Combining Automatic Milking and Precision Grazing

B. O'Brien, A. Van Den Pol-Van Dasselaar, F. Oudshoorn, E. Sporndly, V. Brocard and I. Dufrasne

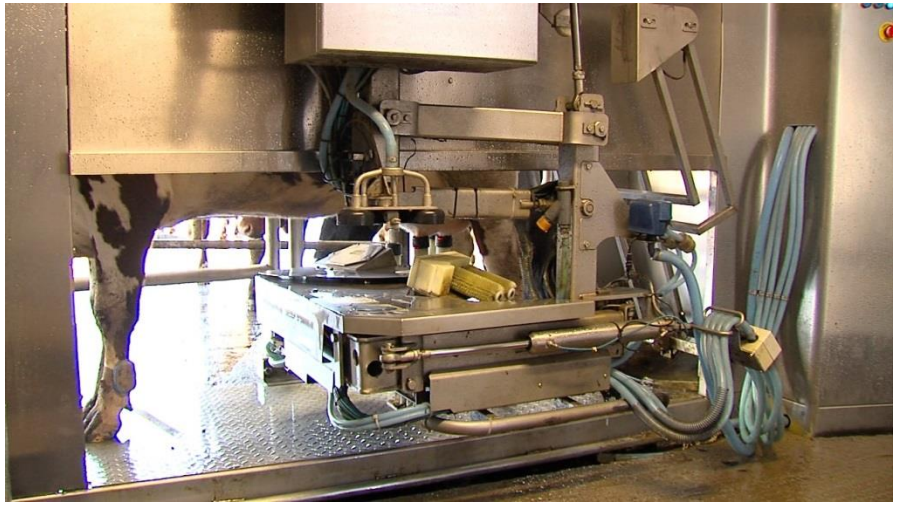
Teagasc, Ireland; Wageningen UR Livestock Research, The Netherlands; Danish Agricultural and Food Council, Denmark; Swedish University of Agricultural Sciences, Sweden; Institut de l'Elevage, France; University of Liege, Belgium

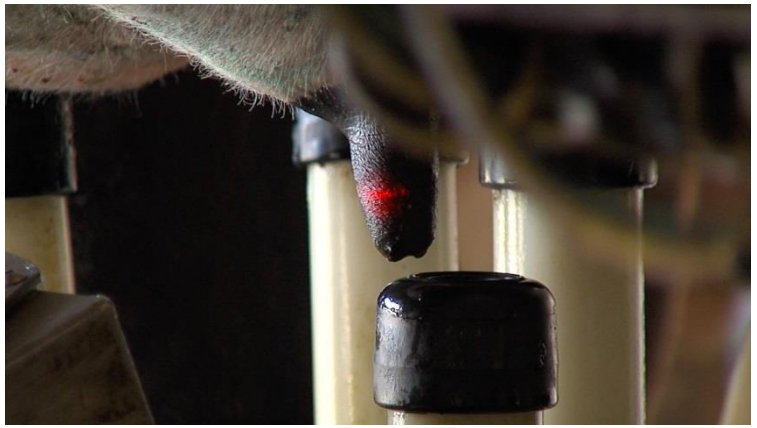
Outline of presentation

- Progression in automatic milking
- AUTOGRASSMILK project
- A snapshot of results mid way though the project
- Focus on the Irish perspective
- Results from 2 recent trials
- Current research
- Grazing management
- Economic aspect
- Concluding remarks

What is an automatic milking system ?

- The AM system can perform the tasks of:
- cow identification,
- supplementary feeding,
- teat washing,
- teat location,
- milking cup attachment,
- milking and
- cup removal
- – all without human intervention

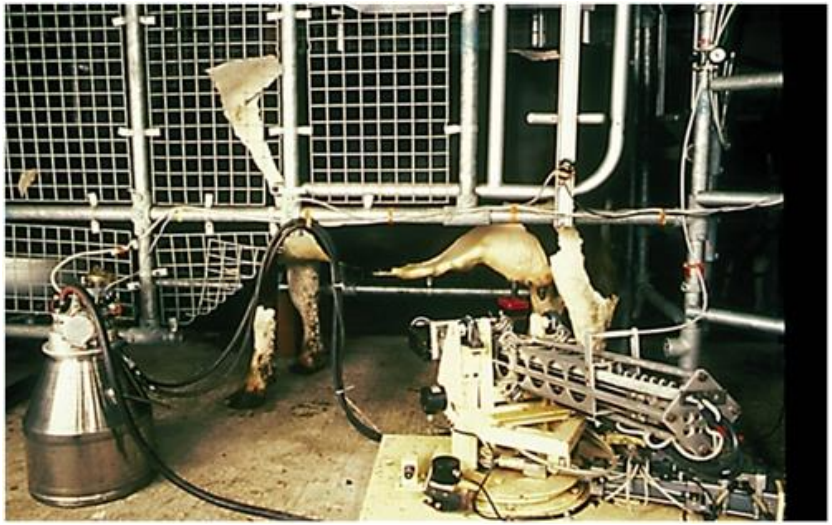




1st AMS Units

1985 First milking cup attached to a cow using a robotic arm in exp. setting

1992 First commercial AMS installed on a farm in The Netherlands



One of the first successful attempts in attaching a teat cup to an udder with robotic arm, Silsoe Research, UK. (Picture: EJ Hillerton) Source: www.dairynz.co.nz

Lely Press Release 15th Aug 2012:
more than 15,000 Lely Astronaut Robots sold

DeLaval Press Release 10th Sept 2013:
10,000 Voluntary Milking Systems sold

Current estimate 2015:
Up to 30,000

Further development in early 2000s
Integrating automatic milking systems with grazing

Australia:
http://www.dairynz.co.nz/page/pageid/2145870032/Latest_Research_and_Development

New Zealand:
http://www.dairynz.co.nz/page/pageid/2145869624/Automated_Milking_Systems_AMS_

USA:
http://pasturedairy.kbs.msu.edu/robotic_milking/

Research integrating automatic milking with grazing *using different systems*

Mobile AMS at University of Liege, Belgium

Mobile AMS at Institut de l'Elevage, Trévarez, France

Rotary automatic system Swedish University of Agricultural Sciences, Sweden

Situation:
Automatic milking (AM) and grazing in EU & Ireland

- AM is increasing in most EU countries
- But here - AM usage is ssociated with a decrease in grazing
- There is also increasing interest in AM in Ireland
- But in Ireland the majority of milk production is from spring calving herds on a seasonal grass based system
- Challenges:
  - (i) increase pasture grazing in conjunction with AM in EU countries with traditional indoor systems
  - (ii) if AM to be introduced in Ireland - have to be integrated with an intensive grazing based system so that the established economic benefits of grazing will be maintained

Grazing management in context

- A strong relationship between costs of production and proportion of grass in the cow's diet
- French et al. (2015) profit per hectare is increased by €267 for each additional tonne of grass utilized within dairy systems
- Dutch study: zero grazing farms earned ~€0.5 to 2.0 /100 kg milk less than farms using full or time limited grazing (Van den Pol-van Dasselaar *et al*., 2008)
- Competitive advantage of grazed grass expected to increase :
  - anticipated higher concentrate prices
  - conserved feed costs expected to continue to increase - contractor charges also –inflation in labour costs, energy and machinery costs.
- **BUT the higher the proportion of grass in the cows diet – the more important is accurate measurement of pasture – it is critical for effective grazing management**

AUTOGRASSMILK

Representatives from 6 countries developed a proposal for FP7 funding
14 partners – 6 research performers, 6 SME- associations and 2 end-user farmers

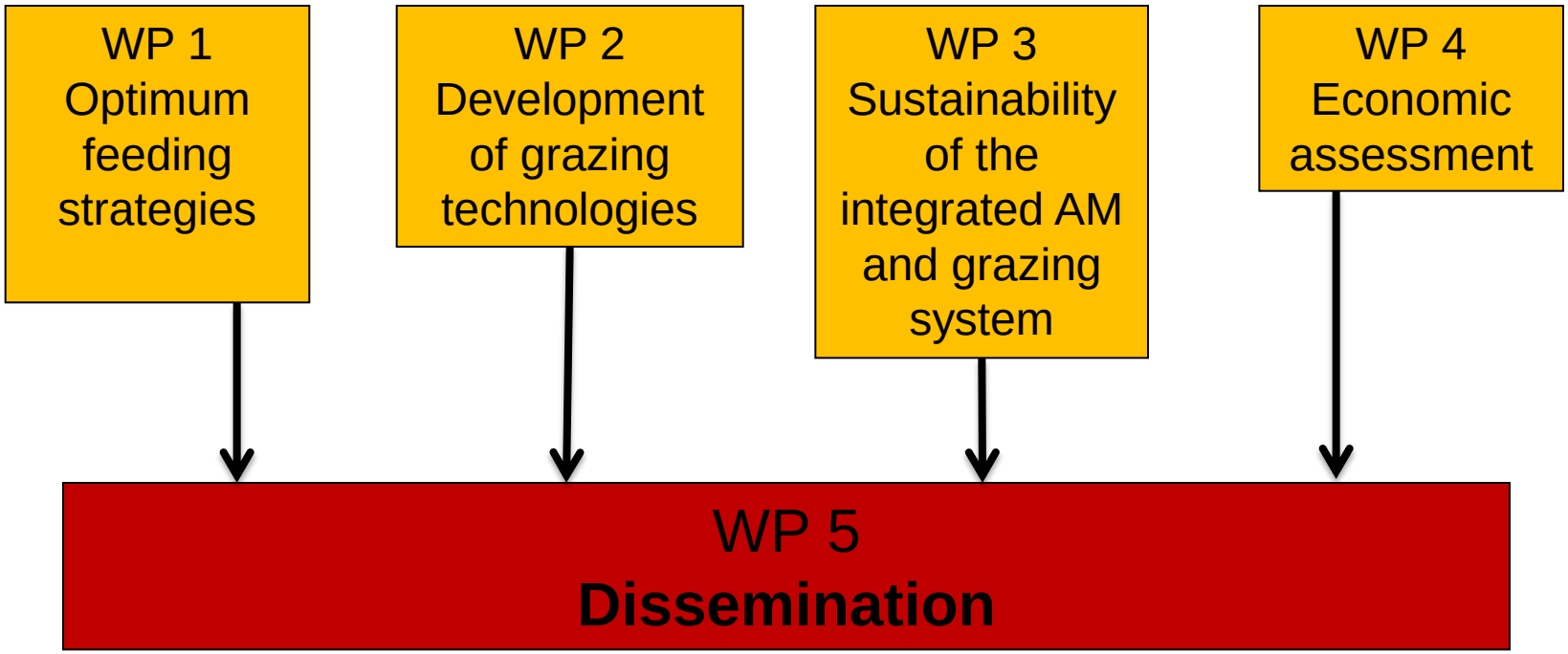
RTD	SME-AG	Country
Teagasc	IGA	Ireland
IDELE	CNIEL	France
WLR	LTO	The Netherlands
SLU	SDA	Sweden
Ulg	CDL	Belgium
AU	VFL	Denmark
SME Farm IE - Ireland		
SME Farm - Denmark		

Aidan & Ann Power
Robotitc Farm
SME Farm IE

SME Farm DK
Thure and Susanne Worm

FP7-SME-2012-314879-AUTOGRASSMILK is co-funded by the European Commission

Graphical presentation of the project



Planned deliverables of project

- Protocols for optimum feeding strategy for dairy cows incorporating grazing with AM technology for the various countries as influenced by grass supply and quality, farm infrastructure and cow type
- Pasture management tools that will facilitate AM dairy farmers to implement excellent grazing management practices
- A sustainability assessment tool for farmers to evaluate their own AM /cow grazing system
- Web based decision support tool that will facilitate dairy farmers to optimise economic efficiency when combining grazing with AM technology
- Guidelines for optimized operation of both mobile and carousel AM units in grazing scenarios

Summary of findings at mid term review

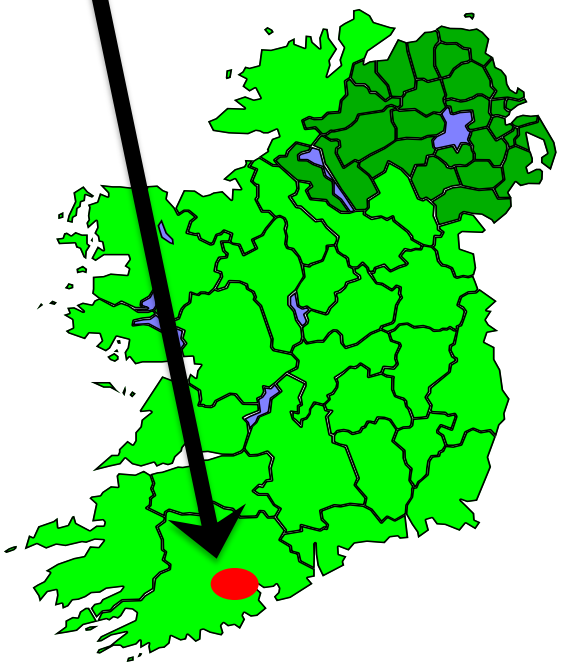
- In Ireland (2013) a 70 cow herd was milked in an AM system with grass contributing 85% of cow diet. The average milk yield was 4,222L and milk solids yield was 369kg

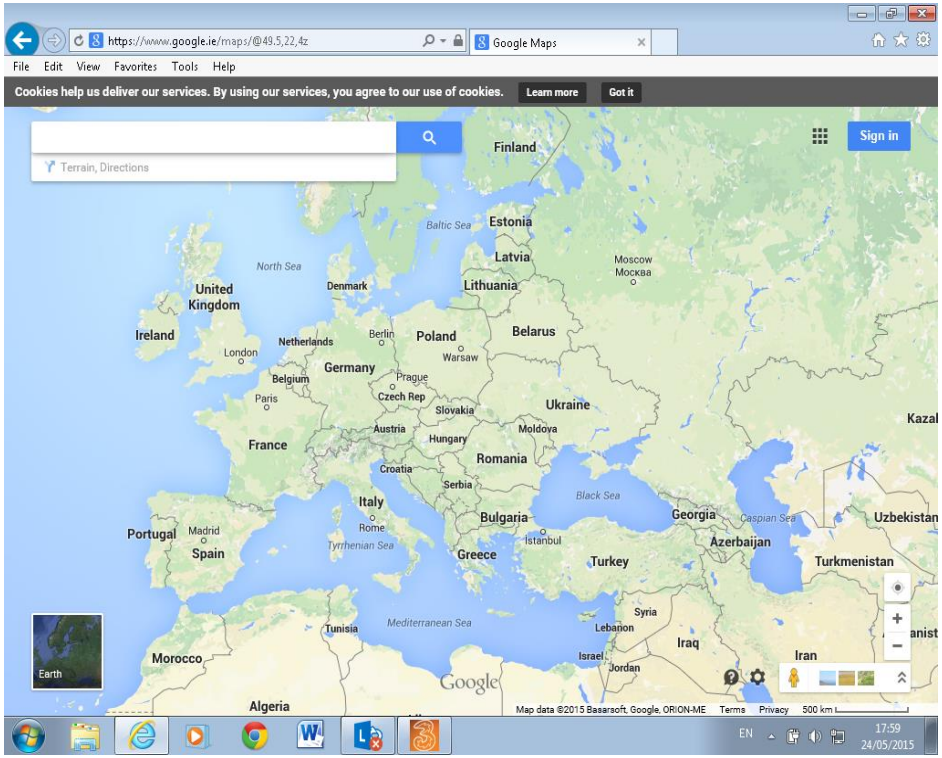
- Swedish study (2013) found no difference in milk production of high yielding cows on diets of 8% and 27% grazed grass

- French study showed grazing can be combined with AM and, although milk yield was reduced, feed cost was lowered substantially (by 66% per1,000 L milk)

- Belgian study demonstrated that supplementation with concentrates during pasture shortage increased milk yield, but the economic cost has to be examined

Moorepark





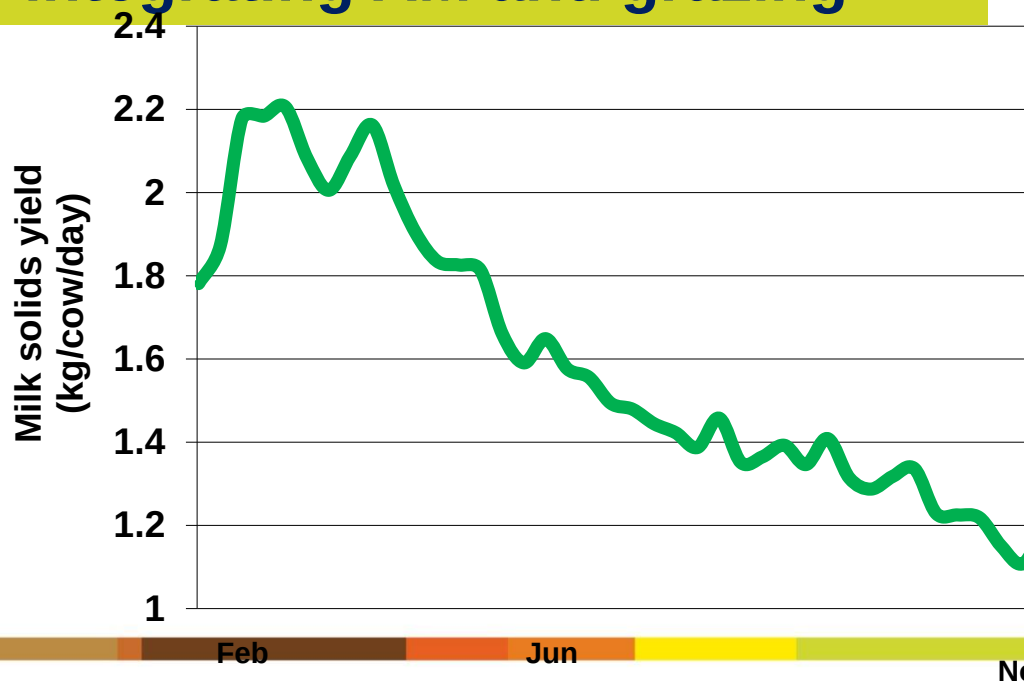
- **Climate: mild, temperate; Rainfall: ~1500mm**
- **Excellent grass growth; 10 tonne DM/ha/year**
- **Growth season–280d; Dairying profitable enterprise**
- **18,000 farms; 1.2m cows; 90% dairy products export**

Research perspectives in relation to grazing

- in most EU countries – include some grazed grass in cow diet if possible on automatic milking farms
- in Irish scenario - integrate automatic milking into a grass based system of milk production

Practical challenges of integrating AM and grazing

- **Seasonal limitation - peak milk yields**
- **Correct grass allocation critical for optimal cow visits to the AM unit**
- **Time spent waiting to be milked**
- **Achieving high utilization of the AM unit to minimize capital costs**



ABC grazing system to aid movement of cows to the milking unit

Section A

00:00 to 08:00

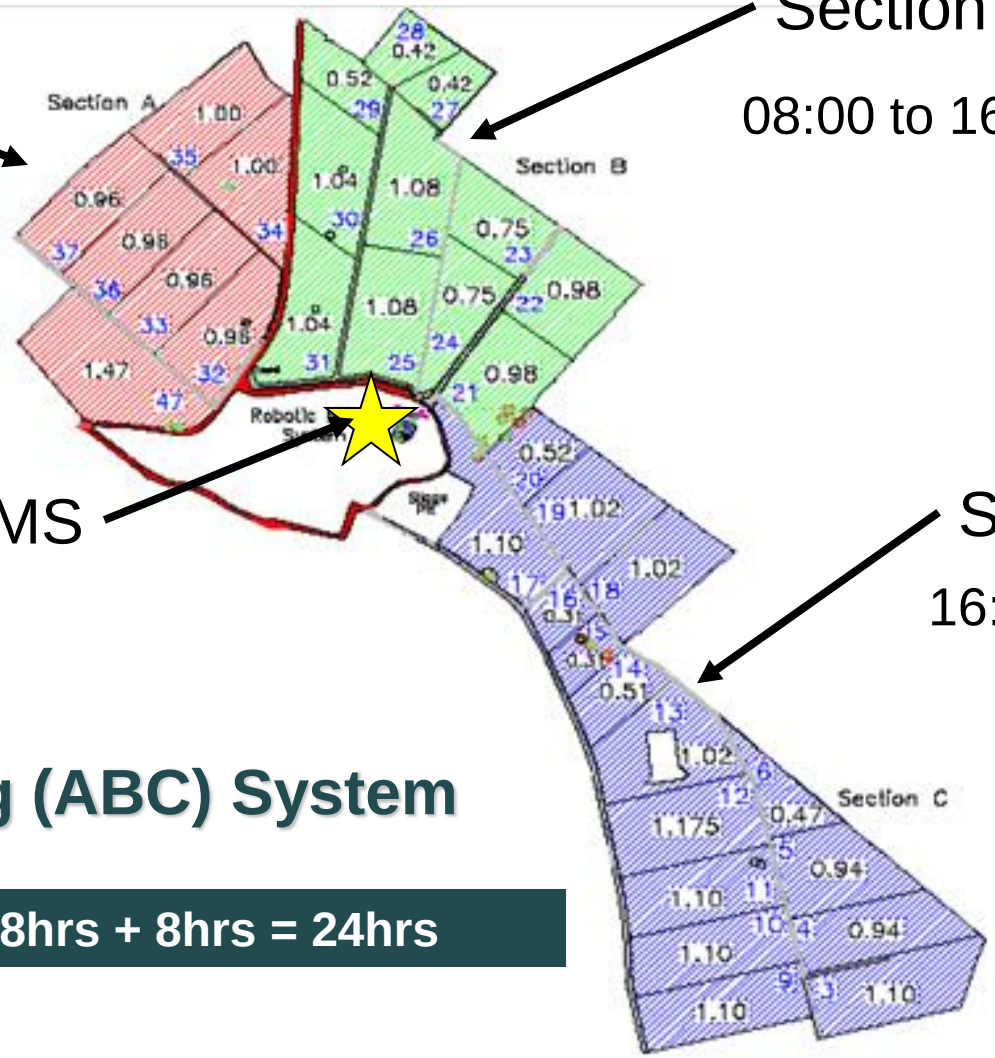
Section B

08:00 to 16:00

AMS

Section C

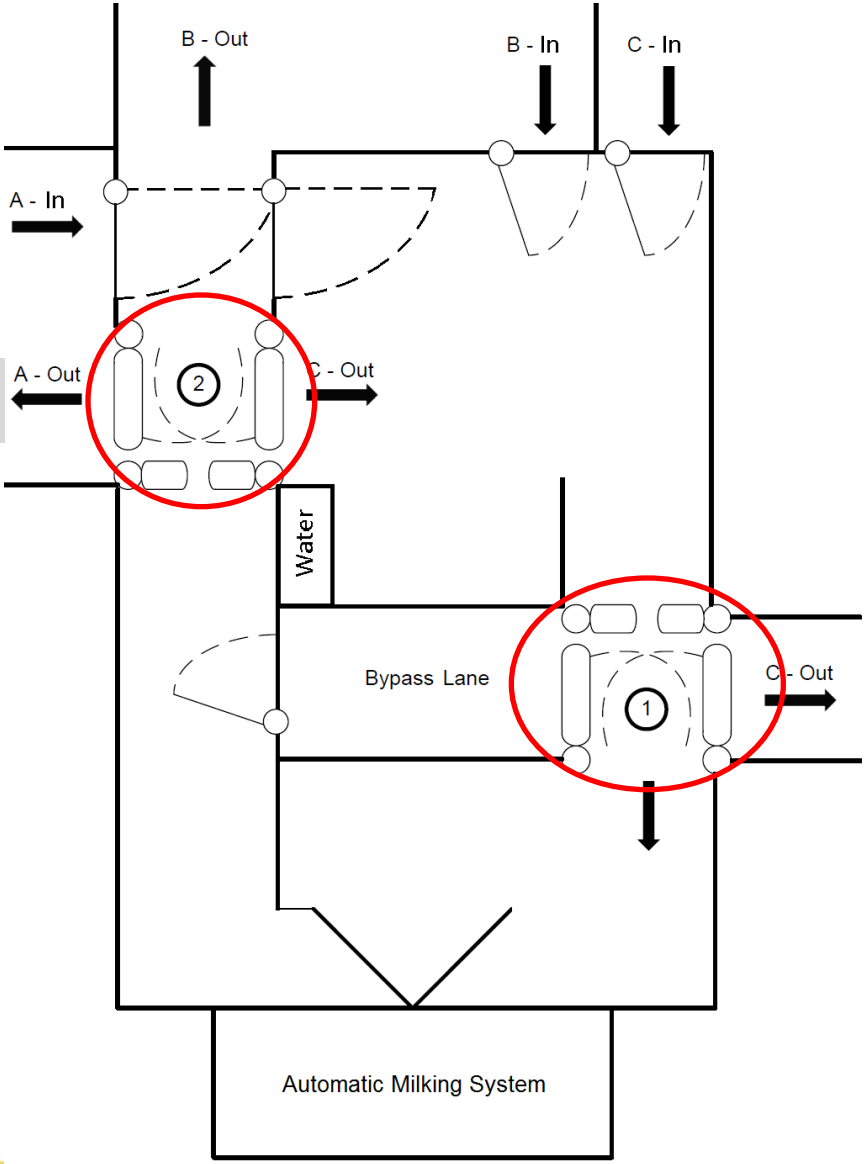
16:00 to 00:00



3-Way Grazing (ABC) System

A + B+ C = 8hrs + 8hrs + 8hrs = 24hrs

Yard Layout



Post Selection Gate

- Separate entry points for A, B and C blocks
- Cows recognised at two selection gates (1 and 2).

- At pre-selection gate 1: Cows due for milking go to robot
- Cows destined for C go out to C

Pre Selection Gate

- Cows destined for A or B go through bypass to selection gate 2

Specifically in Ireland

Milking frequency (MF) is likely to be less than in indoor systems and quality and quantity of grass deteriorates in autumn (late lactation)

Report on 2 specific studies

- Examine effect of reduced MF on milk production and cow traffic in mid lactation

- Examine effect of different MF and concentrate supplementation levels on milk production and cow traffic in late lactation

Milking frequency trial in mid lactation (May to Aug 2014)

Materials and methods:

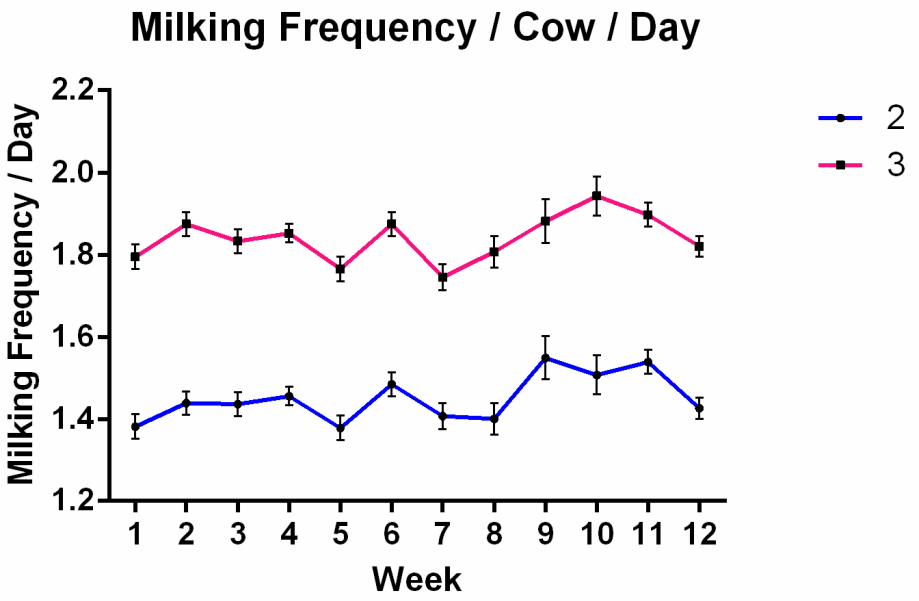
- 12/05/2014 to 03/08/2014 (Trial period = 12 weeks)
- 64 cows in two groups, each group balanced for: breed, lactation, days in milk, previous 20 days milk production and milking frequency
- Treatment: Milking Permission 2 & 3 times /d (adjustment period =10d)
- Measurements:
  - Milk Characteristics: Milk Yield
  - Cow Traffic: Milking Frequency, Wait Time, Box Time

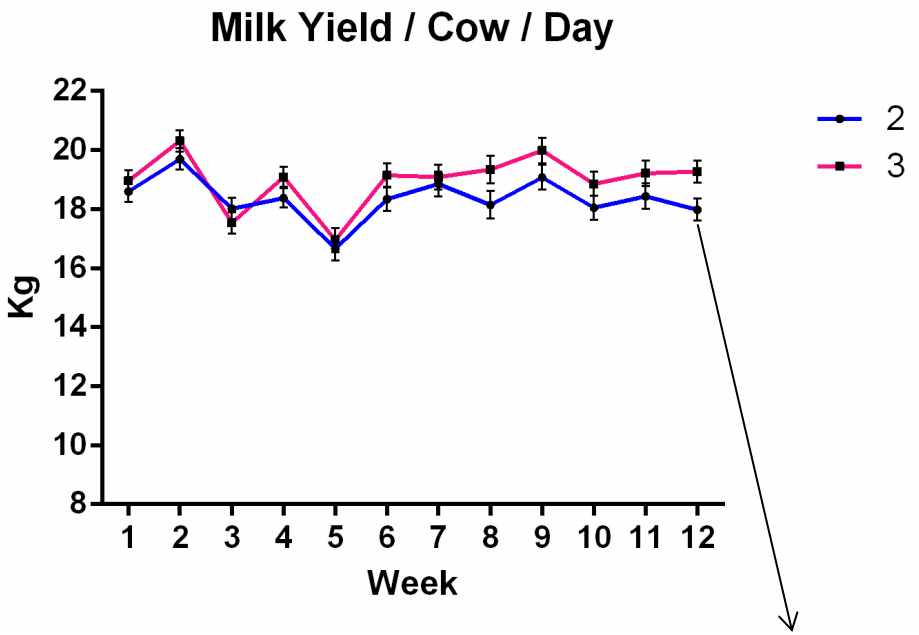
Results

	MP 2	MP 3	Difference	*p* value	
Milking Frequency/day	1.5	1.8	0.3	<.0001	Different
Milking Interval/visit (h)	15.1	12.6	2.5	<.0001	Different
Milk Yield/visit (kg)	12.7	10.4	2.3	<.0001	Different
Milk Yield/day (kg/cow)	18.4	19.0	0.6	NS	Not Different
Milk Duration/day (min)	10.7	12.3	1.6	<.0001	Different
Wait Time/day (h)	1.8	2.5	0.7	0.0007	Different

Effect of milking frequency

- Concentrate consumed at AMS kg/cow/day = 0.7
- Total grass DM kg/cow/day = 17.3





Not Different

Conclusions

Cows milking 1.8 and 1.5 times per day produced 19.0 and 18.4 kg of milk/cow/day, respectively

Not significantly different

Potential to reduce milking frequency without adverse production effects

Reduced MF reduced waiting time – potentially good – less time standing on concrete

Reduced MF reduced milking duration /day and increased AMS free time and therefore would permit more cows to be milked throughout the day – potential for larger herd size

Milking frequency and supplementation trial in late lactation (Aug to Nov 2014)

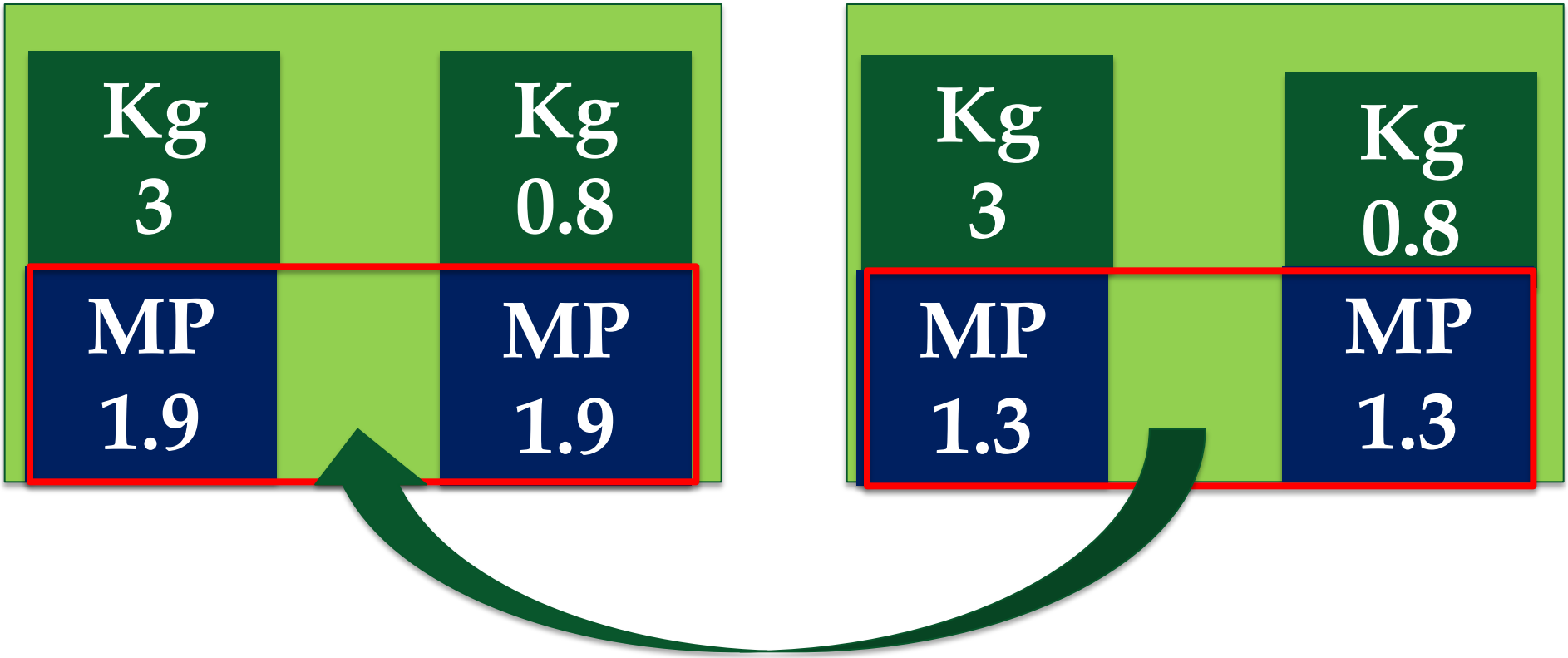
Materials and methods:

- 18/08/2014 to 02/11/2014 (11 weeks)
- 64 cows in four groups, each group was balanced for: breed, lactation, days in milk, previous 14 days milk production and milking frequency
- Treatment: Milking Permission 2 & 3 times/d (adjustment period =14d) and supplementation at 0.8 and 3.0 kg
- Measurements: Milk Characteristics: Milk Yield, composition, SCC, TBC;

  Cow Traffic: Milking Frequency, Wait Time, Box Time;

  Grass measurements: grass cover, allocation, height

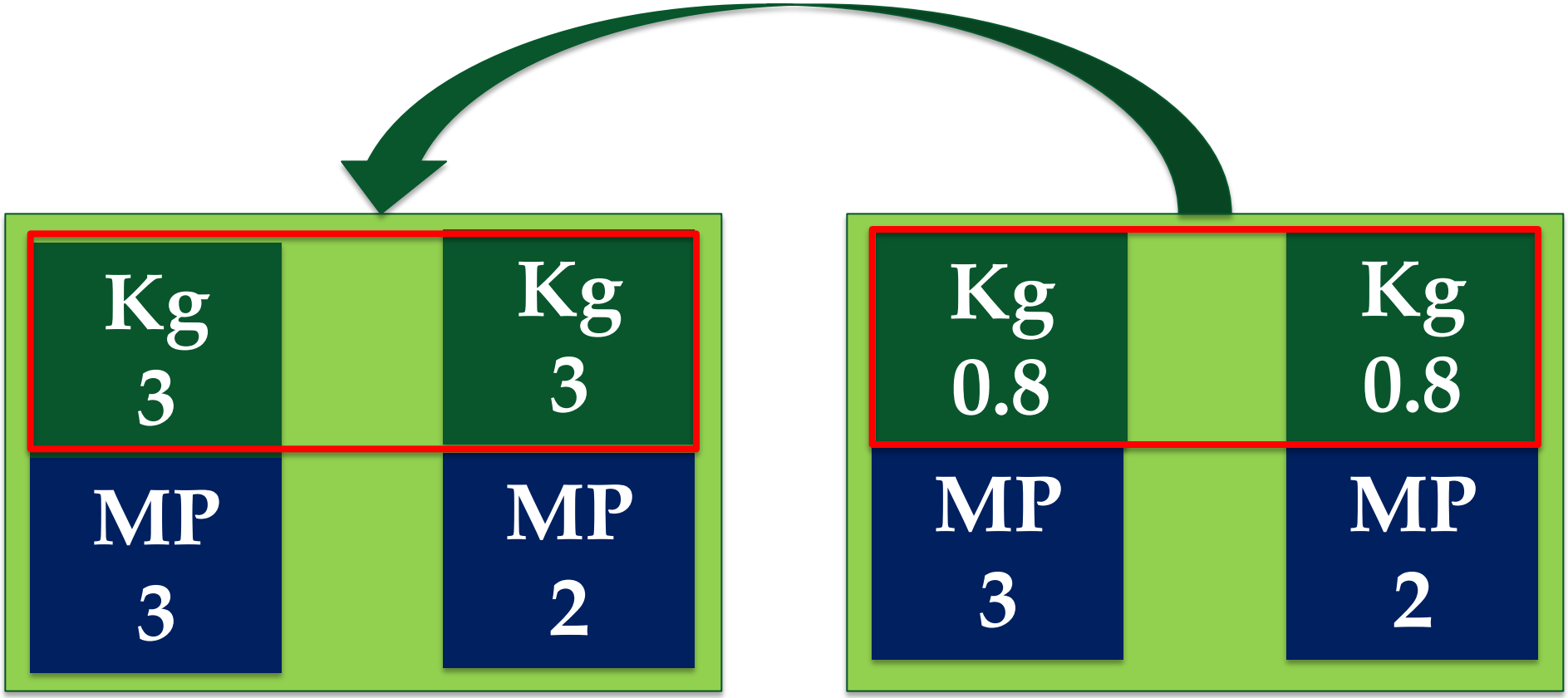
Analysis – Milking frequency



Results – Milking permission

	Milking Permission/Day			
	3	**2**	***p* value**	
Milking Frequency/day	1.9	1.3	<.0001	Different
Milk Yield/day (kg/cow)	15.7	15.0	0.002	Different
Milk Yield/visit (kg/cow)	8.1	11.1	<.0001	Different
Milking Interval/visit (h)	11.6	16.6	<.0001	Different
Milk Duration/day (min)	10.5	8.6	<.0001	Different
Wait Time/day (h)	2.1	1.6	0.003	Different

Analysis - Concentrate



Results - concentrate

	Concentrate/Day (kg)			
	3.0	**0.8**	***p* value**	
Milk Yield/day (kg/cow)	16.3	14.5	<.0001	Different
Milk Yield/visit (kg/cow)	10.0	9.3	0.008	Different
Milking Interval/visit (h)	13.6	14.6	0.012	Different
Milk Duration/day (min)	9.9	9.2	0.001	Different
Wait Time/day (h)	1.7	2.0	0.230	Not Different

Conclusions

- Reducing MF in late lactation
  - reduced milk yield
  - increased milking interval (>16h)
  - reduced milking duration and waiting time
- A milk yield response to concentrate supplementation was obtained

FP7-SME-2012-314879-AUTOGRASSMILK is co-funded by the European Commission

2015 - Optimum cow breed/type for an integrated grazing and AM milk production system

Study 1 – Spring Supplementation

- Treatment: high and low concentrate

Study 2 – Breed Comparison

- HOxFR v JExHO v NR

Study 3 – Autumn supplementation

- Treatment: high and low concentrate

- Grass is the main component of the diet
- Grassland management is vital

Only **300 - 400** kg/cow/ lactation

Need to:

- Grow large quantities of grass
- Utilise as grazed grass
- Long grazing season

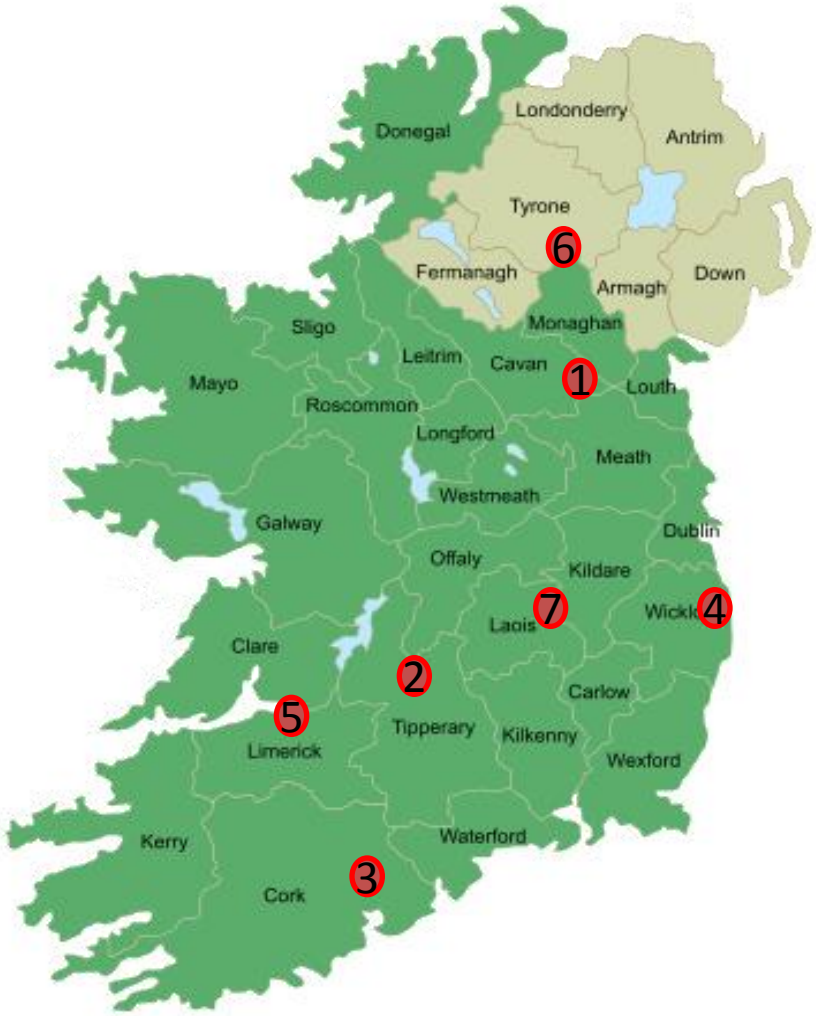
- Optimise milking frequency
  - Milk 80 cows per robot
  - Milking frequency 1.5 times/day

Challenge of grass and grazing management on farms where automatic milking is integrated with grazing

Grasshopper


Pre grazing
herbage mass
1300 - 1500
kg DM/ha
Post grazing
sward height
4.0 - 4.5cm

Monitor Farm Study



Conducting data collection on farms over 2 year period (2014, 2015)

Environmental data

- Electricity and water - total energy of milking process and cooling, water usage recorded

- Nutrient use and farm inputs – fertiliser used, silage made, manure management, contract use, farm fuel

Labour data collected monthly

Economic data Production data (milk yield, composition, SCC

Economics

- **Comparison of conventional and AMS systems**
  - Interaction between capital investment, labour requirement and running costs
  - Financial metrics: profitability and return on investment.
- **Optimizing the system**
  - Focus on output of the system rather than output per cow
  - Reducing MF and increasing cow number versus higher number of high yielding cows
- **Additional Scenarios**
  - External land block – Fragmentation
  - Alternative enterprise, beef or tillage
  - Working off-farm

Concluding: Where do we go from here

- Can reduce milking frequency without reduction in milk yield
- But limit
- Could have larger herd size
- Focus on maximizing output from system rather than cow
- Look at MS – best breed
- Focus on maximizing cow number by reducing milking frequency during peak – this is the limiting time – but could have carry over effect
- Focus on grazing management – AB versus ABC grazing
- Altering grass availability and gate time changes to maximize milkings
- AM is being discussed and considered increasingly in Ireland


http://autograssmilk.dk/