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Managing Food Waste in Rural Tourism: An Integrated Approach Based on One Health Principles and the Circular Economy in the Rucăr–Bran Area

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ABSTRACT

Given the multidimensional impact of food waste on the environment, economy, and public health, this research investigates perceptions, behaviours, and practices of food resource management in rural guesthouses, taking the Rucăr–Bran agro-tourism area as a case study. The region was selected due to its relevance to rural tourism in Romania, given the density of guesthouses, the traditional gastronomic offer, and the direct relationship between producer and consumer. The main objective is to identify the determinants of food waste from the perspective of both managers and tourists, with the aim of formulating sustainable recommendations applicable to the entire rural guesthouse sector, in line with the principles of the circular economy and the One Health concept. The methodology included mixed-method design with guesthouse managers and questionnaires to tourists on holiday eating behaviour. The data was collected between August and December 2024, using a conventional sample consisting of 30 rural guesthouse managers and 100 tourists. The questionnaires were designed using the funnel design, including dichotomous, multiple choice and Likert scale questions. The results show significant wastage generated by oversized portions, lack of planning in provisioning and tourist habits linked to excessive consumption. The study proposes a set of recommendations for

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circular food resource management, including adapting menus to real demand, reusing surplus food, composting waste, and raising tourist awareness, thereby supporting the economic sustainability of rural guesthouses and protecting the local ecosystem in accordance with One Health principle.

1. Introduction

Food waste is a global problem with significant economic, environmental and human health implications (Gustavsson et al., 2011). According to Food and Agriculture Organization (FAO, 2021), about one third of food produced worldwide is wasted. Almost 17% of global food waste is generated by the hospitality industry (Juvan et al., 2023), and in Europe, the sector is responsible for approximately 12% of food waste (Stenmarck et al., 2016). This represents a major global challenge, amplified in the post-pandemic period by increased food consumption and intensified tourism activities (Dhir et al., 2020; Filimonau et al., 2022). Arbulú et al. (2017) statistically demonstrated that a marginal increase in tourist flows leads to a disproportionate generation of food waste. In this context, food service establishments are responsible for approximately 26% of the estimated 931 million tons of waste globally (United Nations Environment Programme (UNEP), 2021; Üngüren et al., 2023). Furthermore, approximately two-thirds of this waste is produced in restaurants (Filimonau et al., 2024). The negative impact of food waste is felt economically (e.g., costs of unexploited food), socially (e.g., food insecurity), and ecologically (e.g., climate change and biodiversity) (Dhir et al., 2020). Although the hospitality sector benefits from multiple waste reduction strategies, their implementation is limited by the complexity and rigidity of everyday food practices (Nand et al., 2025).

In Romania, food waste is a systemic problem with implications for economic, environmental, and social sustainability, affecting sectors such as the food industry and rural tourism. According to the report Study of Food Waste in Romania – Advisory Group 2: Policy and Governance Tools, conducted by Babeș-Bolyai University (2021), the annual volume of food waste in Romania is estimated at approximately 2.5 million tons. In terms of per-capita food waste, data from the Food and Agriculture Organization (2021) indicate that Romania generates approximately 70 kg per person per year (FAO, 2021). In Romania, the HoReCa sector significantly contributes to food waste, with estimates indicating that between 1% and 15% of food used in hotels, restaurants, and catering services is discarded, with an average of approximately 8.6% of the production volume of HoReCa units (Dumitru et al., 2021).

The behaviour of Romanian consumers, especially in the context of tourism and occasional consumption (e.g., vacations, events), directly influences the level of food waste through practices such as excessive purchasing, inadequate portioning, and failure to utilize food scraps (Ștefan et al., 2013).

In the context of rural tourism, where the emphasis is on sustainability, local products and a direct relationship with nature, the integration of One Health principles is essential. The One Health model is based on internationally recognized principles that support an integrated approach to human, animal, and environmental health (Stoican & Sonea, 2021). This promotes interdisciplinary collaboration between fields such as human medicine, veterinary medicine, and environmental sciences, recognizing the interdependence between humans, animals, and ecosystems. The focus is on prevention and integrated monitoring, through surveillance of risks at the human–animal–environment interface, to enable rapid and effective interventions. (Zinsstag et al., 2015). At the same time, it seeks equitable and ethical solutions that protect vulnerable groups and consider the social, economic, and ecological dimensions of health. In addition, the model incorporates an eco-centric vision, emphasizing the importance of ecosystem conservation and resilience as the basis for long-term health. A central element of this model is the recognition of the link between food practices, public health, and environmental management, with an emphasis on food waste prevention and responsible waste management (Papargyropoulou et al., 2014, Destoumieux-Garzón et al., 2018).

Applying the principles of the One Health model in the hospitality industry, including the hospitality industry, restaurant, and catering sector, involves integrating sustainable and preventive measures into food chain management. This involves monitoring food resources and waste, adjusting portions, optimising stocks and preventing environmental contamination with organic waste (FAO, 2021). Food safety is approached in an interdisciplinary manner, through the continuous assessment of supply sources, hygiene, and zoonotic risks (Zinsstag et al., 2015). Staff education and consumer awareness also contribute to reducing waste, while collaboration with local producers and responsible reuse of resources (through composting or donations) support the transition to a fair and sustainable food system (Destoumieux-Garzón et al., 2018; Papargyropoulou et al., 2014).

The article is based on a study conducted in the Rucăr–Bran agro-tourism area, a landmark of rural tourism in Romania due to the high density of guesthouses, traditional gastronomic identity, and a long-standing tradition in breeding and marketing animals. These elements, alongside the intense tourist flows during peak

periods, justify the selection of the region as a research site for analyzing how rural tourism can influence food waste. The interaction between hosts and tourists, the availability of abundant meals, and the lack of clear surplus management policies constitute relevant factors to investigate.

The aim of this research is to formulate sustainable recommendations for rural tourism in the Rucăr-Bran area, in accordance with the principles of the circular economy and the One Health concept, by analysing the phenomenon of food waste in rural tourist guesthouses. The overall objective is to identify the main factors determining food waste, both from the perspective of guesthouse managers and tourists, to develop strategies to reduce food losses without compromising the quality of the services offered. The fundamental novelty of the present study lies in the inclusion and simultaneous analysis of data from both rural guesthouse administrators and tourists, providing a bidirectional perspective on the behaviors, perceptions, and practices associated with food waste. This comprehensive approach allows for a deeper understanding of the dynamics of the phenomenon and serves as a solid foundation for the development of sustainable and scalable recommendations tailored to the Romanian rural tourism context.

In this context, the study highlights the influence of factors such as education, access to information, and daily eating habits, providing a relevant starting point for the development of an educational tool aimed at reducing food waste in rural accommodation facilities. Moreover, the importance of the study goes beyond the informative level, having social and environmental implications in the context of Romania's international commitments to combat climate change and promote sustainability. It also outlines the premises for developing sustainable strategies in the rural hospitality sector, thus laying the groundwork for the development of sustainable strategies in the rural hospitality sector.

2. Literature Review

In recent decades, the problem of food waste has become a major concern in the field of sustainability, involving not only economic and social aspects but also direct effects on the health of populations and the environment (Gustavsson et al., 2011; FAO, 2019). Rural tourism, with its specific strong interaction between local communities, an economy based on traditional agri-food resources, and natural heritage, offers a privileged framework for implementing innovative solutions for reducing food waste. The approach to these solutions involves an interdisciplinary perspective, combining the optimization of consumption and production practices

with the protection of human health and the environment (Antonescu et al., 2022; Juvan et al., 2023).

2.1. Food waste

Food waste is defined as any food intended for human consumption that is wasted, lost or discarded at any stage of the food chain (FAO, 2019). Globally, about one-third of food produced is wasted annually, equivalent to 1.3 billion tonnes (Gustavsson et al., 2011). Eurostat data (2023) on per capita food waste in the EU, ranging from 131 to 132 kg, does not explicitly include Romania, and estimates for member states start from 2020. According to the available data (Fig. 1), the total annual volume of food waste in Romania varied between 2.3 and 2.7 million tons between 2019 and 2023. (UNEP, 2024; Ministry of Environment, Waters and Forests, 2023; Popescu & Ionescu, 2022; Eurostat, 2023; FAO, 2021.)

Fig. 1. Estimated dynamics of food waste in Romania between 2019 and 2024

Source: Data centralized and estimated by the author based on UNEP (2024), Eurostat (2023)

Furthermore, the estimated level of food waste per capita ranged between 67 and 75 kg/year. After a slight decrease in 2020, there was a general trend of moderate increase in both total waste and per capita waste, reaching a peak in 2024 (2.7 million tons and 75 kg/person). Although approximate, these data reflect a worrying trend, justifying the need for sustainable interventions in food resource management, especially in vulnerable sectors such as rural tourism.

In the literature, food wastage is addressed as a phenomenon with major environmental, economic and public health impacts. International and national studies show that food waste is caused by a combination of factors, including consumption habits, poor meal planning and over-portioning (Jansson-Boyd, 2021).

At a behavioural level, research by psychologist Jansson-Boyd (2021) shows that consumer attitudes to waste are influenced by emotional, social and perceived value factors.

Research conducted by Ștefan et al. (2013) indicates that the lack of planning and shopping routines among Romanian consumers contributes significantly to waste. This behaviour is also reflected in the context of tourism, where the abundance and relaxation specific to holidays amplifies the tendency to overconsume.

In rural tourism, among the major causes of food waste are oversized portions, excessive menu preparation, poor stock management and lack of anticipation of the flow of tourists (Antonescu et al., 2022). Leftovers from the preparation process and consumption habits also contribute significantly to the problem (Antonescu & Surdu, 2022).

Ștefan et al. (2020) suggest that education on food management and waste minimisation could help reduce these losses. The authors emphasise the importance of food planning and responsible shopping strategies, with this perspective supporting the importance of educational campaigns among tourists as an integral part of sustainable strategies.

2.2. One Health management and the circular economy in rural tourism

The One Health concept provides a fundamental theoretical framework for understanding the complex interdependencies between human health, animal health, and the state of ecosystems (Zinsstag et al., 2015; Destoumieux-Garzón et al., 2018). In particular, the application of One Health principles in rural tourism highlights the need for responsible food management that prevents contamination, minimizes epidemiological risks and protects local biodiversity (Stoican & Sonea, 2021; Häsler et al., 2014; FAO, 2022). This framework supports an integrated approach focused on prevention, continuous monitoring, and multisectoral collaboration, involving tour operators, farmers, health and environmental authorities, thus creating the conditions for real and effective sustainability (Centers for Disease Control and Prevention (CDC), 2025).

In addition, the circular economy paradigm provides a robust conceptual framework, and a set of principles and practices aimed at optimizing the sustainable use of resources, significantly reducing waste generation through reuse, recycling, and integrated recovery strategies (Kirchherr et al., 2017; Geissdoerfer et al., 2017). In the context of rural tourism, implementing these principles requires a systemic

approach, in which resource flows are kept in circulation for as long as possible, minimizing losses and maximizing economic and ecological benefits at the local level. A first fundamental principle is the recirculation of resources and the reuse of food, by keeping ingredients in the chain of use as long as it is safe and legal. In rural accommodation facilities, this may mean transforming surplus food into secondary dishes or redistributing it to charitable organizations, thus preventing waste (Papargyropoulou et al., 2014).

Composting organic waste is another essential practice, through which nutrients are returned to the soil, supporting local agriculture and reducing the amount of waste sent to landfill (Kirchherr et al., 2017). In rural guesthouses, composting not only reduces the polluting impact on the environment, but also strengthens the link between tourism activities and sustainable agricultural production.

Furthermore, optimizing the consumption of local raw materials helps reduce losses associated with transportation and long-term storage, while also strengthening the local economy. Integrating food resources from the geographical vicinity promotes a short supply cycle, reducing the carbon footprint and supporting community producers (Bahnaru, 2016).

In addition, tailored planning and portion customization are effective measures for adjusting food production to actual demand, avoiding overproduction and surplus portions that remain unconsumed. This adaptation can be achieved through seasonal menus and flexible portion sizes (Popescu & Ionescu, 2022).

The educational component of the circular economy plays a crucial role. Educating and raising consumer awareness about the impact of food waste can be implemented through sustainable cooking workshops, informative posters, or actively involving tourists in waste reduction activities (Ștefan et al., 2020).

Last but not least, monitoring and reporting food waste is essential for identifying sources of loss and implementing effective corrective strategies in line with the principles of the circular economy (Papargyropoulou et al., 2014; Kirchherr et al., 2017).

Overall, applying the circular economy in rural tourism—by adapting menus to actual demand, efficiently managing stocks, using food surpluses as animal feed or compost, and collaborating with local producers—leads to a reduction in environmental impact and increased economic resilience of communities (Ingrassia et al., 2023; Bahnaru, 2016; Tavares de Carvalho et al., 2024).

2.3. The interconnection between food waste, One Health, and the circular economy

The One Health concept is an essential integrated framework for understanding and managing the impact of food waste, promoting a holistic vision focused on prevention, multisectoral monitoring, and interdisciplinary collaboration, which supports the protection of public health, biodiversity conservation, and rural sustainability.

At the same time, the circular economy proposes a model of sustainable production and consumption, in which resources are kept in the economic cycle for as long as possible, thus preventing the generation of waste (Kirchherr et al., 2017). Applying these principles to rural tourism, especially in rural guesthouses, involves adopting concrete practices such as adjusting menus, reusing food surpluses, composting waste, and cooperating with local producers, all of which contribute to reducing the ecological impact and supporting the local economy (Tavares de Carvalho et al., 2024; Ingrassia et al., 2023).

The simultaneous integration of One Health and circular economy approaches is increasingly recognized internationally as a comprehensive and effective solution for sustainable food management. It facilitates the prevention of health risks associated with food waste, reduces pollution, minimises greenhouse gas emissions and promotes responsible rural tourism (Destoumieux-Garzón et al., 2018; Papargyropoulou et al., 2014; Zinsstag et al., 2015). Current studies show that the implementation of multisectoral and multi-stakeholder strategies optimises the rural food chain and reduces food losses, providing models that are adaptable and replicable in different geographical and cultural contexts (Stoican & Sonea, 2021; Sánchez-Teba et al., 2021).

To date, research in the field has predominantly focused on the perspective of guesthouse administrators, providing a partial representation primarily centered on the operational aspects of food management, while the strategic and behavioral dimensions remain insufficiently explored. (Antonescu et al., 2022; Juvan et al., 2023).

Reducing food waste by applying the principles of the circular economy has direct and positive effects on the health of ecosystems and communities, in particular by reducing the impact of pollution and conserving natural resources (Kirchherr et al., 2017). The use of food waste—through methods such as composting or animal feed—prevents environmental contamination and reduces the risk of communicable diseases, which are essential aspects of the One Health approach (Papargyropoulou et al., 2014).

The successful implementation of these strategies requires constructive, multisectoral, and interdisciplinary collaboration, bringing together farmers, veterinarians, public health specialists, environmentalists, and tourism operators. This cooperation is crucial for the development and implementation of effective policies and practices that reduce food waste, protect public health, and ensure the sustainability of rural areas (Destoumieux-Garzón et al., 2018).

Hence, combining the One Health concept with the principles of the circular economy provides a robust, adaptable, and practical framework for an integrated approach to food waste, generating substantial social, economic, and environmental benefits. This synergy becomes a key component in promoting responsible, sustainable, and resilient rural tourism.

3. Methodology

This research adopted a mixed methodological design (quantitative-qualitative), conducted in a non-experimental setting, applied in the real environment of tourist guesthouses in the Rucăr–Bran area. The study was exploratory and descriptive in nature, aiming to identify behaviours and perceptions related to food waste in the context of rural tourism, as well as to highlight sustainable local practices. The adoption of a mixed methodology was motivated by the need to obtain a complete perspective on the phenomenon under investigation. Quantitative data, collected through structured, face-to-face questionnaires, allowed for the assessment of the extent and distribution of waste-related behaviours, while qualitative data (obtained through interviews and participatory observation) provided interpretative depth, identifying motivations, barriers, and opportunities for intervention. Thus, data triangulation increased the validity of the investigated construct—food waste in rural tourist guesthouses—and provided a more accurate picture of the reality in the field, in line with the recommendations of applied research in the social and environmental sciences.

3.1. Tools and structure

Two separate questionnaires were administered: one addressed to guesthouse administrators and one to tourists. Both were constructed gradually (using a "funnel" model) – from factual and closed questions (dichotomous or multiple choice) to 5-point Likert scale items (1 = total disagreement, 5 = total agreement), thus facilitating both data comparability and the exploration of the attitudes and values involved.

The questionnaire for managers (15 questions) included:

▪ Section I: socio-demographic data (gender, age, level of education) and data on the guesthouse's activity (type of unit, capacity, agricultural or craft activities, sources of raw materials);

▪ Section II: identified causes of food waste, methods of prevention and recovery, openness to circular economy initiatives, and interest in environmental education.

The questionnaire for tourists (also 15 questions) was structured as follows:

▪ Section I: basic demographic data (gender, age, residence, level of education);

▪ Section II: eating habits on vacation (culinary preferences, portion sizes, frequency of leftovers, awareness of food waste, attitude towards sustainable solutions).

3.2. Data validation and collection

The instruments were validated through a pilot study applied to a limited sample (5 administrators and 10 tourists), followed by minor adjustments to the wording. The reliability of the questionnaires was confirmed by Cronbach's Alpha coefficient, with values above 0.80, indicating high internal consistency. Data were collected between August and December 2024, using a conventional (non-probabilistic) sample consisting of 30 rural guesthouse administrators (selected based on availability) and 100 tourists, who were surveyed on site during their stay. Data collection was supplemented by participatory observation in 10 guesthouses and semi-structured interviews with 12 key individuals (chefs, serving staff, local farmers) to gain more in-depth information on food behaviours, supply sources, and waste reduction strategies.

3.3. Analysis and processing

The quantitative data were processed using descriptive statistical methods (frequencies, percentages, means), and the interpretation aimed to identify patterns and differences between groups (for example, according to age or education level). Qualitative data were analysed thematically, identifying recurring categories regarding:

▪ local sources, including own production vs. commercial supply;

▪ motivations for large portions;

▪ methods of reusing or disposing of leftover food;

▪ attitudes towards waste and sustainability.

Triangulation of the results provided robustness to the interpretations and contributed to the formulation of contextualised and applicable conclusions.

4. Results and Discussion

To contextualize the results regarding behaviours and practices related to food waste in rural tourism, we present below the socio-demographic data of the two categories of respondents: tourist accommodation managers and tourists. This information allows for a differentiated interpretation of perceptions and behaviours, depending on demographic variables, educational level, place of residence, and the specific nature of the activities carried out.

In the case of tourist accommodation managers, the gender structure is balanced, with a slight advantage for male respondents (52.5%) over female respondents (47.5%). In terms of age, the 35–44 (40%) and 25–34 (26.6%) categories predominate, followed by 45–54 (20%) and over 55 (13.4%). The absence of respondents under the age of 25 may suggest a link between age and managerial experience in this sector.

In terms of educational level, half of the participants (50.1%) have secondary education, 36.66% have a bachelor's degree, and 13.3% have postgraduate studies. At the operational level, most guesthouses have been operating for over 10 years, have an accommodation capacity of between 10 and 20 beds, and are classified as 3-star (83.34%) and 4-star (16.6%). The average annual occupancy rate of approximately 85% is good in relation to the tourist potential of the area. In terms of services offered, 20% of establishments provide only breakfast, while 80% have their own restaurant. In terms of sourcing raw materials for food production, 36.66% mainly use resources from their own households, indicating the existence of complementary agricultural activities, while 63.33% source from local and commercial sources.

The socio-demographic profile of tourists reveals a predominance of women (68.5%) compared to men (31.5%). The age distribution is dominated by the 35–44 age group (36.5%), followed by 25–34 (27.7%) and 45–54 (25.6%). The 18–24 (4.1%) and over 55 (6.1%) age groups are less represented. Most respondents come from urban areas (78.6%), and the rest from rural areas (21.4%).

Regarding education, 38.9% of tourists have a bachelor's degree, 28.6% have a high school diploma, and 11.8% have postgraduate degrees. This educational profile indicates a high level of education among tourists, which may positively influence awareness of food waste issues.

Analysis of the data presented in Fig. 2 reveals that the main cause of food waste in rural guesthouses is the excessive size of the portions served, an issue highlighted by 35% of respondents. Lack of adequate planning ranks second, mentioned by 25% of guesthouse managers, followed by the unpredictability of

tourists' preferences (20%). It is noteworthy that overproduction and the use of perishable products have equal percentages (10%), suggesting that both surplus food and the supply of food with a short shelf life contribute similarly to food losses, requiring complementary prevention solutions. These results indicate that food waste is determined both by hospitality practices and by tourists' consumption behaviours in the context of their vacation. Therefore, integrated strategies need to be developed to adjust portion sizes, optimize supply planning, and improve demand forecasting mechanisms through effective communication with customers.

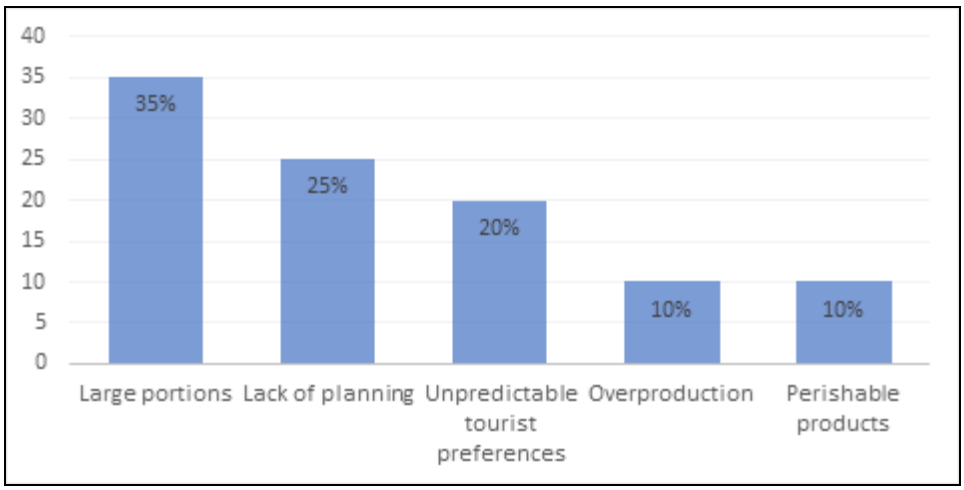

Fig. 2. Reasons for food wastage in rural guesthouses
Source: Authors' calculations based on questionnaires

Tourists' food consumption behaviour, assessed using a Likert scale (Fig. 3), reveals a marked preference for large portions (average score 4.3) and local products (4.5), in contrast to a low level of meal planning (2.1). Also, an average score of 3.8 indicates that many tourists refuse to consume food leftovers, and the level of awareness of food waste is moderate (3.0). These findings suggest the need to implement information and education campaigns aimed at encouraging both waste reduction and the adoption of more responsible consumption practices.

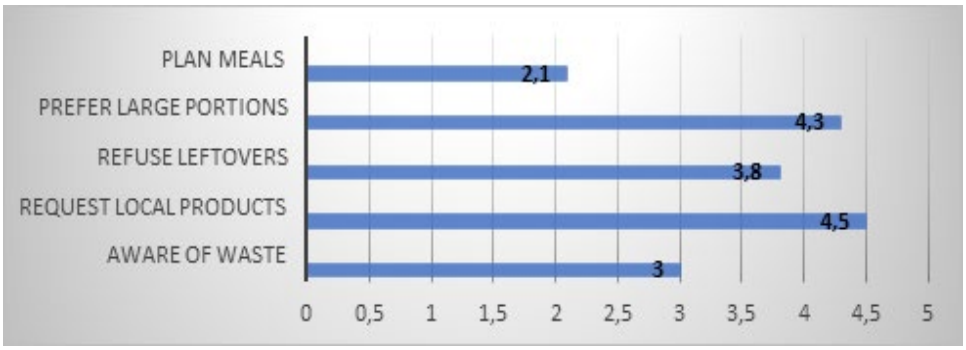

Fig. 3. Food consumption behaviour of tourists (Likert scale 1-5)

Source: Authors' calculations based on questionnaires

In terms of tourists' openness to solutions to reduce food waste (Fig. 4), the majority indicated a favourable attitude towards adjusted portions (60%) and visual information (50%). Other options favoured were sustainable cooking workshops (45%) and composting (30%). Food donations are less favoured (25%). These results suggest opportunities for guesthouses to integrate practical measures and educational activities, with the potential to increase tourist engagement and capitalize on initiatives with ecological and economic impact.

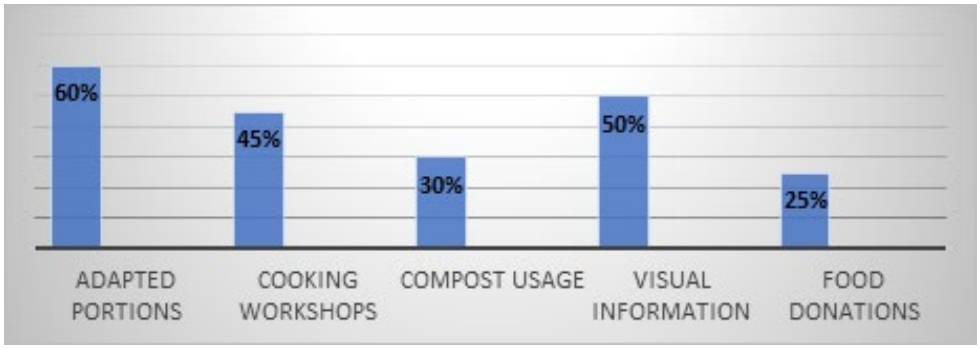

Fig. 4. Tourists' openness to solutions to reduce food waste

Source: Authors' calculations based on questionnaires

The analysis of socio-demographic data highlighted how variables such as age and educational level, both among guesthouse managers and tourists, are associated with behaviors and perceptions related to food waste in rural tourism.

The influence of age is manifested by the fact that managers with longer managerial experience, usually in the middle age groups (35–54 years), show a higher degree of awareness of the operational issues that cause waste, such as portion adjustment and menu planning. They tend to recognise the importance of efficient management in preventing food losses. On the other hand, younger tourists (aged 25–44), who make up the majority, show a preference for large portions and a generally

low level of food consumption planning, which contributes to the generation of leftovers. These behaviours are not necessarily reflected positively among older age groups, who generally have a more cautious attitude toward consumption and waste.

Educational level adds an important dimension: administrators with higher education and especially those with additional training are more open and interested in adopting sustainable strategies and the circular economy, while tourists with a university education also show a higher level of awareness of the risks of food waste and greater openness to the proposed solutions (adapted portions, involvement in educational and sustainable activities).

These socio-demographic influences support the idea that effective interventions must consider both managerial and operational characteristics and consumer profiles, integrating educational components and continuous training for both groups.

Based on this analysis, a series of practical recommendations were formulated, aimed at addressing the identified causes of food waste, backed up by a theoretical framework reflecting the principles of One Health and the circular economy:

(1) Adapting menus to actual demand and seasonality supports the health of the food chain by integrating responsible resource monitoring (One Health) and reducing waste by optimizing quantities and using local ingredients (circular economy).

(2) Full use of ingredients and reuse of leftover food, where legally possible, prevents waste and reduces the risks of contamination and pollution, in line with the One Health principle, and from a circular economy perspective, transforms surpluses into valuable resources.

(3) The implementation of a monitoring and reporting system facilitates the timely identification of sources of waste and the continuous adjustment of the operational strategy, ensuring adapted and sustainable management, in line with the prevention and surveillance recommended by One Health and the principles of continuous improvement in the circular economy.

(4) Composting of organic waste by administrators who use raw materials from their own production. This is an obvious circular economy practice, which closes the resource cycle while also contributing to the protection of the environment and the health of local communities (One Health).

(5) Clear portion labeling and choice-based options aim to change consumer behavior by promoting individual control and social responsibility, which are essential elements of public health and food waste reduction.

(6) Educational workshops and awareness campaigns for tourists are essential for changing mindsets and adopting responsible food practices that have a positive impact on the health of the ecosystem and the community (One Health), as well as for stimulating sustainable consumption characteristic of the circular economy.

These recommendations represent concrete steps but require an applicable framework for practical and scalable implementation in the field of rural tourism.

To this end, the study proposes a Code of Good Practice, which summarises the recommendations and organises them into relevant thematic areas. The code acts as a bridge between the operational and educational approaches, explicitly respecting both the One Health principles, which ensure the prevention of health and environmental risks, and the principles of the circular economy, which optimise the sustainable use of food resources.

Table 1. Code of Good Practices for rural guesthouses to reduce food waste and promote sustainability

No.	Field	Key recommendations	Compliance with the principles of One Health and the Circular Economy
1	Planning and managing food production	Plan menus adaptively, based on the estimated number of guests, monitor stocks and expiration dates, use local seasonal products.	Ensures a safe and healthy food chain, prevents contamination, and supports a sustainable local economy.
2	Reducing food waste	Adjust portion sizes, offer flexible options (including smaller portions or the option to take leftovers home), and recycle leftovers through composting, animal feed, or donations.	Prevents the accumulation of polluting waste and protects public health, enabling the closure of the resource cycle.
3	Sustainable resource management	Implement selective collection, reduce water and energy consumption (e.g., solar panels, LED lighting, smart thermostats), avoid excessive chemicals.	Protect ecosystems and minimize environmental impact by optimizing resource reuse.
4	Hygiene and health	Maintain cleanliness and disinfection of premises, educate staff on food handling according to standards.	Prevents contamination and disease, ensures the integrity of the food chain in accordance with One Health.
5	Education and awareness	Inform guests about risk and sustainable practices, promote responsible consumption, organize training for personnel.	Supports behavioral change and social responsibility, promoting sustainability.
6	Collaboration and innovation	Collaborate with local producers, explore funding for green technologies,	Optimize the local food chain and develop

		implement environmentally friendly waste treatment methods.	sustainable practices, protecting health and the environment.
7	Monitoring and improvement	Regularly evaluate the effectiveness of measures taken to reduce waste and promote sustainability, collect feedback from tourists, update the code in line with new legislation and technologies.	Ensures continuous adaptation in line with public health standards and circular efficiency.

Source: Authors' elaboration

By consistently implementing this Code of Good Practice, rural guesthouses can strengthen a harmonious relationship between tourism, the environment, and public health, in full compliance with the principles of One Health and the circular economy, transforming food waste from a problem into an opportunity for sustainable development.

4.1. Limitations and future research directions

This study has some limitations that need to be acknowledged. One of these concerns the limited geographical scope, restricted to the rural tourist area of Rucăr-Bran, which may influence the generalizability of the results to other regions with different socio-economic and cultural characteristics.

Additionally, the relatively small sample size, both among pension administrators and tourists, may limit the diversity of opinions and behaviors captured, with the potential risk of underrepresenting certain social or age groups.

Finally, there are temporal limitations, as the study provides only a snapshot in time, without a longitudinal perspective to capture long-term trends or the impact of potential interventions.

5. Conclusion

Our study aimed to investigate aspects and factors associated with food waste in rural tourism in the Rucăr-Bran area by analyzing the socio-demographic profiles of guesthouse managers and tourists, as well as their behaviors and attitudes, with a view to formulating recommendations and a code of good practice aimed at supporting waste reduction and promoting sustainability.

The results showed that socio-demographic variables such as age and level of education are associated with perceptions and behaviors related to waste. More experienced managers with higher education show a greater awareness of the importance of efficient food resource management, and tourists with higher

education are more open to adopting responsible practices. The main causes of food waste identified were oversized portions, lack of adequate planning, and unexpected tourist preferences.

Based on these findings, practical recommendations were formulated that explicitly integrate the principles of One Health, by protecting human, animal, and ecosystem health, as well as those of the circular economy, by recovering and reusing resources. The recommendations include adapting menus to actual demand and seasonality, using ingredients in their entirety, reusing leftover food (where permitted by law), implementing a meticulous waste monitoring system, composting organic waste, clearly labeling portions, and providing ongoing education for both staff and tourists.

For the effective and adaptable implementation of these recommendations, the study proposes a Code of Good Practice, structured around key areas (planning and management, waste reduction, sustainable management, hygiene, education, collaboration and innovation, monitoring), which serves as a concrete and flexible guide for rural guesthouses in various geographical contexts, with the potential to be adjusted to the local specificities of other regions.

From an academic perspective, the study makes a valuable contribution by highlighting the connections between socio-demographic characteristics, consumer behaviour, One Health principles and the circular economy in rural tourism. This contribution facilitates and stimulates the further development of interdisciplinary research and informed public policies for sustainable food management.

The findings of this study have significant implications for the advancement of sustainable rural tourism on a global scale. By providing a framework grounded in universal principles such as One Health and the circular economy, the study offers adaptable recommendations and a code of good practice that can be tailored to diverse geographical and cultural contexts, thereby serving as a foundational model for other rural regions without claiming universal implementation.

The adoption of an integrated One Health approach facilitates the prevention of health risks and the protection of biodiversity, both of which are critical for fostering responsible and sustainable rural tourism. Complementing this, the implementation of circular economy practices—including the reuse of food surpluses, composting, and collaboration with local producers—contributes to the reduction of environmental impact while simultaneously supporting local economies, addressing essential components of global climate change mitigation.

Furthermore, actively engaging tourists through educational campaigns promotes behavioral change towards responsible and sustainable consumption, amplifying the impact of these initiatives across diverse tourist destinations. The proposed code of practice also provides a valuable reference for policymakers and tourism operators, guiding the development of effective strategies to minimize food waste while generating tangible social and environmental benefits.

Ultimately, the integration of these practices enhances the economic and environmental resilience of rural communities, ensuring the preservation of natural and cultural heritage for future generations and reinforcing the broader objectives of sustainable rural development.

Thus, the study provides an applied, multidisciplinary, and adaptable framework that can contribute to transforming rural tourism into an engine of sustainable, responsible, and innovative development, in harmony with human and animal health and the environment.

This study makes a significant contribution to the scientific community by offering an integrated, multidisciplinary perspective that links human, animal, and environmental health with food sustainability in rural tourism. It further enriches the existing literature by providing original empirical data from a specific rural context, including analyses of socio-demographic factors influencing food waste.

In addition, the study introduces a practical instrument—the code of good practice—which is flexible, adaptable, and capable of being tested across diverse contexts. This tool not only facilitates implementation but also opens new avenues for research on impact assessment, thereby advancing the scientific understanding of effective interventions in rural tourism sustainability. The findings also provide a robust foundation for the development of evidence-based public policies, supporting sustainable planning and regulatory frameworks within the tourism sector.

By fostering interdisciplinary and collaborative approaches, the study encourages researchers to address complex environmental, health, and economic challenges through integrated methodologies. Moreover, it contributes to scientific education and awareness by promoting the integration of best practices into educational curricula and professional training programs.

Therefore, the study strengthens the link between theory and practice, building an adaptable and applied framework for preventing food waste and promoting sustainable rural tourism.

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