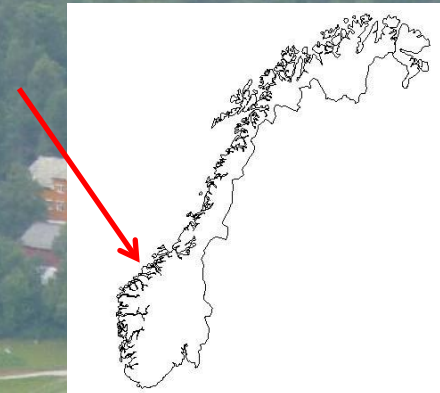


Long-term changes in soil nutrients and grass/clover yields on Tingvoll farm

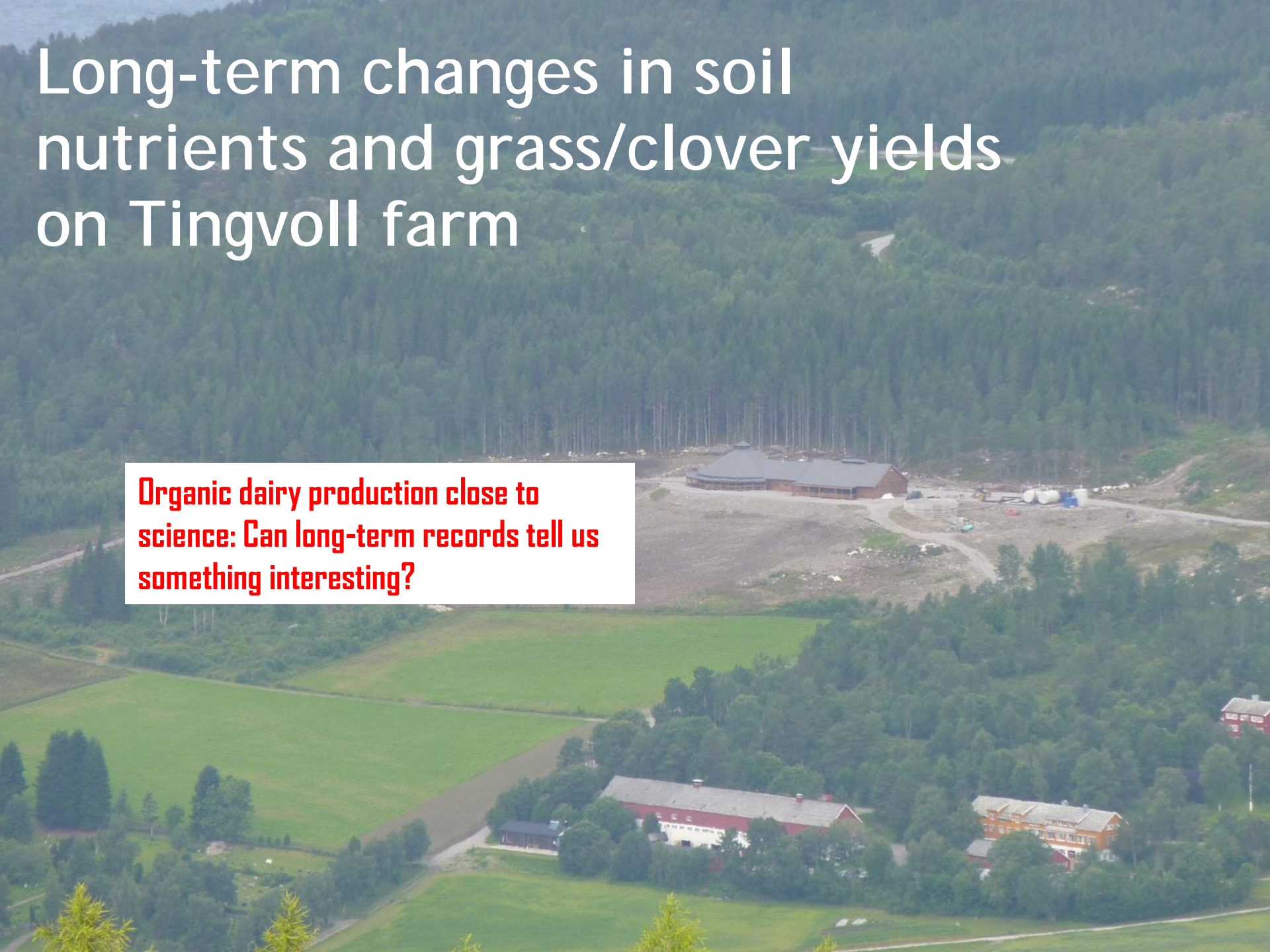
NJF seminar 461
Vingsted, Denmark
August 22, 2013

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Long-term changes in soil nutrients and grass/clover yields on Tingvoll farm

Organic dairy production close to science: Can long-term records tell us something interesting?



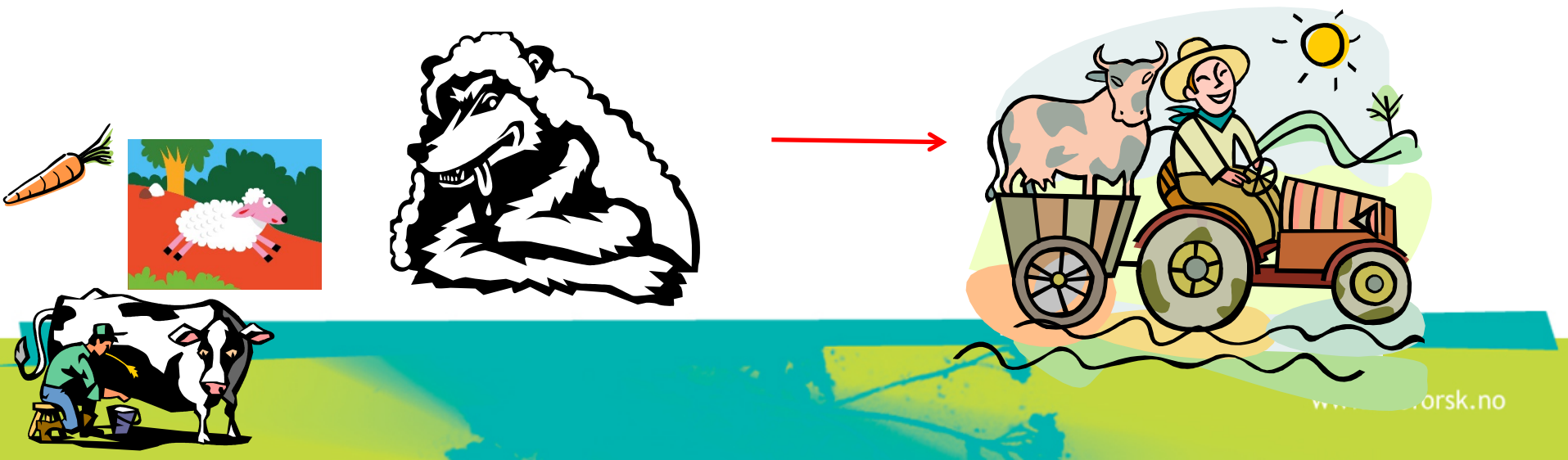
Outline of presentation

- The practical management of Tingvoll farm
- Methods for long-term farm study
- Results: **NPK accounts, soil, yields**
- Conclusions



Tingvoll farm 1990-2013

- Public research station for sheep turned into mixed sheep and dairy cow production
- Certified organic management since 1993
- Gradually less sheep and more cows
- Gradually less people involved
- Gradually more renting of farmland + quota
- New cow barn in 2010



Tingvoll farm, 2010



New cow-barn

Biogas plant

Farmland under cultivation

Private house

Old cow-barn

Administrational building

Church yard

Centre for solar- and bioenergy

Storage of exp. equipment

Details from the new cow-barn



Social organisation of Tingvoll farm

- Tenant family owns the herd + machinery, rents land + buildings
- Norwegian Centre for Ecological Agriculture owns the land + buildings
- Bioforsk Organic Food and Farming (40 employees) rents land for experiments and conducts farm level registrations



Erik Lindhart, Anne de Boer, Jesper and Arne

Production at Tingvoll farm



- Big shift 2004: Milk quota + farmland almost doubled
- Current milk quota 150 tons y^{-1} ; 22 organic dairy cows
- Aiming for low proportion of concentrates and high quality silage
- Shifts 2010:
 - From tower silage to round bales, earlier and quicker harvest
 - From FYM to (anaerobically digested) slurry
 - From spring calving and 24 h grazing in summer to spread calving and day grazing
- Ley renewed each 4.-5. year
- Cover crop = Cereals for green fodder



Methods, long-term farm studies

- Soil (0-20 cm depth) sampled regularly at fixed sites (1989, 1995, 2000, 2009)
- Dry matter (DM) yields recorded on most fields belonging to Tingvoll farm (23 ha)
- 1st cut measured in 2-11 fields per year
- 2nd cut often used for grazing and then no measurement; 1-6 fields per year measured
- Weather data:
 - Sum of precipitation May + June
 - Average temperature May + June
- Farm level nutrient accounts
 - Purchased minus sold items containing N, P, K
 - N fixation not included!

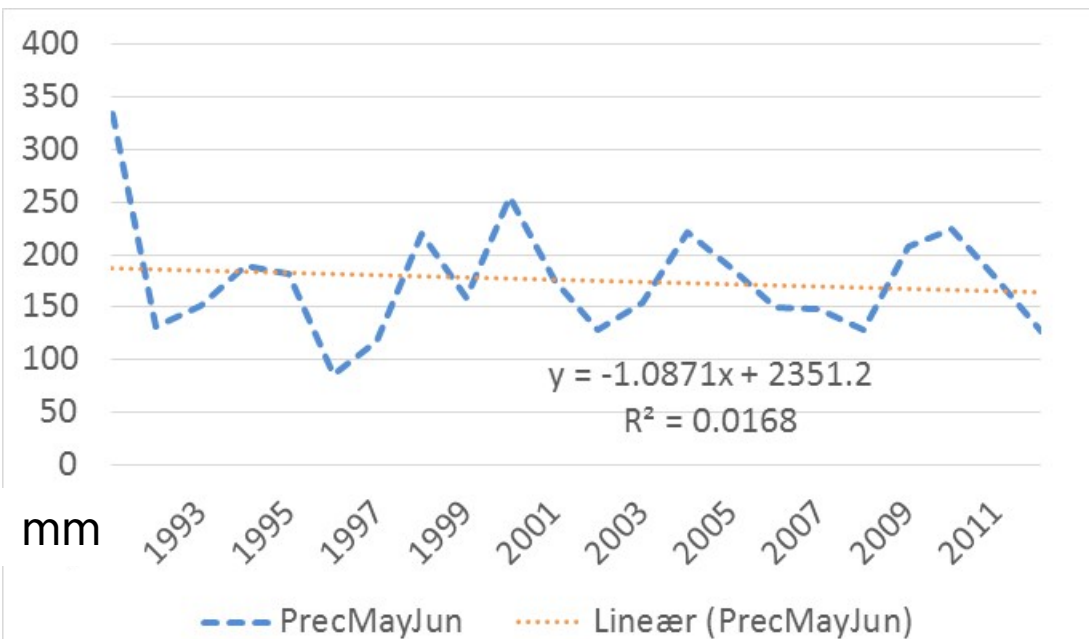


Can we see any long-term trends?

- *Former farm level study:* Soil nutrients depleted by organic dairy production aiming for self-sufficiency - (Løes and Øgaard 1997; 2001; 2003). Do we find the same pattern at Tingvoll farm?
- Weather will be more warm and wet due to climatic change ---- will the yield levels on Tingvoll farm increase?
- Lots of changing frame conditions... can long-term records tell us something of interest?



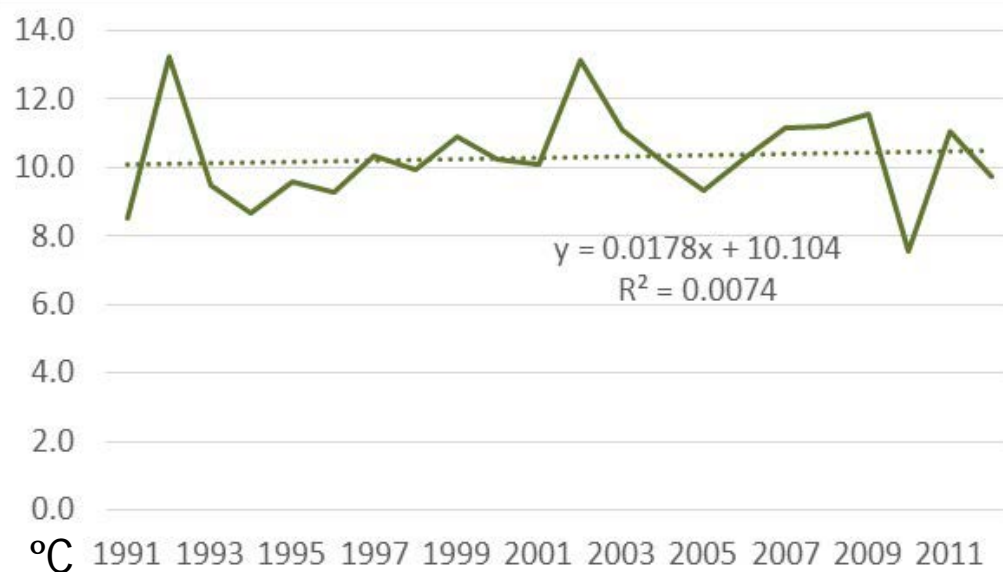
Weather data 1991-2012



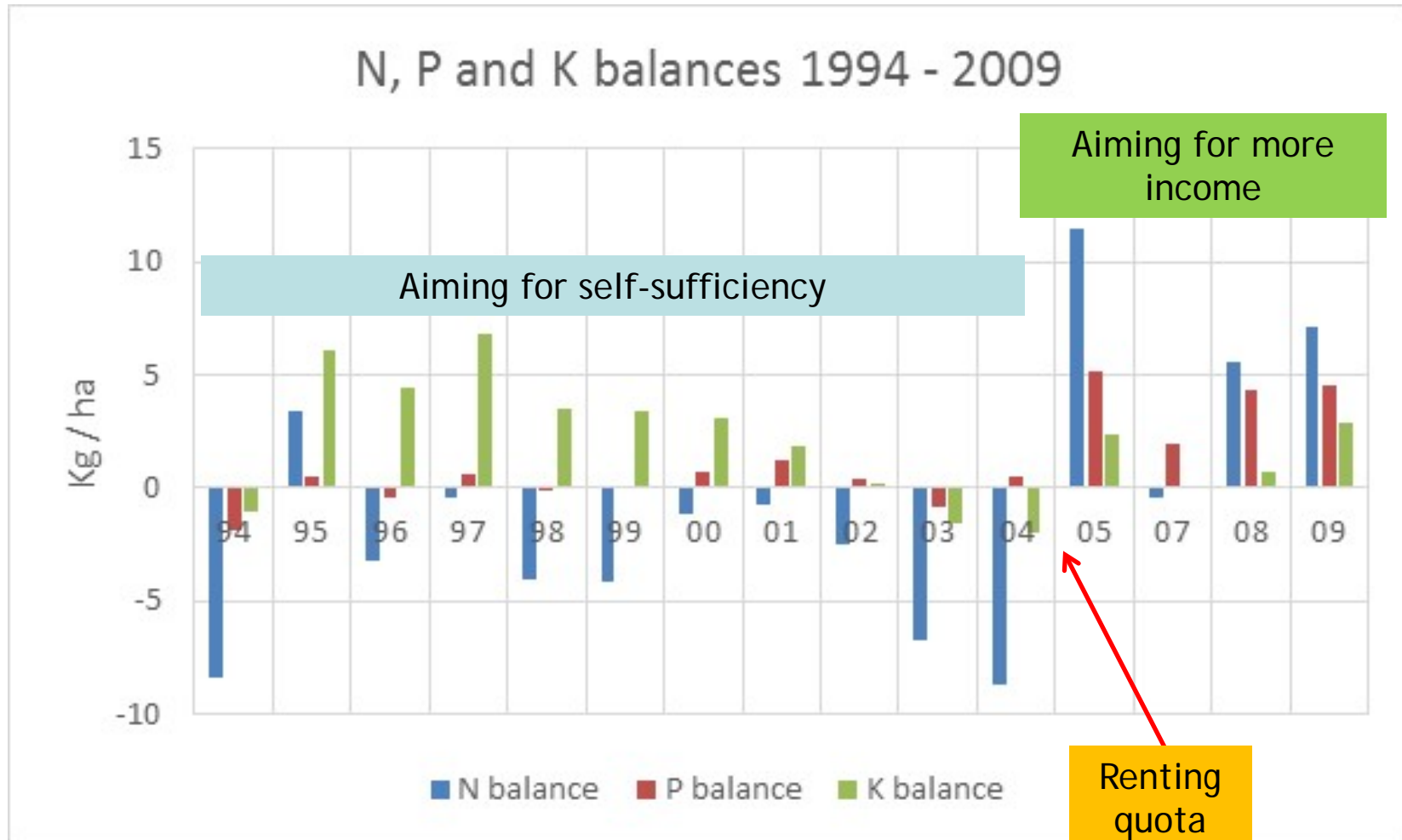
- More wet? More warm?
- No clear trends for May + June

Sum of precipitation May + June

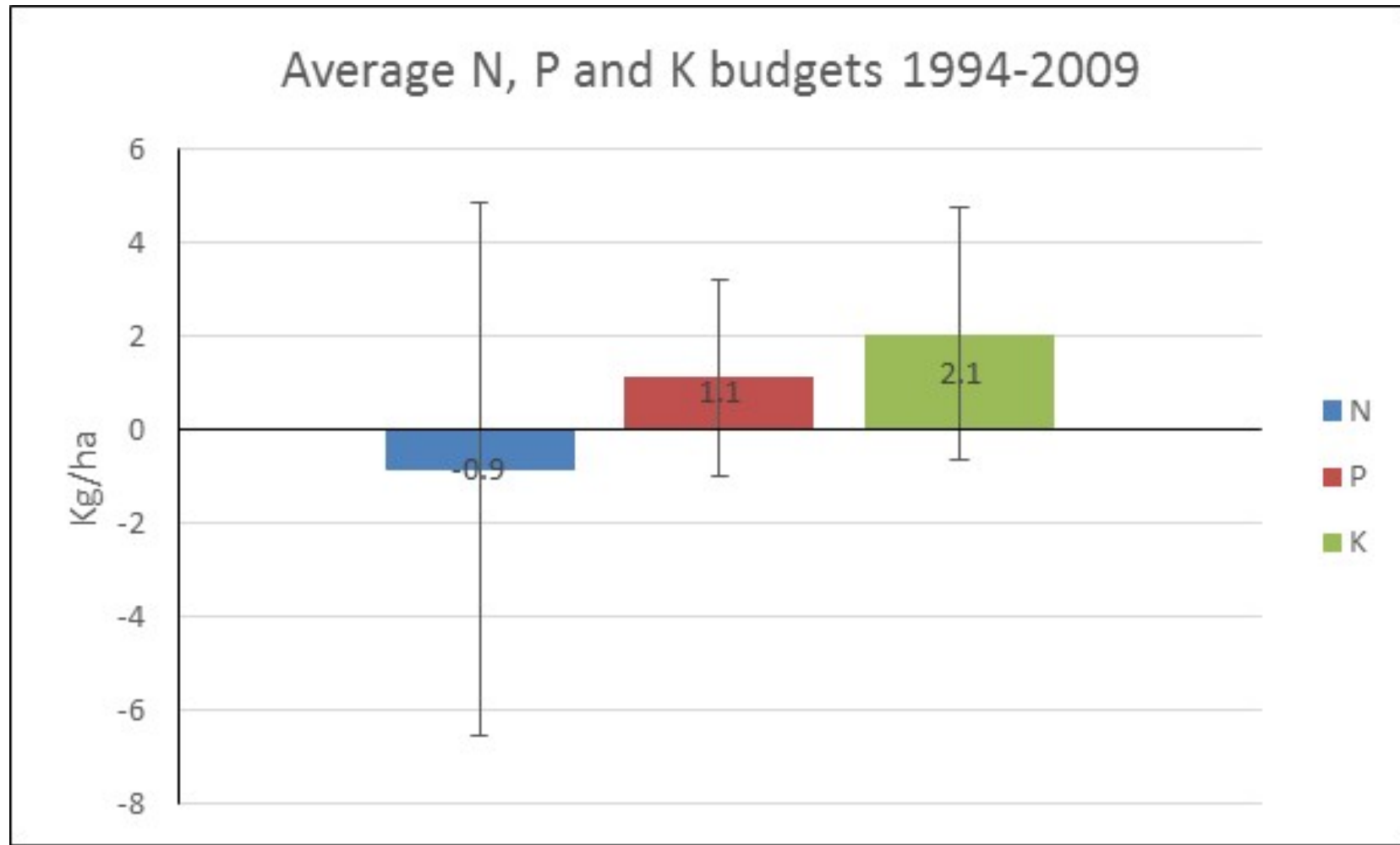
Average temperature May + June



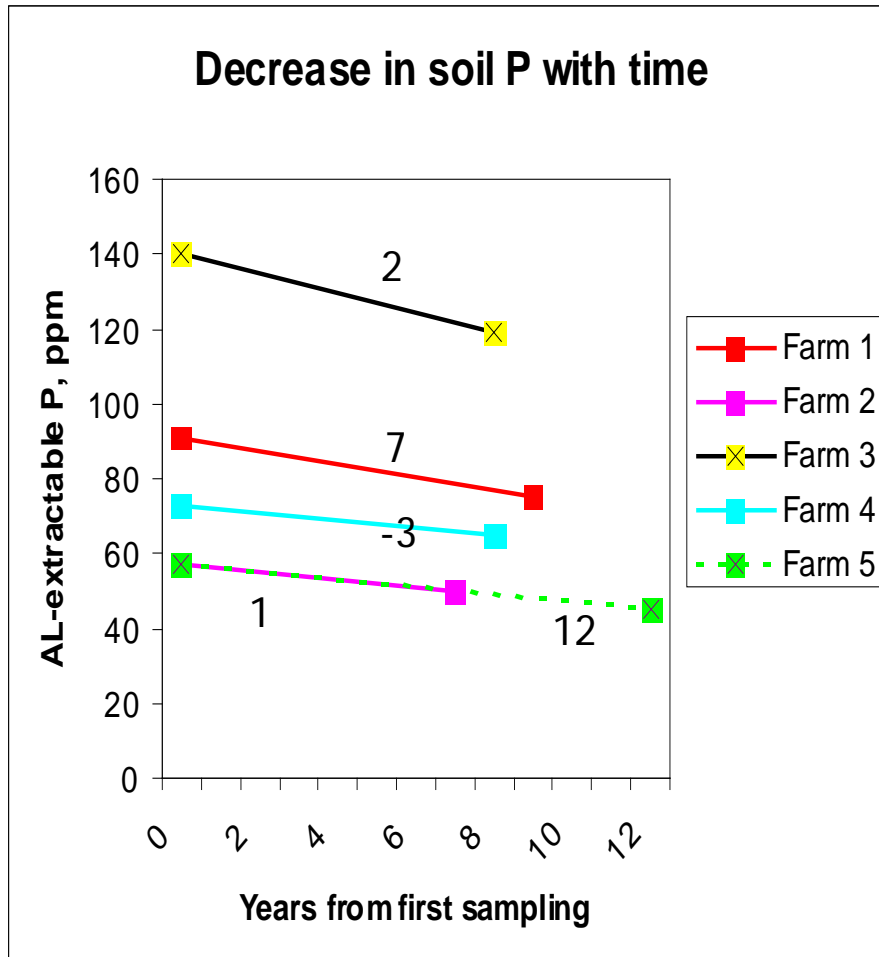
Results, nutrient accounts



Results, nutrient accounts



Results, soil

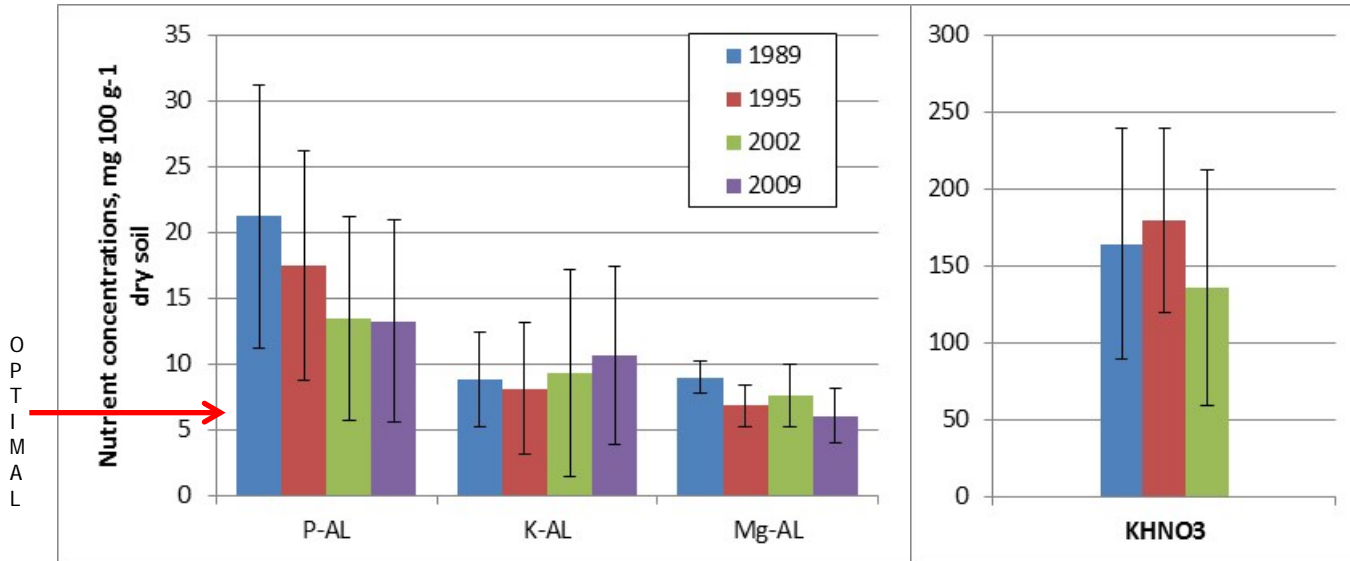


Decrease of P-AL concentrations with time on organic dairy farms aiming at self-sufficiency with fodder

Average farm level P balance, kg P ha⁻¹ y⁻¹ shown for each farm (-3, 1, 2, 7, 12)

Løes and Øgaard 2001: Long-term changes in extractable soil P in organic dairy farming systems. Plant and Soil 237:321-332.

Results, soil

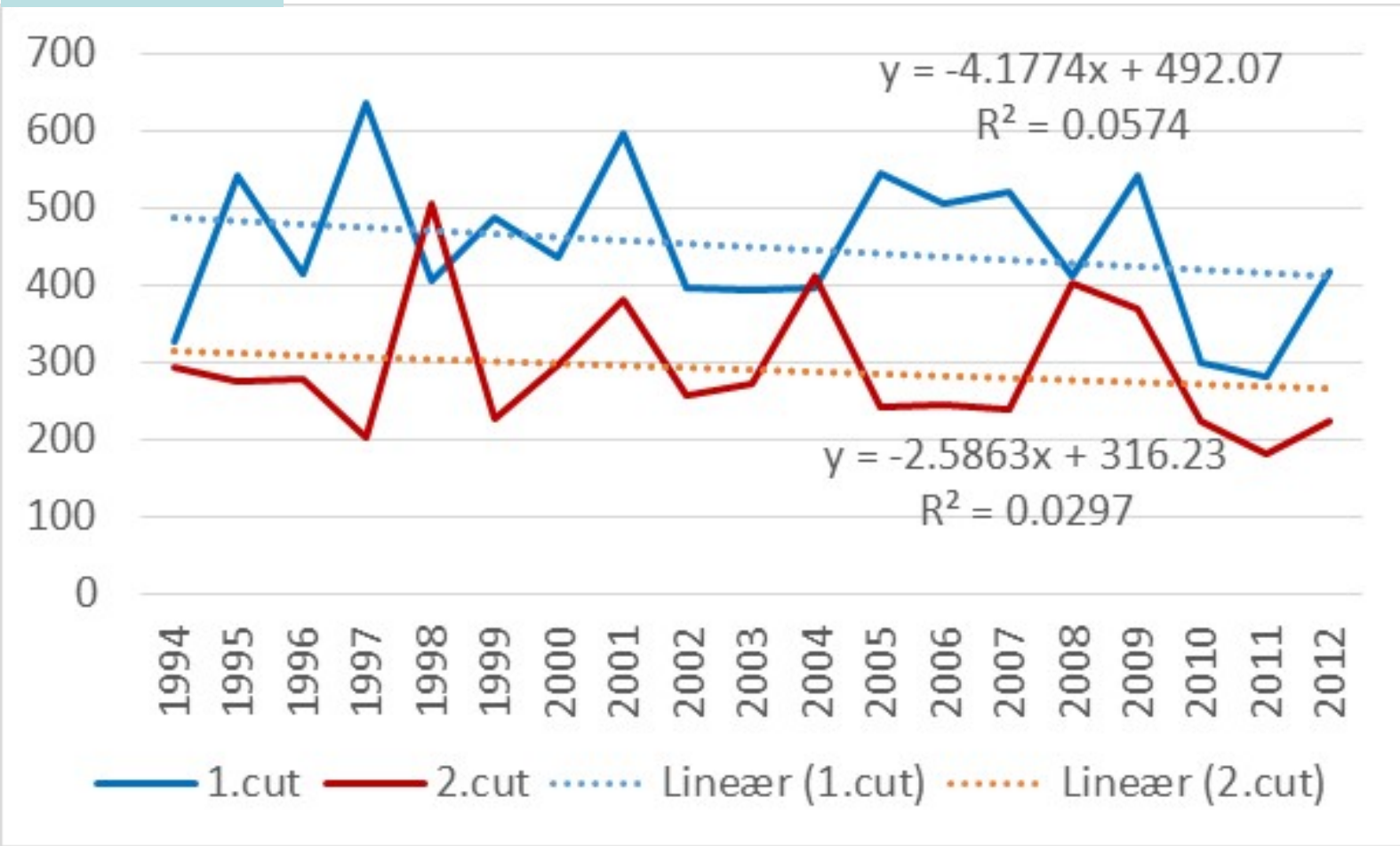


- Decrease of P concentrations with time on Tingvoll farm. Average P surplus 1.1 kg P ha⁻¹ y⁻¹
- Decreasing trend also for Mg and acid-soluble K

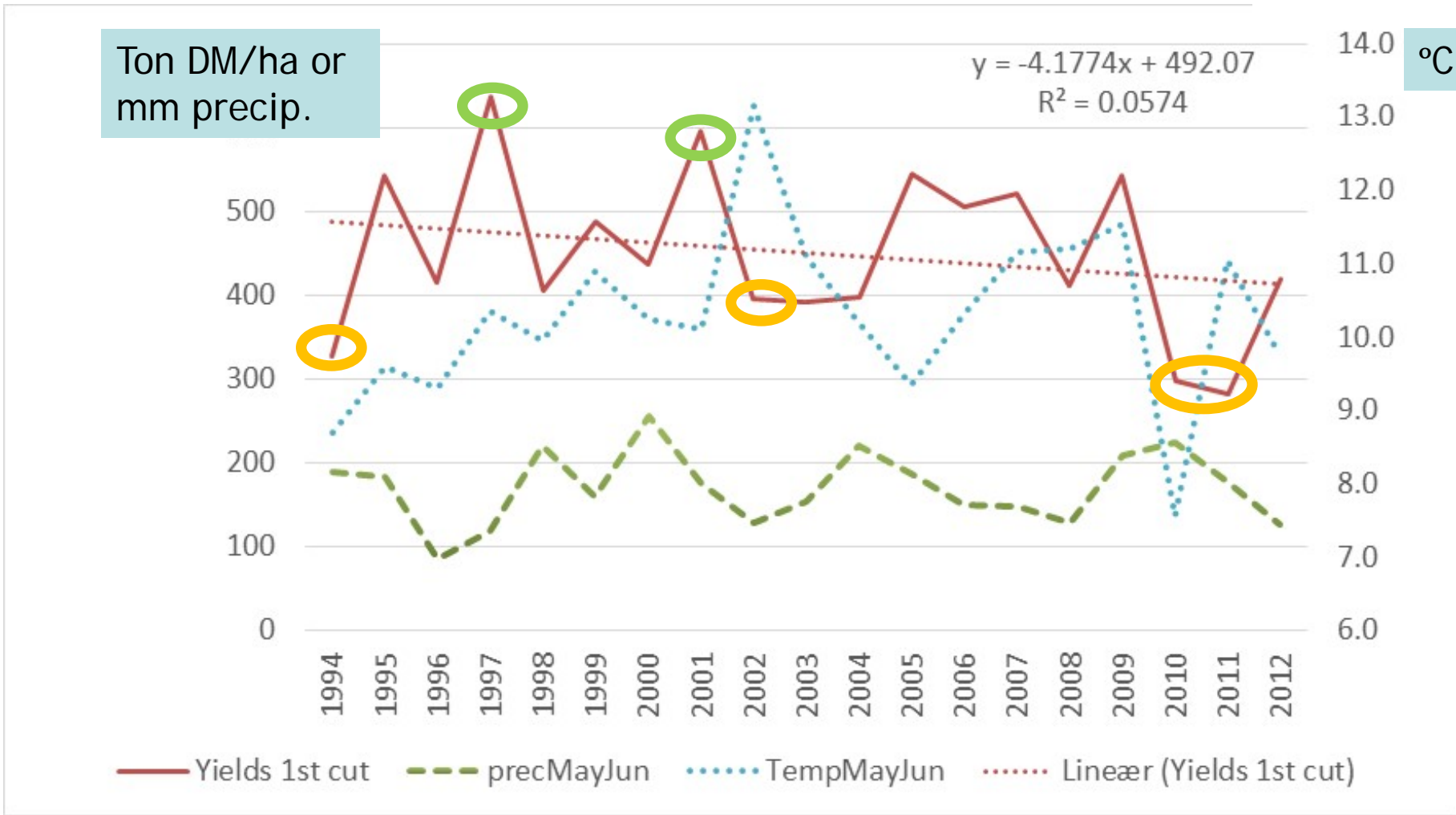
Results, yields



Ton DM/ha

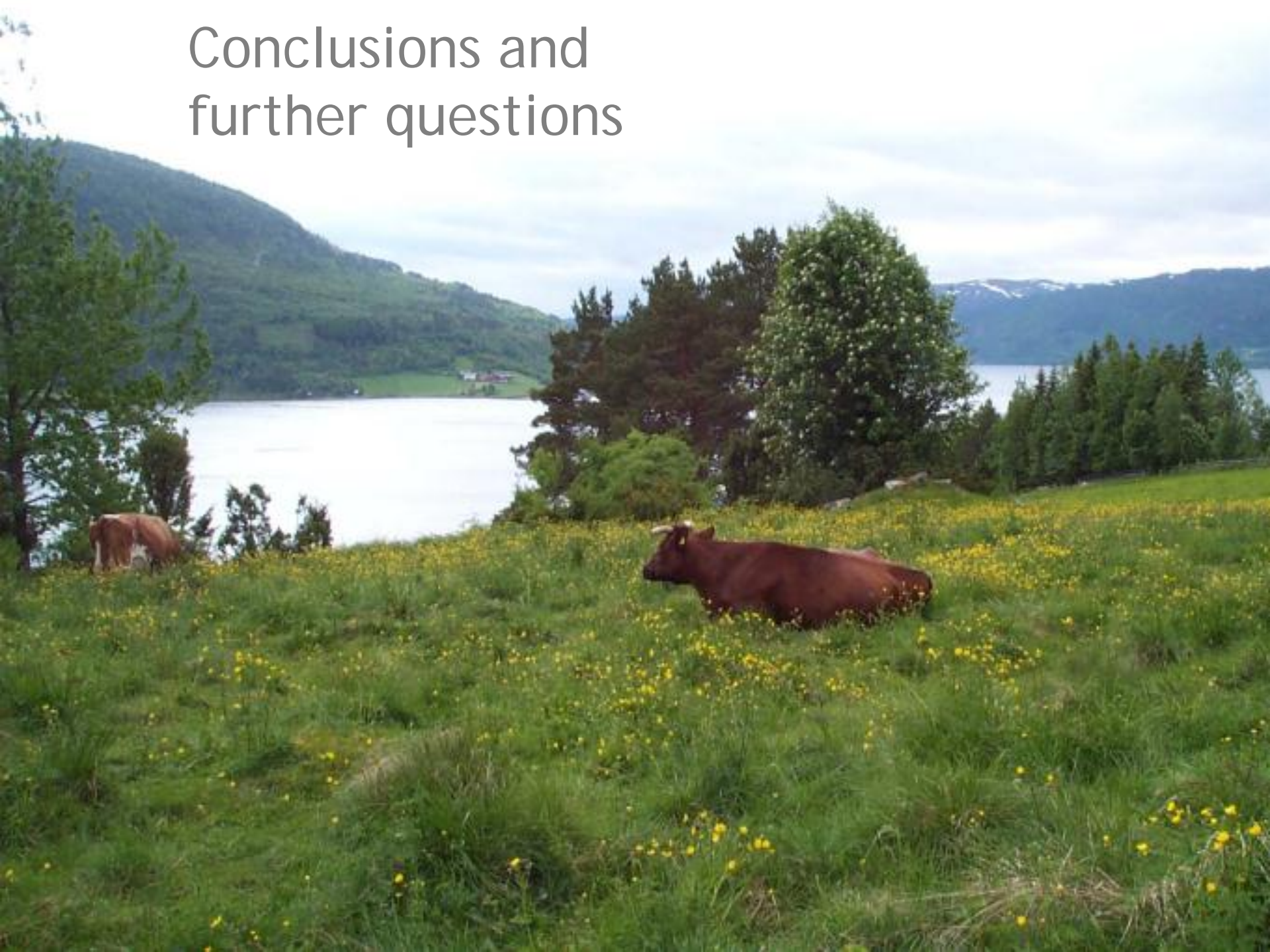


Results, combined



○ High yields: Dry, medium temp (1997, 2001). ○ Low yields: Wet and cold (1994, 2010) or dry and warm (2002, 2011)

Conclusions and further questions



Conclusions

- Nutrient accounts show small surpluses until 2004
- Small surpluses correspond well to decreasing soil nutrient concentrations
- Yield levels on Tingvoll farm highly variable; no clear long-term trend



Further questions

- Average levels still optimal for plant growth, but what happens on field level?
- What can be learned from combining **field level** nutrient accounts (applied in manure minus removed in yields) with soil nutrient concentrations, botanical composition (to estimate N fixation), and weather records?

