Present and Future Innovations to Improve Cow and Herd Management:

"Impact on Herd Size and Production System"

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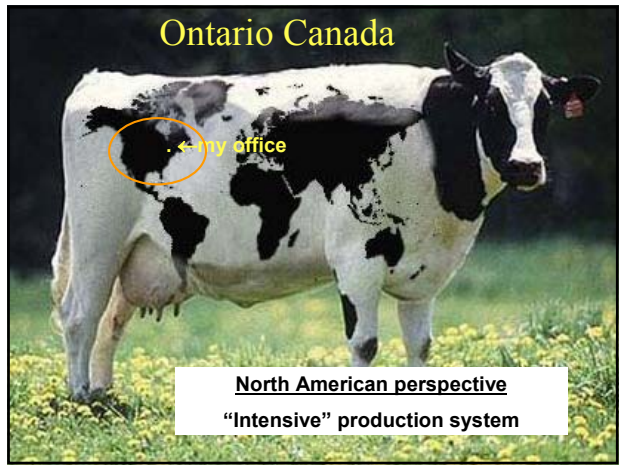


North American perspective

"Intensive" production system

North America- Intensive production systems:

Cows housed for all or part of the year

1974 Tie stall barns

2004 Freestall barns

North America- Intensive production systems:

Milked in the barn or a connected parlor

Some rotaries in large herds

1974-Tiestall milking

2004-Parlors, mostly herringbone and parallel

and a few robotic systems

North America-Intensive production systems:

Diets of 30-50% grain+ stored alfalfa and corn silage

1974- individually fed grain, hay and silage from tower silos

2004- Total Mixed Rations, silages stored in bunker silos

The Ontario Dairy Industry

	1974	2004	
Ave. milk/cow (Kg)	5200	8200	+60%
Ave. cows/herd	39	70	+80%
Ave. cows/man	18??	32	+80%
Ave. milk/man (Kg)	93,600	260,000	+180%
No. of cows	620,000	370,000	- 40%
No. of herds	15,700	5,300	-66%

Labour Efficiency

Herd Size	Hours/Cow/Day	No. Farms
all farms (ave.70 cows)	0.31	5300
< 100 cows	0.29 ± 0.11	29
100 - 200	0.22 ± 0.08	44
200 - 300	0.17 ± 0.06	14
> 300 cows	0.14 ± 0.02	5

ONTARIO FARM ACCOUNTING PROJECT 1999

	TIE STALL		FREE STALL	
	MEDIUM	LARGE	SMALL	LARGE
COWS	52	74	52	108
MILK/COW	7340	7442	7595	7804
COWS/WORKER	26.9	27.1	28.7	41.6
HRS./COW/DAY	0.24	0.25	0.24	0.18
HRS./HL MILK	1.18	1.23	1.16	0.85
$ INCOME/COW	1441	1416	1083	1300
$ INCOME/HR	16.64	15.47	12.30	19.60

Productivity Drives Feed Efficiency

Milk/cow (liters)	6000	10000
Feed/cow:		
forage@$120/t	4500 Kg	4000 Kg
grain@ $240/t	2000 Kg	3700 Kg
Feed Cost :		
per cow	$1020.	$1368
per liter	$ 0.17	$0.14

Feed is 30 - 40% of input costs

Cost of production in Intensive systems

	per Hl milk
Feed (Purchased $7.78 grown $10.71)	$18.49 (30-40%)
Vet., Breeding, Stable Supplies	4.23
Utilities	1.47
Other direct costs	1.80
Overhead (repairs, taxes, depreciation)	5.53
Labour @ average farm wage of $11.89/hr	$17.84 (36%)
@ average industrial wage of $ 19.63/hr	$29.44 (48%)

Types of Technology

1. Production Technology:
   - Increased production per cow, decreased input cost
   - The stuff of research (J. Dairy Science 2003- 47% nutrition, 29% physiology, health and repro, 20% genetics)
   - Herd size neutral..does not alter industry structure.

2. Mechanization:
   - Increased productivity of labour
   - Under valued, not studied much (4% of J.D.Science)
   - Traditionally leads to increase in herd size.

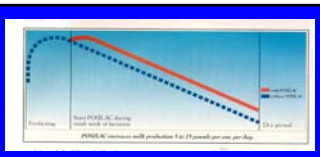
Production Technology

Recombinant Bovine Somatotropin (rBST)

The "Scientists Dream"

- Blood levels of BST are higher in high producing cows
- Extracted from the pituitary at slaughter, injected BST increases milk production
- Produce BST with recombinant DNA technology
- Prove treatment is safe and effective (10-15% more milk!!)
- Prove meat and milk from treated cows is safe for consumers

(rBST)



USA - FDA approved 1994, rapidly adopted and now used in more than 30% of cows

- Good cost benefit ($.40 drug + $.12 feed + $.03 labour = $.55…returns $.91 milk
- Discontinue treatment if cow is stressed
- Handling, sorting and needling labour is a challenge for some farms

(rBST)

The "Marketers Nightmare"

- acknowledged safe and effective but not approved in Europe for " socio-economic implications"
- not approved in New Zealand, Australia, Japan, Canada

Consumers, in the developed world will influence future dairy technology with priorities for : a perception of food safety

a perception of animal welfare

"socio-economic benefit??"

Recombinant Bovine Somatotropin (rBST)

Delivered by injection in a sorted and restrained animal

would an rBST pour-on delivered in a feeding station have been accepted???

Reproduction Technology

Programmed Breeding Schemes

interest is declining:

- sorting and needling labour is substantial
- 3 injections/insemination is a welfare issue
- use of hormones a perceived food safety issue

Reproduction Technology

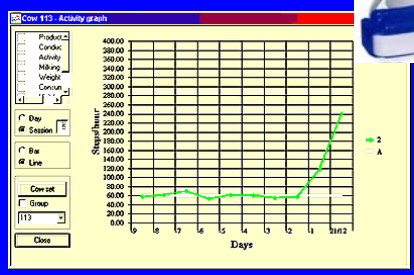
Ultra-sound for Pregnancy Diagnosis

- accurate @ 25 days, detects twins, luteal and follicular cysts, sex of fetus

- skilled labour is costly
- sorting and handling costs labour and milk

Reproduction Technology

Pedometers



Reproduction Technology

Pedometers

- detect over 80% of estrus with over 80% accuracy
- can help in early detection of lameness
- labour free
- non-intrusive, animal friendly, natural

In-line sensors for progesterone and pregnancy specific hormones

Sensor Based Management

- Electronic Identification is here now
- ID will improve, driven by demand for "conception to consumption" traceability
- Leg bands, neck tags, ear tags, implants can collect and store data as well as provide ID.
- Combined with low cost accurate sensors, and computing capability this marks the birth of

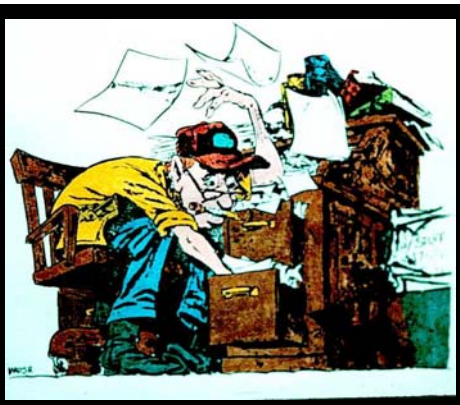
"PRECISION DAIRY PRODUCTION"

Precision Dairy Production

- Milk weights for genetics, and monitoring health and nutrition.
- In-line conductivity, colour for udder health.
- In-line SCC, milk components, nutritional indicators (urea nitrogen, ketones) repro indicators (progesterone, pregnancy hormones.)
- Motion sensors for heat, rumination, calving labour.
- Electronic scales for weight and body condition.
- Pressure plates for gait analysis and lameness.
- Visits from selection gates, plus intake from feeders

Precision Dairy Production

- will require complex management software
- decision making based on:
  1. Research
  2. Experience (data from this farm)
  3. Monitor and mimic herdsman
- systems will direct or apply outcomes directly



Data without automated decision making is not useful !

Precision Dairy Production

Pedometer signal of increased activity

⇓

Milk sensor data of decreased progesterone, no pregnancy hormones

⇓

Data check for days in milk, weight change and health parameters

⇓

Sort cow to breeding pen at next milking and alert herdsman

Can we mechanise artificial insemination??

Precision Dairy Production

30% Decrease in milking visits ⇓

10% Decrease in feed intake ⇓

20% fewer steps, no change in gait ⇓

High unchanged SCC, slight increase in conductivity ⇓

Direct cow through the footbath to treat early stage of lameness?

Sort cow to treatment pen at next milking and alert herdsman of suspected mastitis?

Adjust diet composition to account for change in feed intake?

Nutrition Technology

Research- fine tune feed quality, rumen fermentation, post rumen nutrient supply

- fine tune animal nutrient requirements

A plus for complex diets fed from storage as a total mixed ration, but……not very compatible with group feeding

Mechanisation of Feeding

Bigger mixers filled from bigger bunkers, using bigger loaders all reduce labour

Mechanisation of Feeding

Total Mixed Rations

- permits complex formulation, with minimum labour
- prevents sorting/selection of individual feeds
- assures minimum fiber level for rumen health is met
- unpalatable ingredients are masked

Mechanisation of Feeding

-Group feeding means we cannot feed to individual requirements

- Solution is to Feed Many Groups:
  far off dry, close up dry, fresh, high cow, high heifer, low cow, low heifer.
- This adds feeding labour, milking labour, handling labour, and lots of complexity

Automated TMR Fed to Individual Cows

- **Automated "chore free" delivery**
- **Up to 12 feeds, blended into manger in 1 Kg allotments**
- **ID'd cow fed to requirements, data on intake and visits**

"Chore-free" TMR Feeding

- will initially be rejected in the USA because:
  - perceived as high maintenance
  - too costly, especially in large herds
  - managed by skilled labour

But - unskilled labour will become more costly

- feed savings and production benefits of precision feeding will increase with increased use of sensor technology and automated management software.

Traditional Calf Feeding

Mechanization and herd size reduce labour

"Chore-free" Calf Feeding

Reduces labour 40 -75%, but group housing has health issues

"Chore-free Milking"

40% of dairy farm labour is milking

Survey of 100 large Ontario dairy farms

	cows/ man hr.	milk(l)/ man hr.	Set up and cleanup min./milking	minutes /cow@3x 100 cows	300 cows
7 tiestall herds	23	360	45	9.17	8.28
15 2x6 parlors	46	694	58	5.65	4.48
26 2x8 parlors	56	782	58	4.65	3.78
14 2x10 parlor	65	891	65	4.72	3.43
7 2x12 parlors	81	1136	52	3.78	2.73

A study of 22 robotic milking herds reported 1.02 minutes of milking labour/cow/day

(Fisher, McKnight, Rodenburg 2003)

ASSUMPTIONS

- BUILDING COST $25 PER SQUARE FOOT
- EQUIPMENT AT TYPICAL ONTARIO QUOTE
- 5 % INTEREST REPAID OVER 15 YEARS ($95 YEARLY/$1000 INVESTED)
- 2 X MILKING
- MAINTAINANCE, HYDRO, CHEMICALS ETC. EXCLUDED

RATE OF PAY PER HOUR

ALL PAID EMPLOYEES $11.89
[8.19-15.59]

MILKERS $12.52
[8.83-16.21]

RAPID EXIT PARALLELS			THROUGHPUT/MAN	
FARMS	UNITS	PEOPLE	COWS /HR	MILK /HR
2	2 X 6	1	43	487
15	2 X 8	1.1	57	781
6	2 X 10	1.3	63	961
7	2 X 12	1.2	81	1136
1	2 X 14	1.5	67	667

RAPID EXIT PARALLELS		SET UP	WASH
FARMS	UNITS	MIN	MIN
2	2 X 6	21	59
16	2 X 8	23	40
8	2 X 10	20	44
7	2 X 12	19	33
1	2 X 14	18	30

2 X 12 PARALLEL, HOLDING AREA, FULL AUTOMATION, I.D. ETC.

SPACE = 43 X 80 = $ 86,000
EQUIPMENT = $280,000
THROUGHPUT = 90 COWS/HOUR (survey said 81)
SET UP + CLEAN UP = 56 MINUTES (survey said 52)

	60 COWS	120 COWS	240 COWS	480 COWS
HRS./DAY	3.13	4.47	7.13	12.47
COST/YR $	49073	55197	67353	91755
COST/COW/YR	818	460	281	191

2 X 8 PARALLEL, HOLDING AREA, FULL AUTOMATION, I.D. ETC.

SPACE = 43 X 60 = $ 64,500
EQUIPMENT = $220,000
THROUGHPUT @ 63 COWS/HOUR(survey said 57)
SET UP + CLEAN UP = 48 MINUTES (survey said 63)

	60 COWS	120 COWS	240 COWS	480 COWS
HRS./DAY	3.50	5.41	9.22	16.84
COST/YR $	43043	51747	69161	103973
COST/COW/YR	717	431	288	217

SINGLE BOX ROBOTIC MILKING SYSTEM

SPACE 15 X 20/MILKING STALL =$7500, $15,000, $30,000, $60,000

EQUIPMENT $250,000 @60 $450,000 @120, $800,000 @240, $1,450,000@480 COWS

	60 COWS	120 COWS	240 COWS	480 COWS
HRS./DAY	1.0	2.0	4.0	8.0
COST/YR $	29032	53315	97129	180008
COST/COW/YR	484	442	405	375

LOW COST MILKING OPTIONS 2 X 10 SWING PARLOR IN OLD TIE BARN, USING EXISTING PIPELINE

SPACE (RENOVATION COST FOR 24 X 70 OLD BARN SPACE) $10,000

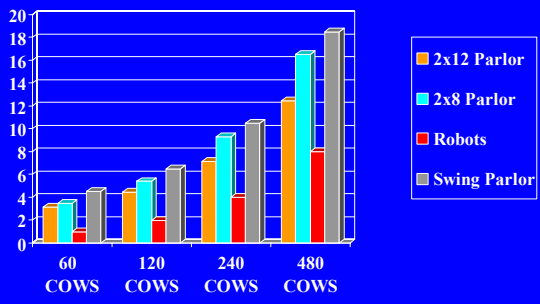
EQUIPMENT (USED) $50,000

THROUGHPUT @ 60 COWS/HOUR(survey said 58)

SET UP + CLEAN UP = 75 MINUTES (survey said 75)

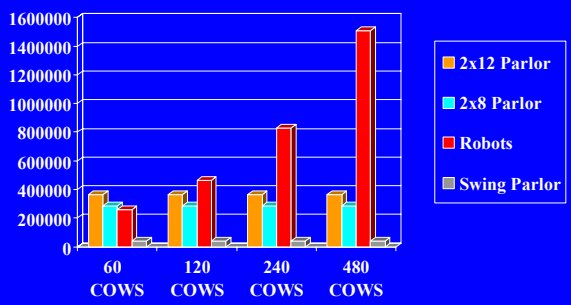
	60 COWS	120 COWS	240 COWS	480 COWS
HRS./DAY	4.5	6.5	10.5	18.5
COST/YR $	26264	35403	53683	90241
COST/COW/YR	438	295	224	188

Milking Labour (2X)



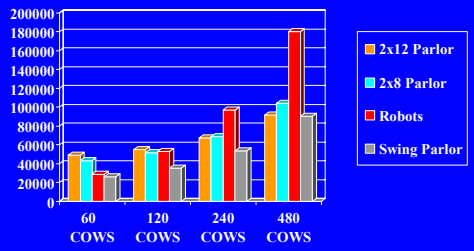
"Chore-free" technology always saves labour

Capital Investment in Space and Equipment ($)



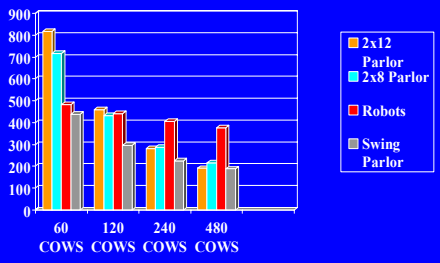
"Chore-free technology has a higher capital cost"

Total Annual Labor and Ownership Cost ($)



"Chore-free technology is much more economical on mid-size dairies than on very large farms

2x Milking Annual Labor and Ownership Cost per Cow($)



For Large Farms, robotic milking will be competitive when labour costs double or robotic milking system costs decrease to half.

What is the Future of the North American Dairy Herd??

Technology Shaping the Future Dairy Herd

Traditional mechanization is proven and familiar

Technology Shaping the Future Dairy Herd

-For at least the next decade, we are heading for Bigger herds!!

-Economies of Scale in parlor milking and group fed TMR means more 3000 to 10,000 cow dairies

-Urban pressures will mean relocation to the mid-west USA

-Large dairies will adopt the precision management tools they can

But!!……..

- In traditional dairy areas growth in herd size will be limited by urbanization.
- Well managed dairies in these areas will survive and will adopt chore-free technology
- For these herds, the ability to deal with cows as individuals means greater benefit from "precision dairying"
- In 20 to 30 years this advantage plus other benefits (less disease risk, environmental impact, transportation of feed and manure) may stop the trend to larger herds.

Regional Trends

1000 to 10,000 cow dairies in California, the southwest, midwest.

120 to 2000 cow dairies in more populated areas close to markets (northeast, eastern Canada)

What about Consumer Influence??

If consumers can stop the regulatory approval of rBST, they can also stop large "factory farms".

- www.themeatrix.com

USA - Guidelines for Concentrated Animal Feeding Operations (CAFOs > 600 cows)

Housing Design for Cow Comfort based on time lapse video observation

Bigger open stalls with lunging space and sand or mattress base

Rubber floors

Fans and sprinklers for summer cooling

The Ontario Dairy Industry: a thirty year projection based on current trends

	2004	2034
Ave. milk/cow (Kg)	8,200	13,120
Ave. cows/herd	70	126
Ave. cows/man	32	58
Ave. milk/man(Kg)	260,000	470,000
No. of cows	370,000	220,000
No. of herds	5,300	1,800

If the average is about 20 years behind the leaders there is much opportunity to learn from experience !!