Agricultural Research Organization (ARO) Israel

Agricultural Engineering Institution

Precision feeding

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EAAP EU-PLF Joint session

Copenhagen Denmark

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In brief

Precision feeding is based on knowing the **cow individual feed intake**

Feed efficiency is based on knowing the **cow individual feed intake**

Monitoring Cow individual feed intake

- **Direct meassurment**
- **Sensor (and model)-based estimation**

Please ask during the presentation

Incentive (1)

- **Feed intake is the most costly single factor in intensive livestock operation.**

- **Feed costs make up 64% of the total farm day-to-day costs.**
- **(all medicine and vet treatments < 20 % ; labor < 20 % , energy, water etc)**

- **Other intensive livestock species: over 70% fish netcages (FAO 2008) , Beef, and poultry**

- **Therefore,**

- **Animal Feed efficiency (via feed intake) should be monitored**

Calculation -

- **Animal Feed efficiency (via feed intake) should be monitored**

$$\text{Animal Feed efficiency} = = \frac{\text{animal input (feed costs, \$)}}{\text{animal output (milk production, \$)}}$$

are well known factors. measured in real time on individual level

$$\text{Feed Conversion Ratio FCR} = \frac{\text{Feed (kg)}}{\text{Weight Gain (kg)}}$$

The animal output is <u>well</u> known, accurate, in real-time on animal level

Milk meters
Milk analyzer

Walk-through body weight scale

Peiper, U.M., et al Maltz, E., 1993. Automatic weighing of dairy cows. J. Agric. Eng. Res. 56 (1), 13–24

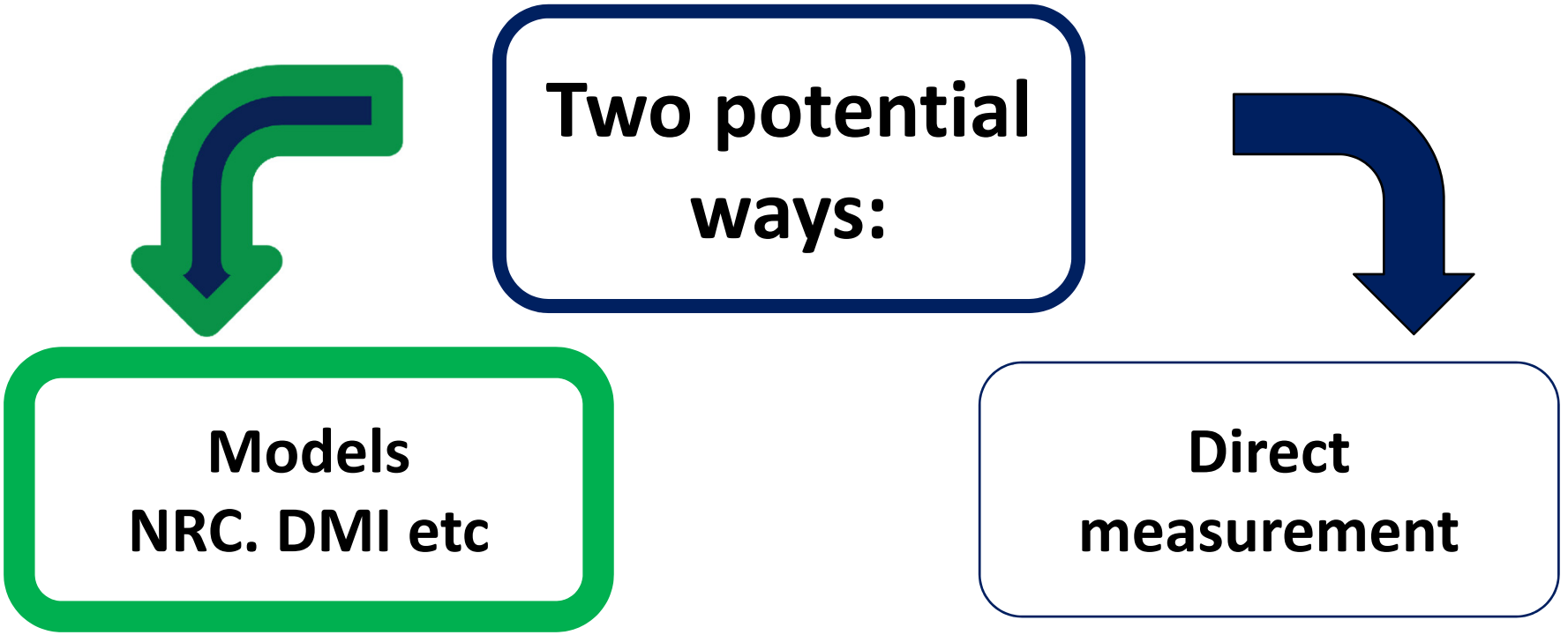
Schmilov 001)
Spectros tion
no. 1464

Incentive (3)

- The *'animal output'* is known (milk yield, body weight gain, milk contents)
- But,

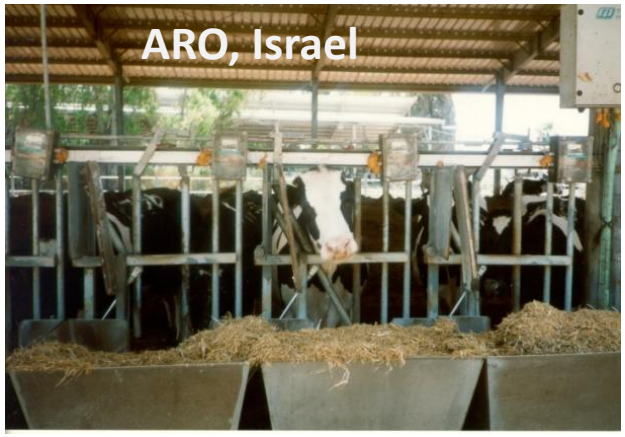
$$\text{Animal Feed efficiency} = \frac{\text{animal input (feed costs, \$)}}{\text{animal output (milk production, \$)}}$$

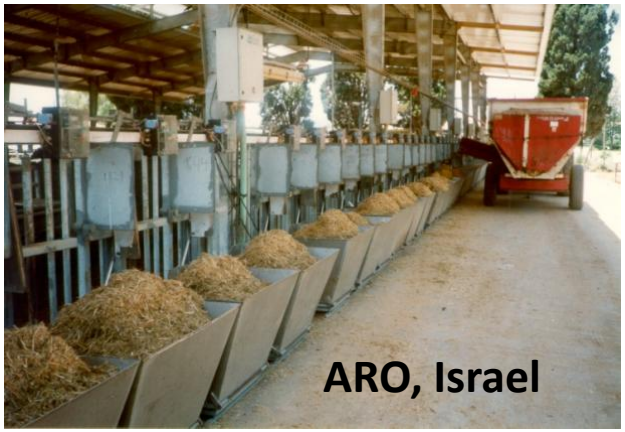
Knowing the cow individual feed intake:



regression, indirect, interpretation (NRC, Halachmi et al., JDS 2004. cow individual DMI

Direct monitoring of feed intake



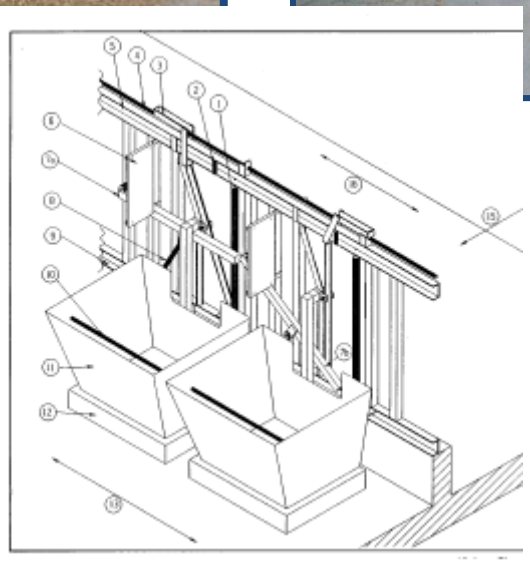


DCRC Foulum Denmark

Halachmi I., et al., **Animal individual Feed intake monitoring.** *Computers and Electronics in Agriculture*, 1998. 20: p. 131-144.

I. Halachmi et al. / Livestock Science 138 (2011) 56–61 I. Halachmi C.F. Børsting, M.R Weisbjerg et al

A commercial farm

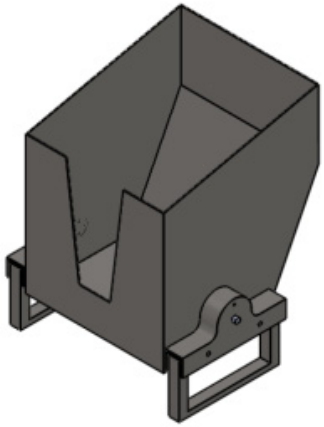


The ARO's research farm

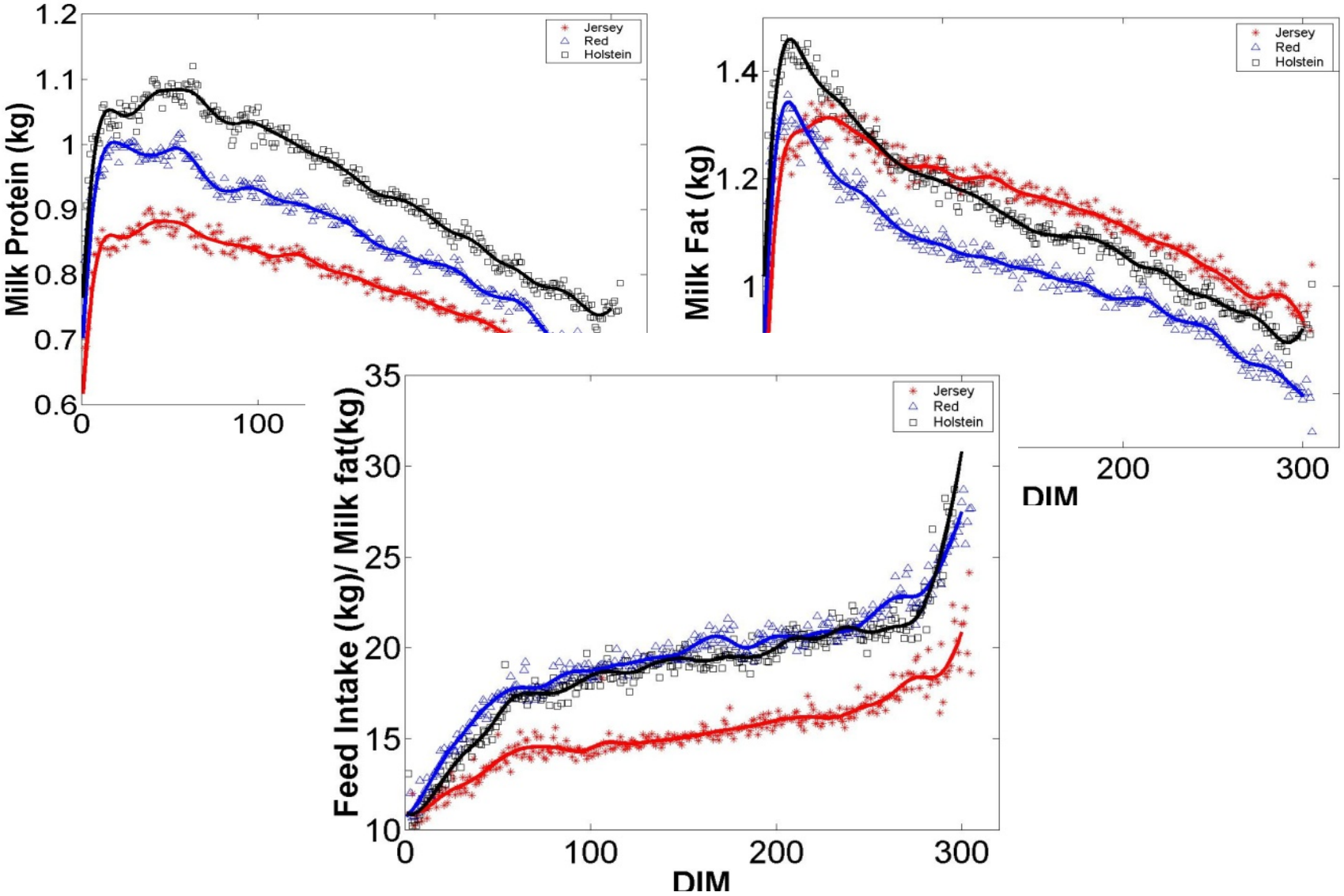
DCRC Foulum Denmark Research farm

Halachmi I., Maltz, et al., **Animal individual Feed intake monitoring.** 1998.
Computers and Electronics in Agriculture, 20: p. 131-144.

The classic ways: direct monitoring of feed intake

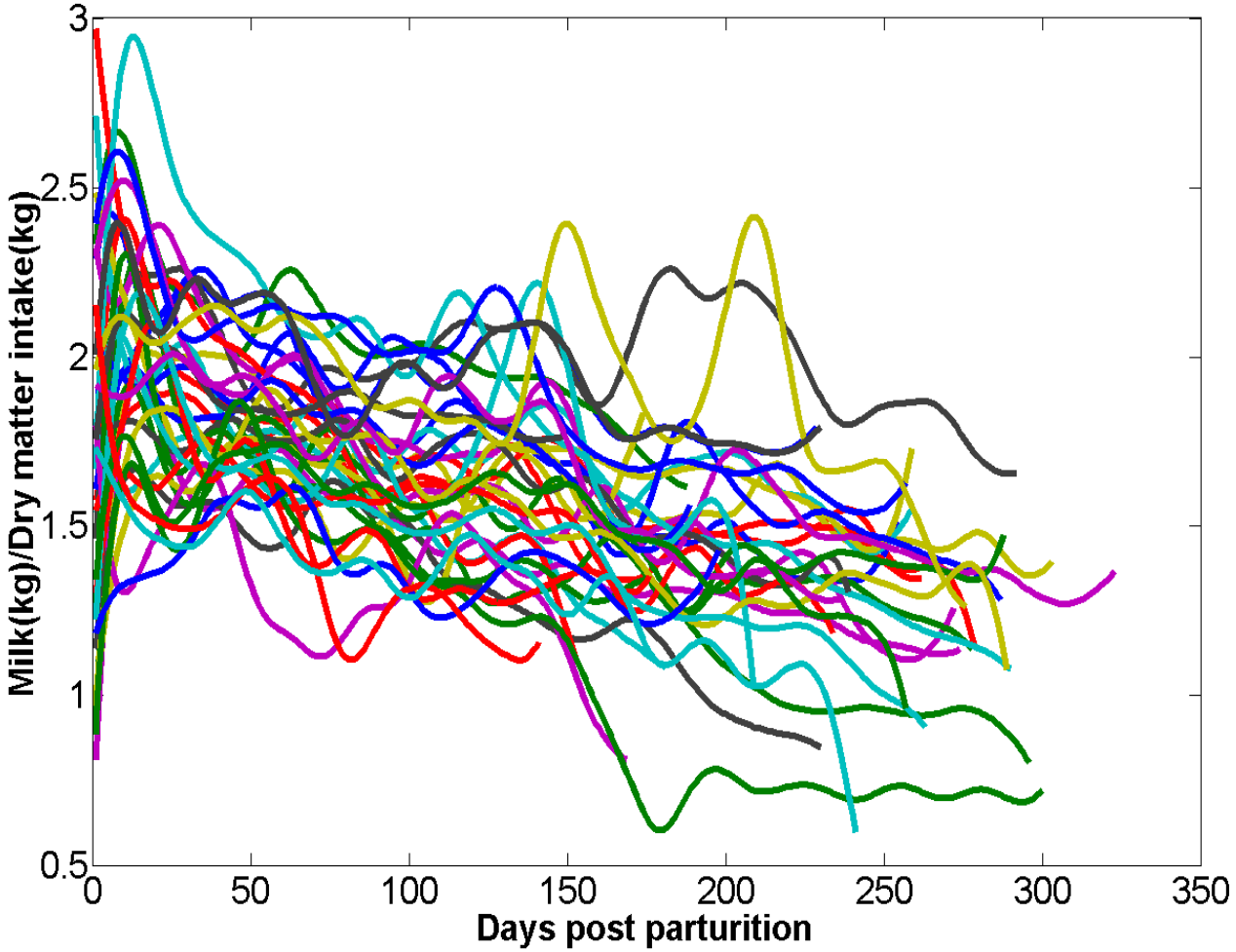


Feed efficiency among breeds



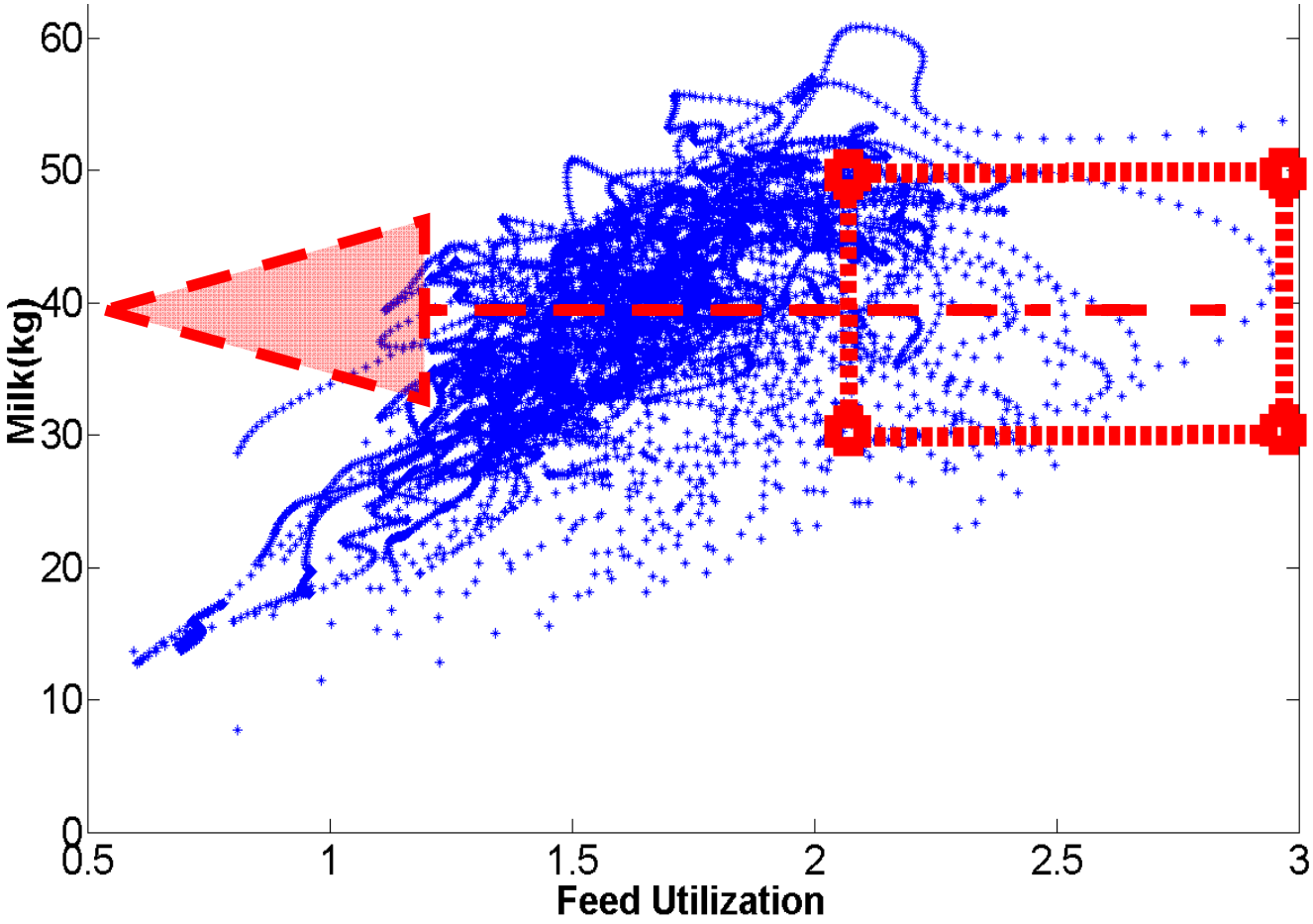
I. Halachmi, et al C.F. Børsting, M.R. Weisbjerg. Livestock Science 138 (2011) 56–61 . (PhD thesis – Dr Dorte Bossen)

Feed efficiency among <u>individuals</u>



Data from: Halachmi I., et al., (2004). **Predicting Feed Intake of the Individual Dairy Cow.** *Journal of Dairy Science*, 2004. 87(7): p. 2254-2267.

Which individual cow does deliver the best feed efficiency ?



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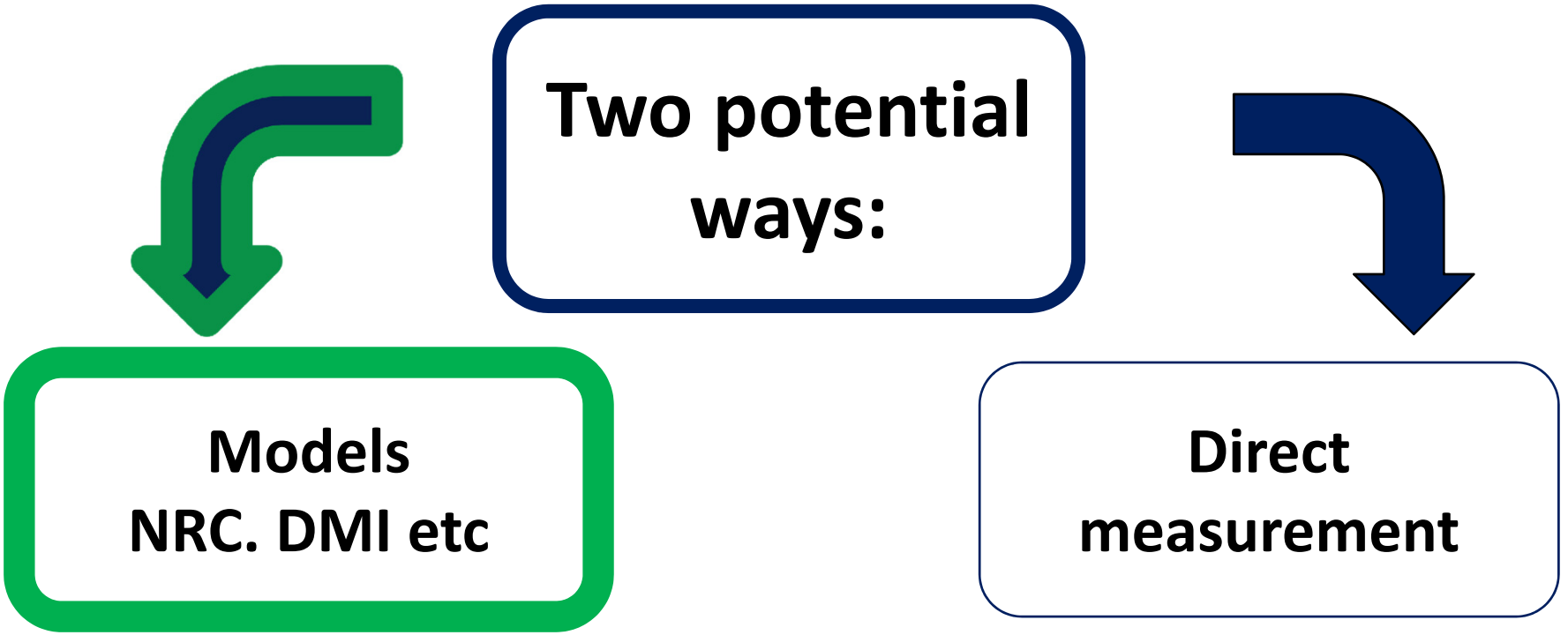
Knowing the cow individual feed intake:



regression, indirect, interpretation (NRC, Halachmi et al., JDS 2004. cow individual DMI

Models. NRC and...

Cow individual feed intake =

(==> cow individual efficiency) =

=

$$DMI_{0,i} = b_{0,i} + b_{1,i}\frac{MY_0}{BW_0} + b_{2,i}\frac{MY_{-1}}{BW_{-1}} + b_{3,i}\frac{MY_{-2}}{BW_{-2}} + b_{4,i}BW_0 + b_{5,i}\frac{BW_{-1}}{BW_0} + b_{6,i}fat + e,$$

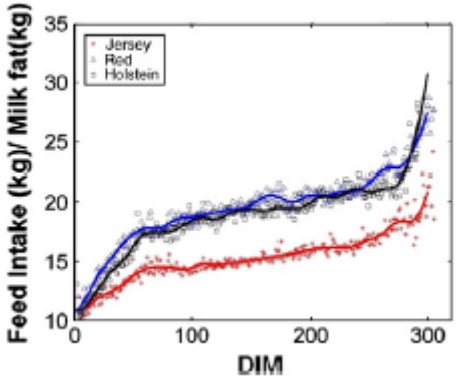
J. Dairy Sci. 87:2254–2267

Predicting Feed Intake of the Individual Dairy Cow

I. Halachmi,[1] Y. Edan,[2] U. Moallem,[1] and E. Maltz[1]

Models for cow individual feed intake (2)

DMI vs. NRC



J. Dairy Sci. 87:2254–2267

Predicting Feed Intake of the Individual Dairy Cow

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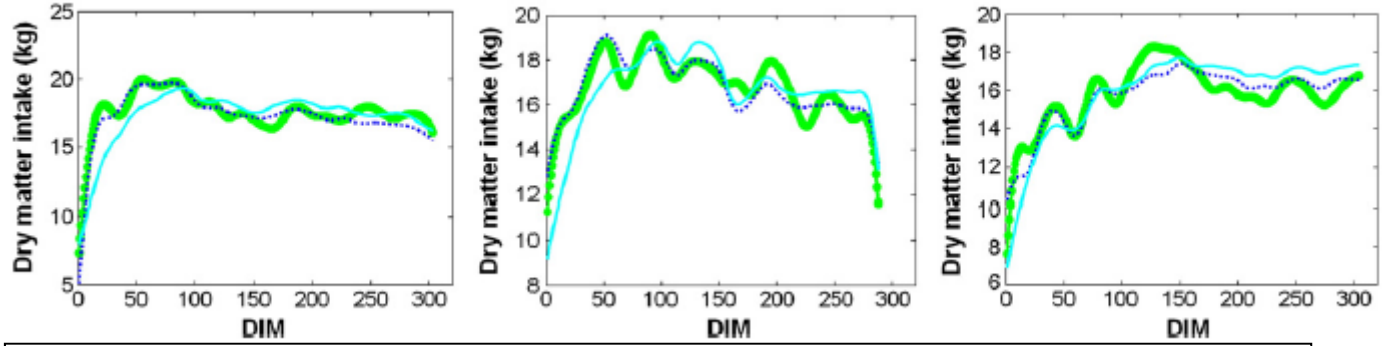
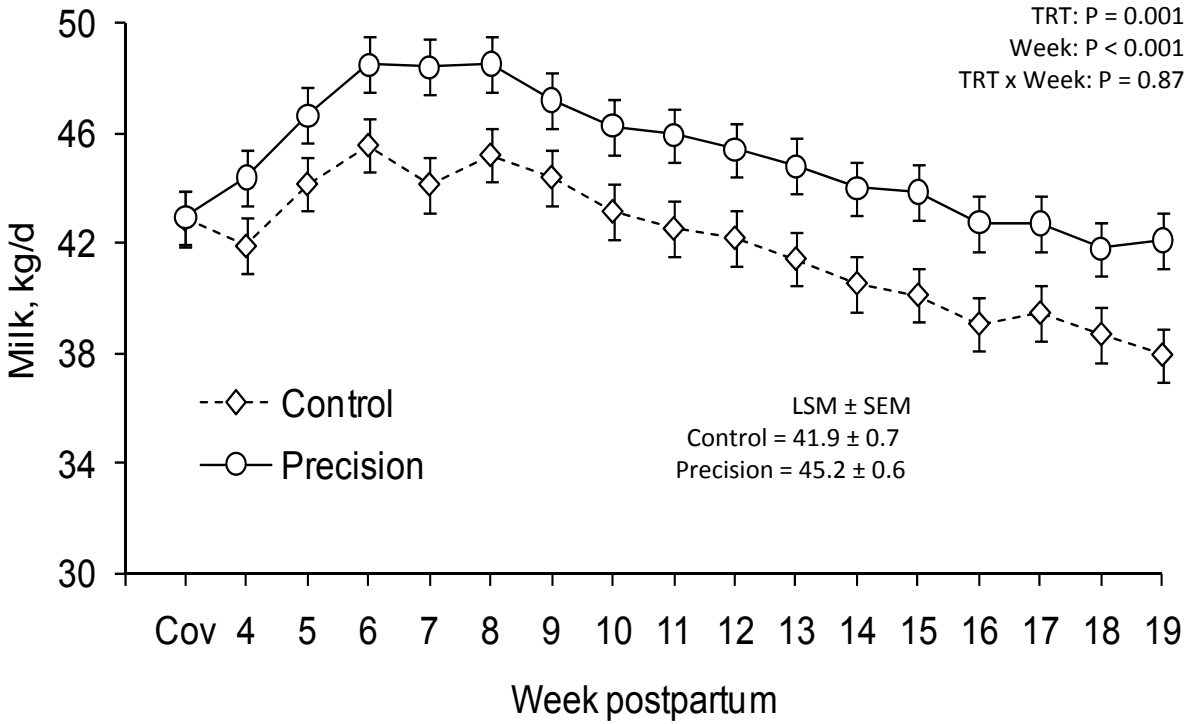


Feed intake of Holstein, Danish Red, and Jersey cows in automatic milking systems

I. Halachmi [a,*], C.F. Børsting [b], E. Maltz [a], Y. Edan [d], M.R. Weisbjerg [c]

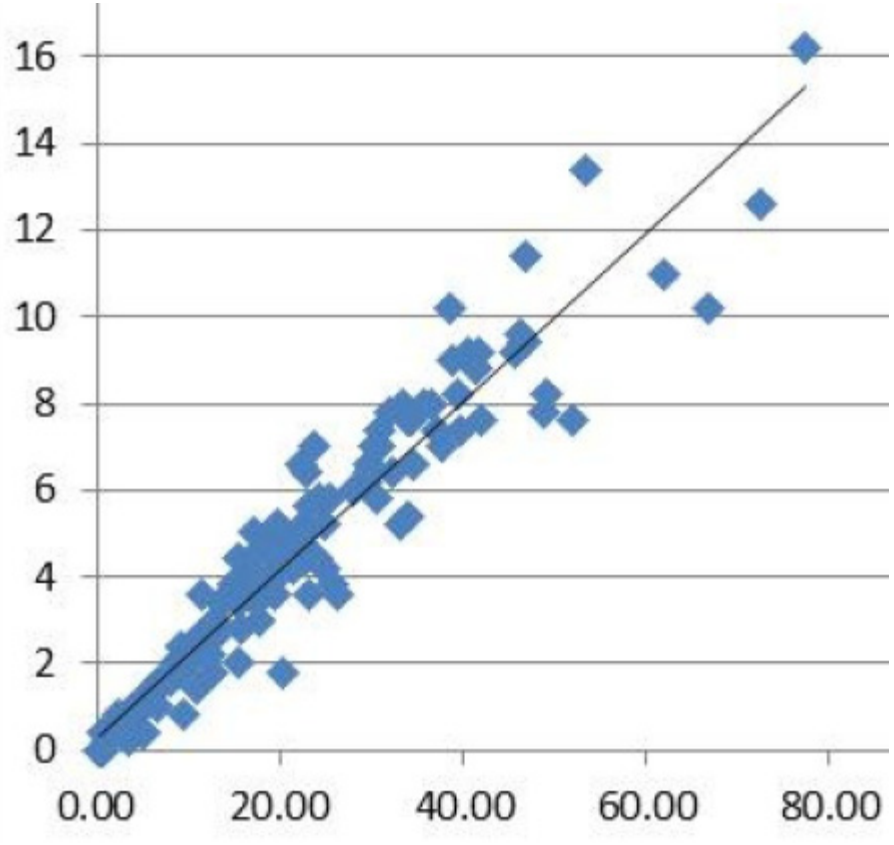
Applying the cow individual feed intake (DMI or NRC)



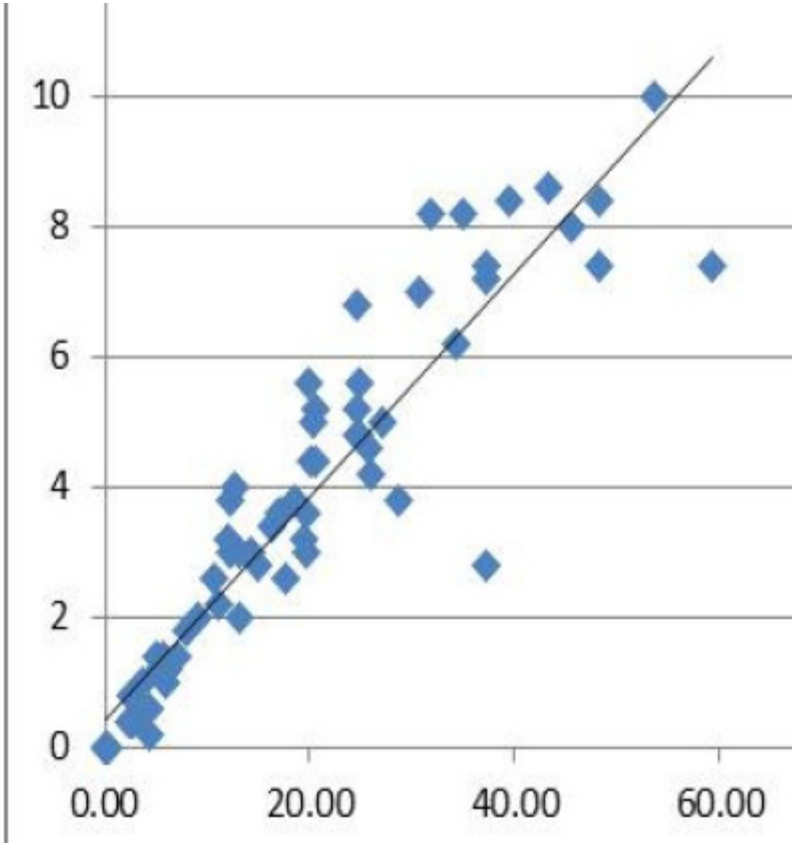
NRC **Feeding according to cow individual energy balance. Maltz et al. JDS 2013**

DMI **Predicting the feed intake of the individual dairy cow Halachmi et al., JDS 2004**

The DMI Model with additional parameter – feeding behavior

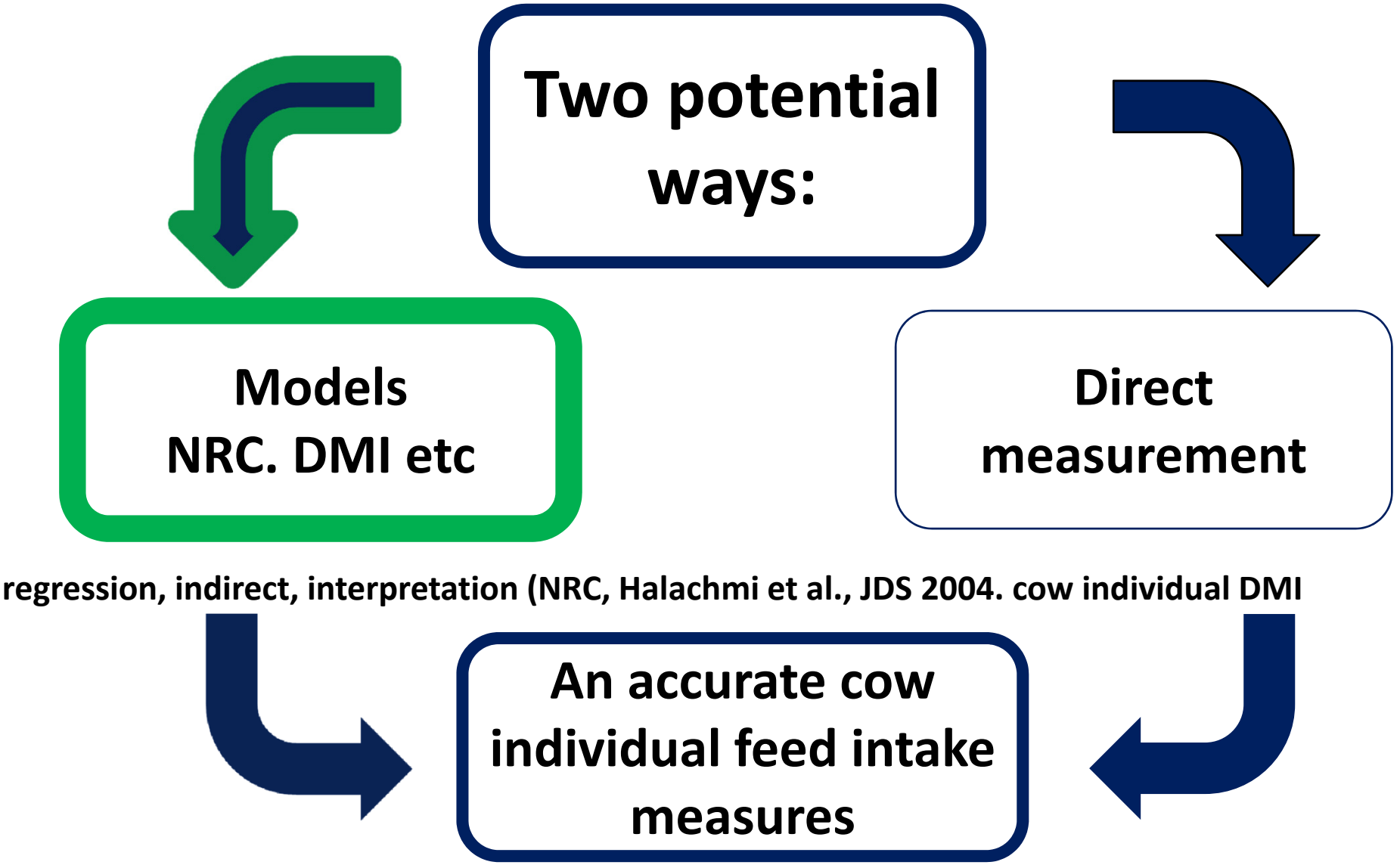


Cow individual (2628) Feed intake over time. R^2= 0.91



Cow individual (2573) Feed intake over time. R^2= 0.86

Knowing the cow individual feed intake:



In brief

- Feed intake can be applied in:
  - estimating the cow individual feed efficiency.
  - feed effciancy
- Feed intake can be monitored
  - directly (reserch farms) or
  - via sensor based models (commercial farms)
- Feeding behavior can be a parameter in a DMI model

Dissuasion further research -

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Acknowledgment

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Panel discussion

The WWH questions:

- **Where are we ?**
- **Where do we go ?**
- **How do we go ?.**