REVIVAL OF THE HOTEL INDUSTRY: THE IMPACT OF FOOD WASTE REDUCTION ON SERBIA'S ECONOMIC PROSPECTS

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A R T I C L E I N F O

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A B S T R A C T

Food waste represents a global issue with serious economic, environmental, and social implications. This study investigates the impact of food waste on the economic stability of hotels and restaurants in the Republic of Serbia using a structural modeling approach. The survey included 136 managers across 30 hotels in various cities and mountainous regions of the Republic of Serbia. Results indicate a high awareness of the food waste issue and identify key factors affecting the economic stability of these enterprises. Although no significant link was found between biodiversity, climate, and environment, as well as economy with economic stability, a positive relationship between social environment and economic stability was discovered. This research model provides a deeper understanding of the factors shaping food waste management practices in hotels and restaurants, thereby offering guidelines for enhancing the economic stability of these sectors.

Introduction

Food waste is defined as using food intended for human consumption for non-edible purposes, diverting it for animal feed, or discarding edible food (FAO, 2019). Hospitality, as a large sector of the hospitality industry, contributes significantly to the global economy by providing lodging and dining services to travelers all over the world. However, this sector is confronted with a significant challenge: food waste, which has serious ecological, social, and economic consequences. Food services in hotels represent

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an organizational unit whose primary function is to provide food and beverages to the guests (Collison & Colwill, 1987; Al-Maliky & ElKhayat, 2012; Hersey & Blanchard, 2013; Ai & Zheng, 2019). Hotels generate 49% of their revenue from accommodation, 42% from food services, and 9% from other services (Kasavan et al., 2017; Aamir et al., 2018; Eriksson et al., 2018; Kim et al., 2019). Hotels, particularly large chains, serve thousands of meals daily via restaurants, banquets, and room service, with a significant portion of food going to waste. This includes kitchen scraps, banquet leftovers, and uneaten buffet food (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015; McAdams et al., 2019). Food waste in the hospitality industry not only contributes to environmental degradation by producing methane in landfills, but it also wastes resources used in production, transportation, and preparation (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015). Furthermore, it causes a significant economic loss for hotels due to the costs of procurement, preparation, and food storage. Reducing food waste can result in cost savings and increased profits.

The issue of food waste within the hospitality sector, which accounts for about 12% of all food waste, is a notable concern but has not been sufficiently explored in scientific studies. Despite its critical nature, there's a lack of comprehensive research in this area. Tackling food waste not only addresses environmental concerns but also has a profound impact on the global economy. The agriculture, food production, and distribution sectors are vital to the economic health of numerous nations. A deeper understanding of food science and technology can lead to more efficient agricultural practices, improved food production methods, and better international food trade. Progress in this field is essential for economic advancement, job creation, and the enhancement of food safety standards (Chakona & Shackleton, 2017; Berkowitz et al., 2016; Gajić et al., 2023; Bugarčić et al., 2023; Nica et al., 2023).

This study sought to assess the impact of food waste on the economic stability of the hotel industry. It used factor analysis to identify critical elements involved in this interplay. Structural modeling was then used to investigate how these identified food waste elements (climate and environmental factors, economic aspects, biodiversity, and the social environment) influence economic stability. The study also aimed to deepen our understanding of how food waste impacts operational expenses, profit margins, and sustainability in the hospitality sector. This study, which makes significant contributions to the fields of sustainability and economics, delves into a relatively unknown area by investigating the effects of food waste on the economic balance in hotels. It provides important strategies for hotel managers and policymakers to maximize food resource utilization. The findings reveal a multifaceted link between food waste and economic stability in the hospitality industry, highlighting the study's innovative approach to a previously unexplored topic.

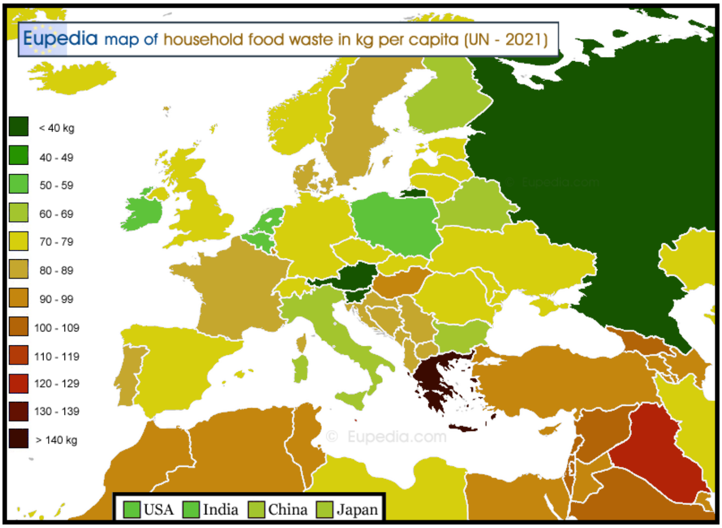
Literature review

The issue of food waste is becoming increasingly important on a global scale, garnering attention from both political and social sectors. This problem goes beyond simply squandering edible items, it involves the loss of a variety of resources such as water, land, financial investment, and energy (Thanh et al., 2010; Oberlin, 2013; Thyberg & Tonjes, 2016; Halloran et al., 2014). These losses have profound effects on both the environment and the economies of nations. Recent scholarly research in this area has been extensive and varied, examining numerous facets of food waste. These studies cover a range of topics including waste in households, waste management in the hospitality industry, sustainability practices, methods for quantifying food waste, strategies for its reduction, waste across the entire food supply chain, solid waste management techniques, and historical analyses of programs like national school lunch initiatives (FAO, 2020; Petrović et al., 2023; Camilleri-Fenech et al., 2020; Juvan et al., 2018). The Food and Agriculture Organization (FAO, 2019) has presented startling figures, estimating that about a third of the food produced globally is either wasted or unnecessarily thrown away. Food waste can be categorized into two main types: 'food loss,' which includes any uneaten edible items from unharvested crops to unconsumed food in homes and stores, and 'food waste,' which pertains to food that spoils during transportation or fails to reach retail destinations (Nicholes et al., 2019; Mekoth & Thomson, 2018; Nahman et al., 2012; Hennchen, 2019).

The food waste scenario in the United States, especially in restaurants, is a significant issue, with estimates suggesting that these establishments generate between 22 and 33 billion pounds of food waste annually (Strotmann et al., 2017; Corrado & Sala, 2018; Petrović et al., 2023; Bugarčić et al., 2023; Dusmanescu et al., 2016). Additionally, other sectors like schools, hotels, and hospitals contribute an extra 7 to 11 billion pounds of waste each year. A notable observation is that restaurants end up not serving 4 to 10 percent of the food they purchase (Collison & Colwill, 1987; Thanh et al., 2010; Hersey & Blanchard, 2013; Chakona & Shackleton, 2017). This could be attributed to various factors such as oversized meal portions, inefficiencies in the supply chain, and the diversity of menu offerings leading to increased waste. Research from Cornell University indicates that customers typically leave about 17 percent of their meals uneaten in restaurants, and alarmingly, 55 percent of these edible leftovers end up being discarded (Suthar & Singh, 2015; Nahman et al., 2012; Al-Maliky & ElKhayat, 2012; Tajfel & Turner, 2004). Factors within the kitchen, including over-preparation of food, poor storage practices, and the non-utilization of leftover food, further exacerbate the problem of food loss ().

Buffet-style restaurants are particularly vulnerable to high levels of waste, mainly because health regulations often prevent them from repurposing or donating excess food. In developing countries, the majority of food loss occurs during the post-harvest and processing stages, which accounts for about 44% of the global food waste (Berkowitz et al., 2016; Aamir et al., 2018; Eriksson et al., 2018; Abeliotis et al., 2015; Gajić et al., 2023b). This is frequently due to inadequate practices, technological constraints, financial limitations, and a lack of efficient infrastructure for proper transportation and storage. In stark contrast, developed countries, which are responsible for 56% of global food waste, see about 40% of this waste occurring at the consumer level (Chen & Jai, 2018; Kim et al., 2019; Halloran et al., 2014; Thyberg & Tonjes, 2016). This is largely driven by consumer behaviors, values, and attitudes towards food. Additionally, a significant portion of food waste in these regions results from misunderstandings about expiration labels on products and the improper handling of prepared foods (Kasavan et al., 2017; Oberlin, 2013; McAdams et al., 2019; Nicholes et al., 2019). A study from 2018 highlighted that in the European Union, 10% of the 88 million tons of food thrown away annually is actually waste (Chen & Jai, 2018; Kim et al., 2019; Halloran et al., 2014).

Figure 1. Map of household food waste (2021) This map is based on the data from UNEP Food Waste Index Report



The Zero Waste concept is an innovative approach and strategy that encourages people to modify their lifestyles and daily habits in order to reduce waste production. This concept establishes visionary goals and proposes solutions to reduce waste generation in modern society (Kasavan et al., 2017; Oberlin, 2013; McAdams et al., 2019; Nicholes et al., 2019). With the problem of massive waste production that society struggles to manage, ethical concerns arise, particularly in terms of environmental protection (Mekoth & Thomson, 2018; Corrado & Sala, 2018; FAO, 2020; Hennchen, 2019). According to estimates, Serbia discards approximately 247,000 tons of edible food each year, which equates to 30-40 kg per person (Juvan et al., 2018; Ai & Zheng, 2019; Camilleri-Fenech et al., 2020; Petrović et al., 2023; Vukolić et al., 2022; Sima & Gheorghe, 2014)). The household, hospitality, and retail sectors have been identified as major food waste generators. It is estimated that the domestic hospitality sector produces around 40,000 tons of food waste per year, of which up to 99% ends up in landfills, emitting greenhouse gases equivalent to approximately 28,000 tons of CO_2 (Gajić et al., 2022; Bugarčić et al., 2023; Strotmann et al., 2017; Petrović et al., 2023).

Hotels and restaurants are obligated to generate large amounts of food waste. After food consumption, waste can occur as a result of oversized portions, inefficient service methods, and menu diversity, which influences consumer decisions (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012; Thyberg & Tonjes, 2016). The types of waste produced in hotels and restaurants vary according to the food materials used. Examples include eggshells, potato and fruit peels, bones, food scraps, and packaging materials (Thanh et al., 2010; Oberlin, 2013; Halloran et al., 2014; Berkowitz et al., 2016). Typically, the priority order goes from prevention to reuse, recycling, and finally disposal (Chakona & Shackleton, 2017; Collison & Colwill, 1987; Kasavan et al., 2017; Eriksson et al., 2018). Others would prefer to optimize prevention if it fails. This means redirecting waste for human and animal consumption (Aamir et al., 2018; Chen & Jai, 2018; Kim et al., 2019; McAdams et al., 2019). Alternatively, waste can be composted or used for renewable energy production (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012). Hotel waste management practices include prevention and reduction, recycling, donation, composting, monitoring, improving ingredient procurement and storage, smart food sales, menu design, staff training, customer engagement, portion control, and service model changes (FAO, 2020; Juvan et al., 2018; Camilleri-Fenech et al., 2020; Gajić et al., 2023).

Many authors emphasize the critical interplay between climate, environment, economy, social factors, and biodiversity within the food system, all of which have a substantial impact on economic stability (Petrović et al., 2023; Strotmann et al., 2017; Bugarčić et al., 2023; Hennchen, 2019). Favorable climate and environmental conditions, coupled with a well-performing economy, can lead to increased agricultural productivity, lower food shortages, and price fluctuations, ultimately promoting economic stability (Corrado & Sala, 2018; Mekoth & Thomson, 2018; Abeliotis et al., 2015; Al-Maliky & ElKhayat, 2012). Additionally, social inclusivity and a supportive environment, along with biodiversity, contribute to addressing food waste and enhancing resource efficiency, benefiting both social and economic stability (Hersey & Blanchard, 2013; Ai & Zheng, 2019; Nicholes et al., 2019; Petrović et al., 2023). Understanding these intricate relationships is crucial for addressing challenges related to sustainability, food waste, and economic resilience in this ever-changing world (Tajfel & Turner, 2004; Thanh et al., 2010; Suthar & Singh, 2015; Chen & Jai, 2018).

The assumption is that biodiversity plays a key role in reducing food waste and enhancing economic stability (Al-Maliky & ElKhayat, 2012; Kasavan et al., 2017; Eriksson et al., 2018; Kim et al., 2019; Vukolić et al., 2023). Biodiversity encompasses the variety of life on Earth, including different species, ecosystems, and genetic resources (Berkowitz et al., 2016; Aamir et al., 2018; McAdams et al., 2019; Abeliotis et al., 2015). This assumption suggests that regions with rich biodiversity are ehind this hypothesis lies in the connection between biodiversity and ecosystem services that more likely to address food waste challenges and achieve economic stability. The rationale b directly impact agriculture and various economic sectors. A diversified and balanced ecosystem can provide essential services such as pollination, natural water purification, and pest control, which are of vital importance for sustainable agriculture and, consequently, economic stability (Hersey & Blanchard, 2013; Chakona & Shackleton, 2017; Nahman et al., 2012; Halloran et al., 2014).

H1: Biodiversity has a significant positive impact on Economic Stability.

Climate and the environment encompass factors such as weather patterns, natural resources, and environmental quality (Thyberg & Tonjes, 2016; Oberlin, 2013; Mekoth & Thomson, 2018; Corrado & Sala, 2018). It is believed that regions with favorable climates, abundant natural resources, and well-maintained environments are more likely to impact food waste and economic stability positively (FAO, 2020; Hennchen, 2019; Nicholes et al., 2019; Ai & Zheng, 2019; Wang et al., 2018). Such regions often have advantages in agriculture, energy production, and overall productivity. For instance, consistent and favorable weather conditions can lead to higher agricultural yields, reducing the economy's vulnerability to food shortages and price fluctuations (Collison & Colwill, 1987; Al-Maliky & ElKhayat, 2012; Hersey & Blanchard, 2013). Additionally, the presence of a clean and well-preserved environment can enhance the quality of life, attract investments, and stimulate economic growth (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015; McAdams et al., 2019; Sima & Gheorghe, 2017). Therefore, this hypothesis establishes a positive relationship between climate, the environment, and economic stability.

H2: *Climate and environment have a significant positive impact on Economic Stability*.

Economic stability is closely linked to the issue of food waste (Nicholes et al., 2019; Mekoth & Thomson, 2018; Nahman et al., 2012; Hennchen, 2019). A stable economy can support initiatives aimed at reducing food waste by providing resources and incentives for businesses and individuals to adopt sustainable practices (Berkowitz et al., 2016; Aamir et al., 2018; Eriksson et al., 2018; Abeliotis et al., 2015). Moreover, the reduction of food waste can contribute to economic stability by optimizing resource use, reducing costs, and enhancing the overall economic well-being of communities (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012; Thyberg & Tonjes, 2016). As a result, this hypothesis suggests a positive relationship between the overall state of the economy and economic stability.

H3: *The economy has a significant positive impact on Economic Stability*.

A socially inclusive and supportive environment can also play a key role in addressing food waste issues (Corrado & Sala, 2018; Mekoth & Thomson, 2018; Abeliotis et al., 2015; Al-Maliky & ElKhayat, 2012). When communities have access to quality education and healthcare, there is not only a higher probability of having a qualified and healthy workforce but also greater awareness of the importance of sustainable practices, including reducing food waste (Hersey & Blanchard, 2013; Chakona & Shackleton, 2017; Nahman et al., 2012; Halloran et al., 2014). Furthermore, reducing food waste can have a positive impact on social and economic stability. Less food waste implies more efficient resource utilization, which can lead to cost savings for individuals and businesses (Thyberg & Tonjes, 2016; Oberlin, 2013; Mekoth & Thomson, 2018; Corrado & Sala, 2018). These savings can contribute to overall economic well-being improvement, especially for vulnerable communities (Collison & Colwill, 1987; Thanh et al., 2010; Hersey & Blanchard, 2013; Chakona & Shackleton, 2017). Thus, this hypothesis suggests a positive association between the social environment and economic stability.

H4: *The social environment has a significant positive impact on Economic Stability*.

Methodology

Objective of the Study

The aim of the study was to investigate the different perceptions of hotel management in the Republic of Serbia, with a special focus on determining opinions about the impact of food waste on Economic Stability.

Sample

The study used a purposeful sample of 136 managers from 30 hotels. These hotels are located in four major cities: Belgrade, Novi Sad, Subotica, and Sombor, as well as two mountain hotels in Kopaonik and Zlatibor. This diverse sample was chosen to ensure representation from various geographic locations and hotel types, allowing for a comprehensive understanding of Serbia's hotel industry.

Questionnaire Design and Data Collection

The data collection process used a structured questionnaire that was carefully designed to assess and capture multiple aspects of hotel management. Given that we did not find a structured questionnaire through the literature review on the given issue, because the authors only dealt with the literature review and suggestions for reducing food waste, we decided to construct the questionnaire ourselves according to previous review manuscripts. The focus was on food waste management, economics, and environmental sustainability. The survey was conducted in the field, face to face with the participating managers. This method enabled real-time interactions, further clarification of queries, and a faster response rate. Throughout the study, ethical guidelines were strictly followed. Participants were given clear explanations of the study's objectives, and they provided informed consent. Respondents' privacy was protected through strict confidentiality and anonymity.

Construction of the Questionnaire

The questionnaire included 15 questions that used a 5-level Likert scale to assess respondents' attitudes, perceptions, and practices. The scale went from "Strongly disagree" (1) to "Strongly agree" (5). The questionnaire contained a comprehensive series of statements, each of which addressed specific aspects of food waste and its impact on the hotel industry, including economic efficiency, environmental and social sustainability.

Data analysis

The responses to each of the 15 questionnaire items were summarized using descriptive statistics such as mean and standard deviation. These statistics provided an overview of the central tendencies and variability in participants' perceptions. In this study, the Cronbach's alpha value of 0.837 for the set of items indicates a high level of internal consistency and reliability in the responses, implying that the items together form a coherent measure of attitudes and perceptions about food waste. Factor analysis was used to investigate the latent variables or constructs present in the questionnaire data (Kasavan et al., 2017; Aamir et al., 2018; Eriksson et al., 2018; Kim et al., 2019). This analysis aimed to uncover patterns and relationships between survey items, allowing for a deeper understanding of the key factors influencing hotel management practices.

The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are two important statistics used in the context of factor analysis to assess the suitability of data for this statistical method (Williams et al., 2010). The KMO value is 0.850, which is very good since KMO values range between 0 and 1, with values closer to 1 indicating that correlation patterns between variables are relatively compact, and therefore factor analysis should yield distinct and reliable factors (Williams et al., 2010; García-Santillán et al., 2013). A KMO value of 0.850 suggests that the data is suitable for factor analysis. This test examines the hypothesis that your correlation matrix is the identity matrix, indicating that your variables are uncorrelated and unsuitable for factor analysis. In your case, Bartlett's test has an approximate chi-square value of 702.739, with 105 degrees of freedom and a significance level (Sig.) of 0.000. This highly significant result (p-value < 0.05) rejects the null hypothesis, indicating that the variables are correlated, and the data is suitable for factor analysis.

Advanced statistical techniques, such as regression modeling or Structural Equation Modeling (SEM) in SmartPLS, were applied to examine relationships between variables and test hypotheses, providing valuable insights into the complex interactions of factors within the hotel industry. Various assessment parameters were considered, including Cronbach's alpha, composite reliability, Average Variance Extracted (AVE), Fornell-Larcker criterion, and Standardized Root Mean Square Residual (SRMR). These parameters ensured the reliability and validity of the data and analysis results. The predictive power of the model (R^2) for economic stability is 0.496, suggesting that nearly 50% of the variance in economic stability can be explained by the independent variables (biodiversity, climate and environment, economy, social environment). Other reliability values will be presented in the results chapter tables.

Results and discussion

In this chapter, we will analyze and interpret the findings from the study on hotel management in Serbia. The chapter is organized to provide information about three key aspects of analysis: first, the results of descriptive analysis, second, the results of factor analysis, and finally, the results of structural modeling. Table 1 shows the means and standard deviations for each individual item, as well as the Cronbach's alpha coefficients.

Table 1. Descriptive values of items and reliability values

Items	M	sd	α
Food waste contributes to a significant increase in greenhouse gas emissions	3.54	0.804	0.801
Food waste has a serious impact on air quality due to the decomposition process and methane generation	4.58	0.822	0.811
Reducing food waste could significantly reduce water consumption in agriculture	3.62	0.690	0.823
Food waste results in significant economic losses due to unused resources in food production."	3.35	0.594	0.865
Reducing food waste can contribute to lower operating costs for businesses in the food industry	4.27	0.829	0.838
More efficient household food management can contribute to saving money and reducing living costs	4.15	0.673	0.861
Food waste contributes to the reduction of biodiversity due to the excessive use of land for agriculture	4.66	0.877	0.961
Reducing food waste can have a positive impact on the conservation of natural habitats and wildlife	4.22	0.504	0.822
Increasing efficiency in food production and distribution can reduce pressure on biodiversity	3.09	0.082	0.827
Food waste contributes to social injustice because while some people waste food, others struggle with hunger	4.01	0.747	0.847
Reducing food waste can improve economic efficiency and reduce the cost of living for consumers	3.51	0.736	0.813
Greater awareness and education about reducing food waste can have a positive impact on social responsibility and sustainability	3.34	0.735	0.844
Large amounts of food waste in the hotel industry directly affect the profitability and economic efficiency of hotels	3.34	0.661	0.873
Food waste in hotels adds to operational costs and can negatively impact guest service prices	3.20	0.663	0.887
Effective management of food waste in the hotel industry can significantly contribute to the sustainability and long-term economic stability of the sector	3.05	0.874	0.814

*M-arithmetic mean; sd – standard deviation, α – Cronbach alpha

Source: Authors.

Items with higher mean scores (above 4.0) typically discuss the serious impact of food waste on air quality, its contribution to social injustice, and the benefits of reducing food waste in terms of conservation, economic efficiency, and operational costs in the food industry. These high scores indicate a strong agreement or concern among respondents about these specific aspects of food waste. Items with lower mean scores (close to or below 3.5) are likely to address with indirect consequences of food waste, such as its impact on economic stability in specific sectors such as hotels or the broader implications for biodiversity and food production efficiency. The relatively narrow range of standard deviations (mostly between 0.5 and 0.9) across all items suggests that respondents' opinions are generally consistent, indicating that while there are differences in the level of concern or agreement for each statement, these differences are not extremely wide. Cronbach's alpha values, mostly above 0.8 for each item, suggest a high level of reliability in the responses, indicating that the items together constitute a consistent measure of attitudes towards food waste and its impacts.

Exploratory factor analysis with Promax rotation revealed a total of five factors, which are shown in Table 2.

Table 2. Results of EFA (Exploratory Factor Analysis).

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
Climate and Environment	4.861	32.409	32.409	4.861	32.409	32.409	3.709
Economy	1.800	11.998	44.407	1.800	11.998	44.407	2.745
Biodiversity	1.084	7.228	51.636	1.084	7.228	51.636	2.902
Social Environment	1.019	6.792	58.428	1.019	6.792	58.428	1.766
Economic Stability	1.848	5.653	64.081	.848	5.653	64.081	2.325

Source: Authors.

In the analysis of Principal Component Analysis (PCA) results, it is evident that the data represent a different structure concerning explained variance. Initially, the eigenvalues from PCA indicate a clear hierarchy in the importance of components, with the first component standing out as the most significant, explaining over 32% of the variance in the dataset. The data reveal that the first three components together explain just over half of the total variance (51.636%). This cumulative contribution highlights the interplay and combined significance of these top components in understanding the essence of the dataset. After rotation, the contribution of the first component slightly decreases, while the role of the third becomes more pronounced. The cumulative percentage of variance explained by the components, especially noticeable when considering the first five or six components, is significant. These components together account for approximately 64% to 69% of the total variance.

Table 3 gives an insight into the reliability and validity values of all study factors. After examining the metrics of reliability and validity, it is found that the constructs differ in their internal consistency but generally show adequate reliability.

Table 3. Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Biodiversity	0.787	0.704	0.736	0.785
Climate and Environment	0.709	0.727	0.835	0.728
Economic Stability	0.762	0.892	0.814	0.896
Economy	0.822	0.779	0.834	0.730
Social Environment	0.746	0.871	0.765	0.821

Source: Authors.

Cronbach's alpha for the constructs ranges from 0.787 (Biodiversity) to 0.822 (Economy), with Social Environment (0.746), Climate and Environment (0.709) and Economic Stability (0.762) also showing strong values. While the alpha values for biodiversity and the social environment are slightly below the generally accepted threshold, they still suggest a moderate level of internal consistency, which can be considered acceptable in research contexts.

The values of rho_A closely mirror the Cronbach's Alpha results, enhancing the internal consistency of the constructs. The composite reliability for all constructs exceeds the acceptable threshold of 0.7, emphasizing the overall reliability of the measurement model.

Regarding construct validity, all values of the extracted average variance (AVE) surpass the reference value of 0.5, indicating that most constructs explain more than half of the variance in their indicators. Specifically, the Economy factor shows the highest AVE at 0.730, followed by Climate and Environment with 0.728, suggesting strong convergent validity for these constructs.

The construct with the most significant impact on Economic Stability is the Social Environment, which not only exhibits a strong and statistically significant path coefficient but also demonstrates satisfactory measures of reliability and validity. Although Biodiversity, Climate and Environment, and the Economy show positive relationships with Economic Stability, they are not statistically significant, implying that their direct impact may be limited within the scope of this study.

In the analysis of structural equation modeling using SmartPLS, the assessment of discriminant validity using the Fornell-Larcker Criterion was presented as part of the research on the determinants of economic stability (Table 4).

Table 4. Discriminant Validity: Fornell-Larcker Criterion

	Biodiversity	**Climate and Environment**	**Economic Stability**	**Economy**	**Social Environment**
Biodiversity	0.796				
Climate and Environment	0.723	0.793			

	Biodiversity	**Climate and Environment**	**Economic Stability**	**Economy**	**Social Environment**
Economic Stability	0.714	0.819	0.772		
Economy	0.780	0.764	0.745	0.794	
Social Environment	0.789	0.806	0.812	0.812	0.722

Source: Authors.

Using the Fornell-Larcker criterion, discriminant validity within the model has been confirmed. The square roots of the average variance extracted (AVE) for each construct (Biodiversity, Climate and Environment, Economic Stability, Economy, Social Environment) were compared to the correlations between the constructs. The values on the diagonal, representing the square root of AVE, were greater than the values off the diagonal in the corresponding rows and columns. This indicates that each construct has more variance with its indicators than with other constructs, satisfying the conditions of discriminant validity.

Composite reliability for each construct was found to be above the generally accepted threshold of 0.7, indicating a reliable measure. The t-statistics associated with these reliabilities were significantly large (all exceeded the value of 22), and the p-values were at the 0.000 level, indicating that the construct reliabilities were statistically significant (Table 5).

Table 5. Composite Reliability

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
Biodiversity	0.735	0.730	0.033	22.256	0.000
Climate and Environment	0.835	0.831	0.025	33.888	0.000
Economic Stability	0.816	0.814	0.026	31.209	0.000
Economy	0.833	0.826	0.033	25.593	0.000
Social Environment	0.766	0.763	0.031	24.851	0.000

Source: Authors.

Confidence intervals for composite reliability estimates, both standard and bias-corrected, did not include the critical lower threshold of 0.7, further confirming the reliability of our constructs. The small bias observed in the bias-corrected intervals did not significantly change our confidence in these estimates (Tables 6 and 7).

Table 6. Confidence Intervals and Confidence Intervals Bias Corrected

	Confidence Intervals				**Confidence Intervals Bias Corrected**			
	Original Sample (O)	**Sample Mean (M)**	**2.5%**	**97.5%**	**Original Sample (O)**	**Sample Mean (M)**	**2.5%**	**97.5%**
Biodiversity	0.735	0.730	0.658	0.790	0.735	0.730	-0.005	0.667
Climate and Environment	0.835	0.831	0.777	0.874	0.835	0.831	-0.004	0.783
Economic Stability	0.816	0.814	0.759	0.861	0.816	0.814	-0.002	0.761
Economy	0.833	0.826	0.748	0.873	0.833	0.826	-0.007	0.763

Source: Authors.

Model fit was assessed using multiple indices, indicating acceptable fit. The results presented in Table 7 detail the fit of two different models within structural equation models: the Saturated Model and the Estimated Model. It is interesting to note that both models show identical values across all the evaluated measures, which indicates a consistent level of adaptation of the model in relation to the considered parameters. Specifically, the SRMR (Standardized Root Mean Square Residual) values are extremely low, exactly 0.001 for both models, implying an excellent fit. This measure, which evaluates the average difference between observed and predicted correlations, in this case indicates an almost perfect correlation, given that values below 0.08 generally signal a good fit. Likewise, d_ULS (Unweighted Least Squares discrepancy) values are equal for both models and amount to 0.032. These values, which are well below any conventional thresholds, suggest that the discrepancy between observed and model-predicted covariances is minimal, further indicating the effectiveness of both models. Additionally, d_G (Geodesic discrepancy) shows values of 0.073 for both models, providing further evidence of good model fit. This result, which relies on the geodetic discrepancy as a measure of fit, confirms that both models adequately reflect the structure of the data. Chi-Square values of 2.537, equal for both models, further support this interpretation. In the context of the Chi-Square test, lower values are preferred, and the results obtained are in line with expectations for high-quality models. Finally, the NFI (Normed Fit Index) values of 0.915, identical for both models, exceed the conventional threshold of 0.90, which categorizes them as models with good fit. This indicates that both models fit the structure of the data effectively compared to the null model which assumes no correlations between the variables.

Table 7. Fit Summary

Indicators of model fit	**Saturated Model**	**Estimated Model**
SRMR	0.001	0.001
d_ULS	0.032	0.032
d_G	0.073	0.073
Chi-Square	2.537	2.537
NFI	0.915	0.915

Source: Authors.

Model shows good discriminant validity and reliability in all constructs, with the measurement model providing a strong foundation for assessing various factors influencing economic stability. While fit indices indicate satisfactory model fit, they also suggest that future research can explore potential improvements to enhance the model. Figure 2 and Table 8 show the path coefficient model of results from the SmartPLS analysis, focusing on the impact of various factors on Economic Stability.

Figure 2. Graphic representation of the structural modeling equation with the average load.

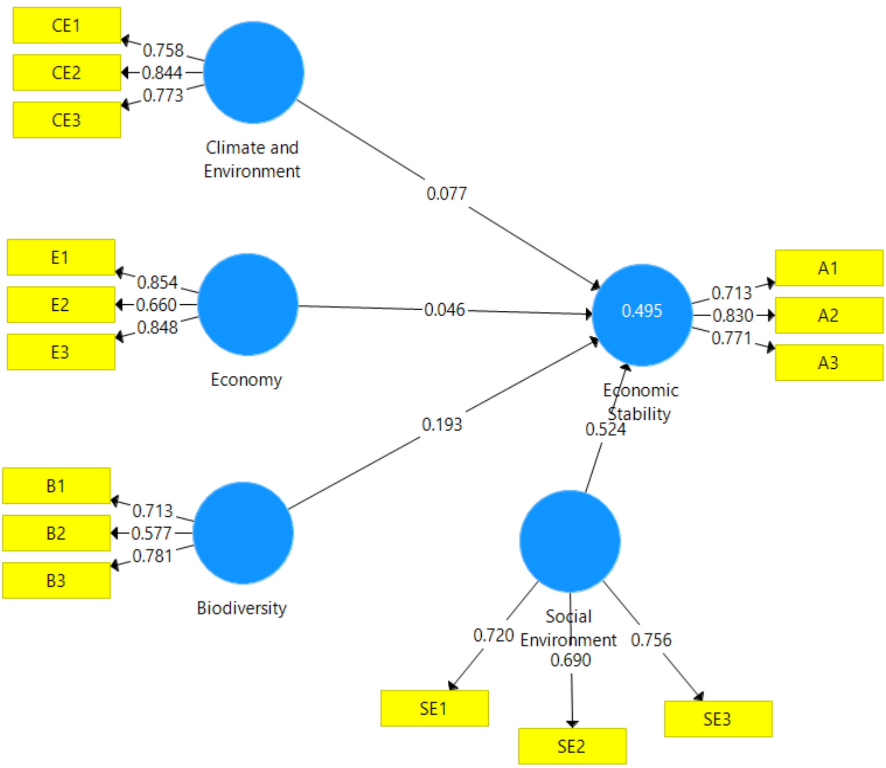


Table 8. Path coefficients

	Estimate	Sample mean	sd	t Statistics (|O/ STDEV|)	p
Biodiversity ->Economic Stability	0.193	0.191	0.110	1.766	0.077
Climate and Environment -> Economic Stability	0.077	0.084	0.075	1.026	0.305
Economy -> Economic Stability	0.046	0.054	0.067	0.695	0.487
Social Environment -> Economic Stability	0.524	0.526	0.091	5.732	0.000

*Note: sd-standard deviation; p –statistical significance

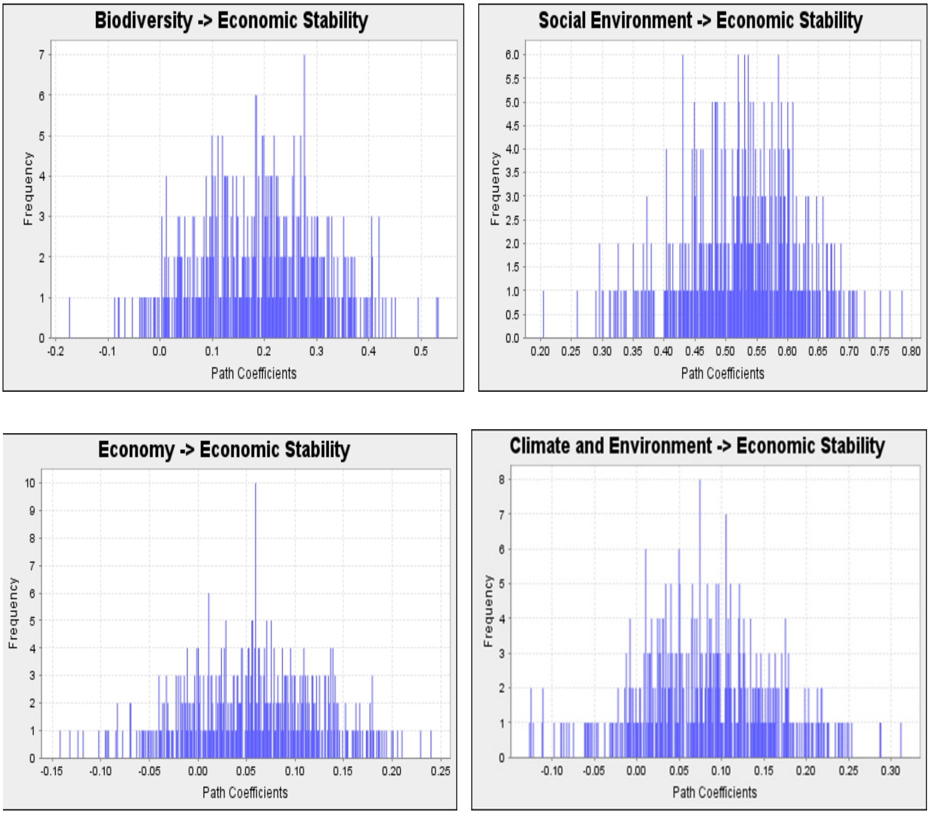
Source: Authors.

It has been determined that the path coefficient from biodiversity to economic stability is 0.193, indicating a positive relationship between these two constructs. Although this suggests that greater biodiversity may contribute to improved economic stability, the relationship is not strong, and with a p-value of 0.077, it fails to reach conventional levels of statistical significance ($p < 0.05$). This implies that while there may be a positive trend, the evidence is not strong enough to confirm a definitive impact of biodiversity on economic stability within this study. Similarly, the impact of climate and the environment on economic stability yielded a path coefficient of 0.077. This result also points in a positive direction, but the relationship is even weaker than that of biodiversity and is not statistically significant ($p = 0.305$). This finding suggests that any direct influence of climate and environmental factors on economic stability is minimal and not strongly supported by the data at hand.

The direct impact of the economy on economic stability was surprisingly weak, with a path coefficient of 0.046 and a p-value of 0.487. This suggests that there is no significant direct relationship between the general economic factors measured in this study and the construct of economic stability as defined by our model. Contrary to these findings, the social environment showed a strong and statistically significant influence on economic stability, with a path coefficient of 0.524 and a p-value of 0.000. This result is robust and implies a significant positive impact of social factors in the environment on economic stability. Such a strong connection underscores the importance of social structures and systems in supporting economic stability.

The histograms provided represent the initial distribution of path coefficient estimates for the relationships between biodiversity, social environment, economy, climate and environment, and economic stability within the Structural Equation Model. Each histogram visualizes the frequency distribution of initial path coefficient estimates obtained from the PLS analysis.

Figure 3-6. Histograms of the starting distribution



Source: Authors.

For the relationship between Biodiversity and Economic Stability, the distribution for bootstrapping is centered slightly above zero, predominantly between 0.1 and 0.3. This implies a general trend towards a positive impact of biodiversity on Economic Stability. However, the spread of the distribution towards negative values suggests some variability in the samples that were generated, indicating that the positive relationship is present but not highly consistent across all estimates.

In contrast, the Social Environment shows a pronounced positive effect on Economic Stability, with a distribution that leans towards higher values, mainly in the range of 0.4 to 0.8. This strong positive relationship indicates a robust and consistent impact of Social Environmental factors on Economic Stability, as consistently high initial estimates support statistical significance and potential substantive relevance of this path.

The distribution of path coefficients for the impact of the Economy on Economic Stability is tightly clustered around zero, with most values lying in the positive spectrum but close to zero. The narrowness of the distribution suggests a positive but weak relationship. The presence of some values in the negative range suggests that the impact of the economy on economic stability, while generally positive, is not as strongly supported or as strong as the impact of the social environment.

The relationship between Climate and the Environment and Economic Stability is also predominantly positive, with initial estimates concentrated between 0 and 0.3. Despite the overall positive trend, the spread of values towards zero and into the negative range implies a degree of uncertainty, suggesting that while there is a positive connection, the relationship may not be strong or consistent across different samples.

Current findings offer valuable insights, with the construct of the Social Environment, in particular, demonstrating a significant and strong impact on Economic Stability. Statistical evaluations support the essential conclusions drawn from the analysis and underscore the importance of social factors in the context of Economic Stability. These results should inform both academic discourse on this topic and policy considerations aimed at strengthening economic resilience.

While hypotheses 1, 2, and 3 were not confirmed because their p-values exceeded the conventional significance level of 0.05, hypothesis 4 was strongly confirmed as its p-value was very low (0.00). These findings suggest that the Social Environment indeed has a significant positive impact on Economic Stability, while other factors (Biodiversity, Climate and the Environment, Economy) did not exhibit statistically significant relationships in this analysis.

Conclusion with limitations and future implications

Food waste in Serbia represents a significant economic challenge. Not only does it lead to losses in the food production sector, but it also contributes to economic inefficiency. Particularly in the hotel industry, poor food waste management can have a negative impact on the profitability and long-term economic stability of hotels. Therefore, it is essential to adopt sustainable waste management practices to mitigate the adverse effects on the growth and development of the hospitality sector.

This study investigated these issues through a survey conducted among 136 managers at all levels working in various cities across the Republic of Serbia, including mountain hotels. The research was carried out in 2023. The aim was to gain a deeper understanding of the complex relationships between food waste and economic stability. We used factor analysis to extract latent variables or factors from the dataset, such as Biodiversity, Climate, Environment, and Economic and Social surroundings. In addition to factor analysis, advanced statistical techniques were used, including Structural Equation Modeling (SEM) using SmartPLS software. We analyzed path coefficients, means, standard deviations, t-values, p-values, Cronbach's Alpha, Composite Reliability, Average Variance Extracted (AVE), Fornell-Larcker Criterion, and Standardized Root Mean Residual (SRMR). These data helped us assess the reliability, validity, and significance of our structural model.

The results of the descriptive analysis showed that participants recognized the significant environmental consequences of food waste, giving high ratings to items related to the impact of food waste on air quality and biodiversity. Potential economic benefits of more efficient food management were also highlighted. However, items related to social issues, such as the impact of food on social injustice, received moderate ratings. This indicates the multifaceted nature of the food waste problem and the need for solutions that encompass both ecological and economic aspects.

In the statistical analysis conducted for this study, hypotheses formulated to examine the influence of various factors on economic stability were assessed. Hypothesis 1, which posited a relationship between Biodiversity and Economic Stability, did not receive statistical confirmation (estimate = 0.193, p = 0.077). Similarly, Hypothesis 2 (Cimate and Environment -> Economic Stability) was not supported, as the p-value was 0.077. Furthermore, Hypothesis 3 (Economy -> Economic Stability) was not confirmed in the analysis, as the estimate was 0.046 and did not reach statistical significance. However, in complete contrast, Hypothesis 4 (Social Environment -> Economic Stability) was strongly supported by the analysis, revealing a significant positive relationship between the Social Environment and Economic Stability (estimate= 0.524, p = 0.000).

Limitations

The research was conducted in specific cities in Serbia and in several hotels in mountainous areas. This may limit the scope of sample representativeness since not all parts of the country were included. Although the results can be applied to these specific locations, it is necessary to be cautious about general conclusions that apply to the entire country. In Serbia, it is important to note that the structure of job positions in the hotel sector can vary from one hotel or location to another. Not all hotels have a standardized structure with managers at all levels. Instead, some positions may encompass not only managers but also department or sector heads. This can vary depending on the size and organizational structure of a specific hotel. Such diversity in the structure of job positions in the hotel sector can further impact the way different business functions are managed and their responsibilities. Therefore, when analyzing research and directing future activities, it is important to keep this diversity in mind and adapt the approach in line with the specific organizational model and business structures in different hotels in Serbia.

Theoretical implications

This study has significant theoretical implications across multiple aspects. Firstly, it complements the existing body of literature on the impact of food waste on the economy and the hospitality industry, providing fresh insights and knowledge into these intricate relationships. This contribution to the literature is pivotal for advancing the theoretical understanding of the issue.

Secondly, the research adopts a multidisciplinary approach by integrating elements of ecology, economics, and hospitality. This holistic approach contributes to the theoretical synthesis of diverse disciplines and enables a deeper comprehension of their interactions.

Thirdly, the findings of this research are not solely of theoretical relevance but can also be directly applied in practice. They offer guidelines for the development of strategies to reduce food waste in the hospitality sector and optimize economic stability within that industry, bridging the gap between theoretical knowledge and practical utility. Furthermore, this study underscores the importance of addressing food waste from an economic perspective, which can raise awareness and significance of this issue among decision-makers, businesses, and society at large.

Lastly, the research results provide a theoretical framework for future studies in this field. Identifying the factors influencing economic stability concerning food waste can inspire further research and investigations. In summary, the theoretical significance of this research lies in its ability to deepen the understanding of the complex relationships between food waste, economics, and the hospitality sector, offering new theoretical perspectives and practical implications.

Practical implications with a proposal for corrective measures

For the hospitality sector, the research findings underscore the importance of reducing food waste to improve economic stability. Hotels are advised to consider strategies for waste reduction, such as better inventory management, staff education, and collaboration with organizations involved in food redistribution. Reducing food waste can lower operational costs and enhance profitability. Preserving biodiversity and reducing environmental impact are crucial factors for long-term ecological sustainability. Hoteliers are encouraged to adopt environmentally friendly practices, including resource conservation, support for local ecosystems, and the reduction of greenhouse gas emissions. For economic decision-makers, the research indicates that reducing food waste can have a positive impact on economic stability. This can spur the development of policies and initiatives that support food waste reduction within a broader economic context. Raising awareness about the issue of food waste and its implications can have a significant influence. Hotels, consumers, and organizations are recommended to collaborate on education and information dissemination to promote responsibility and sustainable practices. The practical implications of this research emphasize the importance of reducing food waste as a key factor for economic stability, environmental sustainability, and social responsibility. A collective effort among different stakeholders is recommended to achieve positive outcomes in all of these areas.

In the context of researching the impact of food waste on economic stability, there are several key steps and activities that can be taken to reduce negative impacts and improve efficiency in the food sector. Conducting a food waste audit involves analyzing and tracking food waste from its source to the point of disposal. The primary focus during this process includes quantifying the amount of food being wasted and the number of people visiting restaurants. This way, management can identify the major sources of food waste. Monitoring is done through two methods - food logging that tracks the type of food being wasted, reasons for it, and the quantity, and traffic log that takes into account the restaurant's traffic, weather changes, and other relevant information for future planning. Avoiding the habit of wasting ingredients before they are prepared is also crucial. This involves assessing food inventory to better understand how long it takes to use up stored food materials in the restaurant. This helps in reducing unnecessary ordering and the loss of perishable ingredients. Additionally, restaurant staff should receive waste management training through appropriate training, allowing them to develop effective strategies for managing these challenges. Creating a food waste management plan is also essential. Restaurants face the issue of leftover food when waiters serve portions that cannot be fully consumed by guests. This problem can be addressed by improving the accuracy of customer orders. Customers can also be encouraged to take leftover food home or donate it to others. Furthermore, forming food waste management teams is essential for effectively addressing these issues. Restaurant staff should work as a team while implementing food waste management strategies, with sensitivity to the problems of poor food waste management in restaurants. Team members should be educated about methods of monitoring, storing, and recycling food waste. New staff should always be familiar with the food waste management policy in the restaurant before integrating into the teams.

Ultimately, composting food waste represents a sustainable practice that hotels and restaurants can adopt to reduce negative impacts on the environment. This practice requires appropriate composting equipment and can contribute to reducing the amount of food waste ending up in landfills. All of these activities and strategies contribute to reducing food waste, which has a positive impact on the economic stability and sustainability of hotels and restaurants.

The conducted research provides valuable insights into the issue of food waste and its impact on economic stability, especially in the context of hotels and restaurants in Serbia. However, this research opens the door for further research and the improvement of food waste management strategies. Future research can focus on the implementation and evaluation of proposed food waste management strategies to better understand their effectiveness and applicability in different situations. Additionally, research can further analyze the factors influencing consumer decisions regarding food leftovers and ways to efficiently utilize them. Furthermore, future research can focus on monitoring the long-term effects of applied strategies on the economic stability of hotels and restaurants, as well as their environmental impact. This would allow for a deeper understanding of the long-term benefits of sustainable food waste management. Through further research, we could also explore best practices in other countries and apply them in the local context, taking into account the specificities of the food market and consumer needs in Serbia.

Conflict of interests

The authors declare no conflict of interest.

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