

The “Food, Waste, and Sustainability: Synergizing Ontology Efforts” 2025 Workshop – A Report

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Abstract

This paper synthesizes the activities of the “Food, Waste, and Sustainability: Synergizing Ontology Efforts” workshop, held at the 16th International Conference on Biological and Biomedical Ontology (ICBO), on November 14, 2025. This online workshop brought together experts across ontology communities to explore present and future trajectories for enhancing the contributions of such communities to sustainability. The debates centered on food systems waste as the main use case. This report introduces the area of interest, presents the workshop structure, topics of relevance, and reports on the main outcomes. Finally, the next envisioned steps are outlined.

Keywords

sustainability, waste, food systems, ontologies

1. Introduction

Nowadays, waste from and in food systems is a serious concern both with respect to sustainability and human health. Consider, for instance, the occurrence of disease outbreaks due to the abandonment of food waste, food waste contributions to the increase of CO₂ gas emissions, agricultural soil contamination by plastics and microplastics, and the presence of micro and nano plastics in human bodies.

Ontologies show up as an attractive tool for harmonizing approaches to health and sustainability across diverse fields of study and communities, thanks to ensuring meaning clarification and data interoperability; a critical step to consistently deal with complex and widespread issues such as food systems waste [1, 2].

There are now almost three decades of work on ontologies for health and biomedical research – leading, for instance, to the Open Biological and Biomedical Ontology (OBO) Foundry [3, 4]. Only recently, however, attention turned to sustainability, resulting in ontologies such as the Sustainability Core Ontology (SCO), the Sustainable Development Goals Interface Ontology (SDGIO), the Sustainable Meat Systems Ontology (SuMSO), and the Sustainable Development and Climate (SDC) Ontology [5, 6, 7]. On one hand, further efforts are required to implement ontology scenarios and related applications concerning sustainability, on the other it is critical that this occurs in interconnection with both existing

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biomedical and health-related projects, especially across different ontology communities. This aims to match the intrinsic interrelation between sustainability and health that appears to be evident, especially when considering complex issues such as food systems waste.

The *Food, Waste, and Sustainability: Synergizing Ontology Efforts 2025 Workshop* intended to promote discussions that can translate into initiatives in this direction, using food systems waste as the main use case of conversation.

The rest of this paper is organized as follows. Section 2 presents the workshop structure, topics of relevance, and main outcomes. Section 3 concludes the report by way of summarizing the next planned steps.

2. A Workshop for Synergizing Ontology Efforts on Food, Waste, Health, and Sustainability

The *Food, Waste, and Sustainability: Synergizing Ontology Efforts 2025 Workshop* encouraged conversations, especially with regard to ontologies, logics, semantics, and related applications for sustainability and health, with a particular emphasis on modeling food systems waste and pollution, and initiatives to synergize such resources across ontology communities. The workshop consisted of three main sessions:

1. A session dedicated to existing and work-in-progress ontologies and applications in the domain of waste, food, sustainability, and health.
2. A session dedicated to exploring conceptualizations of waste, food, and sustainability, especially in relation to ontology.
3. A final general open discussion with experts in the field.

2.1. Session 1: Ontologies for Wastes in Food Systems

The first session covered two presentations:

- “Integrated Ontological Framework for Food Waste Prevention, Recovery, and Valorization”, by Matthew Lange and Emily Steliotes from IC-FOODS.
- “Great Expectations About the Production and Consumption of Food: A Story of Fields, Hearths, and Digital Twins”, by the keynote speaker Damion Dooley from Simon Fraser University.

The first presentation reported the ongoing design of a Food Loss and Waste (FLW) Ontology, that models food loss and waste in compliance with existing OBO-Foundry and sustainability ontologies, such as SCO, the Environmental Ontology (EnvO) and the Relation Ontology (RO), and international standards, such as FAO and USDA vocabularies, and the Upcycled Food Association’s standard [8, 9]. This work has been elaborated in a paper included in this proceedings volume.

The second presentation described the interpretation of food and food waste currently endorsed by the Food Ontology (FoodOn) and the related community, outlining implications and connections with the FoodOn and companion ontologies' representation of food system activities and the work-in-progress FoodOn Recipe 2.0 process model [10].

2.2. Session 2: Conceptualizations of Sustainability, Food Systems, and Wastes

The second session covered three presentations:

- “Towards a Meta-ontology of Sustainability. An Educational Perspective”, by Antonio Lizzadri from Catholic University of Milan.
- “From Rock to Soil: Biomimetic and Ontological Reflections on Substrate Transformation for Sustainable Systems”, by Ille C. Gebeshuber from the Technische Universität Wien.
- “Towards a Logic of «Food Waste»”, by the keynote speaker Andrea Borghini from the University of Milan.

The first presentation introduced a meta-ontology that, adopting an educational and practical perspective as a starting basis, points to complement currently available sustainability ontologies to support sustainability efforts. This work has been elaborated in a paper included in this proceedings volume.

The second presentation delved into modeling rocks, waste, and debris to soil transformations, highlighting implications for food systems sustainability. The abstract for this presentation is available in the workshop GitHub repository.

The third presentation provided an overview of a set of criteria to account for food waste and loss, proposed by Borghini and Piras (2025) [11]. It also details the “adverbialism” approach that the authors recommended to deal with the semantic ambiguity concerning such issues.

2.3. Session 3: Discussion with Panelists

Under the chairmanship of Laurette Dubé from the McGill Centre for the Convergence of Health and Economics, the third section brought together five experts to integrate previous sessions’ insights into a general conversation on food systems waste, namely the two keynote speakers Andrea Borghini and Damion Dooley, Elena Milivinti from the SUNY University at Buffalo, Nicola Piras from University of Minho, and Magalie Weber from the National Research Institute for Agriculture, Food and the Environment (INRAE, France). Experts’ backgrounds span philosophy, economics, food sciences, sustainability, and computer sciences. Briefly, the discussion take-home messages can be summarized in the following three steps:

- Common modelling patterns must be established (and mapped) across different ontology communities to ensure the consistent design and integration of health and sustainability ontologies, especially with regard to issues such as food systems waste.
- Most promising approaches to modeling food systems waste seem to be those that leverage processes and role-based representations.
- In complement, ontological representations of food system waste must emphasize the relevance of contexts, temporality, and system dynamics.

Such practices will assist in ensuring health and sustainability ontologies supporting efficient accommodation and interconnection of the various existing definitions, metrics, and approaches to food systems waste, and related data for sustainability efforts.

2.4. Workshop Materials

For further details on the workshop sessions and program, please visit the workshop website at <https://sites.google.com/view/fws2025workshop/home-page>. The recording of the event is available on YouTube at the URL <https://youtu.be/ywyW8tALU-Q> via the ICBO YouTube channel (<https://www.youtube.com/@biomedicalontologyworld>). In addition, materials used during the three sessions are retrievable at the URL <https://github.com/gioUbbiali/2025-Food-Waste-and-Sustainability-Workshop>.

3. Conclusions and Future Steps

We envision that further conversations may follow the debates that took place at this workshop, fostering ontology initiatives and projects around sustainability, health, food, and waste. We foresee such conversations occurring across diverse communities to establish shared approaches across stakeholders and fields of study and practices. Such discussions may lead to the establishment of a Community of Common Ontologies, Semantics, and Models for Sustainability (COSMOS) that can ultimately assist integrated efforts concerning sustainability and globally related issues, such as waste in food systems.

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Declaration on Generative AI

During the preparation of this report, the authors used Grammarly and the Free AI Paraphrasing Tool in order to check grammar and spelling, paraphrase, and reword. After using these tools, the authors reviewed and edited the content as needed and took full responsibility for the publication’s content.

References

- [1] R. Arp, B. Smith, A. D. Spear, Building ontologies with Basic Formal Ontology, 1st ed., Cambridge, Massachusetts: Massachusetts Institute of Technology, 2015.
- [2] G. A. Ubbiali, A. Borghini, M. C. Lange, Ontologies for sustainability: theoretical challenges, *Sustainable Development* (2026): 1–14. <https://doi.org/10.1002/sd.70562>.

- [3] R. Jackson, N. Matentzoglou, J. A. Overton, R. Vita J. P. Balhoff, P. L. Buttigieg, S. Carbon, M. Courtot, A. D. Diehl, D. M. Dooley, W. D. Duncan, N. L. Harris, M. A. Haendel, S. E. Lewis, D. A. Natale, D. Osumi-Sutherland, A. Ruttenberg, L. M. Schriml, B. Smith, C. J. Stoeckert, N. A. Vasilevsky, R. L. Walls, J. Zheng, C. J. Mungall, B. Peters, OBO Foundry in 2021: operationalizing open data principles to evaluate ontologies, *Database* (2021) baab069 (2021). <https://doi.org/10.1093/database/baab069>.
- [4] The OBI Consortium, B. Smith, M. Ashburner, C. Rosse, J. Bard, W. Bug, W. Ceusters, L. J. Goldberg, K. Eilbeck, A. Ireland, C. J. Mungall, N. Leontis, P. Rocca-Serra, A. Ruttenberg, S. Sansone, R. H. Scheuermann, N. Shah, P. L. Whetzel, S. Lewis, The OBO Foundry: coordinated evolution of ontologies to support biomedical data integration, *Nature Biotechnology* 25(11) (2007) 1251–1255. <https://doi.org/10.1038/nbt1346>.
- [5] A. Davarpanah, H. Babaie, N. Dhakal, Semantic Modeling of Climate Change Impacts on the Implementation of the U.N. Sustainable Development Goals Related to Poverty, Hunger, Water, and Energy, *Earth Sci. Inf.* 16(1) (2023) 929–943. <https://doi.org/10.1007/s12145-023-00941-9>.
- [6] FAO, Sustainable Development Goals Interface Ontology (SDGIO) on Support of United Nations Sustainable Development Goals (SDG) Project, 2016. URL: <https://aims.fao.org/news/sustainable-development-goals-interface-ontology-sdgio-support-united-nations>.
- [7] G. A. Ubbiali, Designing Foundational Strategies for Developing a Family of Food Systems Sustainability Ontologies, PhD. Thesis UNIMI, Italy, 2025. <https://air.unimi.it/handle/2434/1161515>.
- [8] P. L. Buttigieg, E. Pafilis, S. E. Lewis, M. P. Schildhauer, R. L. Walls, C. J. Mungall, The Environment Ontology in 2016: Bridging Domains with Increased Scope, Semantic Density, and Interoperation, *J. Biomed. Semantics* 7(1) (2016):57. <https://doi.org/10.1186/s13326-016-0097-6>
- [9] B. Smith, W. Ceusters, B. Klagges, J. Köhler, A. Kumar, J. Lomax, C. Mungall, F. Neuhaus, A. L. Rector, C. Rosse, Relations in Biomedical Ontologies, *Genome Biol.* 6(5) (2005) R46. <https://doi.org/10.1186/gb-2005-6-5-r46>
- [10] D. M. Dooley, E. J. Griffiths, G. S. Gosal, P. L. Buttigieg, R. Hoehndorf, M. C. Lange, L. M. Schriml, F. S. L. Brinkman, W. W. L. Hsiao, FoodOn: A Harmonized Food Ontology to Increase Global Food Traceability, Quality Control and Data Integration, *npj Sci Food* 2(1) (2018) 23. <https://doi.org/10.1038/s41538-018-0032-6>.
- [11] A. Borghini, N. Piras, Semantic and Philosophical Approaches for Advancing the Identification and Measurement of Food Waste, *Nature Food* 6(6) (2025) 547–552. <https://doi.org/10.1038/s43016-025-01167-2>