Improved Precision Calf Rearing by the use of networked Feeding and Monitoring Systems

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Precision Livestock Farming

Information Technology in Livestock Farming

... creates better management information for animal production by

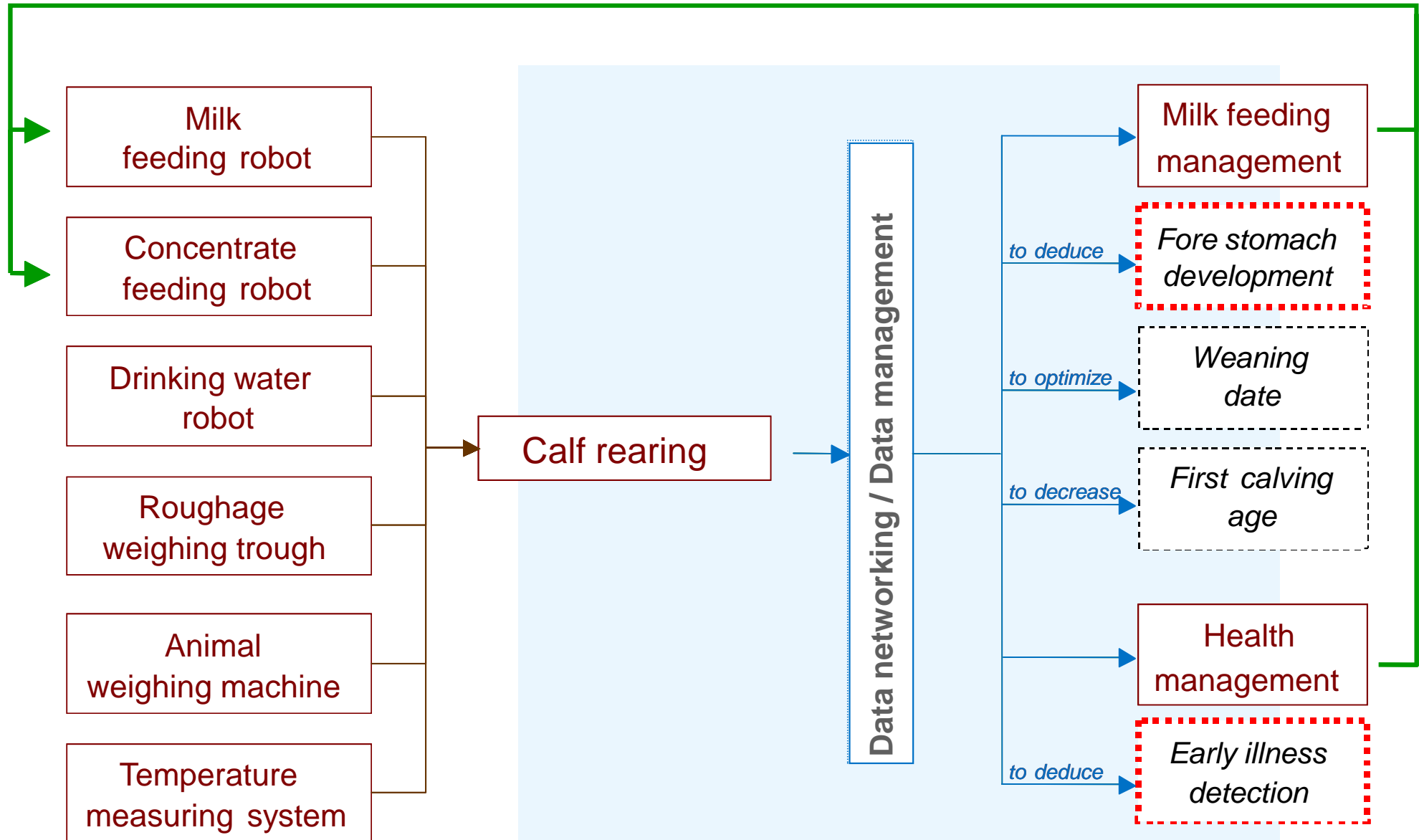networking electronic process control systems.

Electronic systems

... provide information about food intake, animal behavior, animal health

and other parameters.

→ Data have to be acquired, validated, processed and fed back to control

of the overall system.

→ Unusual or critical situations can be detected as early as possible.

But: More and more proprietary solutions of <u>different</u> manufacturers are available.

Control

Milk feeding robot

Concentrate feeding robot

Drinking water robot

Roughage weighing trough

Animal weighing machine

Temperature measuring system

Calf rearing

Data networking / Data management

Milk feeding management

to deduce → *Fore stomach development*

to optimize → *Weaning date*

to decrease → *First calving age*

Health management

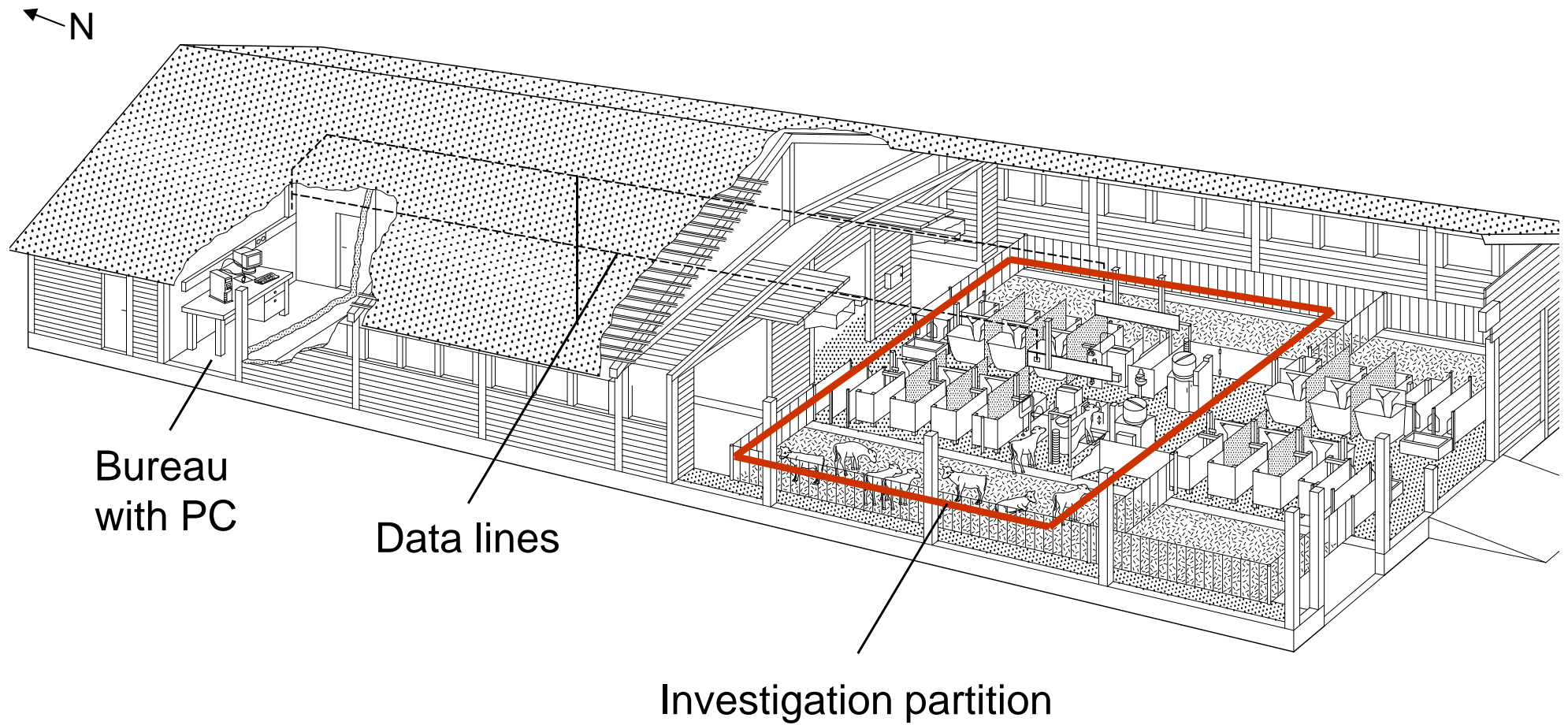*to deduce* → *Early illness detection*

Aims and method

Aims of the research project:

- Estimation of technical and informational requirements

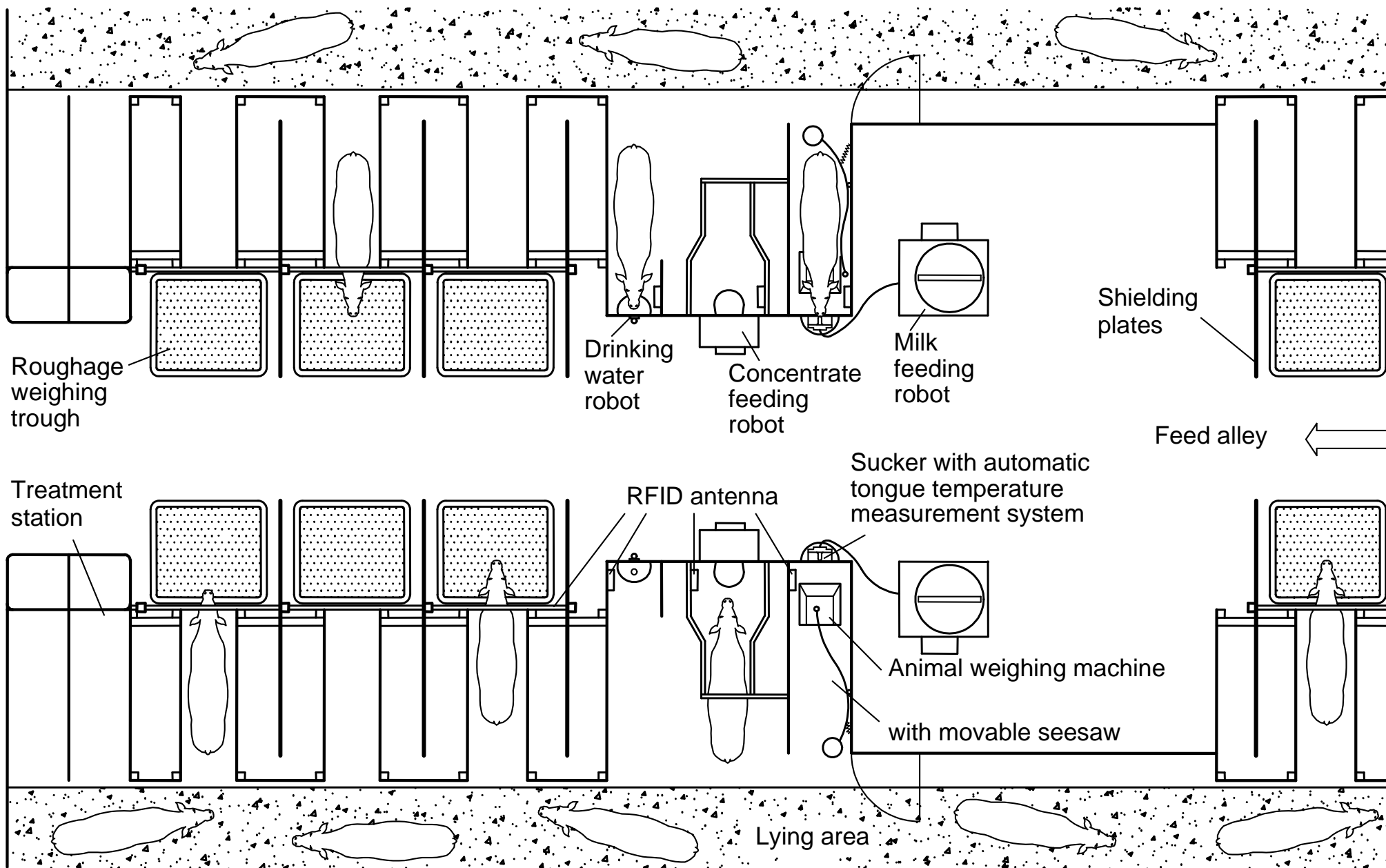- Deduction of the potential of complex networked systems in calf rearing

Method:

- Implementation of a comprehensive feeding and monitoring system for calves

- **Linkage of all – up to now available – technical components**

- Acquisition of highly resolved process parameters
  (individual milk, water and feed intake, body weight, body temperature)

N

Bureau
with PC

Data lines

Investigation partition

Roughage weighing trough

Drinking water robot

Concentrate feeding robot

Milk feeding robot

Shielding plates

Feed alley

Treatment station

RFID antenna

Sucker with automatic tongue temperature measurement system

Animal weighing machine
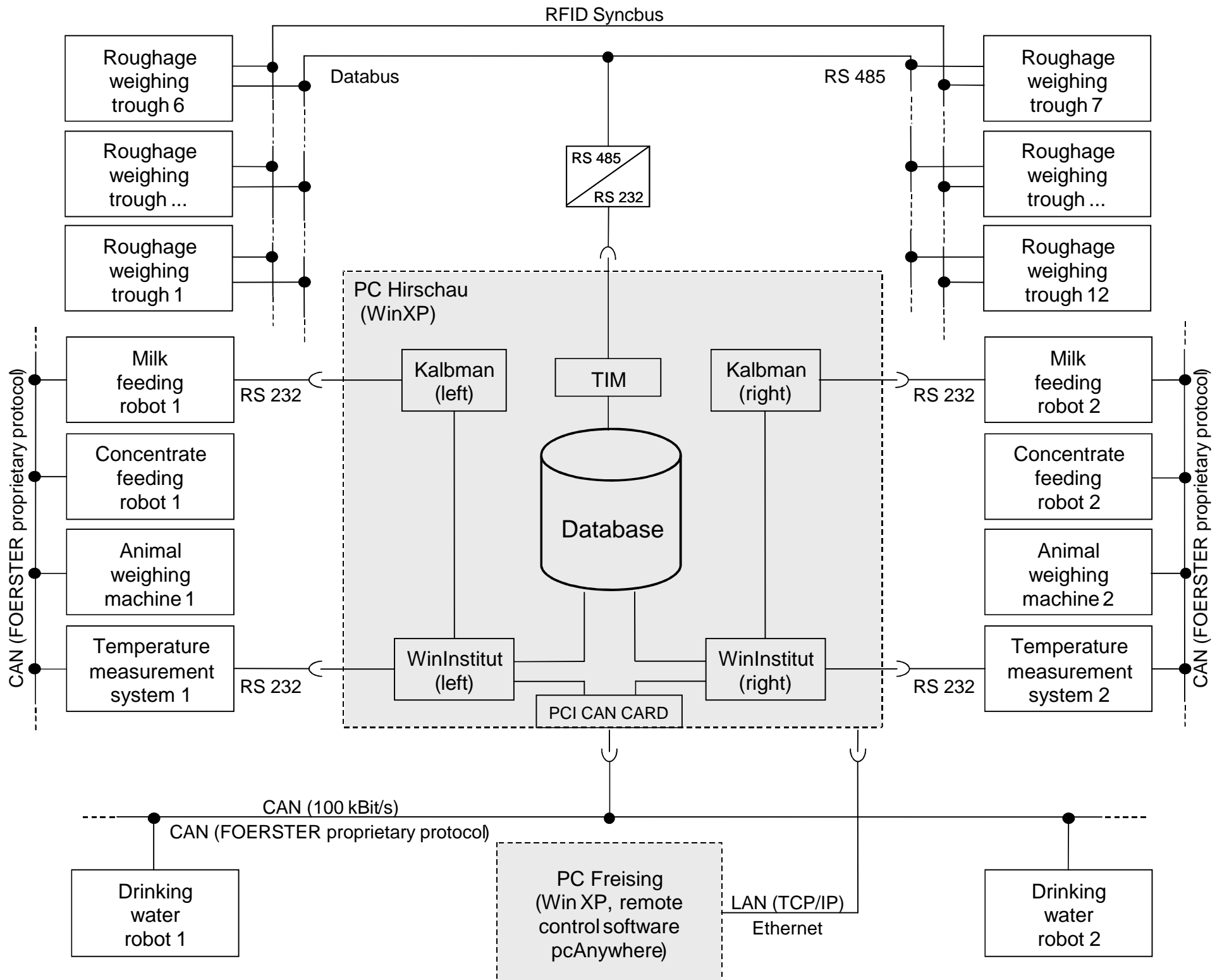
with movable seesaw

Lying area

Milk replacer mixing station

Milk replacer supply and Front body scale

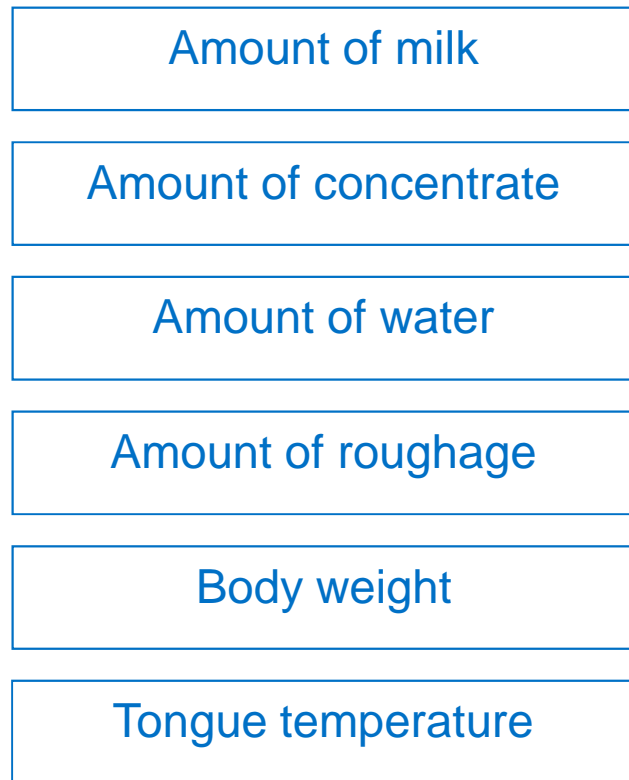Concentrate supply

Water supply

Roughage weighing troughs

Calf individual recorded parameters

Milk feeding robot
- Retrieved amount of milk [ml]
- Number of break-offs
- Suckling speed [l/s]
- Number of visits at the station

Temperature measurement system
- Tongue temperature [°C]

Animal weighing machine
- Body weight [kg]

Database

Concentrate feeding robot
- Retrieved amount of concentrate [g]
- Number of visits at the station

Drinking water robot
- Retrieved amount of water [ml]

Roughage weighing trough
- Retrieved amount of hay [g]
- Number of visits at the station

System validation using control parameters

Technical parameters

Control parameters

Amount of milk

Amount of concentrate

Amount of water

Amount of roughage

Body weight

Tongue temperature

Fore stomach development

Early illness detection

Clinical examination

Carcass

Rectal temperature

Animal watching

Weighing for control

Blood analyses

Data

Data

Validation

Mean values of feed intake and body weight (all 66 calves)

Legend:
- Total dry matter
- Milk replacer dry matter
- Concentrate dry matter
- Hay dry matter
- Total water
- Milk replacer drinking
- Drinking water

Y-axis left: [l/d] with values 16, 8
Y-axis right: [kg/d] with values 4, 2
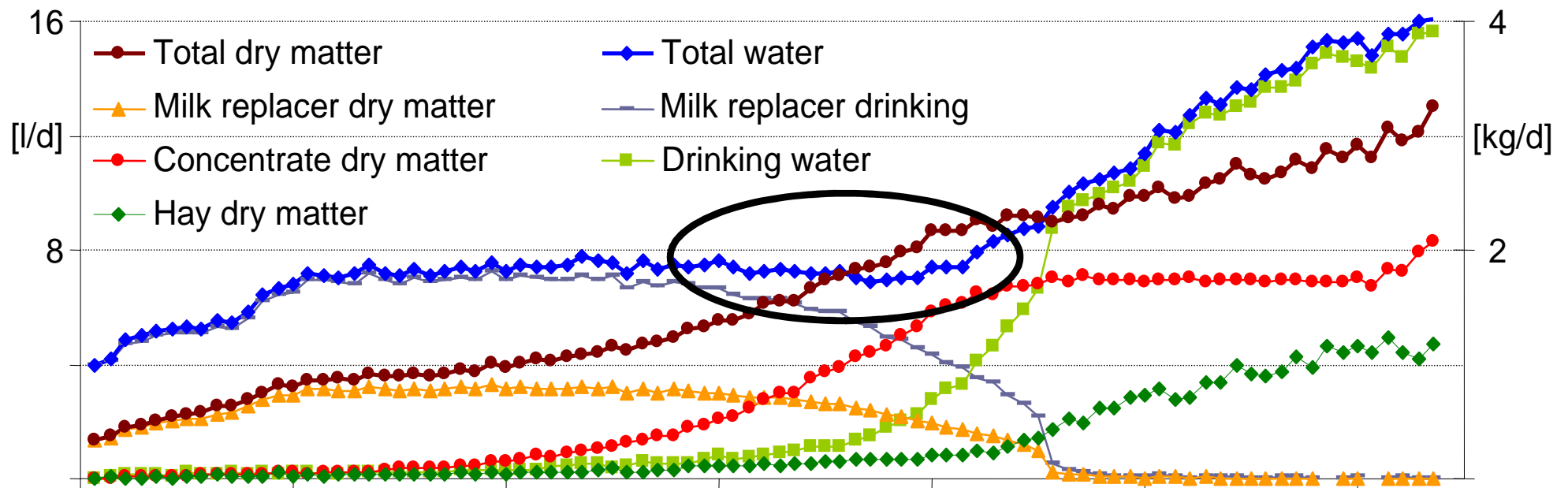
Correlation between feed intake and age (P < 0,0001)

| Component	Total DM	Milk replacer DM	Concentrate DM	Hay DM	Age
Total water	0.67	-0.45	0.60	0.66	0.65
Drinking water	0.76	-0.81	0.77	0.78	0.78
Age	0.89	-0.69	0.90	0.70	1.00
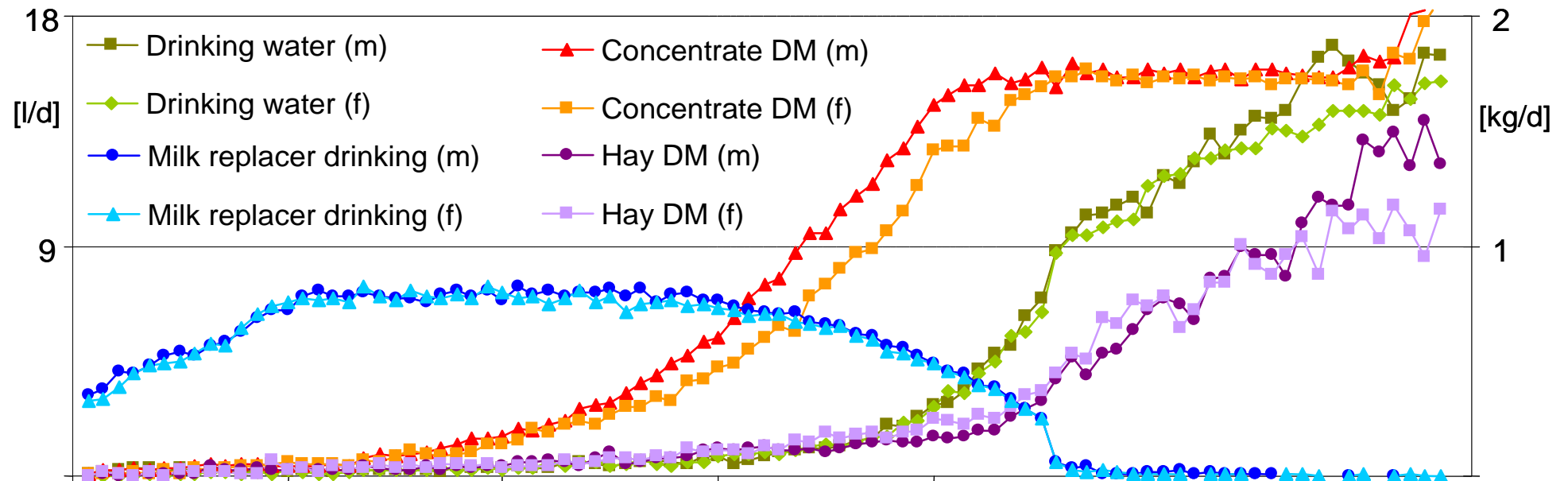
→ Hesitant increase of drinking water intake although decreasing amount of milk replacer drinking.

→ Increasing hay and concentrate intakes during weaning.

→ Intake amounts primarily dependents on age.

→ Temporarily obvious differences between sexes.

Component		Total dry matter TDM $[kg\ d^{-1}]$	Total water TW $[l\ d^{-1}]$	Milk replacer drinking MRD $[l\ d^{-1}]$	Drinking water DW $[l\ d^{-1}]$	Milk replacer dry matter MRDM $[kg\ d^{-1}]$	Concentrate dry matter CDM $[kg\ d^{-1}]$	Hay dry matter HDM $[kg\ d^{-1}]$
Age	F	227	72	464	311	553	436	110
	P	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Sex	F	39	21	25	5.3	19	64	0.7
	P	< 0.0001	< 0.0001	< 0.0001	0.0212	< 0.0001	< 0.0001	0.4084
CI	LL	0.045	0.171	0.077	0.020	0,007	0.044	-0.018
	UL	0.086	0.430	0.176	0.248	0.017	0.072	0.007

Intakes and health status of calf No. 826 relative to age
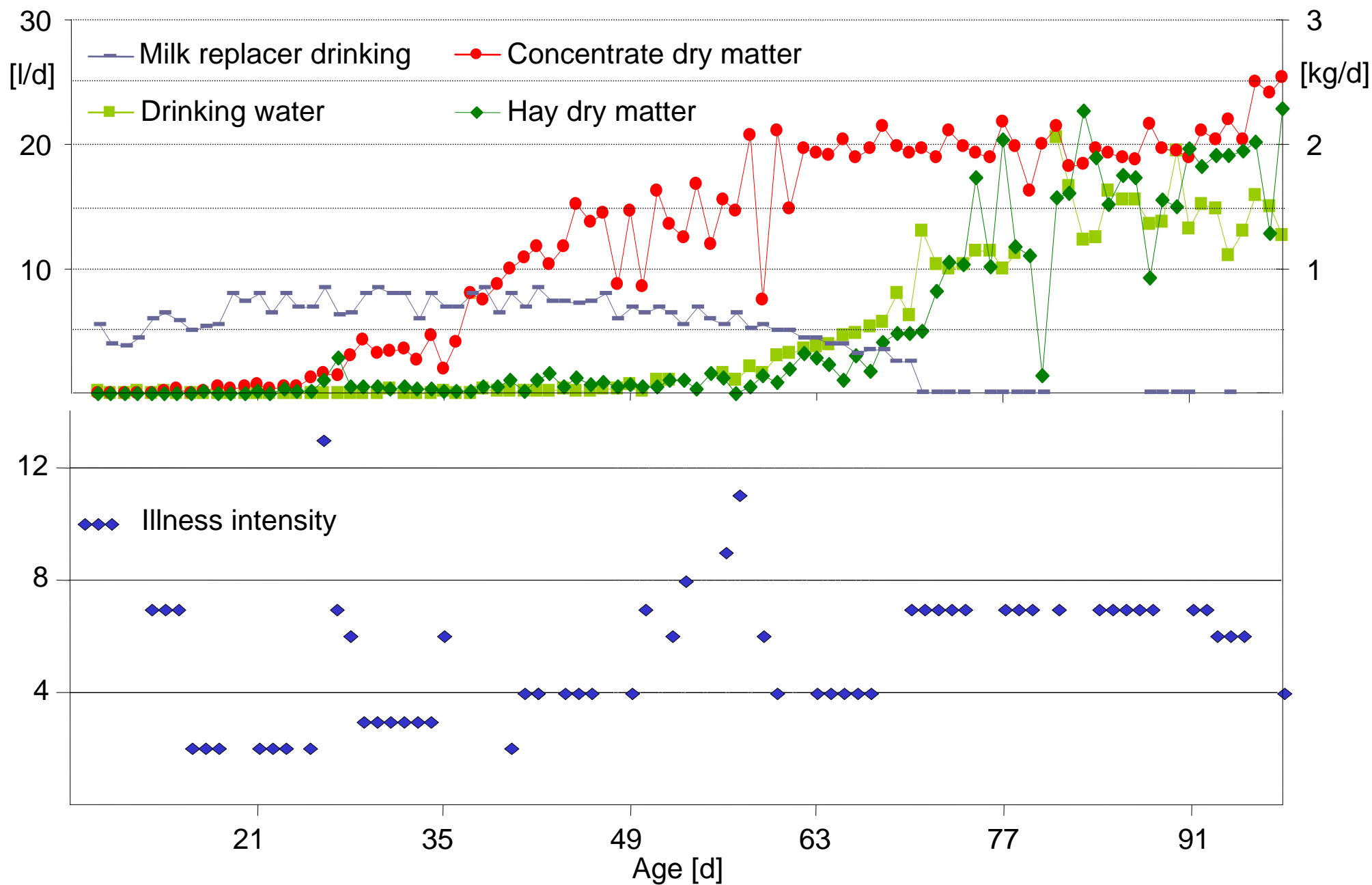
- The established calf feeding and monitoring system allows us to get individual, highly resolved data.

- Control measurements are necessary to validate the data of technology.

- The shown results demand an individual or at least age- and sex-related adaptation of the milk feeding program to the dry matter intake.

- Special attention has to put on the weaning period.

→ Early illness is detectable can be estimated.

After further processing and data networking, algorithms have to be developed for the implementation within a knowledge-based decision support system.

Thanks for your attention !

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