PRRS impact on nursery pigs. The major impact for farm A-2 was pig death loss in the nursery. The increased cost for reduced feed efficiency was $1.17 per pig for each farm. The increased cost for reduced average daily gain ranged from $1.13 to $1.40 per pig.

Table 26 provides information on the variability of the economic impact of a PRRS outbreak on grow-finish pigs. Variability of impact is also present in the grow-finish phase. Farm G had an economic impact of $28.30 per pig. This was significantly higher than what the other operations experienced. The economic impact ranged to a low of $.21 per pig for farm J-2. A comparison of J-1 and J-2 provides an interesting comparison. They are both from the same pig farm – farm J; J-1 represents pigs that were negative in the nursery and experienced clinical PRRS in the grow-finish phase while J-2 represents pigs that were also affected in the nursery. While most farms experienced an increased cost from reduced feed efficiency ($.68 to $14.73 per pig), Farm J-2 experienced a cost savings of $2.02 per pig. Farms A-2 and G both experienced higher pig death loss than the other farms. Farm G also experienced severe impacts from feed efficiency and average daily gain.

Table 24. Economic Impact of a PRRS Outbreak on the Farrowing Phase of Production – by Case Study Farm

Item	Farm								
	A-1	A-2	B-1	B-2	C	D-1	D-2	E	F
Reduced Revenue per Litter	$21.00	$16.50	$88.50	$103.20	$60.00	$39.00	$18.00	$27.00	$33.00
Increased Variable Cost per Litter	$11.34	$10.08	$2.52	$25.19	$16.88	$8.82	$4.53	$11.34	$33.10
Increased Fixed Cost per Litter	$12.70	$11.29	$2.82	$28.21	$18.90	$9.87	$5.08	$12.70	$36.96
Total Economic Impact per Litter	$45.04	$37.87	$93.84	$156.60	$95.78	$57.69	$27.61	$51.04	$102.96
Duration of Impact	28 months	10 months	3 months	2 months	3 months	4 months	12 months	4 months	4 months

Table 25. Economic Impact of a PRRS Outbreak on the Nursery Phase of Production – by Case Study Farm

Item	Farm	
	A-2	J
Increased Cost from Death Loss	$6.55	$1.05
Increased Cost from Reduced Feed Efficiency	$1.17	$1.17
Increased Cost from Reduced Average Daily Gain	$1.40	$1.13
Total Increased Cost per Pig	$9.12	$3.35

Table 26. Economic Impact of a PRRS Outbreak on the Grow-Finish Phase of Production – by Case Study Farm

Item	Farm					
	A-2	G	H	I	J-1	J-2
Increased Cost from Death Loss	$6.24	$8.89	$2.14	$0.78	$0.79	$1.49
Increased Cost from Reduced Feed Efficiency	$2.96	$14.73	$0.68	$2.27	$0.78	$-2.02
Increased Cost from Reduced Average Daily Gain	$1.21	$4.68	$0.73	$0.21	$.33	$.73
Total Increased Cost per Pig	$10.41	$28.30	$3.55	$3.28	$1.70	$0.21

Tables 27, 28, and 29 provide information on the total economic impact for the case farms. Table 27 shows that the range in loss per farm in the gestation farrowing phase was from $20,538 for Farm D-1 to $786,083 for Farm A-1. Nursery phase losses ranged from $466,807 for Farm A-2 to $737,164 for Farm J (Table 28). Impact at the grow-finish level ranged from $13,103 for Farm G to $617,503 for Farm J-1 (Table 29).

Production Impacts from PRRS Using NAHMS Information

During 2000, NAHMS conducted a national survey on the swine production industry. One survey covered the December 1999 to May 2000 time period while the second survey covered the June 2000 to November 2000 time period. Information was collected on a variety of items including if PRRS was present in the swine herd. Information was also collected on pig productivity such as pigs weaned per litter, farrowing rate, pig mortality, etc. Tables 30, 31, and 32 provide information from the NAHMS surveys.

The NAHMS information shows that PRRS was present in more than six-in-ten breeding herds in the South and Midwest regions of the U.S. (Table 33). It was present in about four-in-ten breeding herds in the Mideast and West region. PRRS presence in pre-weaned pigs was the highest in the South region (50.6 percent). About one-third of the operations in the Midwest indicated the prevalence of PRRS in pre-weaned pigs. This compared to one-in-six (17.6 percent) operations in the Mideast and West regions.

PRRS was also more prevalent in the nursery and grow-finish operations in the South region (84.5 percent of nurseries and 69.6 percent of grow-finish). It was lower for the Midwest, Mideast, and West regions for both nursery and grow-finish operations.

PRRS is more prevalent in larger swine production operations (Table 34). As shown by the NAHMS 2000 survey results, about eight-in-ten operations which had 10,000 or more hogs and pigs per site had PRRS present in the breeding herd and the grow-finish herd. About six-in-ten had PRRS present in the pre-weaned and nursery pigs. For those operations with less than 2,000 hogs and pigs per site, about three-in-ten (28.6 percent) had PRRS present in the breeding herd. Only about one-in-five had PRRS present in the nursery and grow-finish herd.

In 2000, 28.3 percent of all pig production sites administered vaccines against PRRS (NAHMS-USDA-APHIS-VS, Part II, March 2002). One-half of the breeding females (53.5 percent) received a PRRS vaccine. About one-third (30.6 percent) of breeding operations with less than 250 females vaccinated while seven-in-ten (69.4 percent) of those operations with 500 or more females vaccinated against PRRS. A PRRS vaccine was not widely used on weaned pigs. Only 6.4 percent of the weaned market pigs received a vaccination against PRRS.

Table 27. Economic Impact of PRRS Outbreak by Case Study Sow Farms

Case Farm	Farm Size	Impact per Litter (a)	Duration	Litters per Sow per Year (b)	Number Litters Impacted	Total Impact per Farm
A-1	3400 sows	$45.04	28 months	2.20	17,453	$786,083
A-2 (c)	3400 sows	$37.87	10 months	2.27	6,432	$243,580
B-1	1400 sows	$93.84	3 months	2.18	763	$71,600
B-2 (d)	1400 sows	$156.60	2 months	1.81	422	$66,085
C	4000 sows	$95.78	3 months	2.24	2,240	$214,547
D-1	475 sows	$57.69	4 months	2.25	356	$20,538
D-2 (e)	475 sows	$27.61	12 months	2.27	1,078	$29,764
E	2800 sows	$51.04	3-4 months	2.25	1,837	$93,760
F	1000 sows	$102.96	3-4 months	1.48	432	$44,479

(a) Impact due to reduced farrowing rate and number weaned per litter.
(b) Litters per sow per year farrowed during PRRS positive period.
(c) A-1 and A-2 are the same farm; A-1 is inclusive of A-2; A-2 is the last 10 months of A-1; A-2 corresponds with nursery and finish pigs represented by farm A-2.
(d) B-1 and B-2 are the same farm; B-2 is a second outbreak of a new PRRS strain one year later.
(e) D-1 and D-2 are the same farm; D-2 is inclusive of D-1; D-2 reveals the residual impacts.

Table 28. Economic Impact of PRRS Outbreak by Case Study Nursery Farms

Case Farm	Number of Pigs Impacted (Number of Groups)	Impact per Pig (a)	Total Impact per Farm
A-2	51,185 (40)	$9.12	$466,807
J	220,049 (66)	$3.35	$737,164

Table 29. Economic Impact of PRRS Outbreak by Case Study Grow-Finish Farms

Case Farm	Number of Pigs Impacted (Number of Groups)	Impact per Pig (a)	Total Impact per Farm
A-2 (b)	44,358 (38)	$10.41	$461,767
G	463 (2)	$28.30	$13,103
H	5,774 (12)	$3.55	$20,498
I	9,500 (27)	$3.28	$31,160
J-1 (c)	363,237 (325)	$1.70	$617,503
J-2 (d)	233,281 (221)	$0.21	$48,989

(a) Impact due to increased mortality and reduced feed efficiency and average daily gain.
(b) A-2 nursery and finish pigs are 10 months of production from sow farm A.
(c) J-1 positive represents pigs that were negative in the nursery.
(d) J-2 positive represents pigs that were also positive in the nursery.

Table 30. PRRS Productivity Impact in Gestation-Farrowing - 2000 NAHMS Study

(PRRS NEGATIVE INCLUDES ONLY THOSE INDICATED AS NEGATIVE)

(PRRS POSITIVE OPERATIONS ARE DOCUMENTED POSITIVE IN SOW HERD)

ITEM	Period 1 (Dec. 1999-May 2000)				Period 2 (June 2000-Nov. 2000)				Average Difference	Average Percent Difference
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference		
Number Operations	118	255			118	255				
FARROWING										
Total Born Per Litter	10.51	10.23	0.28	2.74%	10.45	10.21	0.24	2.35%	0.26	2.54%
Born Alive Per Litter	9.27	9.49	-0.22	-2.32%	9.61	9.38	0.23	2.45%	0.005	0.07%
Percent Born Alive Per Litter	87.85	93.01	-5.16	-5.55%	92.13	91.96	0.17	0.18%	-2.495	-2.68%
Born Dead Per Litter	1.24	0.74	0.5	67.57%	0.84	0.84	0.00	0.00%	0.25	33.78%
Percent Born Dead Per Litter	12.15	6.99	5.16	73.82%	7.87	8.04	-0.17	-2.11%	2.495	35.85%
Number Weaned Per Litter	8.16	8.46	-0.3	-3.55%	8.56	8.12	0.44	5.42%	0.07	0.94%
Percent Weaned Per Litter	87.29	89.30	-2.01	-2.25%	89.23	86.97	2.26	2.60%	0.125	0.17%
Farrowing Rate	75.59	77.41	-1.82	-2.35%						
PREWEANING										
Percent Prewean Mortality	12.71	10.70	2.01	18.79%	10.77	13.03	-2.26	-17.34%	-0.125	0.72%
Prewean Death - Respiratory	31.26	2.90	28.36	977.93%	13.92	1.85	12.07	652.43%	20.215	815.18%
Percent Prewean Death - Respiratory	6.67	3.69	2.98	80.76%	2.32	1.02	1.30	127.45%	2.14	104.10%
NURSERY										
Percent Mortality	4.35	2.67	1.68	62.92%	3.32	2.89	0.43	14.88%	1.055	38.90%
Percent Mortality - Respiratory	2.87	0.52	2.35	451.92%	0.72	0.64	0.08	12.50%	1.215	232.21%
Percent Death - Respiratory	48.34	18.38	29.96	163.00%	30.27	21.20	9.07	42.78%	19.515	102.89%
SOW HERD										
Percent Mortality	3.38	2.29	1.09	47.60%	3.33	2.52	0.81	32.14%	0.95	39.87%
Cull Rate	26.12	18.27	7.85	42.97%	26.05	24.15	1.90	7.87%	4.875	25.42%
Cull Rate - Old Age	9.30	9.01	0.29	3.22%						
Cull Rate - Lame	1.88	1.16	0.72	62.07%						
Cull Rate - Performance	2.23	1.82	0.41	22.53%						
Cull Rate - Reproductive	7.80	2.33	5.47	234.76%						
Cull Rate - Other	4.92	3.94	0.98	24.87%						

Table 31. PRRS Productivity Impact In Nursery and Grow-Finish - 2000 NAHMS Study

(PRRS NEGATIVE INCLUDES ONLY THOSE INDICATED NEGATIVE)
(PRRS POSITIVE OPERATIONS ARE DOCUMENTED POSITIVE IN NURSERY)

ITEM	Period 1 (Dec. 1999-May 2000)				Period 2 (June 2000-Nov. 2000)				Average Difference	Average Percent Difference
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference		
Number Operations	98	376			98	376				
NURSERY										
Mortality Percent	4.41	2.47	1.94	78.54%	3.48	2.30	1.18	51.30%	1.56	64.92%
Mortality Percent - Respiratory	2.56	0.51	2.05	401.96%	0.83	0.48	0.35	72.92%	1.20	237.44%
Percent Mortality - Respiratory	40.42	21.15	19.27	91.11%	22.06	20.67	1.39	6.72%	10.33	48.92%
GROW-FINISH										
Mortality Percent	2.87	2.03	0.84	41.38%	3.60	1.65	1.95	118.18%	1.40	79.78%
Mortality Percent - Respiratory	1.42	0.77	0.65	84.42%	1.45	0.61	0.84	137.70%	0.75	111.06%
Percent Mortality - Respiratory	46.30	33.70	12.60	37.39%	34.97	26.12	8.85	33.88%	10.73	35.64%

Table 32. PRRS Productivity Impact in Grow-Finishing - 2000 NAHMS Study

(PRRS NEGATIVE INCLUDES ONLY THOSE INDICATED NEGATIVE)

(PRRS POSITIVE OPERATIONS ARE DOCUMENTED POSITIVE IN GROW/FINISH)

ITEM	Period 1 (Dec. 1999-May 2000)				Period 2 (June 2000-Nov. 2000)				Average Difference	Average Percent Difference
	PRRS Positive	PRRS Negative	Difference	Percent Difference	PRRS Positive	PRRS Negative	Difference	Percent Difference		
Number Operations	112	441			112	441				
Mortality Percent	3.3	2.17	1.13	52.07%	3.79	1.97	1.82	92.39%	1.48	72.23%
Mortality Percent-Respiratory	1.53	0.86	0.67	77.91%	1.89	0.85	1.04	122.35%	0.86	100.13%
Percent Mortality - Respiratory	49.12	34.30	14.82	43.21%	41.13	26.93	14.2	52.73%	14.51	47.97%

Table 33. Percent of Swine Herd on PRRS Positive Farms – by Region

NAHMS Survey Results 2000

Item	Region of United States			
	South	Midwest	Mideast	West
PRRS in breeding herd				
Yes	62.8	63.3	36.4	38.0
No	34.8	36.0	55.2	58.4
Don't know	2.4	0.7	8.4	3.7
PRRS in pre-weaned pigs				
Yes	50.6	34.7	17.6	17.6
No	45.8	60.2	71.2	66.0
Don't know	3.6	5.2	11.2	16.3
PRRS present in nursery				
Yes	84.5	30.1	32.2	40.2
No	11.2	67.7	60.2	53.8
Don't know	4.4	2.2	7.5	6.0
PRRS present in grow-finish				
Yes	69.6	43.9	22.3	39.2
No	23.4	51.5	63.1	51.7
Don't know	6.7	4.6	14.7	9.1

Table 34. Percent of Swine Herds on PRRS Positive Farms – by Size

NAHMS Survey Results 2000

Item	Site Size – Total Hogs and Pigs		
	0-1,999	2,000-9,999	10,000+
PRRS present in breeding herd			
Yes	28.60	48.70	83.3
No	61.50	49.10	16.7
Don't know	9.90	2.20	0.0
PRRS present in pre-weaned pigs			
Yes	13.40	24.90	63.4
No	74.10	64.60	35.7
Don't know	12.50	10.40	0.9
PRRS present in nursery			
Yes	19.62	44.56	60.8
No	70.93	50.20	39.2
Don't know	9.45	5.24	0.0
PRRS present in grow-finish			
Yes	17.80	40.20	79.7
No	67.40	50.80	15.0
Don't know	14.80	9.00	5.3

Cost of PRRS – Delphi Study Approach

A. Level of and Duration of PRRS Outbreak

A Delphi survey was conducted of industry personnel familiar with PRRS to obtain insight into their opinions on its impact on production efficiency, duration of impact, etc. Individuals surveyed were primarily veterinarians who are quite familiar with PRRS. There were twelve respondents. Information in Table 35 shows the percent of the respondent's herds that were PRRS positive and the percent that were showing clinical signs of infection. There was a high level of variability for both responses. Two respondents indicated they did not have any sow herds positive for PRRS. Five of the twelve respondents indicated that 90 percent or more of their client's sow herds were PRRS positive. The average response was that 57 percent of the respondents sow herds were PRRS positive.

Three respondents indicated they did not have any nursery or grow-finishing groups which were PRRS positive. One respondent indicated that 85 percent of the nursery and grow-finish groups were PRRS positive.

Table 35. Percent of Respondents Herds PRRS Positive and Showing Clinical Signs -Delphi Survey Respondents

	Percent of Herds Positive			Percent Showing Clinical Signs		
Respondent	**Sow Herd**	**Nursery**	**Grow-Finish**	**Sow Herd**	**Nursery**	**Grow-Finish**
1	20	20	20	20	20	20
2	80	75	80	80	75	80
3	0	0	0	0	0	0
4	97	15	30	10	5	15
5	98	15	18	1	5	0
6	90	Varied	Varied	40	40	20
7	0	0	0	0	0	0
8	95	85	85	10	50	50
9	10	0	0	0	0	0
10	95	50	50	25	10	10
11	50	60	60	25	20	10
12	50	50	50	20	25	15
Average	**57**	**33**	**35**	**19**	**20**	**18**

The average response was that 34 percent of the respondent's nurseries were PRRS positive while 36 percent of the respondent's grow-finish herds were PRRS positive. The percent of herds showing clinical signs was lower. The percent of herds, on average, showing clinical signs of PRRS was 19 percent for the sow herds, 21 percent of the nurseries, and 18 percent of the grow-finish herds. Or, about one-in-five herds exhibited clinical signs for PRRS.

Most respondents indicated they were not using a PRRS vaccine for the nursery and grow-finish pigs. Three were using vaccine on nursery pigs and one was using vaccine on grow-finishing pigs. Of those using vaccines on nursery and/or grow-finish pigs, only a small percent of the pigs on the operation were receiving a vaccination. One-half the respondents (6 of 12) indicated they used vaccines on sows. Of those using vaccines on sows, they were only using the vaccines about 10 percent of the time.

Respondents were asked to estimate what percent of U.S. swine herds annually experience an acute outbreak of PRRS (Table 36). Again, there is a range in what the respondents indicated. The percent of the sow herd they felt suffered an acute outbreak per year ranged from 5 to 50 percent. The average response was that 30.4 percent of the sow herds had an acute outbreak. The range in response for nursery groups which suffered an acute outbreak was from 0 to 50 percent; on average, 24 percent. The range for grow-finish pigs which had an acute outbreak was also 0 to 50 percent; on average 20 percent. About one-in-four sow herds and groups of nursery pigs had an acute PRRS outbreak. One-in-five grow-finish groups had an acute outbreak.

Table 36. Percent of United States Swine Herds Which Have an Acute Outbreak - Delphi Survey Respondents

Respondent	Percent of Sow Herds Annually	Percent of Nursery Groups	Percent of Grow-Finish Groups
1	50	0	0
2	33	45	37
3	35	35	50
4	50	25	15
5	38	50	50
6	40	40	10
7	10	15	15
8	N/A	N/A	N/A
9		Depends upon pig density.	
10	12.5	5	5
11	5	10	5
12	30	10	10
Average	**30.4**	**24**	**20**

Table 37 provides information on the percent of the herds which respondents felt suffered from chronic PRRS. This again showed variability in response and was slightly higher than the acute outbreak response. They felt about one-in-three (34.2 percent) sow herds had chronic PRRS. About one-in-four nursery operations (26 percent) and grow-finish operations (27.8 percent) had chronic PRRS.

Table 37. Percent of United States Swine Herds Which Have Chronic PRRS - Delphi Survey Respondents

Respondent	Percent of Sow Herds	Percent of Nursery Groups	Percent of Grow-Finish Groups
1	20	0	0
2	50	50	50
3	50	20	50
4	20	5	15
5	57	60	60
6	15	0	0
7	50	60	60
8	N/A	N/A	N/A
9		High in large herds.	
10	25	15	2.5
11	25	40	30
12	30	10	10
Average	**34.2**	**26**	**27.8**

Respondents were asked the likelihood of herds experiencing repetitive outbreaks and if the repeat outbreak would be caused by a new or repetitive PRRS strain. Estimates ranged from 100 percent of repeat outbreaks being caused by new strains to only 5 percent due to new strains.

Most respondents indicated that an acute PRRS outbreak in the sow herd lasted for about three to five months (Table 38). Two respondents indicated the duration was in the one month range. Respondents exhibited a bit more variability on duration of an acute outbreak in the nursery. The tendency was a duration of two to four months for an acute PRRS outbreak. The longest time was a six month duration. An even greater variability of response for duration of an acute outbreak of PRRS was shown in the grow-finish phase. The range was from one to four weeks to eight to ten months.

Responses for how long the effects of endemic PRRS can be measured was larger than the responses for the duration of an acute outbreak. This was in the six months to a year or more time span for the sow herd. It was in the six months to a year time span for the nursery and six months to two years or more time span for the grow-finish phase.

Table 38. Duration of an Acute PRRS Outbreak-Delphi Survey Respondents

Respondent	Percent of Sow Herds	Percent of Nursery Groups	Percent of Grow-Finish Groups
1	4+ months	As long as sow herd positive	As long as nursery positive
2	4 months	N/A	N/A
3	12 weeks	8 weeks	6 weeks
4	5 months	5 months	8-10 months
5	4 months	6 months	6 months
6	20 weeks	20 weeks	20 weeks
7	4 months	N/A	N/A
8	4-6 weeks	2-4 months	4 months
9	Depends upon duration of herd immunity.		
10	6-16 weeks	4-8 weeks	1-4 weeks
11	1 month	4 months	6 months
12	3 months	2 months	1 month

B. Production Efficiency Impacts

Information on pig productivity impacts is provided in Table 39. This represents a summary of the respondents to the Delphi Survey. The summary provides the average as well as the affects at the peak of the outbreak and during the recovery phase. The detailed information supporting Table 39 is provided in Appendix B. Farrowing rate during the peak of the PRRS outbreak was estimated to decline by 20 percent and the length of the peak outbreak was 3.25 months. The recovery phase for the farrowing rate was estimated to require 8.50 months and the farrowing rate was 4.55 percent lower than normal. The total duration of the reduced farrowing rate was approximately one year (11.75 months). Factors such as sow abortion rates, number of pigs born alive, number of pigs stillborn or mummies and prewean mortality were also thought to be impacted by PRRS. Pig weaning weight was reduced by 22 percent for an approximately a 2 month peak outbreak period.

Sow mortality increased by six percentage points during the peak outbreak period. Weaned pigs impacted by PRRS also had a reduced value at weaning. This was indicated to be reduced by 25.83 percent over a 1.33 month time period.

Table 39. Summary of PRRS Impacts on Pig Productivity and Veterinary-Medicine Costs – Delphi Survey Respondents

Item	Peak of Outbreak (%)	Duration (months)	Recovery Phase (%)	Duration (months)	Average (%)
Sow Herd					
Reduced Farrowing Rate	20.00	3.25	4.55	8.50	12.28
Increased Abortion Rate	26.25	1.36	2.68	3.75	14.47
Reduced Number Live Born	32.50	2.35	9.11	5.44	20.81
Increased Percent Stillborn	43.00	1.68	7.11	4.05	25.06
Increased Percent Mummies	39.00	1.97	9.44	3.94	24.22
Increased Prewean Mortality	32.25	1.77	5.61	4.16	18.93
Reduced Weaning Weight	22.00	1.78	7.41	4.33	14.71
Increased Sow Mortality	6.10	1.30	2.81	5.02	4.46
Reduced Pigs Per Sow Per Year	29.55	3.00	8.85	4.85	19.20
Reduced Weaned Pig Value	25.83	1.33	9.58	3.20	17.48
Nursery					
Reduced Daily Gain	25.71	2.80	15.00	5.33	20.36
Reduced Feed Conversion	11.66	2.25	5.00	5.00	8.33
Increased Mortality	18.06	2.25	3.66	5.16	10.86
Increased Lighter/Culls	18.57	2.07	5.00	4.16	11.79
Increased Vet/Med Expense/Pig	$1.68	2.23	$.73	3.43	$1.21
Grow-Finish					
Reduced Daily Gain	11.42	4.00	7.33	5.75	9.38
Reduced Feed Conversion	11.50	3.50	3.70	6.12	7.60
Increased Mortality	9.50	3.31	3.21	5.35	6.36
Increased Lighter/Culls	11.50	3.42	4.75	5.08	8.13
Increased Vet/Med Expense/Pig	$1.91	3.71	$1.07	5.08	$1.49

Nursery pigs impacted by PRRS also experienced reduced levels of production. Average daily gain was 25 percent under normal pigs during the peak outbreak of 2.8 months, and 15 percent under normal pigs for another 5.33 months during the recovery period. Feed conversion was impacted to where 11.66 percent more feed was needed per pound of gain. Mortality was 18 percentage points higher while the number of lightweight or cull pigs was 18.57 percentage points higher. General veterinary/medicine cost was $1.68 higher per pig.

Pigs impacted by PRRS in the grow-finish production phase had production efficiency declines as well. Average daily gain was 11.42 percent less while 11.50 percent more feed was needed per pound of gain.
Mortality was 9.5 percent points higher while there were 11.50 percent more lightweight/cull pigs. Veterinary cost was $1.91 more per pig.

C. Economic Impact on Cost of Production

The economic impact using the Delphi Survey information will be evaluated for the three phases of production; the farrowing phase, the nursery phase, and the grow-finish phase. Pig price, feed prices, etc. will be the same as used with the case study approach.

The economic impact of a PRRS outbreak in the farrowing phase of a pig production operation is $136.17 lost revenue per litter and $53.40 per litter from reduced farrowing rate; or a total of $189.58 per litter during the peak outbreak. This is based on the above information and shown in Table 39. The loss level, on average, was $123.47 per litter (Table 40). It was $52.19 per litter during the recovery phase. Number of pigs weaned per litter fell by 2.94 pigs per litter during the peak outbreak period. The farrowing rate for PRRS positive groups declined by 20.00 percentage points during the peak PRRS outbreak. Reduced farrowing rate results in open spaces in the farrowing facility and increased breeding costs, etc. There are also females in breeding/gestation consuming feed that are not producing pigs. Thus, you have an economic impact of fixed cost for the open space and variable costs for the feed etc. the female is consuming. Iowa State University budgets show fixed costs of $125.95 per litter of weaned pigs. Variable costs are $141.07 per litter of weaned pigs. Given this and the reduced farrowing rate of 20.00 percent, the increased cost per litter farrowed is $189.58 during the peak outbreak period, $52.19 during the recovery phase, and $123.47 on average.

The economic impact of an acute PRRS outbreak in the nursery phase of a pig production operation is $11.68 per pig during the peak PRRS outbreak (Table 41). It was $3.37 per pig during the recovery phase, and $7.30 per pig on average. This is comprised of increased mortality, reduced feed efficiency, reduced average daily gain, increased light weight and cull pigs, and increased veterinary expense for PRRS positive pigs. The increased death loss was 10.86 percentage points on average (Table 39). It was 18.06 percent higher during the peak outbreak. Given a weaner pig price of $30.00, the increased cost is $6.61 per pig out of the nursery during the peak outbreak, and $3.26 on average. The feed efficiency was reduced by 11.66 percent during the peak outbreak; 8.33 percent on average (Table 39). Given a normal amount of feed consumed of 77 pounds for a pig growing from 12 to 50 pounds, it requires nine more pounds of feed per pig during the peak outbreak and 6.41 more pounds on average. At a feed cost of $.13 per pound, the increased feed cost is $1.17 per pig during the peak outbreak and $.83 on average. Average daily gain was reduced by, on average, 20.36 percent; 25.71 percent during the peak outbreak. With a normal feeding time of 50 days, the pig is on feed for 10.2 more days. With a facility cost of $.10 per day the increased cost from reduced average daily gain is $1.02 per pig, on average. Veterinary cost was $1.21 higher per pig and the impact of increased level of light weight/cull pigs was $.59 per pig.

Table 40. Economic Impact of PRRS Outbreak on Farrowing Phase of Production: Delphi Survey

Item Lost Revenue from Reduced Number of Pigs and Reduced Value	Peak Outbreak	Recovery Period	Average Impact
Reduced Number of Pigs			
Number pigs weaned per litter for negative periods	9.13	9.13	9.13
Number pigs weaned per litter for positive periods	6.19	8.62	7.40
Reduced number of pigs per litter (a)	2.94	0.51	1.73
Reduced number of pigs per litter	2.94	0.51	1.73
Value of weaned pig	$30.00	$30.00	$30.00
Reduced revenue per litter	$88.20	$15.30	$51.90
Reduced Pig Value			
Reduction in positive weaned pig value (b)	$7.75	$2.87	$5.24
Weaned pigs per litter for positive periods	6.19	8.62	7.40
Reduced value of litter	$47.97	$24.74	$38.78
Reduced revenue per litter	$136.17	$40.04	$90.68
Reduced Farrowing Rate			
Reduced farrowing rate (c)	20.00%	4.55%	12.28%
Variable cost per litter	$141.07	$141.07	$141.07
Fixed cost per litter	$125.95	$125.95	$125.95
Total cost per litter	$267.02	$267.02	$267.02
Fixed cost per missed litter	$125.95	$125.95	$125.95
Reduced farrowing rate	20.00%	4.55%	12.28%
Cost per litter	$25.19	$5.73	$15.47
Variable cost per litter	$141.07	$141.07	$141.07
Reduced farrowing rate	20.00%	4.55%	12.28%
Cost per litter	$28.21	$6.42	$17.32
Total increased cost per litter in positive	$53.40	$12.15	$32.79
Total cost per litter in positive herd	$189.58	$52.19	$123.47

(a) Supporting information is in Table 39 and Appendix Table B6. The reduction in number of pigs weaned is 32.25 percent for the peak outbreak; 5.61 percent for the recovery period; and 18.93 percent on average.

(b) Supporting. information is in Table 39 and Appendix Table B10. The reduction in value was 25.83 percent during the outbreak period; 9.58 percent during the recovery period; and 17.71 percent on average.

(c) Supporting information is in Table 39 and Appendix Table B1. The reduction in farrowing rate is 20.00 percent during the outbreak period; 4.55 percent during the recovery phase and 12.28 percent on average.

Table 41. Economic Impact of PRRS Outbreak on Nursery Phase of Production: Delphi Survey

Item Cost of Increased Nursery Mortality	Peak Outbreak	Recovery Period	Average Impact
Increased percent death loss (a)	18.06%	3.66%	10.86%
Value of weaner pig	$30.00	$30.00	$30.00
Cost of death loss per pig placed	$5.42	$1.10	$3.26
Cost of death loss per pig out of nursery	$6.61	$1.14	$3.65
Cost of Reduced Feed Efficiency			
Normal pounds feed per pig (2.02 FE)	77	77	77
Increased feed efficiency impact (b)	11.66%	5.00%	8.33%
Increased pounds of feed fed	8.98	3.85	6.41
Nursery feed price (per lb)	$0.13	$0.13	$0.13
Increased nursery feed cost per pig	$1.17	$0.50	$0.83
Cost of Reduced Average Daily Gain			
Normal number of days (12 to 50 lbs)	50	50	50
Increased days on feed per pig (c)	25.71%	15.00%	20.36%
Increased number of days on feed	12.9	7.5	10.2
Facility, etc. cost per day	$0.10	$0.10	$0.10
Increased ADG cost per pig	$1.29	$0.75	$1.02
Cost Impact per Nursery Pig			
Mortality	$6.61	$1.14	$3.65
Reduced feed efficiency	$1.17	$0.50	$0.83
Reduced average daily gain	$1.29	$0.75	$1.02
Total increased cost per pig	$9.07	$2.39	$5.50
Additional Costs			
Increase in light weights/culls (d)	18.57%	5.00%	11.79%
Reduced value of light weight/cull	$5.00	$5.00	$5.00
Cost of light weights/culls per pig	$0.93	$0.25	$0.59
Increase in vet med expense per pig (e)	$1.68	$0.73	$1.21
Total Increased Cost per Nursery Pig	$11.68	$3.37	$7.30

(a) Supporting information is in Table 39 and Appendix Table B13.
(b) Supporting information is in Table 39 and Appendix Table B12. A PRRS negative pig is on feed for 50 days from 12 to 50 pounds.
(c) Supporting information is in Table 39 and Appendix Table B11.
(d) Supporting information is in Table 39 and Appendix Table B14.
(e) Supporting information is in Table 39 and Appendix Table B15.

Table 42. Economic Impact of PRRS Outbreak on Grow-Finish Phase of Production: Delphi

Survey

Item Cost of Increased Grow-Finish Mortality	Peak Outbreak	Recovery Period	Average Impact
Increased percent death loss (a)	9.50%	3.21%	6.36%
Value of feeder pig	$50.00	$50.00	$50.00
Cost of death loss per pig placed	$4.75	$1.61	$3.18
Cost of death loss per pig sold	$5.25	$1.66	$3.39
Cost of Reduced Feed Efficiency			
Normal pounds feed per pig (3.00 FE)	630	630	630
Increased feed efficiency impact (b)	11.50%	3.70%	7.60%
Increased pounds of feed fed	72.45	23.31	47.88
Finisher feed price (per lb)	$0.063	$0.063	$0.063
Increased grow-finish feed cost per pig	$4.56	$1.47	$3.02
Cost of Reduced Average Daily Gain			
Normal number of days (50 to 260 lbs)	120	120	120
Increased days on feed per day (c)	11.42%	7.33%	9.38%
Increased days on feed	13.7	8.8	11.3
Facility, etc. cost per day	$0.10	$0.10	$0.10
Increased ADG cost per pig	$1.37	$0.88	$1.13
Cost Impact per Grow-Finish Pig			
Mortality	$5.25	$1.66	$3.39
Reduced feed efficiency	$4.56	$1.47	$3.02
Reduced average daily gain	$1.37	$0.88	$1.13
Total increased cost per pig	$11.18	$4.01	$7.54
Additional Costs			
Increase in lightweights/culls (d)	11.50%	4.75%	8.13%
Reduced value of lightweight/cull	$20.00	$20.00	$20.00
Cost of lightweights/culls per pig	$2.30	$0.95	$1.63
Increase in vet med expense per pig (e)	$1.91	$1.07	$1.49
Total Increased Cost per Grow-Finish Pig	$15.39	$6.03	$10.66

(a) Supporting information is in Table 39 and Appendix Table B18.
(b) Supporting information is in Table 39 and Appendix Table B17. The PRRS negative pig is on feed for 120 days from 50 to 200 pounds.
(c) Supporting information is in Table 39 and Appendix Table B16.
(d) Supporting information is in Table 39 and Appendix Table B19.
(e) Supporting information is in Table 39 and Appendix Table B20.

Table 43. Projected Annual Cost of PRRS to the United States Swine Industry: Delphi Survey

Reduced Pigs Weaned per Litter		
Number of females	6 million	
Percent in positive herd	15%	
Number of litters impacted	0.9 million	
Reduced revenue per litter impacted	$90.68	
Total reduced revenue		$81.61 million
Reduced Farrowing Rate		
Increased fixed cost per litter impacted	$15.47	
Number of litters impacted	0.9 million	
Increased fixed costs for reduced farrowing rate	$13.92 million	
Increased variable costs per litter impacted	$17.32	
Number of litters impacted	0.9 million	
Increased variable costs for reduced farrowing rate	$15.59 million	
Total increased cost of reduced farrowing rate		$29.51 million
Projected Annual Cost in Nursery		
Number of nursery pigs annually	104.16 million	
Percent pigs in positive nursery	32.16%	
Number of positive nursery pigs	33.50 million	
Cost per pig in positive nursery	$7.30	
Total increased cost nursery phase		$244.53 million
Projected Annual Cost in Finisher		
Number of grow-finish pigs annually	100 million	
Percent pigs in positive grow-finish phase	38.10%	
Number of positive grow-finish pigs	38.1 million	
Increased cost per pig in positive finisher	$10.66	
Total increased cost grow-finish phase		$406.15 million
Total Annual Cost		$761.80 million

Information on the economic impact of PRRS on the grow-finish production phase is provided in Table 42. The increased cost for a PRRS positive group of pigs is $15.39 per pig during the peak outbreak and $10.66 on average. Pig mortality increased by 6.36 percentage points, on average, leading to an increased cost of $3.39 per market hog sold, $5.25 during the peak outbreak. Feed efficiency declined by 7.60 percent (Table 39) leading to increased feed costs of $3.02 per pig. The impact from reduced average daily gain was $1.13 per pig; $1.37 during the peak outbreak.

The annual economic impact of PRRS outbreak on the U.S. swine industry using the Delphi Survey information is shown in Table 43. The impact of reduced litter size from PRRS is $81.61 million. The impact of reduced farrowing rate is $29.51 million, for a total of $111.12 million in the farrowing phase. The projected annual cost increase for the nursery phase is $244.53 million. The projected annual cost increase for the finishing phase is $406.15 million. Given the above information, the projected economic impact of PRRS on the United States swine industry using the Delphi information is $761.80 million annually (Table 43).

Table 44. Cost of a PRRS Outbreak-Delphi Survey Respondents

Respondent	Per Pig	Per Sow	Per cwt	Per Litter
1		$282		
2	$10.00	$250		
3	$15.00	$100	$6.00	$100
4	$14.00	$120	$6.00	$120
5	$7.50	$160		
6	$15.00	$125	$12.50	
7	$9.00			
8				
9				
10	$12.50	$250	$3.50	$95
11	$5.00	$60	$1.60	$25.00
12	$5.00	$200	$2.50	$50
Average	**$10.33**	**$171**	**$5.35**	**$78.00**

The Delphi survey respondents also indicated how much they felt a PRRS outbreak cost a producer (Table 44). Again, a range was shown. The average was $10.33 per pig, $171 per sow, $5.35 per hundred pounds produced, and $78.00 per litter. The range in cost per pig was $5.00 to $15.00. The range in cost per sow was $60 to $282. The range in cost per litter was $25.00 to $120.

All respondents indicated that they provide a monitoring program for PRRS for their clients (Table 45). Program costs indicate that the programs vary widely in what is offered to clients. Program costs also appear to have different services provided with the fee. Some are charged on a per sow basis but include all pigs through the finishing phase. Some include vaccinations, etc. while others would be herd observation. Some appear to be so much per sow per year, while others are a monthly or annual fee.

Table 45. Cost of PRRS Monitoring Program-Delphi Survey Respondents

Respondent	Monitoring Program Cost
1	$50 per sow (lifetime) – farrow-to-finish
2	$.50 per pig
3	$5-6 per sow per year – farrow-to-finish
4	$.50 per sow per year
5	$1.00 per sow per year
6	$1.00 per sow per year
7	Unknown
8	$5-10 per sow per year – farrow-to-finish
9	NA
10	$.12 per pig
11	$83.00 per month commercial sow farm; $117 per month multiplier sow farm
12	$1.00 per pig

Respondents were asked to provide a breakdown of how they felt the economic cost or impact was distributed for PRRS. The allocation was between the sow herd, the nursery, and the grow-finishing production phase. On average, they felt that 35 percent of the economic cost was in the sow herd, 27 percent was in the nursery, and 38 percent was in the grow-finish phase (Table 46). There again was variability in the

responses. For the sow phase it ranged from 5 percent to 55 percent of the economic cost. Most were in the 30-55 percent area. The nursery phase ranged from 0 to 60 percent. Only one observation was above 40 percent. For the grow-finish phase the range was 10 to 85 percent. Only one observation was above 50 percent.

Table 46. Distribution of Economic Cost Impacts of PRRS-Delphi Respondents

	Percent of Economic Cost in		
Respondent	**Sow Phase**	**Nursery Phase**	**Grow-Finish Phase**
1	50	0	50
2	25	25	50
3	20	40	40
4	50	35	15
5	30	60	10
6	40	30	30
7	30	20	50
8	35	15	50
9	55	30	15
10	5	10	85
11	30	25	45
12	55	30	15
Average	**35**	**27**	**38**

Summary of Case Study and Delphi Approach

A summary of the physical production efficiency impacts for the case study farms and the Delphi approach is provided in Table 47. This information was presented in the Case Study and Delphi sections above. Table 48 provides information on increased costs resulting from a PRRS outbreak. For the farrowing phase the economic impact per litter was $74.16 for the case farm approach and $123.47 for the Delphi approach. Nursery increased cost per pig was also higher for the Delphi approach or $7.30 per pig as compared to $6.01 for the case farm approach. Increased cost per pig in the grow-finish phase was $7.67 for the case farm approach as compared to $10.66 for the Delphi approach. Total annual cost of PRRS was $560.32 million for the case farm approach as compared to $761.80 million for the Delphi approach (Table 49).

Table 47. Impact of PRRS on Pig Productivity: Summary of Case Study and Delphi Approaches

Item	Percent Change	
	Case Study	Delphi
Farrowing Phase		
Farrowing rate	-10.92	-12.28
Percent rebreeds	10.90	
Abortion rate		14.47
Litters per sow per year	-8.73	
Total pigs born per litter	-6.55	
Stillborn pigs per litter	45.80	25.06
Mummies per litter	188.86	24.22
Pigs born alive	-9.34	-20.81
Percent prewean mortality	7.79	18.93
Pigs weaned per litter	-16.43	
Litter weaning weight		-14.71
Value of weaned pig		-17.48
Pigs weaned per sow per year	-22.44	-19.20
Percent sow mortality		4.46
Nursery Phase		
Average daily gain	-25.29	-20.36
Average daily feed intake	-16.09	
Feed efficiency	-11.69	-8.33
Percent mortality	10.65	10.86
Percent lightweights/culls		11.79
Veterinary/medicine per pig expense		$1.21
Grow-Finish Phase		
Average daily gain	-12.03	-9.38
Average daily feed intake	-8.21	
Feed efficiency	-7.57	-7.60
Percent mortality	6.05	6.36
Percent lightweights/culls		8.13
Veterinary/medicine per pig expense		$1.49

Table 48. Economic Impact of PRRS Outbreak: Summary of Case Study and Delphi Approaches

Item	Case Farm	Delphi
Farrowing phase		
Reduced revenue per litter	$45.00	$90.68
Reduced farrowing rate	29.16	32.79
Economic impact per litter	$74.16	$123.47
Nursery phase		
Increased mortality	$3.58	$3.65
Reduced feed efficiency	$1.17	$.83
Reduced average daily gain	$1.26	$1.02
Subtotal	$6.01	$5.50
Increased subtotal lightweight/culls		$.59
Increased veterinary medicine		$1.21
Economic impact per pig	$6.01	$7.30
Grow-Finish Phase		
Increased mortality	$3.23	$3.39
Reduced feed efficiency	$3.00	$3.02
Reduced average daily gain	$1.44	$1.13
Subtotal	$7.67	$7.54
Increased subtotal lightweight/culls		$1.63
Increased veterinary medicine		$1.49
Economic Impact per Pig	$7.67	$10.66

Table 49. Annual Cost of PRRS to the United States Swine Industry: Summary of Case Study and Delphi Approaches

Item	Case Farm	Delphi
Farrowing Losses		
Reduced pigs weaned	$40.50 million	$81.61 million
Reduced farrowing rate	$26.25 million	$29.51 million
Nursery losses	$201.34 million	$244.53 million
Finisher losses	$292.23 million	$406.15 million
TOTAL	$560.32 million	$761.80 million

Summary

This study used a combination of techniques and data sources to arrive at the annual estimated cost of porcine reproductive and respiratory syndrome on the United States swine industry. By using a case study approach and comparing production parameters on PRRS-affected farms to the same parameters on non-affected (or recovered) farms, costs of the disease were summarized for the breeding-farrowing phase, the nursery phase, and the growing-finishing phase of production. The economic affect of PRRS in the breeding-farrowing phase was calculated to be $74.16 per litter. Approximately 60% ($45.00 per litter) of this cost was derived through a reduction in the number of pigs weaned per litter with the remaining 40% ($29.16 per litter) coming from a reduction in farrowing rate. The cost of PRRS in the nursery production phase was estimated to be $6.01 per head on an affected farm. Nursery pig mortality was responsible for the majority of this cost ($3.58 per head) with less impact on feed conversion efficiency ($1.17 per head) and average daily gain ($1.26 per head). The economic affect of PRRS in the growing-finishing production phase was estimated to be $7.67 per head on affected farms. Similar to the nursery production phase, mortality was responsible for the majority of the cost ($3.23 per head) with lesser, but still important impacts on feed conversion efficiency ($3.00 per head) and average daily gain ($1.44 per head). In order to extrapolate the data collected through the case study into a national cost aggregate, information collected by the USDA-National Animal Health Monitoring System (NAHMS) in their study of swine production in 2000 was used to estimate the prevalence of PRRS affected farms in the U.S. industry. The NAHMS data indicated that approximately 44.91 percent of breeding females in the U.S. were in PRRS positive herds. Assuming that once a herd is found to be positive, it will remain positive for an extended period, and that approximately one-third of breeding females are replaced each year, it was estimated that 15% (44.91% divided by 3) of breeding herds experience a clinical outbreak of PRRS each year. With the U.S. inventory of breeding females standing at around 6 million, one can then calculate that approximately 0.9 million litters per year are affected by PRRS at a cost of $40.50 (0.9 million times $45.00 per affected litter) million annually. To calculate an aggregate cost of PRRS in the nursery and growing-finishing phases, NAHMS data was again utilized. NAHMS reported in 2000 that 32.16% and 38.10% of U.S. pigs were in PRRS positive nurseries or finishers, respectfully. United States slaughter pig throughput traditionally averages about 100 million pigs per year. This allows one to calculate the estimated cost of PRRS in U.S. nursery pigs to be $201.34 million per year and finishing pigs to be $292.23 million per year. Combining the aggregated costs of PRRS to the breeding herd, nursery herd, and finishing herd yields an annual estimate of $560.32 million borne by U.S. pork producers.

As a comparison to the case study approach for estimating an average annual cost of PRRS to the U.S. swine industry, a Delphi survey of swine disease experts (primarily swine veterinarians) was conducted. A variety of information was collected from the respondents in an effort to estimate the impact of PRRS on specific production parameters as well as the duration of a typical outbreak and their estimates of the prevalence of the disease. When this data was summarized and aggregated to a national level, a somewhat higher impact of PRRS on the industry was reported. The impact of PRRS on the breeding herd was estimated to be $111.12 million per year, on the nursery herd to be $244.53 million, and on the finishing herd to be $406.15 million for a total impact of $761.80 million.

Conclusions

This study provides two estimates of the average annual cost of PRRS to the U.S. swine industry. A case study approach yielded an annual cost of $560.32 million and a Delphi approach yielded $761.80 million. With approximately 100 million market swine being sold each year in the country, PRRS can be estimated to add somewhere between $5.60 and $7.62 of cost per head sold. Several limitations of this study should be made clear. First, costs associated with treating other diseases that are aggravated by a PRRS outbreak were difficult to collect and not included in this study. Also, costs associated with PRRS specific management strategies that may have included purchasing PRRS vaccines, changing replacement stock suppliers or locating a PRRS-negative semen supplier, making modifications to facilities in an effort to reduce the affect of the disease, implementation of PRRS-monitoring programs, and others costs were also difficult to collect and were not included in this analysis. This analysis was confined to the direct cost of PRRS to pork producers and did not include the possible positive effect on market pig prices due to fewer slaughter swine being produced (due to PRRS-related mortality).

With the current economic climate of the U.S. swine industry in a state of persistent low profitability, PRRS is proving to be a significant hindrance to the sustainability of the U.S. industry. While a great deal of research is being attempted to unravel some of the unique epidemiologic, immunologic, and virologic properties of the virus, comprehensive control or eradication strategies for swine-dense production regions are not yet a reality.

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Appendix A

Economic Impact of PRRS

for each

Case Study Farm

Table A1. Economic Impact of a PRRS Outbreak on the Farrowing Phase of Production by Case Study Farm

Item	A-1 (a)	A-2 (b)	B-1 (c)	B-2 (d)	C-1 (e)	D-1 (f)	D-2 (g)	E (h)	F (i)	Average
Lost Revenue from Reduced Number of Pigs										
Number pigs weaned per litter for negative periods	9.1	8.85	10.46	10.50	8.4	9.1	8.8	8.9	8.1	9.13
Number of pigs weaned per litter for positive periods	8.4	8.3	7.51	7.06	6.4	7.8	8.2	8.0	7.0	7.63
Reduced number of pigs weaned per litter	0.70	0.55	2.95	3.44	2.00	1.30	0.60	0.90	1.10	1.50
Reduced number of pigs weaned per litter	0.70	0.55	2.95	3.44	2.00	1.30	0.60	0.90	1.10	1.50
Value of weaned pig	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
Reduced revenue per litter	$21.00	$16.50	$88.50	$103.20	$60.00	$39.00	$18.00	$27.00	$33.00	$45.00
Reduced Farrowing Rate										
Farrowing rate for negative periods	81.00%	78.00%	85.00%	91.00%	70.10%	83.20%	83.20%	75.60%	67.10%	79.36%
Farrowing rate for positive periods	72.00%	70.00%	83.00%	71.00%	56.70%	76.20%	79.60%	66.60%	40.90%	68.44%
Farrowing rate difference	9.00%	8.00%	2.00%	20.00%	13.40%	7.00%	3.60%	9.00%	26.20%	10.92%
Variable cost per litter	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07
Fixed cost per litter	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95
Total cost per litter	$267.02	$267.02	$267.02	$267.02	$267.02	$267.02	$267.02	$267.02	$267.02	$267.02
Fixed cost per missed litter	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95	$125.95
Reduced farrowing rate	9.00%	8.00%	2.00%	20.00%	13.40%	7.00%	3.60%	9.00%	26.20%	10.92%
Increased fixed cost per litter	$11.34	$10.08	$2.52	$25.19	$16.88	$8.82	$4.53	$11.34	$33.00	$13.75
Variable cost per litter	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07	$141.07
Reduced farrowing rate	9.00%	8.00%	2.00%	20.00%	13.40%	7.00%	3.60%	9.00%	26.20%	10.92%
Increased variable cost per litter	$12.70	$11.29	$2.82	$28.21	$18.90	$9.87	$5.08	$12.70	$36.96	$15.41
Total increased cost per litter in positive herd from reduced farrowing rate	$24.03	$21.36	$5.34	$53.40	$35.78	$18.69	$9.61	$24.03	$69.96	$29.16
TOTAL Economic Impact per Litter in Positive Herd	$45.03	$37.86	$93.84	$156.60	$95.78	$57.69	$27.61	$51.03	$102.96	$74.16

(a) 28 month chronic PRRS outbreak from Dec. 1988-Mar. 2001. The comparison negative sows are from two identical farms during the same period.
(b) 10 month PRRS outbreak from June 2000-Mar. 2001. The comparison negative sows are from two identical farms during the same period.
(c) acute 3-month PRRS outbreak from Mar.-May 2002. The comparison negative period is the same period in 2001.
(d) acute 2-month PRRS outbreak from Feb.-Mar. 2003. The comparison negative period is the same period in 2001 and 2002.
(e) acute 3-month PRRS outbreak from Dec. 2002-Feb. 2003. The comparison negative period is April-Nov. 2002 and Mar. 2003.
(f) acute 4-month PRRS outbreak from Dec. 2001-Mar. 2002. The comparison negative period is Dec. 1999-Mar. 2000 and Dec. 2000-Mar. 2001.
(g) 12-month chronic PRRS case from Dec. 2001 to Nov. 2002. The comparison negative period is Dec. 1999-Nov. 2001.
(h) acute 3-4 month PRRS outbreak from Jan.-Mar. The comparison negative period is the 7 month pre and 2 months post PRRS.
(i) acute 3-4 month PRRS outbreak from Oct.-Dec. The comparison negative period is the 9 month period prior to the outbreak.

Table A2. Economic Impact of a PRRS Outbreak on the Nursery Phase of Production by Case Study Farm

Item	Case Farm A-2 (a)	Case Farm J (b)	Average
Cost of Increased Nursery Mortality			
Increased percent death loss	17.91%	3.39%	10.65%
Value of weaner pig	$30.00	$30.00	$30.00
Cost of death loss per pig placed	$5.37	$1.02	$3.20
Cost of death loss per pig out (c)	$6.55	$1.05	$3.58
Cost of Reduced Feed Efficiency (d)			
Normal pounds feed per pig (12-50 lbs)	77	77	77
Increased feed efficiency impact	11.73%	11.64%	11.69%
Increased pounds of feed fed	9.03	8.96	9.00
Nursery feed price (per lb)	$0.13	$0.13	$0.13
Increased nursery feed cost per pig	$1.17	$1.17	$1.17
Cost of Reduced Average Daily Gain (d)			
Normal number of days (12-50 lbs)	50	50	50
Increased days on feed per pig (%)	28.00%	22.58%	25.29%
Increased days on feed	14.0	11.3	12.6
Facility, etc. cost per day	$0.10	$0.10	$0.10
Increased ADG cost per pig	$1.40	$1.13	$1.26
Increased Cost Impact per Nursery Pig			
Mortality	$6.55	$1.05	$3.58
Reduced feed efficiency	$1.17	$1.17	$1.17
Reduced average daily gain	$1.40	$1.13	$1.26
Total increased cost per pig	$9.12	$3.35	$6.01

(a) PRRS positive pigs are weaned from a chronic sow herd during June 2000 to March 2001. The comparison negative pigs are weaned from two identical farms during the same time period.
(b) PRRS positive pigs are weaned from chronic sow herds during March to October 2002. The comparison negative pigs are from identical farms weaned during the same time period.
(c) This is the cost per head placed divided by the percent survivability.
(d) The PRRS negative is on feed for 50 days from 12 to 50 pounds.

Table A3. Economic Impact of a PRRS Outbreak on the Grow-Finish Phase of Production by Case Study Farm

Item	Case Farm A-2 (a)	G (b)	H (b)	I (b)	J-1 (c)	J-2 (d)	Avg.
Cost of Increased Grow-Mortality							
Increased percent death loss	11.10%	15.09%	4.10%	1.53%	1.56%	2.90%	6.05%
Value of feeder pig	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
Cost of death loss per pig placed	$5.55	$7.55	$2.05	$0.77	$0.78	$1.45	$3.03
Cost of death loss per pig sold	$6.24	$8.89	$2.14	$0.78	$0.79	$1.49	$3.23
Cost of Reduced Feed Efficiency							
Normal pounds feed per pig (50-260 lbs)	630	630	630	630	630	630	630
Increased feed efficiency impact	7.45%	37.11%	1.72%	5.71%	1.45%	-5.09%	7.57%
Increased pounds of feed fed	46.94	233.79	10.84	35.97	9.14	-32.07	47.69
Finisher feed price per lb	$0.063	$0.063	$0.063	$0.063	$0.063	$0.063	$0.063
Increased grow-finish feed cost per pig	$2.96	$14.73	$0.68	$2.27	$0.58	$(2.02)	$3.00
Cost of Reduced Average Daily Gain							
Normal number of days (50-260 lbs)	120	120	120	120	120	120	120
Increased days on feed per pig (%)	10.06%	39.02%	6.11%	1.96%	2.78%	6.11%	12.03%
Increased number of days on feed	12.1	46.8	7.3	2.4	3.3	7.3	14.4
Facility, etc. cost per day	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Increased ADG cost per pig	$1.21	$4.68	$0.73	$0.24	$0.33	$0.73	$1.44
Increased Cost Impact per Grow-Finish Pig							
Mortality	$6.24	$8.89	$2.14	$0.78	$0.79	$1.49	$3.23
Reduced feed efficiency	$2.96	$14.73	$0.68	$2.27	$0.58	$(2.02)	$3.00
Reduced average daily gain	$1.21	$4.68	$0.73	$0.24	$0.33	$0.73	$1.44
Total increased cost per pig	$10.41	$28.30	$3.55	$3.28	$1.70	$0.21	$7.67

(a) This represents grow-finish pigs from the chronic sow herd which were weaned during the June 2000 to March 2001 time period. The comparison pigs are grow-finish pigs from the two identical systems produced at the same time.
(b) This represents an acute PRRS outbreak in the grow-finish pigs.
(c) This represents pigs which were negative in the nursery and positive (break) in the finisher. The comparison pigs are pigs in the same production system that were negative in the nursery and grow-finish facilities.
(d) This represents pigs that are positive in both the nursery and grow-finish facilities. The comparison pigs are pigs in the same production system that were negative in the nursery and grow-finish facilities.

Appendix B

Delphi Survey Responses on

Impact of PRRS on

Pig Productivity and Veterinary-Medicine Costs

Table B1. Impact of PRRS Outbreak on Reduced Farrowing Rate – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	30%	4 mo	5%	6-8 mo
2	0-50%	0-6 mo	0-10%	0-18 mo
3	20%	12 wk	5%	9 mo
4	10%	3 mo	5%	2 mo
5	10-15%	4 mo	5%	12 mo
6	10%	4 mo	5%	10 mo
7	20%	4 mo	5%	12 mo
8	25%	2 mo	NA	4 mo
9	20%	3 mo	3%	14 mo
10	30%	1 mo	3%	6 mo
Average	**20.00%**	**3.25 mo**	**4.55%**	**8.50 mo**

Table B2. Impact of PRRS Outbreak on Increased Abortion Rate – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	10%	2 mo	5%	6-8 mo
2	0-50%	0-3 mo	0-10%	0-5 mo
3	20%	12 wk	NA	NA
4	10%	6 wk	2%	4 mo
5	0-20%	4 wk	0-5%	6 mo
6	1-4%	1 mo	1%	1 mo
7	50%	6 wk	1%	4 wk
8	80%	3 wk	NA	NA
9	40%	5 wk	2%	11 wk
10	15%	3 wk	3%	6 mo
Average	**26.25%**	**1.36 mo**	**2.68%**	**3.75 mo**

Table B3. Impact of PRRS Outbreak on Reduced Number Pigs Born Alive – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	50%	1 mo	10%	2 mo
2	0-80%	1-4 mo	0-20%	1-5 mo
3	15%	12 wk	5%	6 mo
4	35%	4 mo	15%	2 mo
5	15%	2.5 mo	7%	6 mo
6	25-45%	3-4 m	5-25%	3-4 mo
7	60%	4 mo	10%	12 mo
8	40%	6 wk	NA	NA
9	20%	5 wk	5%	11 wk
10	15%	3 wk	5%	12 mo

Average	**32.50%**	**2.35 mo**	**9.11%**	**5.44 mo**

Table B4. Impact of PRRS Outbreak on Increased Percent of Pigs Stillborn – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	30%	2 mo	20%	1 mo
2	0-80%	1-2 mo	0-10%	1-4 mo
3	20%	6-8 wk	5%	6 mo
4	10%	4 wk	3%	1 mo
5	15%	2-3 mo	5%	8 wk
6	15%	3-4 m0	10%	3-4 mo
7	60%	2 mo	10%	12 m
8	150%	4 wk	NA	NA
9	20%	5 wk	1%	11 wk
10	70%	3 wk	5%	6 mo
Average	**43.00%**	**1.68 mo**	**7.11%**	**4.05 mo**

Table B5. Impact of PRRS Outbreak on Increased Percent of Pig Mummies – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	20%	3 mo	10%	1 mo
2	0-80%	2-4 mo	0-20%	2-5 mo
3	10%	12 wk	3-5%	6 mo
4	3%	6 wk	10%	2.5 mo
5	100%	2-3 mo	25%	6 mo
6	20-30%	3-4 mo	10%	3-4 mo
7	60%	3 mo	10%	6 mo
8	100%	4 wk	NA	NA
9	30%	3 wk	5%	4 wks
10	2%	3 wk	1%	6 mo
Average	**39.00%**	**1.97 mo**	**9.44%**	**3.94 mo**

Table B6. Impact of PRRS Outbreak on Increased Preweaning Mortality – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	25%	2 mo	5%	2 mo
2	0-50%	1-2 mo	0-5%	1-3 mo
3	15-20%	6 wk	5%	6 mo
4	5%	6 wk	2%	2 mo
5	10-100%	2-3 mo	10%	3 mo
6	20-40%	1-2 mo	15%	3-4 mo
7	50%	4 mo	5%	12 mo
8	100%	4-6 wk	NA	NA
9	10%	5 wk	3%	4 wk
10	15%	3 wk	3%	6 mo

Average	**32.25%**	**1.77 mo**	**5.61%**	**4.16 mo**

Table B7. Impact of PRRS Outbreak on Reduced Pig Weaning Weight – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	0-40%	1-2 mo	0-10%	1-3 mo
3	NA	NA	NA	NA
4	16%	6 wks	0	0
5	25%	4 wks	10%	3 mo
6	16-33%	3 mo	8-15%	3 mo
7	40%	4 mo	10%	12 mo
8	16-25%	4 wks	NA	NA
9	NA	NA	NA	NA
10	8%	3 wks	8%	6 mo
Average	**22.00%**	**1.78 mo**	**7.41%**	**4.33 mo**

Table B8. Impact of PRRS Outbreak on Increased Sow Mortality – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	6.25%	2 mo	5%	2 mo
2	0-10%	1 mo	0-3%	2 mo
3	5%	6 wk	3%	6 mo
4	5%	3 wk	0	0
5	10%	4 wk	5%	12 mo
6	8.75%	2 mo	5.75%	3-4 mo
7	10%	6 wk	2%	12 mo
8	5%	4 wk	NA	NA
9	3%	5 wk	1%	11 wk
10	3%	1 mo	2%	6 mo
Average	**6.10%**	**1.30 mo**	**2.81%**	**5.02 mo**

Table B9. Impact of PRRS Outbreak on Reduced Pigs per Sow per Year – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	50%	4 mo	NA	NA
2	0-35%	0-3 mo	0-13%	0-6 mo
3	18-27%	12 wk	9%	6 mo
4	25%	6 mo	0	0
5	30%	2.5 mo	10%	4 mo
6	18-32%	3 mo	9-18%	3 m
7	60%	4 mo	10%	12 mo
8	13-23%	2 mo	NA	NA
9	NA	NA	NA	NA
10	18%	1 mo	13%	6 mo
Average	**29.55%**	**3 mo**	**8.85%**	**4.85 mo**

Table B10. Impact of PRRS Outbreak on Reduced Value of Weaned Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	0%	0	0%	0
2	30%	1-2 mo	10-15%	1-3 mo
3	50%	12 wk	10%	NA
4	40%	6 wk	10%	2 mo
5	15%	4 wk	120%	6 mo
6	NA	NA	NA	NA
7	NA	NA	NA	NA
8	NA	NA	NA	NA
9	NA	NA	NA	NA
10	20%	1 mo	15%	6 mo
Average	**25.83%**	**1.33 mo**	**9.58%**	**3.20 mo**

Table B11. Impact of PRRS Outbreak on Reduced Daily Gain of Nursery Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	25%	1-2 mo	10%	2-4 mo
3	40%	2 mo	26%	4 mo
4	20%	2 mo	5%	1 mo
5	10-30%	5-8 wk	10%	6 mo
6	13-26%	6 mo	13%	6 mo
7	NA	NA	NA	NA
8	10-20%	8-12 wk	NA	NA
9	NA	NA	NA	NA
10	40%	4 mo	26%	12 mo
Average	**25.71%**	**2.80 mo**	**15%**	**5.33 mo**

Table B12. Impact of PRRS Outbreak on Feed Conversion for Nursery Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	0-20%	1-2 mo	0-10%	2-4 mo
3	10%	2 mo	5%	4 mo
4	10%	2 mo	0	0
5	10-20%	5-8 wk	10%	6 mo
6	NA	NA	NA	NA
7	NA	NA	NA	NA
8	10-20%	8-12 wks	NA	NA
9	NA	NA	NA	NA
10	10%	4 mo	5%	12 mo
Average	**11.66%**	**2.25 mo**	**5%**	**5 mo**

Table B13. Impact of PRRS Outbreak on Increased Mortality of Nursery Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	5-30%	1-2 mo	0-10%	2-4 mo
3	5%	2 mo	2%	4 mo
4	7%	6 wk	2%	2 mo
5	10-50%	1 mo	NA	NA
6	10%	4 mo	5%	4 mo
7	10%	4 mo	4%	12 mo
8	50%	8 wk	NA	NA
9	NA	NA	NA	NA
10	15%	2 mo	4%	6 mo
Average	**18.06%**	**2.25 mo**	**3.66%**	**5.16 mo**

Table B14. Impact of PRRS Outbreak on Increased Percent Lightweights/Culls of Nursery Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	15-25%	1-2 mo	5-10%	2-4 mo
3	10%	2 mo	5%	4 mo
4	5%	6 wk	2%	2 mo
5	10-100%	5-8 wk	5-10%	6 mo
6	10%	4 mo	5%	4 mo
7	NA	NA	NA	NA
8	25%	8 wk	NA	NA
9	NA	NA	NA	NA
10	5%	2 mo	3%	6 mo
Average	**18.57%**	**2.07 mo**	**5%**	**4.16 mo**

Table B15. Impact of PRRS Outbreak on Increased Veterinary/Medicine Expense for Nursery Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	$1-2/pig	1-2 mo	$1/pig	2-4 mo
3	$2/pig	2 mo	$1/pig	4 mo
4	$.30/pig	2 mo	$.15/pig	2 mo
5	$2/pig	5-8 wks	$.50/pig	5-8 wks
6	$2/pig	4 mo	$1/pig	4 mo
7	NA	NA	NA	NA
8	$2-3/pig	8-12 wk	NA	NA
9	NA	NA	NA	NA
10	$1.50/pig	2 mo	$.75/pig	6 mo
Average	**$1.68/pig**	**2.23 mo**	**$.73/pig**	**3.43 mo**

Table B16. Impact of PRRS Outbreak on Reduced Daily Gain of Grow-Finish Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	25%	2-4 mo	10%	3-6 mo
3	23%	2 mo	11%	4 mo
4	10%	2 mo	5%	2 mo
5	10%	NA	6%	NA
6	11%	6 mo	6%	6 mo
7	NA	NA	NA	NA
8	10-20%	4 mo	NA	NA
9	NA	NA	NA	NA
10	11%	6 mo	6%	12 mo
Average	**11.42%**	**4 mo**	**7.33%**	**5.75 mo**

Table B17. Impact of PRRS Outbreak on Feed Conversion for Grow-Finish Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	10-20%	2-4 mo	5-10%	3-6 mo
3	7%	2 mo	3%	4 mo
4	10%	2 mo	0%	NA
5	15%	4 mo	5%	4 mo
6	NA	NA	NA	NA
7	NA	NA	NA	NA
8	10-20%	4 mo	NA	NA
9	NA	NA	NA	NA
10	7%	6 mo	3%	12 mo
Average	**11.50%**	**3.5 mo**	**3.70%**	**6.12 mo**

Table B18. Impact of PRRS Outbreak on Increased Mortality of Grow-Finish Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	10-15%	2-4 mo	2-5%	3-6 mo
3	5%	2 mo	2%	4 mo
4	5%	6 wk	3%	2 mo
5	5-30%	5 mo	5%	5 mo
6	3%	4 mo	2%	4 mo
7	8%	2 mo	2%	12 mo
8	10%	4-6 mo	NA	NA
9	NA	NA	NA	NA
10	15%	4 mo	5%	6 mo
Average	**9.50%**	**3.31 mo**	**3.21%**	**5.35 mo**

Table B19. Impact of PRRS Outbreak on Increased Percent Lightweights/Culls of Grow-Finish Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	10-15%	2-4 mo	5-10%	3-6 mo
3	10%	2 mo	6%	4 mo
4	5%	2 mo	3%	2 mo
5	10%	4 mo	5%	4 mo
6	3%	4 mo	2%	4 mo
7	NA	NA	NA	NA
8	20%	4-6 mo	NA	NA
9	NA	NA	NA	NA
10	20%	4 mo	5%	12 mo
Average	**11.50%**	**3.42%**	**4.75%**	**5.08 mo**

Table B20. Impact of PRRS Outbreak on Increased Veterinary/Medicine Expense for Grow-Finish Pigs – Delphi Survey

Respondent	Peak of Outbreak	Duration	Recovery Phase	Duration
1	NA	NA	NA	NA
2	$2-3	2-4 mo	$1-2	3-6 mo
3	$2	2 mo	$1	4 mo
4	$1	3 mo	$0.50	2 mo
5	$2.50	4 mo	$1.50	4 mo
6	$1-2	4 mo	$1-1.50	4 mo
7	NA	NA	NA	NA
8	$3-5	6 mo	NA	NA
9	NA	NA	NA	NA
10	$0.85	4 mo	$0.65	12 mo
Average	**$1.91**	**3.71 mo**	**$1.07**	**5.08 mo**

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