*28 - 30 Novembre 2006 - Cégep de Victoriaville, Victoriaville, Quebec, Canada*
*SÉMINAIRE: Les sols et la nutrition végétale adaptée à l'agriculture biologique*
*Développements européen et américain*

# Soil and plant nutrition adapted to organic agriculture: European developments

Guido Haas

Content (3rd session)

## Organic profile - Ecobalance (LCA)

- Intensity levels of organic dairy farming
- LCA of agriculture in Hamburg
- LCA dairy grassland farming in southern Germany

Organic AgroExpertise Consultancy
www.agroexpertise.de

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# Organic dairy demonstration farm "Haus Riswick"
# State extension agency NRW

| | | Conventional | Organic farming conversion | | | Comparison |
|---|---|---|---|---|---|---|
| | Year | 2000 | 2001 | 2002 | 2003 | 2003 Conventional |
| **FPCM** | kg/cow*yr | 7.500 | 7.400 | 8.200 | 9.700 | 9.770 |
| Milk roughage | kg/ cow*yr | | 5.000 | 4.800 | 4.800 | |
| Concentrate | dt/ cow*yr | | 9 | 13 | 18 | |

= > Organic dairy performance can be as high as conventional,

= > if high amounts of concentrates are fed.

= > Is there a difference to conventional? Organic profile?

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# National organic dairy farm evaluation

Krutzinna et al. 1996 n = 253, 1993 -'95

"... the organic farming approach (in dairy farming) is most likely realized in feeding because of

- low amounts of concentrate use and
- almost no feed purchase."


**Performance kg/cow**

| | |
|---|---|
| Organic | 5 000 |
| Conventional | 6 100 |

**Organic profile -**

**Consumer expectation?!**

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# Impact of feeding pattern and feed purchase on dairy performance and nutrient balances of organic farms

Förderung im Rahmen des Bundesprogramms Ökologischer Landbau des Bundesministeriums für Verbraucherschutz, Ernährung und Landwirtschaft

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# Characteristics of the analysed organic dairy farms in two regions in Germany (North-Rhine Westphalia; Allgeau)

(mean, coefficient of variation [%] in parenthesis, range underneath)

| | Farmed area [ha] | Proportion of grassland [1] [%] | Herd size [no. of dairy cows] | Stocking rate [2] [LU ha$^{-1}$] | Annual milk yield [3] [kg cow$^{-1}$] | Annual replacement rate [%] |
|---|---|---|---|---|---|---|
| All farms | 81 *(70)* | 69 *(25)* | 59 *(46)* | 1.35 *(25)* | 6,740 *(14)* | 26.0 *(27)* |
| n = 26 | 25 - 320 | 31 - 100 | 25 - 153 | 0.77 - 1.96 | 5,150 - 8,790 | 14.4 - 45.5 |
| NRW | 116 *(59)* | 52 *(19)* | 71 *(45)* | 1.14 *(26)* | 7,220 *(13)* | 29.2 *(47)* |
| n = 12 | 63 - 320 | 31 - 88 | 42 - 153 | 0.77 - 1.77 | 5,300 - 8,790 | 19.1 - 45.5 |
| Allgaeu | 53 *(43)* | 83 *(20)* | 48 *(35)* | 1.55 *(17)* | 6,325 *(12)* | 23.2 *(14)* |
| n = 14 | 25 - 109 | 42 - 100 | 25 - 75 | 1.06 - 1.96 | 5,150 - 7,460 | 14.4 - 38.5 |

1) Almost all of it permanent grassland

2) LU - livestock-unit (each 500 kg live weight) including replacement stock.

3) **Standardised fat and protein corrected milk (FPCM): 4.0% fat and 3.4% protein which is very close to average.**



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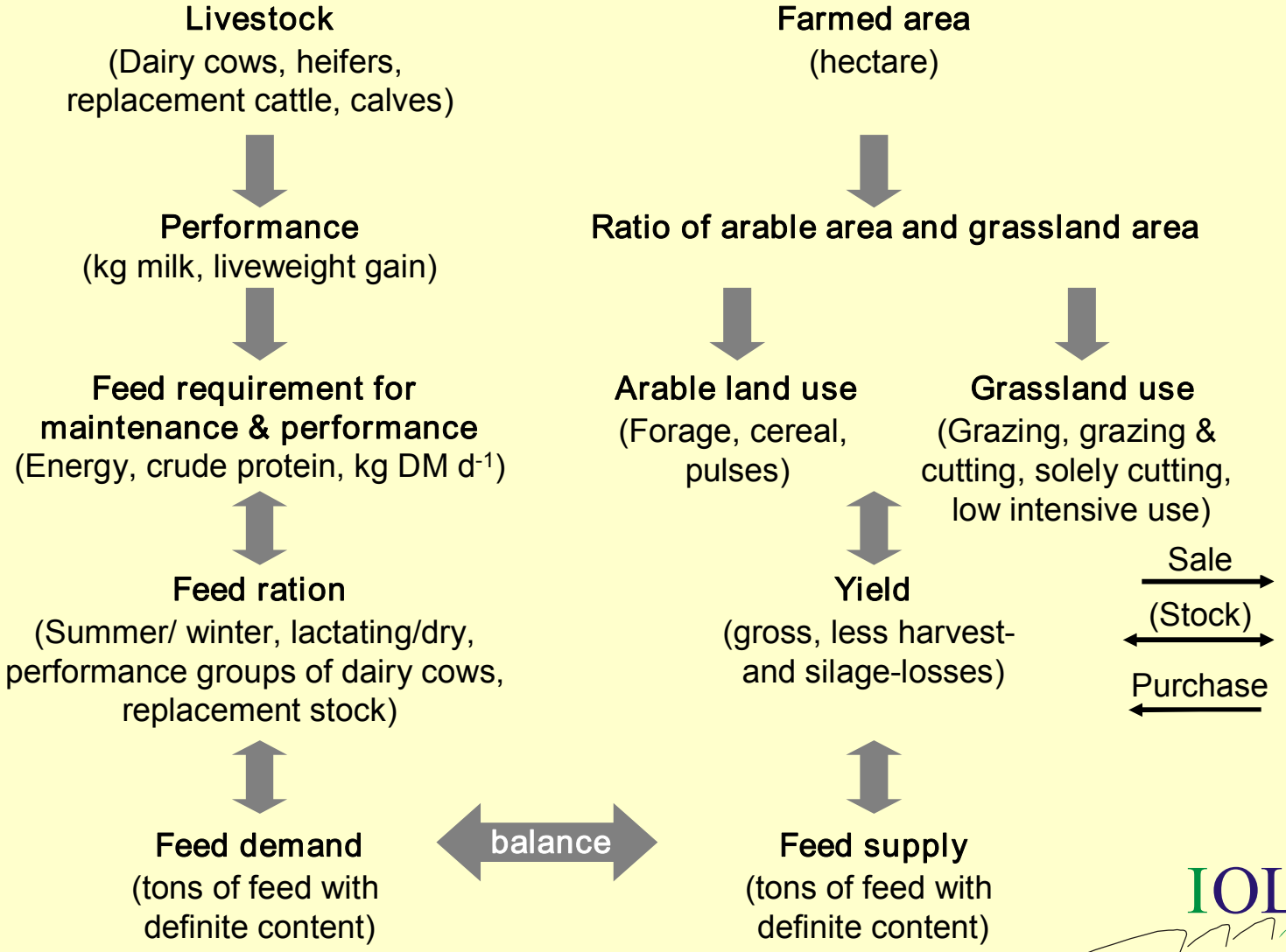
# Model to analyse, calculate and check plausibility of the annual feed balance of demand and supply of a dairy farm




Haas et al. 2006/2007: Livestock Science

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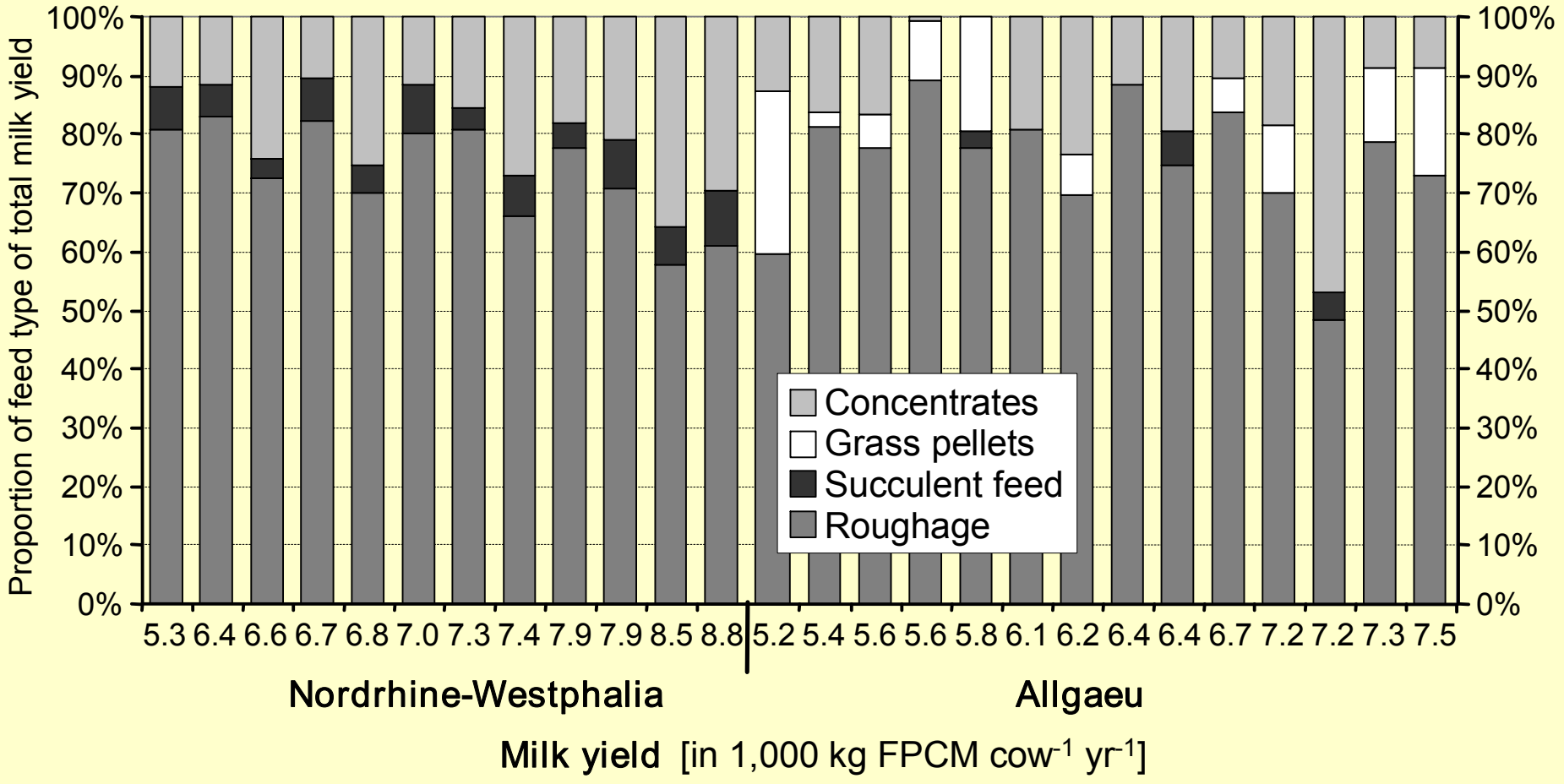
# Proportion of feed type on energy basis [NEL MJ] of total milk yield

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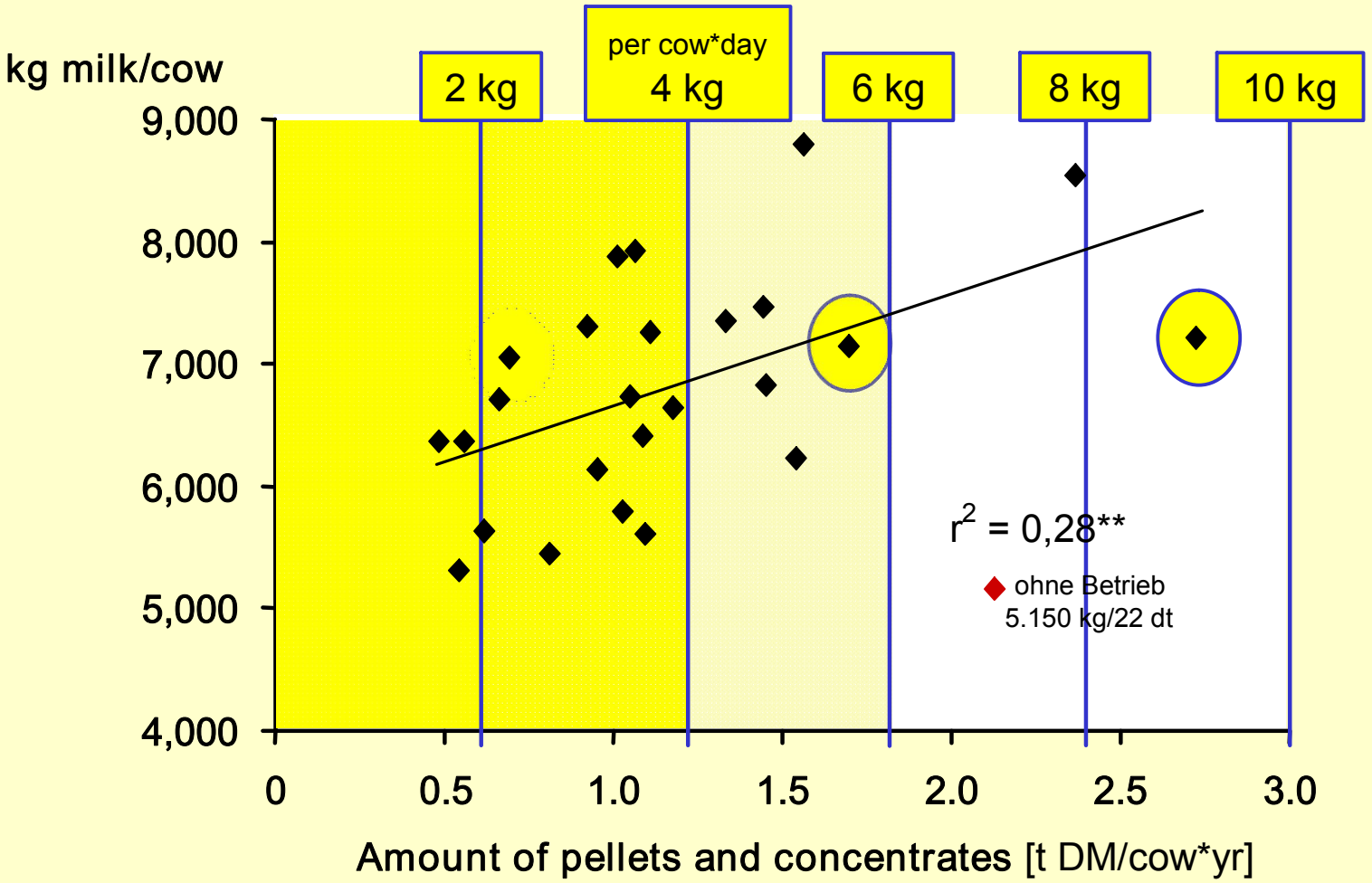
# As higher concentrate use as higher milk yiled - but clear difference between farms (n = 24)




= > Profile: appropriate amount of concentrate?

Haas & Deittert 2004, report

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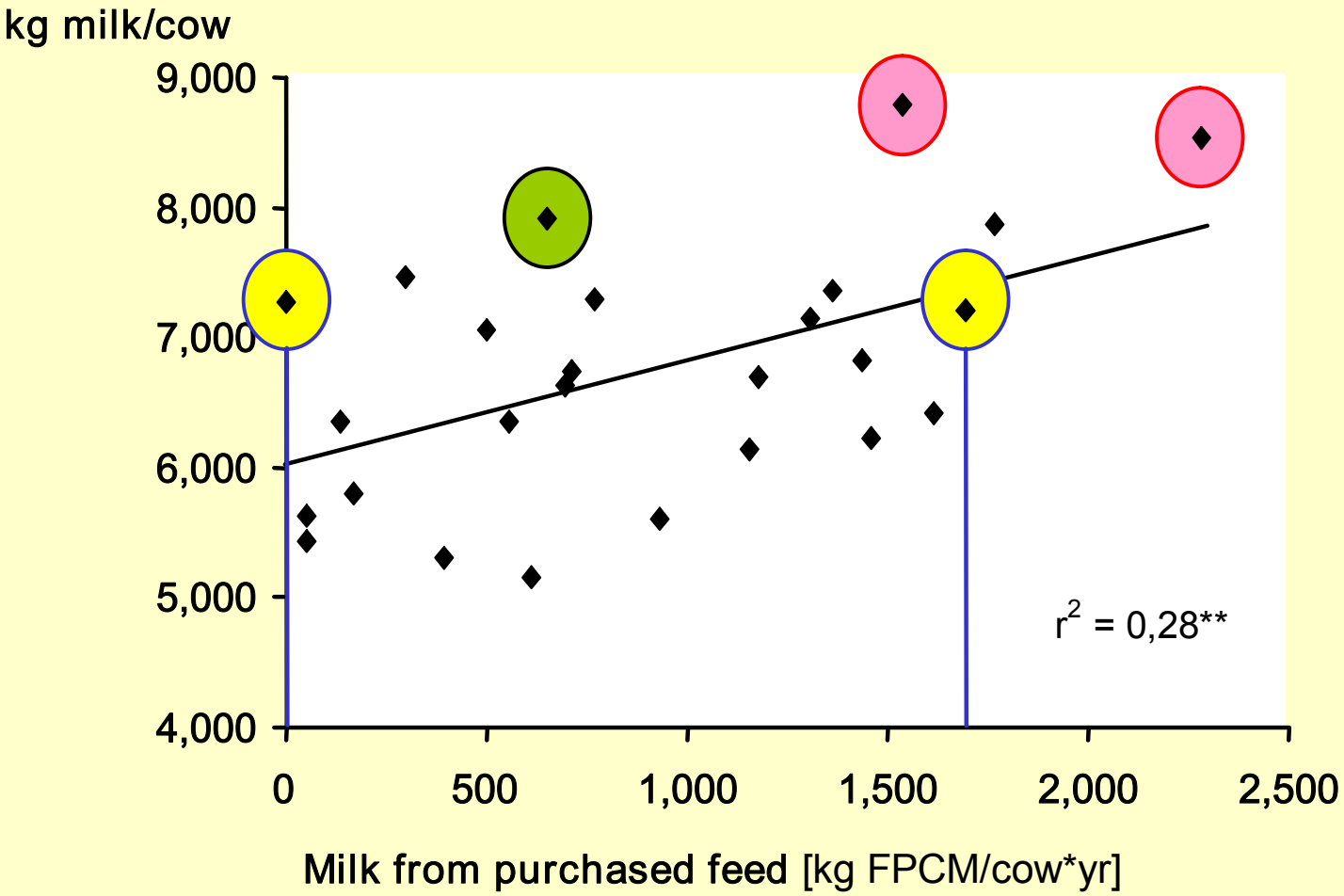
# As higher milk from purchased feed as higher total milk performance- but farm variation is high (n = 24)

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# Milk from purchased feed of organic dairy farms

in two regions in Germany (n = 26), mean, range underneath

| | Unit | 26 farms |
|---|---|---|
| Milk from concentrates and succulent feed | kg FPCM / cow*yr | 1.500<br>50 - 3.700 |
| Milch from purchased feed (concentrate/ succulent feed) | kg FPCM / cow*yr | 900<br>0 - 2.300 |
| Proportion of milk from feed purchase of milk from concentrate & succulent feed | | 65%<br>0 - 100% |
| Proportion of milk from feed purchase of total milk yield | | 13%<br>0 - 27% |
| Milk from home-grown feed | kg FPCM / cow*yr | 5.800<br>4.500 - 7.300 |

=> Up to ¼ of milk from purchased feed:
Profile home-grown feed? Low external input?

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# Milk yield and feed acreage

## of organic dairy farms in two regions in Germany (n = 26)

| | Milk per acreage [kg FPCM $ha^{-1}$] | Feed acreage per cow [$ha\ cow^{-1}$] | | |
|---|---|---|---|---|
| | | **Total area** | **Farm area** | **Off-farm area** |
| Mean (coefficient of variation)<br>Range | **6,968**<br>4,237 - 10,186 | 0.96<br>0.60 - 1.52 | 0.85<br>0.46 - 1.44 | 0.11<br>0 - 0.32 |

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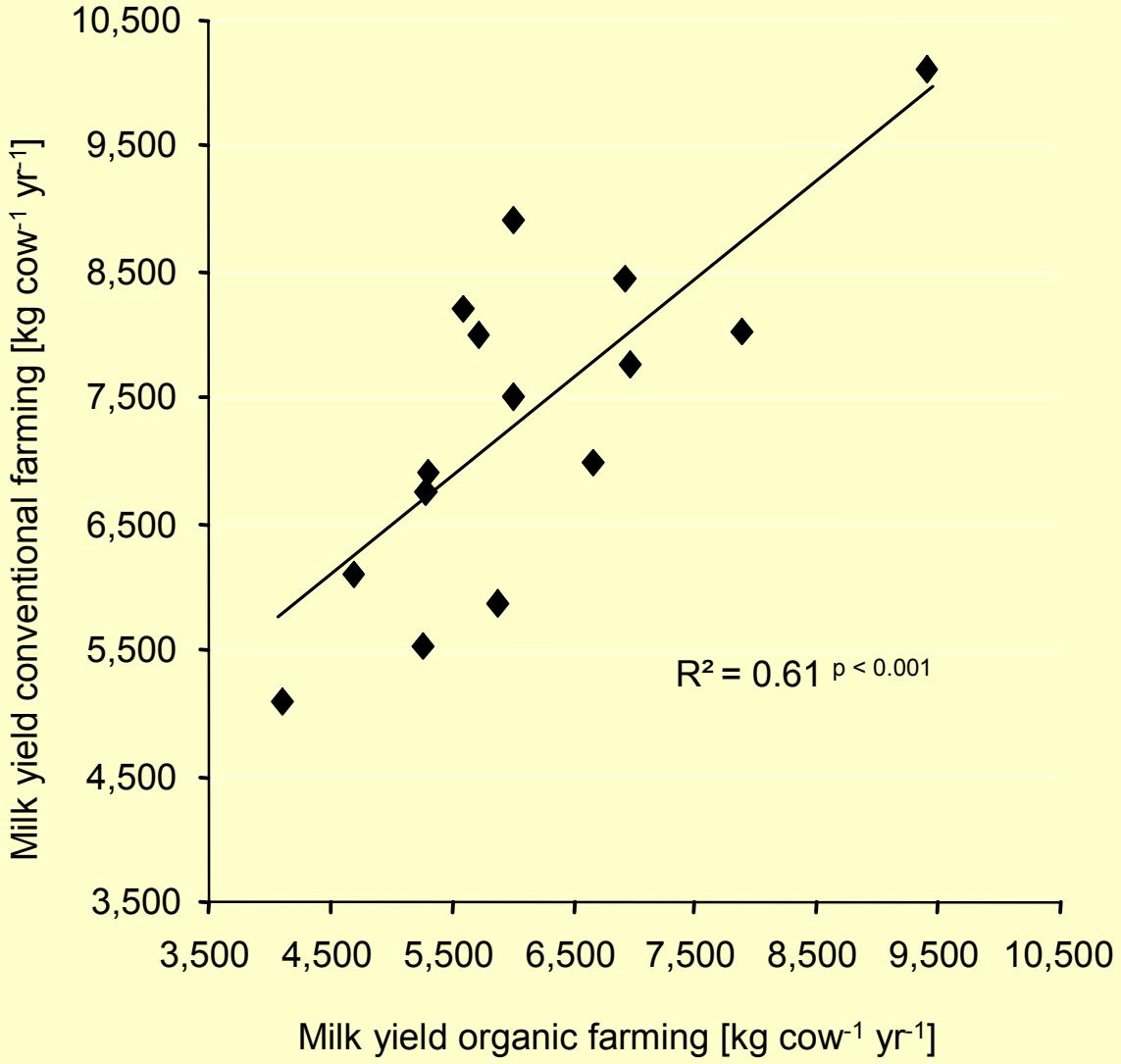
# Relationship between milk yield of organic and conventional dairy farming in comparison studies in several European countries

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# NPK-farmgate balances of 26 organic dairy farms in two regions

## Schema of a extended (including $N_2$-fixation) farm gate nutrient balance

| Input | Output |
|---|---|
| Symbiotic $N_2$-fixation of legume crops | Livestock produce (milk, animals) |
| Purchase of feed | Crops (cash crops, forage) |
| Straw for bedding, cattle, fertiliser seed potatoes | |

## Annual area related farm gate nutrient balance [kg $ha^{-1}$ farmed area]

*(rounded, mean, coefficient of variation [%] (in parenthesis), range underneath)*

| | N | | | P | | | K | | |
|---|---|---|---|---|---|---|---|---|---|
| | Input | Output | **Balance** | Input | Output | **Balance** | Input | Output | **Balance** |
| All farms | 78 (*29*) | 35 (*22*) | **43** (*51*) | 4.4 (*67*) | 7.2 (*33*) | **-2.8** (*129*) | 10.3 (*64*) | 9.4 (*38*) | **0.8** (*905*) |
| n = 26 | 43 - 125 | 20 - 51 | 8 - 85 | 0 - 10 | 4 - 16 | -14 - 4 | 0 - 20 | 5 - 21 | -13 - 15 |



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# NPK-farmgate balances of 26 organic dairy farms in two regions

**Nitrogen** balance: **share [%]** of input and output components

(rounded, mean, *coefficient of variation [%] in parenthesis*, range underneath)

| | Input | | | Output | | |
|---|---|---|---|---|---|---|
| | $N_2$-fixation | Feed | Straw/ animals/ seed potatoes | Milk | Cash crops | Animals |
| All farms | **72** (*23*) | **25** (*68*) | **3** (*203*) | **79** (*15*) | **7** (*192*) | **14** (*31*) |
| n = 26 | 34 - 100 | 0 - **58** | 0 - 26 | 38 - 92 | 0 - 55 | 7 - 24 |

**=> Up to 58% of external N input -**
**Profile almost closed inner farm nutrient cycle?**

**Phosphorus** balance: **share [%]** of input and output components

| | Input | | | Output | | |
|---|---|---|---|---|---|---|
| | Feed | Straw | Animals / seed potatoes | Milk | Cash crops | Animals |
| All farms | **86** (*29*) | **11** (*224*) | **2** (*174*) | **75** (*19*) | **8** (*206*) | 17 (*32*) |
| n = 26 | 2 - 100 | 0 - 98 | 0 - 15 | 29 - 90 | 0 - 65 | 6 - 30 |

Haas et al. 2007, RAFS

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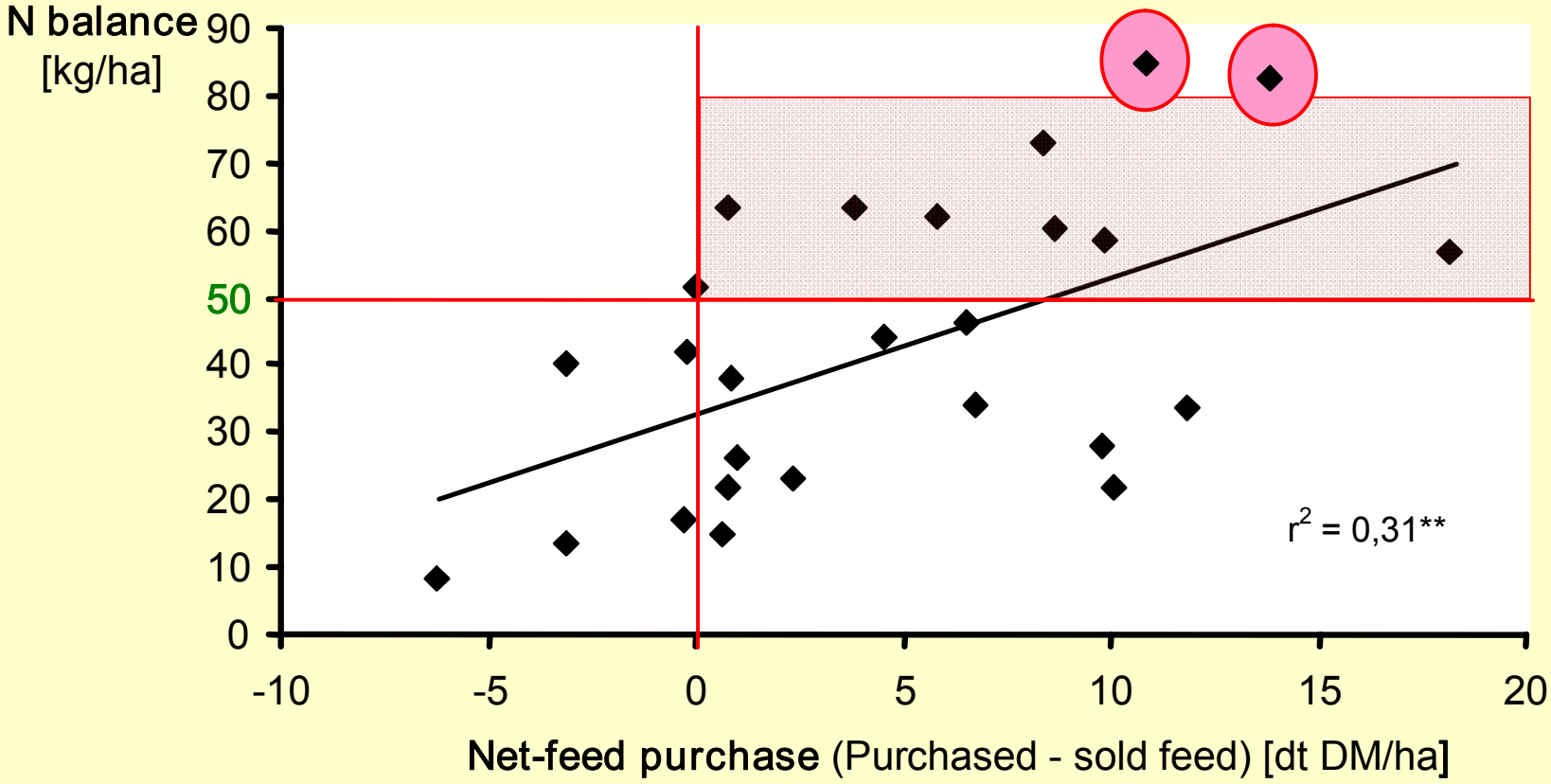
# As higher net feed purchase as higher N surplus (n = 26)




= > Up to 85 kg N/ha surplus because of feed purchase

Profile almost closed inner farm nutrient cycle?

Haas & Deittert 2004, report

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## Reported N surplus of organic and conventional dairy farms in Europe (Haas et al. 2007)

| Reference, region/country and year of investigation if reported | Number of farms | Organic | Conventional optimised [2] | Conventional mainstream |
|---|---|---|---|---|
| Presented study<br>RW and Allgaeu [3] 2001/02 | 26 | 43 kg $ha^{-1}$<br>6,740 kg milk | | |
| Haas et al.[18]<br>Bavarian Allgaeu [3] 1998 | 6 each | 31 kg $ha^{-1}$<br>5,280 kg milk | 31 kg $ha^{-1}$<br>6,390 kg milk | 80 kg $ha^{-1}$<br>6,760 kg milk |
| Scheringer[21], p. 28<br>Lower Saxony [3] 1998/99 | 7 / 10 /[10+29] | 56 kg $ha^{-1}$<br>5,300 kg milk | 77 kg $ha^{-1}$<br>6,660 kg milk | 146 kg $ha^{-1}$<br>6,900 kg milk |
| Taube and Poetsch[31]<br>Austria | 40 / 51 / 66 | 24 kg $ha^{-1}$<br>4,710 kg milk | 25 kg $ha^{-1}$<br>4,650 kg milk | 37 kg $ha^{-1}$<br>6,100 kg milk |
| Jonsson[37] [4]<br>Sweden (north-east) 1990 - 2001 | Field scale experiment | 27 kg $ha^{-1}$<br>7,892 kg milk | | 90 kg $ha^{-1}$<br>8,038 kg milk |
| Cederberg and Flysjoe[38], p.19<br>Sweden (south-west) 2002 | 6 / 8 [5] / 9 | 71 kg $ha^{-1}$<br>9,400 kg milk | 114 kg $ha^{-1}$<br>9,130 kg milk | 158 kg $ha^{-1}$<br>10,100 kg milk |
| Halberg et al.[23]<br>Denmark 1989-1991 | 14 / 16 pilot farms | 103 kg $ha^{-1}$<br>5,600 kg milk | | 221 kg $ha^{-1}$<br>8,200 kg milk |
| Kristensen[32]<br>Denmark 2002 | 133 / 93 / 212 [6] on sandy soil | 104 kg $ha^{-1}$<br>6,958 kg milk | 112 kg $ha^{-1}$<br>7,764 kg milk | 174 kg $ha^{-1}$<br>7,764 kg milk |
| Leach and Roberts[40]<br>Scotland (1989 -)1996 - 1998 | Field scale experiment | 90 kg $ha^{-1}$<br>5,717 kg milk | | 258 kg $ha^{-1}$<br>8,000 kg milk |
| Veer[41] & Pinxterhuis et al.[42]<br>Netherlands: 1997 conv. - 2000 org. | Transition of research farm | 101 kg $ha^{-1}$<br>6,930 kg milk | | 253 kg $ha^{-1}$<br>8,450 kg milk |
| Smolders and Wagenaar[43]<br>Beldman et al.[44]; Netherland [7] | 11 / 91 / 91 [8] | 102 kg $ha^{-1}$<br>7,350 kg milk | 153 kg $ha^{-1}$<br>8,073 kg milk | 237 kg $ha^{-1}$<br>7,837 kg milk |

# Conclusion: Productivity and profile organic dairy farming

- Milk yield as high as conventional possible, if feeding particular concentrate use is similar.
- Optimizing conventional farms can result in similar performance, e.g. N balance: differentiation?
- Intensification in organic dairy farming must be considered carefully.

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## Dairy


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