ELECTRICITY AND WATER CONSUMPTION ON IRISH COMMERCIAL DAIRY FARMS

P.Shine[1], T.Scully[2], M.D.Murphy[1], J.Upton[3], L.Shalloo[3]

[1] Department of Process, Energy and Transport Engineering, Cork Institute of Technology, Cork, Ireland

[2] Department of Computing, Cork Institute of Technology, Cork, Ireland

[3] Animal and Grassland Research and Innovation Centre, Teagasc Moorepark Fermoy, Co. Cork, Ireland

CIT Institiúid Teicneolaíochta Chorcaí Cork Institute of Technology

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teagasc Agriculture and Food Development Authority

Itinerary

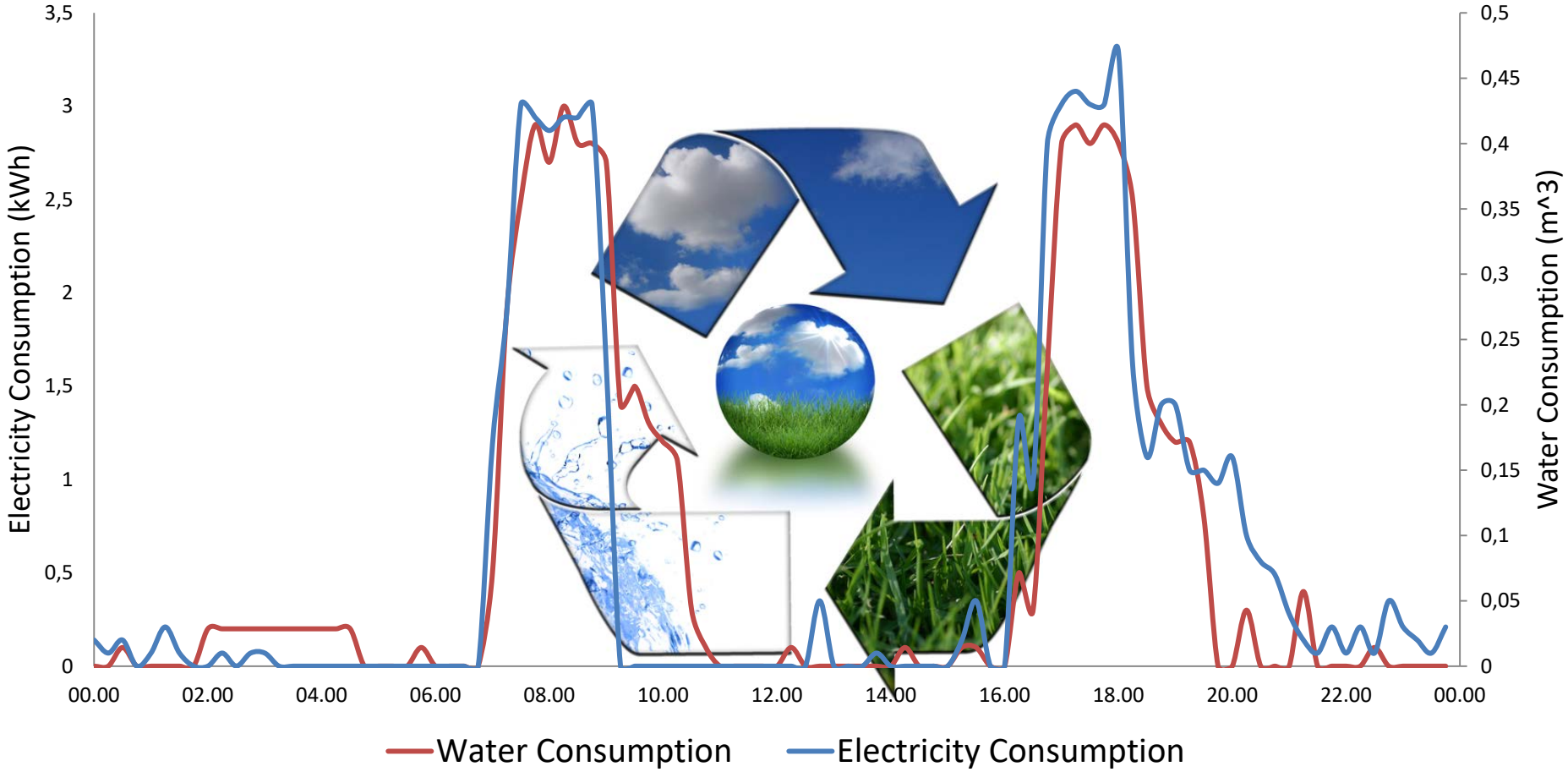
- Electricity & Water Introduction
- Data Acquisition
- Pre / Post Quota Comparison
- Milk Cooling Technology Comparison
- Linear Prediction Capabilities

Philip.Shine@mycit.ie

Typical Milking Process

Philip.Shine@mycit.ie

Electricity & Water - Why?



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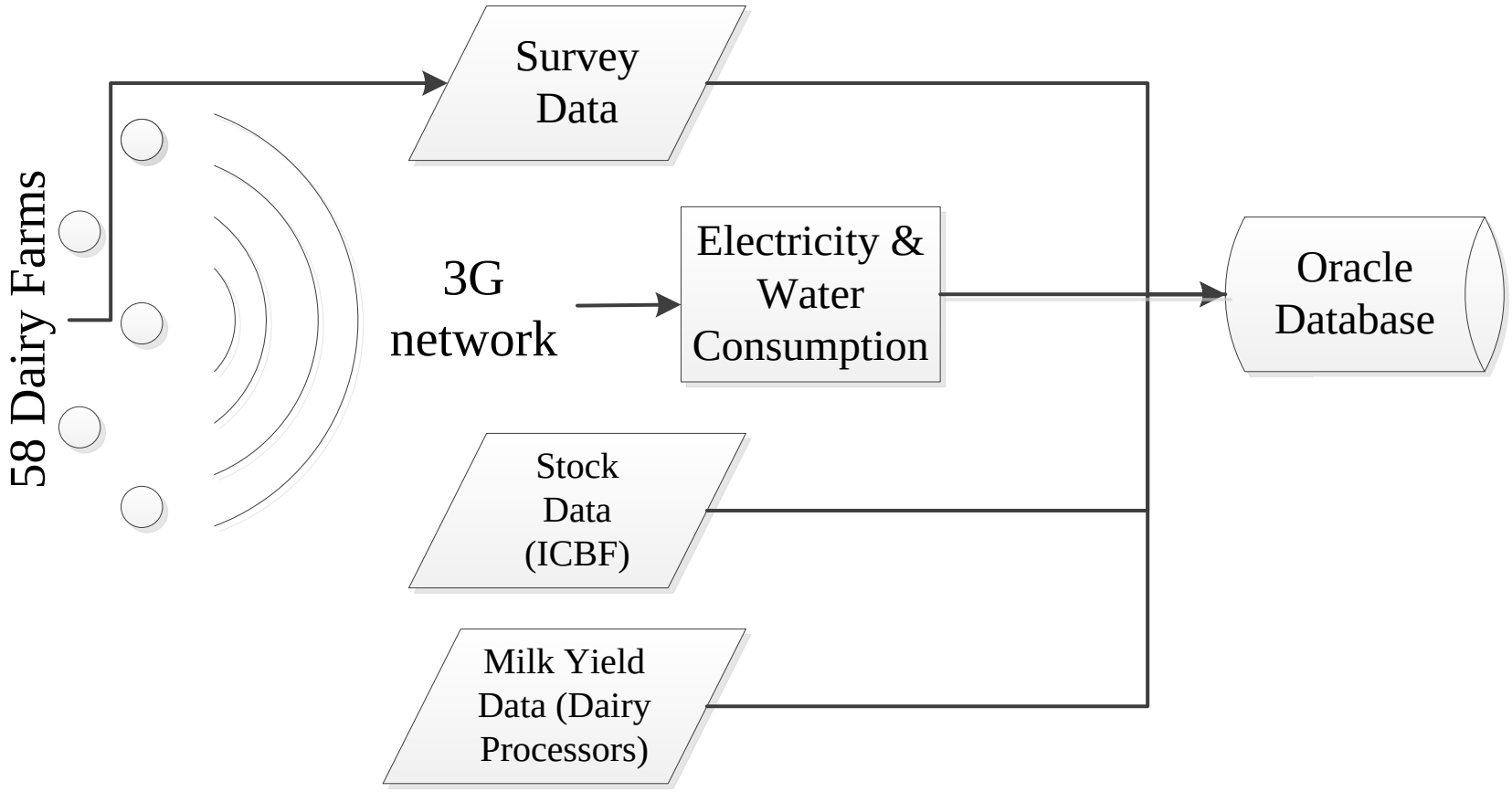
Data Acquisition



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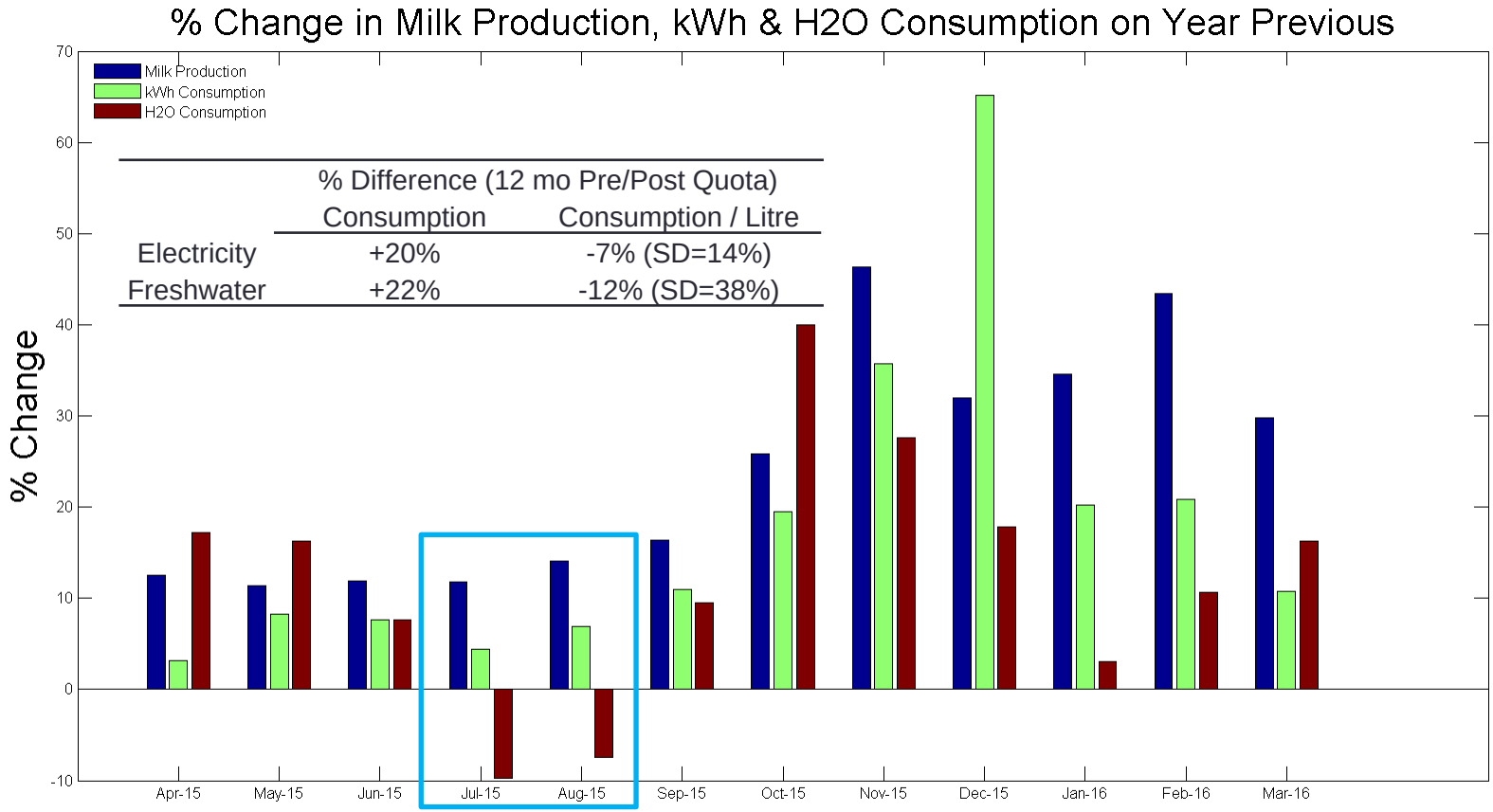
Post Quota Consumption Change



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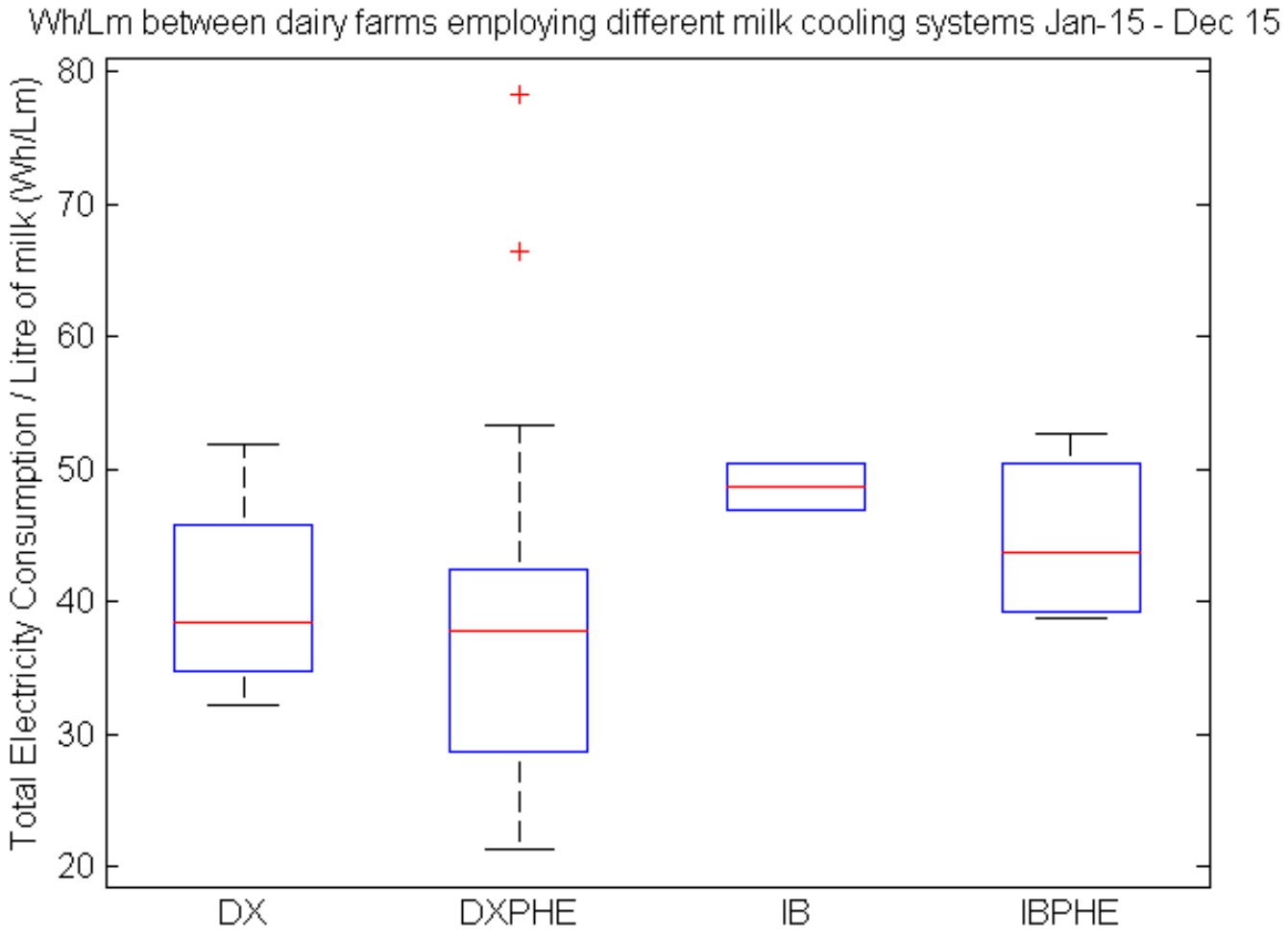
Effect of Cooling System on Electricity



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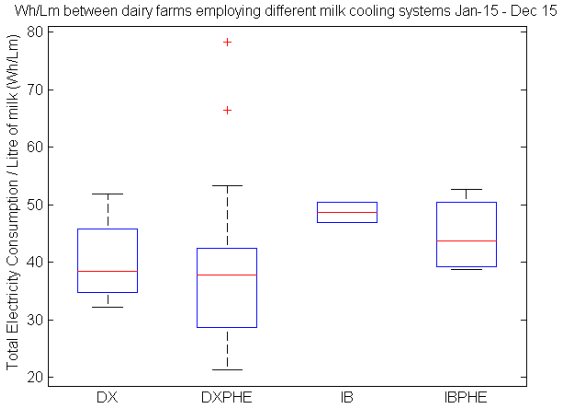
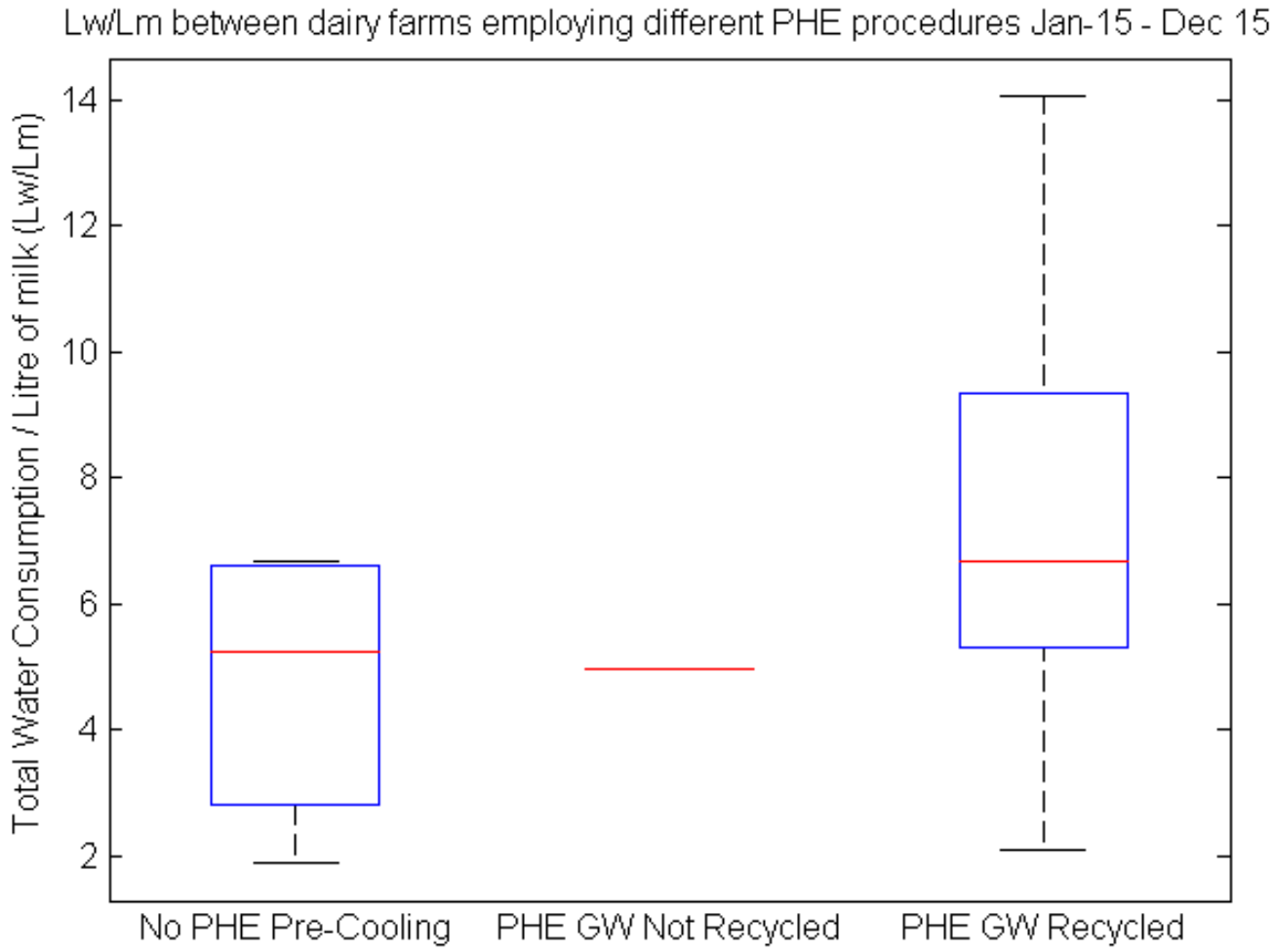


	Cooling System	Wh/Lm ^{2} n	Mean	SD	Median	% Difference
A	DX $^{C2^, D2^}$	137*	81.9	293.44	39.89	
B	DXPHE $^{C2^, D2^}$	888*	70.41	144.09	37.48	-6%
C	IB $^{D2^}$	60*	102.88	174.82	52.62	
D	IBPHE	135*	69.07	104.75	43.32	-18%

^Small Effect Size

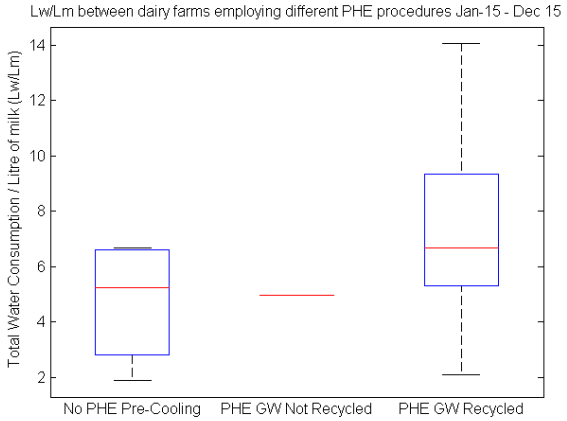
Philip.Shine@mycit.ie

Effect of Cooling System on Water



Philip.Shine@mycit.ie

Effect of Cooling System on Water



	PHE Water Procedure	Lw/Lm n	Mean	SD	Median	% Difference
A	GW PHE Not Recycled	21*	23.64	76.98	5.46	
B	GW PHE Not Utilized	172*	13.39	37.71	5.77	
C	GW PHE Recycled	761*	12.25	30.22	6.33	+8%

Philip.Shine@mycit.ie

Linear Prediction - Electricity

Variable	Estimate	SE	Tstat	p-Value
Intercept	258.82	133.81	1.93	0.05
Total Number of Milking Cows	5.86	0.75	7.85	$1.13x^{-14}$
Total Number of Dairy Cows	5.72	0.69	8.30	$3.69x^{-16}$
Milk Production (Litre)	0.01	0.00	9.41	$3.87x^{-20}$
Mean Maximum Temperature (˚C)	-35.19	5.66	-6.22	$7.37x^{-10}$
Cooling System - DXPHE	-113.70	56.47	-2.01	0.04
Cooling System – Ice Bank	333.44	96.41	3.46	0.00
Cooling System – Ice Bank with PHE	172.96	69.05	2.50	0.01
Air Compressor - No	-221.55	39.89	-5.55	$3.63x^{-08}$
Frequency of Hot Wash	11.21	1.67	6.69	$3.78x^{-11}$
Total Water Heater Power (kW)	206.45	23.07	8.95	$1.89x^{-18}$

Number of observations: 950, Error degrees of freedom: 939

Root Mean Squared Error: 498

Adjusted R-Squared 0.805

Linear Prediction - Water

Variable	Estimate	SE	Tstat	p-Value
Intercept	14.76	30.46	0.48	0.63
Total Number of Milking Cows	0.29	0.20	1.45	0.15
Milk Production (Litre)	$1.3x10^{-03}$	0.00	4.50	$7.64x^{-06}$
Mean Minimum Temperature (˚C)	2.00	1.50	1.33	0.18
Air Compressor - No	64.27	13.18	4.88	$1.27x^{-06}$
Frequency of Hot Wash	2.04	0.47	4.30	$1.85x^{-05}$
Number of Parlour Units	11.90	1.48	8.05	$2.46x^{-15}$
Cooling System PHE Water - Recycled	49.55	12.60	3.93	$9.03x^{-05}$
Winter Building Troughs - Not Leaking	-96.43	13.79	-6.99	$5.05x^{-12}$

Number of observations: 944, Error degrees of freedom: 935

Root Mean Squared Error: 142

Adjusted R-Squared 0.346

Conclusion & Future Work

- 40.14 Wh/kg FPCM & 6.54 Lw/kg FPCM
- 12 month post quota:
  - Consumption increased, efficiencies on average decreased (large variance)
- Milk pre-cooling system saves 13% Wh/Lm while increasing water consumption of 8%.
- Water consumption difficult to predict linearly
- Increase in water consumption may cause problems with limited borehole supplies in peak milk production months
- Cost optimum exist for milk pre-cooling

Philip.Shine@mycit.ie

Thank you, Questions?

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