

出國報告  
(類別：考察)

考察美國養豬產業現況及其生產系  
統整合應用

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## 摘要

美國為養豬先進國家，其產業及豬肉產品具有相當競爭力，出口量位居世界第一。本次考察係美國穀物協會為協助促進我養豬產業發展，邀集產官學代表赴美參加一年一度全球養豬大展，一併了解瞭解美國養豬產業現況與其生產系統整合應用，做為我國養豬生產及產業輔導推動之參考。主要心得如下：（一）美國現今養豬產業發展考量飲食健康、肉品營養價值、食品安全、動物福祉及環保意識，朝母豬減量而豬肉生產量增加目標前進。（二）另因應國際穀物價格上漲，美國亦採取相關配套措施（如精密種植與基因改造增加產量、使用玉米乾酒粕替代飼料中玉米比例等），降低養豬飼料成本及增加競爭力。（三）美國養豬產業透過互助金（Checkoff）收取制度，使產業擁有可運用資金從事推廣、教育及研究，並協助開拓國內、外豬肉市場及遊說立法，維持產業永續發展。此次舉辦之世界性養豬大展即由美國豬肉生產者協會（NPPC）透過相關基金於愛荷華州首府 Des Moines 舉辦，鼓勵新設備、產品與技術參展，提供新式養豬概念及帶動新式養豬技術交流應用。另亦透過此項資金推動形象塑造及宣導計畫，重新定義養豬業者為優良豬肉生產者並積極對全美推廣，賦予養豬業者生產衛生安全豬肉，保障公眾健康責任及新形象。（四）美國養豬生產、飼養管理、疾病防疫及生物安全等均有整套系統，並儘量以最簡化之方式提供農民參考使用及推廣，並多有相關法令或規範進行配合。除以專業分工之分地式生產系統方式飼養，維持高育成率，其新式豬隻生產系統已規格模組化，並有專門公司提供豬場總承包建設服務。（五）整合生產為美國未來之趨勢，面對垂直整合大型公司之競爭，美國養豬中小農透過 Pipestone System 或類似系統整合母豬至肉豬之生產鏈，確保生產效率，提升核心競爭力。豬場逐漸轉型成豬肉生產工廠，藉由批次專業管理，排定豬隻生產流程及預計肉品生產重量，讓管理者易於管控豬場經營所需資金。而美國獸醫服務體系亦自疾病診療轉為生產系統專業管理及疾病防治，以完善管理，組織內專業分工以及諮詢服務，確保畜牧生產效率。

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## 一、前言及目的

美國為養豬先進國家，藉由不斷增進養豬生產效率，以及改善飼料配方降低成本，使其產業及豬肉產品具有相當競爭力，出口量位居世界第一位。近年來適逢國際穀物價格大幅上揚之際，美國成功且持續強化之養豬產業政策，如產業基金制度及產業團體自主運作機制等、如何調整飼料內容成分增進飼料效率運用、生產與管理系統整合及相關配套措施等，均值得我國學習與借鏡。美國穀物協會為協助促進我國養豬產業發展，配合美國一年一度全球養豬大展舉辦之時機，邀集產、官、學代表組團赴美參加養豬大展及考察美國養豬產業現況與其生產系統，一併了解美國養豬產業政策及措施，做為我國養豬生產及產業輔導推動之參考。

## 二、過程

### (一) 行程

年	月日	起迄地點	活動內容
100年	6月5日 (星期日)	台北→ 日本東京→ 美國明尼蘇達州明尼亞波里斯 (Minneapolis, MN) → 愛荷華州首府底模依市 (Des Moines, Iowa)	啓程
100年	6月6-7日 (星期一~二)	愛荷華州底模依市 (Des Moines, Iowa) → 伊利諾州 (Illinois) → 愛荷華州底模依市 (Des Moines, Iowa)	參加全美養豬大展產業參觀活動
100年	6月8-10日 (星期三~五)	美國愛荷華州底模依市 (Des Moines, Iowa)	參觀全球養豬大展 (World Pork Expo)
100年	6月11日 (星期六)	美國愛荷華州底模依市 (Des Moines, Iowa)	參觀假日農民市場 (Downtown Farmer's Market)
100年	6月12日 (星期日)	愛荷華州底模依市 (Des Moines, Iowa) → 明尼蘇達州 Pipestone (Pipestone, MN)	路程
100年	6月13日 (星期一)	明尼蘇達州 Pipestone (Pipestone, MN)	參觀 Pipestone Veterinary Clinic、了解 Pipestone System 及其契約豬場
100年	6月14日 (星期二)	明尼蘇達州 Pipestone (Pipestone, MN) → 明尼蘇達州 Marshall (Marshall, MN)	參觀 Duane Carrow farm 及 Ralco 營養飼料配方公司
100年	6月15日 (星期三)	明尼蘇達州 Marshall (Marshall, MN) → 明尼蘇達州明尼亞波里斯 (Minneapolis, MN)	參觀玉米酒精工廠
100年	6月16-17日 (星期四~五)	美國明尼蘇達州明尼亞波里斯 (Minneapolis, MN) → 日本東京→ 台北	返國

## (二) 內容重點

本次行程重點係參加全球養豬大展 (World Pork Expo) 及其舉辦單位安排之產業參觀活動 (Industry Tour of World Pork)、另參訪 Pipestone 臨床獸醫團隊機構 (Pipestone Veterinary Clinic; 簡稱 PVC) 與了解其自母豬至肉豬生產管理之整合系統 (Pipestone System), 及實地參觀其整合之養豬場, 最後參訪玉米酒精工廠。利用參觀活動與相關參訪機會, 瞭解美國養豬產業現況、產業互助金之運作、美國玉米生產運輸及其與畜牧事業配合雙贏發展之合作關係, 以及養豬生產系統整合應用情形, 重點內容如下:

### 1. 全球養豬大展產業參觀活動

#### (1) 阿馬納殖民地

阿馬納殖民地為美國全國性之歷史地標及其現存最長之社區, 始於 1714 年之德國。18 世紀動盪的德國出現所謂 pietism 宗教運動, 主張信心重建, 禱告和聖經研究, 但相繼而來之迫害和經濟衰退迫使德國社會開始尋找新家園, 由梅斯領導之基督教徒於 1843-1844 年離開德國, 希望於美國找到宗教自由, 最後於 1855 年定居愛荷華州, 成立阿馬納, 東阿馬納, 西阿馬納, 南阿馬納, 高阿馬納和中東阿馬納六村。生活形態屬社區生活, 採取財產和資源共享制度, 無論男人和女人均被分配工作, 而沒有工資, 現繼續存於愛荷華州大草原農莊, 其資金多用於增進農業或畜牧生產設施, 以自給自足, 並增加其收益; 其社會組織指派專人專職進行畜牧飼養, 且不吝花費資金購置良好生產設施, 因此, 雖其豬隻飼養型態大部分仍維持一貫式家庭飼養, 但仔豬育成率不差, 可達 25-27 隻/年。

另外本次行程亦參觀其社區所設之糞便消化槽, 該設施可處理 4,000 隻架子牛產出之糞便, 經由卡車載運至厭氧消化槽, 經由 21 天無氧發酵處理, 固体部分再經脫磷程序將磷去除, 糞便即可作為草原肥料, 污水則用作玉米及大豆之種植肥料, 所產生之甲烷可用來發電供社區使用, 場內計有四台發電機, 可見其對可利用能源之重視及再利用。



圖 1、社區糞肥集中地



圖 2、糞肥集中池



圖 3、處理室



圖 4、處理完畢後之糞肥

## (2) Cinnamon Ridge Farms

此次參訪農場於 1840 年開始經營，至今經營超過 100 年，主人 John Maxwell 為德裔第 6 代，父親曾擔任美國豬肉生產者協會（National Pork Producers Council, NPPC）會長。該農場為一綜合式農場，其範圍內有豬場、乳牛場、肉牛場、山羊場、肉雞場及自我服務商店（農場主人創意之舉，係用以供應農場所生產之生鮮雞蛋、屠宰冷藏之豬肉與牛肉，以及自家所製之派、甜點或手工織品等），佔地超過 4,000 英畝（Acre = 0.40468 公頃 = 4046.8 平方公尺），農地採輪作方式種植玉米及黃豆，完全使用大型農業機具進行機械化耕種及收穫，僅須農場男女主人及 2 名僱工負責種植及收割相關工作，所種植玉米為抗蟲（Bt）系列基因改造玉米品系。



圖 5、農場播種玉米之大型農機具



圖 6、大型農機具展開狀況



圖 7、農場種植之黃豆苗



圖 8、農場種植之玉米苗



圖 9、自我服務商店（供應農場生產之生鮮雞蛋、屠宰冷藏之豬肉與牛肉，以及自家製造之派、甜點及手工織品等）



圖 10、商店冰箱冷藏待售之包裝雞蛋



圖 11、自我服務商店門口



圖 12、商店冰箱冷藏待售之牛肉（自家不屠宰，係送屠宰場屠宰分切）

農場內有 2 豬場，採契約式經營管理，均為飼養 2,400 頭規模之密閉溫控肉豬舍，糞池式設計，設施採用高床，建置成本約 60 萬美元，平時

不清豬廢料及糞肥，糞尿處理乃採取厭氣發酵方式，每年約於 10 月份以機械車輛吸取豬舍條狀地板下之豬糞尿並運送至鄰近之玉米田施灌，此方式與我國每日清洗豬舍，豬糞尿採固液分離及污水處理後排放之方式具有明顯差異與不同。另農場主人表示，於美國養豬必須有自場糞肥處理計畫，並送政府審核通過，透過農畜糞肥直接應用於穀物生產之策略，除有效處理畜牧廢棄物，亦可將其作為農作氮肥，節省肥料支出，營造雙贏局面。由於美國化學性氮肥價格約為動物糞便 2 倍，故一般農場內畜牧場所產生之糞肥不作買賣，多作為自家農地使用之肥料，若仍有不足，再購入化學性氮肥補足。

2 豬場年產豬隻約 9,600 頭，由契約場負責人或管理人負責監看豬隻健康狀況並進行生產管理，豬舍採全自動給料給水，每欄飼有 20-25 頭豬隻。該等豬場飼養經營方式，係由鄰近場移入離乳仔豬，育成為肉豬後交契約屠宰或肉品加工公司，飼養時間約 5.5 個月，上市前體重約 127 公斤。美國農場契約經營方式多元，常見有兩種，一種將豬舍租用給契約人，以收取租金方式經營，另一種以契約飼養豬隻數計價，於豬隻上市時按隻抽取費用（如：單隻 15 美元）。



圖 13、農場內肉豬場外觀



圖 14、農場內肉豬場右側外觀



圖 15、場內溫度及中央控制設施



圖 16、場內肉豬飼養情形及密度



圖 17、豬舍外帆布升降控制設施及通風設施



圖 18、豬舍地熱保溫系統（使用瓦斯）

### (3) John Deere 農機具展場

John Deere 係美國知名農業機具生產組裝公司，1837 年由該公司創始人 John Deere 研製出適合美國中西部大草原之不黏土鋼犁，並由此起家所創立，強調研發。所研發及量產之主力農業機具為牽引機、玉米及黃豆採收用穀斗車、播種機與農藥噴灑車，通過與世界各地農民合作，該公司已成為世界馳名品牌。此公司規模相當大，所生產之穀斗車等農業機具，有大中小不同規格，堅固且耐用。

現於美國均使用大型農業機具進行穀物耕種，搭配衛星導航與電腦系統，精確導航播種及精準收割（扯斷、脫穗、脫包葉及脫粒），美國穀物耕種已相當精密與科學化，搭配大型農機具開發及使用，所需人力很少。另於耕種前，農民會在土地邊角採取土壤進行養分及氮肥測試，依其結果訂定施肥與播種計畫，亦搭配不耕犁方式 (No-tillage)，減少土壤過度使用及養分流失。



圖 19、John Deere 展場外團員合照

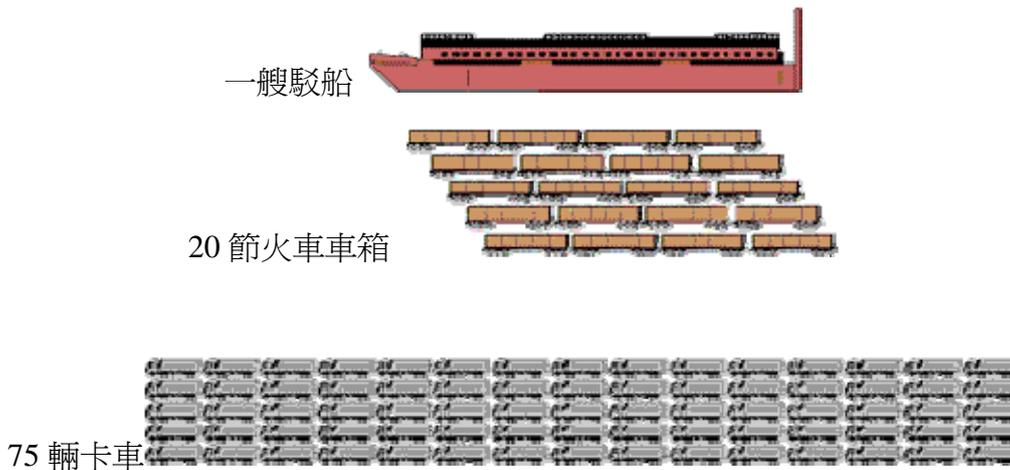


圖 20、展場內各項農業大型機具

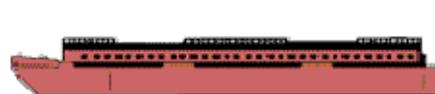
#### (4) 密西西比河玉米運輸

密西西比河為美國最大天然內陸航運水道，自開發以來，流域鄰近城鎮均依靠密西西比河水運進行貨物及材料運輸，所使用運輸工具為駁船（Barge）。以裝載能力而言，一艘駁船運載能力相當於 75 輛卡車或 20 節車箱，通常運送穀物（玉米、黃豆等）至下游，回程時再裝運煤、肥料及水等材料物品到上游，一般於裝填穀物前，會完成清洗工作及裝船前檢查，以防止交叉污染問題產生。

圖例：運輸 1,500 噸重量物質需要



圖例：以 1 加侖燃料運輸 1 噸貨物計算不同交通工具可行駛英里數



駁船可行駛 500 英里



鐵路運輸 200 英里



卡車只有 60 英里

使用駁船運輸相較於卡車或火車，具有下列好處：

- 最省油：以駁船運送，一加侖燃料可運一噸重物質長達 500 英里。
- 減少空氣污染。
- 減少卡車造成之交通阻塞。
- 減少道路磨損、噪音、輪胎磨損及回收處置。
- 減少交通意外。
- 增加市場競爭力（有效降低運輸成本）。



圖 21、密西西比河駁船運輸碼頭



圖 22、上船前團員合影



圖 23、駁船及其上蓋



圖 24、未裝貨前之駁船



圖 25、終點穀倉（Terminal elevator）將玉米裝入駁船內之作業情形



圖 26、駁船深度刻度，用以評估裝船深度及完成程度

#### (5) 美國豬肉董事會（National Pork Board, NPB）

美國互助金(Checkoff)收取單位有二，一為美國豬肉董事會(National Pork Board, NPB)，此項基金係經美國政府立法，豬隻於屠宰場交易結價時強制收取豬價千分之四（100 美元之 40 分）之互助金，由美國豬肉董

事會負責管理該基金，主要用於產業相關推廣、教育及研究，不可用來從事立法遊說相關工作。教育部份具有大型教育計畫（Large education program），提供各式各樣再教育專題，如豬肉品質保證、抗生素使用、豬隻移動及運輸注意及應行作為等，使養豬業者及其第二代可以快速接受相關概念及依良好原則經營；研究部份以產業關切之專題（如水質、外銷及推廣）為優先支持項目，邀請大學院校提供計畫書至基金會審查，一年有 2 次審查會，依優先順序及預算決定研究經費，研究計畫一般為 2 年期，首年收集分析資料，次年產出結果。

美國互助金（Checkoff）制度來自 1966 年 5 月之 moline 90，其由 90 位豬肉生產者組成，成員來自伊利諾州、印地安納州、愛荷華州、堪薩斯州、明尼蘇達州、密蘇里州、北卡、南達克塔州、田納西及威斯康新州，當時籌資自願性產業基金 40,000 美元，成立基金，並聘請首位執行秘書來管理基金及其研究計畫。1968 年 16 個州陸續加入，後續發展成立全國性組織，1970 年時會員已達 40,000 人，基金達 100 萬美金；抽取的基金亦由剛開始的 5 分錢/頭，發展至每賣出 100 元豬肉，即收取 0.40 美元基金（即千分之四）。

美國續於 1985 年通過豬肉推廣、研究及資訊法立法，基金收取轉為**強制性**，並開始接受美國農業部監督，收費標準為豬價千分之四（100 美元之 40 分）。另為提昇養豬業者形象及社會地位，1987 年後至今著重推廣豬肉為另一優值白肉，其肉質健康，可提供豐富且營養之蛋白質來源，養豬業者為生產衛生安全豬肉之優良豬肉生產者，賦有保障公眾健康之責任，並直接面對消費者。

養豬產業另有一組織為美國豬肉生產者協會（National Pork Producers Council, NPPC），其基金採**自願方式**收取豬價千分之一（100 美元之 10 分），由美國豬肉生產者協會負責管理，經費主要用於開拓國內、外豬肉市場、遊說立法（如空氣及水污染控制法）與扭轉產業負面形象。NPB 與 NPPC 關係密切，每年均有定期會議聯繫研商。



圖 27、於美國豬肉董事會聽取簡報



圖 28、團長與 NPB 工作人員合影

## 2. 全球養豬大展（World Pork Expo）

全球養豬大展每年舉辦一次，本年度由美國豬肉生產者協會（NPPC）於愛荷華州首府 Des Moines 舉辦第 23 屆大展，展期自 6 月 9 日至 6 月 11 日中午，計兩天半。展覽場分為主展區、副展區、運輸及大型機械展區、種豬及小豬比賽展區，其中主展區於展期頭 2 天設有不同專題的小型研討會（如經營管理、營養、飼料利用及效率、疾病控制及免疫成效等），供觀展人員選擇有興趣專題進行參與，獲取及交流專業相關資訊。全區展場內計有來自全美各地及其他 10 個國家四百餘個參展廠商，以及來自世界各地共 39 個國家近兩萬名觀展者一同參與，共襄盛舉。舉凡養豬所需軟硬體設施、相關設備、產品與技術【如：豬舍及通風系統、條狀地面、餵飼餵水系統及夾欄等舍內設施、動物標示產品（耳標）、人工授精工具及相關設備、運輸車與聯結貨櫃、起重台、屍體堆肥處理設備、飼料添加物、疫苗、消毒水、傳統或氣壓式注射器、背脂測定及懷孕診斷超音波設備、管理軟體、育種、豬場興建整合服務（Turn-key construction）等】，均在展場中展示、交流及供觀展人員詢問訂購。從事養豬相關產業人員可藉此展覽會中迅速得到新資訊、新產品與技術服務，用以評估應用及改善其養豬生產效率。

為吸引參觀養豬大展的人潮，會場除設備技術交流展示外，並於展覽期間辦理品嚐會、露天音樂會、小豬賽跑親子運動及種豬展示比賽等活動；同時美國豬肉生產者協會為鼓勵養豬業者下一代繼續從農，藉由種豬展示比賽使業者第 2 代或對畜牧有興趣的家庭子女從事飼養並照顧參賽的豬隻，親身參與趕豬及比賽，促使其從小瞭解與體會養豬工作，進而由比賽中贏得榮譽與對養豬產業之尊重。另於此次參觀過程中巧遇杜洛克專門育種公司（Waldo

Farms, Inc.) 負責人 Dr. Max Waldo，與其交換育種看法及概念，並誠摯邀請其來台進行育種經驗分享。



圖 29、養豬大展外攤位陳列及人員參與情形



圖 30、本團員於主辦單位 (NPPC) 攤位前合影



圖 31、養豬大展主展區入口



圖 32、副展區種豬廠商參展情形



圖 33、團員於主展區大廳合影



圖 34、主展區設備廠商參展情形



圖 35、主展區內團長與軟體管理廠商洽詢情形



圖 36、主產區內廠商向團員介紹蒼蠅防治產品剪影



圖 37、與杜洛克專門育種公司 (Waldo Farms, Inc.) 負責人 Dr. Max Waldo 合影



圖 38、運輸及大型機械展區-堆肥設施



圖 39、運輸及大型機械展區-大型運豬貨櫃



圖 40、運輸及大型機械展區-大型運豬貨櫃 (內裝)



圖 41、小型運豬貨櫃



圖 42、小型運豬貨櫃內裝情形



圖 43、業者子女種豬展區趕豬比賽情形



圖 44、業者子女種豬展區趕豬比賽情形



圖 45、種豬展區趕豬比賽情形



圖 46、種豬展區趕豬比賽情形

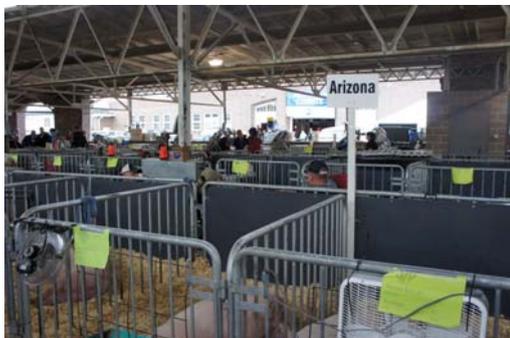


圖 47、Arizona 參賽者豬隻暫養區  
(參賽者來自各州)



圖 48、豬隻暫養區  
(以木屑鋪底，乾淨無臭)



圖 49、種豬暫養欄位 (左方為種豬登錄資料，含父母系與其子代資料)



圖 50、業者子女全程照料參賽豬隻  
(趕豬進入清洗區進行清潔)



圖 51、參賽豬隻受妥善照顧情形（乾淨環境與妥善照顧，符合動物福利）



圖 52、參賽業者子女照料豬隻如寵物般（親身飼養並照顧比賽豬隻，瞭解與體會養豬工作，進而尊重）

本次於主展區內參展之New Modern Concepts，是一個具有 25 年資歷的豬場興建整合服務公司，提供豬場總承包建設服務（Turn-key construction business），自母豬舍（Sow Complex）、保育舍（Nursery）至肥育舍（Finisher）外觀與構形、穀倉（Barn）、舍內設施（電腦化溫度控制系統、飼料及水供應與餵飼系統、糞肥儲存及吸引清除系統、通風、光照及地熱保溫系統等）均有固定規格或模組設計，可以由該公司依客戶需求，一次興建與組裝完成，一應俱全，除以符合豬隻生長之生物安全及相關因子需求，並可依需求增減或升級相關配件設施，美國所見豬場多為固定規格或模組化生產系統，屬於糞池式豬舍，豬舍下方留有 8-10 英尺深的空間供儲放約一年份糞便量。模組化豬舍部分，肉豬舍設計為可飼養 2,400 頭之隧道式豬舍，亦有 4,800 頭規格豬舍可供選購建造，此類模組化豬舍方便肉豬進行批次管理，但普遍未設有水濺設施。而母豬舍具有水濺設施，與保育豬舍容納規格頭數較無固定，可依業者需求訂定，該公司目前可建造最高單位規模為 4,200 頭母豬舍及 16,000 頭保育舍（如附件 1）。另亦提供豬隻載運車輛清洗消毒設施及其工舍建造之服務。

此次全球養豬大展經所看、所見及所聞，得有以下心得進行分享：

- (1) 由參展廠商及其項目，可充分認知美國強調專業分工，自豬舍建造、硬體設施、營養、人工授精、懷孕診斷、藥物或疫苗、生產效能監控軟體...等等，均有專業廠商進行研發及代理，少有單一家廠商代理或

- (2) 豬用疫苗發展很快，考量人力不足及施打緊迫問題，朝開發多價疫苗方向發展，減少施打次數及人力需求，目前已有單價疫苗（PCV-2、Mycoplasma 及 PRRS 單價疫苗）及雙價疫苗（PCV-2+Mycoplasma；PRRS+Mycoplasma）產品，三價疫苗（PCV-2+Mycoplasma+PRRS）持續發展中。
- (3) 豬舍生產系統完整且模組化，為分地式飼養，肉豬舍早期以 1,200 頭/棟為單位規模，經研發推廣，現在普遍為 2,400 頭/棟單位規模，最高可達 4,800 頭/棟單位規模，模組規模逐漸增大。
- (4) 美國種豬登錄不單侷限於純種豬，此次參訪了解到其合成豬（Cross breed）相關數據亦亮眼，我國是否還聚焦在純種種豬登錄，是值得思考及評估之處。
- (5) 本次研討會專題著重於養豬業者風險管理、營養、飼料利用及效率、PRRS 控制與清除、PCV-2 及 Mycoplasma 免疫成效等議題，依其內容得知美國養豬疾病問題仍以 PRRS、PCV-2 及 Mycoplasma 為首要，其中 PCV-2 因相關疫苗上市，大幅提高豬隻育成率，經免疫豬隻除育成率提高，整齊度佳，亦提升平均增重。而 PRRS 配合大學發展之區域性控制清除模式，自 2004 年明尼蘇達州 7 個郡開始採自願參加方式推動，2011 年已擴展到全明尼蘇達州北部，目前至少有 20 個區域控制計畫於美國境內施行。

### 3. 假日農民市場（Downtown Farmer's Market）參訪

該假日農民市場起於 1976 年，提供百餘名生產者販售其種植或生產之農畜產品，透過農民直接與消費者面對面交易之機會，使消費者更直接瞭解所購賣農畜產品之來源及生產資訊，建立信心，直接或間接地促進家庭農場經營及繁榮成長。本次參訪的假日農民市場已經變成該社區的傳統，自今（2011）年 5 月 7 日起至 10 月 29 日期間，固定於每週六上午 9 點開始營業，

至中午 12 點即收攤。每週吸引將近 2 萬名訪客到地參觀，到處可見攜家帶眷的訪客，超過 200 個攤販擺攤，市場內到處可見從事種植或生產農畜產品的農民親自推銷在地或自家生產之水果、蔬菜、蜂蜜、肉品、蛋品、乳製品及花卉等，販售給城市訪客，也有自製飾品、衣服等物品在場兜售，倡行在地生產在地消費，促進了地區經濟成長及提供在地生產者更多商機。由於該活動對地區經濟及家庭農場發展成效頗佳，故於 2006 年重新恢復冬季市場（Winter Market）運作，並預計於今年 8 月 31 日至 10 月 5 日止，於該 6 週期間之每星期三上午 11 點至下午 2 點試辦星期三市場（Wednesday Market），所銷售之農畜產品將儘量與假日農民市場有所區隔。



圖 53、假日農民市場 Logo



圖 54、販賣自產蜂蜜及雞蛋攤位



圖 55、假日農民市場人潮盛況



圖 56、蔬果攤販



圖 57、自產蔬菜攤販  
(農民直接與消費者推銷及交易)



圖 58、花卉攤販



圖 59、自產家禽肉攤販  
(標榜符合動物福利所生產)



圖 60、攤販內禽肉屠體標有生產資料  
(攤位樣本不出售，生鮮禽肉冷藏於冰箱，確定購買時方拿出；左方為一人份量包裝)



圖 61、禽肉攤販內陳列符合動物福利生產之聲明，供消費者認知為健康、安全、重視環保及人道飼養之產品



圖 62、愛荷華州當局核發之假日農民市場擺攤許可證照



圖 63、自製羊乳乳酪攤位

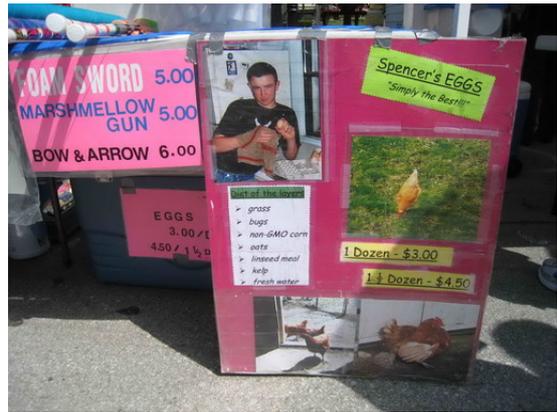


圖 64、自產雞蛋攤位，標榜“簡單自然最好”，不使用基因改造玉米



圖 65、自產牛肉販售攤位，標榜為“不使用荷爾蒙之牛肉”



圖 66、自製圖說告知消費者該場肉牛飼養環境及餵飼物全為植物來源，無餵飼動物性來源飼料



圖 67、自產穀物攤位

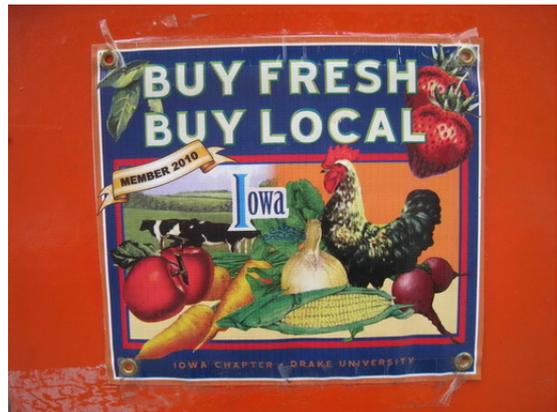


圖 68、鼓勵購買新鮮及當地農畜產製品海報（倡行在地生產在地消費）

#### 4. 參訪Pipestone Veterinary Clinic (PVC)

PVC係由G.F. Kennedy D.V.M.於 1942 年所創立，於 1990 年開始經營管

理一種豬繁殖公司，提供小場需要之新母豬，迄今已發展成由 12 位獸醫師組成之獸醫臨床醫療及諮詢團隊，位於美國明尼蘇達州Pipestone，提供豬、牛、羊及伴侶動物生產、醫療諮詢及服務，並由相關領域之獸醫師進行業務領導。豬隻部分係由G.D. Spronk及B.R. Kerkaert兩位獸醫師主導，本行主要目的在於瞭解該團隊所建立之Pipestone System如何整合美國養豬中小農及應用，有效提升其生產效率，增加其競爭力，並使該系統之豬肉生產擠進全美前 10 大。本次由B.R. Kerkaert為本團簡介（詳如附件2）及陪同至現場參訪。

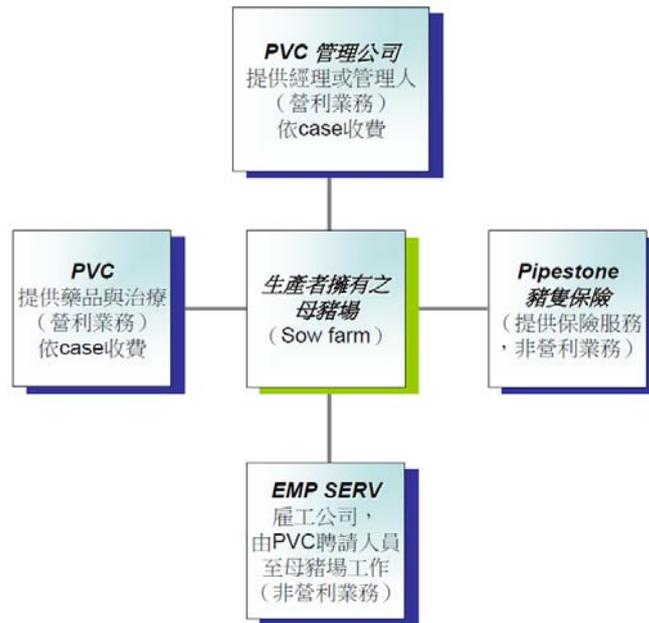
由於美國規模化養豬技術之演進，以及垂直整合豬隻生產公司（Smithfield Foods、Tyson Foods、Iowa Select Farms）擴展與競爭，美國養豬中小農意識若不從事變革與整合，將成為美國最後一代養豬農民，10 年後將消失於產業鏈。PVC（Pipestone Veterinary Clinic）為避免中小農退出產業而面臨失去客戶之困境，因此發展類似大型企業整合經營之 Pipestone System 模式，以母豬場為標的，協助中小農整合，提升其生產效率及競爭力，差異點在於大型企業係整合其契約肉豬場至屠宰場端之豬肉生產，Pipestone System 係整合母豬場至肉豬場之生產與供應。

該經營系統（Pipestone System）宗旨係幫助今日之農民創造明日可持續經營之農場（Helping farmers today create the farms of tomorrow）。目前於主要產糧區：愛荷華州、明尼蘇達州、威斯康辛州（Wisconsin）、南達科他州（South Dakota）及內布拉斯加州（Nebraska）均有該系統運行，而美國養豬產業亦多集中於此，系統內農民大部分係主動尋求PVC協助，自願加入。該系統生產模式為專業管理母豬場，依場內母豬數每週產出定量健康的離乳小豬（19-21 天離乳）供WTF肉豬場飼養至上市，離乳豬價格取決母豬成本價格。該系統經營至 2011 年，於 5 個州管理 46 場母豬場，飼有 14 萬頭母豬，擁有 650 員工及 250 個豬場。母豬場大小自 2,500-6,000 規模均有，每週產出 1,200-3,000 頭仔豬，離乳到上市豬場有 600-2,400 頭規模。母豬場規模平均為 3200 頭，每年平均生產離乳至上市肉豬 13,000 頭（範圍自 4,000 至 100,000 頭）。

### (1) Pipestone System

此系統係養豬農民透過契約方式與 PVC 訂定權利義務關係，集合固定肉豬場數為一單位，共同投資或擁有一母豬場，定期供應該單位內豬場所需仔豬數量，該單位內肉豬場主人共同持有母豬場所有權，但必須放棄母豬場的經營管理權，授權由 PVC 全權管理，不得干涉，契約的肉豬場不能拒絕由母豬場生產且已排定給入的仔豬。PVC 指派專業經理人及管理人經營管理母豬場（須收費），並作為人力派遣公司訓練及派遣豬場工作人員專責飼養及照顧母豬群，母豬場所有工作人員均受 PVC 管理指揮並由 PVC 發放薪資，不受單位內肉豬場主人管轄及影響，母豬場仔豬送至肉豬場後，則由肉豬場自主經營，自負盈虧，PVC 不予負責。以一單位內具有 8 個肉豬場為例，其共同擁有飼養規模 3,200 頭母豬場，每個肉豬場每 8 週將得到 1 批 1,200 仔豬進場飼養（依據契約，輪到者一定要購入），藉以操作統進統出或批次飼養，降低疾病風險，肥育後販售，以此輪替。

Pipestone System 核心競爭力在於完善管理，組織內專業分工以及諮詢服務，確保生產效率。原先為一貫場經營養豬業者因加入該系統，不再需要自己飼育母豬，而可於固定時間獲得健康離乳仔豬進行批次飼養或統進統出，所需藥品及醫療服務亦可洽 PVC 提供，價格比市價便宜 1-2 成，大幅降低生產成本與風險、增加生產效率及收益，並且可多出空閒時間從事休閒，實值我國借鏡與參考。另經與 B.R. Kerkaert 意見交流，得知中國大陸已自該公司引進 Pipestone System 進行示範，目前由 G.D. Spronk 前往中國大陸進行輔導。



另外，PVC 亦可提供商業肉豬場生產管理、疾病診療之諮詢或服務，依業者需求進行收費。PVC 更與三家育種公司(PIC、Genetic Pork、Danbred)合作，具有 4 個人工授精站，提供優良公豬精液，經其評估，肉用豬種以 PIC 為佳，因此 85%精液來自 PIC。

Pipestone System 為防治清除 PRRS，目前於其 30%經營管理之母豬場加裝 filter 系統，過濾空氣，使用前後效果顯著。經其分析，加裝後 PRRS 年爆發率自 49.79%降至 6.83%，且 PRRS 陽性場不再增多。PVC 已訂於 2013 年於該系統內之母豬場全面清除 PRRS，更期許於 2015 年可以達到系統內所有豬場均為 PRRS 清淨之目標，所採取的策略係將母豬場建置於低風險區域，使用過濾系統，以及搭配疫苗（其建議自家疫苗為佳）免疫清除。



圖 69、團員與 Dr. B.R. Kerkaert 於 PVC 入口合影



圖 70、PVC 門口陳列 12 名合夥獸醫師名字



圖 71、Dr. B.R. Kerkaert 為本團簡報 PVC 及 Pipestone System 經營現況



圖 72、團員與 Dr. B.R. Kerkaert 進行討論及意見交流

## (2) Pipestone System 運輸及消毒設備參訪

Pipestone System 裡豬隻（女豬、仔豬等）之運輸均以專門載具運輸，且每次運輸後均需進入清洗廠進行徹底清洗與消毒，首先以洗滌劑清潔完畢後，再使用對 PRRS 有效之消毒水（Synergize）進行高壓噴灑後，移入另一廠房進行風（烘）乾，始得再次運輸，此舉大幅減低可能交叉污染的機會，為重要之風險管控點。

執行清潔消毒及風（烘）乾工作之所有員工均為 PVC 直接聘用且管理，清洗廠及用以乾燥之廠房均為 PVC 所有。落實運輸載具之清潔消毒可確實殺滅病原及其媒介傳染機會，掌握該重要風險管控點，對疾病防治實在有事半功倍之效，反觀諸我國豬場經營者及相關業者普遍未有此生物安全觀念，而不經意藉運輸載具媒介疾病或使疾病蔓延，影響豬場健康經營及耗費大量治療或防治成本。



圖 73、Pipestone System 所有之載豬運輸車輛與載具清洗消毒廠房（兩個入口，分別可容納一個大型載具）



圖 74、廠房內正準備進行清潔消毒之大型運豬貨櫃



圖 75、大型運豬貨櫃由專人清洗情形



圖 76、廠房內高壓噴霧管線，白桶內為清潔劑，藍桶內為對 PRRS 有效之消毒藥劑，先以清潔劑清洗完畢後，再噴灑消毒水



圖 77、每個大型運豬貨櫃由 1 人專門處理，清理人員由 PVC 聘僱及訓練



圖 78、專人拆卸運豬貨櫃清洗情形（底層可見木屑與糞便）



圖 79、風乾廠房。運豬貨櫃清潔消毒完畢後，送至另一個廠房進行風乾或烘乾（冬天）



圖 80、風乾廠房（於貨櫃內或外以風扇造風吹乾）



圖 81、完成清潔消毒貨櫃置於廠房內風乾情形



圖 82、Dr. B.R. Kerkaert 向團員展示運輸 PRRS-free 豬隻運輸貨櫃內之濾過系統



圖 83、木屑鋪料，鋪於載豬貨櫃底面，減少糞尿隨車滲漏問題



圖 84、貨櫃內擺入風扇風乾情形

### (3) Pipestone System 契約肉豬場參訪

本次行程未參訪其母豬場及公豬站，所參觀 2 豬場均為離乳至上市之肉豬場，均自 Pipestone System 取得離乳仔豬進場飼養，並由 PVC 提供諮詢及管理服務。為求經濟效益，該兩場仔豬早期飼養密度高，由於糞池式設計、保溫及密飼，進場即可聞到高濃度之氨氣，原可飼養 2,400 頭肉豬空間之豬場，先飼以 2 倍量之離乳豬，俟其成長 1 個月後，再分半至肉豬舍飼養。雖飼養密度相當高，但 Dr. B.R. Kerkaert 表示因其豬隻健康品質及豬場生物安全良好，透過正常管理流程育成率佳，飼養過程中死亡率均小於 0.5%（低於 20 隻）。



圖 85、WTF 肉豬場外觀（出豬中）



圖 86、著拋棄式防護衣鞋進場參觀



圖 87、左邊棟舍飼養離乳仔豬情形（此肉豬棟舍，分隔左右兩邊，左邊飼養離乳仔豬，右邊飼養肥育至上市肉豬）



圖 88、左邊棟舍保溫設備（雖相當密飼，仔豬健康均相當有活力，整齊度佳）



圖 89、右邊飼養肉豬棟舍（出豬中）



圖 90、該場由單一動線出口出豬情形



圖 91、運豬貨櫃內鋪有木屑墊料，單位密度不高，避免緊迫



圖 92、該場離乳仔豬管理人員（由 2 位專責管理，由 PVC 提供獸醫服務）



圖 93、另一 WTF 肉豬場外觀（兩場均為相同規格：密閉糞池式，單一動線，具 4 個飼料桶、溫控及通風系統）



圖 94、豬場右側外觀（兩側均飼養離乳仔豬）



圖 95、場內仔豬飼養情形，密飼但育成率高



圖 96、Dr. B.R. Kerkaert 向團員解說該場仔豬與肉豬換料供應管線如何運行

## 5. 參訪Duane Carrow農場及Ralco Nutrition Inc.營養飼料配方公司總部

### (1) Duane Carrow 農場

該農場種植生產玉米，並於農場內建有豬舍從事養豬。原先為一貫場經營，後來因為母豬飼育不易，育成率不佳，遂加入 Pipestone system，由其每 6 週提供約 1,000 頭離乳仔豬，而不再飼育母豬，並將其 2 棟母豬舍改為離乳豬舍（不是模組化豬舍），專門飼養離乳豬（離乳豬平均死亡率約 1%-1.5

%)，達一定年齡後送契約肉豬場飼養至上市，按隻抽取契約金。產生之糞肥供玉米田施灌使用，所產玉米賣予飼料公司製作飼料後，買回回飼場內豬隻。一般農場收割之玉米不會全數賣出，會留存部分比例於穀倉內，若需資金，即可抽取變賣求現。



圖 97、Duane Carrow 農場玉米播種大型機具



圖 98、Duane Carrow 農場收成玉米儲存穀倉（農家穀倉；Farm elevator）



圖 99、該農場穀倉與牽引運送設施接口（黃色部份均為玉米粒）



圖 100、連接穀倉與運輸車之牽引運送設施



圖 101、玉米運輸車輛



圖 102、運輸車輛運送玉米前往市場途中剪影（農場主人藉此換取資金）



圖 103、農場內保育豬舍  
(母豬舍原舍原址改裝為保育豬舍)



圖 104、團員於保育豬舍門前合影

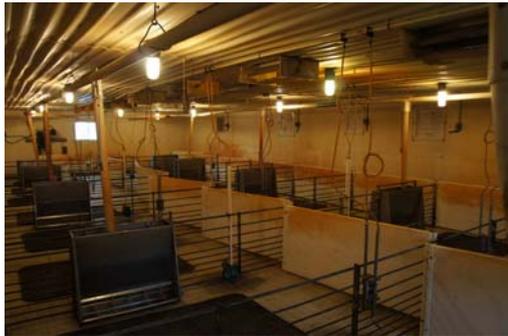


圖 105、保育豬舍內欄舍及管線配置情形



圖 106、豬舍內溫控設施(著重保溫)

## (2) Ralco Nutrition Inc. 營養飼料配方公司總部

Ralco Nutrition Inc. 為成立 40 年之營養飼料配方公司，總部位於明尼蘇達州 Marshall，係第三代掌管經營之家族企業，全世界超過 20 個國家有其經銷點，以科學研究結果為基礎，發展相關配方以提升飼料運用效益 (EnMax)、或增進玉米產能 (AgNite)。拜訪後由 Dr. Jeff Knott 進行玉米乾酒粕 (DDGS) 應用於肥育豬隻飼料經濟效益之專題報告 (詳如 [附件3](#))，試驗結果顯示飼料中含有 40% DDGS 會造成豬隻較差之生長表現，而以 20% DDGS 飼料飼育之上市豬隻，不會影響其屠體品質 (瘦肉率、脆度、肌肉附著度、屠後重量等等)，有效減低飼料中使用玉米之成本，此策略目前廣為美國養豬產業接受並應用。



圖 107、Dr. Jeff Knott 專題簡報



圖 108、團員於 Ralco Nutrition Inc. 營養飼料配方公司總部合影

## 6. 參訪Granite Falls Energy LLC玉米酒精工廠

美國為減少進口原油使用，積極尋求降低石油依賴之再生能源替代品，以留給後世一個永續生存的環境。經其評估，酒精成為首要選擇，並於 2007 年 12 月 19 日由其總統簽署 Energy Independence and Security Act of 2007 (EISA)，其中 SEC. 202. RENEWABLE FUEL STANDARD 規範 2022 年後美國每年應使用再生能源至 360 億加侖 (36 billion gallons)，其中玉米提煉酒精 (Renewable Biofuel) 於 2015 年後應達到每年使用 150 億加侖，以替代部份汽油。使用 65 億加侖酒精可減少約 1,010 萬噸二氧化碳同等物之溫室氣體排放，約等於 150 萬輛汽車行駛中排放量。美國政府另以每加侖酒精補貼 51 美分措施鼓勵業者投入，全美酒精工廠至今，已自原先 2008 年之 139 家增加至 209 家；加拿大目前亦有 14 家酒精工廠。

此次參訪之 Granite Falls Energy LLC 玉米酒精工廠位於明尼蘇達州，於 2004 年 8 月動工至 2006 年完工，總投資約 7,500 萬美元，主要投資成員為玉米農民，該廠每英斗 (bushel) 玉米可提煉 2.7-3.0 加侖酒精，一年約可產 4,400 萬加侖酒精及約 13 萬公噸玉米乾酒粕 (DDGS) 副產品。目前美國銷售的汽油有半數以上是混加入酒精，而該工廠生產之酒精係用作 E85 (85% 酒精加 15% 汽油) 汽油生產。

該廠於中央控制室電腦化控制及監控所有玉米提製酒精及生產 DDGS 過程，工作人員全日 24 小時輪職，惟因已高度自動化，故於週末及平日晚上僅 4 人即可維持工廠正常運作。由於該廠運輸及製作流程均設有管控點由電腦及專人巡視監控，加上平時設備定期維護，其設備仍保持新穎，所生產

DDGS 品質良好。

業者係利用澱粉冷發酵、玉米分餾以及玉米油壓榨等方法來精煉酒精，並於過程中回收能源使用，如生質能氣化以及甲烷蒸煮等，同時設法降低蒸餾和乾燥成本，減少能源消耗和降低成本，增加精煉廠效能，並持續改進餵料副產品（DDGS）蛋白含量，以及採用最佳控制技術以減少排放。美國養豬業者為因應穀物價格上漲，已被迫更廣泛使用玉米乾酒粕、玉米精粉及玉米精蛋白等各項副產品，以降低飼料成本。



圖 109、Granite Falls Energy LLC 玉米酒精工廠

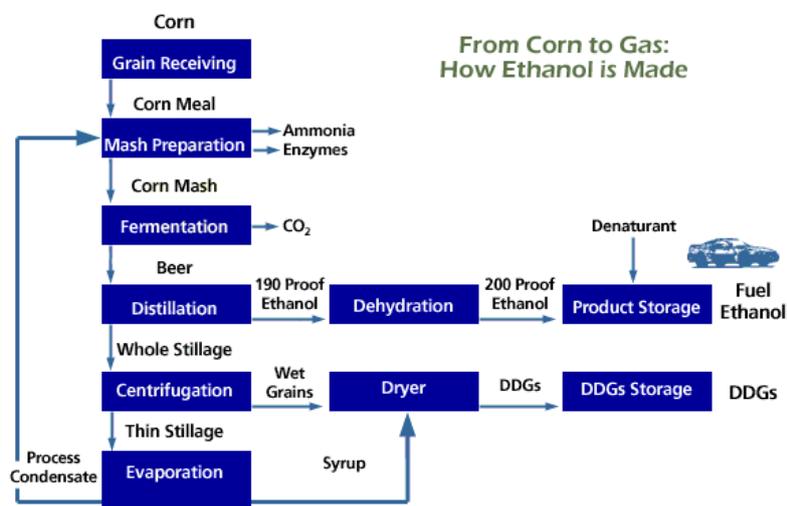


圖 110、Granite Falls Energy LLC 玉米酒精工廠自玉米提煉酒精流程



圖 111、進場前玉米品質檢測（由箭頭處儀器進行採樣）



圖 112、採樣玉米樣本送機器檢驗含水量、油脂、蛋白質、澱粉等



圖 113、運輸車至指定區域卸下玉米



圖 114、團員參觀廠房情形



圖 115、廠方人員向團員解說玉米酒精提煉純製過程



圖 116、玉米酒精工廠中央控制室，藉電腦軟體管理一切製程及其品質



圖 117、團員一同檢視玉米酒精工廠製成之 DDGS 品質



圖 118、團員於 Granite Falls Energy LLC 玉米酒精工廠外合影，結束本次訪查行程

## 7. 美國培林（受體素）使用概況及情形：

藉由此次參訪機會亦詢問美國培林（受體素）使用概況及情形如下：

美國約 60%豬隻於飼料中添加使用，僅用於豬隻，其他動物不使用。

使用方式有下列兩種，劑量及天數若增加，飼料換肉率及經濟效益均下降。

(1) 上市前四週(28天)使用至上市，使用劑量 4.5g/ton，因其屬自然荷爾蒙，故無停藥期問題。(來源：Pipestone veterinary Clinic, Dr. Bary R. Kerkaert)。

(2) 上市前 5 週使用至上市，以 4.5g/ton使用 2 週，續以 6.75g/ton使用 3 週，亦無停藥期。(來源：Elanco Animal Health公司依Dr. Matt Ritter研究結果所建議該產品Paylean®之使用方式，詳如附件4)

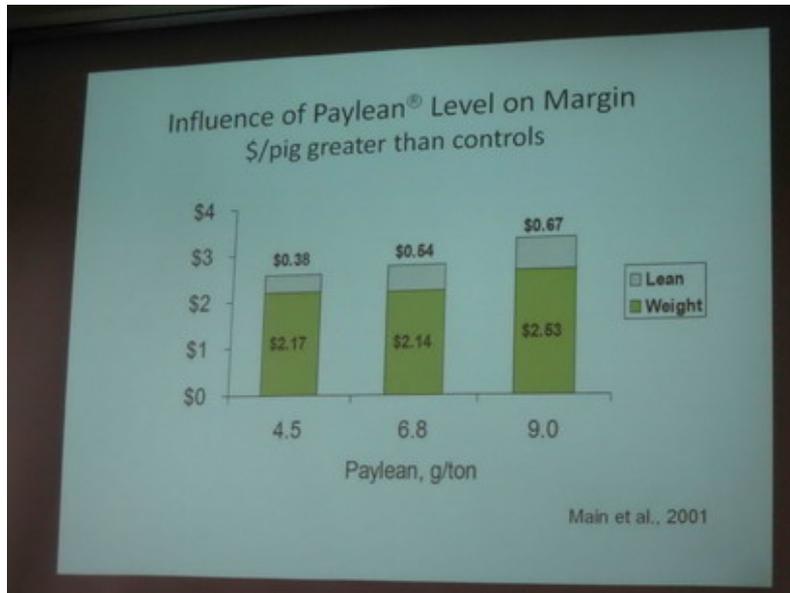


圖 119、Dr. Bary R. Kerkaert 引據之試驗報告

### 三、心得與建議

1. **美國現今養豬產業發展考量飲食健康、肉品營養價值、食品安全、動物福祉及環保意識，朝母豬減量而豬肉生產量增加目標前進。**美國生產之肉豬多以契養方式集中於中西部玉米黃豆生產州飼養，但因近年穀物價格持續飆漲，美國 270 磅（約 123 公斤）上市豬隻生產成本由 2006 年 112.68 美元增加至 2011 年 3 月 167.65 美元以及同年 6 月的 175 美元（以一美元換算新台幣 30 計算，由 3,380 元增加至 5,250 元），為增加其競爭力，美國養豬產業走向專業、契約及企業化，降低豬場數量但增大豬隻飼養量規模，產業經營走入低利高風險時代，特點為透過系統管理及常態契養由少數人從事生產、降低生產成本與提高生產效率，但仍著重動物福祉與環保。
2. **因應國際穀物價格上漲，美國採取相關措施降低成本及增加競爭力。**(1) 美國使用大型農業機具進行穀物耕種，搭配衛星導航與電腦系統，精確導航播種及精準收割（扯斷、脫穗、脫包葉及脫粒）。耕作相當機密與科學化，所需人力很少；另已發展為耕種前於邊角取土壤進行養分及氮肥測試，依其結果訂定施肥與播種計畫，以科學導向進行效率種植，並搭配不耕犁方式 (No-tillage)，減少土壤及其沃度流失。(2) 培育及生產基因改造產品（如抗蟲或耐除草劑品系）。其經美國農業部、環保署及食品藥物管理局三方進行嚴格審視及評估（新品系能否種植、是否造成人類過敏、可否給人食用等）通過後，才核准上市。美國基因改造黃豆比例將近 100%，基因改造玉米佔 86%。(3) 節省運輸成本。美國玉米自南往北收割（由德州開始），一般期末庫存約 20%，倉庫裡均留有存量，並有農家穀倉 (Farm elevator)、鄉村穀倉 (Country elevator)、終點穀倉 (Terminal elevator) 及出口穀倉 (Export elevator) 4 種穀倉可進行儲存。農家收割穀物後，通常以卡車運輸送至農家穀倉儲放，或送鄉村穀倉（大部分鄉村穀倉為農民組織及合作社所擁有）儲存，而終點穀倉通常設於河邊，接受自鄉村穀倉以卡車或火車運輸之穀物，以水路運輸穀物至出口穀倉（儲放出口其他國家穀物之用），出口穀倉再利用船運出口。(4) 加強玉米乾酒粕、玉米精粉及玉米精蛋白等各項副產品利用，以降低飼料成本。由於美國玉米種植具有一致性及普遍化的特色，產量相當大，一旦遭受污染，容易引發飼料困擾，以 2009 年所產玉米品質問題

3. **美國養豬產業透過互助金（Checkoff）制度維持永續發展。**其互助金收取單位一為美國豬肉董事會（NPB），此項互助金係經美國政府立法，豬隻於屠宰場交易結價時強制收取豬價千分之四（100 美元之 40 分），由美國豬肉董事會負責管理該基金，主要用於產業相關推廣、教育及研究；另一為美國豬肉生產者協會（NPPC），該互助金係採自願方式收取豬價千分之一（100 美元之 10 分），由美國豬肉生產者協會負責管理，主用於開拓國內、外豬肉市場、遊說立法（如空氣及水污染控制法）與扭轉產業負面形象。
4. **每年舉辦世界性養豬大展，鼓勵新設備、產品與技術參展，提供新式養豬概念及帶動新式養豬技術交流應用。**藉由舉辦展覽會及種豬比賽，提供平台使美國養豬農民迅速得到新資訊與技術，有效改善其養豬生產效率，並透過競賽方式鼓勵新生代親身養豬，培養年輕人對產業了解認同與成就感，繼而投入產業經營。
5. **產業自主，並透過互助金推動相關計畫，重新定義養豬業者為優良豬肉生產者形象，賦予其生產衛生安全豬肉，保障公眾健康之責任。**積極推廣豬肉為另一種具高營養價值之白肉，促進其消費認同，並強調提升動物福利及注重環境和諧等觀念，以符社會之期待。
6. **美國養豬生產、飼養管理、疾病防疫及生物安全等均有整套系統，儘量以最簡化之方式提供農民參考使用及推廣，並多有相關法令或規範進行配合。**美國養豬必須有糞肥處理計畫，送政府審核通過後才可進行飼養，豬場設施採用高床，平時不清洗（除）豬廢料及糞肥，採取厭氣發酵方式處理糞肥，每年以機械車輛吸取豬舍條狀地板下之豬糞尿並運送至鄰近之玉米田施灌。透過農畜糞肥直接應用於穀物生產之策略，除有效處理畜牧廢棄物，亦可將其作為農作氮肥，節省肥料支出，營造雙贏局面。
7. **以專業分工之分地式生產系統方式飼養，維持高育成率。**美國垂直整合豬隻生產公司，藉由分地式生產系統、將母豬飼養及分娩舍設置於一地，仔豬 19-21 天離乳後移到 WTF（wean to finish）豬場飼養到上市體重 270 磅，此模式生產產量約佔全國豬隻產量 50-60%。除少數清教徒社區農場仍維持一

8. **新式豬隻生產系統已規格模組化，並有專門公司提供豬場總承包建設服務。**  
依其模組（舍式溫控自動化豬舍）飼養，各項因子（溫度、濕度、空氣品質等）及環境控制（溫控、通風）均能符合良好飼養管理條件，飼養品質可維持一致，並方便管理。若需擴增飼養量，只要依其規則進行擴充，即可維持飼養條件與生產效率。反觀之，台灣養豬農民雖均有自己的一套硬體設置及管理邏輯，但於缺乏整體條件搭配規劃之豬舍進行飼養，因各項條件不易控管，又缺乏批次化生產管理，常見有育成率及生產效率低下問題的困擾，豬場經營變得累又不賺錢。
9. **整合生產為未來趨勢，美國養豬中小農透過 Pipestone System 或類似系統水平整合母豬至肉豬之生產鏈，確保生產效率，提升核心競爭力。**透過整合生產系統，豬場已轉型為豬肉生產工廠，可排定豬隻生產流程及預計肉品生產重量，讓管理者易於管控豬場經營所需資金。美國獸醫服務體系範疇已自疾病診療轉為生產系統專業管理及疾病防治，以完善管理，組織內專業分工以及諮詢服務，輔導客戶（飼養業者）確保畜牧生產效率。

#### 四、致謝

感謝美國穀物協會妥善規劃及安排此次行程，得以深入瞭解美國養豬現況，並承蒙美國穀物協會張學義代表於領隊及相關事務上之熱忱協助，謹此致上最深之謝意。

## 五、附件

- (一) 附件 1、全球養豬大展主展區內 New Modern Concepts 展區資料。
- (二) 附件 2、PVC 與 Pipestone System 英文簡介。
- (三) 附件 3、玉米乾酒粕 (DDGS) 應用於肥育豬隻飼料經濟效益之專題報告。
- (四) 附件 4、Dr. Matt Ritter 對 Paylean®使用方式之研究結果。

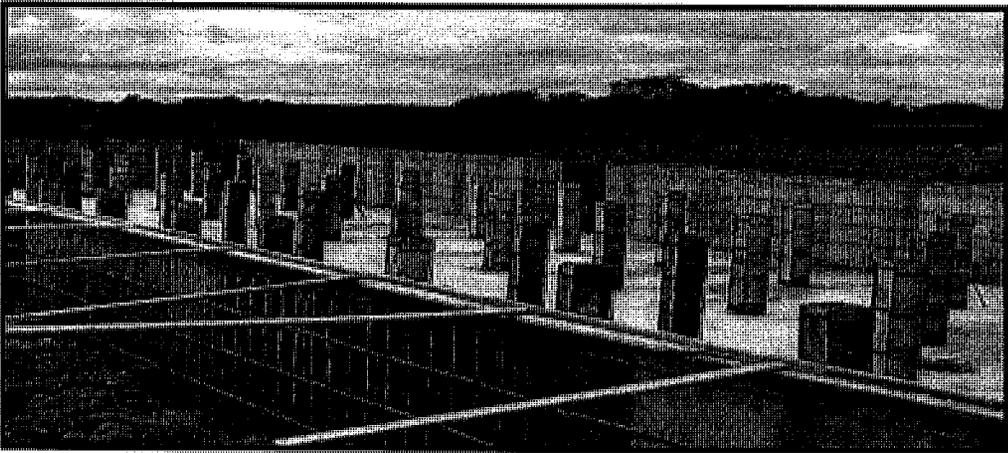
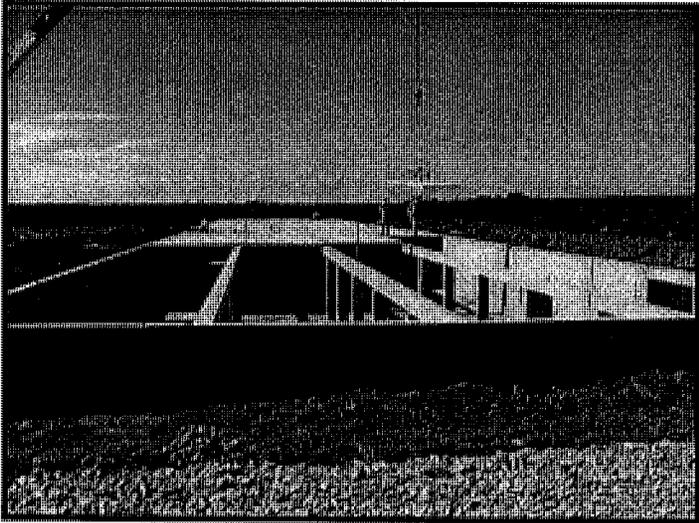


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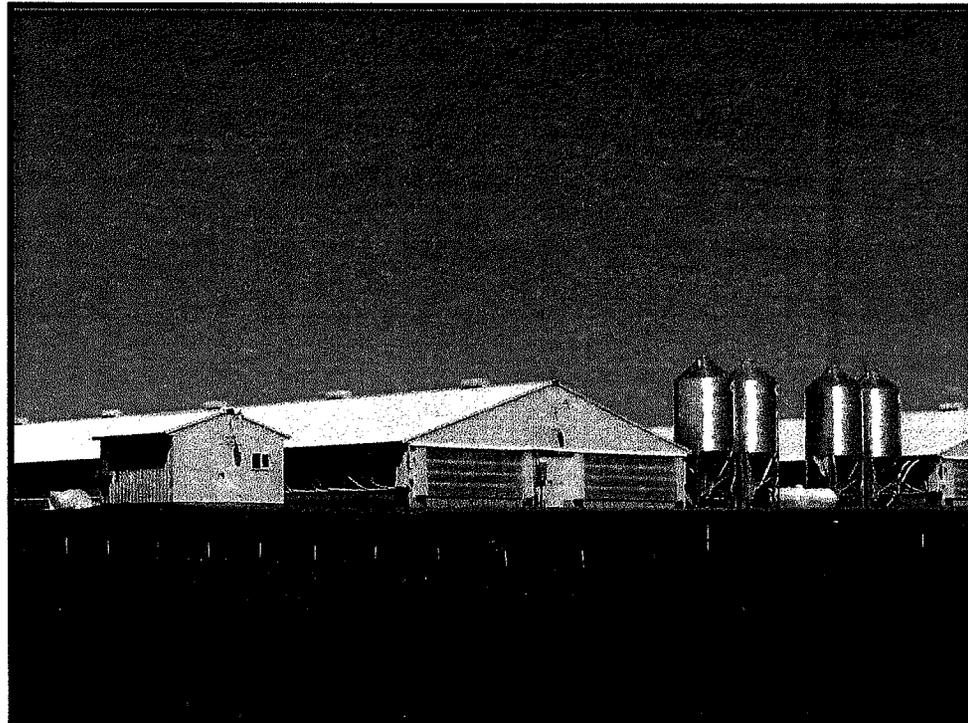
# Turn-key Construction

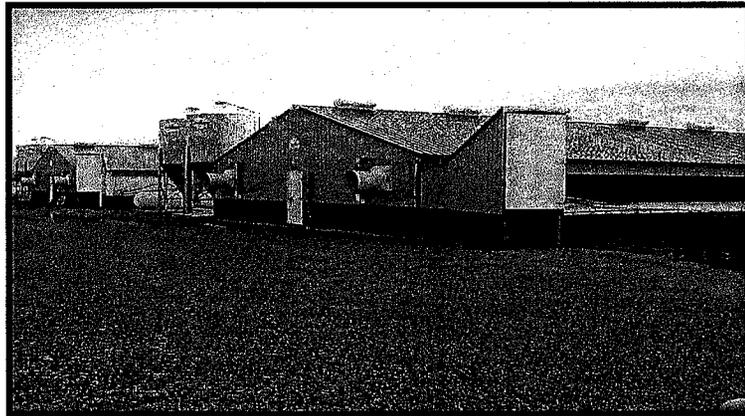
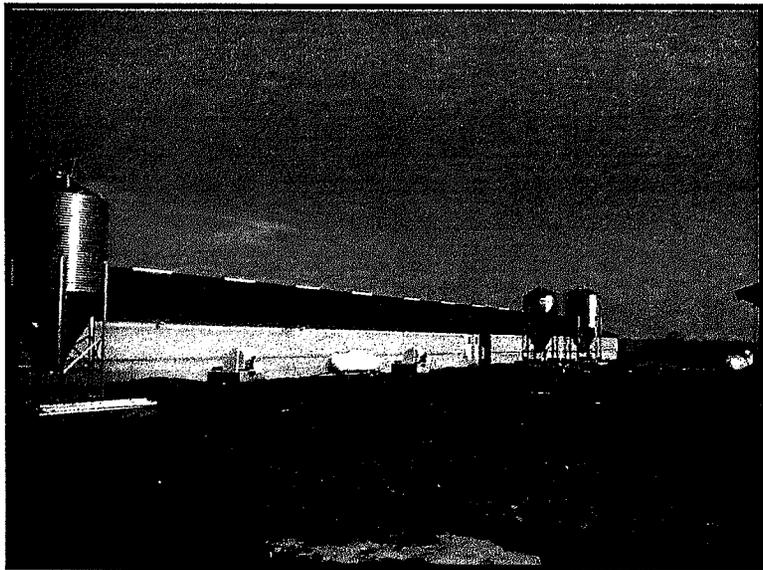
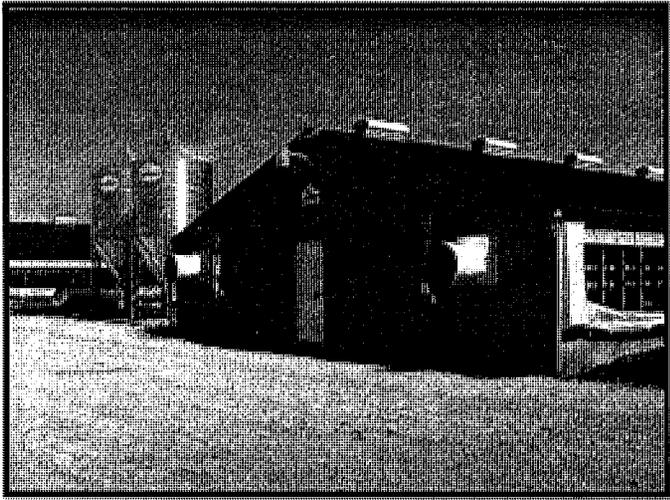
## FINISHERS





2400 Head  
Tunnel  
Barns

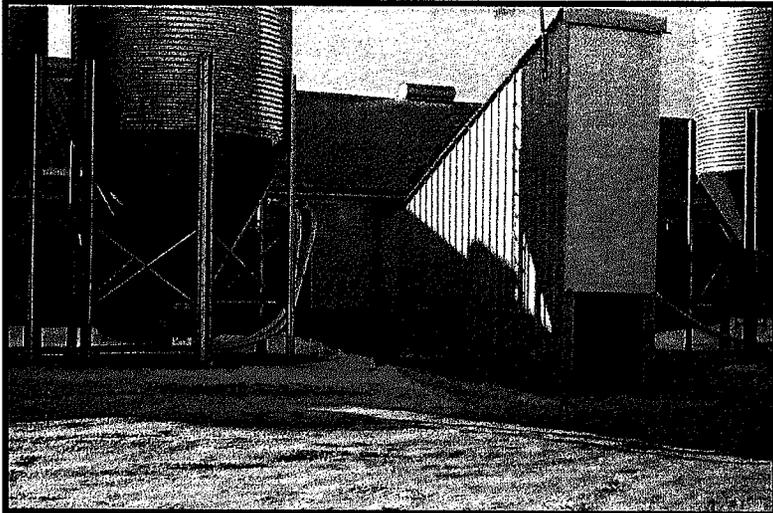
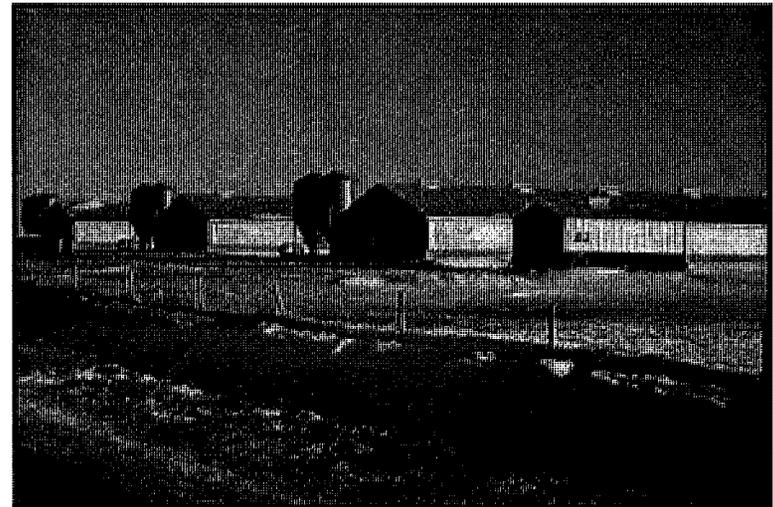
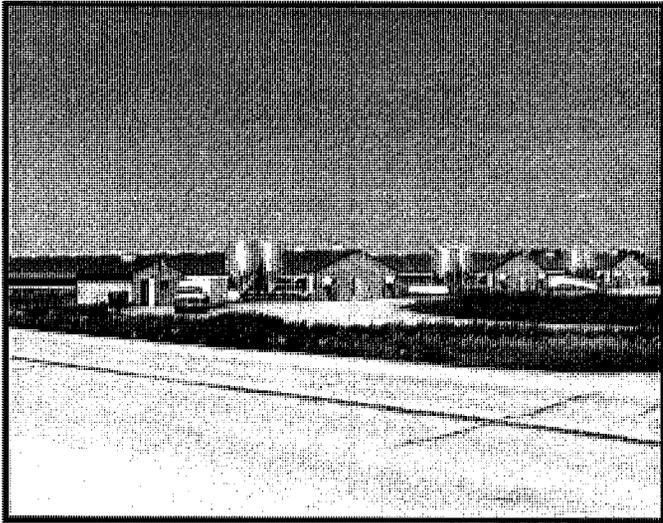




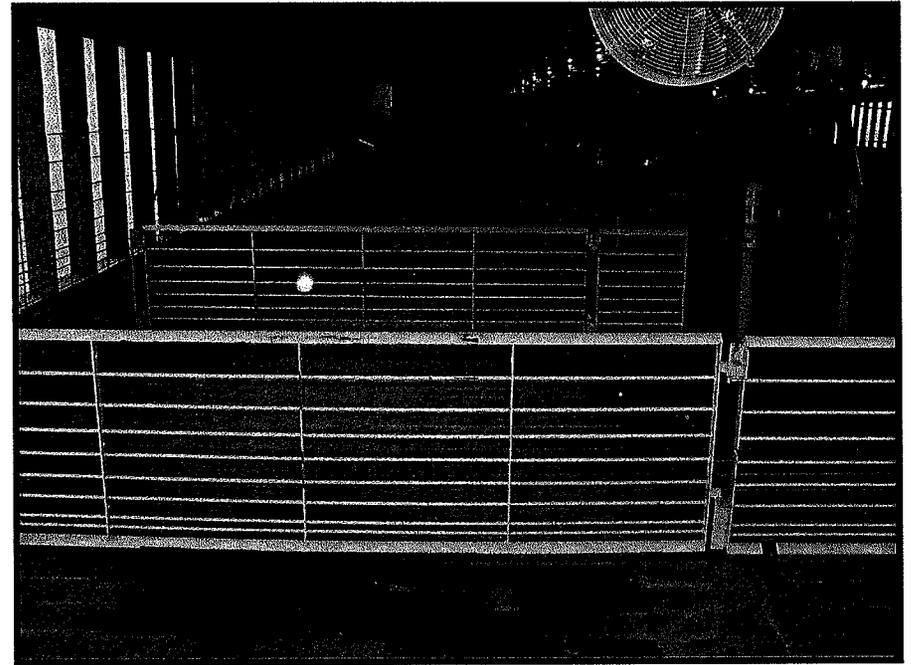


Finishing barn  
with swing gates  
and wet/dry  
feeders



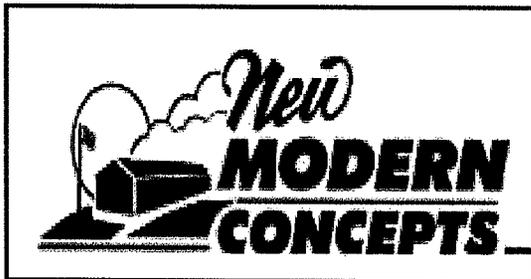


4' load in the center  
of a 2400 head barn

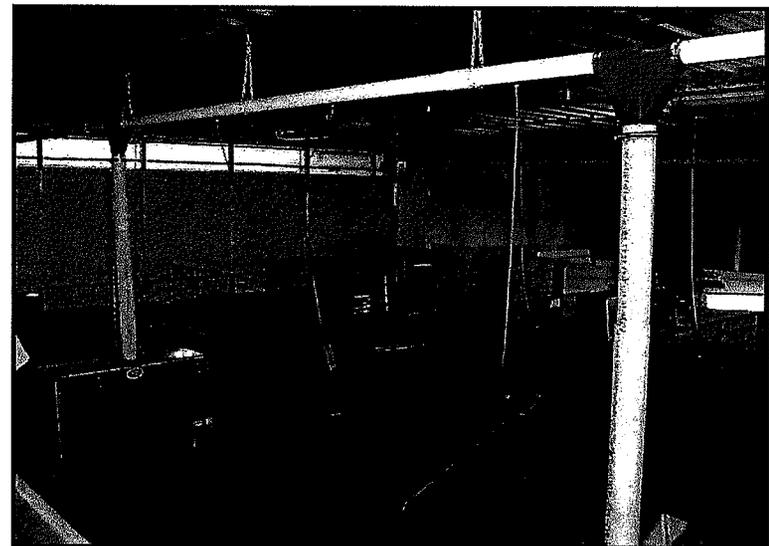
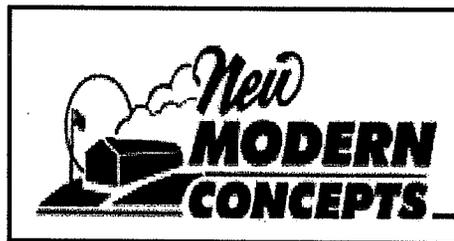
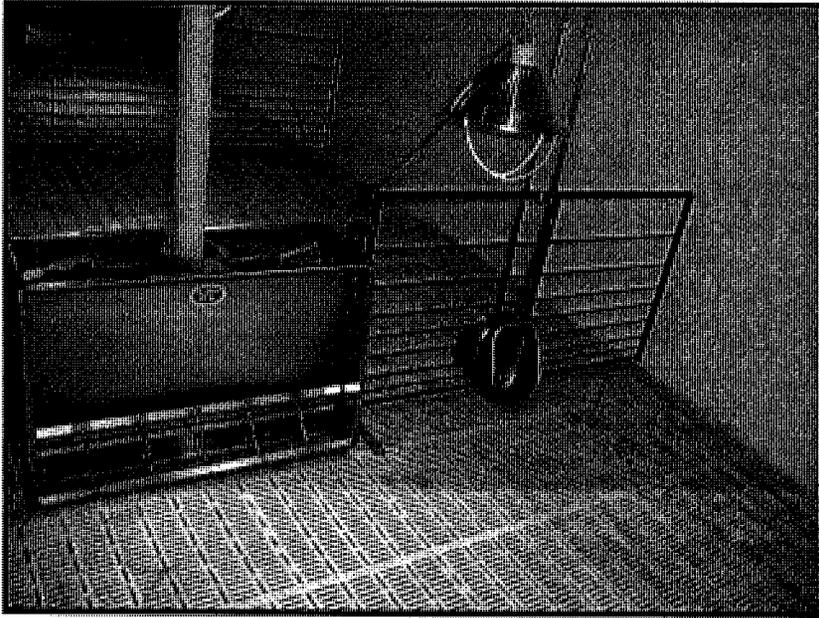


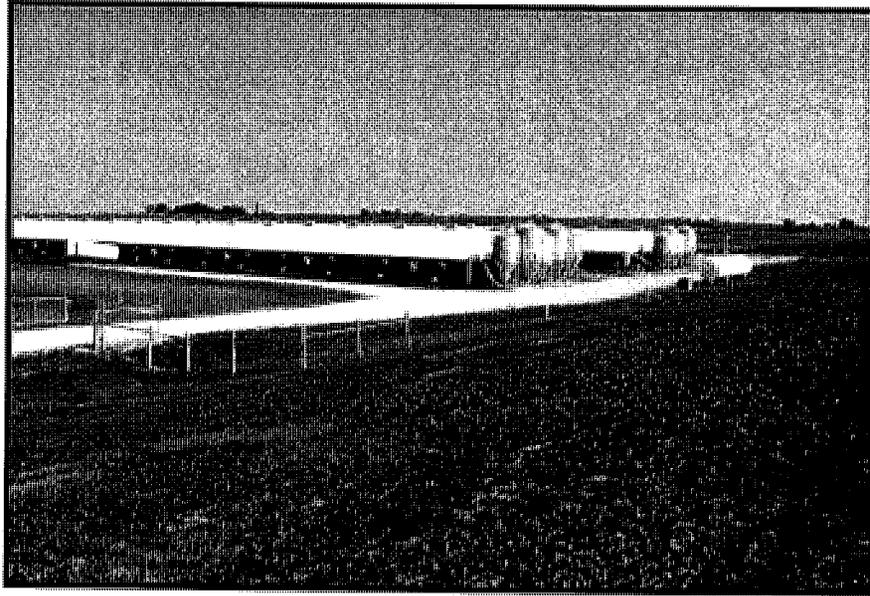
Swing gate option  
allows for variable  
pen size and ease  
of load out.

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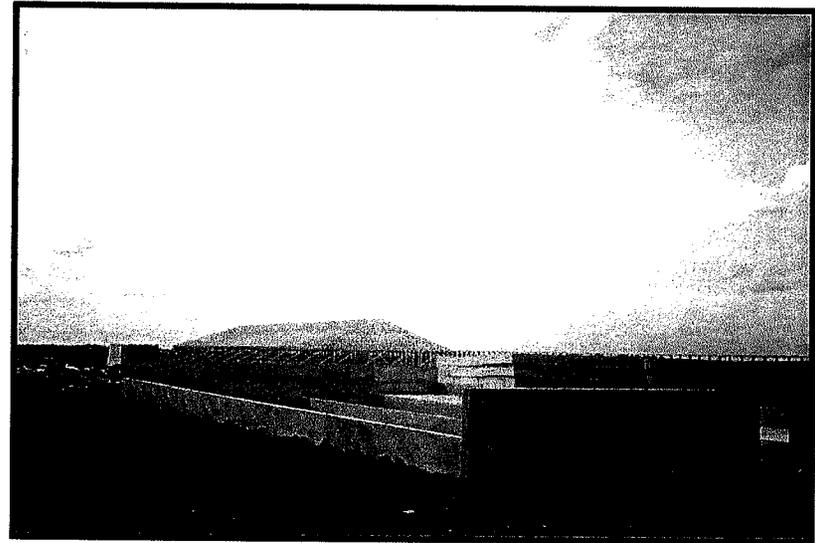


# NURSERY

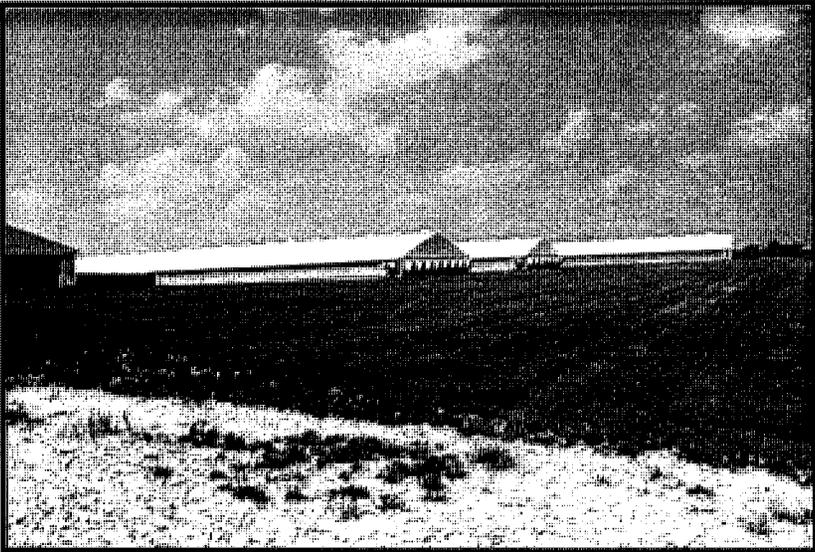


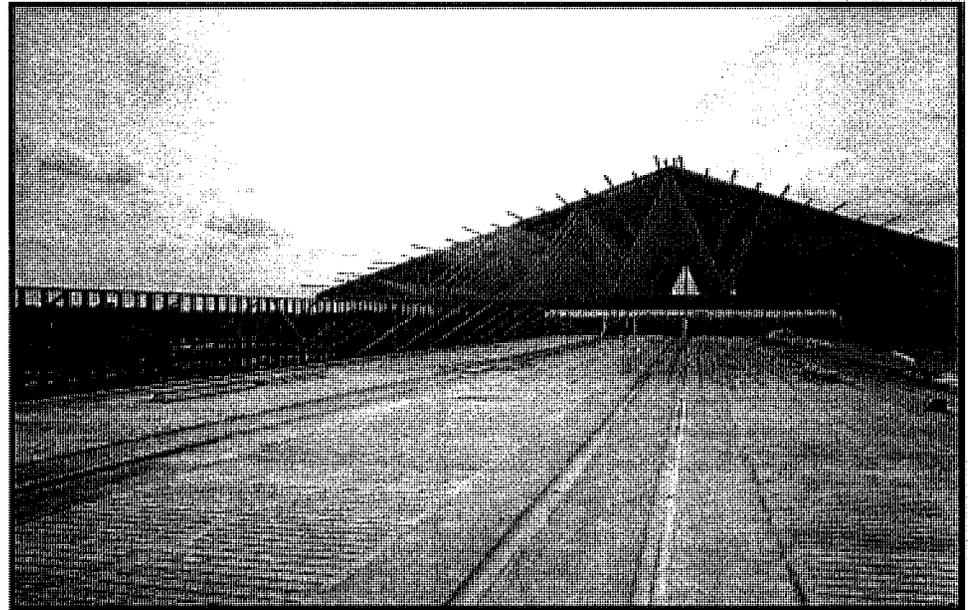
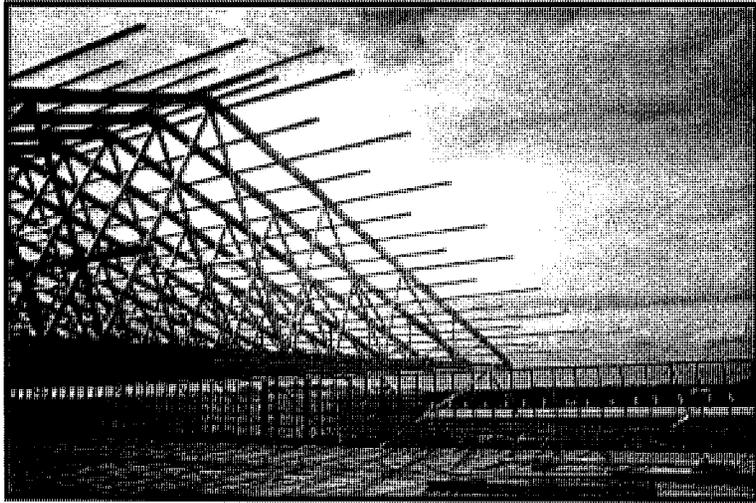


16,000 Head  
Nursery site

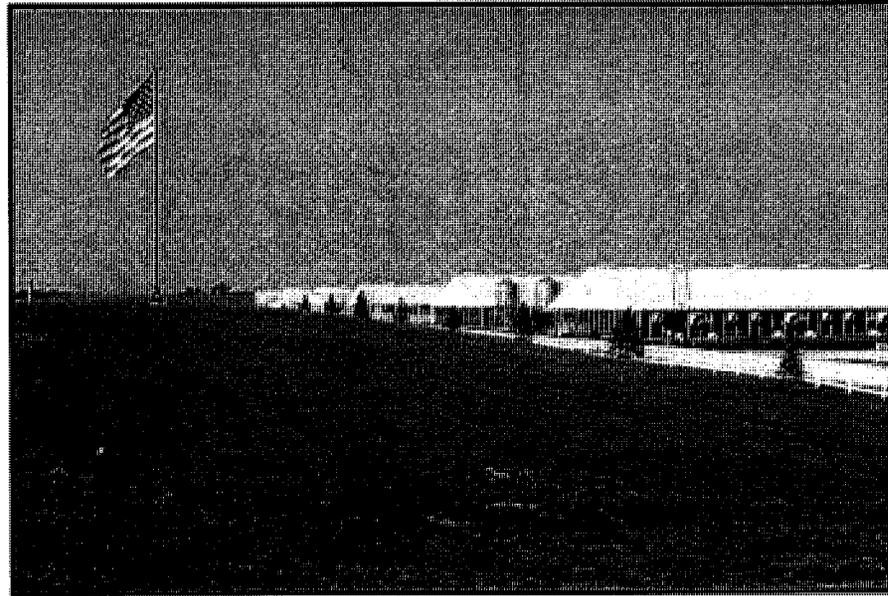
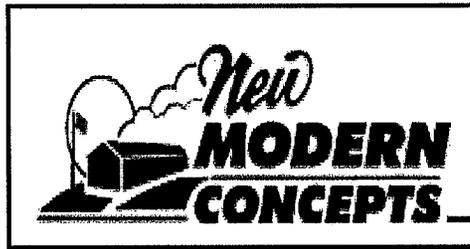


# SOW COMPLEXES

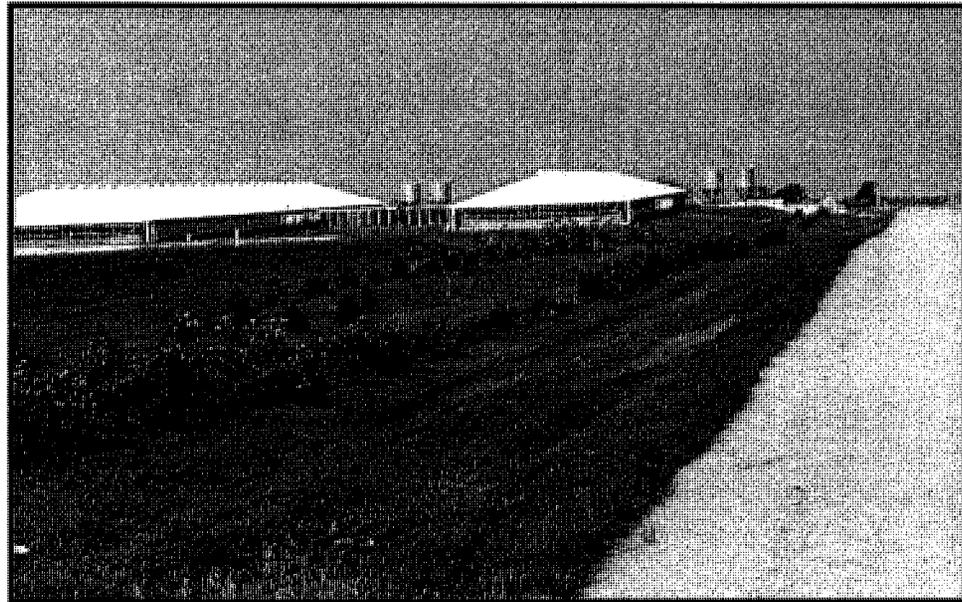
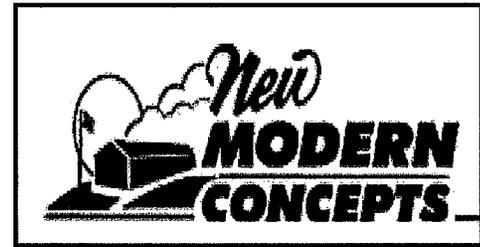
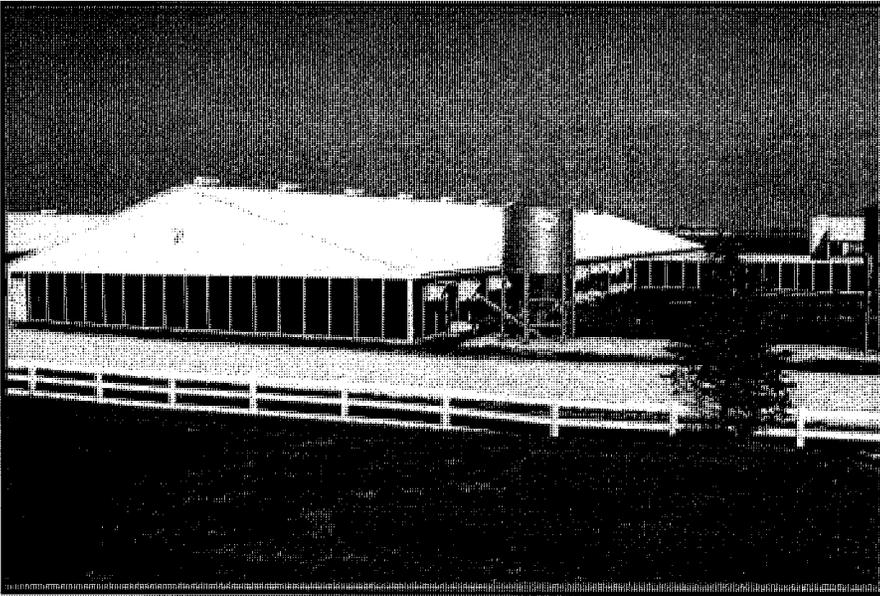


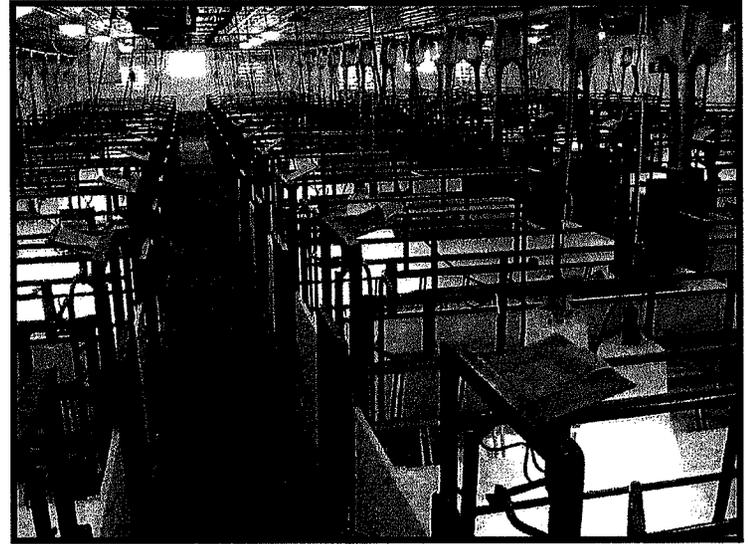


Sow complexes  
big or small we  
can handle  
them all.

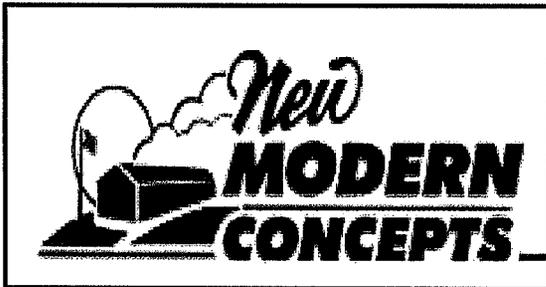
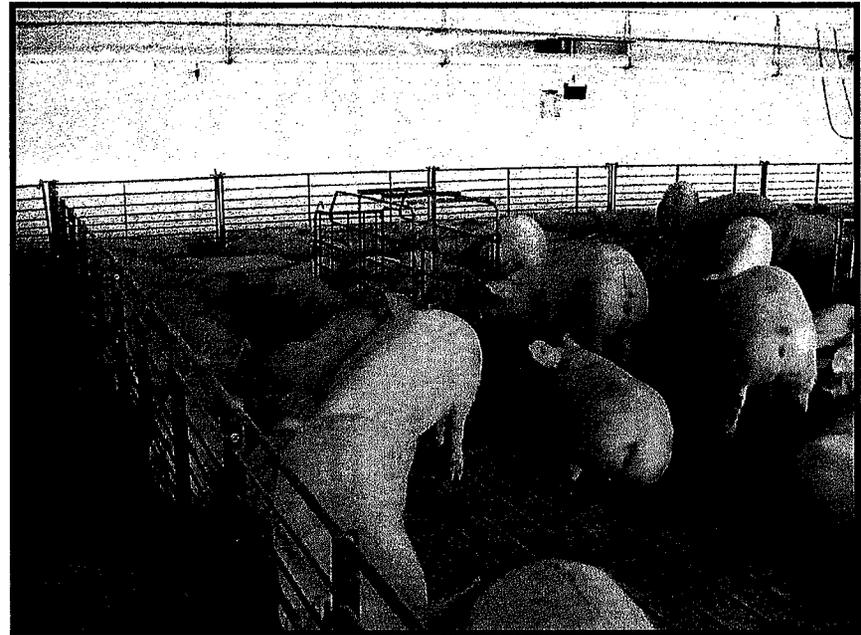
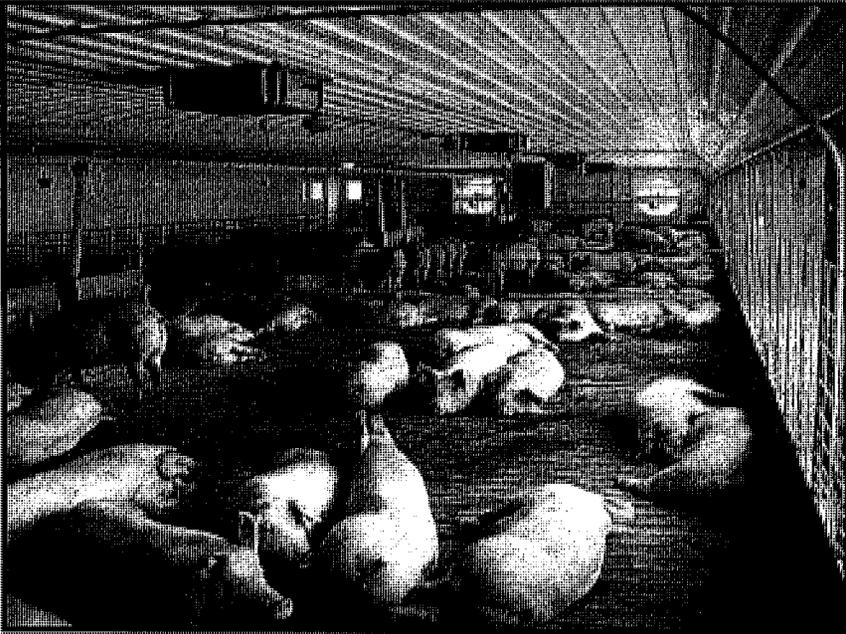


Iowa Select Farms  
4200 head sow unit





# GILT DEVELOPERS



# BOAR STUDS

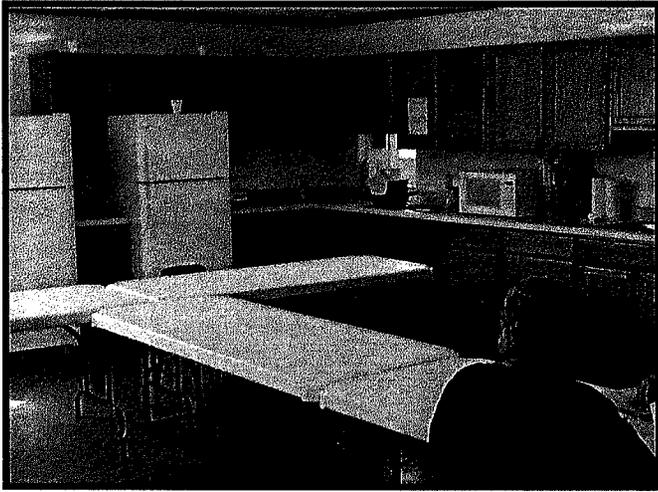


A.I. Lab



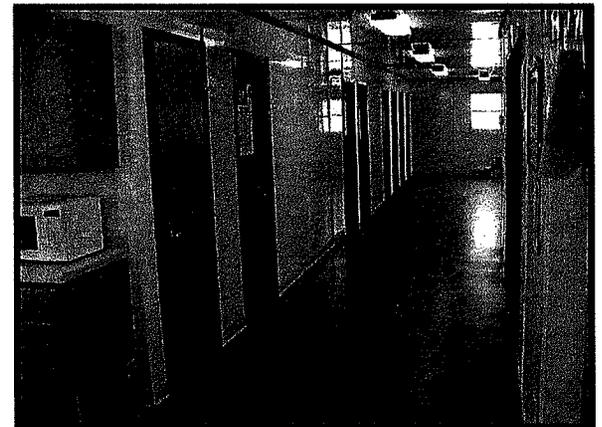
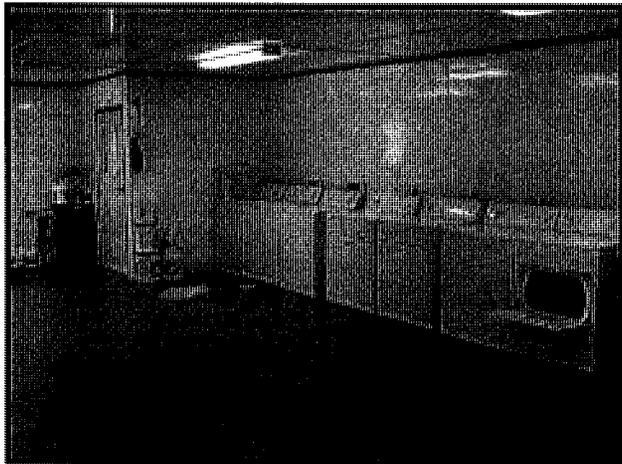
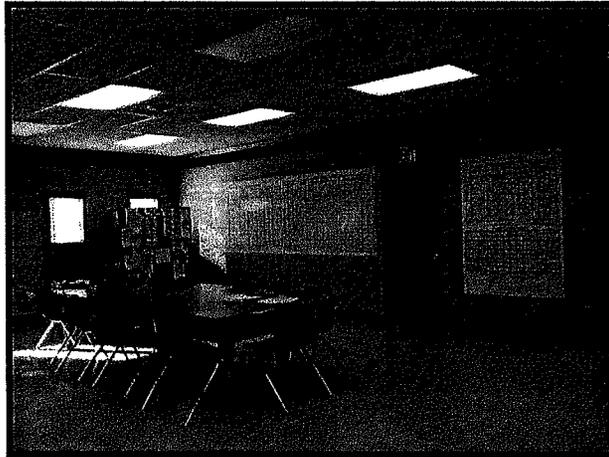
Collection Pens



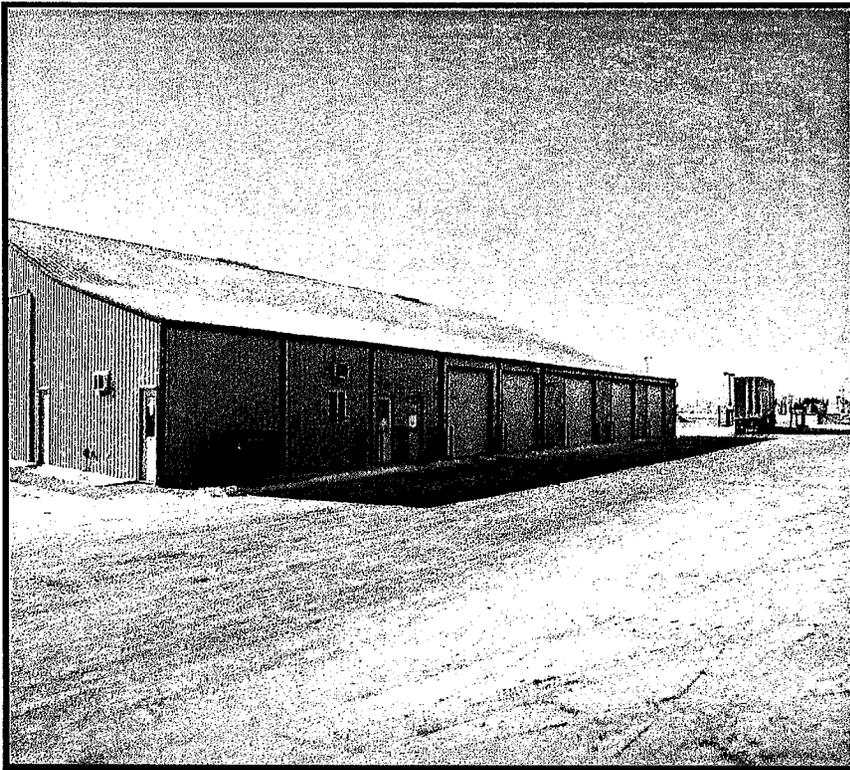


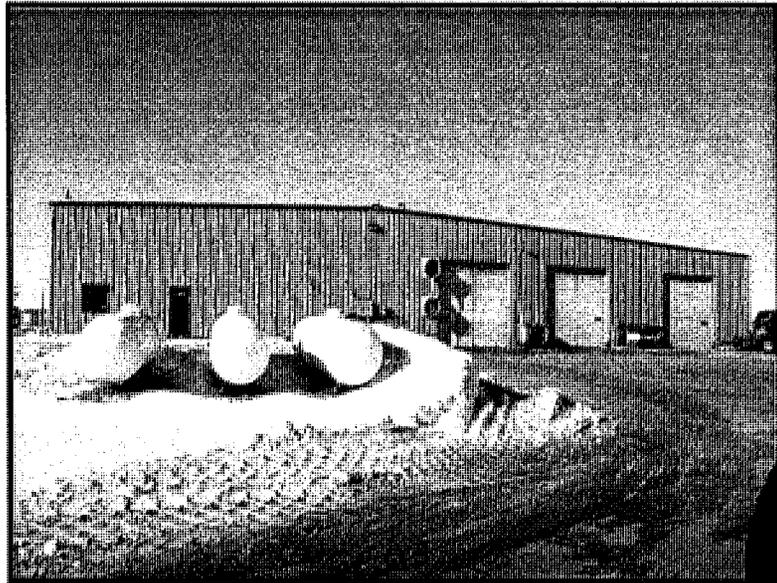
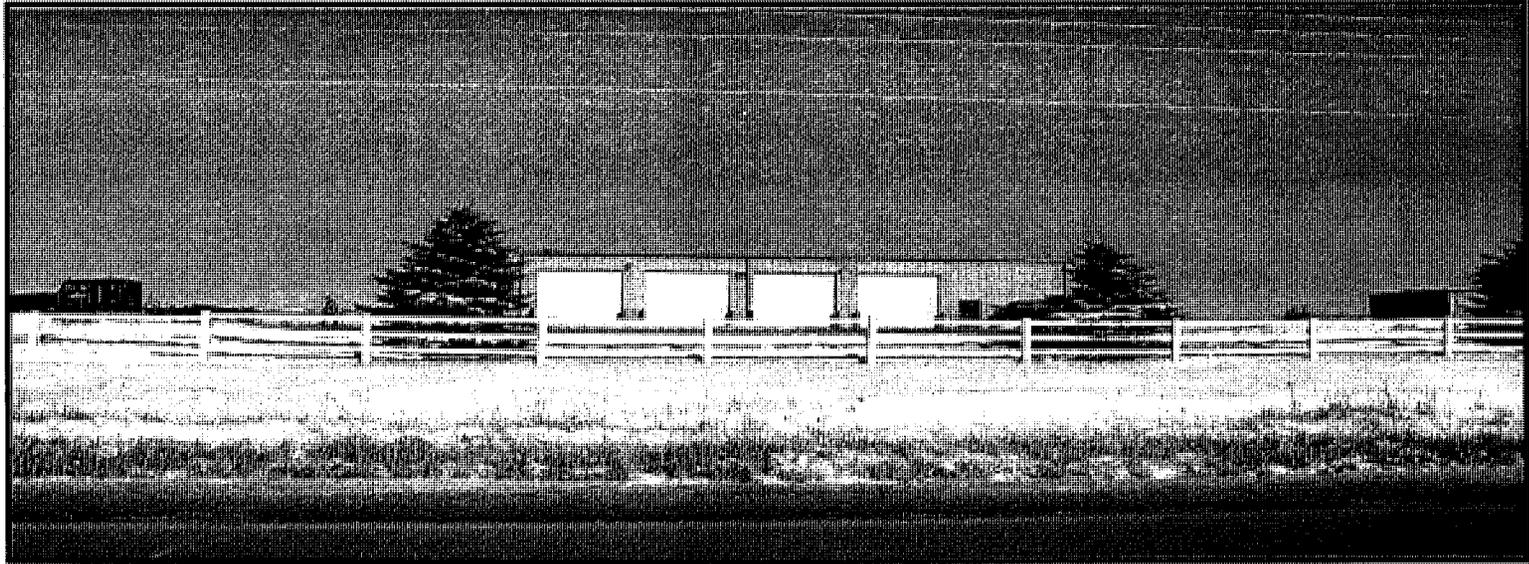
# OFFICES

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needs

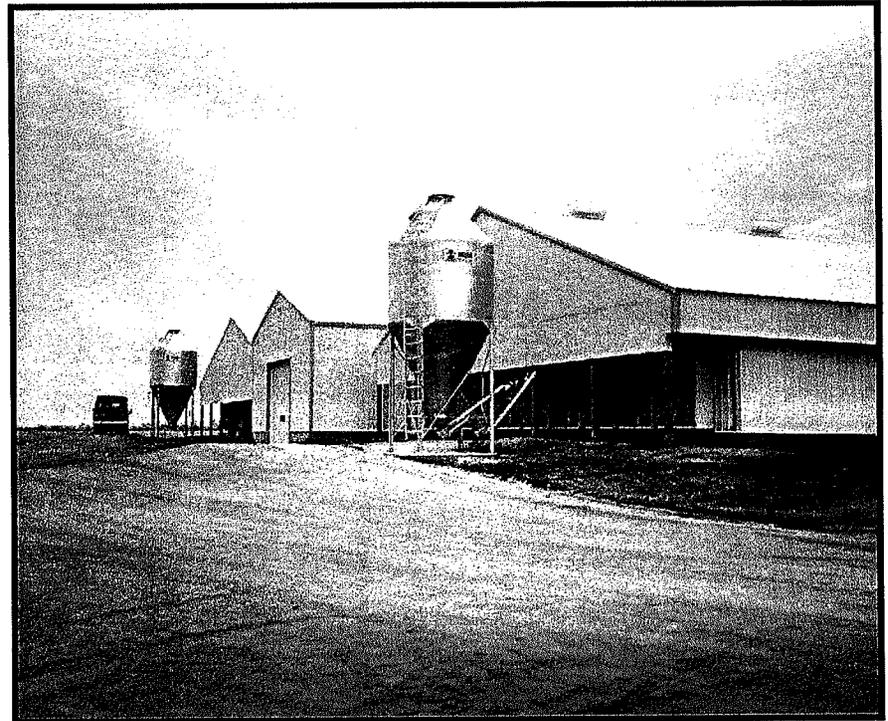
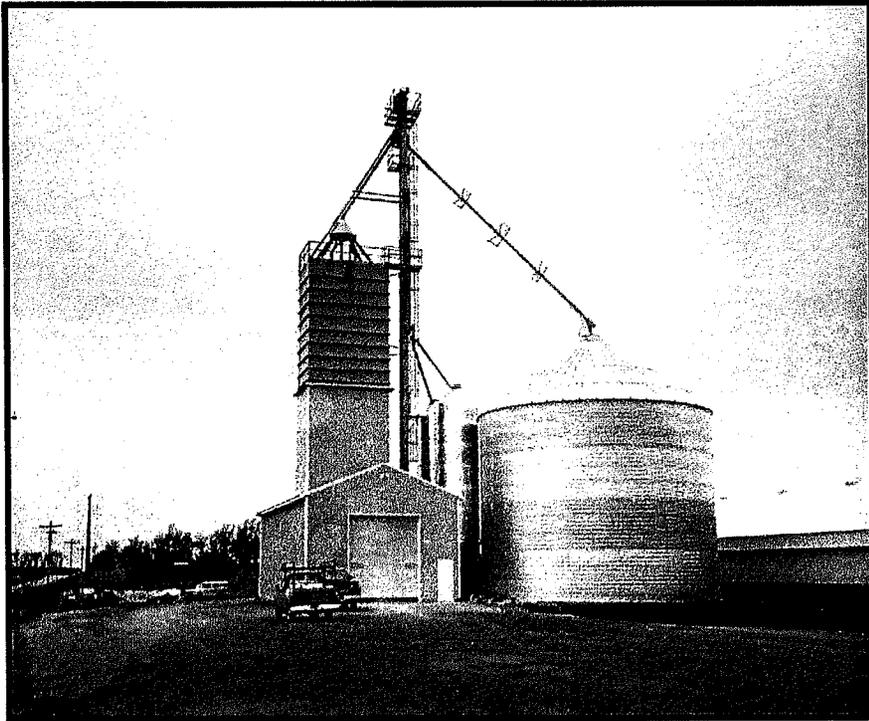


Other Projects:  
Truck Wash  
Truck dryer buildings  
Maintenance buildings





# Other Projects: Poultry Complexes



# MAJOR PROJECTS COMPLETED

## SOW COMPLEXES:

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Iowa Falls, Iowa

• **PARTNERS IN PORK – 4,000 SOWS**

Kent, Iowa

• **LYLE GREENFIELD – 5,000 SOWS**

Jewell, Iowa

• **CIP – 1,200 SOWS**

Toledo, Iowa

• **BURT FARMS – 1,200 SOWS**

Marshalltown, Iowa

• **JOHN HEJLIK – 1,600 SOWS**

Britt, Iowa

• **EDLER BROTHERS 1,200 SOWS**

State Center, Iowa

**MTM FARMS 2,800 SOWS**

Haverhill, Iowa

## FINISHERS:

• **State Line Cooperative, Burt, Iowa – 120,000 spaces**      • **M2P2, Inc., Ames, Iowa – 62,000 spaces**

• **Prairie States Management, Emmetsburg, Iowa – 150,000 spaces**

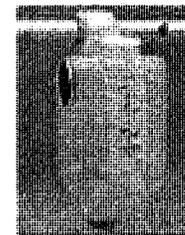
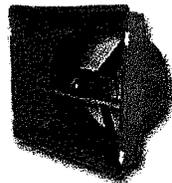
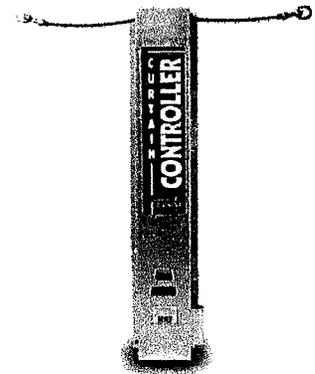
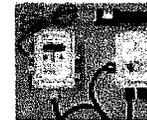
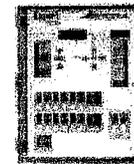
• **Iowa Select Farms, Iowa Falls, Iowa – 750,000 spaces**      • **Prestage Farms, Ames, IA – 55,000 spaces**



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Contact one of these New Modern Concepts representatives to  
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**PIPESTONE**  
*System*  
Pipestone

The Pipestone System Business Model

Dr. Gordon Spronk  
Dr. Barry Kerkaert  
June, 2011  
[www.pipestonesystem.com](http://www.pipestonesystem.com)



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Our Brands:

**PIPESTONE**  
*Veterinary Clinic*

**PIPESTONE**  
*System*



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Mission & Values

- Mission  
"Helping farmers today create the farms of tomorrow"
- Values
  - Integrity
  - Caring
  - Commitment
  - Growth
  - Teamwork



Copyright

**PIPESTONE**  
*System*

Pipestone  
Pipestone System operates in 5 states



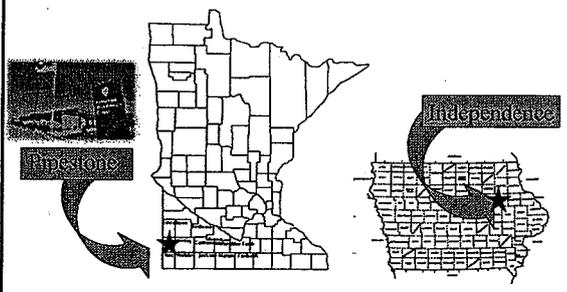
South Dakota / Minnesota /  
Wisconsin / Nebraska / Iowa



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**PIPESTONE**  
*System*

Pipestone - Pipestone  
Pipestone Veterinary Clinics—home of the Pipestone System



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**PIPESTONE**  
*System*

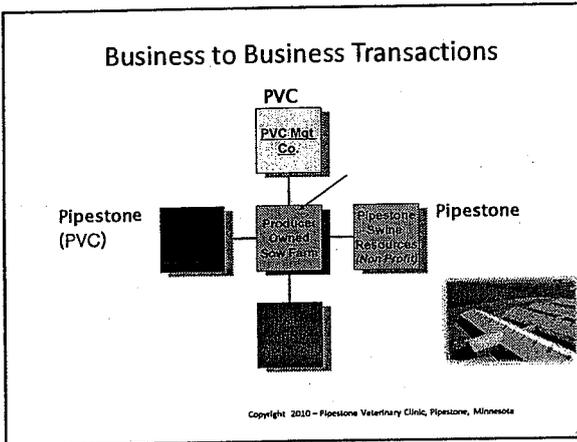
Pipestone  
Geographical Location - Pipestone System



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**PIPESTONE**  
*System*

354



### Pipestone System Model

- Production
- Business
- Ownership

PIPESTONE System

### Pipestone System Swine Model

- **Production Model**
  - Breed to wean sow sites
  - Sow farm size - 2,500 to 6,000 sows
  - 1,200 to 3,000 pigs per week
  - Professionally managed
  - WTM barns - 600 to 2,400 head
  - Or use nursery & finishers

PIPESTONE System

### Pipestone System Swine Model

- **Business Model;**
  - Mission of farm - to supply large groups of high health pigs to owners to be used as profit enterprise on their own farms
  - Sow farms organized as a separate corporation or partnership *PIPESTONE 养猪公司*
  - Owned by farmers in share lots or % *入股或比例*
  - Daily Administration and Management by Pipestone
  - Governed by Board of Directors
  - Central employment company owned by Pipestone (No Profit) *人力中介, 提供养猪员工*

PIPESTONE System

### Pipestone System Swine Model

- **Ownership**
  - Sow farm shares owned by farmer
  - Sow farm ownership = WTM (wean to market) capacity *拥有的权重, 看你养多少头猪*
  - Pig ownership transfer at weaning (delivery to farmer) to farmer
  - All WTM profits/loss are farmers

PIPESTONE System

### History

- Pipestone Veterinary Clinic - 1942
- First managed farm in 1990 *养猪公司*
- Growth from one sow farm to 46 farms in 5 states by 2011

PIPESTONE System

### Current Demographics

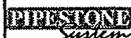
- 46 sow farms
- 140,000 sows
- 5 states
- 650 employees 650人
- 250 Farmers/shareholders
- Average sow farm size – 3,200 sows 1,994年算大和模坊
- Average WTM annual production – 13,000 (range 4,000 to 100,000 +)



### Commonly asked questions by visitors;

#### How many shareholders in Pipestone System?

- See demographics slide



#### What value has been created by the Pipestone System?

- Large groups of pigs are more efficient than continuous flow
- Professional management of sow farm has higher value as measured by PSY pig sow per year
- Long term value of fixed assets higher than single site value 長遠固本成本
- Value of land, corn, manure, swine
  - Manure is an asset to crop operation
  - Crop operation produces corn, SBM.
  - Crops fed to swine operation
  - Increased value of land with agronomic management of manure



#### What is the value of the negotiating power of the Pipestone System?

- Based on size – more sows = more volume
- In US, more volume = different price grids 议价空间大
- Most commonly impacts;
  - Pharmaceuticals
  - Genetics (gilts)
  - Transportation
  - Management contracts
  - Nutrition
  - Labor (all the employee benefits)
  - Insurance (property, plant ,equipment)



#### What problems have been encountered in the Pipestone System business model (PS Model)?

- PRRS (industry wide problem, not specific to PS model) 最惨!
- Market volatility 市场变化风险
- Education and execution of risk management → 以期须东西于估中
- Communication 风险培育
- Governance - Farmers relinquishing control 农民放弃控制权



*Dangers?*

- PRRS
- Market volatility
- Communication
- Governance




*What lessons have you learned in operating the PS Model, from the beginning to now?*

- Communicate clearly
- Communicate often
- On farm visits are a important
  - Standard protocols
  - Implement protocols
  - Monitor any variance from protocol and correct immediately.
- Have clear lines of authority, Make sure everyone understands governance
- Do not let sow farm owners interfere with employees
- Manage expectations when there is a new PRRS break
- Start with a PRRS free pig
- Manage Market risk



设在2013, 猪只 PRRS free  
 (目标)  
 风险降低是重要的



*Can a similar business and production model be started in Taiwan?*

- Yes?, but be clear on the understanding of the difference in the **production** model ;
  - Breed to wean
  - WTM Wean to Market
- And the **management** model;
  - Sow farms are managed by Pipestone, not the farmers




*What are the crucially important factors we have to overcome for the success of the PS Model in Taiwan?*

- Clearly understand governance, the farmers will need some sort of control of the company, but not day to day management
- Communication – how will information be passed to stakeholders?
  - Clear lines of communication rather than “Word of mouth”
- There may be cultural differences that Pipestone is not aware of.



*What agreements are used to organize and administer this business model?*

- There are at a minimum 5;
  - Organizational documents
  - Member control agreements
  - Operating agreements
  - Pig Purchase agreements
  - Management contract (for the sow farm)
- Optional agreements
  - WTM management




*What specific administration techniques or written agreements are used to resolve shareholder disputes over pig health/quality?*

- Wean age standards that everyone agrees on
  - Today 19 to 21 days
- Group weight standards similar to open market transactions
- Count disputes
- Minimum individual pig quality standards;
  - No pigs less than 8 pounds
  - No blemishes 外傷問題
  - Mobile
  - Castrated
- Disputes are resolved by on site visit by manager or supervisor
- Understanding of expectations




*Any quality specifications in Pig Purchase Agreement?*

Yes – 簽約時要記

- Wean age
- Individual weight
- Quality specifications




*How is pig price determined?*

- Overall approach – sow farm is “cost” center, all excess cash is returned to owners
- Normal management agreement is to manage cash flow to meet sow farm cash needs and to retire debt. 固定成本(設備)及存貯成本
- Budgeting is updated frequently enough to manage sow farm cash flow to production
- In general, pig price set at CBBE Cash Based Break Even




*What specific programs are used to educate shareholders on organization, business model, business operation, swine production techniques etc.?*

- Individual meetings – at the farm
- Small groups
- Frequent face to face meetings
- Owners meetings
- Web based communication
- Emails
- All farms have internet access




*What are the roles of PVC in managing herd health of sow farm?*

- The Pipestone team has complete control, not a consulting relationship.
- All employees are from a central not for profit employee company owned by Pipestone, giving a clear line of authority to Pipestone, not the sow farm owners.
- All inputs into the farm are under Pipestone control with transparency of transactions.



*What are the roles of PVC in managing herd health of shareholders' wean-finish operation?*

- The Pipestone team has a consulting relationship. Mostly veterinary service.
- In most cases, we do the production work, but not in all cases.
- This is changing as market conditions put pressure on improving management at the 管理 增加利益

WTF WTM farms – we continue to play a more important role



*Any consulting or extension programs for owner/farmer?*

- No extension programs
- Consulting arrangements are available. 由其利潤空間愈差, 需要此服務需求愈高



How is market hog price discovered?

- Open market price discovery
- Or long term contracts



Sell finished market hog collectively or independently?

- Both are available – it is the farmers decision



Are the shareholder farmers satisfied with the PS Model?

- We will have farmers available for you to interact with to ask this question



How do you compare your shareholder farmers' business performance and swine productivity with others'?

- This is difficult to answer, we will discuss at the meeting

美金

Estimated Returns to Farmers to Finish Hog Production  
in Iowa - Southern Minnesota, by Sale Month

Month sold	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Avg 00-09
January	(4.76)	(6.45)	6.53	(19.12)	(5.33)	41.98	1.94	(6.60)	(55.96)	(23.25)	(12.89)
February	2.78	0.24	1.76	(14.07)	9.53	14.85	12.15	12.07	(24.57)	(21.63)	4.25
March	3.53	14.14	(5.79)	(10.95)	14.49	23.86	19.65	6.08	(39.40)	(30.51)	2.82
April	23.17	23.46	(19.40)	(33.5)	12.11	27.48	8.33	8.54	(26.75)	(18.41)	6.42
May	25.48	31.54	(12.21)	10.61	19.40	46.42	27.32	22.44	5.07	(18.59)	21.71
June	25.07	41.57	(5.79)	20.69	17.26	31.32	46.45	23.23	(5.62)	(24.58)	25.60
July	21.41	39.06	3.53	12.16	40.28	33.23	32.19	14.65	(11.61)	(23.69)	20.46
August	11.51	35.75	(13.94)	1.50	35.14	34.33	46.12	17.77	8.78	(41.99)	15.15
September	6.40	19.34	(17.07)	1.70	36.76	29.37	28.29	2.28	(15.43)	(47.65)	8.15
October	7.24	4.24	(27.35)	(5.64)	20.40	23.23	21.29	(9.73)	(34.81)	(26.41)	7.11
November	(7.40)	(12.01)	(33.76)	(11.05)	40.16	14.01	11.79	(23.83)	(45.43)	(28.85)	(7.06)
December	1.33	(12.09)	(20.49)	(14.23)	35.49	16.05	1.20	(25.35)	(46.37)	(15.97)	(6.83)
Average	9.76	14.71	(15.97)	(3.15)	27.61	21.42	21.09	3.14	(21.53)	(24.64)	4.20

2008 2009 损失相当严重



ISU Estimated profits for feeder to finish

Estimated Returns from Finishing Feeder Pigs  
in Iowa - Southern Minnesota, by Sale Month

Month sold	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Avg 00-09
January	0.10	(1.30)	(0.15)	9.89	4.53	27.31	(7.29)	(11.65)	(14.64)	(6.40)	(1.61)
February	1.04	1.20	(0.95)	(3.85)	17.86	25.54	(4.40)	0.01	(19.57)	(9.44)	(0.12)
March	(1.19)	14.05	(5.81)	(3.01)	25.26	10.16	(6.66)	(11.31)	(22.26)	(16.15)	(3.29)
April	6.17	18.10	(24.15)	(13.55)	14.76	1.74	(21.47)	(5.71)	(4.73)	(20.02)	(5.97)
May	6.24	19.90	(23.33)	0.46	55.23	15.93	(1.97)	6.99	9.22	(29.40)	7.79
June	(7.11)	21.79	(16.71)	12.89	31.37	(4.62)	11.30	(1.37)	(5.83)	(30.51)	2.13
July	7.34	16.47	(7.82)	3.74	32.37	(7.71)	3.27	(11.68)	(1.75)	(16.29)	(1.90)
August	(21.07)	14.25	(20.47)	(6.41)	27.34	(3.25)	15.17	(0.04)	11.41	(57.41)	(3.90)
September	(22.25)	3.00	(25.95)	0.11	31.29	2.00	11.21	(17.80)	(6.70)	(43.10)	(6.83)
October	(12.73)	(5.85)	(19.72)	(7.40)	26.99	0.21	6.29	(13.06)	(9.90)	(18.85)	(5.87)
November	(23.52)	(19.20)	(17.86)	(9.55)	48.82	1.23	(0.33)	(29.50)	(17.63)	(12.10)	(6.47)
December	(13.41)	(16.73)	(0.23)	(7.02)	34.20	8.88	(4.67)	(31.26)	(29.25)	2.24	(8.21)
Average	(6.91)	4.53	(15.90)	(1.34)	26.43	6.62	0.54	(12.40)	(12.31)	(23.13)	(3.04)



Any member dropped? Why?

- Yes, farmers continue to leave the industry;
  - Retire and the farm is sold to others
  - Disillusioned with the swine industry, sell all parts of livestock operation and remain in crop farming
  - Sell shares and buy pigs on the open market

2-5% 平均2%



*Protocols of sow farm and wean-finish farm operation?*

- There are many, we will discuss at the meeting



*Barns and facilities? Design and operation?*

- We have available plans for a
  - 5,000 sow farm
  - 2,400 head WTF barn



*What are the major contributors to enable the PS Model achieve such a remarkable improvement in business performance and swine productivity i.e. high PSY?*

- There are many, but can be summarized as follows;
  - Clear lines of authority
  - Employees dedicated to swine production and professional improvement
  - Sound, proven protocols
  - Monitoring execution of protocols and immediately correcting any deviation
  - Minimizing interference of farmers



*What about vertical integration vs. horizontal integration?*

- Most top ten USA production companies are packer based companies that have then entered live production - i.e. Smithfield
- Pipestone System is production based with land assets to fully utilize manure, corn, beans, labor and animal caretakers – family farms

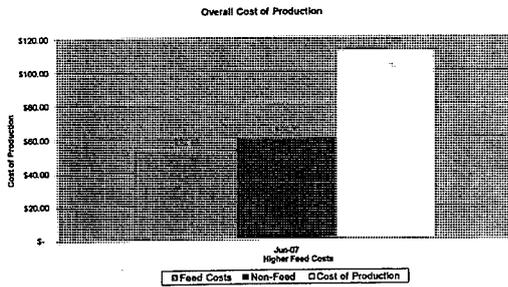
自给自足 → 资源整合



The Industry

2011

### It Used to be Easy

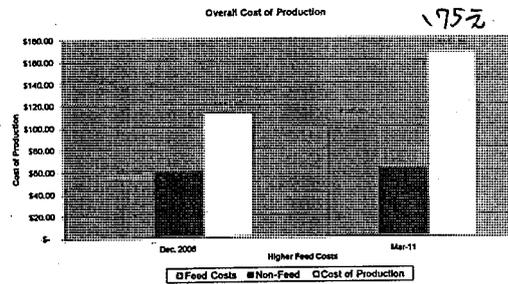


### The Good Old Days

- Corn ranged from \$2-\$3 a bushel 每英斗
- Soybean meal from \$150-\$250 a ton
- Cost of production was much more predictable
- Very little variation
- Ever Since 2008 the world changed on Lending to Agriculture for the foreseeable future 期貨
- Extreme Volatility is the norm 操作如貨未 匯市場穩定
- How does a Lender deal with this
- How does a producer manage volatility



### Then & Now



700 每頭  
175元

270 lb  
≈ 130 kg



### Reality of Today

- Extreme moves in all commodities
- Extreme changes in margin day to day
- Margins change by \$1 -\$2 a head per day
- It takes a lot of money to manage risk 要保證 備資金來運作
- It takes a strong stomach to manage risk
- Good bank partners are critical to manage this as well



### Summary

- Rapid volatility is unprecedented
- Creates significant changes in many financial ratios
- Creates nervous producers
- Creates nervous Lenders
- Volatility makes everyone uneasy
- How do you manage the volatility
- It is not easy nor is a lot of fun
- Very difficult to be right all the time



### Performance Summary

Sows

Reality starts with the data...

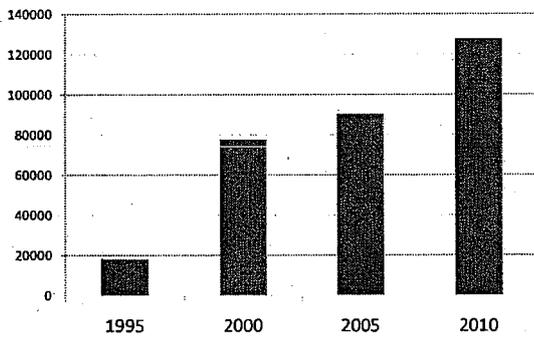


### Farrow To Finish Production Data Overview

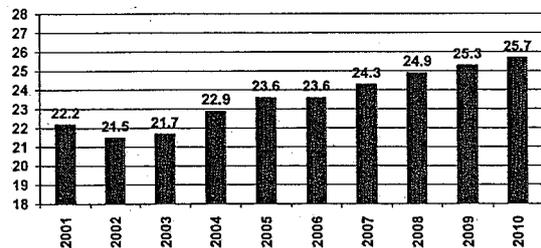
	Best	PSS AVG	PSS Worst
PSY	28.5	25.7	24
Gain Days	168 days	168	168
ADG	1.65	1.5	1.35
% Tops	94%	90%	86%
Pounds Live Sold	7747	6106	4928
Revenue	\$ 4,648,600	\$ 3,663,790	\$ 2,957,300



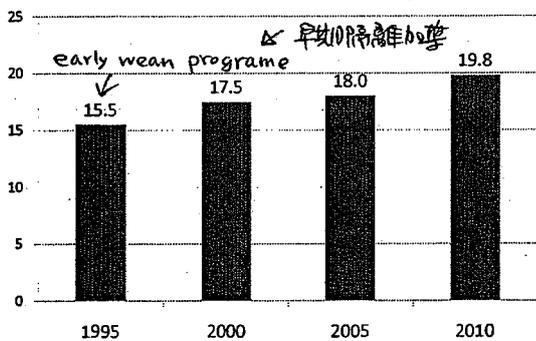
### Pipestone System- Sows Managed



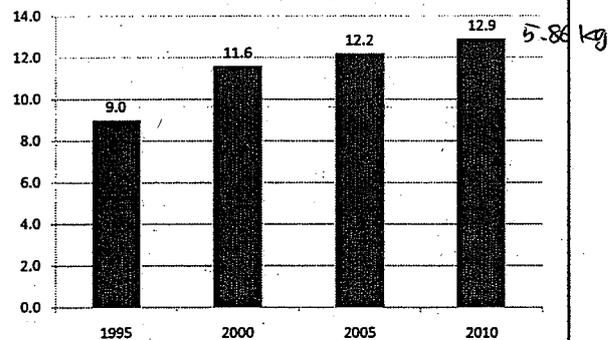
### Pigs Weaned Per Mated Female



### Pipestone System- Wean Age

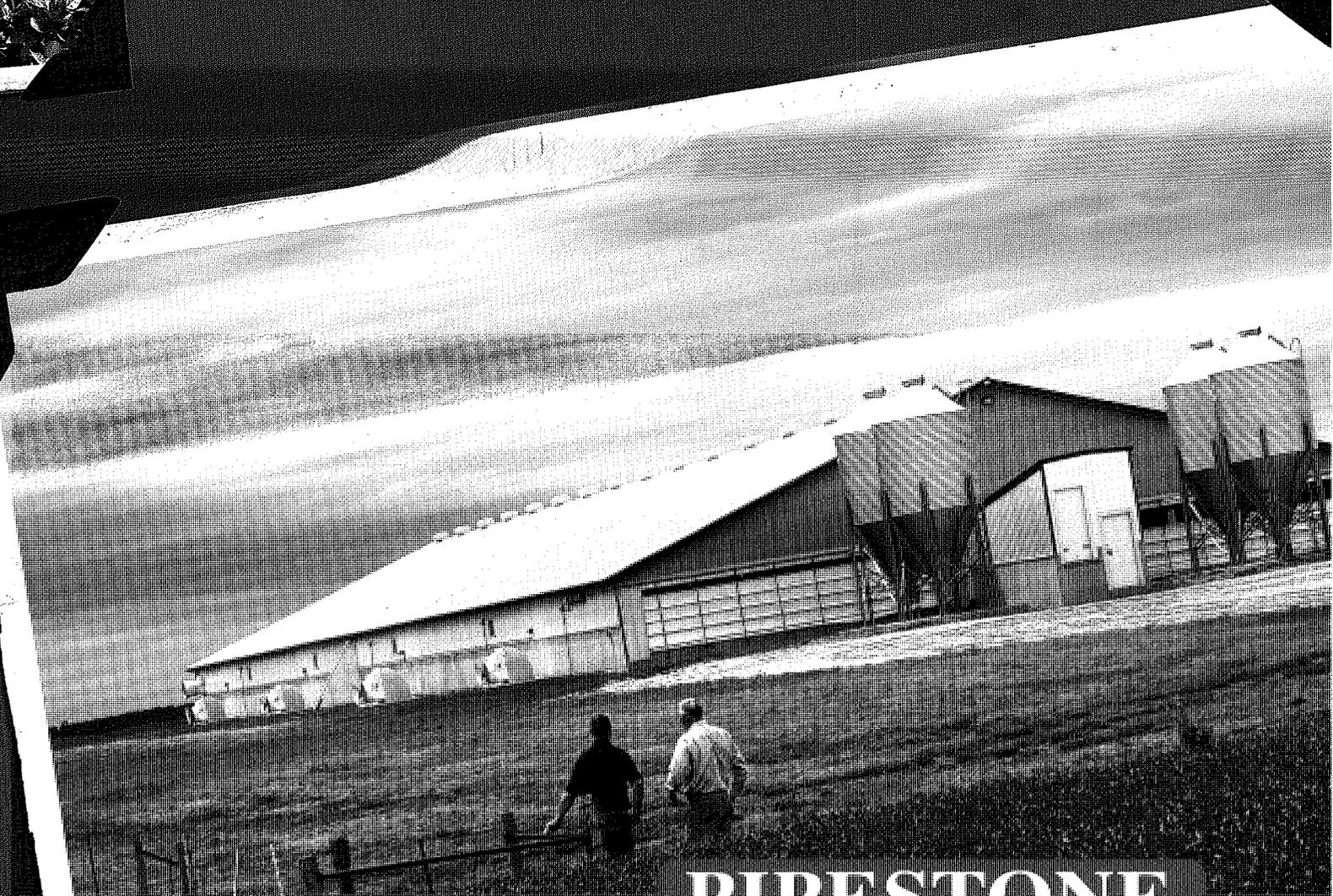


### Pipestone System- Avg. Wean Wt.





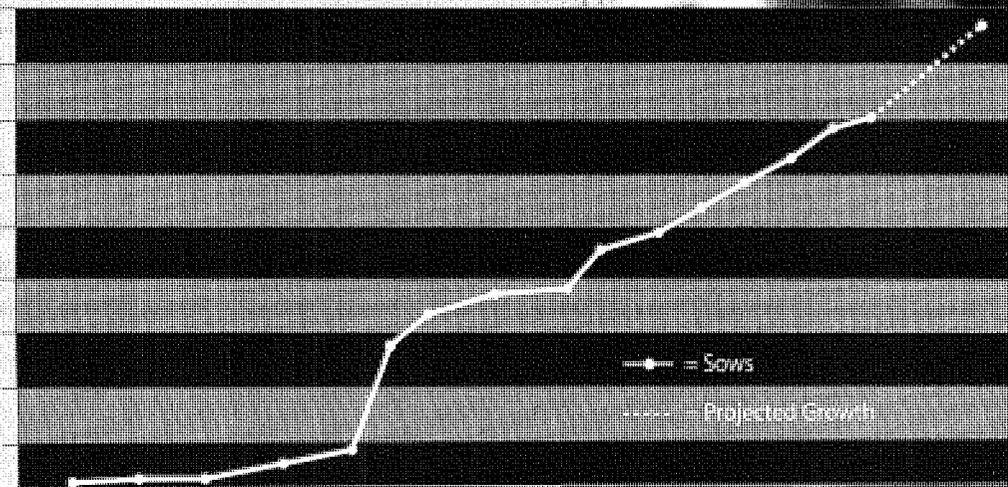
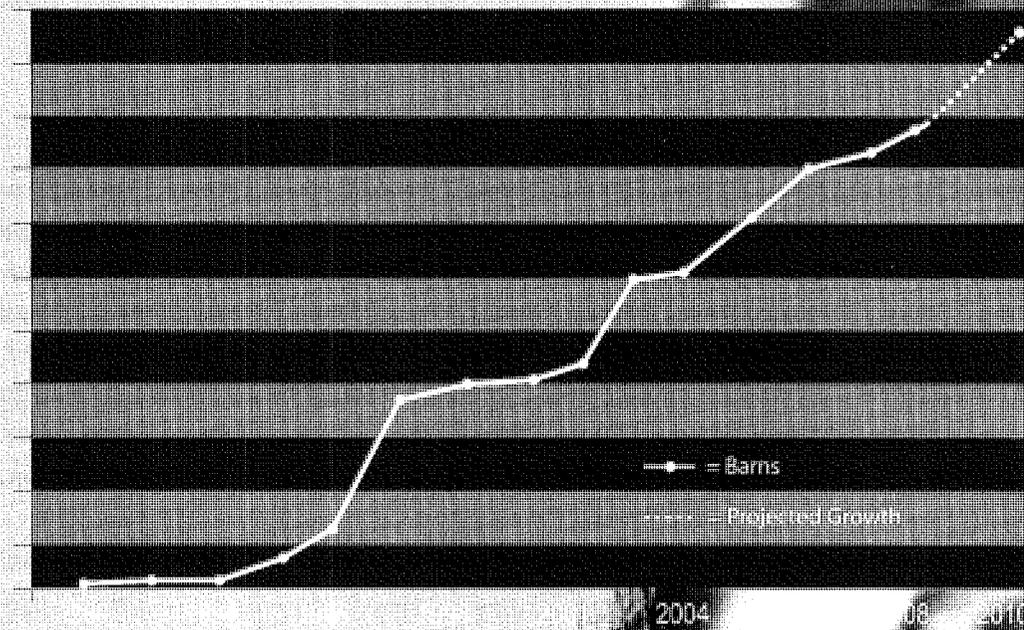
*Preserving Livestock  
Ownership Close to Home*

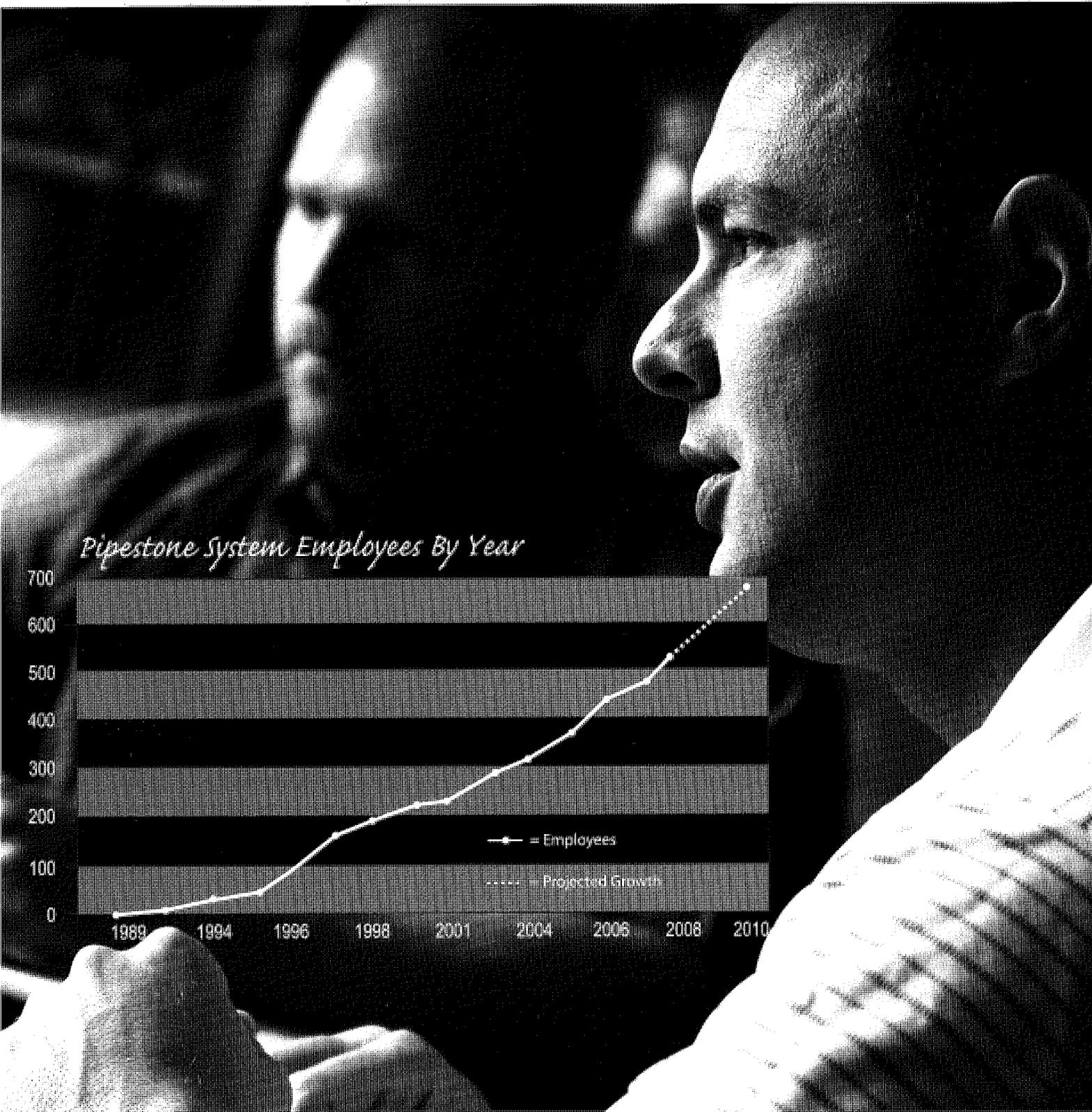


**PIPESTONE**

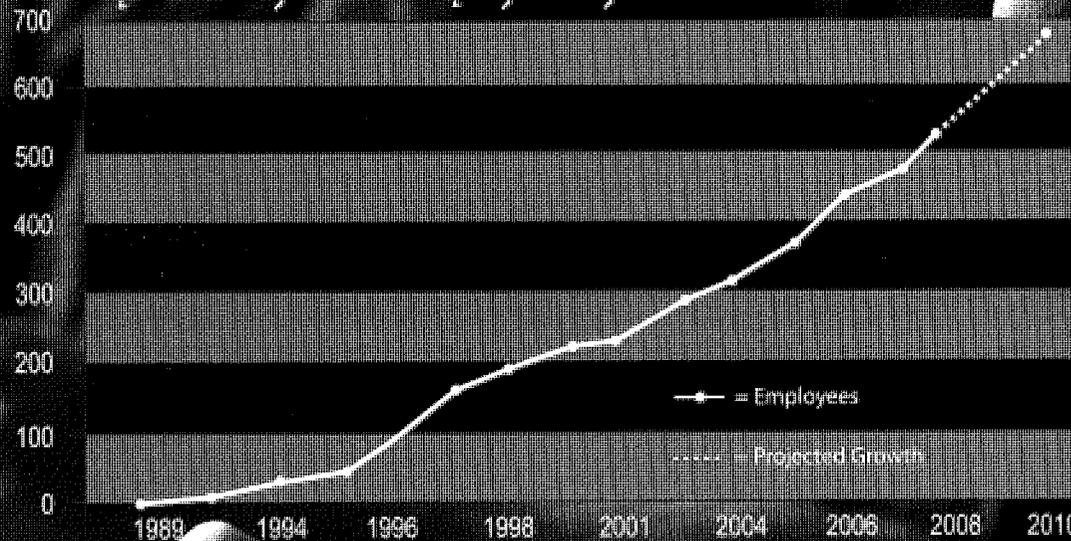
Producer ownership makes our system different from any other pig production company.

Number of barns by year





*Pipestone System Employees By Year*



*"For us this is a nice model because we maintain individual ownership. We're each raising livestock we own. First, we had to understand we didn't have direct control over every pig-raising step. We had to trust somebody else."*

*Don Buhl*

Former National Pork Producers Council President | Swine Producer  
Pipestone System Shareholder

# Values

Ask any employee to name our core values, and you'll hear this list verbatim. Is that remarkable? Maybe so, but what's more impressive is the way our people actually live these qualities.

**Integrity.** We do what we say, successfully producing our farmer-owners' pigs and guiding their employees. Pork producers who turn over certain responsibilities to the System have every right to expect performance beyond their own high standards.

**Caring.** We care about the animals, the employees, the environment, and our shareholders' success. It shows!

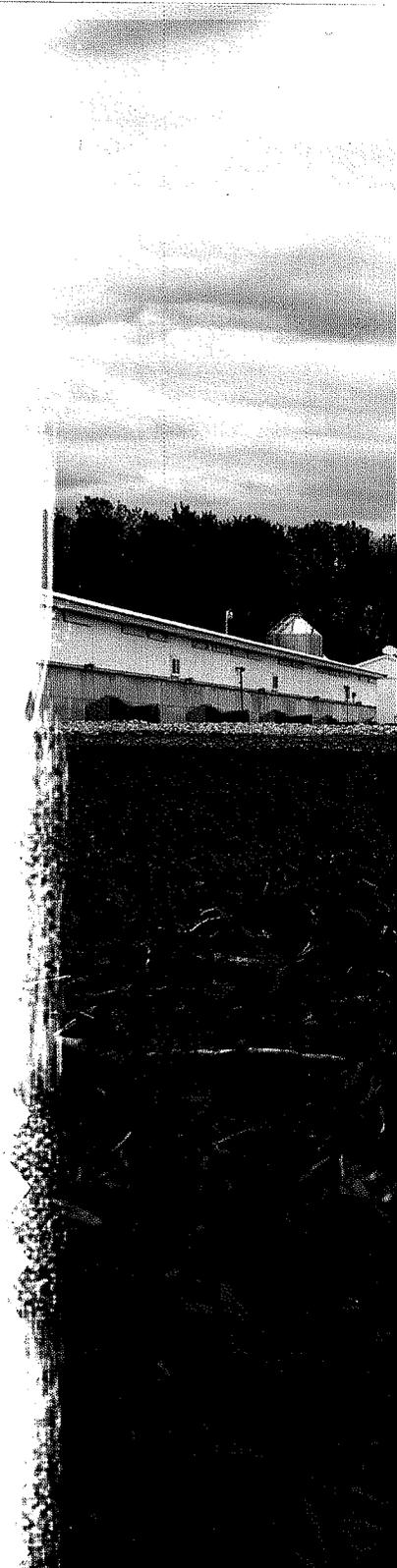
**Teamwork.** Owners of any one barn may not know each other in the beginning. The System is their only connection, so they depend on our team to make it all work.

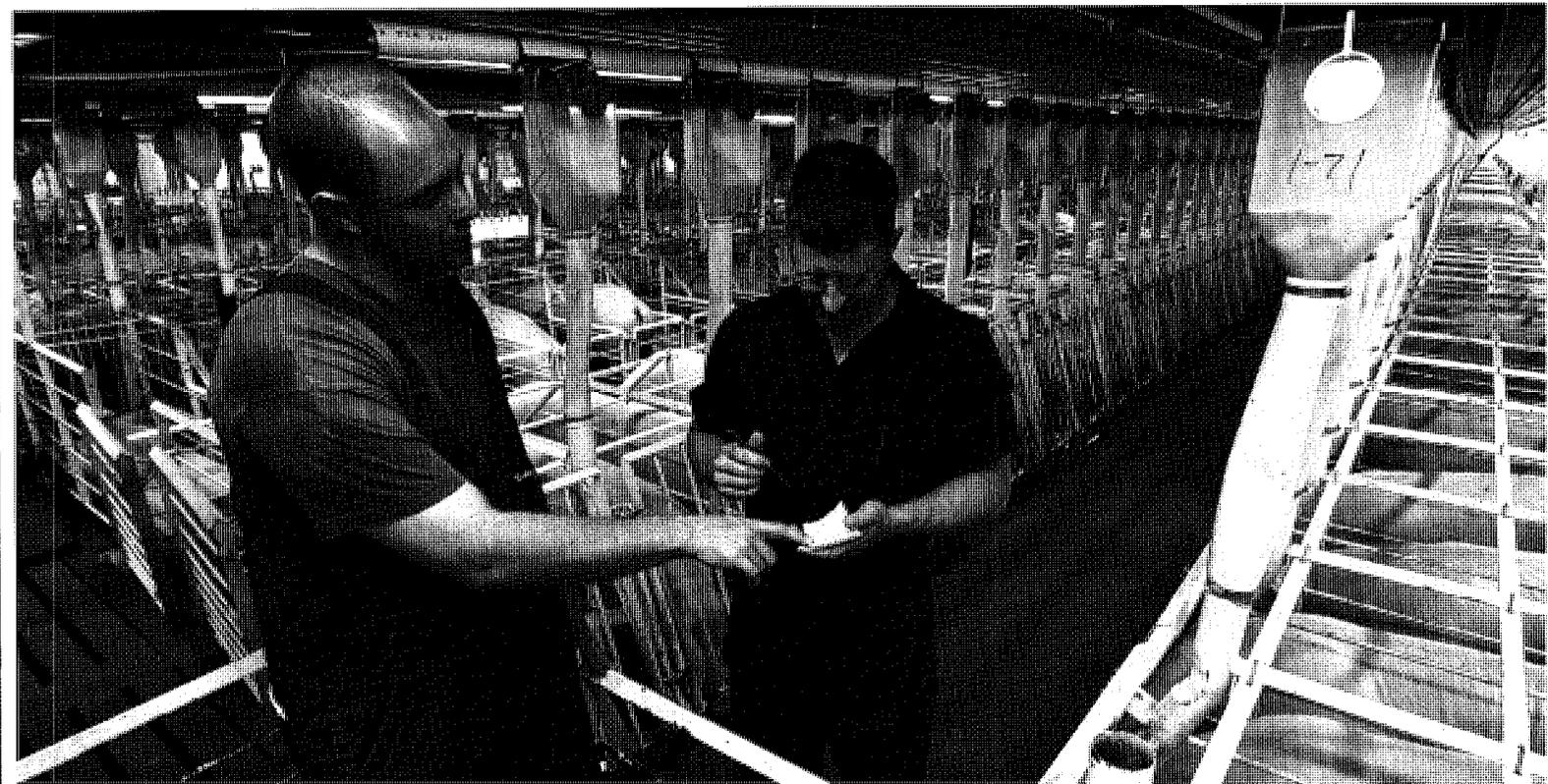
**Growth.** To enhance our value to family farmers, the number of System barns must grow, and our successes must sustain innovation. To keep our valued employees, we must offer them room to grow professionally.

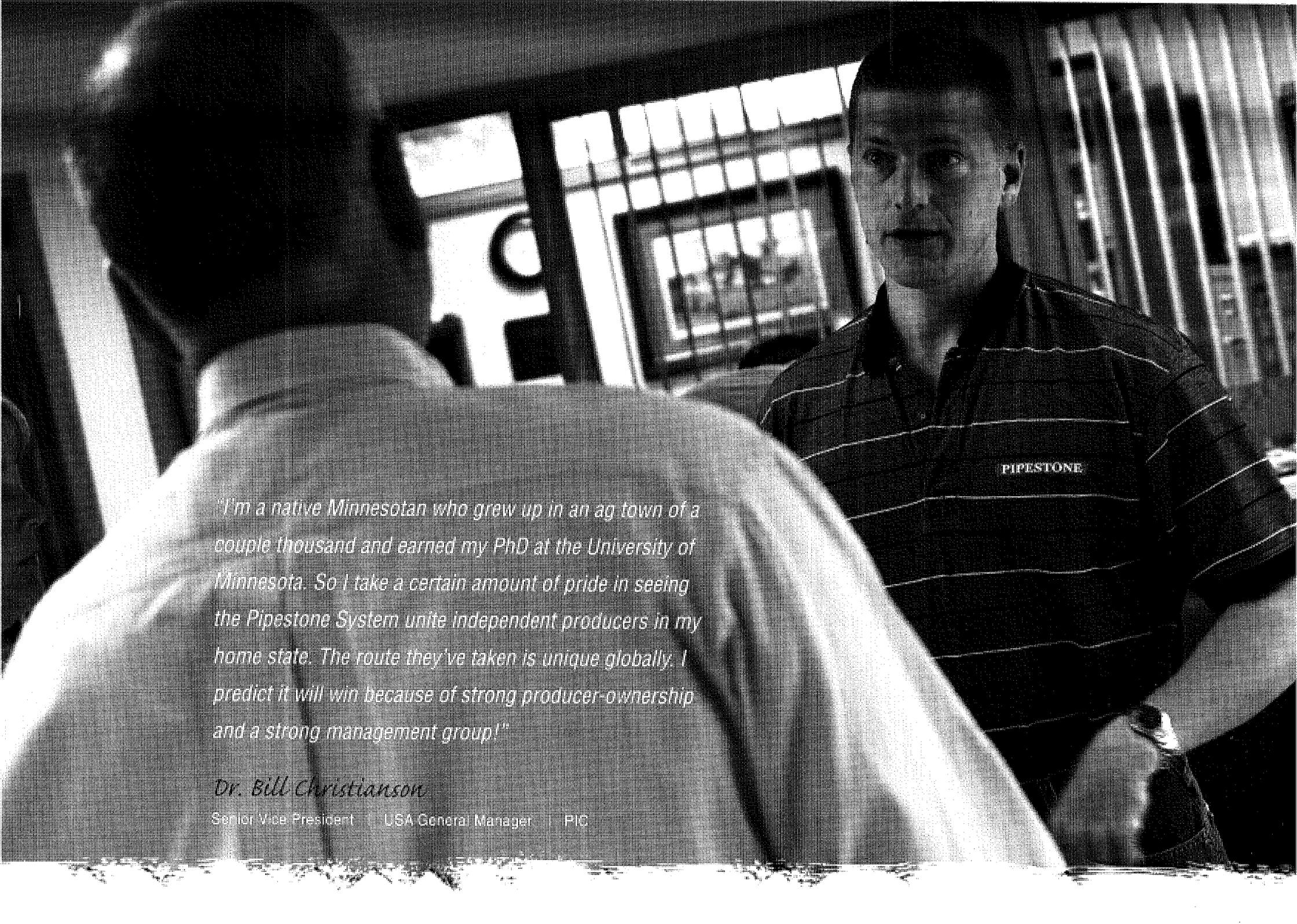
**Commitment.** Everyone in this organization shares devotion to the land and to raising livestock. Farm ownership in our own families spans generations.

Always mindful of our core values, we attract employees who share our passions—people who understand what drives us to do our best.

*Our Mission: Helping farmers today create the farms of tomorrow.*







*"I'm a native Minnesotan who grew up in an ag town of a couple thousand and earned my PhD at the University of Minnesota. So I take a certain amount of pride in seeing the Pipestone System unite independent producers in my home state. The route they've taken is unique globally. I predict it will win because of strong producer-ownership and a strong management group!"*

*Dr. Bill Christianson*

Senior Vice President | USA General Manager | PIC

# People

Back when we started, we probably wouldn't have used the word altruistic...but that's what Pipestone System turned out to be. Had our purpose been to build a pork production company for profit, the idea wouldn't have worked.

We chose to do what would help our veterinary clinic clients become successful as agriculture changed. Simply put, we didn't want our customers to lose their livestock operations, or we'd have no clients!

Continued growth matters, because the size of our operation allows us to attract the brightest minds in the industry. Once they sign on, we treat them very well. Top-notch health and retirement benefits tell our employees we want them to establish their career paths here, but we don't expect them to work for nothing.

Every day, we prove that a world-class swine company doesn't have to be cold and distant.

*"I grew up on a family farm, and I didn't want to leave the ag industry. I'm glad I found this growing company that offers ways for me to better myself within the System. I'm not the only one who sees potential here to grow my career. I'm glad I can train others like me."*

*Marty Rast*

Supervisor | Pipestone System



# *Sustainability*

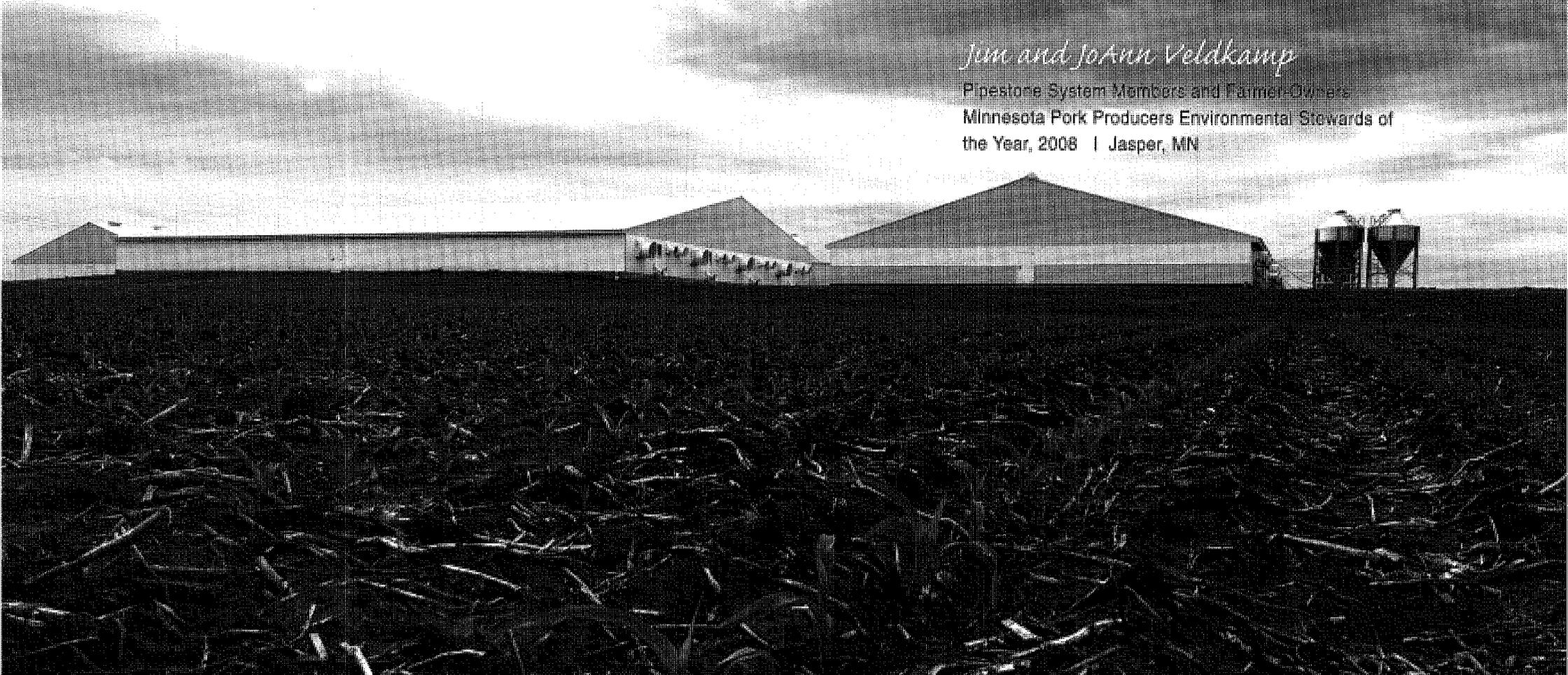
Since they own the land surrounding their hog barns, our shareholders maximize efficiencies with their own production costs. They produce their own corn to feed the pigs we create for them. Their production cycle provides manure they can use to outmaneuver high fertilizer costs. When we introduced the concept in the early 1990s, the biggest challenge was finding a home for manure from our sow barns. Now, other farmers are fighting to get it!

We've proven the early nay-sayers wrong: this approach to farming is very sustainable. Everything about our philosophy fits the thrifty Midwest mindset. And since corn is so abundant here, we're in the best place in the United States to raise pork.

*"When we bought our first share in 1994, Dr. Spronk kept emphasizing that we'd be the last ones to turn the lights out if times get tough! Owning the sows in conjunction with other family farmers has huge value."*

*Jim and JoAnn Veldkamp*

Pipestone System Members and Farmer-Owners  
Minnesota Pork Producers Environmental Stewards of  
the Year, 2008 | Jasper, MN



## *Financial Impact*

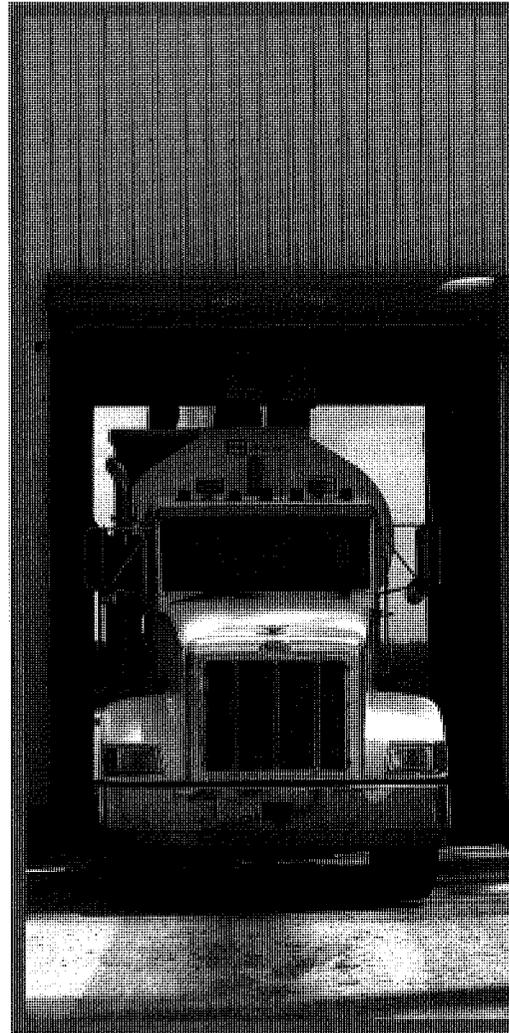
Our owners are satisfied, which is the ultimate proof of the pudding. After all, their expectation is to make a living as pork producers. Their geographic advantages, and our economies of scale, make their profits possible.

By using the best industry practices and spreading costs across all the barns in the System, we produce pigs at a lower cost than our owners could on their own. They fill their barns with the healthiest pigs anywhere, giving them a competitive advantage. Their own feed and labor inputs make finishing pigs more cost-effective. As a result, our owners have economic staying power within the industry.

Over the years, their financial sophistication has increased as well. They are astute businesspeople who carefully review the financial statistics, the health reports, and the testing protocols we share with them.

Owners put their money in our hands. Since many of us have family or friends still on the farm, we picture those faces when we visualize our shareholders and then do our jobs in their best interest.

Whether their responsibilities are in pig production, sow health, or financial oversight, our employees live and breathe their jobs. We all dream of ways to do even better.



*"Whether they're big or small operators, the owners benefit from our System. When we're producing their top-quality pigs, the shareholders become equal... completely equal."*

*Steve Kruse*     *Superior  
Pigrope System*

## Performance

Pipestone System never forgets its true purpose. By controlling their costs and providing them the most productive genetics, we help pork producers compete with big integrators in the United States and other countries. As a result, the System has helped strengthen the rural economy wherever we have shareholders and employees.

Our model becomes easier to understand everywhere it succeeds. As one South Dakota shareholder explains it, "Every pork producer in our county who is still in business is part of the System." With one hand our owners freely relinquish control over pig production; with the other they receive better pigs and a better opportunity to profit. It proves they're smart.

Get to know our progressive farmer-owners and you'll discover bright, hard-working people who would stand out in any industry. Our innovative veterinarians and managers match their determination to raise quality pigs efficiently. When bright people with drive come together, the sky is the limit! Sure, agriculture goes through cycles, yet we can't think of a better team to align with when challenges arise.

*"Here's what sets us apart from any Wall Street-owned company: farmer-owners all over the Midwest. That gives them—and us—strength in numbers. I tell that to anyone who wants to listen."*

*Joe Van Moer* | Supervisor | Pipestone System





## *Ownership Close to Home*

Long before giant swine enterprises blossomed, the American Midwest stood for shared labor and interlocking goals, exemplified in barn raisings and threshing bees. Farmers assumed their neighbor's milking duties on his daughter's wedding day. Children from the next farm herded back curious pigs who'd staged their great escape. Family farmers have always pulled together.

These days, even though rural neighbors live farther apart, farmers still pull together as Pipestone System owners.

They realize that success comes from preserving livestock ownership close to home.

**PIPESTONE**

*System*

## Effects of DDGS Feeding Strategy on Grow-Finish Pig Performance and Carcass Quality

及不同阶段的喂饲

Ralco Nutrition, Inc.



### Introduction

- Typically, an economic advantage exists to utilize DDGS in grow-finish swine diets.
- However, there are limitations
  - Maximum inclusion rate 最高可用重量多少
  - Strategy of feeding at the beginning and ending of grow-finish period
    - Growth Performance
    - Carcass yield
    - Meat quality

### Introduction

- The ability to feed higher DDGS inclusions during the growing-finishing period without negatively affecting growth performance or carcass quality would allow for lower diet costs. 全范围内猪到底可以加多少, 不会
- Performing this evaluation within our EnMax program will provide further data to allow us best utilize DDGS in diets. 影响其品质

### Objective

- To evaluate the effects of DDGS feeding levels and strategy throughout the grow-finish period on growth performance and carcass meat and fat quality measurements

### Materials and Methods

- Commercial finisher research facility
- 987 pigs (Compart genetics)
- Initial body weight = 62.7 lbs 27kg
- Completely randomized design
  - 21 pigs/pen
  - 4 dietary treatments
  - 12 replicate pens per treatment 12个重复

### Dietary treatments

Diet Phase	Start BW, lbs	End BW, lbs	Amount of DDGS			
			Trt 1	Trt 2	Trt 3	Trt 4
1	50	80	15.0%	20.0%	20.0%	20.0%
2	80	125	20.0%	20.0%	30.0%	40.0%
3	125	165	20.0%	20.0%	30.0%	40.0%
4	165	200	20.0%	20.0%	30.0%	40.0%
5	200	230	10.0%	20.0%	10.0%	10.0%
6	230	265	0.0%	20.0%	0.0%	0.0%

拿掉 0.0% 的组  
 增加产量及肉的品质



## Growth Measurements

- Growth and Feed Performance
  - Pen weights every 2 weeks
  - Pen feed deliveries
  - Mortality and culls
- Used to calculate ADG, ADFI, FCR
- Growth study concluded when started marketing pigs out of the barn ~247 lbs avg barn BW
  - 98-day experimental period



## Carcass Measurements

- Meat quality evaluation
  - 2 pigs/pen (94 total pigs)
  - Tracked by tattoo and Trt through packing plant (HCW)
  - Captured loins and bellies for analysis
  - Loins: L\* value, Ultimate pH, Color Score, Marbling Score
  - Bellies: Belly flex, thickness, wt, yield sellable, slicing shatter, sensory analysis
- Carcass measures
  - HCW, FOM BF, Loin Depth, % Lean

*Carcass weight*

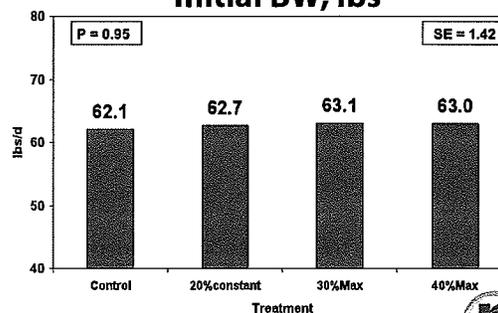
### Phase 3 diets (as-fed basis)

Trt:	1	2	3	4
Ground corn	1300	1300	1148	999
SBM 46%	257	257	209	153
DDGS	400	400	600	800
Limestone	21.7	21.7	22.1	24.6
Salt	8.5	8.5	8.5	8.5
L-Lysine HCl	7.1	7.1	7.9	8.9
DL-Methionine	0	0	0	0
L-Threonine	0.5	0.5	0.3	.1
L-Tryptophan	0	0	0.1	.15
Dicalcium Phos	0	0	0	0
VTM premix	5	5	5	5

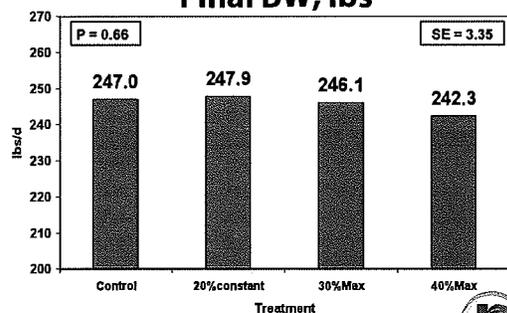
Within each phase, all dietary treatments were formulated to the same NE and TID Lys %



### Initial BW, lbs

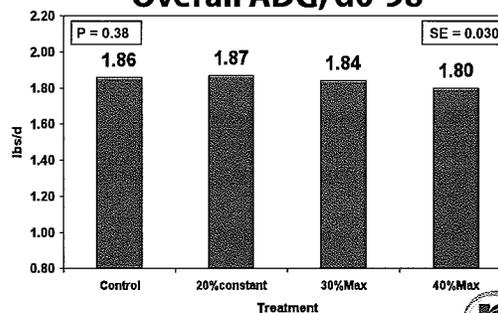


### Final BW, lbs

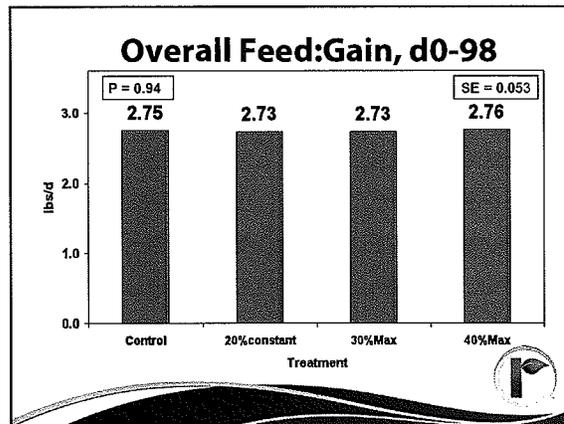
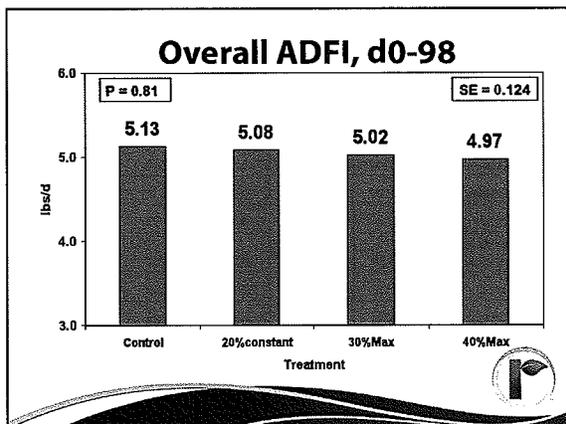


*a daily gain*

### Overall ADG, d0-98



daily feed intake



### Growth Conclusions

- No statistical differences in growth performance for the DDGS strategies tested
- Numerically lowest ADFI, ADG, and final body weight for the highest DDGS feeding strategy (40% Max treatment)

### Carcass and Meat Quality

### Loin meat quality measures

Trt:	1 Ctrl	2 20%Const	3 30%Max	4 40%Max	SE	P<:
L* value	53.8	52.7	53.8	53.8	0.439	0.21
Ultimate pH	5.73	5.79	5.74	5.76	0.026	0.43
Color score	2.89	3.00	2.83	2.88	0.118	0.77
Marbling score	2.64 <sup>a</sup>	2.38 <sup>ab</sup>	2.04 <sup>b</sup>	2.00 <sup>b</sup>	0.180	0.05

94 total carcasses (23-24 per treatment)

### Carcass data collection

Trt:	1 Ctrl	2 20%Const	3 30%Max	4 40%Max	SE	P<:
HCW	213.2	213.5	212.3	210.2	1.07	0.10
Yield, %	76.92 <sup>a</sup>	76.50 <sup>ab</sup>	76.38 <sup>b</sup>	76.10 <sup>b</sup>	0.171	0.05
BF, mm	17.48	17.31	17.02	17.39	0.315	0.72
Loin depth, mm	60.02	61.28	60.13	59.80	0.494	0.14
Lean, %	55.41	55.66	55.70	55.44	0.206	0.64

553 pigs sent on 3 loads (equal number of treatments on each load)

✓ 屠宰後電子秤

### Belly quality evaluation

Trt:	1 Ctrl	2 20%Const	3 30%Max	4 40%Max	SE	P<:
Skinned wt, lbs*	10.00	10.22	10.46	10.03	0.222	0.45
Belly flex angle	45.44	43.21	41.00	40.53	3.41	0.73
Slicing yield*	8.15	8.44	8.60	8.22	0.258	0.60
Shatter, n*	0.90	1.58	3.15	1.44	0.705	0.10
Shat length,mm*	1.53	2.31	2.39	1.85	0.660	0.77

94 total carcasses (23-24 per treatment)  
\*Belly thickness used as covariate in analysis



### Bacon Sensory Analysis

Trt:	1 Ctrl	2 20%Const	3 30%Max	4 40%Max	SE	P<:
Cooking yield,%	35.82	34.26	35.67	35.30	0.014	0.85
Bacon distortion	1.64	1.57	1.54	1.83	0.102	0.17
Crispiness	4.26 <sup>xy</sup>	4.60 <sup>y</sup>	3.89 <sup>*</sup>	4.21 <sup>xy</sup>	0.195	0.08
Tenderness	4.33	4.48	4.48	4.53	0.152	0.68
Bacon flavor intensity	4.95 <sup>y</sup>	4.52 <sup>x</sup>	4.81 <sup>y</sup>	4.50 <sup>x</sup>	0.118	0.02
Fattiness	2.15	1.99	2.06	2.09	0.097	0.65
Rancid taste	1.01	1.01	1.03	1.01	0.009	0.21
Piggy taste	1.05	1.03	1.02	1.03	0.016	0.43
Fishy taste	1.00	1.02	1.01	1.02	0.007	0.24

94 total carcasses

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肌(肉)附 →

### Carcass Conclusions

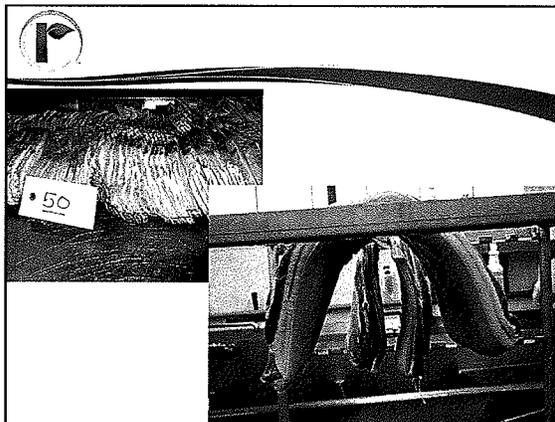
- The control diet (20%Max) resulted in the significantly greater carcass yield and marbling score than the 30%Max and 40%Max treatments.
- Very little other differences in meat and carcass quality were recorded except marbling score and a tendency for belly shatters.

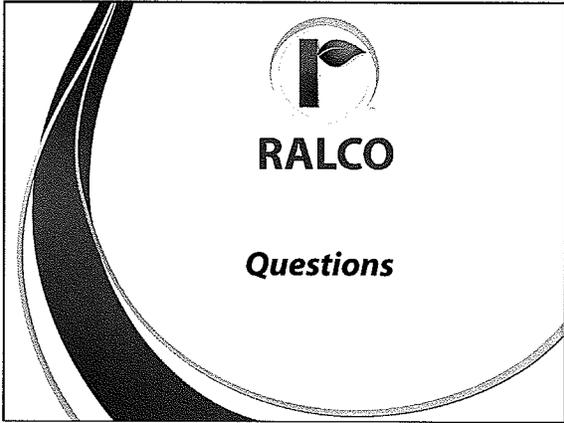
### Sensory Conclusions

- Very little differences in bacon sensory analysis except for:
  - Crispiness
  - Bacon flavor intensity

### Implications

- These DDGS feeding strategies mostly resulted in similar effects.
- However, feeding the DDGS strategy that included 40% max results in numerically less growth performance
- The withdrawal of DDGS in last phase was not enough to completely correct a reduction in yield in the high DDGS diets.
- Few differences in bacon sensory analyses.





## Effects of Paylean® dose on growth performance traits in finishing pigs raised under commercial conditions

Study Number: T4V190709



## Study Investigators

- Elanco Animal Health  
– Matt Ritter, PhD



## Objectives

- To compare the effects of feeding Paylean for 24 days prior to barn close-out versus a standard finishing diet without added nutrition on growth performance traits



## Experimental Design

- A randomized complete block design was utilized to evaluate the effects of 3 different Paylean feeding programs on growth performance traits:
  - 1). NRC control – no added nutrition
  - 2). 4.5 g/ton of Paylean
  - 3). 6.75 g/ton of Paylean

*\*Effects of Paylean are confounded with added nutrition. According to label, Paylean fed to finishing swine in a complete ration requires at least 16% crude protein.*



## Experimental Design

- 1,476 total pigs allotted to treatments cuts
  - Average initial BW = 255.7 lbs ~116 kg
- 72 test pens
  - 20 or 21 pigs per pen
- 2 blocks
  - One per finishing room
- 24 replicates per treatment
  - Single gender replicates were utilized



## Materials and Methods

- 2400 head commercial wean-to-finish research facility in the Midwest
- Industry-representative genetics (PIC TR-4 × Fast females)
- Pigs were placed with 30 pigs per pen
- Industry-type space allowances: ~7.5 ft<sup>2</sup>/pig ~.7 m<sup>2</sup>/pig
- Typical disease load and finishing environment



## Marketing Strategy

- Real world marketing scenario:

Barn Cut	Days of Age, #	Pigs Marketed, %
1	150	25
2	164	25
3	178	50

宿重乃为拉 出去  
取 150% 出售

- First barn cut (not included in the study)
  - All lights and culls were removed from each pen
  - Pens were then reduced to 21 (block 1) or 20 pigs/pen (block 2) by removing the heaviest pigs from each pen



## Treatment Allocation

- After the first barn cut was taken, all of the pens were weighed and the feeders were emptied
- Pens were randomly assigned to Paylean treatments on the basis of previous Ingelvac® Circoflex™ treatment (control vs. vaccinated), gender, and live weight
- Test pigs remained in their original barn pens and were not mixed with unfamiliar pigs during the allotment process

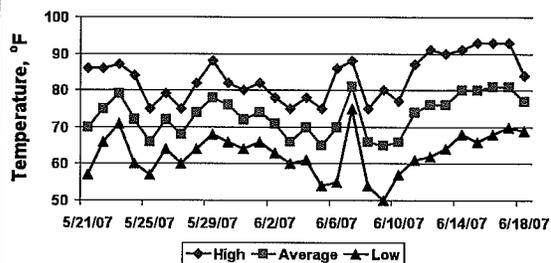


## Paylean Treatments

- Paylean diets started after the first barn cut was marketed
- Typical industry-standard corn/soy/fat diets
  - NRC control at 13.0% crude protein, 0.67% TID Lysine
  - Paylean diets at 16.0% crude protein, 0.90% TID Lysine
- Diets were fed for the last 24 days prior to barn close-out
- Study dates: 5/21/07 to 6/18/07
  - Avg temperature = 73.1°F; 22.8 C Avg RH = 62.6%



## Outside Daily Temperature <sup>1</sup>



<sup>1</sup>Data obtained from a local weather station



使用 paylean 要增加 Lysine 每 100 磅 蛋白质含量

## Study Diets

Diet No.	NRC Control	Paylean 4.5 g/ton	Paylean 6.75 g/ton
Protein, %	13.02	16.03	16.03
Lysine, %	0.75	1.00	1.00
Avail. Lysine, %	0.67	0.90	0.90
Fat, %	7.28	7.32	7.32
Fiber, %	2.52	2.61	2.61
Calcium, %	0.45	0.44	0.44
Phosphorous, %	0.35	0.39	0.39
Avail. Phosphorous, %	0.20	0.22	0.22
M Energy, kcal/lb	1560	1561	1561
Phytase, FTU/lb	181	193	193
Paylean, g/ton	--	4.5	6.75



## Paylean Feed Assays

- NRC control diet
  - Avg. concentration = 0.00 g/ton
- Paylean 4.5 g/ton
  - Avg. concentration = 4.5 g/ton
- Paylean 6.75 g/ton
  - Avg. concentration = 7.24 g/ton



## Marketing the 2nd and 3rd Barn Cuts

Barn Cut	Pigs Removed, #	Paylean Days, #
2	7	14
3	13 or 14	24
<b>Average Paylean Days</b>		<b>20.6</b>

- The 2nd barn cut was marketed on day 14 of the study by selecting the 7 heaviest pigs in each pen
- The remaining pigs in each pen were then subsequently marketed on day 24 of the study



## Performance Measurements

### • Period 1 (Day 0 to 14)

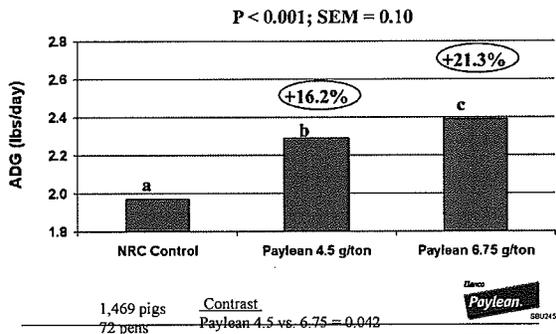
- Based on 20 or 21 pigs/pen
- ADFI
- ADG
- FE

### • Period 2 (Day 14 to 24)

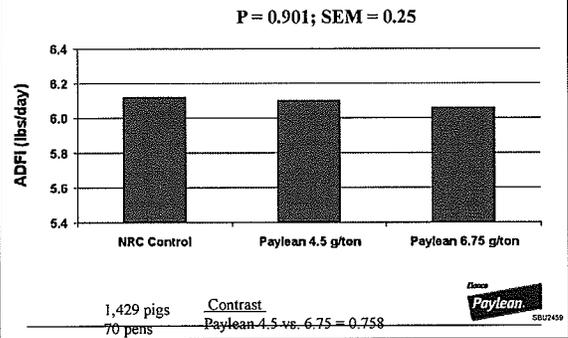
- Based on 13 or 14 pigs/pen
- ADFI
- ADG
- FE



## ADG Period 1 (Day 0 to 14)



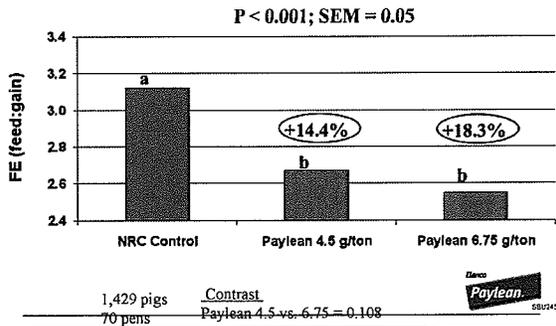
## ADFI Period 1 (Day 0 to 14)



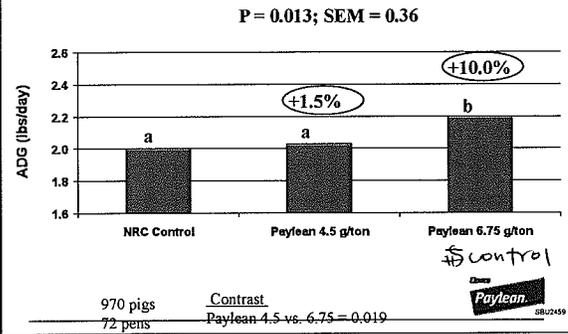
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## FE Period 1 (Day 0 to 14)

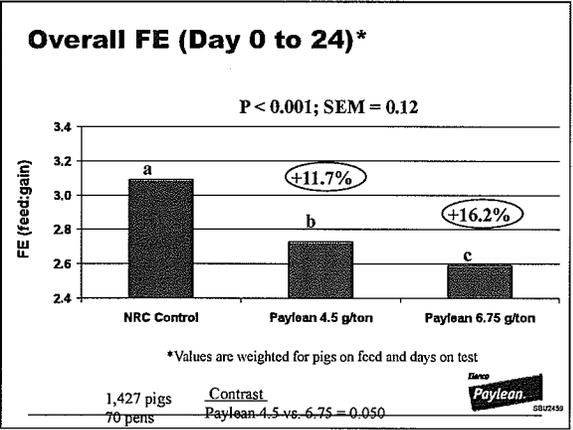
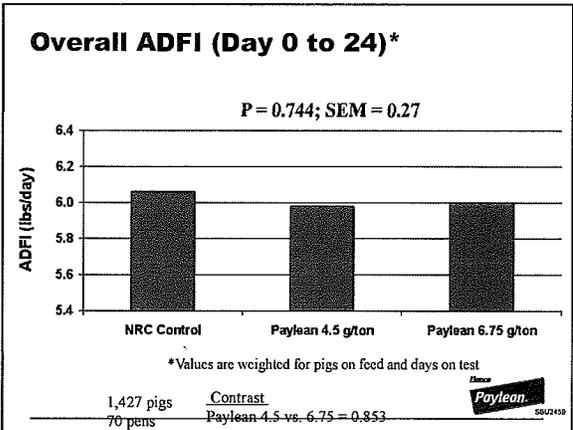
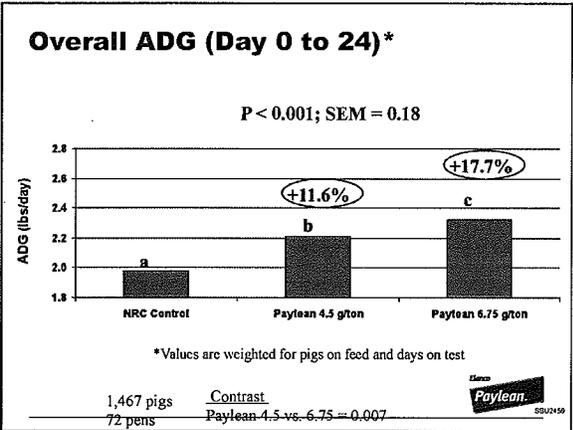
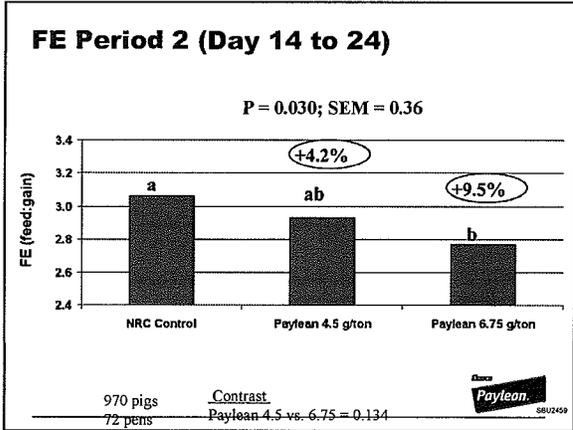
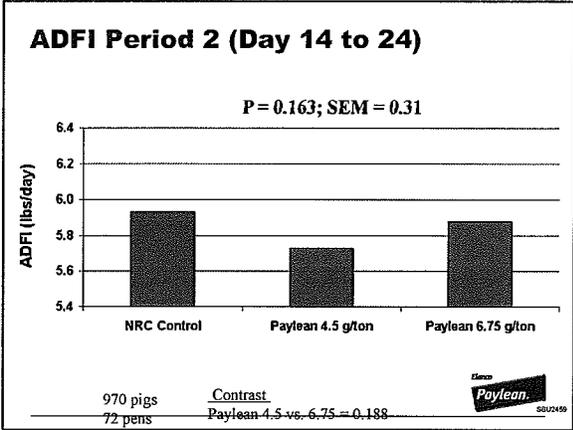
feeding efficiency



## ADG Period 2 (Day 14 to 24)



control 有差異



### Market Weights by Barn Cut

Trait	Paylean Treatment			Pooled SEM	P-value
	NRC Control	4.5 g/ton	6.75 g/ton		
<b>Day 14 - 2nd Barn Cut</b>					
Pigs marketed per pen, #	6.9	6.9	6.9	—	—
Body weight, lbs	301.1 <sup>a</sup>	306.5 <sup>b</sup>	307.1 <sup>b</sup>	1.40	0.029
Improvement, lbs	—	5.4	6.0	—	—
<b>Day 24 - 3rd Barn Cut</b>					
Pigs marketed per pen, #	13.5	13.4	13.5	—	—
Body weight, lbs	294.7 <sup>a</sup>	298.7 <sup>ab</sup>	302.1 <sup>b</sup>	3.74	0.014
Improvement, lbs	—	4.0	7.4	—	—
<b>2<sup>nd</sup> Barn Cut</b>		<b>3<sup>rd</sup> Barn Cut</b>			
497 pigs		970 pigs			
72 pens		72 pens			

**Paylean** SB02459

### Average Market Weights\*

Trait	Paylean Treatment			Pooled SEM	P-value
	NRC Control	4.5 g/ton	6.75 g/ton		
Pigs marketed per pen, #	20.4	20.3	20.4	—	—
Actual market weight, lbs	296.8 <sup>a</sup>	301.3 <sup>b</sup>	303.8 <sup>b</sup>	2.63	0.007
Improvement, lbs	—	4.5	7.0	—	—
Total weight gain, lbs	41.0 <sup>a</sup>	45.7 <sup>b</sup>	48.2 <sup>c</sup>	3.54	<0.001
Paylean days, #	0.0	20.6	20.6	—	—

\*Values are weighted for pigs on feed and days on test

Total Sold  
1,467 pigs  
72 pens



### Paylean 4.5 g/ton Summary

- Feeding Paylean at 4.5 g/ton for 24 days prior to barn closeout compared to a NRC control diet produced:
  - 4.5 lbs Additional live weight over control
  - 11.6% Increase in Average Daily Gain over control
    - 4.5 lbs live weight @ \$0.51 = \$2.30/pig
- OR
- 11.7% Improved Feed Efficiency over control
  - 6 lbs of feed \* 20.6 days = 124 lbs of feed
    - @ 11.7% improvement = 14.5 lbs of feed saved/pig
    - @ \$0.12/lbs of feed = \$1.74/pig

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再  
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再

總共省了4美分/頭



### Paylean 6.75 g/ton Summary

- Feeding Paylean at 6.75 g/ton for 24 days prior to barn closeout compared to a NRC control diet produced:
  - 7 lbs Additional live weight gain over control
  - 17.7% Increase in Average Daily Gain over control
    - 7 lbs live weight @ \$0.51 = \$3.57/pig
- OR
- 16.2% Improved Feed Efficiency over control
  - 6 lbs of feed \* 20.6 days = 124 lbs of feed
    - @ 16% improvement = 20 lbs of feed saved/pig
    - @ \$0.12/lbs of feed = 2.38/pig



### Paylean 4.5 g/ton vs. Paylean 6.75 g/ton

- Increasing Paylean dose from 4.5 to 6.75 g/ton for 24 days prior to barn closeout produced:
  - 2.5 lbs Additional live weight over 4.5 g/ton
  - 5% Increase in Average Daily Gain over 4.5 g/ton
    - 2.5 lbs live weight @ \$0.51 = \$1.28/pig
- OR
- 5% Improvement in Feed Efficiency over 4.5 g/ton
  - 6 lbs of feed \* 20.6 days = 124 lbs of feed
    - @ 5% improvement = 6.2 lbs of additional feed saved/pig
    - @ \$0.12/lbs of feed = \$0.75/pig
- The largest differences between the two doses for ADG and FE were observed from day 14 to 24 of the study



### Proven Results with Paylean®

- Paylean fed 4.5 g/ton for 28 days prior to barn closeout<sup>1</sup> results in:
  - Improve ADG at least 10% over control<sup>2</sup>
  - Improve feed efficiency 10% over control<sup>2</sup>
  - Increase carcass weight (an average of 5 lbs.)<sup>3</sup>
  - 0.5% improvement in yield<sup>3</sup> and 0.4% improvement in lean<sup>3</sup>
  - Improve profits at least \$2/pig<sup>3</sup>

1 Assumptions based on North Carolina State University grow-finish performance guidelines.  
2 200 lbs of average gain per week during final 10 weeks of finisher period plus 17.5 lbs.  
3 Apple, J., Kahl, R., McKeown, F. et al. Meta-analysis of the response to paylean in finishing pork - A review. American Society of Food Quality and Control. 2010. 1-10.



### Proven Results with Paylean®

#### Paylean 4.5 g/ton Performance

- The Effects of Paylean® dose on growth performance traits in finishing pigs under commercial conditions<sup>1</sup>
  - 4.5 lbs Additional live weight over control
  - 12% Improvement in Feed Efficiency over control
  - 12% Increase in Average Daily Gain over control
  - No carcass data was reported
- The Effects of Paylean® Dose and Feeding Duration on the Performance and Carcass Characteristics of Late Finishing Market Hogs<sup>2</sup>
  - 4.5 lbs Additional live weight gain over control
  - 10.4% Improvement in Feed Efficiency over control
  - 11.3% Increase in Average Daily Gain over control
  - 5.4 lbs Hot carcass weight over control
  - 1% Increase in calculated lean percentage over control
  - 1% Increase percent yield over control

1 Elmore and TAY 200710 Data on File  
2 Elmore and TAY 200607 Data on File



## Proven Results with Paylean®

### Paylean 6.75 g/ton Performance

- The Effects of Paylean dose on growth performance traits in finishing pigs under commercial conditions<sup>1</sup>
  - 7 lbs Additional live weight gain over control
  - 16.2% Improved Feed Efficiency over control
  - 17.7% Increase in Average Daily Gain over control
  - No carcass data was reported
- The Effects of Paylean® Dose and Feeding Duration on the Performance and Carcass Characteristics of Late Finishing Market Hogs<sup>2</sup>
  - 7.8 lbs Additional live weight gain over control
  - 15.1% Improved Feed Efficiency over control
  - 19.6% Increase in Average Daily Gain over control
  - 8.38 lbs Hot carcass weight over control
  - 1.2 % Increase in percent yield over control.

<sup>1</sup> Elanco trial TV1700710 Data on File  
<sup>2</sup> Elanco trial TV1700607 Data on File



SB02459

## Proven Results with Paylean®

### Paylean 4.5 g/ton vs. Paylean 6.75 g/ton

- The Effects of Paylean dose on growth performance traits in finishing pigs under commercial conditions<sup>1</sup>
  - 2.5 lbs Additional live weight over 4.5 g/ton Paylean
  - 5% Improvement in Feed Efficiency over 4.5 g/ton Paylean
  - 5% Increase in Average Daily Gain over 4.5 g/ton Paylean
  - The largest differences between the two doses for ADG and FE were observed from day 14 to 24 of the study
- The Effects of Paylean® Dose and Feeding Duration on the Performance and Carcass Characteristics of Late Finishing Market Hogs<sup>2</sup>
  - 3 lbs additional live weight gain over 4.50 g/ton Paylean
  - 5% Improvement in Feed Efficiency over 4.50 g/ton Paylean
  - 7% Increase in Average Daily Gain over 4.50 g/ton Paylean
  - 3 lbs additional carcass weight over 4.50 g/ton Paylean

<sup>1</sup> Elanco trial TV1700710 Data on File  
<sup>2</sup> Elanco trial TV1700607 Data on File



SB02459

### Directions for Use

- Feed at 4.5 to 9 g/ton to finishing swine in a complete ration containing at least 16% crude protein, for the last 45 to 90 lbs. of gain (group average)
- Clinical registration studies showed no statistical difference between the effects of 4.5 and 9 g/ton
- No withdrawal required when fed according to label directions

**CAUTION:** Ractopamine may increase the number of injured and/or fatigued pigs during marketing. Not for use in breeding swine.

The label contains complete use information including cautions and warnings. Always read, understand, and follow the label and use directions.

Paylean® is a trademark for Elanco's brand of ractopamine.  
Elanco®, Paylean®, and the Elanco logo are trademarks of Elanco and Company.  
Ractopamine is a registered trademark of Elanco and Company.



SB02459