Boris Apolo
bhapolo@espol.edu.ec
CADS - ESPOL
Luis Domínguez
ldomingu@espol.edu.ec
CADS – ESPOL
Ángel Ramírez
aramire@espol.edu.ec
FIMCP - ESPOL

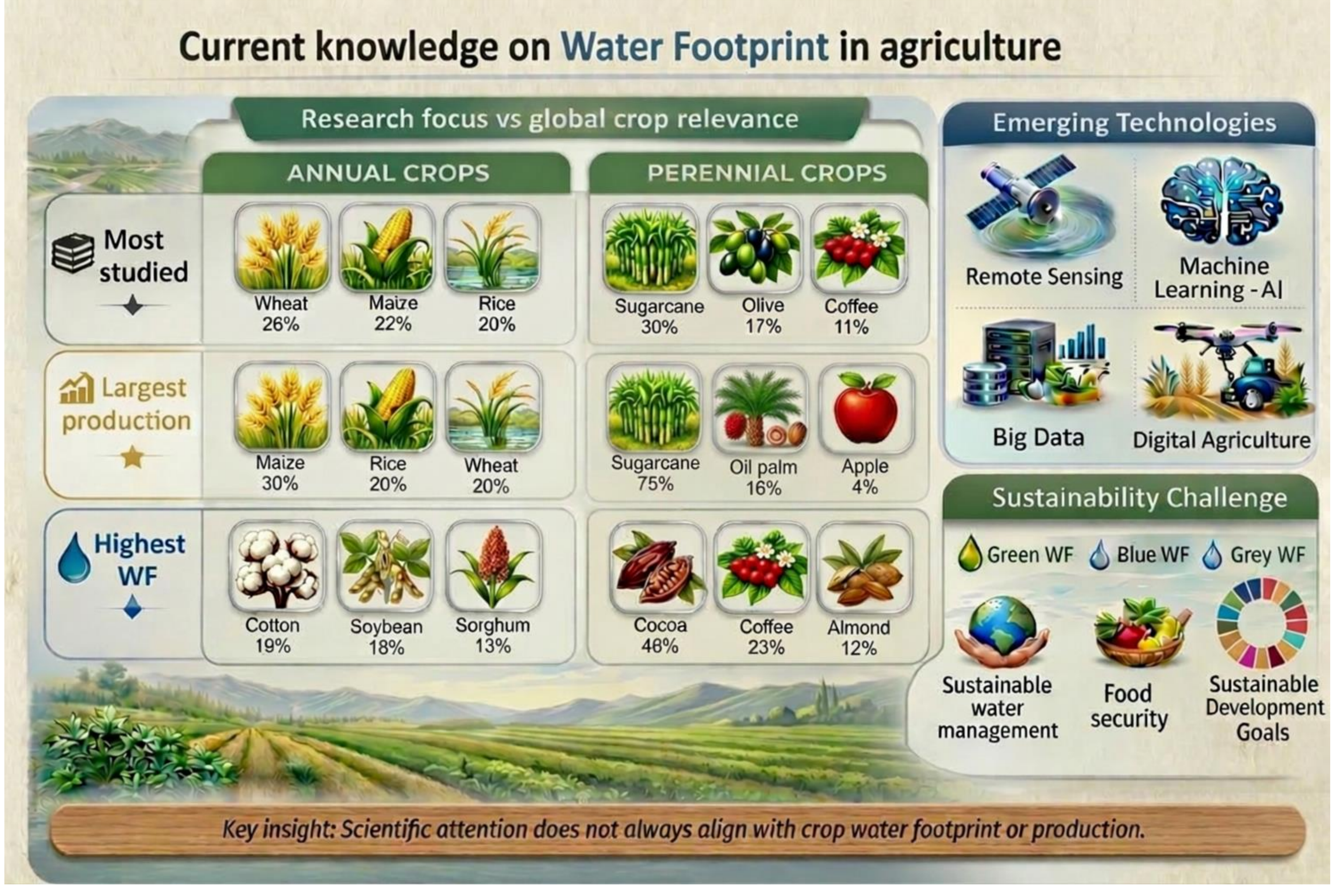
Margarita Baquero
margaritamaria.baquero
rivadeneira@kuleuven.be
KU Leuven

Anne Gobin
anne.gobin@kuleuven.be
KU Leuven

Agricultural water footprint: trends, gaps and pathways to achieving sustainability goals

PROBLEM

Despite growing interest in agricultural water footprint research, knowledge gaps remain regarding studied crops, methodologies, tools, and research trends, limiting a comprehensive understanding needed to support sustainable water resource management.



GENERAL OBJECTIVE

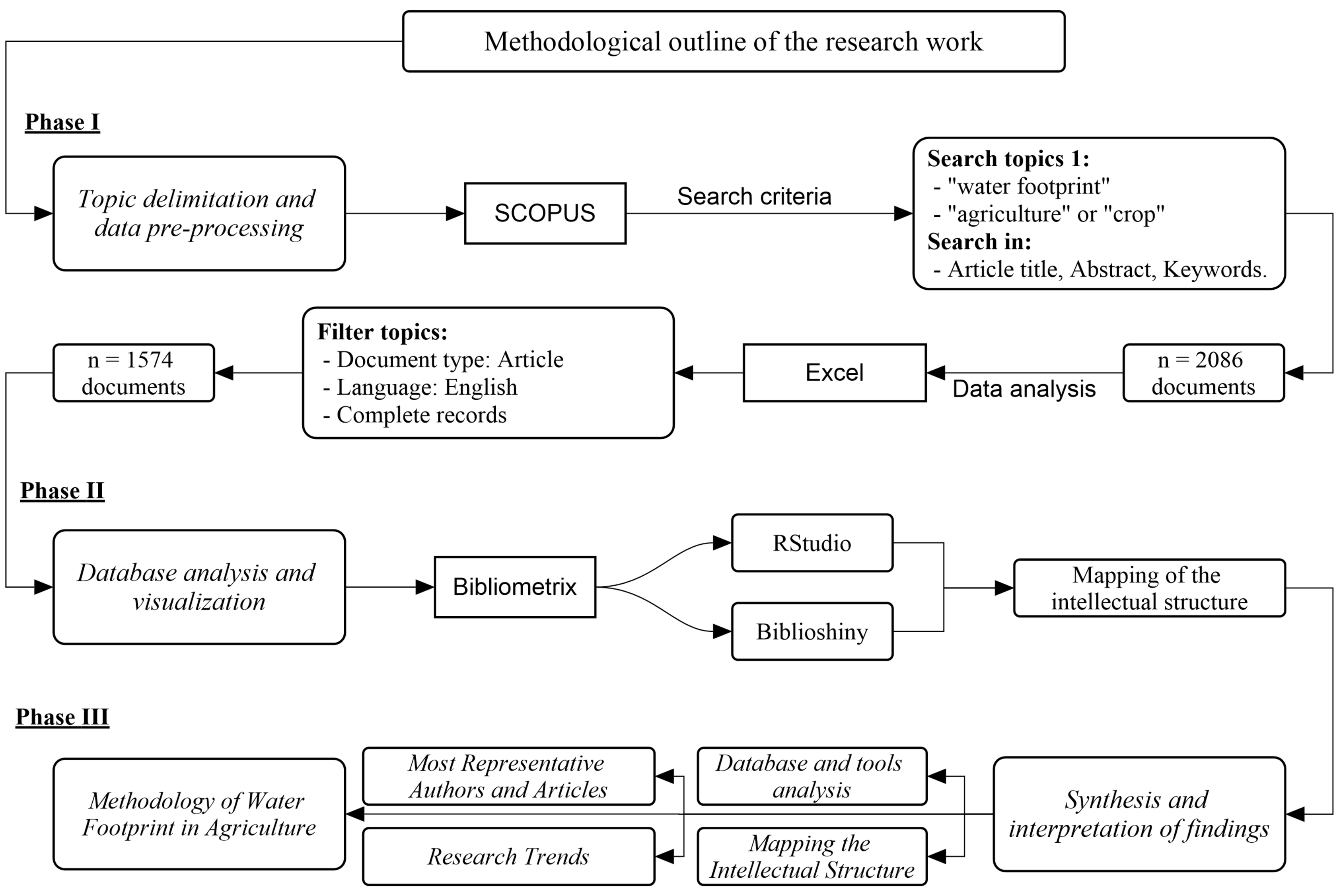
The present study analyses the evolution of agricultural water footprint research through a bibliometric study, identifying studied crops, methodologies, tools, emerging trends, and knowledge gaps that contribute to sustainable water resource management.

METHODOLOGICAL

This study was conducted through a bibliometric analysis of the scientific literature on agricultural water footprint research. Subsequently, keyword co-occurrence analysis and thematic mapping were performed using Bibliometrix to identify the intellectual structure of the research field, the main thematic areas, and emerging research trends. Identified themes were classified according to their relevance and level of development into four categories: motor themes, basic themes, niche themes, and emerging or declining themes.

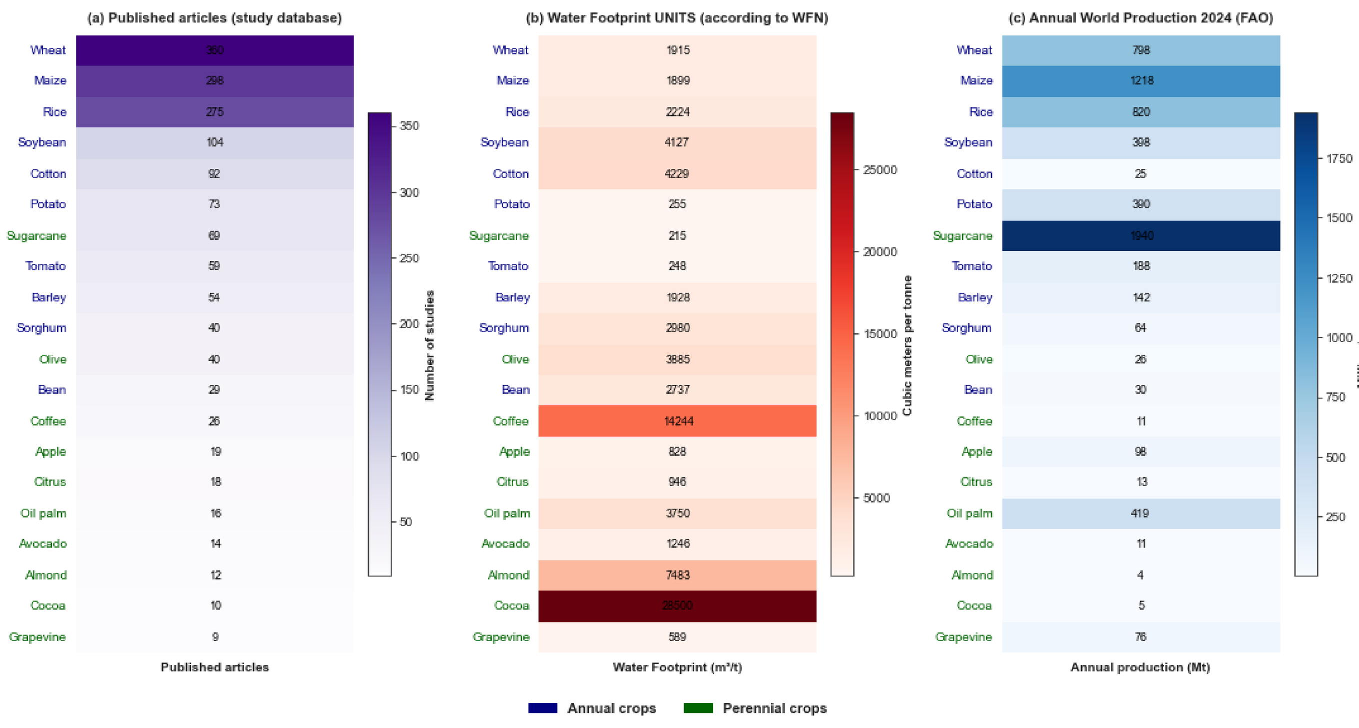
Additionally, the methodologies used for agricultural water footprint assessment were reviewed, including approaches based on the Water Footprint Network (WFN), FAO methodologies for crop water requirement estimation, and Life Cycle Assessment (LCA) frameworks. The study also evaluated the most commonly used tools and models reported in the literature, such as AquaCrop, CROPWAT, SWAT, WEAP, and remote sensing platforms.

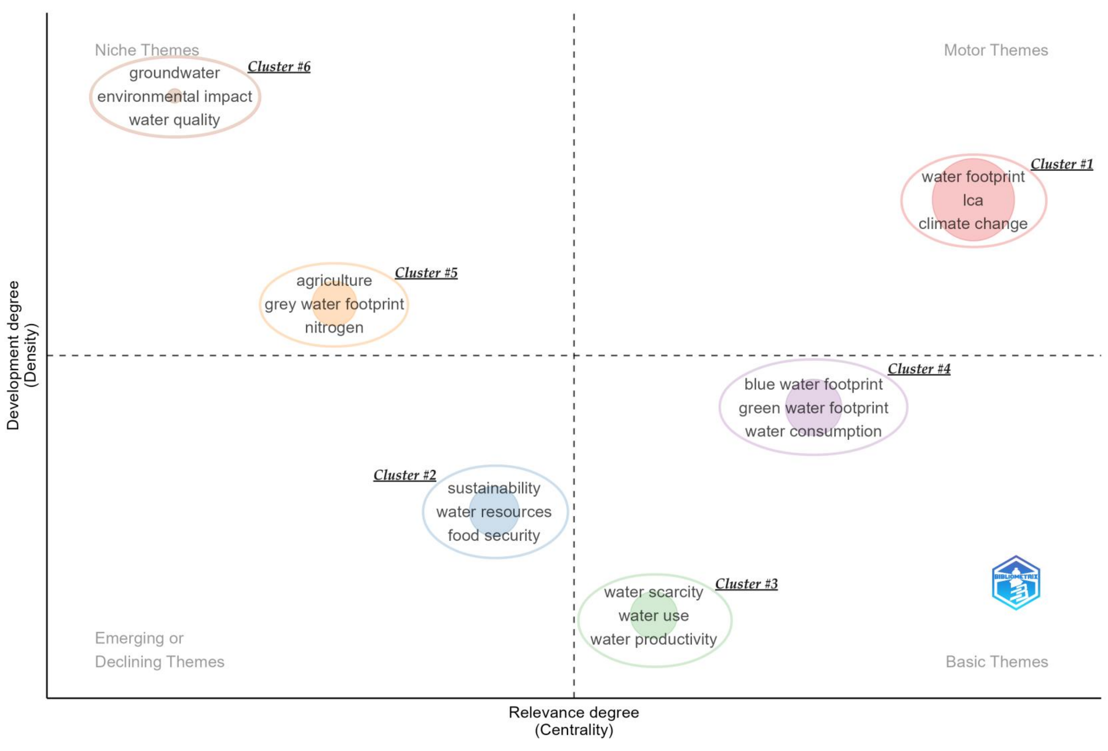
Finally, research trends, knowledge gaps, and future opportunities were identified to support sustainable water resource management in agricultural systems.



RESULTS

- Approximately 94% of the studies focused on annual crops.
- Crops with the highest water footprints (cocoa, coffee, almond) remain underrepresented in the scientific literature.
- The study identifies a clear hierarchical structure in water footprint modelling approaches:
- Crop Scale = AquaCrop, CROPWAT → Irrigation water demand, water-use efficiency, and crop water stress assessment.
- Basin Scale = SWAT, WEAP → Water resource management, water scarcity analysis, and policy-oriented planning.
- Global Environmental = ScaleLife Cycle Assessment (ISO 14046)→ Comprehensive evaluation of total environmental impacts across the product life cycle.
- Sustainability, climate change, food security, and water scarcity emerged as the main future research directions.





CONCLUSIONS

- There is a significant scientific bias: the most studied crops are not necessarily those that exert the highest water stress.
- The global agricultural water footprint is largely theoretical rather than directly measured.
- The WF has evolved beyond a technical indicator and has become a global sustainability assessment tool.
- The future of WF research is digital, spatially explicit, and predictive.
- Water Footprint (WF) and Life Cycle Assessment (LCA) are not competing frameworks, but rather complementary approaches

Acknowledgements

- This research was made possible thanks to the valuable contribution of the CREA project: “Camino a la Reactivación del Ecuador Agroalimentario”. Co-financed by the European Union, led by Rikolto and executed in consortium with ANFAB, COSPE, KU Leuven and ESPOL.