Carbon Footprints for Wheat Cropping Systems in Semiarid Prairies

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Canada

Sustainability

- environments
- production
- social-economics

Policy makers

The general public

Farmers

Carbon footprint
– an indicator of sustainability

Buyers consider grain products with low carbon footprints

- 56% of the world's largest food companies indicate they will reconsider suppliers based on the carbon footprint of products
- Processors and food companies require information on carbon footprints of goods or services
- Producers and input suppliers need information on the carbon footprints of products they grow and inputs they use

Carbon footprints in the business chain

- Carbon footprints may become the mainstream in business
- Direct trading on carbon footprints
- Labelling C-footprints on food products

Japanese products

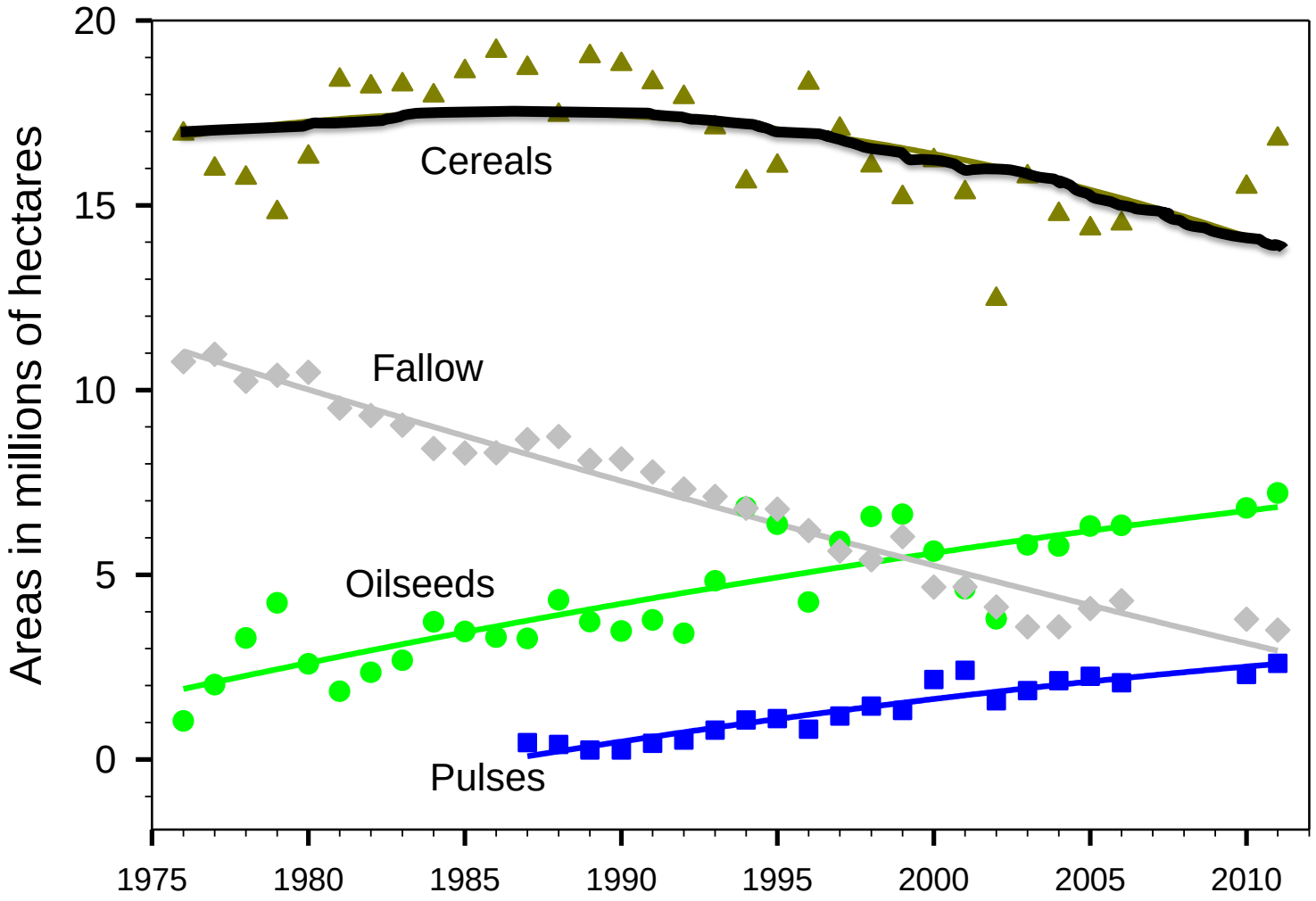
CO2 Labels Proposed for Beer Cans by '09

UK products

Farming – primary contributor to carbon footprints of foods

- About 60-95% of GHG emissions in food products occurs by the time the raw foodstuffs are at farm gates
- Pressure on farms to reduce C footprints
- Farmers do have choices of growing products with low C footprints

Areas seeded to major field crops in Western Canada



(Statistics Canada 2013)

Main sources of GHG emissions in wheat production

- Manufacture, transportation, storage, delivery of fertilizers, pesticides, and farm machinery to farm gates
- Fuel and other inputs used in performing field operations
- Straw and root decomposition post-harvest
- Soil residual N nitrification and denitrification
- Synthetic N volatilization and leaching
- Various farming operations
- Summerfallow effect

(Gan et al. 2011, Agron Sust Dev. 31:643-656)

Calculation of GHG emission in wheat cropping

Emissions of N_2O from synthetic N applications:

$$CO_2\,eq_{SNF} = Q_{SNF} \times \left\{(FRAC_{GASM} \times EF_{VD}) + EF + (FRAC_{LEACH} \times EF_{LEACH})\right\} \times \frac{44}{28} \times 298$$

Emissions from Crop residue decomposition:

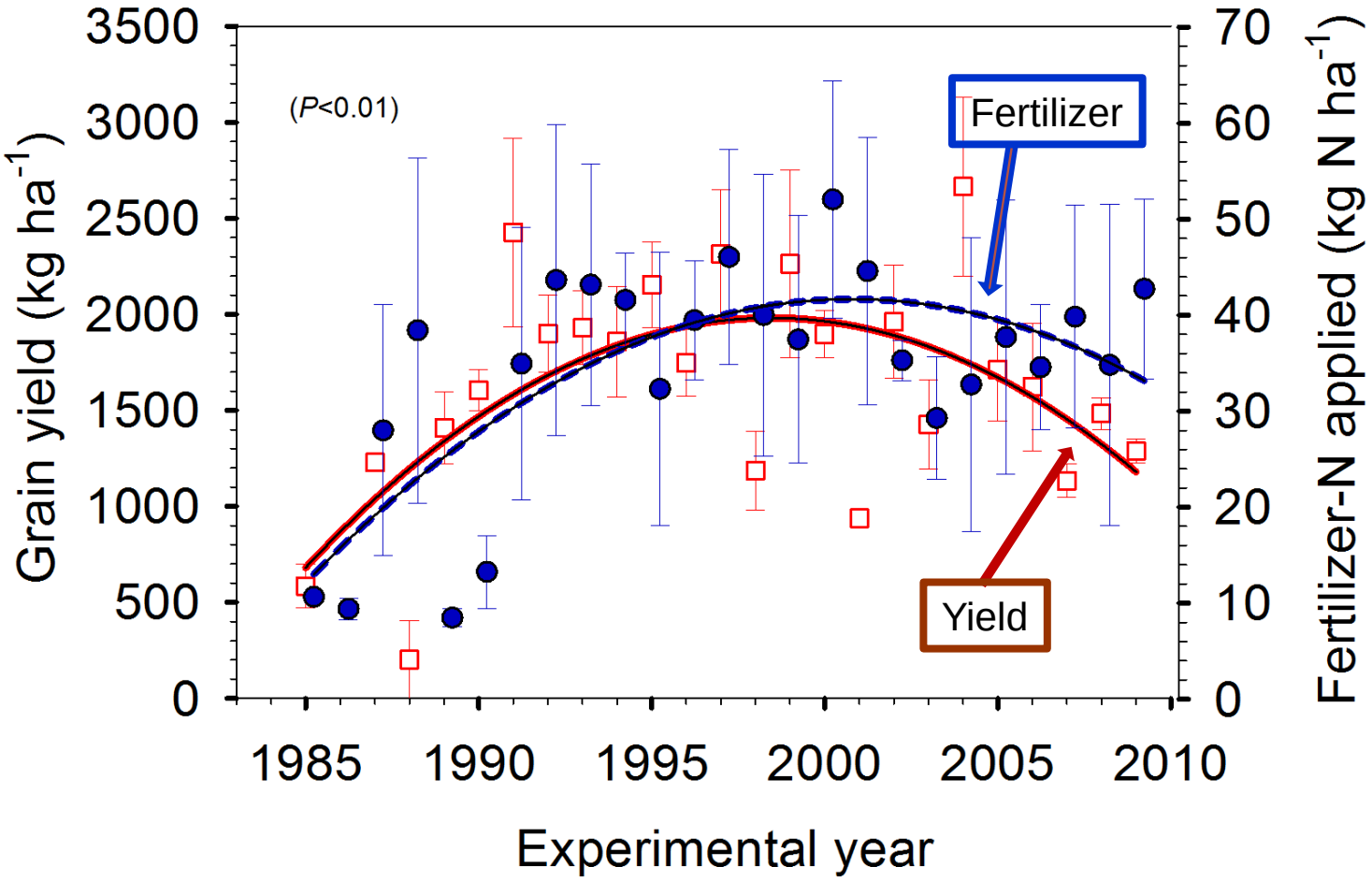
$$CO_2\,eq_{CRD} = Q_{CRD} \times \left\{EF + (FRAC_{LEACH} \times EF_{LEACH})\right\} \times \frac{44}{28} \times 298$$

N subject to leaching:

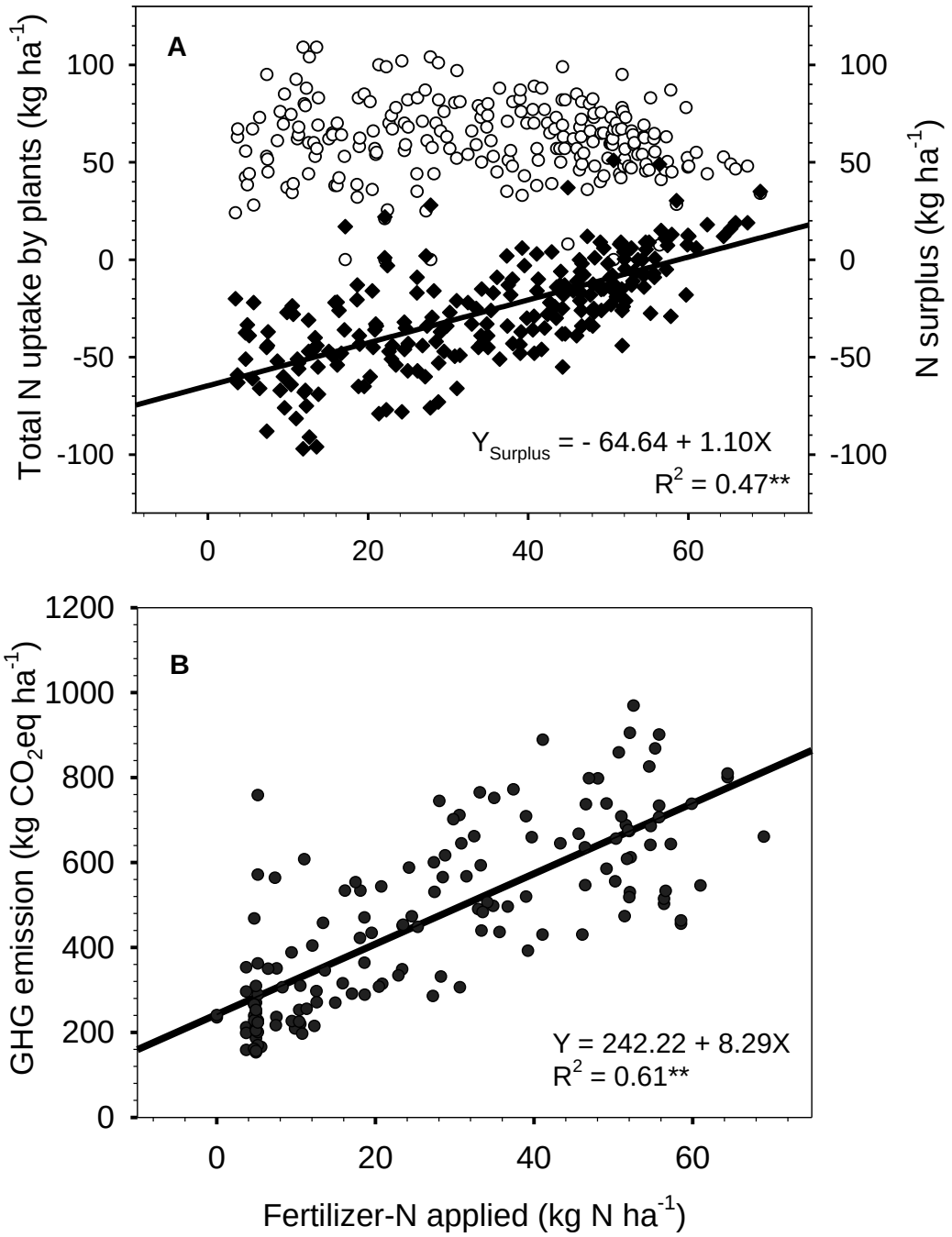
$$FRAC_{LEACH} = 0.3247\ P/PE - 0.0247$$

(Rochette et al. 2008, Can J Soil Sci 88:641-654)

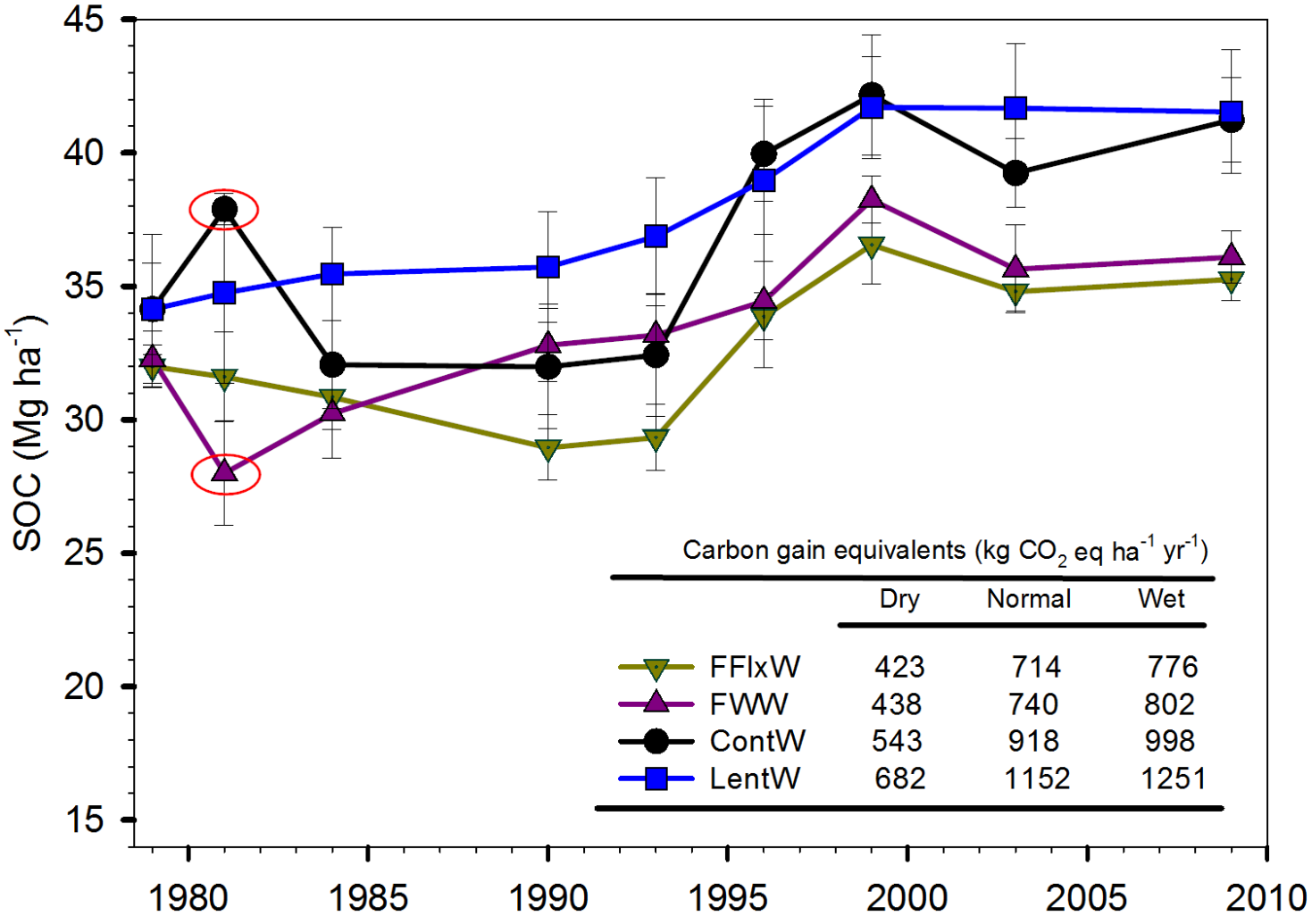
Wheat yield and fertilizer in a long-term experiment at SPARC (1985-2009)



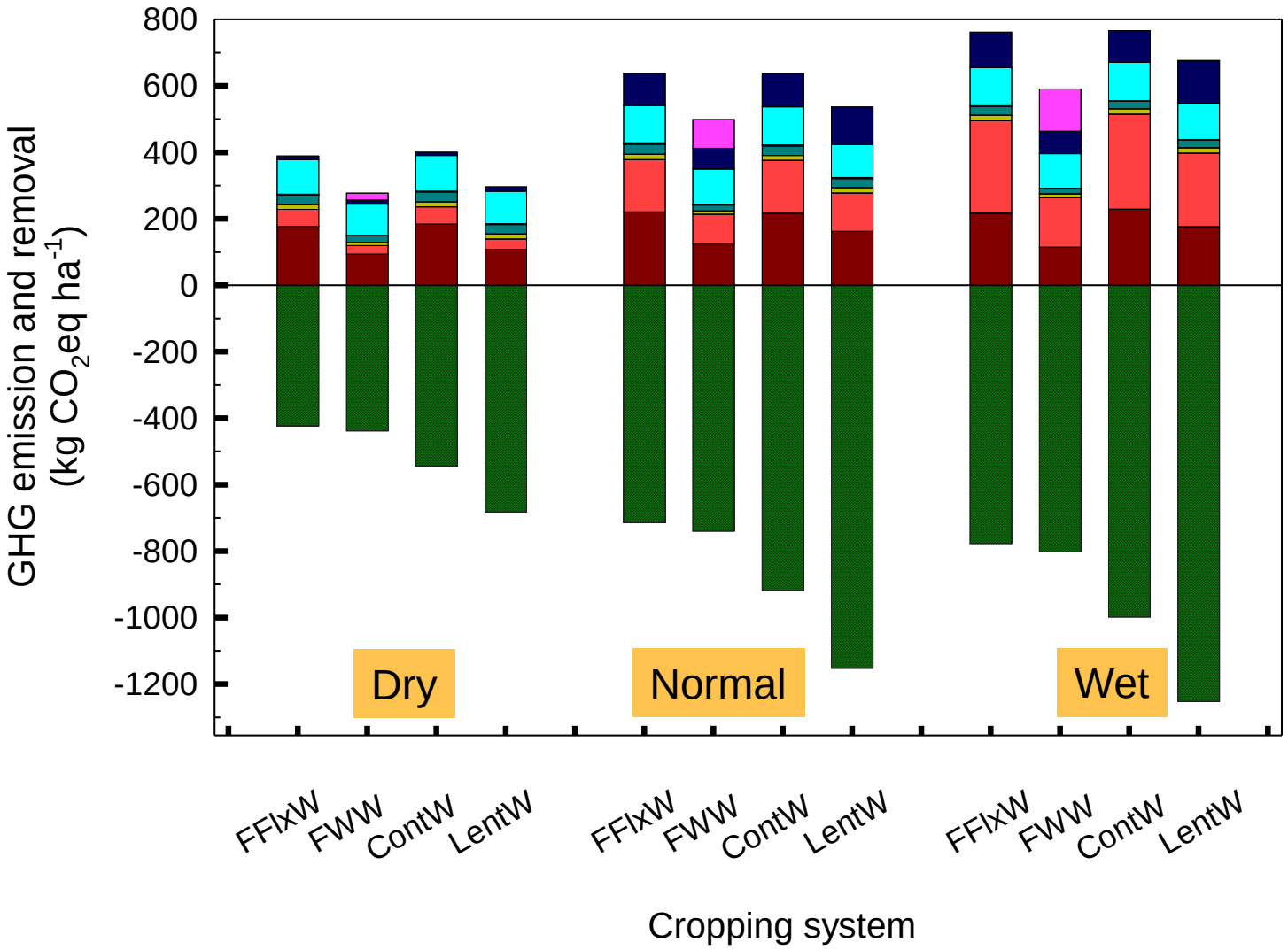
Relationship between N input, N-surplus, and GHG emission in wheat cropping (1985-2009)



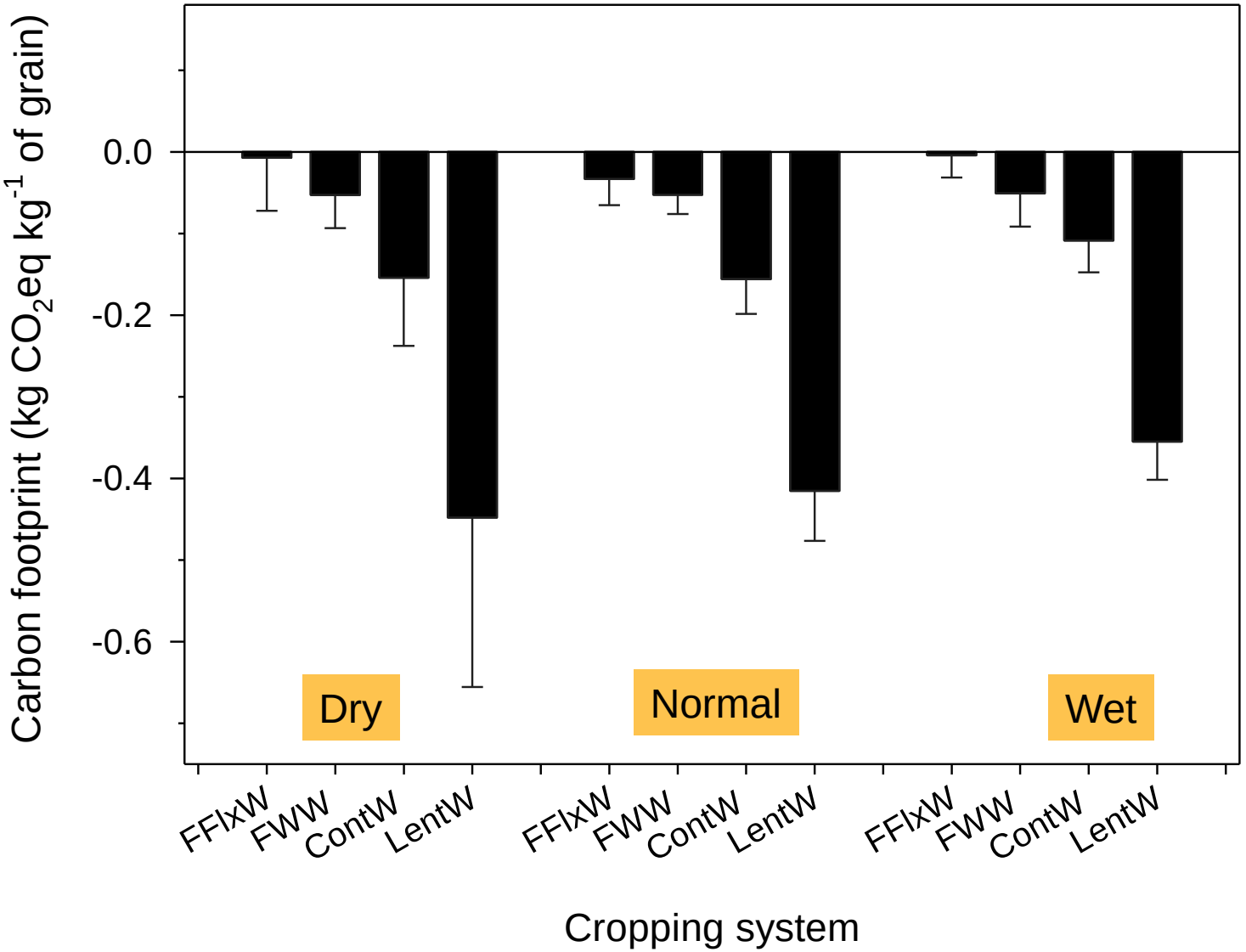
Soil C changes during the 25-yr (1985-2009) in wheat cropping systems



Total GHG emission/removal in different cropping systems (1985-2009)



Carbon footprints of the different wheat cropping systems (1985-2009)



Summary

- On average, improved wheat production systems can sequester up to 263 kg of CO_2 equivalents per hectare annually;

- In wheat-lentil rotation, with each kg of wheat produced, a net 0.406 kg CO_2 equivalent is fixed from atmosphere back into the soil;

- Soils under this latter rotation gained a net 1028 kg CO_2 equivalent of carbon per hectare annually in the 25-yrs;

- Semiarid prairie wheat can fix more CO_2 from atmosphere than is emitted during the production, offering the potential to help mitigate GHG emissions from food production