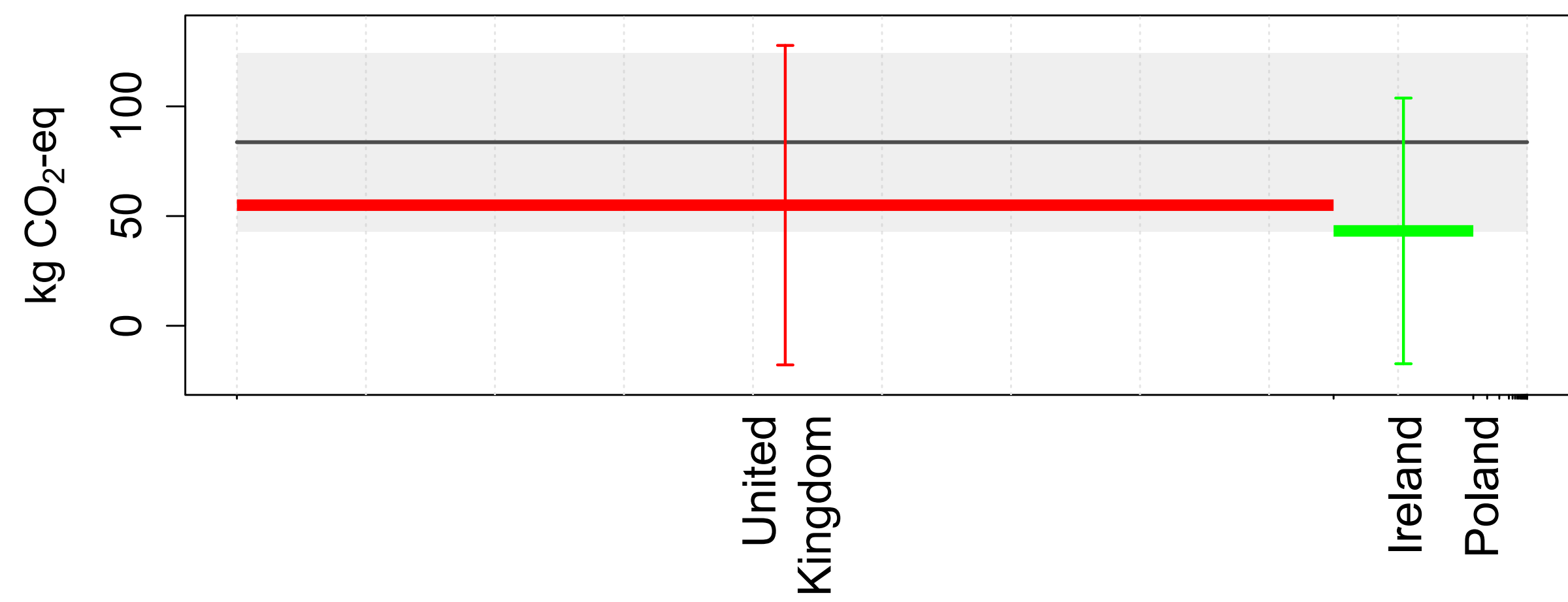
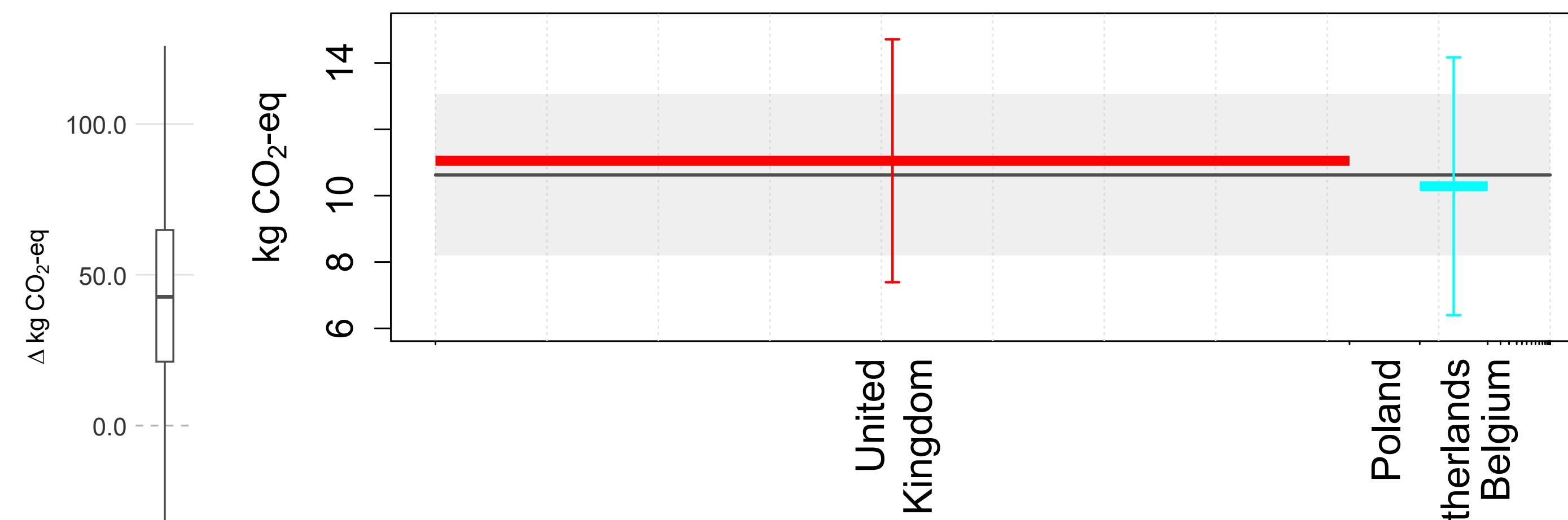


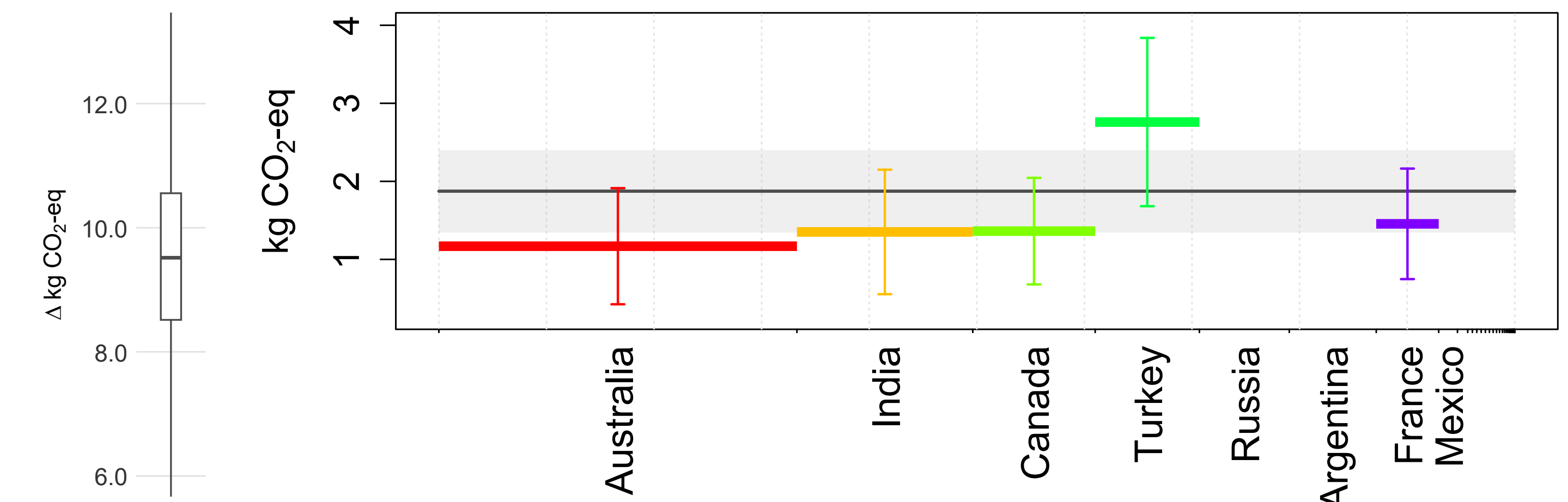
## GHG Impacts and Substitution Savings: Beef → Poultry → Chickpeas. 95% credible intervals



Beef impacts. Grey denotes global average estimate. Others denote country specific estimates and trade share in 2022.

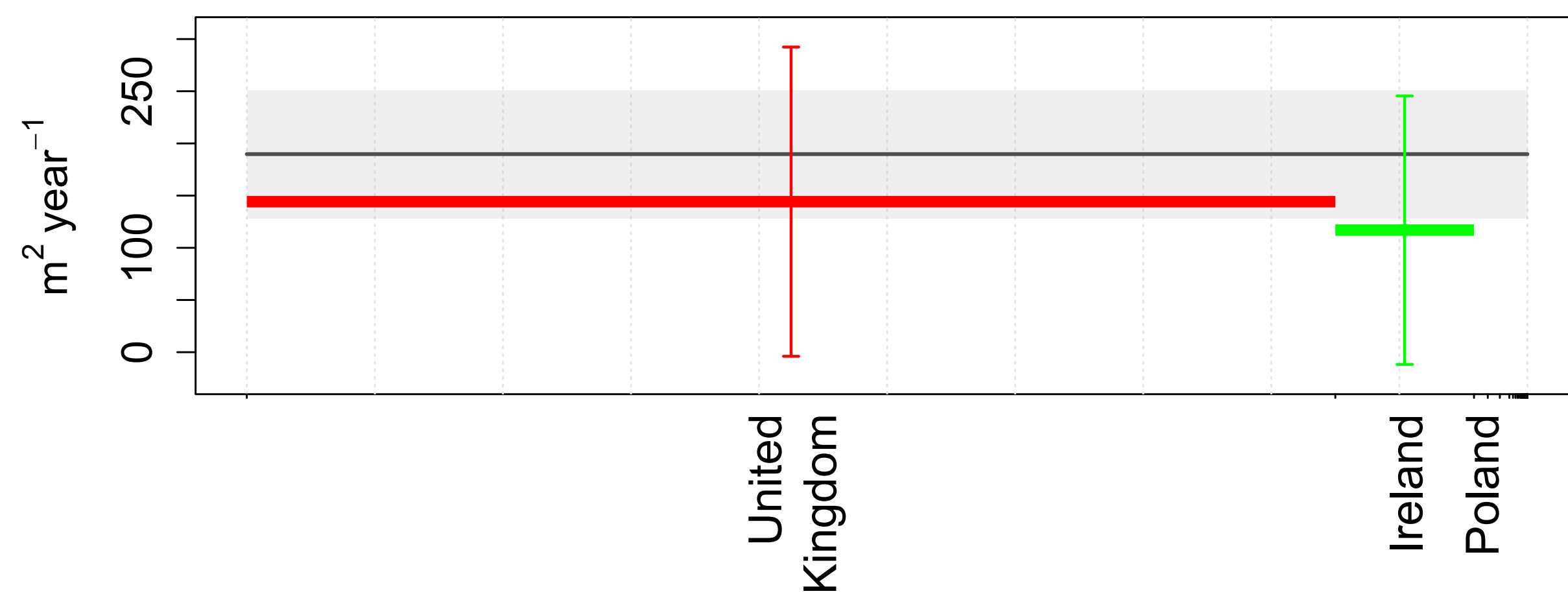


Poultry impacts. Segment width on x-axis denotes FAOSTAT trade proportions in 2022

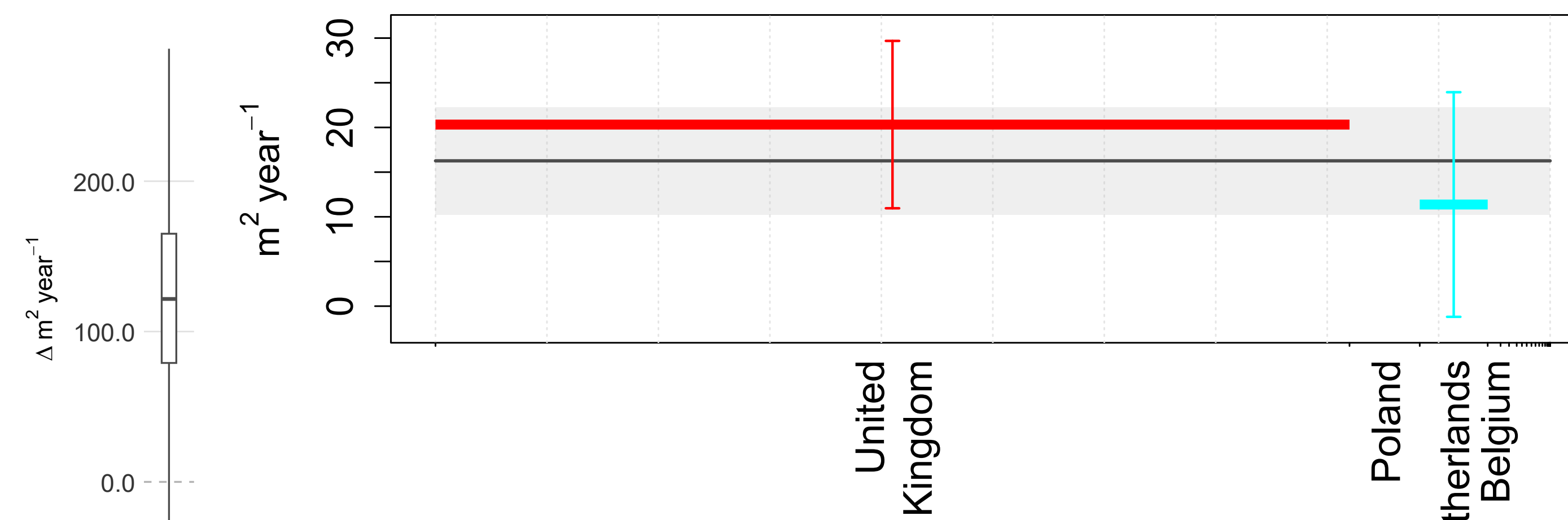


Chickpeas impacts. Substitution is on a mass for mass basis.

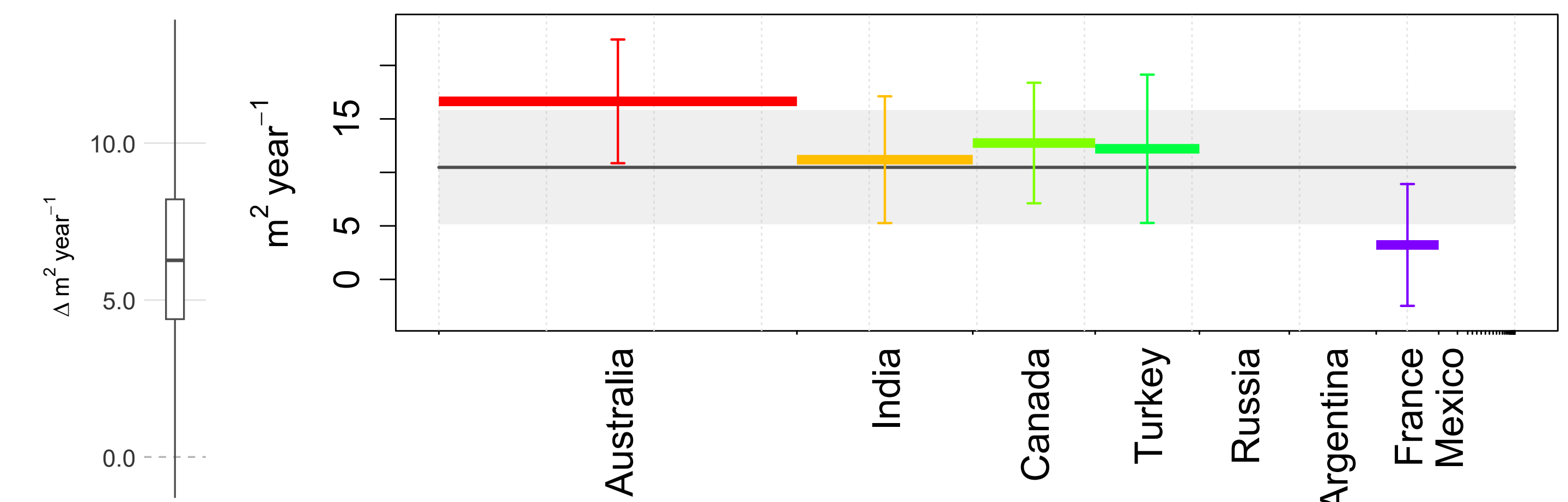
## Land Use Impacts and Substitution Savings



Beef impacts.



Poultry impacts.



Chickpeas impacts.

### Background and Motivation

Food-system LCAs often report single impact values, even though production methods vary enormously by country and producer. Poore & Nemecek's global dataset shows order-of-magnitude differences across producers and locations, making uncertainty an inherent feature of food impact estimates. ISO 14044 requires uncertainty analysis in LCA interpretation, yet this is seldom applied in food-system comparisons.

Aim: To create a UK-centred, uncertainty-aware view of environmental footprints by combining country-specific impacts (with posterior uncertainty from hierarchical modelling) with UK import patterns from FAOSTAT.

This allows us to move beyond point estimates and provide probabilities, intervals, and robustness assessments of potential dietary shifts.

### Methods and Key Results

Hierarchical modelling of impacts: We fitted hierarchical (partial-pooling) models to the Poore & Nemecek dataset, capturing heterogeneity between countries, production systems, and study sources and producing posterior distributions of impacts for each food type by country.

Combining with UK trade patterns: Country-specific posterior draws were weighted by UK import shares from the FAOSTAT Trade domain to generate UK-relevant impact distributions reflecting actual sourcing.

Substitution modelling: Scenario-based substitutions were propagated through these distributions to estimate impact changes with uncertainty, including 95% intervals and probabilities of reductions.

### Importance, Limitations and References

Importance: Uncertainty-aware results help identify which substitutions robustly reduce environmental impacts and which are sensitive to production location, supporting more transparent dietary and sourcing decisions.

Limitations: Trade-share uncertainty is not yet included, and FAOSTAT trade flows do not capture whole supply chains. Systematic effects of different production systems are not explicitly modelled. Analysis was performed without log-transforming, so permits negative impacts.

References: Poore, J. & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360: 987-992.

FAO. 2024. FAOSTAT: Detailed trade matrix. Rome. [Accessed 7 March 2026]. <https://www.fao.org/faostat/en/data/TM>

Defra (2024) United Kingdom Food Security Report 2024. Available at: <https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2024> (Accessed: 7 March 2026)