A Systematic Review on Food Waste Management: Exploring Global Perspectives for Nepal

Dinesh Raj Bhattrai, Managing Director, ARTISTA Engineering Consultancy (P.) Ltd.

Abstract

Food waste presents a significant challenge to sustainability and food security. This study explores various strategies to mitigate food waste and promote a more circular economy. Key strategies are:

Circular Economy Models: Partnerships between peri-urban piggeries and food service sectors offer successful models for reusing food waste as animal feed.

Value-Added Products: Upcycling food waste into high-quality products like ice cream can increase its economic value and promote sustainability.

Consumer Behavior: Education and awareness campaigns are crucial for influencing consumer attitudes and behaviors towards food waste reduction.

Technological Solutions: Mobile applications and artificial intelligence can enhance food waste management and tracking.

Policy and Governance: Implementing legal and strategic frameworks can support food waste prevention and reduction efforts.

By adopting the above strategies in policy, Nepal can contribute to a more sustainable and resilient food system.

Keywords: *"Food Waste", "Waste Management", "Food Security", AND "Sustainable Development"*

Introduction

The reuse of organic residues, such as food waste, for animal feed is a traditional agricultural practice. The informal partnerships between peri-urban piggeries and the food service sector represent a successful **circular economy model,** characterized by reliable daily food waste collection, low-cost feed, and reduced waste volume. However, challenges such as seasonal fluctuations in food waste supply and potential biosafety risks associated with non-infectious pathogens or physical and chemical contaminants in the food waste need to be addressed. To mitigate these challenges, raising awareness among stakeholders throughout the food value chain and at the policy level is essential[1].

In the food industry, food waste leads to financial loss and increases the financial burden to reproduce food. Strategy for Circular economy implementation for managing waste and resources helps to shift towards more sustainable methods of production and consumption. The concept of food waste valorization set an example to achieve SDG 2: 'Zero Hunger', SDG 11: 'Sustainable Cities and Communities', and SDG 12: 'Responsible Consumption and Production', helping to reduce waste and save landfill spaces, contributing to SDG 13: 'Climate Action'. For a food system to be sustainable and secure, the government, businesses, research institutions and individuals will have to contribute, either with a top-down approach to adhering to rules and regulations and

a bottom-up approach to actively influencing and changing consumer's behavior is needed to reduce waste to the greatest extent possible[2].

Upcycled food products are crucial for sustainable food production and waste management to combat urgent climate change and food security challenges. The Value-Attitude-Behaviour (VBA) theory, focusing on "product knowledge", "green perceived quality", and "price sensitivity" for consumer behavior towards upcycled foods, indicates that eco-conscious values strongly influenced consumer attitudes and anticipated guilt, shaping behavioral intentions. While price sensitivity positively influences intentions to prioritization of quality and environmental values over price[3].

Enhancing living standards, an Agro-food industry plays a crucial role, inadequate losses and waste management persists as significant challenges within its processes. Utilizing the waste generated from mango and cheese, to produce a high-quality ice cream base from valorizing food waste and generating value-added products promote the sustainability and resource optimization within the agro-food industry thereby contributing food security and sovereignty[4].

Mobile application, an innovative approach within the circular economy concept, which incorporates surplus food recovery and redistribution and food waste management contributing to the United Nations Sustainable Development Goal (SDG) 12.3 frames the basis of food waste reduction efforts from the public-private-partnership[5].

Food waste encompasses a high risk to the economy, society and environment due to the Consumer behavior, the absence of legal and strategic framework, and an Ineffective food management system causes food waste in food service organizations. To prioritize food security and environmental sustainability, A Novel approach "Zero Food Waste Certification" in food service organization for food management to prevent food waste, contributes to several UN SDGs such as SDG1, SDG2 and SDG13[6].

The reliance on long-distance transportation and cold chains undermines the sustainability of the food system and adds to its vulnerability which is demonstrated during the COVID-19 pandemic causing significant disruptions to food supply chains. Food Hubs performs relatively well in contributing to lowering food waste and loss, environmental sustainability by reducing the food transportation through sourcing from local farms, enhancing social sustainability such as improving access to fresh and healthy food to local consumers leading to food security[7].

Food waste due to the confusion in date labeling is one way that consumers waste food, which is a significant global challenge for humanity and the environment. Stakeholders are confused about the date labeling and associate it with food safety and feel unsafe to consume foods beyond the date indicated on the labels, think that better understanding the science behind such date labels and potential application of modern technology, such as mobile phone app, target community outreach education, social media, and print materials may help reduce food waste contributing to global food security[8].

2

Artificial Intelligence (AI) is one of the modern technological methods that can be used in the whole food production ecosystem ranging from crop production, livestock production, harvesting / slaughtering, postharvest management, food processing, food distribution, food consumption and food waste management. It is a potential tool to enable and facilitate a transition to sustainable and improved food systems[9].

Methodology:

Four different databases are used to find out the most relevant research articles. During the research there are a lot of articles, journals, books that have been found on the database. So, applying different strategies to limit the number of articles for the study topic, are keywords, date range, types etc. Applying different inclusion / exclusion criteria and quality assessment 9 articles have been reviewed for this study. The 4-steps of PRISMA framework have been applied in this study which has been depicted in figure-1, and PRISMA framework in figure-2.

Figure-1: 4-Steps of PRISMA Framework
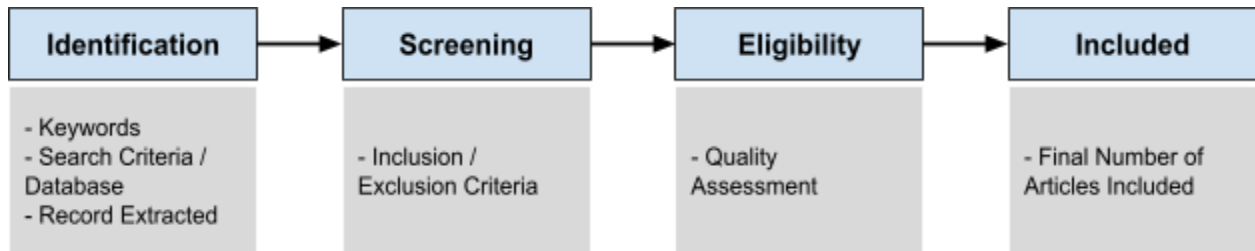
Figure-2: Use of PRISMA Framework for Systematic Review
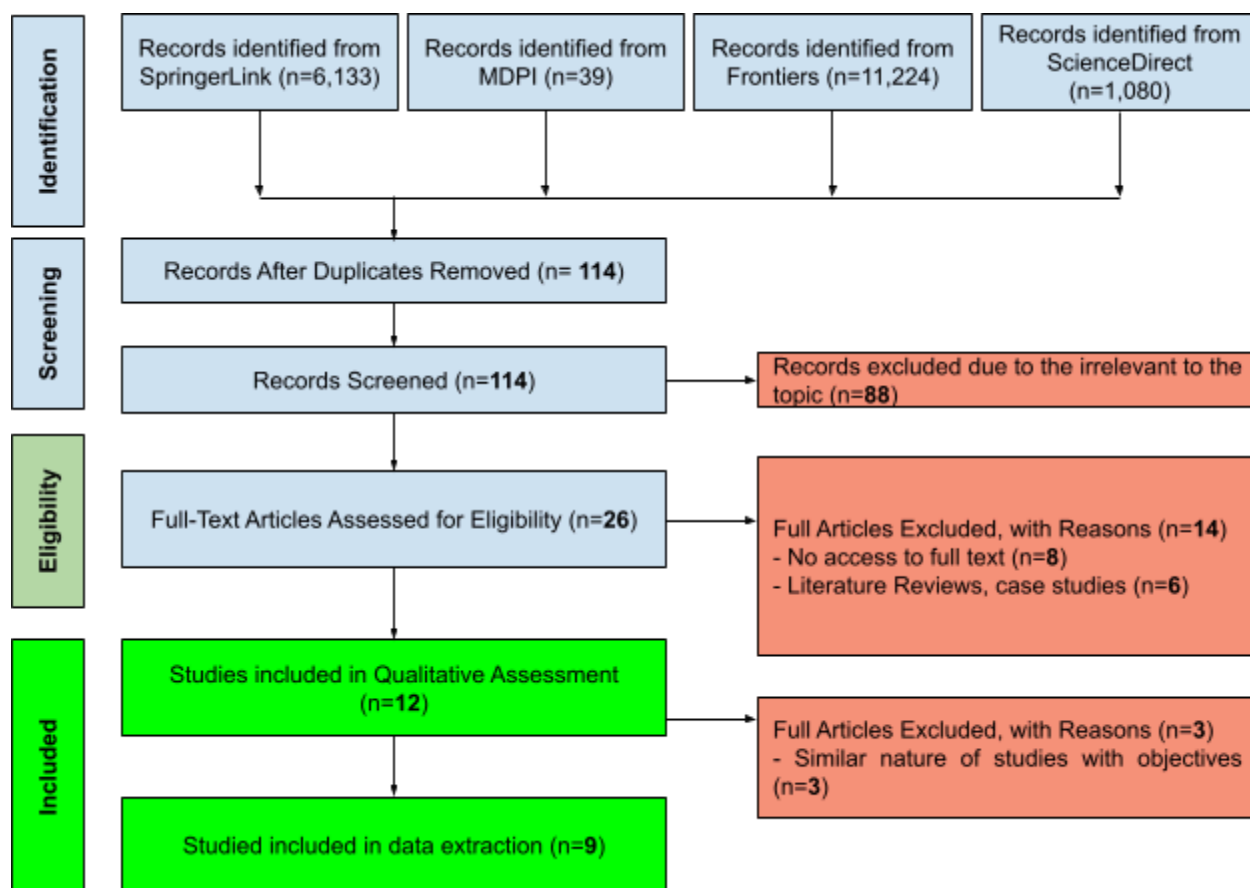
Conclusion

The circular economy model, exemplified by the partnership between peri-urban piggeries and the food service sector, offers a promising approach to reducing food waste and promoting sustainability. While challenges such as seasonal fluctuations and biosafety risks need to be addressed, raising awareness among stakeholders and implementing policies can mitigate these issues. Food waste valorization is crucial for achieving sustainable food systems and contributing to global goals like zero hunger, sustainable cities, responsible consumption, and climate action. By focusing on consumer behavior, implementing innovative technologies like mobile applications, and establishing certification programs, we can significantly reduce food waste and enhance food security. Ultimately, a sustainable and resilient food system requires a collaborative effort from governments, businesses, research institutions, and individuals. By adopting circular economy principles, promoting sustainable practices, and addressing the challenges associated with food waste, we can create a more equitable and sustainable future for all.

References

1. Jayathilake, N., Aheeyar, M. & Drechsel, P. Food Waste to Livestock Feed: Prospects and Challenges for Swine Farming in Peri-urban Sri Lanka.

Circ.Econ.Sust. 2, 1301–1315 (2022). https://doi.org/10.1007/s43615-022-00168-8

2. Heng, K.; Tan, K.; Chan, A.; Lee, C.C.C. Food Waste Valorization: Leveraging Singapore's Zero Waste Master Plan and 30-by-30 Goal. Sustainability 2024, 16, 7321. https://doi.org/10.3390/su16177321

3. Chang, M.-Y.; Lai, K.-L.; Lin, I.-K.; Chao, C.-T.; Chen, H.-S. Exploring the Sustainability of Upcycled Foods: An Analysis of Consumer Behavior in Taiwan. Nutrients 2024, 16, 2501. https://doi.org/10.3390/nu16152501

4. Trejo-Flores, P.G.; Santiago-Rodríguez, L.A.; Domínguez-Espinosa, M.E.; Cruz-Salomón, A.; Velázquez-Jiménez, P.E.; Hernández-Méndez, J.M.E.; Morales-Ovando, M.A.; Cruz-Salomón, K.d.C.; Hernández-Cruz, M.d.C.; Vázquez-Villegas, P.T.; et al. Sustainable Ice Cream Base: Harnessing Mango Seed Kernel (Mangifera indica L. var. Tommy Atkins) Waste and Cheese Whey. Sustainability 2023, 15, 14583. https://doi.org/10.3390/su151914583

5. Abusin, S.; Al-Emadi, N.; Mandikiana, B. An Evaluation of the Alignment of Surplus Food Recovery and Redistribution Technologies with the Circular Economy. Sustainability 2023, 15, 12355. https://doi.org/10.3390/su151612355

6. Sobaih, A.E.E. Saudi Zero Food Waste Certification: A Novel Approach for Food Waste Management in Saudi Arabia. Agronomy 2023, 13, 1654. https://doi.org/10.3390/agronomy13061654

7. Shariatmadary, H.; O'Hara, S.; Graham, R.; Stuiver, M. Are Food Hubs Sustainable? An Analysis of Social and Environmental Objectives of U.S. Food Hubs. Sustainability 2023, 15, 2308. https://doi.org/10.3390/su15032308

8. Patra, D., Henley, S. C., Benefo, E. O., Pradhan, A. K., & Shirmohammadi, A. (2022). Understanding and addressing food waste from confusion in date labeling using a stakeholders' survey. Journal of Agriculture and Food Research, 8, 100295. https://doi.org/10.1016/j.jafr.2022.100295

9. Kutyauripo, I.; Rushambwa, M.; Chiwazi, L. (2023). Artificial intelligence applications in the Agri-food sectors. Journal of Agriculture and Food Research, 11, 100502. https://doi.org/10.1016/j.jafr.2023.100502

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