Ron Plain
Beth Young
Marcia Shannon
John Lory
Joe Zulovich

# The Swine Industry: 1945 to 2009

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# Research Purpose

Document improvements in:

- Sow Productivity/Cost of production (Ron Plain)
- Herd health (Beth Young)
- Herd feed efficiency (Marcia Shannon)
- Environmental impact (John Lory)
- Pork production systems (Joe Zulovich)

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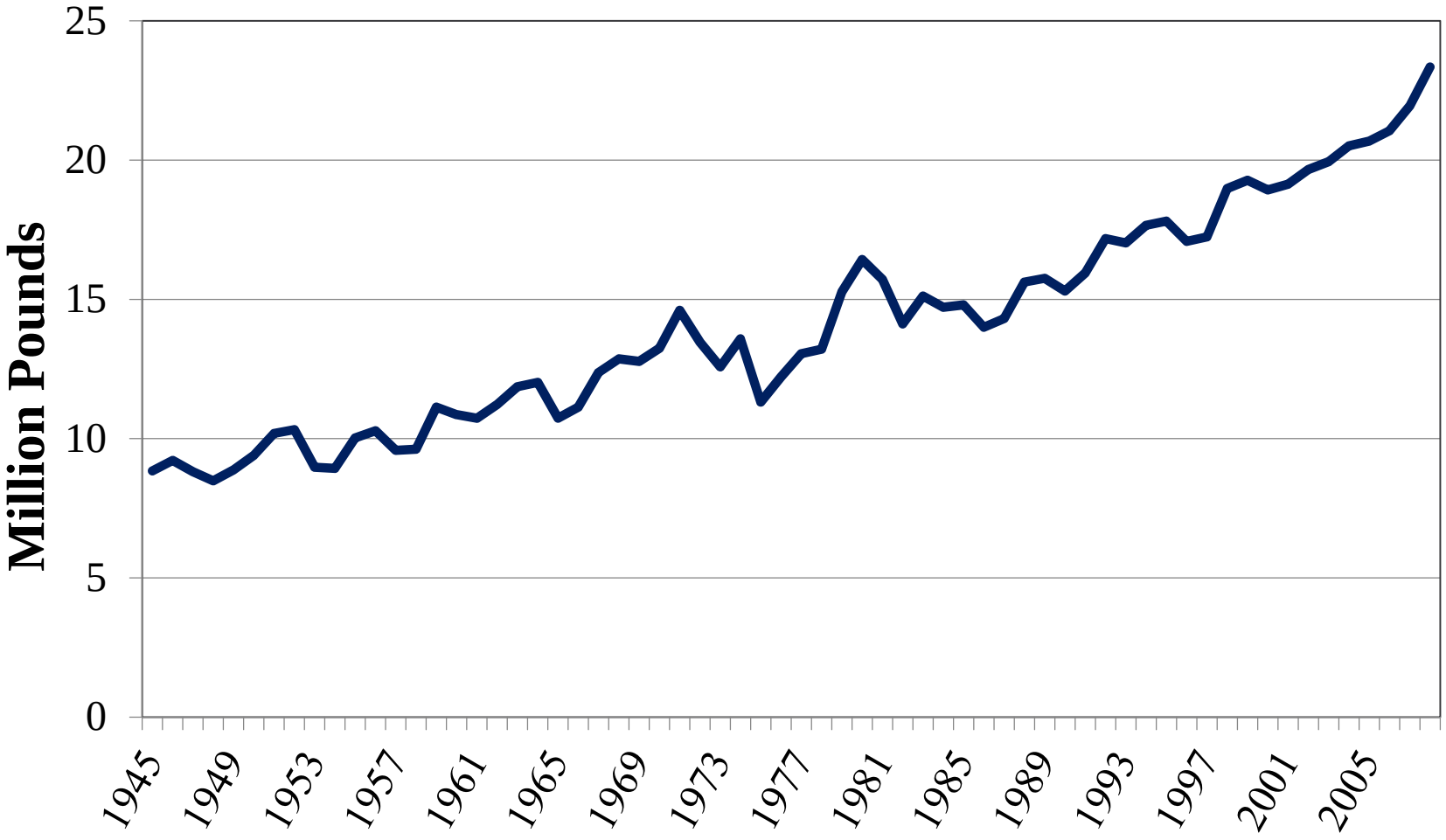
# Pork Production




Source: USDA NASS

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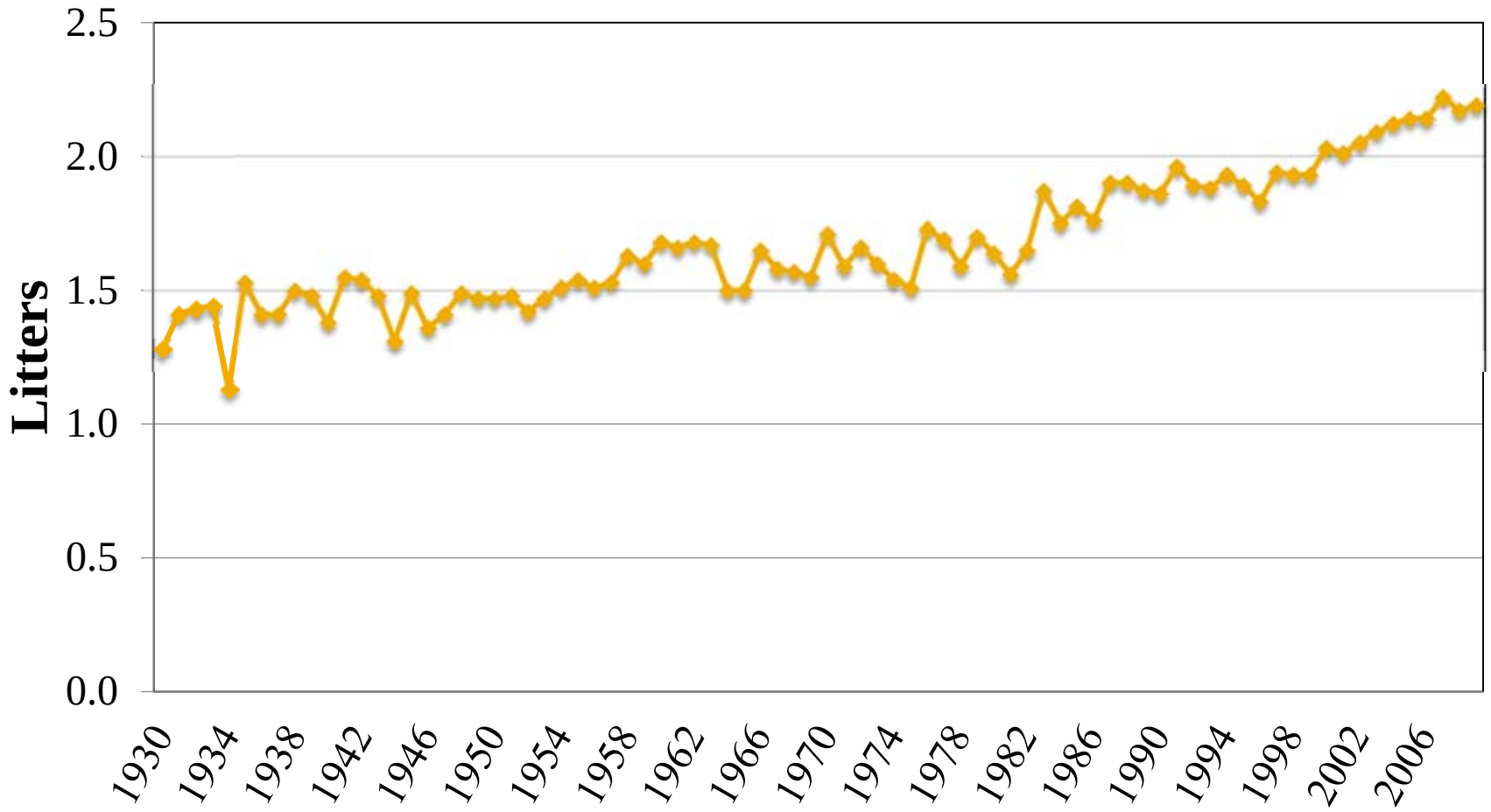
# Litters Per Sow Per Year, 1930-2009




Source: USDA/NASS

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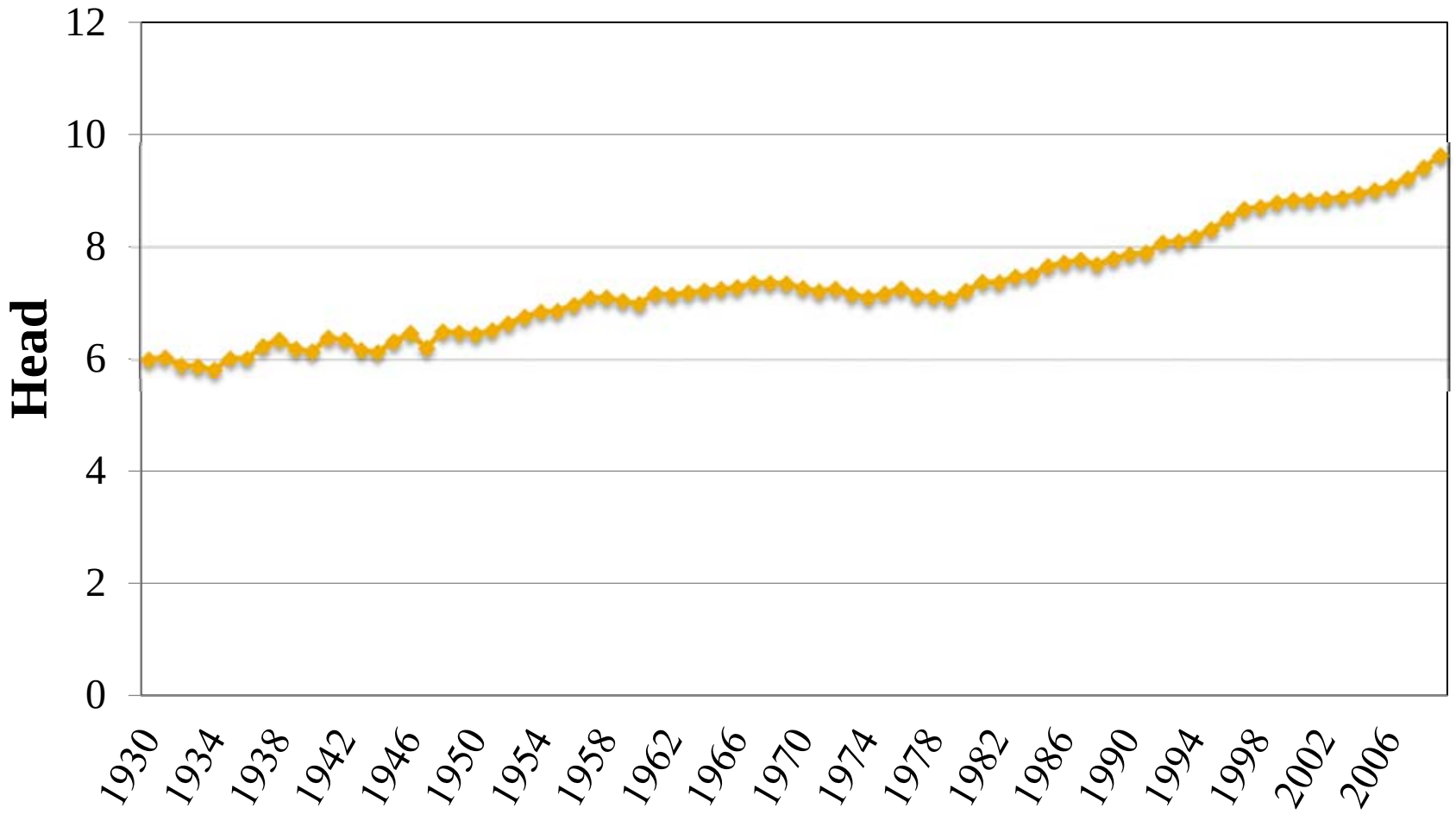
# Pigs Per Litter, 1930-2009




Source: USDA/NASS

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# Pigs Per Sow Per Year, 1930-2009


Source: USDA/NASS

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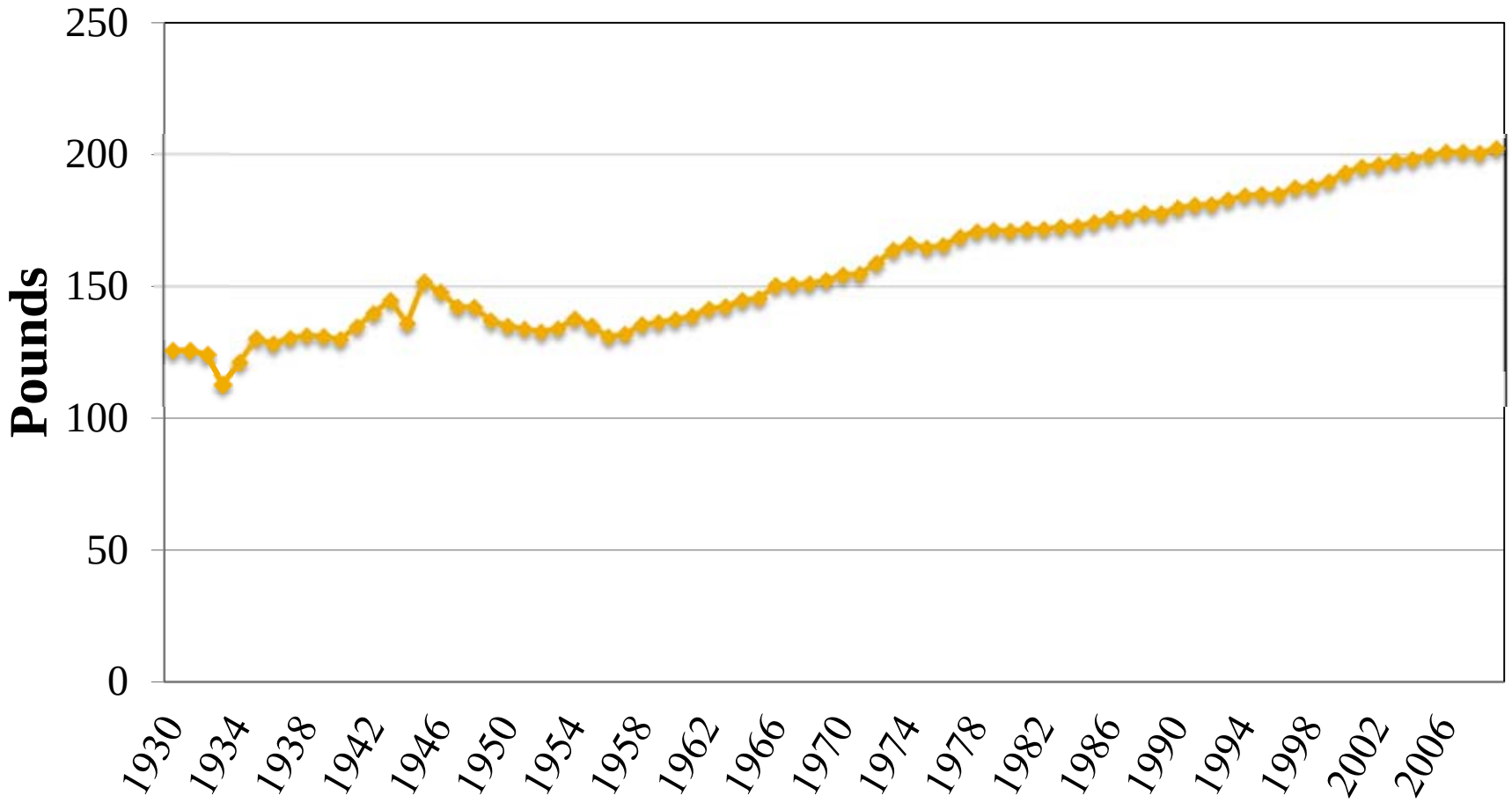
# Pork Per Hog Per Year, 1930-2009




Source: USDA/NASS

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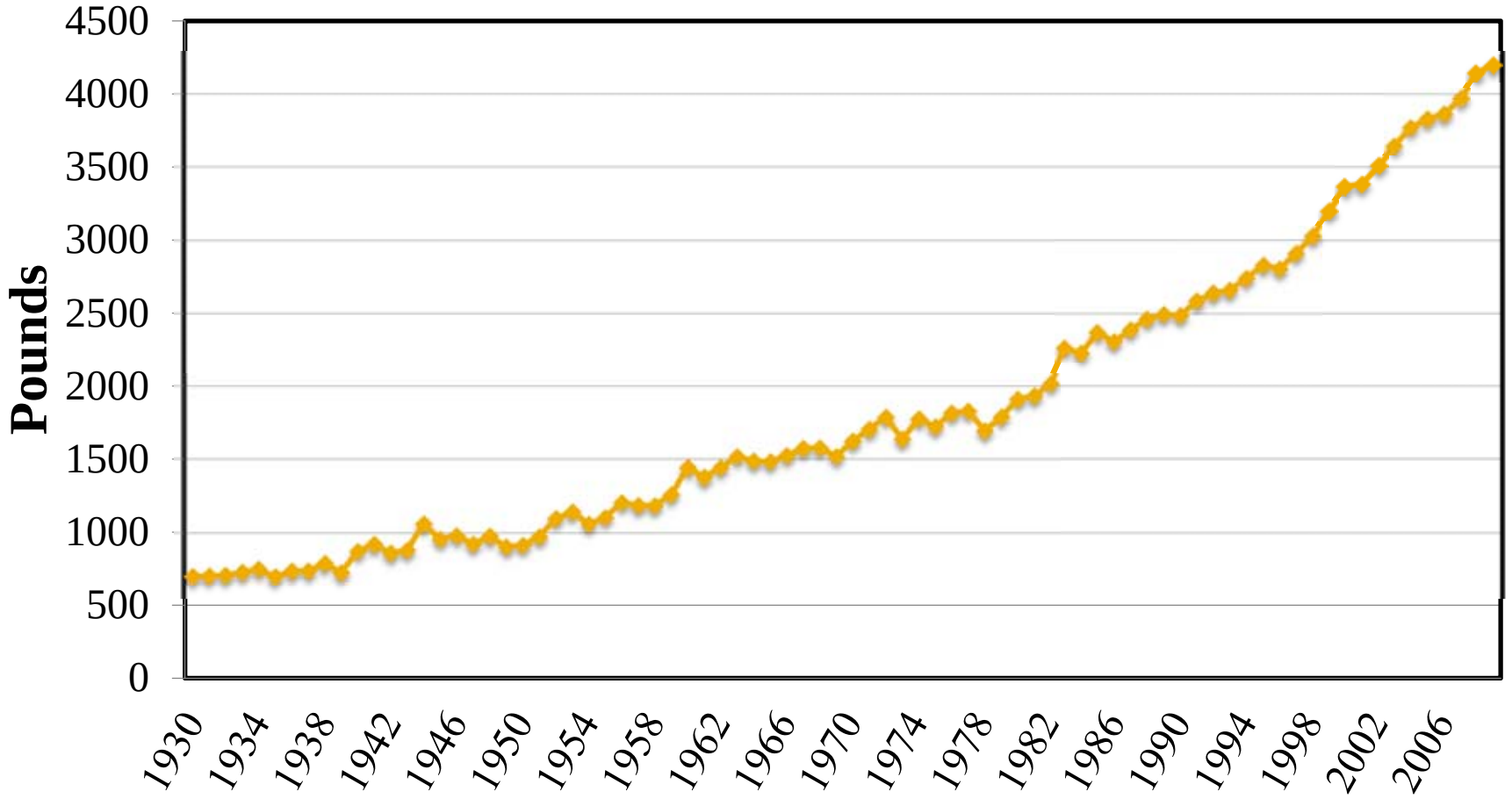
# Pork Per Sow Per Year, 1930-2009




Source: USDA/NASS

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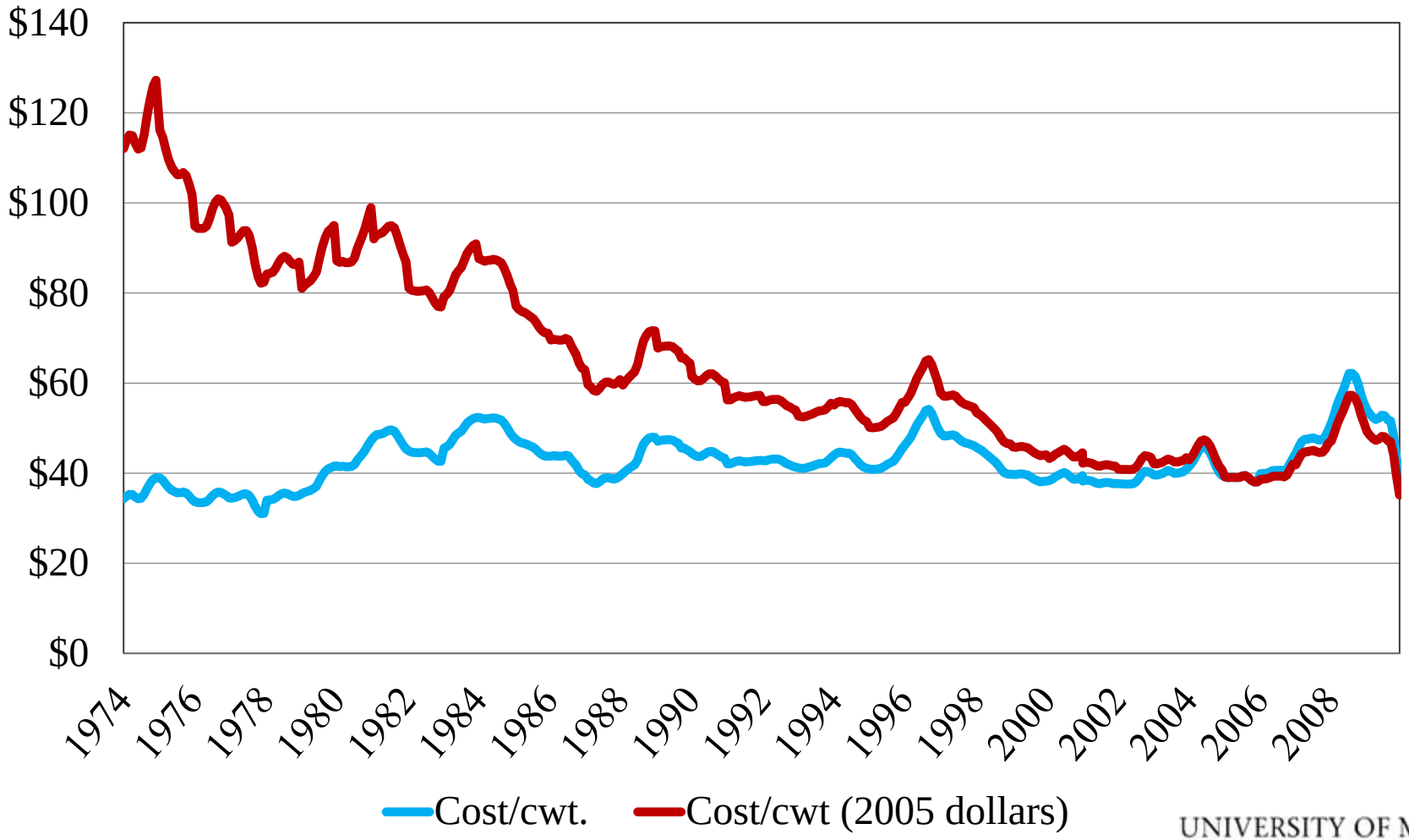
# Cost of Production:
## Farrow to Finish




Source: Iowa State University

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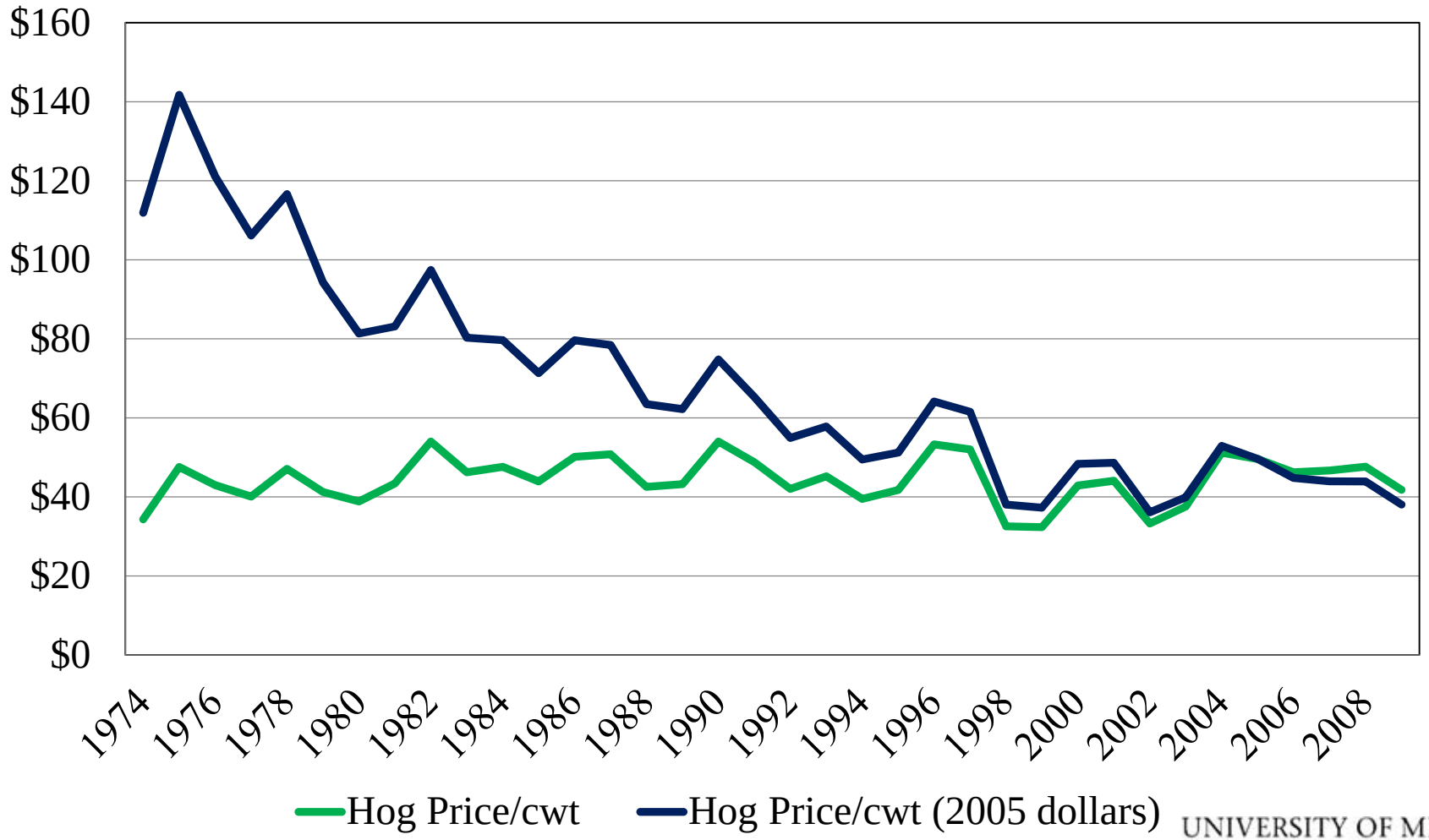
# Value of Production:
## Farrow to Finish




Source: Iowa State University

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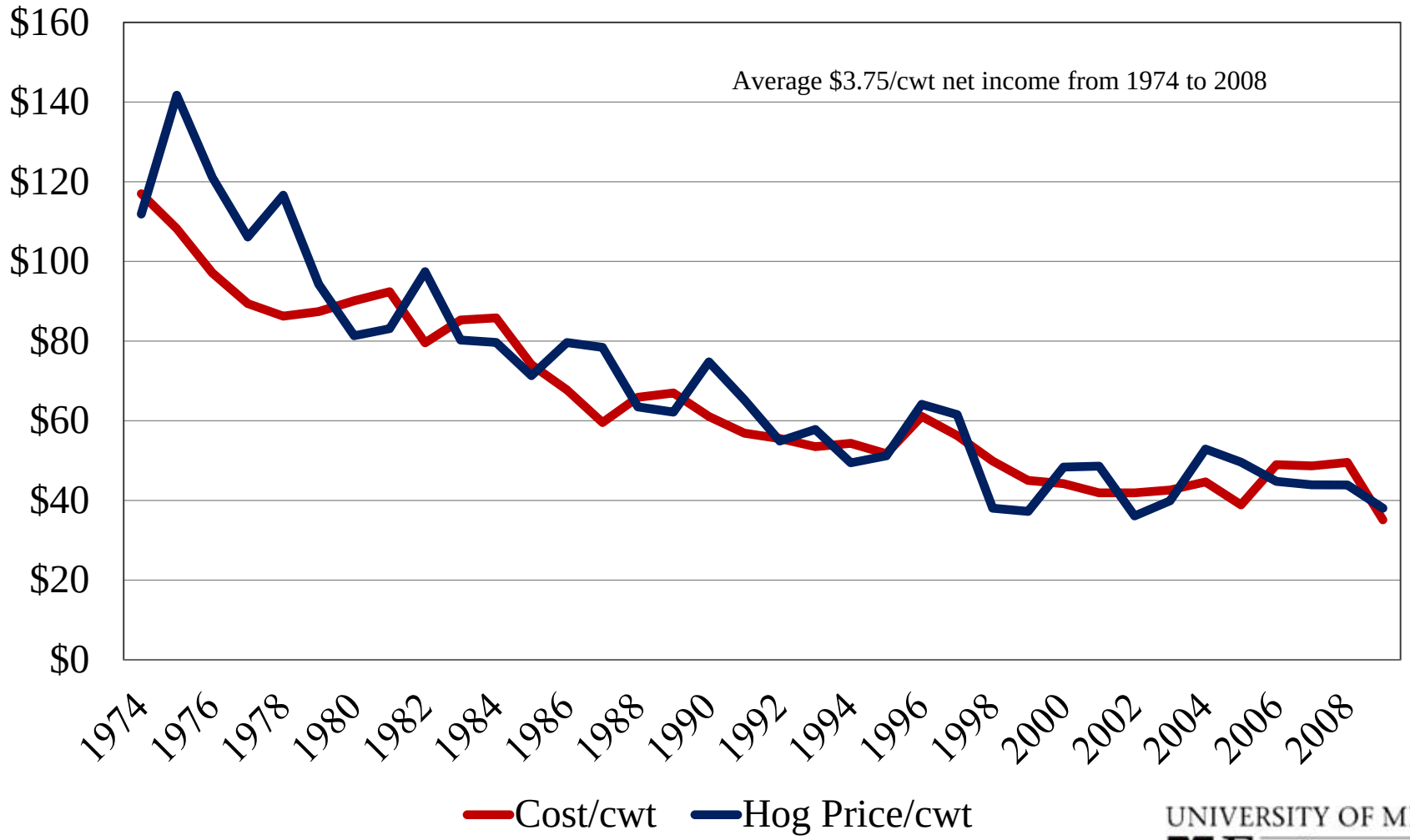
# Returns to Production:
## Farrow to Finish (2005 dollars)




Source: Iowa State University

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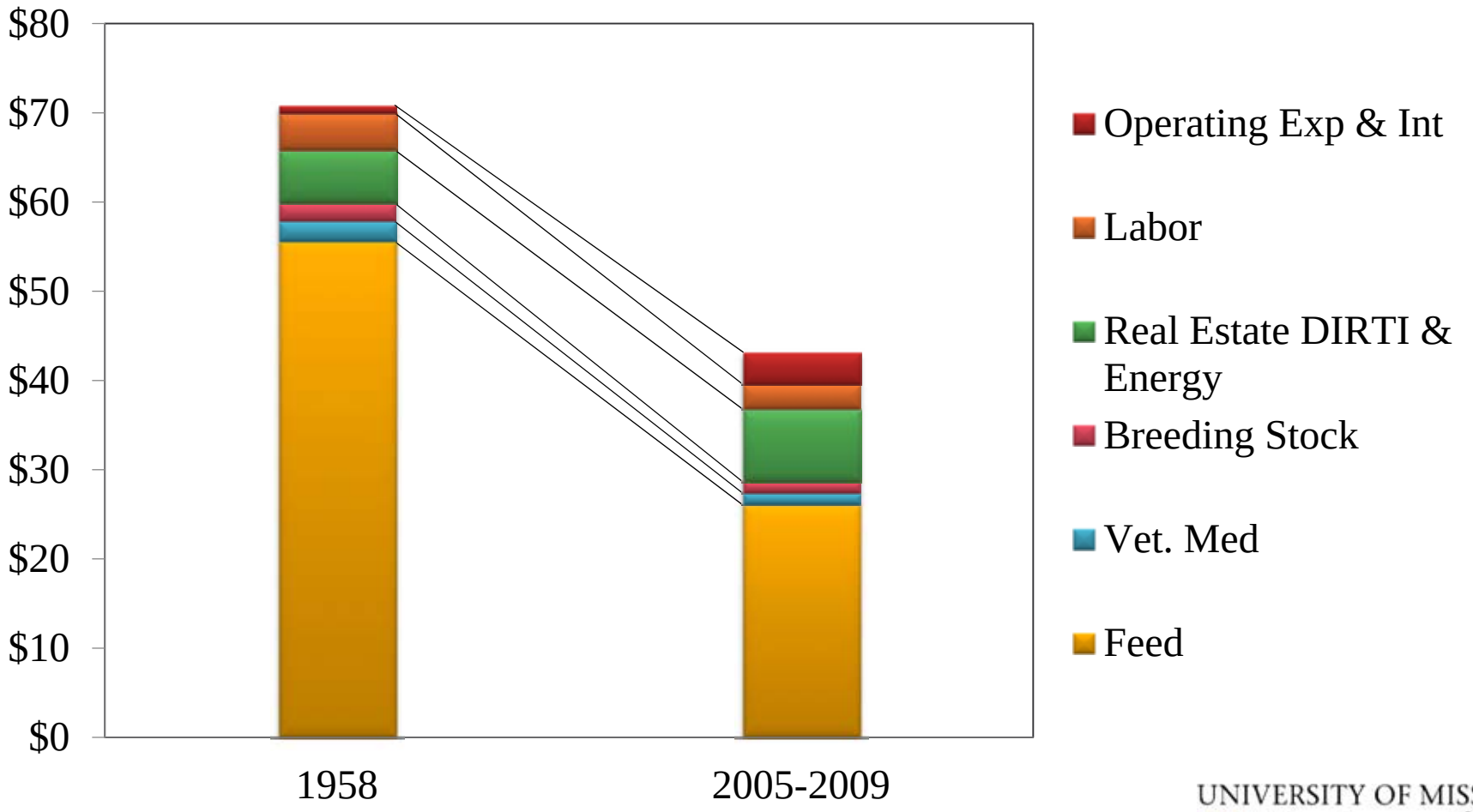
# Cost Analysis
## (2005 dollars)




Source: Missouri Budgets

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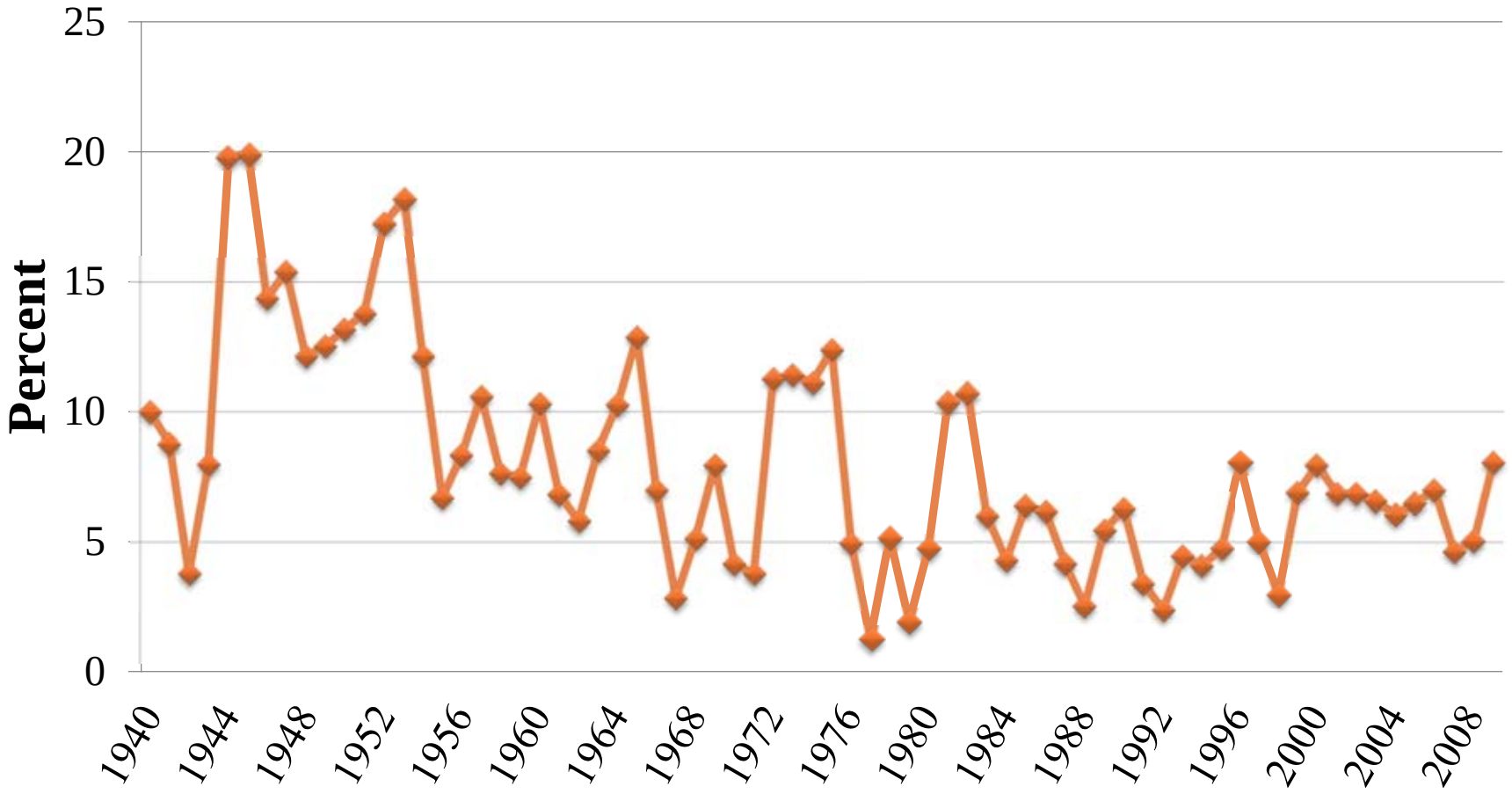
# U.S. Hog Post-weaning Death Loss, 1940-2009




Source: Ron Plain, University of Missouri, 2010

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# Post-weaning mortality has decreased by ~ 50% since the 1940's

- Why?
- We're raising hogs indoors:
  - Better thermal environmental control
  - Protection from predators
  - Improved health

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# Improved Pig Health - Parasites

| Parasite | 1940's | 1970's | 2000's | Why the decrease? |
|---|---|---|---|---|
| Kidney worm | 78-94% of hogs | 68-80% of sows | Rarely seen | Less access to soil |
| Lung worm | 55-70% of hogs | 11% of farms | Rarely seen | Less access to earthworms |

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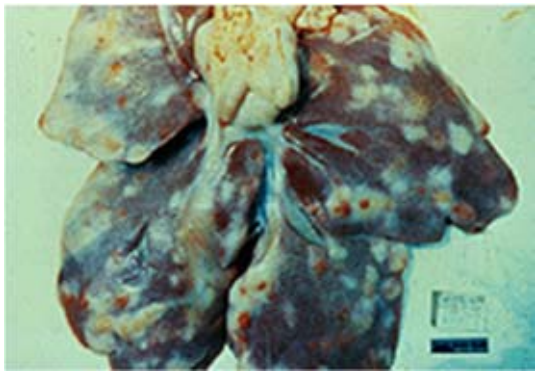
# Improved Pig Health - Parasites



- So what?
- Kidney worm infection:
  - Reduces ADG by 25-69% (Hale and Marti, 1983)
  - Increases F:G by 3-24% (Hale and Marti, 1983)
  - Estimated to cost industry $73 million/year due to organ condemnations (Stewart et al., 1964)

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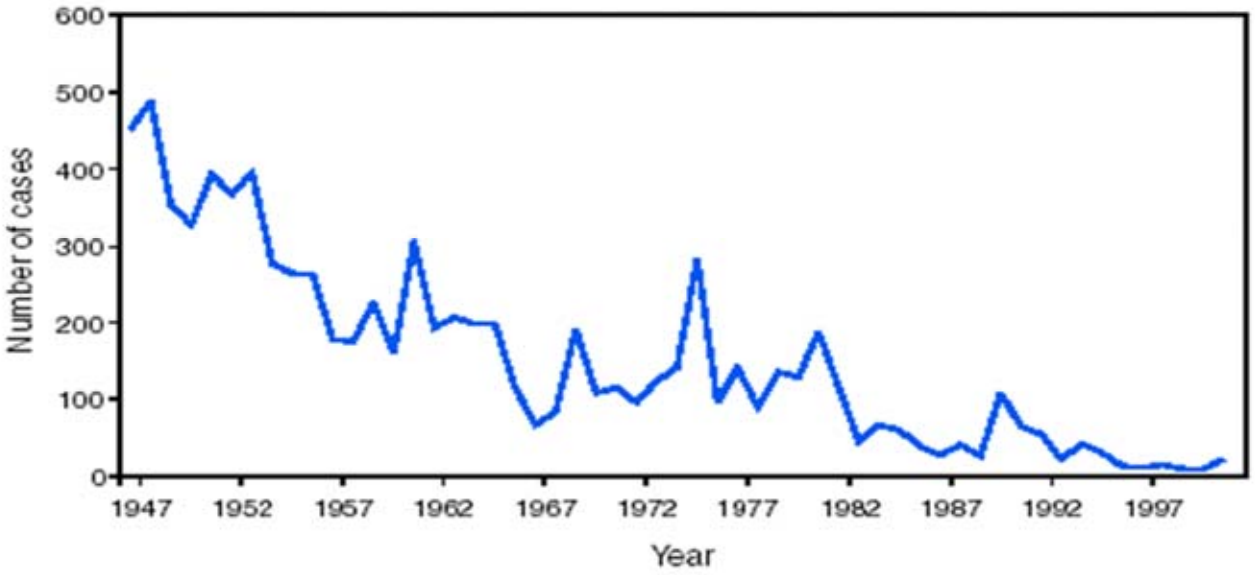
# Improved Pork Safety and Public Health

FIGURE 5. Number of reported trichinellosis cases, by year — United States, 1947–2001




Between 1947-1951, the number of human cases of trichinellosis ranged from 327-487/year, including 57 deaths.

Between 1997-2001, the number of human cases of trichinellosis ranged from 11-23/year, with no deaths.

Source: Trichinella surveillance – United States, 1997-2001

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# Improved Public Health - Trichinella

- Among all human cases of trichinellosis where infection source was known between 1997-2001:
  - 39% were associated with consuming pork products
  - Of these:
    - 41% associated with eating home-raised or direct-from-farm purchased pork
    - 18% associated with eating pork in a foreign country
    - 5% associated with eating wild boar
    - **36% associated with eating commercially purchased pork**

Source: Trichinella surveillance – United States, 1997-2001

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# Trichinella prevalence in pigs

| 1940's | 1970's | 2000's | Why? |
|---|---|---|---|
| 0.63% | 0.13% | 0.007% | Less garbage feeding and less access to wildlife |

Farms where pigs had access to wildlife were 6.33 times more likely to be Trichinella positive than farms where pigs had no access to wildlife (Gamble et al., 1999)

0.34% of pigs housed in outdoor, antibiotic-free systems tested positive for Trichinella compared to 0% of pigs housed in indoor systems (Gebreyes et al., 2008)

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# Improved Public Health - Toxoplasmosis

- ~ 4000 babies are born with congenital toxoplasmosis each year in the USA
  - estimated to cost $8.8 billion annually

| Year(s) | Source of Sera | % Positive | Reference |
|---|---|---|---|
| 1988-1994 | NHANES | 22.5 | Jones et al., 2001 |
| 1999-2000 | NHANES | 15.8 | Jones et al., 2003 |
| 1999-2004 | NHANES | 10.8 | Jones et al., 2007 |

"This reduction in prevalence is likely to be partially due to a reduction in T. gondii cysts in meat through the efforts of meat producers" (Jones et al., 2007)

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# Toxoplasmosis seroprevalence in sows in the USA

| Year(s) | Source of Sera | % Positive | Reference |
|---|---|---|---|
| 1983-1984 | National survey | 42 | Dubey et al., 1991 |
| 1990 | NAHMS | 20 | Dubey et al., 1996 |
| 1994-1995 | NAHMS | 15 | Patton et al., 1998 |
| 2000 | NAHMS | 6 | Patton et al., 2000 |

- Percent of producers using cats as a form of rodent control dropped from 87% in 1990 to 51% in 2000 (NAHMS, 2006)
  - Sows housed outdoors at any time are 23 times more likely to be seropositive than sows always housed indoors (Assadi-Rad et al., 1995)
  - Seroprevalence is significantly higher in outdoor, antibiotic-free herds (7%) than in conventional, indoor herds (1%) (Gebreyes et al., 2008)

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# Crude Protein, %

| Item | NRC | | | Current Industry |
|---|---|---|---|---|
| | 1944 | 1973 | 1998 | |
| Nursery | - | 22 | 25 | 23 |
| Grow-Finish | | | | |
| 50 lbs | 22 | 18 | 23 | 16 |
| 100 lbs | 16 | 16 | 20 | 14.5 |
| 150 lbs | 13.6 | 14 | 17 | 13 |
| 200 lbs | 13.3 | 13 | 15 | 12.5 |
| 250 lbs | 12 | - | 13 | 11 |
| Gestation | 15 | 14 | 13 | 13 |
| Lactation | 15 | 15 | 17 | 18 |

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# Total Phosphorus, %

| Item | NRC | | | Current Industry |
|---|---|---|---|---|
| | 1944 | 1973 | 1998 | |
| Nursery | - | 0.60 | 0.70 | 0.55 |
| Grow-Finish | | | | |
| 50 lbs | 0.40 | 0.50 | 0.65 | 0.45 |
| 100 lbs | 0.40 | 0.50 | 0.60 | 0.40 |
| 150 lbs | 0.35 | 0.40 | 0.50 | 0.40 |
| 200 lbs | 0.35 | 0.40 | 0.45 | 0.21 |
| 250 lbs | 0.30 | - | 0.40 | 0.15 |
| Gestation | 0.60 | 0.50 | 0.60 | 0.55 |
| Lactation | 0.40 | 0.50 | 0.60 | 0.55 |

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# Daily Gain, lb/d

| Item | NRC | | | Current Industry |
|---|---|---|---|---|
| | 1944 | 1973 | 1998 | |
| Nursery | - | 0.66 | 0.90 | 0.95 |
| Grow-Finish | | | | |
| 50 lbs | 0.90 | 1.10 | 1.50 | 1.60 |
| 100 lbs | 1.50 | 1.32 | 1.75 | 1.80 |
| 150 lbs | 1.75 | 1.65 | 2.00 | 2.10 |
| 200 lbs | 1.80 | 1.98 | 2.20 | 2.25 |
| 250 lbs | 1.80 | - | 1.85 | 1.90 |
| Average (GF) | 1.55 | 1.60 | 1.85 | 1.95 |

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# Feed Efficiency – F/G

| Item | NRC | | | Current Industry |
|---|---|---|---|---|
| | 1944 | 1973 | 1998 | |
| Nursery | - | 2.00 | 1.80 | 1.70 |
| Grow-Finish | | | | |
| 50 lbs | 3.00 | 2.50 | 2.00 | 1.80 |
| 100 lbs | 3.33 | 3.00 | 2.40 | 2.20 |
| 150 lbs | 3.77 | 3.50 | 2.75 | 2.55 |
| 200 lbs | 4.17 | 4.00 | 3.00 | 2.90 |
| 250 lbs | 4.61 | 4.50 | 3.60 | 3.40 |
| Average (GF) | 3.78 | 3.50 | 2.75 | 2.55 |

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# Typical Diet – 100 lb pig

| Item, % | NRC | | | Current Industry |
|---|---|---|---|---|
| | 1944 | 1973 | 1998 | |
| Corn | 75.0 | 90.0 | 75.2 | 82.6 |
| Soybean meal | - | 7.5 | 21.5 | 15 |
| Tankage | 12.0 | - | - | - |
| Alfalfa meal | 6.0 | - | - | - |
| Linseed meal | 6.0 | - | - | - |
| Dicalium Phos | - | 0.6 | 1.0 | 0.80 |
| Limestone | - | 0.9 | 1.3 | 0.90 |
| Vit/TM Premix | 1.0 | 1.0 | 1.0 | 0.50 |
| Phytase | - | - | - | 0.05 |
| Amino Acids | - | - | - | 0.15 |

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# Key Nutritional Changes

- Discovery, synthesis and Requirements
  - Energy
  - Protein and AA (1950)
  - Minerals and Vitamins (B12)
- Antimicrobial agents – chlortetracycline 1949
- Metabolic modifiers
- Feeding management
- Diets for early-weaned pigs
- Feeding programs for gestating and lactating
- Instrumentation and technologies

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# Grow-finish Performance

| Era | Grow-Finish Weight Gain | Feed DM |
|---|---|---|
| | lbs/pig space/yr | lbs/pig space/yr |
| 1944 | 373 | 1320 |
| 1972 | 471 | 1600 |
| 1998 | 577 | 1600 |
| 2009 | 631 | 1655 |
| Improvement (%) | 69 | - |

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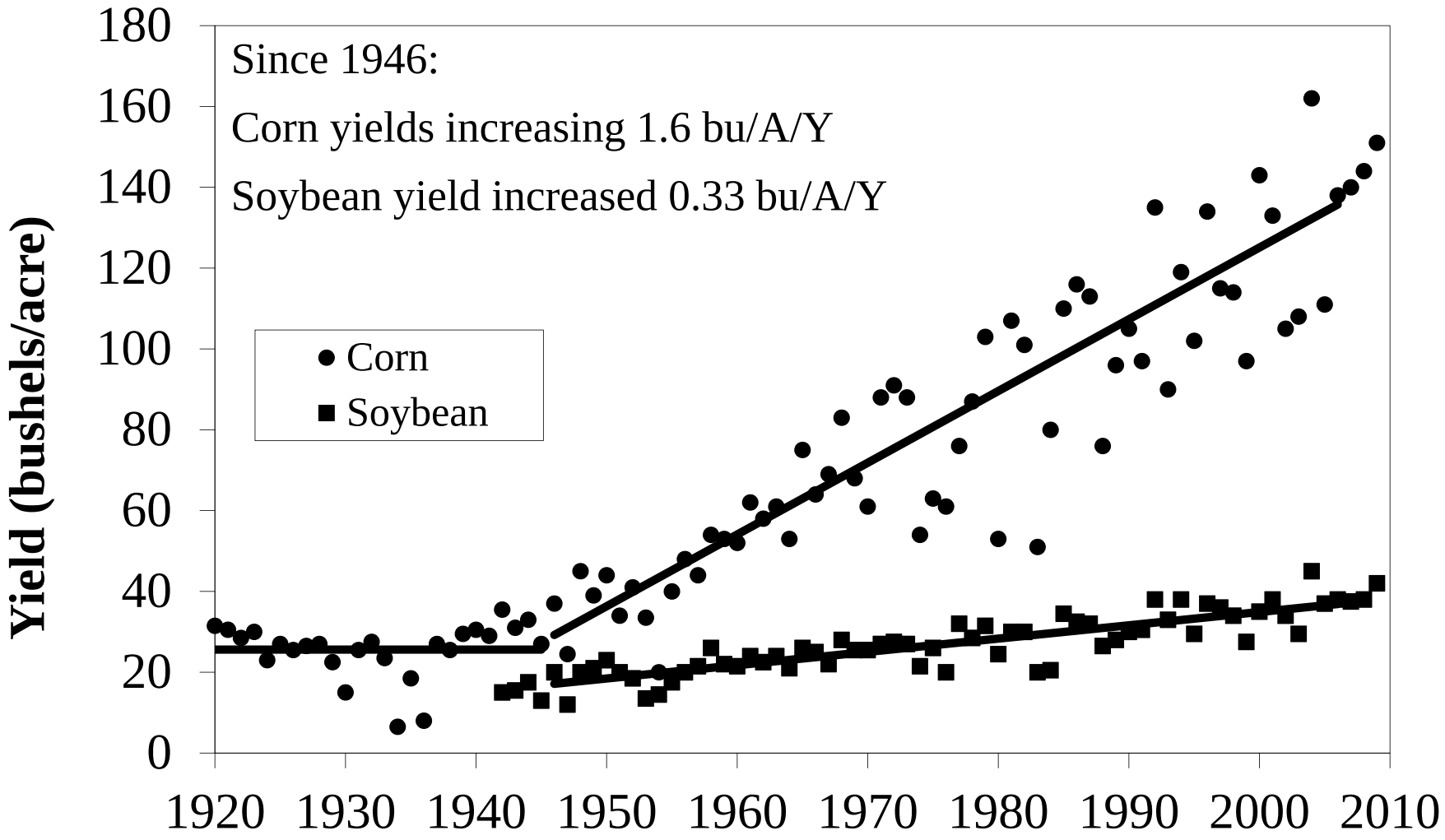
# Mean statewide corn yield 1920 - 2007




Source: Based on State Agricultural Statistics

# Grow-finish Performance

| Era | Acres cropland per pig space | lbs of pork produced per acre of crop land per year |
|---|---|---|
| 1944 | 0.66 | 563 |
| 1972 | 0.49 | 970 |
| 1998 | 0.41 | 1425 |
| 2009 | 0.33 | 1895 |
| Improvement (%) | -50 | 237 |

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# Grow-finish Excreted Nutrients

| Era | Nitrogen | Phosphorus |
|---|---|---|
| | lbs/pig space/yr | lbs/pig space/yr |
| 1944 | 25 | 3.3 |
| 1972 | 27 | 4.8 |
| 1998 | 30 | 5.2 |
| 2009 | 20 | 1.5 |
| Improvement (%) | -20 | -55 |

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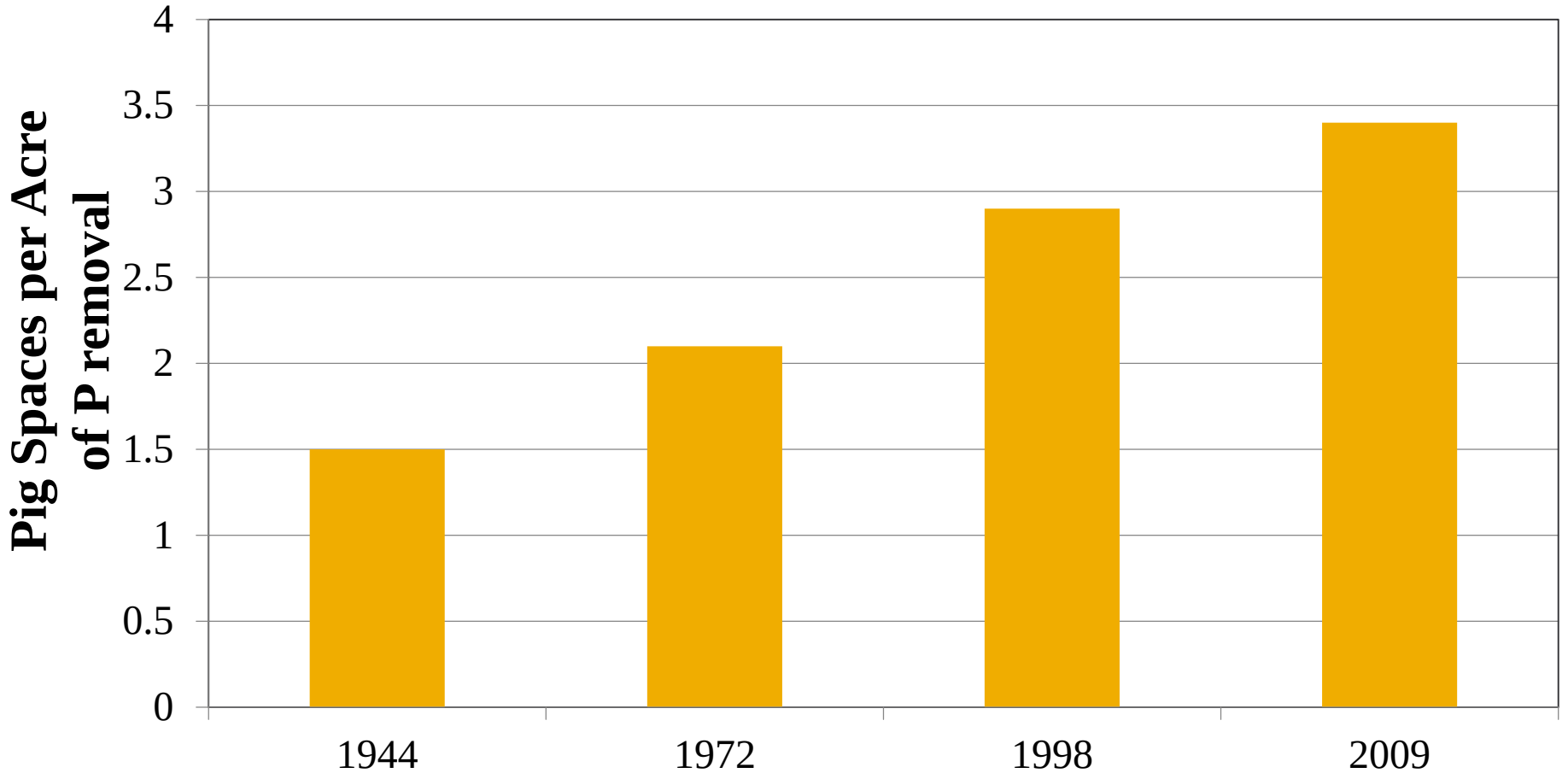
# Land base for P balance




Based on corn

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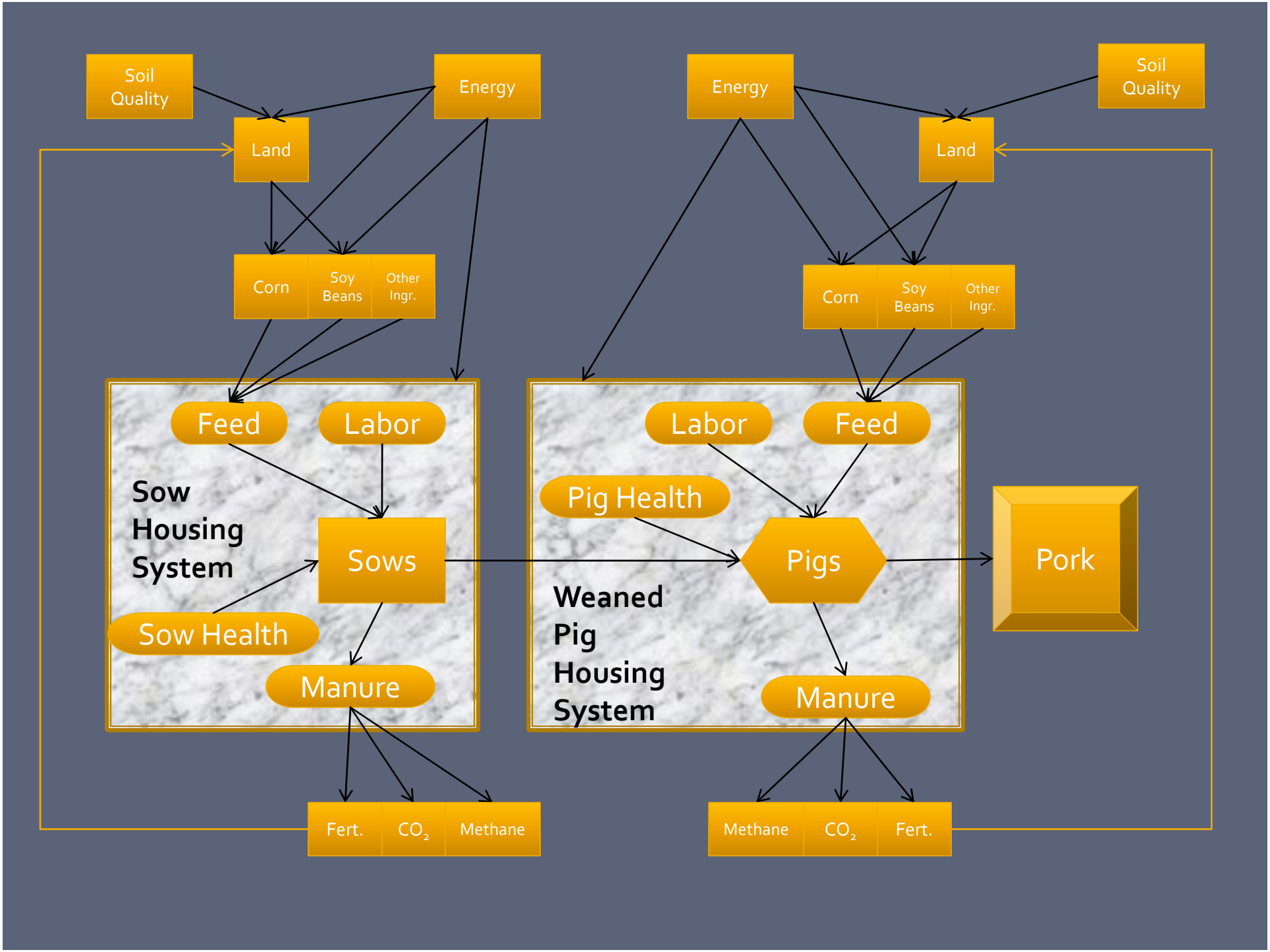
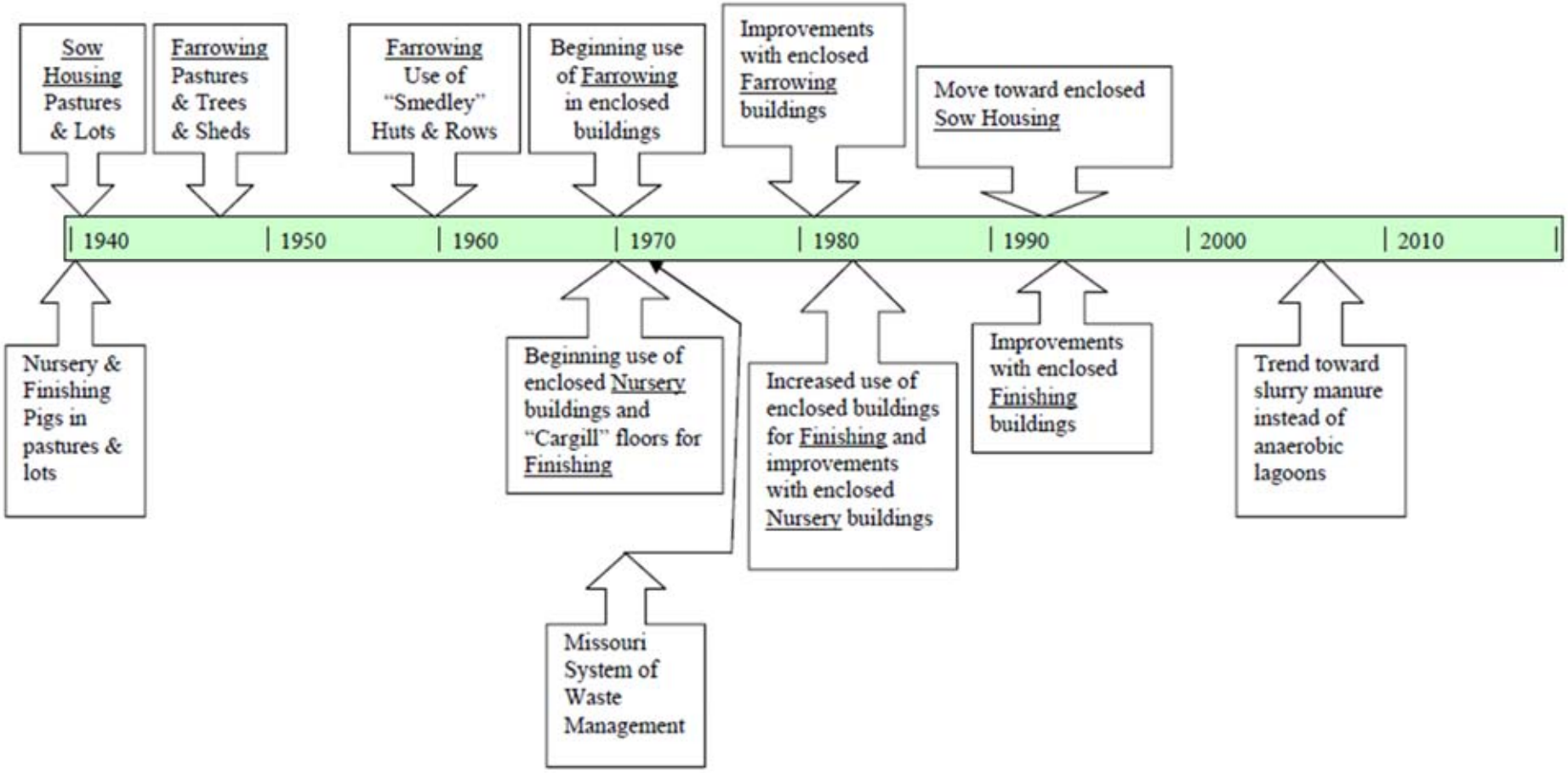

Soil Quality
Energy
Land
Corn
Soy Beans
Other Ingr.
Feed
Labor
Sow Housing System
Sows
Sow Health
Manure
Fert.
$CO_2$
Methane
Energy
Soil Quality
Land
Corn
Soy Beans
Other Ingr.
Labor
Feed
Pig Health
Pigs
Weaned Pig Housing System
Manure
Methane
$CO_2$
Fert.
Pork

# Evolution of Swine Facilities in Missouri

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# Initial Sow & Farrowing Systems

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# Initial Grow-Finish Systems


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# Enclosed Farrowing Facilities

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# Enclosed Nursery Facilities


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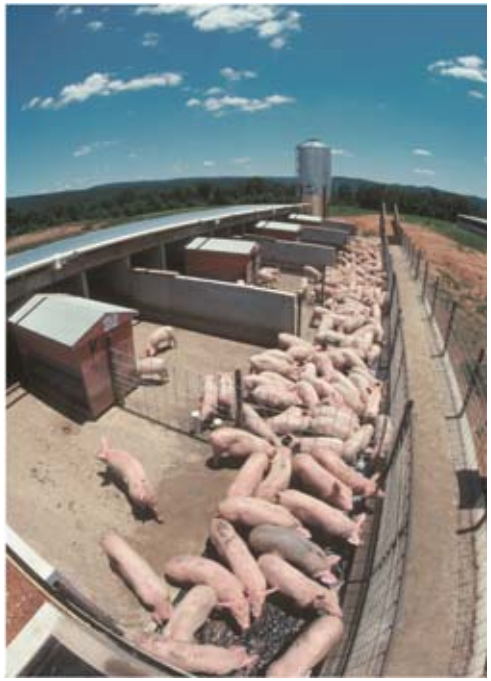
# Outside Grow-Finish Systems



These systems provide the potential to improve water quality but not much potential to improve feed efficiency.

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# Enclosed Finish Facilities

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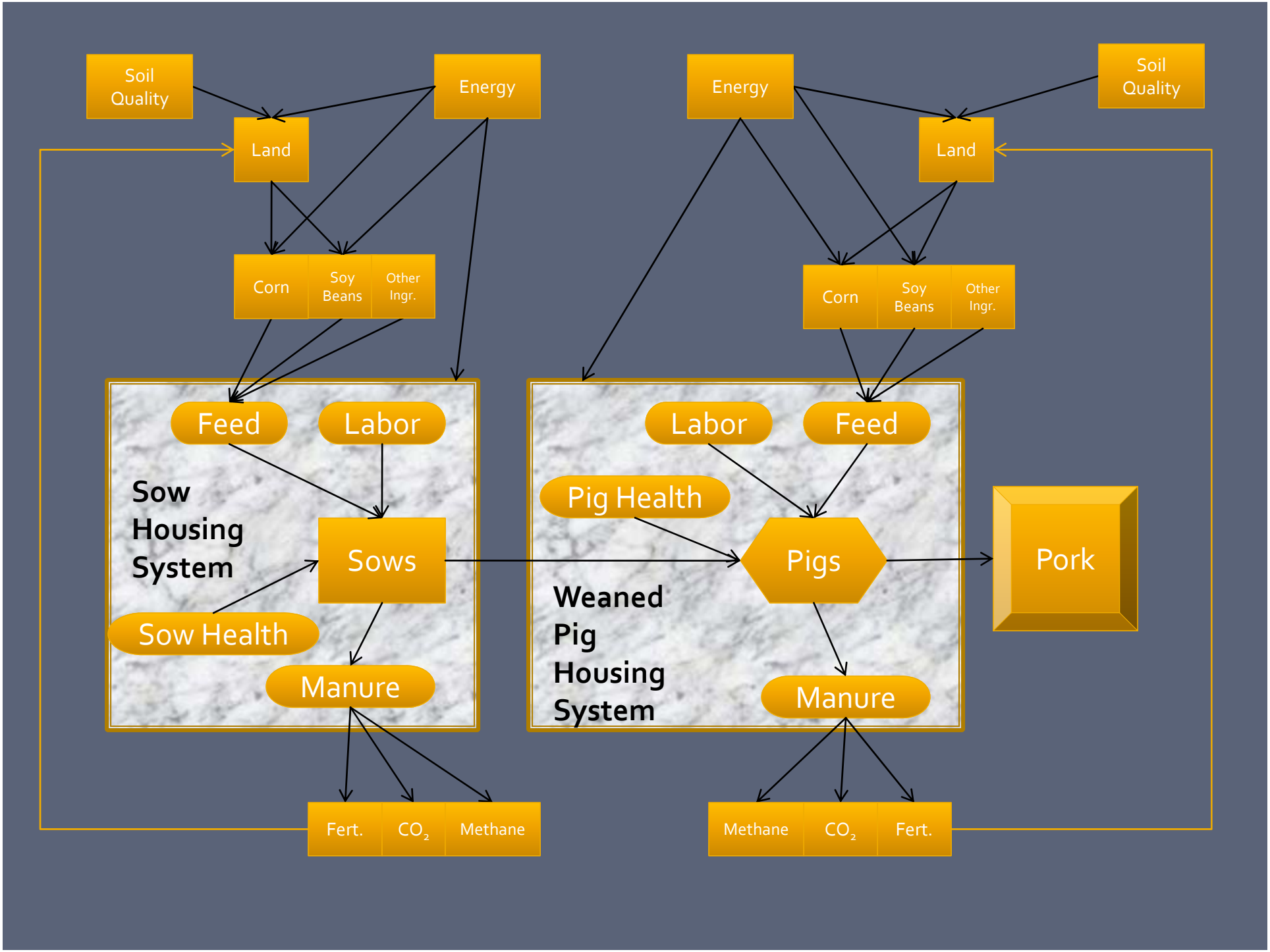
Soil Quality
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Corn
Soy Beans
Other Ingr.
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Sows
Sow Health
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Methane
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Soil Quality
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