GenTORE

Genomic management Tools to Optimise Resilience and Efficiency

Claudia Kamphuis, Yvette de Haas, Nic Friggens

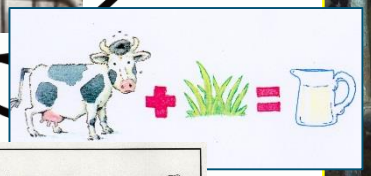
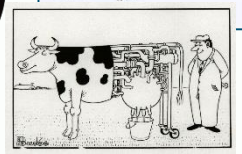
WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

INRA SCIENCE & IMPACT

GENTORE





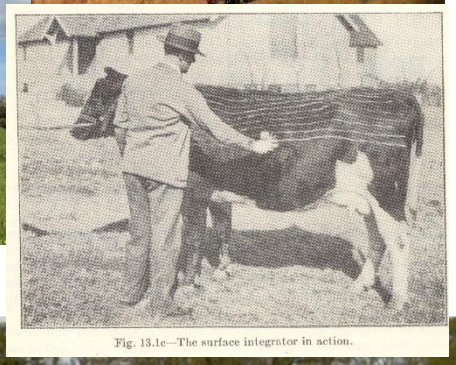
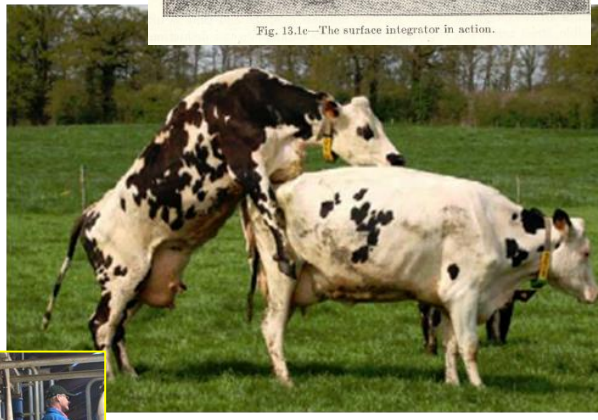


Fig. 13.1e—The surface integrator in action.







GenTORE – 1st June 2017 to 31st May 2022

Innovative tools to optimise Resilience and Efficiency

cow management for farmers
genetic selection for breeding companies

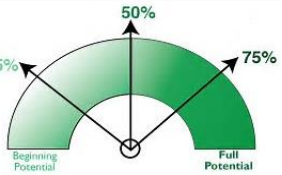
These tools are applicable across

production systems (beef, dairy, mixed)
varying and changing environments

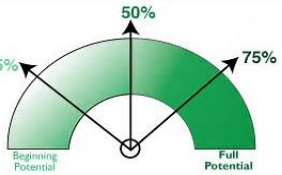
Increase economic, environmental, societal sustainability

of European beef and milk production systems

Resilience



Resilience



Anke

10,000 kg of fat and protein

Society of 3,000 girls in NL

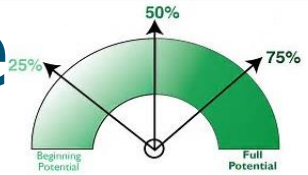
15 years, 12 calves

No veterinarian ever

No recall by farmer for Anke being ill ever

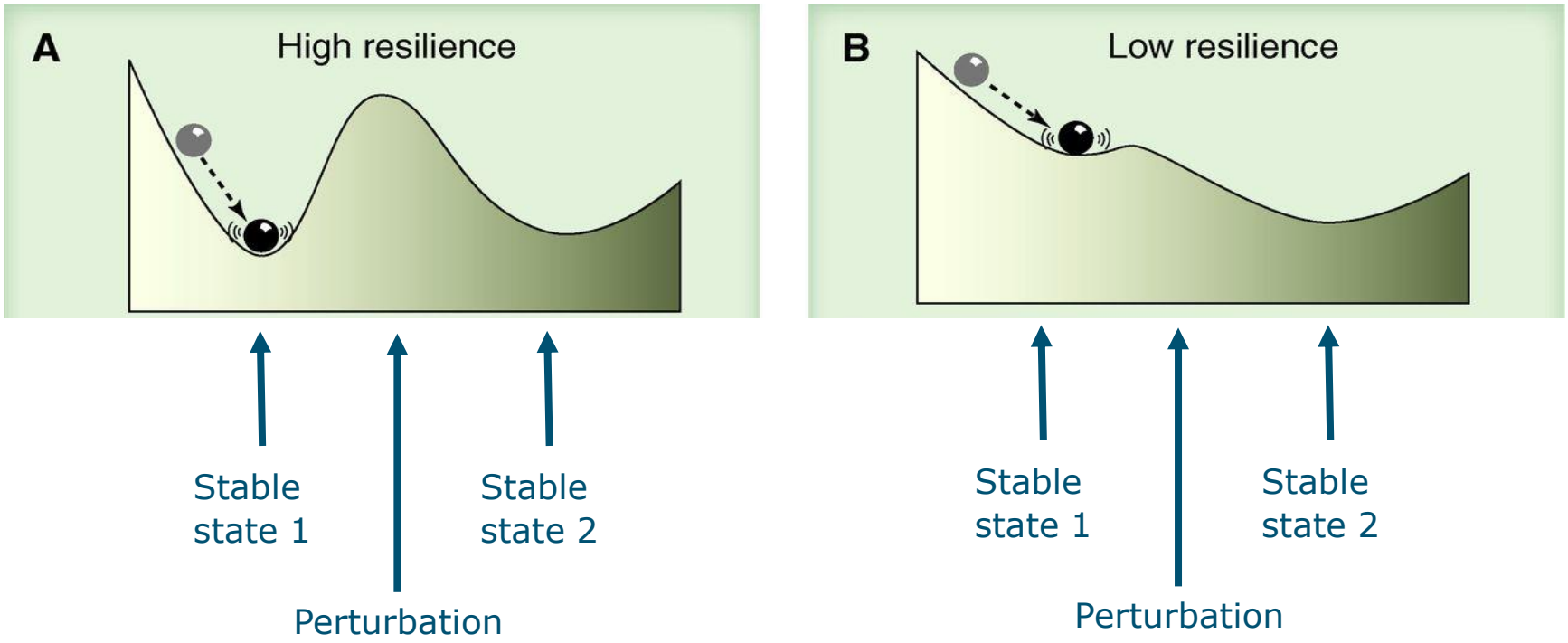
A **resilient** cow

Resilience

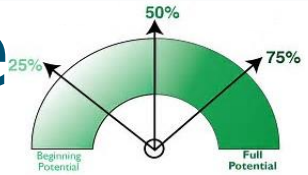


Resilience through the theory of critical transitions

Scheffer et al., 2012



Resilience



The capacity to respond and overcome environmental perturbations and thus safeguard future ability to contribute genes to the next generation

GENTORE

This includes:

survival (no culling) until next reproduction moment

ability to successfully reproduce

Efficiency

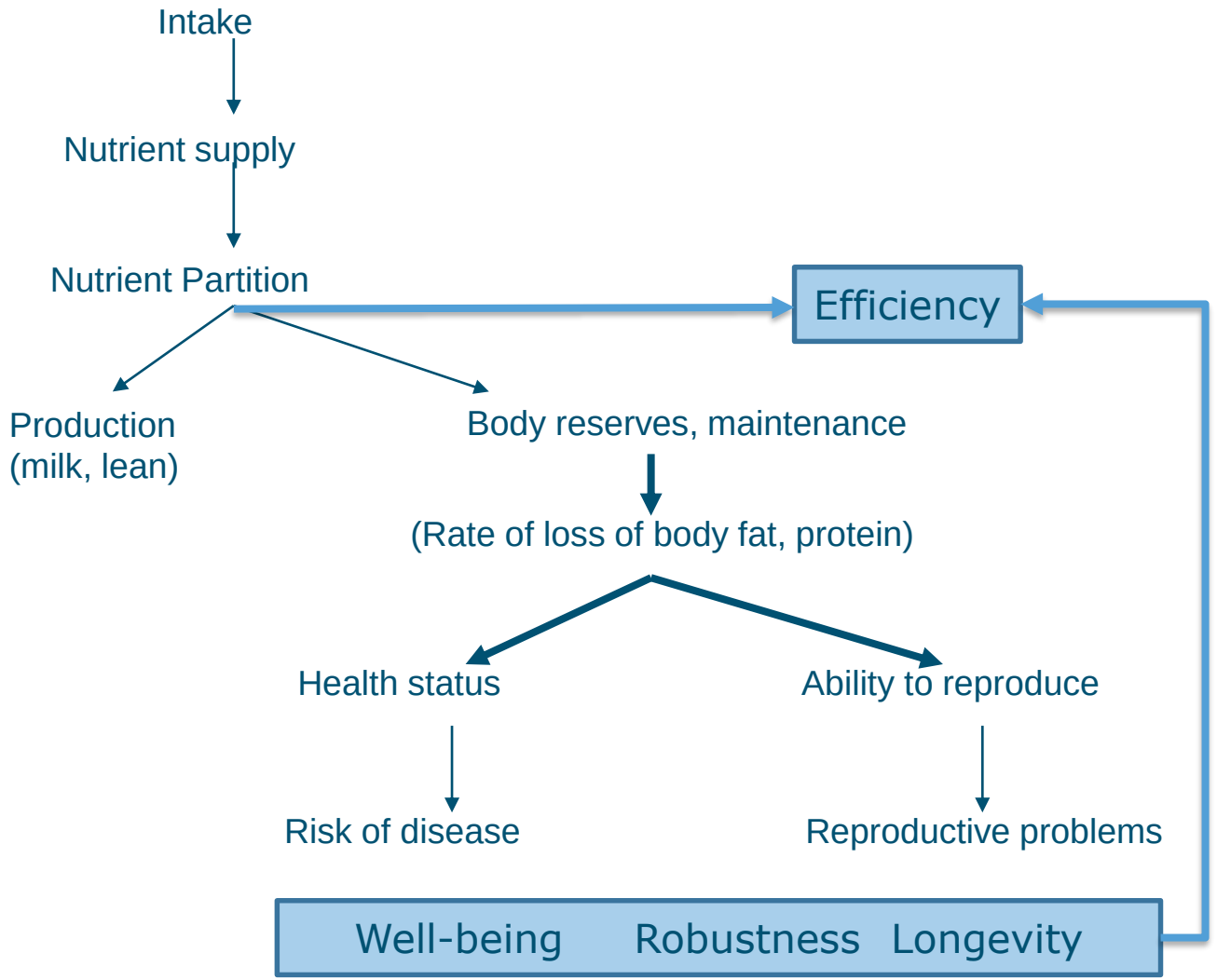
Energy in product : Energy ingested

to achieve production measured

feed efficiency → kg milk : kg dry matter intake

Over time period relevant to ensure efficiency gains are sustainable

Short- vs. long term efficiency



Efficiency

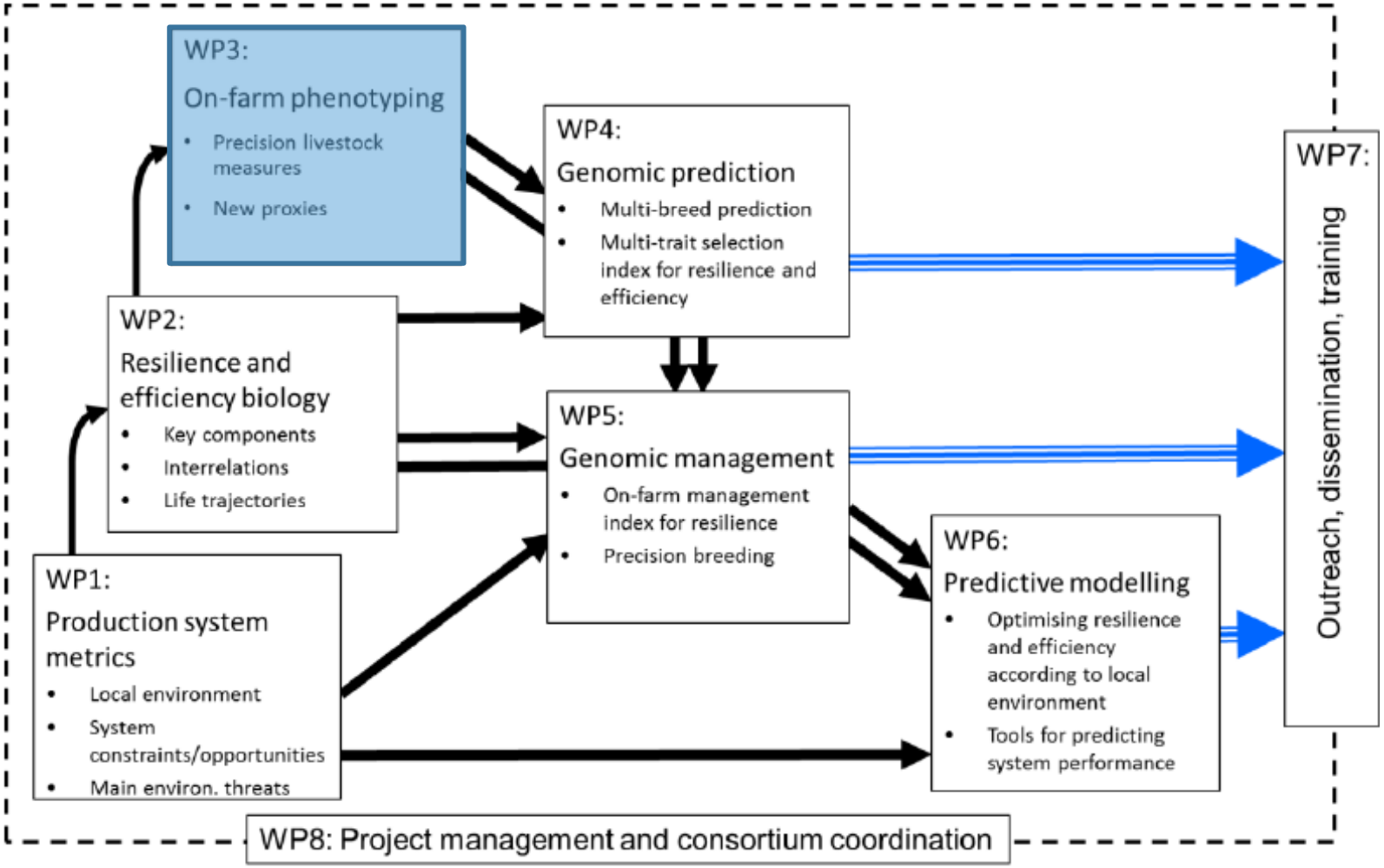
Energy in product: Energy ingested to achieve production measured

kg milk : kg dry matter intake

Over time period that is relevant to ensure that any efficiency gains are sustainable

improving short term efficiency does not include long term consequences of this short term improvement

GenTORE - Work Packages



WP3 On-farm phenotyping

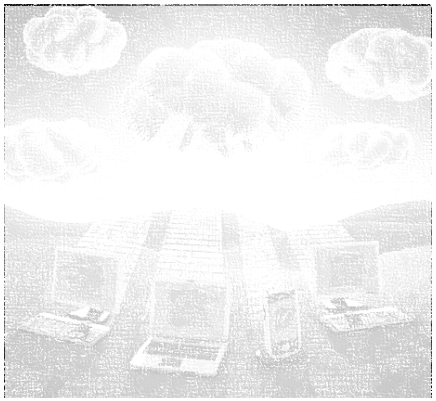
At-market technologies

Big Data across farms

Near or far-off market technologies

On-farm technologies to phenotype proxies for Resilience and Efficiency

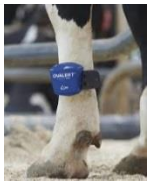
On-farm sensor technologies



Farms in the cloud / national data

Near or far-off market technologies

Using on-farm technologies



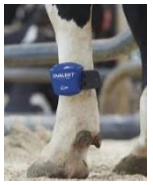
Data from our research farm Lelystad

~400 cows, 2014-2016

Several technologies, including

- Roughage Intake Control (RIC)
- Milk yield
- Live weight
- Activity & Rumination levels

Efficiency definition



Total DM intake (kg) / total milk yield (kg)

efficient cows, thus, have low values

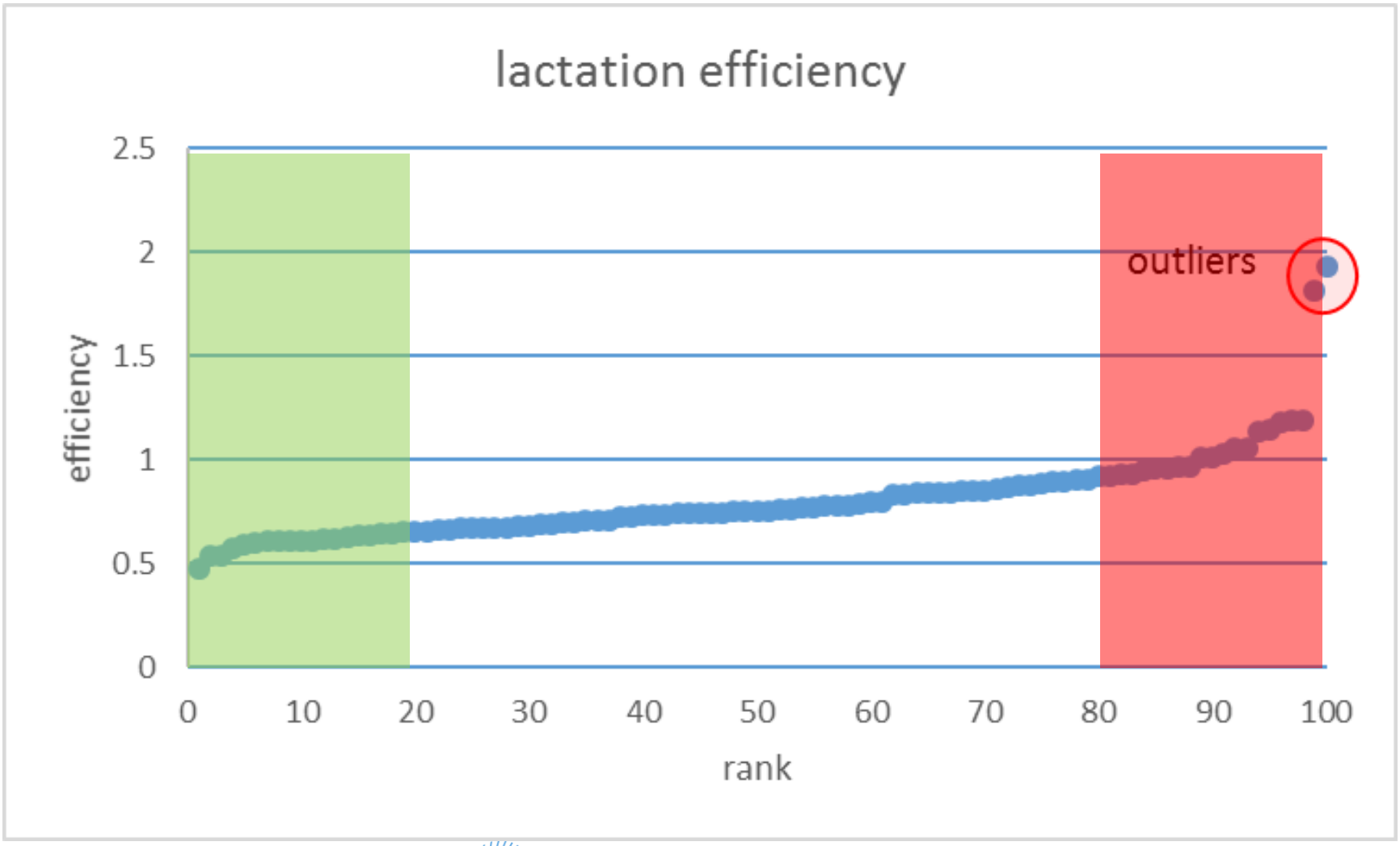
At lactation level, n = 100

at least one RIC record per week

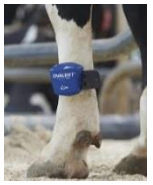
for 36 subsequent weeks (week 1-36)

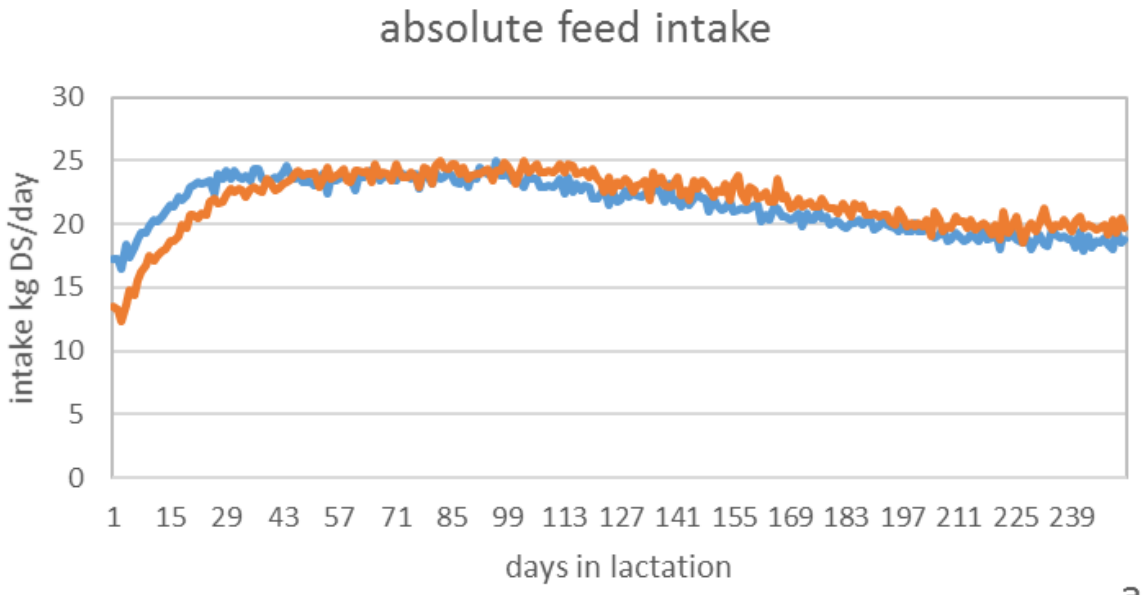
only parity ≥2

Efficiency definition



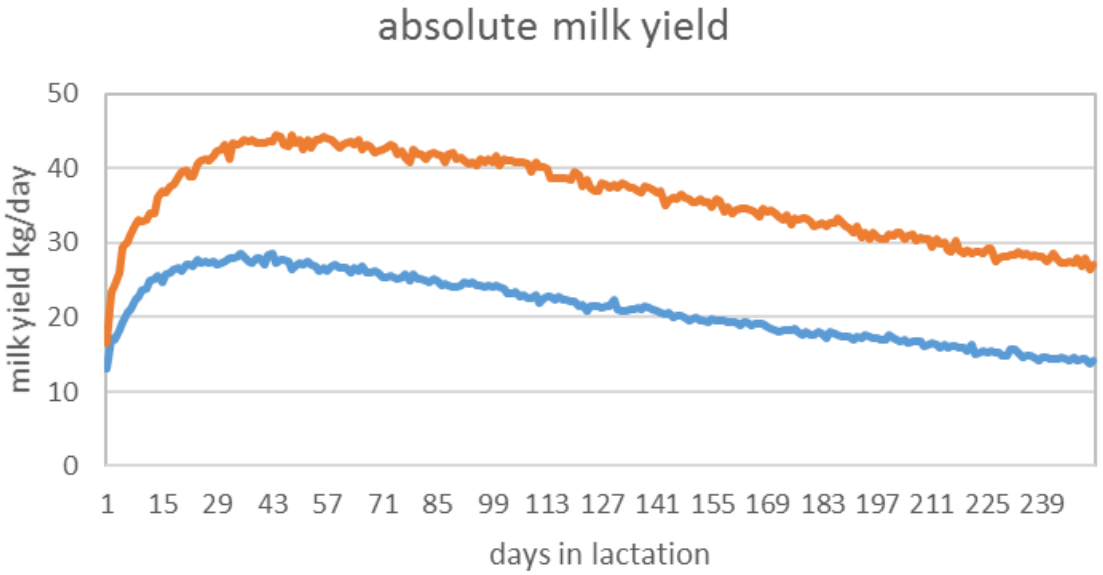
Sensor patterns





Non-efficient

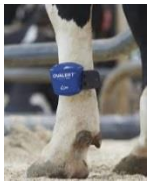
Efficient

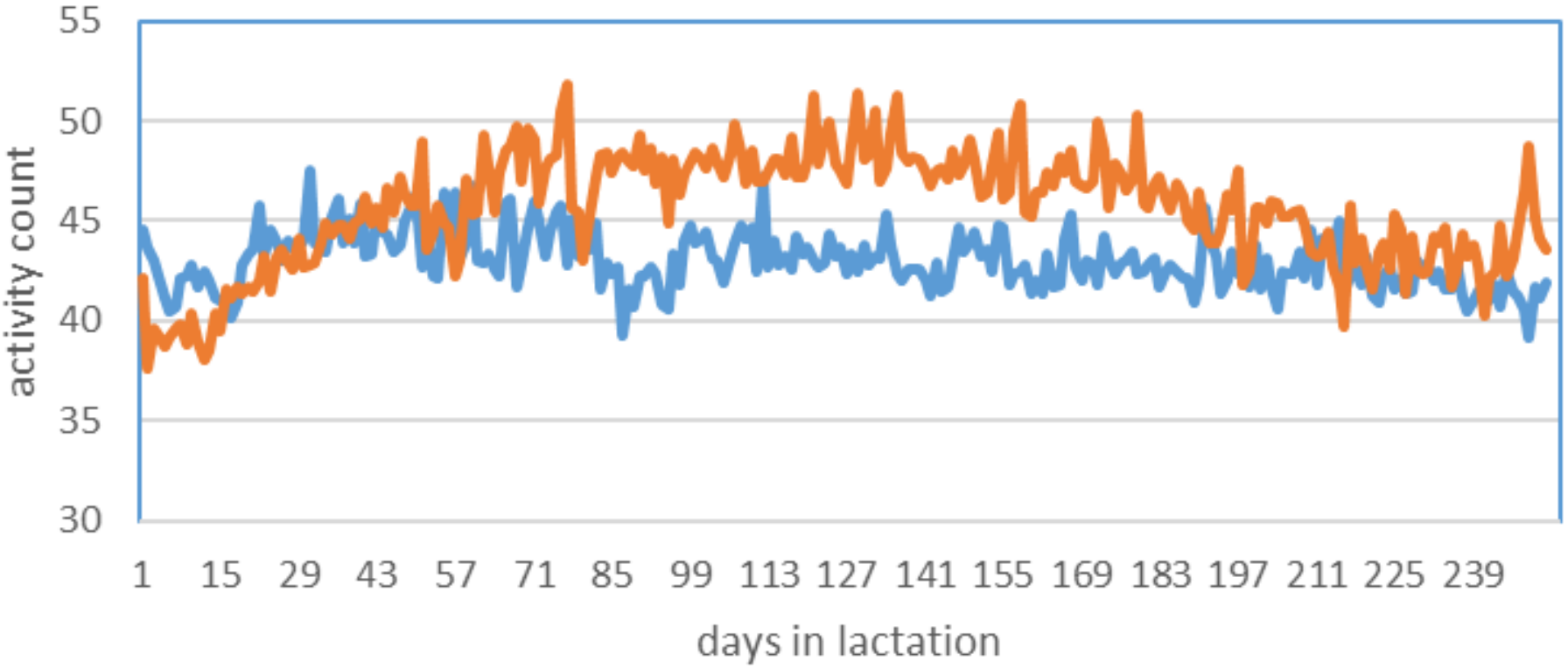


WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Sensor patterns

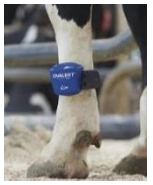


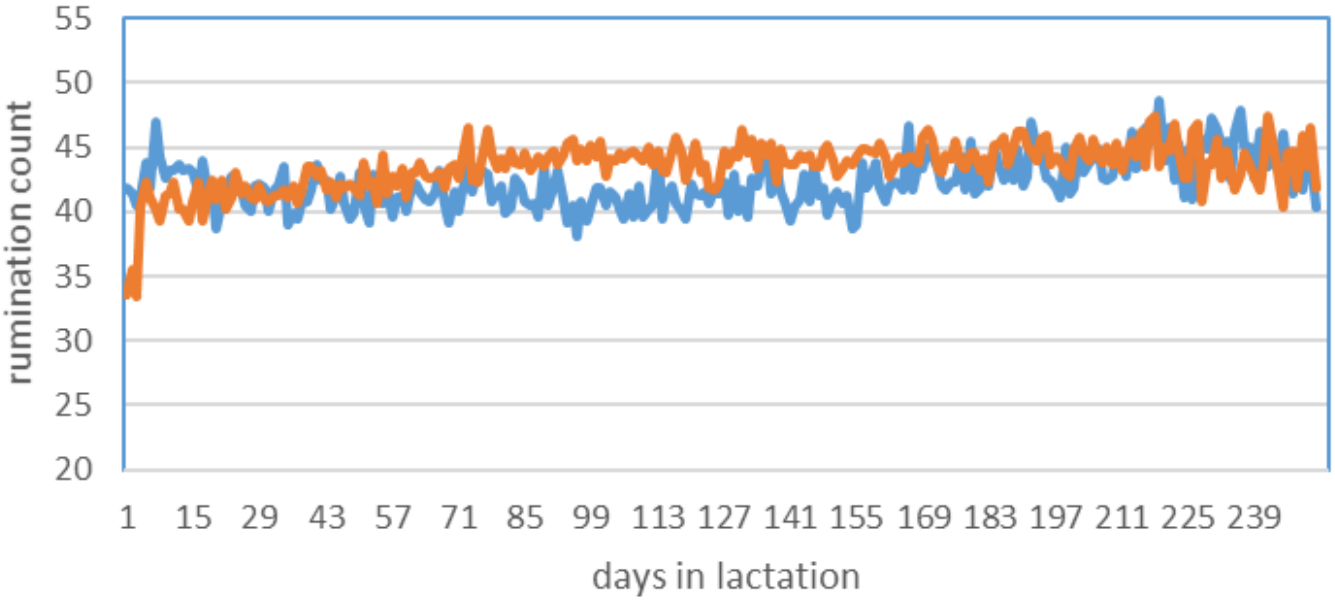


Non-efficient

Efficient

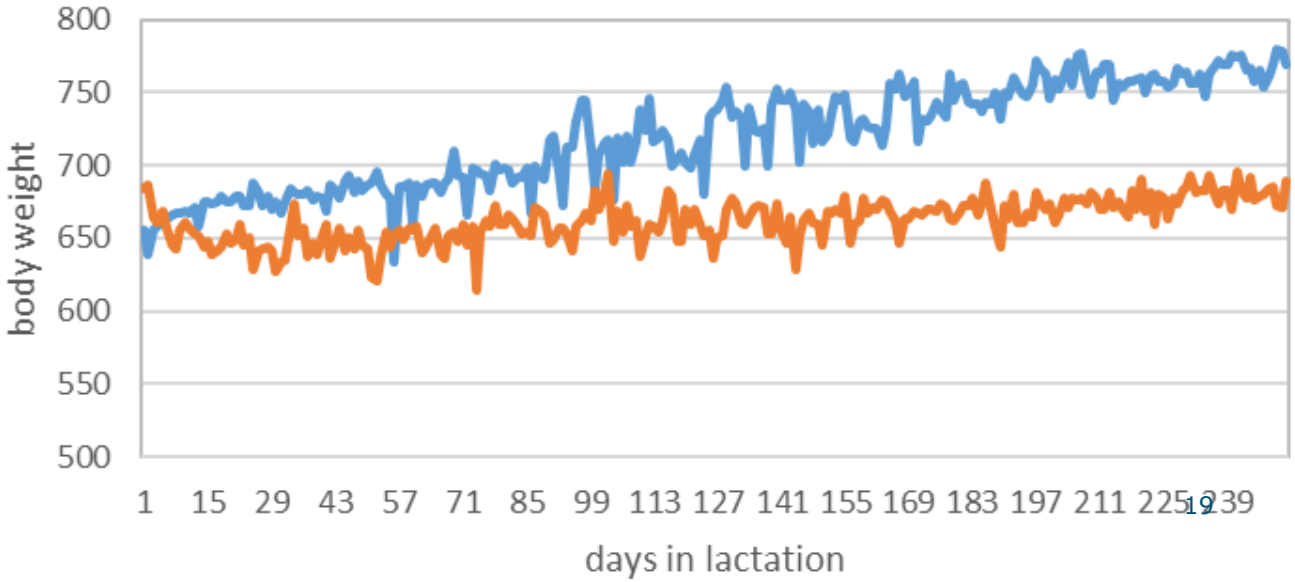
Sensor patterns





Non-efficient

Efficient

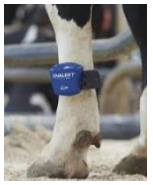


WAGENINGEN
UNIVERSITY & RESEARCH

Sensor patterns

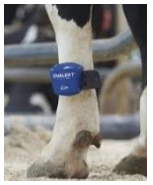
Descriptor	Feed intake	
	E	NE
Mean	21.9	21.5
Min	10	13.1
Max	29.7	30.1
Std	3.48	2.87
Slope	0.13	0.16

Sensor patterns



Descriptor	Feed intake		Milk yield		Live weight		Activity		Rumination	
	E	NE	E	NE	E	N	E	NE	E	NE
Mean	21.9	21.5	36.3	21.3	663	720	45.8	43.1	43.5	42.2
Min	10	13.1	16.6	8.4	386	275	22.0	23.6	23.6	22.4
Max	29.7	30.1	48.3	32.0	816	928	84.5	79.0	63.0	65.1
Std	3.48	2.87	6.30	4.91	42.4	64.3	8.06	7.42	5.72	6.67
Slope	0.13	0.16	0.56	0.43	-1.15	-2.90	0.40	0.07	0.10	-0.12

Resilience definitions



At herd level: Heat stress

All cows experience a period of heat stress at the same time

Temperature humidity index as proxy for heat stress period

$$THI = (1.8*T + 32) - [(0.55 - 0.0055*RH)(1.8*T - 26.8)]$$

Dikmen and Hansen, 2009

At cow individual level: mastitis

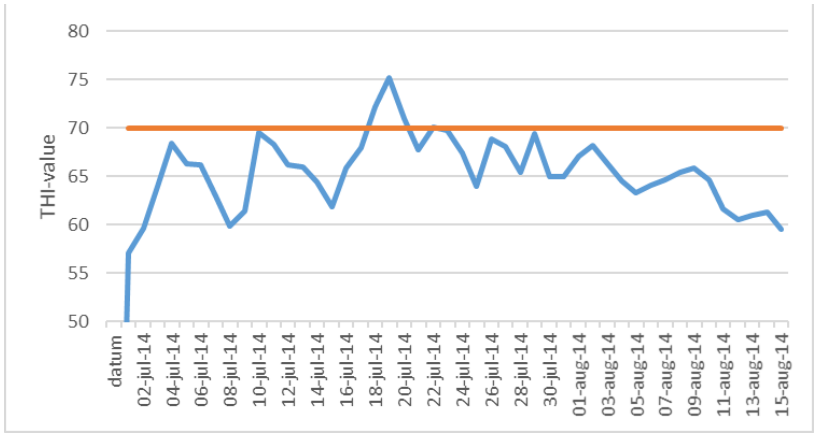
Pathogens are around, but not all cows get mastitis

In case of mastitis, not all cases are equally severe

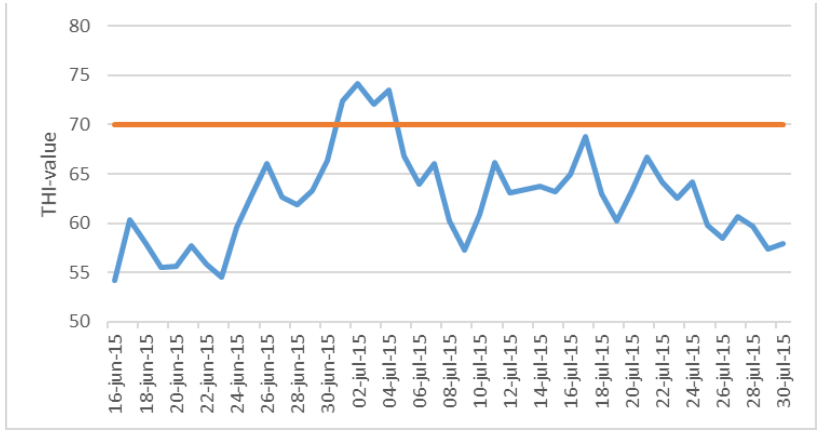
Treatment for mastitis as indicator

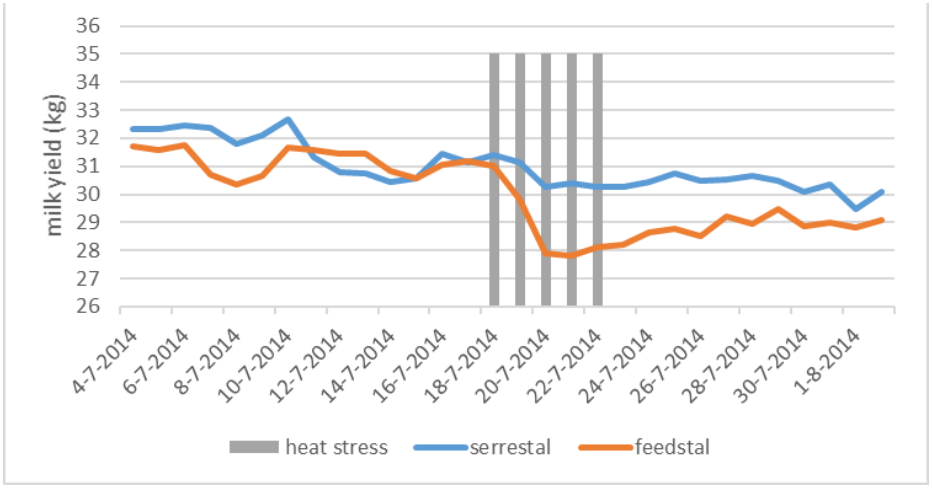
Heat stress

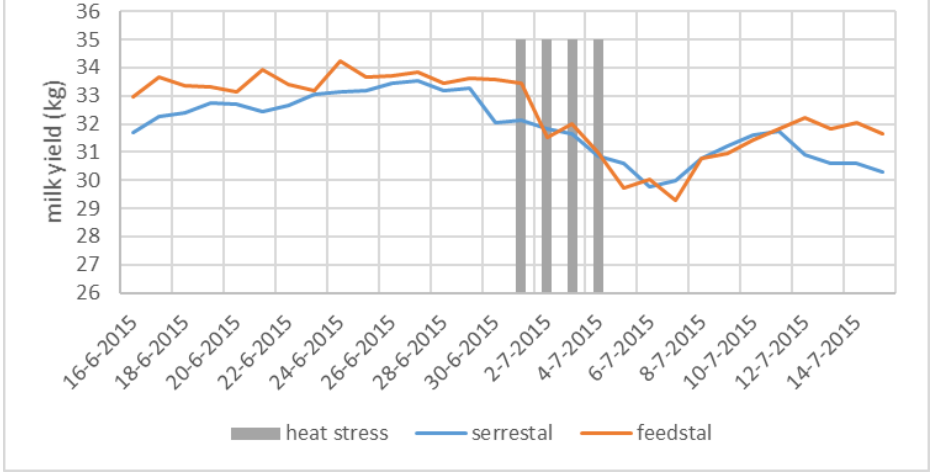
July 2014



June 2015







Heat stress – next steps

Define resilient and non-resilient cows

drop more and longer than average → non-resilient

drop less and shorter than average → resilient

Create sensor data pattern from resilient vs non-resilient

Describe patterns with variable descriptors

Use interesting descriptors for predicting resiliency

Mastitis

Select first cases of mastitis

Define resilient and non-resilient cows

Create sensor data pattern from resilient vs. non-resilient

Describe patterns with variable descriptors

Use interesting descriptors for predicting resiliency

Near-market technologies

36 months, starting next month, aiming at beef

Using location and image information to measure movement patterns of cattle as proxies for R&E

Tracklab (Noldus)

GPS and accelerometer data
visualise and analyse grazing behaviour of cattle

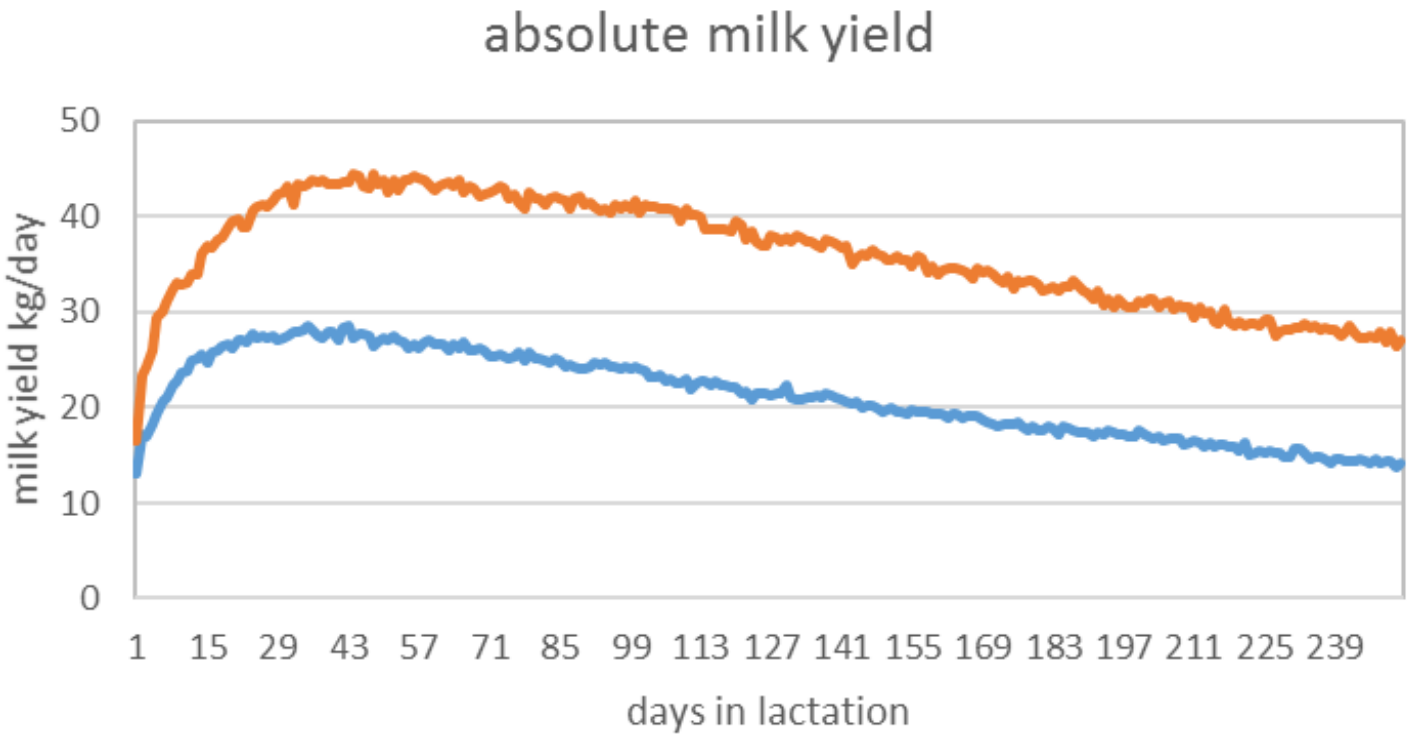
Drone images (Alterra, Wageningen Environmental Research)

monitor growth and body condition score of individual cows
starting with proof of principle

My questions to you

On-farm technologies:

do we have the right efficiency definition?



My questions to you

On-farm technologies:

do we have the right efficiency definition?

how can we define resilient and non-resilient cows for heat stress and mastitis?

can you think of another approach / descriptor variables?

how would you model the data to define resilience/efficiency?

Near-market technologies:

how would you use drone images to define resilience/efficiency?

Thank you

Comments/input are more than welcome

Claudia.kamphuis@wur.nl