

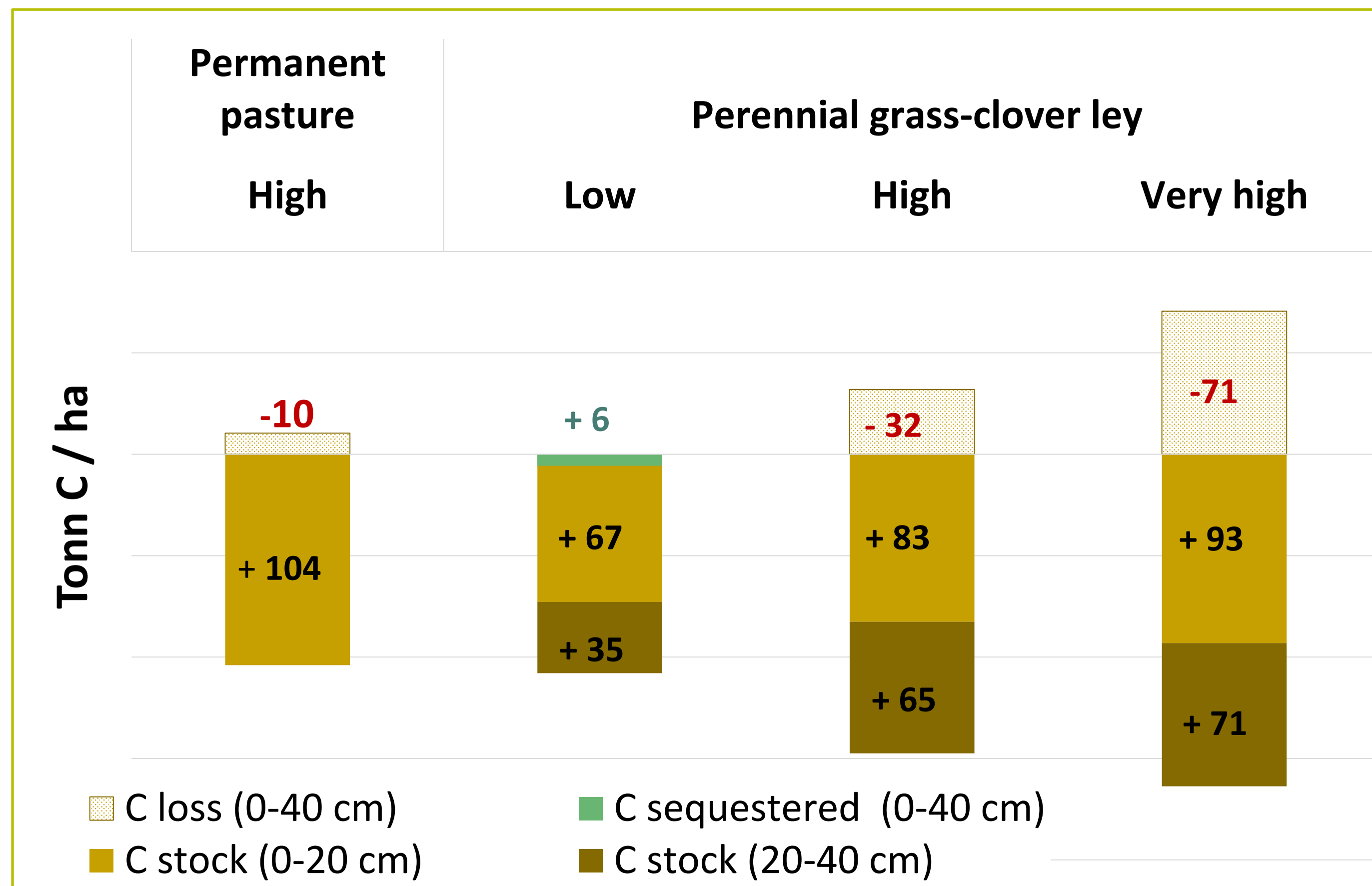
## Background

Organic milk production was established at Tingvoll experimental farm in 1989, replacing the previous conventional sheep production. Since then, soil nutrient supply has been manure from its own herd ( $\pm 20$  Norwegian red cows), biological nitrogen fixation and liming. Here, we report the impacts of 30 years organic dairy farm on soil characteristics and ley yields.

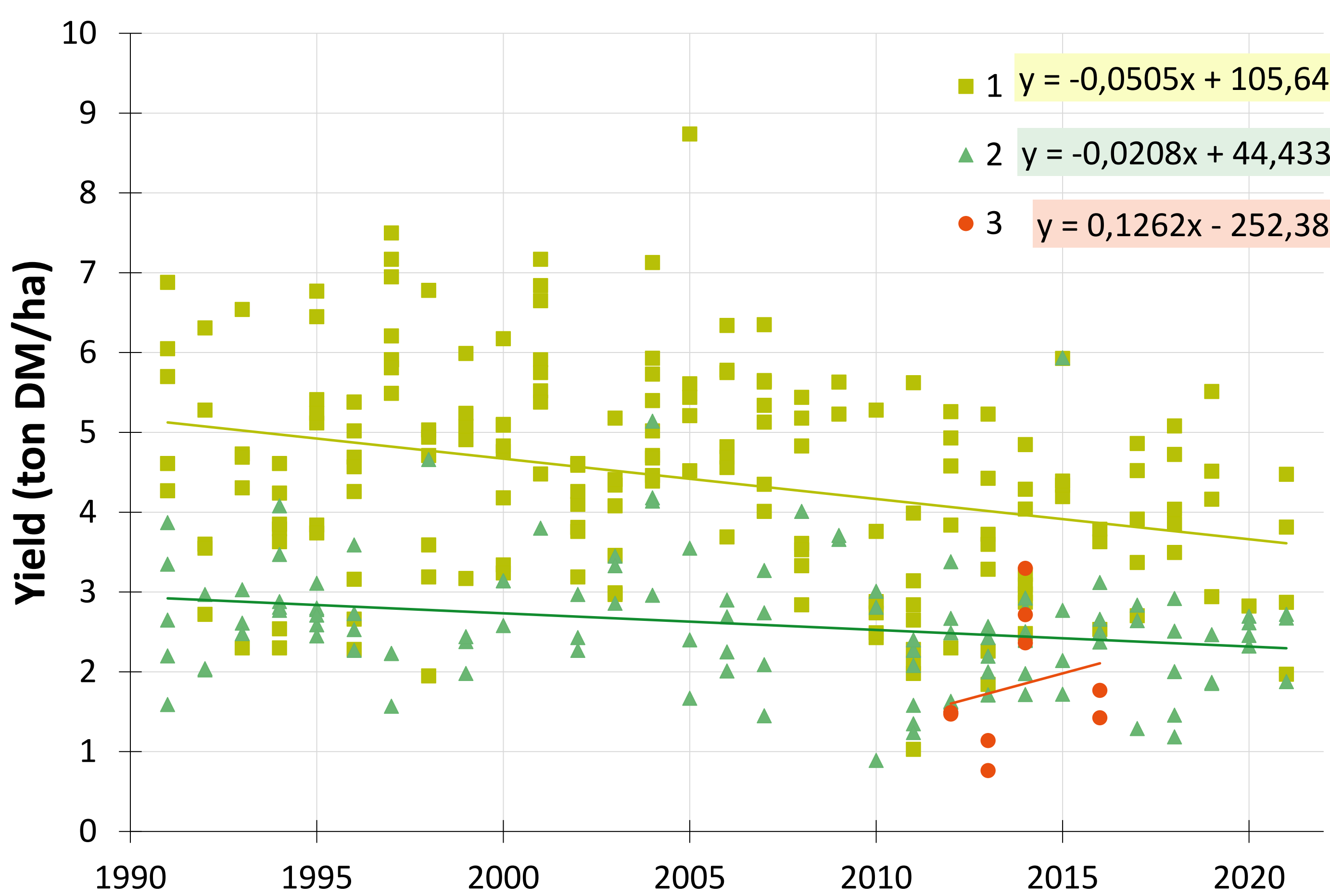
## Materials and Methods

Soil samples for concentrations of nutrients and soil organic matter (SOM) have been taken every 5–7-year intervals since 1990, and grass-clover yields and quality (e.x. crude protein) have been annually measured since 1991.

## Results



**Fig.2.** SOC dynamics and stock over 30-y period in the permanent pasture and perennial grass ley. SOM classes accord to their initial SOM content: **very high initial SOM >12%**, **high 6 < SOM < 12%**, **low SOM < 6%**.



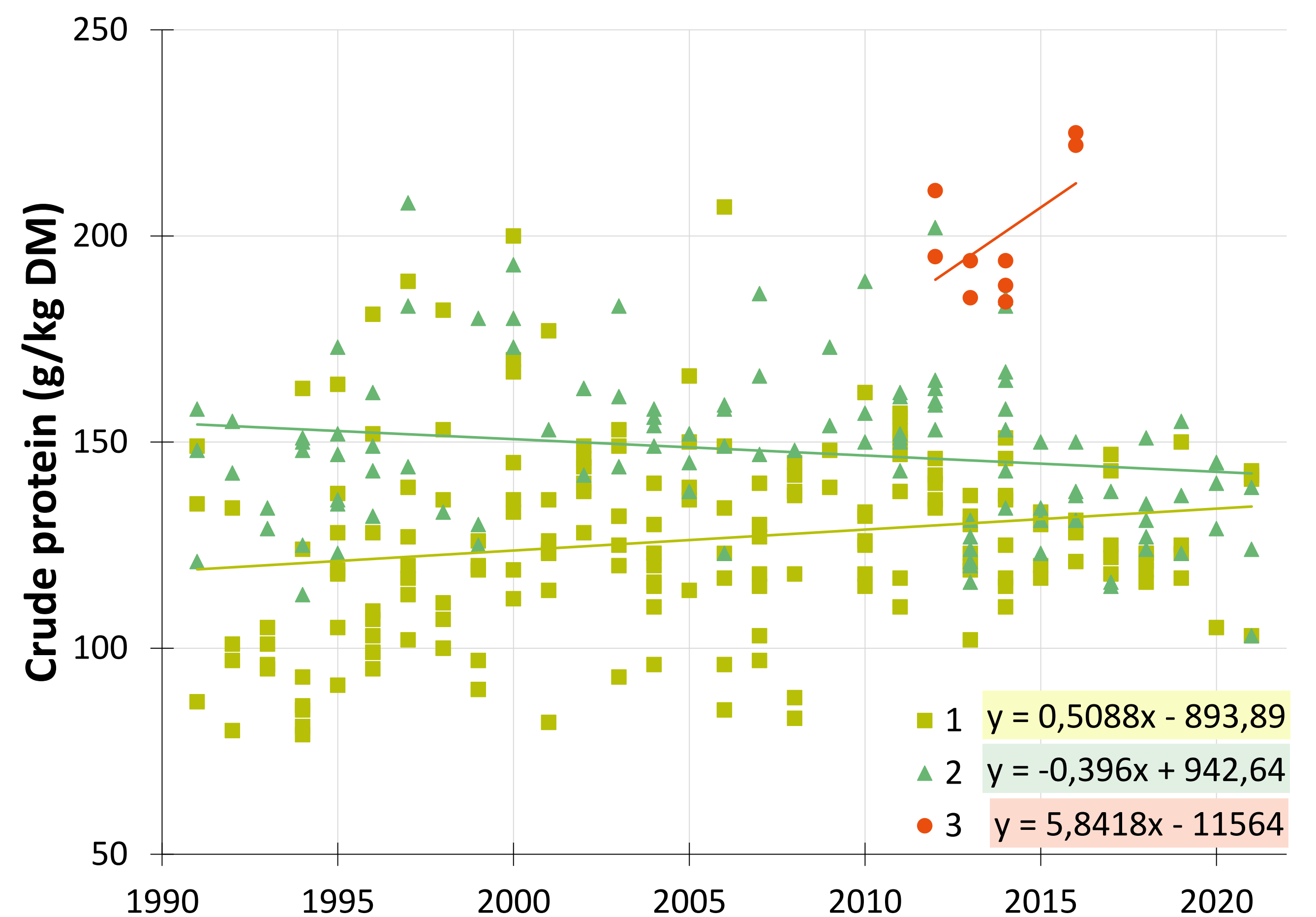
**Fig.3.** Yield of perennial grass-clover ley in the 1, 2 and 3 cut.



**Fig.1.** Tingvoll farm in 1990s (left). Permanent pasture in Tingvoll farm in 2021 (right).

**Tab.1.** Average soil nutrients across the years in the permanent pasture and perennial grass-clover ley

Year	P-AL	Mg-AL	K-AL	pH
	mg / 100 g	mg / 100 g	mg / 100 g	H <sub>2</sub> O
<b>Permanent pasture</b>				
1990	8.83	8.82	8.43	5.25
1995	8.53	6.53	12.02	5.58
2002	8.97	8.97	9.72	5.73
2009	7.52	10.42	11.14	5.82
2015	6.03	7.15	9.83	6.13
2021	7.38	7.63	14.5	5.93
<b>Perennial grass-clover ley</b>				
1990	18.08	8.70	8.30	5.72
1995	15.46	6.61	8.11	6.00
2002	12.11	7.33	8.95	5.99
2009	10.95	6.24	10.98	5.96
2015	8.45	7.27	9.62	6.19
2021	9.89	7.81	9.50	5.98



**Fig.4.** Crude protein concentration in the perennial grass-clover ley in the 1, 2 and 3 cut.

## Conclusions

- Our results suggested that cultivated areas are more prone to loss C than permanent pasture, especially in the areas with initial very high SOM content.
- Cultivated areas with low initial C stock levels were the ones that showed an increase in C storage; however, we just have 6 years of data.
- In the topsoil, SOM concentration and plant-available phosphorus (P-AL) and magnesium (Mg-AL) were lower in 2021 than in 1991.
- In fields with native low content of P-AL, P-AL has slight increased, but still characterized as low. Potassium (K-AL) content has increased from 1991 to 2021.
- The yield of the first and second cuts of the ley has slightly decreased since 1991, but the quality of the ley has been stable.

## Facts about Norwegian milk production

- The average herd of cows per dairy farmer increased from 11.7 cows in 1989 to 27.8 in 2018.
- From 1980 to 2018, Norway's dairy cow population has declined from 391 000 to 217 500 .
- The average farm size in 1999 was 14.7 ha. In 2018 this average was 24.9 ha.
- From 2012 to 2018 the total area of organic farming has decreased by 16.7 percent. The demand for organic food, however, has increased within the same time frame. From 2017 to 2018, sales of organic goods through food retailers increased by 8 percent.

Source: NIBIO