

Which sustainability themes are addressed by livestock models applicable in Europe?

Aart van der Linden, Evelien M. de Olde, Pim F. Mostert, Imke J.M. de Boer

Objective

To provide an overview of European livestock models, which includes:

- the main characteristics of livestock models
- the sustainability themes addressed by the models
- availability of source code and software

Introduction

Models are widely used to assess the effects of innovations and policies on the sustainability performance of farms. An overview of livestock models suited to investigate synergies and trade-offs among sustainability themes was not yet available.

Materials and methods

We reviewed scientific literature and listed European models simulating livestock production from animal to farm level. Information was collected using search engines and existing reviews. Environmental (n=13), economic (n=5), and social sustainability themes (n=4) were defined.

Results and discussion

- Models (n=161) simulated dairy cattle most frequently (Fig. 1).
- Sustainability themes most frequently addressed (Fig. 2):
 - Environmental: land use, nitrogen, and greenhouse gas emissions
 - Economic: costs and revenues (majority of models)
 - Social: labour requirements and animal health and welfare
- Social themes were addressed in fewer models than environmental and economic themes, which corresponds to literature.
- 46% of the models addressed five or more themes (Fig. 3).
- All three dimensions of sustainability were covered by 33% of the models, and two domains by 27%.
- Source code or software was available for 23% of the models. This result highlights the need to increase the availability, which enhances adoption and reuse of models, and ensures the replicability of their results.

Conclusions

- The overview of livestock models is useful to determine which models can be used to investigate the effects of innovations and policies on the sustainability performance of farms *ex ante*.
- The majority of the models does not allow to assess synergies and trade-offs among diverse sustainability themes.
- The availability of source code and software of livestock models is to be improved by the scientific community.

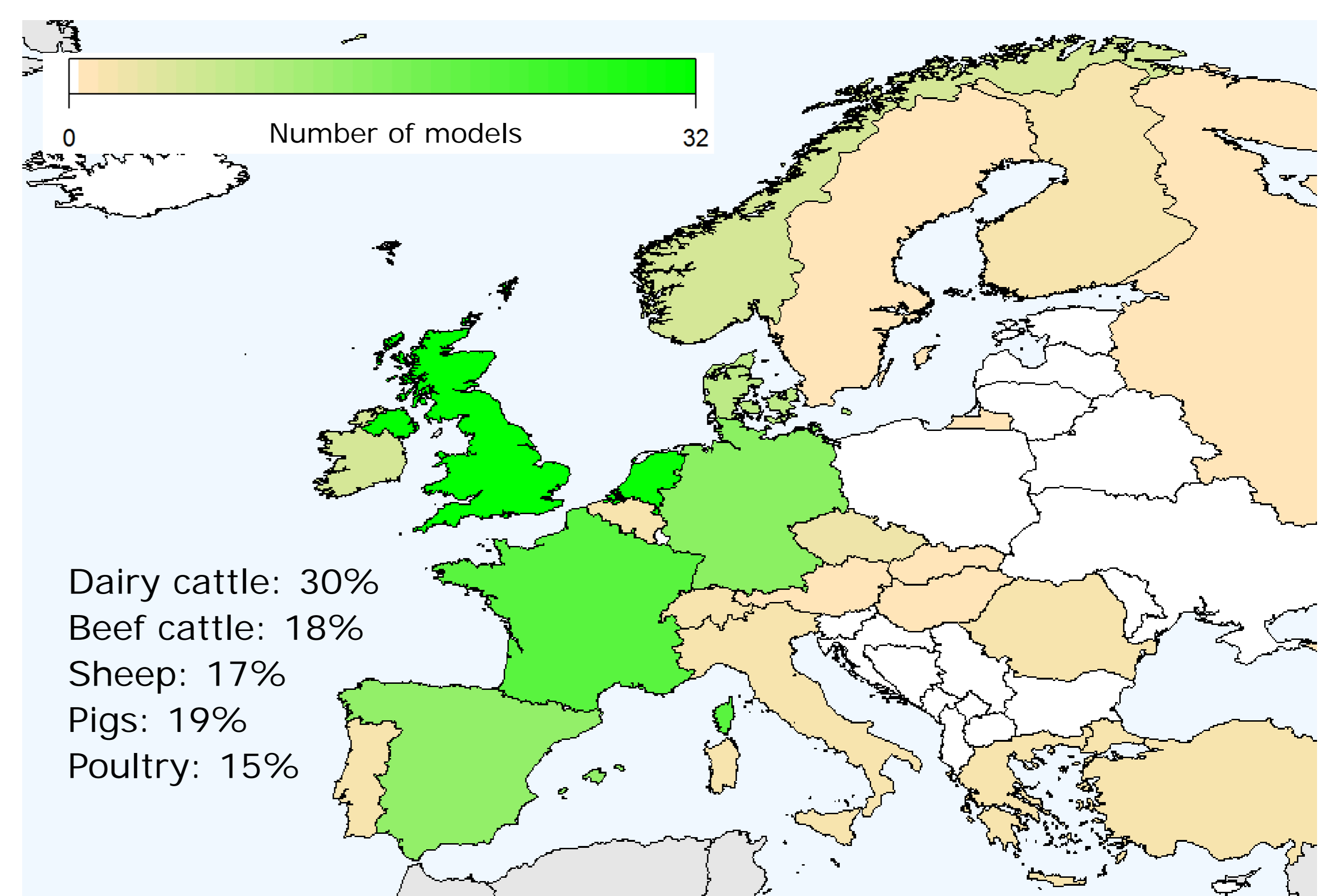


Figure 1. Geographical distribution of livestock models developed per country in Europe. Percentages indicate the share of models simulating specific livestock species and types.

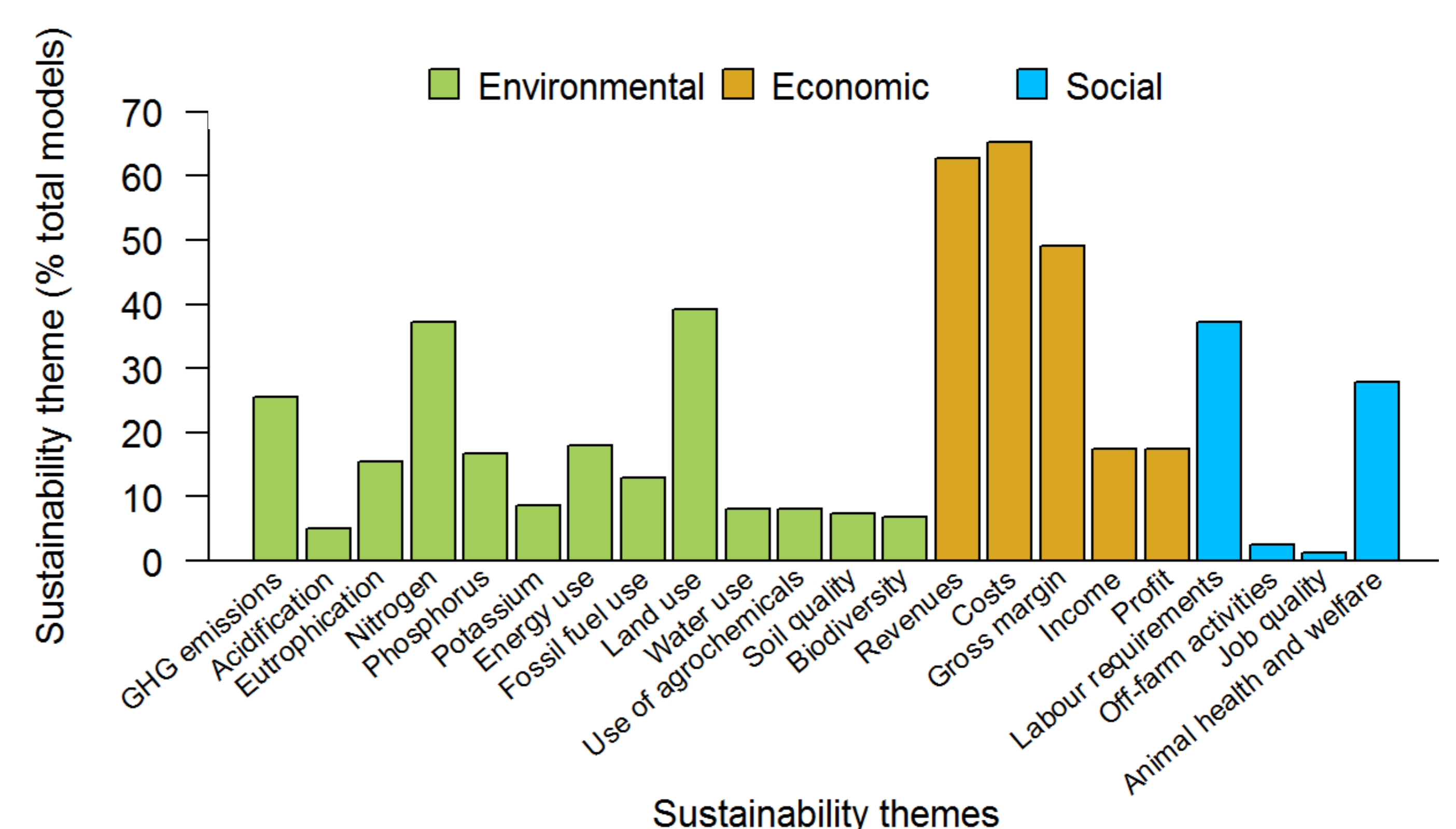


Figure 2. Environmental, economic, and social sustainability themes addressed in the models. GHG = greenhouse gas

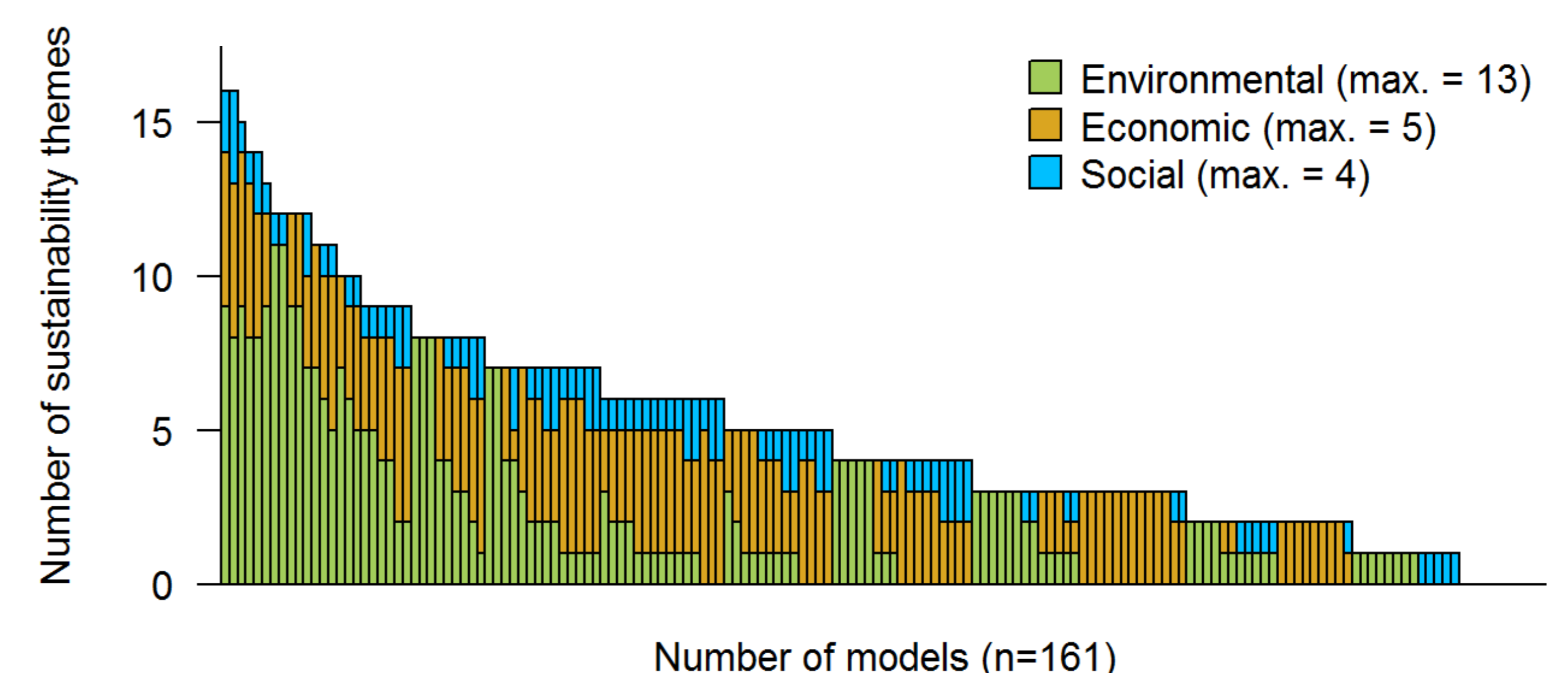


Figure 3. Numbers of environmental, economic, and social sustainability themes addressed per model.

Acknowledgements

This research was conducted within the ERA-NET SUSAN project 'AnimalFuture'. We acknowledge the participants of the annual meeting, held on the 17th and 18th of May 2018 in Wageningen, the Netherlands, for their feedback on a preliminary version of the model overview. We thank Monika Zehetmeier (LfL, Germany) and Alberto Bernués (CITA, Spain) for commenting on a report describing this study.