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Sustainable Food Consumption among Young Hungarian Consumers: An Analysis of Attitudes, Behavior, and Socio-Demographic Factors

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ABSTRACT OF THESIS

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This research investigated the sustainable food consumption behavior of Hungarian students and residents in Hungary from 2023 to 2024. The two overall objectives of the study were to explore the relationship between sustainability attitudes and actual household food practices and to assess the impact of sociodemographic characteristics and perceptions of food waste. The research also established specific goals to identify drivers of sustainable behavior, measure the role of household food waste attitudes, and evaluate the effects of age, income, and place of residence on consumption decisions.

For the purposes of the study, an online survey was conducted among Hungarian students and residents from which 246 answers were gathered. The data analysis was carried out in IBM SPSS Statistics 29, which comprised the reliability test development of composite indices and non-parametric procedures such as Spearman's correlation and Kruskal–Wallis tests. There was a significant positive correlation between sustainability attitudes and sustainable action, and a moderate one between food waste attitudes and sustainable action. Age had a slight, but significant, effect, and income differences were less important.

Gradually, it has been showing that there is ample awareness about sustainability indeed, but a rigorous approach is still scarce in favor of correlating thinking and action. In an effort to narrow or close the gap, some recommendations for mitigation and prevention are as follows: education in food literacy; transparent labeling; supermarket surplus donation; and digital technology that supports household management. Another more applied measure of promoting sustainable food consumption in Hungary, which targets students, is launching community-led initiatives, urban farms, and setting national goals with regard to food waste reduction, while corresponding to EU strategies.

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1. INTRODUCTION

1.1 Background of the Study

Achieving sustainable food consumption requires a combination of market forces, consumer education, and government regulations to maximize positive social and environmental impacts (Meulenberg, 1993). Due to socially irresponsible food consumption, countries waste large amounts of food (Food and Agricultural Organization, 2020). It is estimated that almost one-third of the global food mass and about one-quarter of the total food calories produced are lost or wasted (Gustafsson, Cederberg, & Sonesson, 2011). Food loss typically occurs during the processing stage due to climatic conditions, insufficient facilities, and harmful practices. On the other hand, food waste is the conscious decision to discard nutritious food due to inadequate meal planning or improper storage that results in spoilage or expiration (Etim et al., 2024). In developed countries, most of the food waste occurs at the consumer level, resulting in additional costs and environmental impact (Doorn, 2016). Saudi Arabia, the United States, the UAE, and Canada are among the world's worst food wasters, with higher environmental impact indicators than South Africa, Lebanon, Argentina, and Mexico (Skaf, 2021). Therefore, 5.6% of foods consumed in households were scraps or wasted, mainly consisting of vegetables, fruits, and marine products (Nakamura, 2022).

In previous studies, researchers have examined food waste at distribution, transportation, retail, and other food service stages (Drewitt, 2013). Therefore, food manufacturing companies prioritize the reduction of negative operational impacts and invest in pollution-reducing technology and environmentally friendly raw materials as a key component of their corporate social responsibility strategy (Nagyová, 2016). In addition, open innovation practices in the food industry can improve innovation capabilities and market outcomes. However, further research is necessary to understand their impact and implications (Sarkar, 2008). Nevertheless, one of the key components of an open innovation framework in the food industry is to remove barriers between academia and industry, revise intellectual property models, and enhance social responsibility (Saguy, 2011).

Therefore, it is important to consider the level of customer awareness, which refers to their knowledge of their rights and responsibilities when making purchasing decisions (Rousseau, 1993). Increased online media exposure has a significant positive impact on consumers' adoption of eco-friendly products (Delcea, 2019). After all, Demographics, attitudes, knowledge, visuals, functionality, cross-cultural differences, and affordability influence consumers’ decision to purchase food in environmentally friendly packaging (Popović, 2019).

On the whole, future consumers' consumption behavior can be linked to global concerns regarding sustainability, intertemporal consumer choices, and life cycle models. In today's business landscape, the opinions and attitudes of prospective consumers hold a vital

position in determining the success of any enterprise. Therefore, it becomes imperative to undertake a thorough analysis of their attitudes from a business perspective. This enables the formulation of enduring and sustainable options that cater to the specific needs of consumers while also considering their social acceptance. By catering to these factors, businesses can ensure a long-term strategy that is effective in addressing the needs and expectations of their target audience (Aschemann-Witzel et al., 2015). The focus of this research was on the food consumption and wasting habits of future consumers. The goal of this design research was to address sustainability concerns related to food waste in the field of social design. The study aimed to assess the attitudes, routines, and skills of individuals residing in Hungary and Angola regarding food consumption and food waste habits. Most of all, the identification of key challenges that hinder the adoption of sustainable food consumption practices is of paramount importance for the effective implementation of sustainable consumption programs. The incorporation of these challenges into the development of such programs can significantly enhance their impact and promote sustainable food consumption practices among individuals and communities.

1.2 Justification

Food waste reduction is central to addressing global sustainability challenges, as nearly one – third of the food produced worldwide is lost or wasted. This scenario is contributing to environmental degradation, economic inefficiencies, and food insecurity. While technological innovations in production and distribution have reduced waste of food upstream, at the household level, the waste remains a major unresolved issue, particularly in those markets where high consumption is driven.

An examination of the food waste and consumption patterns peculiar to Hungarian households uncovers challenges and opportunities for sustainability in affluent environments where cost, consumer knowledge, and lifestyle directly affect results.

1.3 Problem/hypothesis

Despite rising awareness of sustainability, there remains a persistent gap between consumer attitudes and actual sustainable food consumption practices. Household food waste continues to be a critical contributor to environmental degradation, resource loss, and economic loss worldwide, particularly in more developed countries. Maybe the Socio-demographic factors (age, income, education, place of residence) influence sustainable consumption behavior.

1.4 Research Questions

1- To what extent do attitudes toward sustainability predict actual sustainable consumption behavior?

2- How do food waste attitudes impact sustainable practices at the household level?

3- What socio-demographic factors (age, income, education, urban/rural residence) influence sustainable food consumption?

1.5 Objectives

1.5.1. General Objective

The aim of this work is to examine the determinants of sustainable food consumption behaviors in Hungary, with a particular focus on consumer attitudes, socio-demographic variables, and food waste perceptions. In addition, this study intends to provide recommendations that can help reduce household food waste and encourage more sustainable practices within Hungarian households.

1.5.2. Specific Objectives

In order to achieve the goal in compliance with the general objective, below are listed some of the specific objectives through which this work will flow and finally test what has been proposed in its hypotheses. These, together with the general objective, define the purpose of this thesis.

- Assess the relationship between sustainability attitudes and sustainable food consumption behavior.
- Analyze the impact of household food waste attitudes on overall sustainable practices.
- Investigate the role of socio-demographic factors in shaping sustainable consumption.
- Propose targeted strategies that can strengthen sustainable food practices and reduce household food waste in Hungary.

2. LITERATURE REVIEW

2.1 The Development of Sustainable Food Consumption Studies Throughout History.

Research on Sustainability of food consumption reflects increased awareness of food systems that has grown over the decades. Early research was mostly about food security and nutrition issues, and as concerns about the environment gained central stage, more significant interest was created in how our consumption of food affects nature (Godfray et al., 2010). The famous research "Livestock's Long Shadow" (Steinfeld et al., 2006) switched the focus to environmental consequences in the production of food, thus preparing the ground for further investigations that combine sustainability with the intake analysis of food. As environmental issues became clearer, academics began to reconsider food consumption within larger debates on sustainability.

Lang and Heasman (2004) assert that in Food Wars, the late 1990s and early 2000s constituted a watershed period when the model focused on maximizing production gave way to an ecologically integrated paradigm linking consumer behavior, resource management, and socio-economic development. Interpreting the 'consumer culture war,' they reveal how industrial marketing altered diets and highlighted the direct connection between personal food consumption and environmental issues like gas emissions, water scarcity, biodiversity erosion, and social justice. Their model underlies integrative solutions to repair that take into consideration ecological limitations shaped by cultural practices and lifestyles, redefining sustainable consumption as an ongoing dialogue between human decision-making and planetary limits, rather than previous models based on a limited set of system components.

According to Vermeir and Verbeke (2006), there was a big gap between consumers' actual food purchases and their attitudes toward sustainability. This difference gave rise to huge research projects into the psychological and institutional impediments that can exclude consumers from sustainability. This sharp shift in focus toward a hybridization of environmental science, psychology, and economics displays the giant interrelated nature of consumption. In addition, Garnett (2014) synthesizes interdisciplinary approaches by mapping how environmental life-cycle assessments, policy research, and qualitative consumer inquiries have converged to establish domains and concepts of sustainable eating patterns. It is argued by Garnett that, when considering greenhouse-gas emissions, land and water use, and socio-economic indicators such as affordability, cultural acceptability, and health outcomes, there is a complex platform for diet evaluation. Moreover, by tracing the evolution of discussions that have occurred among ecologists, nutritionists, economists, and sociologists since the early 2000s, Garnett argues that sustainable diets emerge as a compromise between environmental constraints and nutritional adequacy, as well as social equity. Thus, this comprehensive discussion paper captures the growth of sustainable food consumption research, transitioning from isolated inquiries towards integrative means of arriving at actionable dietary guidelines (Garnett 2014).

Daily research into sustainable food consumption, bringing together environmental life-cycle assessments, policy analysis, and qualitative consumer studies, creates a multi-perspective understanding of diet-related impacts (Reisch, Eberle, and Lorek, 2012). Life-cycle assessments reveal greenhouse-gas emissions, water footprints, and land-use changes that accompany different patterns of diet and put a quantifiable figure on the environmental costs of what we buy (Reisch, Eberle, and Lorek, 2012). Policy analysis tools such as schemes for eco-labelling products, fiscal instruments, and country food guidelines to tests of their potential to direct producers and buyers toward products with less impact (Reisch, Eberle, and Lorek, 2012). Qualitative studies pinpoint cultural norms, socio-economic conditions, and perceived inhibitors that shape everyday food decisions and adoption of measures of sustainability (Reisch, Eberle, and Lorek, 2012). This multi-disciplinary route shows how initial concerns around food security and environment degradation have become multi-layered debates around health equity, climate protection, and economic viability, each responding to emergent policy and society demands (Reisch, Eberle, and Lorek, 2012).

The discussion between social researchers, nutritionists, and environmental scientists has increasingly reinterpreted what sustainability might entail for global food systems (Garnett, 2014). Appreciating how early examinations of resource handling as well as nutrition opened for more long-reaching studies allows us a sense of the historical evolution of these fields while endowing today's intensive life-cycle assessments of eating habits with precisely quantifying greenhouse-gas emissions, land use, as well as water footprints (Garnett, 2014). Building on these cornerstones, more recent writing integrates social equity with cultural acceptability into designs for sustainability that demonstrate how conceptual advances harbor practical strategies, such as customized consumer recommendations alongside policy incentives, that encourage a range of populations toward more environmentally sustainable food habits (Garnett, 2014).

As the historical evolution of sustainable food consumption demonstrates, concerns have expanded from isolated issues toward more integrated frameworks. Building on this foundation, it is now necessary to explore the specific dimensions through which sustainability is expressed in practice.

2.2 Dimensions of Sustainable Food Consumption

Sustainable Food Consumption (SFC) is also a heterogeneous concept with a variety of diverse dimensions (FAO, 2018). The dimensions for sustainable food consumption play a significant role in comprehending food choice implications from a sustainable environment, health, and social equity perspective (FAO, 2018). According to a recent study from the FAO in 2018, the following are the key dimensions tied to sustainable food consumption:

2.2.1 Environmental Dimension

This fact deals with the environmental perspective of the food production, distribution, and consumption systems. The effects, therefore, include greenhouse gas emissions, water usage, land occupancy, biodiversity, etc. (Aleksandrowicz et al. 2016).

Carbon Footprint and Greenhouse Gas Emissions: Some estimates suggest that food system emissions are responsible for approximately one-third of all greenhouse gas emissions released into the atmosphere. Additionally, there is a broad consensus that a disproportionate share of post-farm releases can be attributed to animal production and that such releases are increasing in all areas (Nicola Cerutti et al., 2023). Additionally, plant-based dairy alternatives have been found to have 59–71% lower greenhouse gas emissions per 250-ml consumption, as well as a slower rate of land use and eutrophication effects compared to dairy milk (W. Craig et al., 2023). Moreover, individual targeting of environmental change is an effective strategy for promoting greater consumption of plant-based foods and lower consumption of animal-based foods. (D. Taufik et al., 2019). Lastly, legal innovation discourse can potentially overcome this skepticism and gain consumer acceptance for meat reduction policies independently of ideological and behavioral types (J. Graça et al., 2020).

In addition to sustainability, slow-release fertilizers and precision farming are tangible innovations in the management of nitrogen to counteract climate change and the depletion of this nutrient (A. Viancelli et al., 2024). Sustainable farming using renewable energy has enormous potential to reduce carbon footprints and promote conservation, particularly under new farming systems that have been adopted. The synergy not only ensures environmental sustainability but also becomes a propellant for further transformation into a sustainable farming method (Olagoke Ayeni et al., 2024).

Food Waste and Sustainability: The Tandem challenges of food waste, climate change, and water resource degradation have been presented. Livestock has a higher carbon footprint, while cereal cropping often entails irrigation, a water-intensive process (Yuzhou Tang et al., 2020). Improvements along supply chains, consumer education, and supportive policies have been effective in reducing food loss and waste, thereby enhancing food security while mitigating environmental pressures and generating economic benefits for various actors along the food supply chain (Rosalinda Nicastro et al., 2021). Multiple dimensions of affordability need to be addressed simultaneously to provide an efficient provision of policy interventions. (J. Spangenberg et al., 2019).

The behavior of the consumers in developed countries has, therefore, been found to be one of the major factors contributing to food waste, influenced mainly by motivation, management skills, and trade-offs between competing priorities (J. Aschemann-Witzel et al., 2015). Fresh fruits and vegetables are responsible for most waste at the household level within the European Union, as nearly 50% of waste on an average basis within households in Europe is made up of fresh produce waste. The non-avoidable waste amounts to approximately 21.1 kg per person per annum, while avoidable waste totals 14.2 kg per person per annum (Valeria De Laurentiis et al., 2018). Furthermore, the inability to understand the significance of dates regarding food is one of the contributors to higher food discarding, particularly among those aged between 18 and 34 years (R. Neff et al., 2019).

Converting food waste to animal feed proven to provide several main benefits (P. Nath et al., 2023). In the first place, it helps cut down on waste that is likely to be sent to disposal. Secondly, it provides an alternative source of animal protein (P. Nath et al., 2023). Lastly, it creates a platform for resource conservation and environmental impact mitigation in realizing the stated objective of the circular economy (P. Nath et al., 2023). Consumer education on the opaque food date label "best by, use by" can reduce food waste (M. Kavanaugh et al., 2020).

Sustainability Trade-offs—Organic vs. Conventional Farming: Organic farming is being promoted and demonstrated to have several benefits, including reduced pesticide use and increased biodiversity. Therefore, it is claimed that such benefits minimize disease prevalence and improve public health (C. Benbrook et al., 2021). Organic farming systems, on the other hand, are low-yielding and require approximately 50% more arable land, as well as inducing drastic changes in land use patterns and environmental consequences (H. Kirchmann et al., 2019). Ideally, local food systems have a smaller carbon footprint due to shorter transportation distances, thereby contributing somewhat to environmental sustainability. Strengthening community connections and supporting local food systems to achieve the most benefits from the conservation of cultural heritage and traditional farming systems would also yield positive outcomes through well-established organic farming practices (Stein and Santini, 2022).

Local food systems are commonly associated with reducing transportation emissions and also integrating the community; however, these alone cannot guarantee sustainability. In many cases, these assessments do not guarantee efficient resource allocation, and depending on their environmental or economic context, they may even differ (Brunori et al., 2016). Under certain specific circumstances, one might find that global or local chains perform better on sustainability indicators, and this general notion of the superiority of local chains should therefore be questioned (Brunori et al., 2016). An analysis that simply compares the regional and global paradigms can identify or highlight best practices and areas where weaknesses exist in the structure, thereby contributing to the goal of a resilient and sustainable agricultural system (Brunori et al., 2016).

New methods for assessing land-use efficiency in agriculture could lead to greater efficiency and sustainability in both organic and conventional farming systems (Hung-Chun Lin et al., 2017). Consumers primarily view organic and local food as sustainable, although with more perceived quality and health benefits, rather than environmental and socio-economic sustainability (Azzurra Annunziata et al., 2017). Although Trade-off analysis in agri-food enquiries into the relationship among agronomic, environmental, and socio-economic factors, hence leading toward sustainable development and some targets of the Sustainable Development Goals (D. Kanter et al., 2016).

2.2.2 Economic Dimension

Sustainable food consumption also implies reducing waste and optimizing resource utilization (Hoolohan et al., 2013). This dimension of sustainability includes economic

concerns, focusing both on cost parameters and market dynamics, with environmental and social considerations being both a constant in the process (Parfitt, Barthel & Macnaughton, 2010). In food systems, sustainability appears as the varied outcome of economic policy frameworks, individual consumer behavior, and strategic actions by companies (Graham-Rowe, Jessop & Sparks, 2014).

Being aware of the economic aspects of sustainable food consumption is of utmost importance for policymakers, businesspersons, and consumers because it influences decisions made along the Food Supply Chain (Watson & Meah, 2013). If economic sustainability is assured, financial waste may be minimized, markets may perform well, and continuing profitability may be ensured in the food sector (Dietz et al., 2009). Such goals could be attained only if a set of specific measures are implemented to this effect, i.e., food waste reduction, supply chain structure reforms, consumption behavior-oriented initiatives (Stefan et al., 2013).

Food Waste is a significant financial liability for customers, shops, and manufacturers, as well as producing significant losses all across the supply chain (Gustavsson et al., 2011). Studies suggest that, with significant financial and environmental consequences, one-third of all food produced worldwide is thrown out or lost (Gustavsson et al., 2011). Such a situation of waste generally stems from surplus production, poor stock management, and inefficient logistics, thereby increasing food costs and diminishing profit margins (Gustavsson et al., 2011). Particularly developing countries display these inefficiencies since infrastructure gaps and lack of cold storage facilities aggravate food deterioration (Lipinski et al., 2013).

Market inefficiencies and cost consequences: Inefficiencies in supply chains, such as inadequate inventory control and inadequate storage facilities, define food waste primarily (Gustavsson et al., 2011). Particularly in underdeveloped countries, where a lack of cold storage infrastructure causes great rates of deterioration, especially for perishable goods, these inefficiencies are especially prevalent (Lipinski et al., 2013). Reward systems for bulk purchases often inspire people to buy more food than necessary, therefore producing unnecessary waste (Kummu et al., 2012). These inefficiencies affect businesses as well as consumers economically since wasted food causes greater costs and lost profits (Garrone et al., 2014).

Sometimes food waste is exacerbated by regulations and market systems distorting incentives throughout the supply chain. For example, rigorous cosmetic standards for food lead to the rejection of edible but flawed fruits and vegetables, therefore resulting in significant farm-level losses (de Hooge et al., 2017). Similar overproduction and mismatched supply and demand result from poor coordination among manufacturers, shops, and consumers (Stuart, 2009). These deliberate inefficiencies not only affect food prices but also have wider environmental and social consequences as the resources required to produce wasted food—such as water, energy, and labor—are lost (FAO, 2013). Dealing with these inefficiencies demands coordinated efforts incorporating improved

demand predictions, infrastructure, and legislative measures to realign market incentives (Fattibene, Daniele, et al. 2020)

Macro-financial Effects: Food waste has substantial macroeconomic effects, considering its significant loss of resources and economic value. Estimates by Gustavsson et al. 2011 suggest that almost one-third of all food produced for human use is lost or wasted globally each year. Apart from a direct financial loss, this waste misuses the resources buried in food production, including labor, water, and energy (Kummu et al., 2012). Showing that the direct economic impact of world food waste is around $750 billion annually, the FAO 2013 underlines even more the extent of the problem.

Food waste causes inefficiencies that go beyond just lost edible food. (Kummu et al., 2012) Stress that the resources required to create discarded foods—freshwater, cropland, and fertilizers—are also lost, therefore creating additional economic and environmental difficulties. For example, the water used to grow wasted food could have been used for other purposes, and the energy used in manufacturing and transportation adds another layer of financial loss (Kummu et al., 2012).

To address the macroeconomic consequences of food waste, policymakers are considering several economic instruments (Garrone et al., 2014). Tax incentives for businesses that donate spare food help to reduce waste and tackle food poverty (Garrone et al., 2014). The OECD (2017) highlights the effectiveness of tools such as fines and subsidies in supporting waste-reduction efforts across the supply chain.

Customer Acceptability of Sustainable Products: While some individuals mostly prefer to pay more for fair-trade, locally produced, or organic food, often due to environmental, health, or ethical concerns, this willingness is not universal (Vecchio & Annunziata, 2015). Budget-conscious consumers remain price sensitive and prioritize affordability over environmental impact (Lombardini & Lankoski, 2013). Skepticism toward "organic" or "fair-trade" labels, due to greenwashing and certification inconsistencies, erodes trust. (Vecchio & Annunziata, 2015). Limited consumer awareness of the benefits of sustainable products also delays adoption (Kallbekken & Saelen, 2013).

To conquer these barriers, governments and businesses can make sustainable options more accessible. For instance, subsidies for sustainable farming can reduce price premiums (Kallbekken & Saelen, 2013). One approach that could work is promoting visually imperfect, yet edible products, as Consumers are more likely to purchase these items when offered at a discount, providing affordable options (de Hooge et al., 2017). Public education campaigns can build trust and highlight the social and environmental value of sustainable choices (Vecchio & Annunziata, 2015).

Government Interventions: Governments are increasingly using economic policies to align financial incentives with sustainability goals. South Korea’s 2013 volume-based food waste tax led to a major increase in food waste recycling—rising from under 2% in

1995 to over 90%—and helped Seoul reduce waste by 47,000 tons in six years (Lee & Jung, 2017).

Italy's "Good Samaritan Law" (Legge 155/2003) simplifies food donations by classifying nonprofits as final consumers and reducing liability for donors, encouraging retailers to give unsold food to charities (Garrone et al., 2014). France's Anti-Waste Law (2016) takes a similar approach by mandating food donations. At the production level, subsidies under the EU's Common Agricultural Policy (CAP) support innovations like precision agriculture and advanced storage, helping lower post-harvest losses (European Commission, 2020). Another obvious idea is standardizing food labels. WRAP's "Guardian of Good Food" initiative in the UK promotes consistent, unambiguous labelling so that consumers might tell "best before" from "use by" dates (WRAP, 2020).

Circular Economy and Food Waste Valorization: Food waste can be converted into resources such as biofuels, compost, and animal feed, which helps build sustainable food systems for both businesses and communities, making them cleaner and alleviating losses (Cordell, Drangert, & White, 2009). An example would be anaerobic digestion to turn organic waste into biogas, which has become one of the most successfully scalable renewable-energy-generation processes (Thyberg & Tonjes, 2017).

Circular economy strategies lie beyond environmental sustainability, offering real economic incentives. A business that employs resource recovery strategies, such as converting food waste into electricity, fertilizer, or some sort of salable byproduct, saves money on raw materials, lowers fees for waste disposal, and might even receive some consideration for revenues (Garrone et al., 2014). These businesses tend to build a stronger brand value as consumers increasingly favor environmentally responsible initiatives (De Schoenmakere et al., 2019).

Developments in food waste valorization are improving the application of circular interventions. Black soldier fly larvae are cultivated by insect farming using food waste to generate protein-rich feed, reducing the need for animal feed such as soy and fishmeal (van Huis et al., 2021). On the other hand, the biorefinery offers the next level where the food and pharmaceutical industries extract valuable molecules such as dietary fibers and antioxidants from food wastes (Garcia-Garcia et al., 2019).

Strong policy support facilitates the scaling up of circular economy activities. as visible in the Circular Economy plan by the European Union in 2020 incentivizes and funds R&D for activities across the supply chain aimed at reducing food waste and recovering resources (European Commission, 2020).

Although financial considerations and market inefficiencies reveal the economic weight of food waste, the question of sustainability cannot be separated from nutrition. Linking dietary quality with environmental and social outcomes provides a more comprehensive understanding of sustainable food consumption.

2.2.3 Nutritional Dimension

A key area of study connecting human nutrition with environmental preservation has become sustainable food consumption (Willett et al., 2019). While simultaneously boosting public health, this research looks at how the nutritional quality of diets significantly strengthens sustainable food systems. This topic is critical given the worldwide difficulties of climate change, resource depletion, and rising frequency of diet-related health problems (Springmann et al., 2018).

It is Fundamental to comprehend that in sustainable food consumption, not all calories are equal, and that nutrient quality determines a healthy and sustainable diet (Afshin et al., 2024). Diets marked by more processed or animal-based meals usually have a more significant environmental impact than those stressing the intake of fruits, vegetables, legumes, and whole grains. Still, these meals are rich in vital nutrients (Tilman & Clark, 2014). A few studies have indicated that nutrient-dense meals help to reduce land use and greenhouse gas emissions, therefore implying a tight relationship between nutritional quality and environmental sustainability (Springmann et al., 2018).

Analyzing the production aspect of food systems emphasizes even more the link between environmental sustainability and nutrition (Clark et al., 2019). By stressing organic approaches and crop diversity, agricultural systems can improve food nutrient profiles and lower dependence on synthetic inputs, hence maintaining biodiversity (Tilman & Clark, 2014). Furthermore, boosting long-term food security by reducing chemical discharge and soil degradation helps ecosystems be resilient (Willett et al., 2019).

Nutrition and environmental impact are intended to be the two benefits that researchers seek to incorporate using life cycle assessment and nutrient profiling tools (Clark et al., 2019). These frameworks assess food based on emissions, water, and land use, alongside nutritional content, precisely in line with the FAO and WHO recommendations to link sustainability to dietary guidelines (FAO & WHO, 2019).

Empirical studies show that a plant-based diet brings health and environmental benefits through better nutrient intake and lower levels of pollutant exposure (Tilman & Clark, 2014). Furthermore, these diets are correlated with lower risks of chronic lifestyle diseases and lower environmental footprint (Springmann et al., 2018).

The integration of nutrition with environmental metrics is essential for designing future food systems (Siminiuc, Rodica, et al. 2025). Comprehensive assessments that incorporate nutrient density with sustainability indicators can help in identifying diets that weigh in on the balance between health issues and environmental issues (Clark et al., 2019), (FAO & WHO, 2019). As research moves on, true sustainability of diets must rely on an integrated approach to nutritional quality and environment (Willett et al., 2019).

While environmental and economic aspects dominate much of the policy debate, social and cultural dimensions equally shape consumer behavior, as the next section explores.

2.2.4 Social and Cultural Dimension

Apart from the financial and environmental consequences, sustainable food consumption has attracted more attention over the past decade because of its strong social and cultural roots (Garnett, 2013; Vermeir & Verbeke, 2006). Though ecological sustainability has attracted much interest in studies, more recent studies indicate how strongly our daily food choices are linked to our social contacts, cultural traditions, and socioeconomic reality (Vermeir & Verbeke, 2006).

Usually produced from the social circles that shape our lives, food serves as a means of expression of identity and belonging rather than only sustenance (Tobias & Dieterle, 2023). Along with Sobal and Bisogni (2009, family habits, peer pressure, and society expectations influence many of our food choices. For example, the values and actions seen in one's intimate social circle could either inspire or discourage sustainable eating (Thøgersen, 2005). Research on strong people in social networks adopting sustainable practices shows that these behaviors typically propagate more successfully (Onwezen, Bartels, & Antonides, 2013).

Traditional cooking techniques and cultural heritage significantly shape the perception and application of sustainability in daily life (Worldchefs, 2025). Apart from ways of expressing cultural identity, traditional cooking methods, local food, and traditional recipes help individuals maintain a connection to their past and values (Hughner et al., 2007). A few studies claim that consumers view sustainable food as a mirror of cultural pride, whereby modern environmental knowledge is linked with old traditions (Magnusson et al., 2003).

Acceptance of sustainable diets is not consistent elsewhere, as global inequities and economic constraints define them (Schneider et al., 2023). For example, the focus on rice as a staple crop in many Asian countries has great cultural importance, even though the heavy water and land use connected with rice farming may cause environmental problems (Garnett, 2013). Likewise, in Sub-Saharan Africa, urbanization and globalization are progressively substituting imported, processed foods for traditional diets high in millet and sorghum, therefore compromising both cultural legacy and environmental sustainability (FAO, 2021).

Sustainable diets are difficult to adopt due to financial constraints, as many consumers perceive environmentally friendly food choices to be more expensive and less accessible (Nichifor et al., 2025). Urban areas especially show this economic difference since processed and fast food are usually less expensive and more practical than sustainable, fresh ones (Garnett, 2013). Dealing with these issues calls for focused policies with incentives for stores to provide reasonably priced nutritional options and subsidies for sustainable farming (FAO, 2021).

Social and cultural elements combined create a complicated scene for the consumption of sustainable food (Weder, Golob, and Podnar, 2025). One could argue that shared meals, community gatherings, and even public personalities help to encourage group behavior toward sustainability by social aspects (Sobal & Bisogni, 2009). Conversely, cultural

stories and customs help to transmit the symbolic meaning behind why particular meals are valued and why local, sustainable traditions endure in the face of the pressures of globalization (Vermeir & Verbeke, 2006).

The way cultures modify classic food methods to fit modern environmental challenges vividly illustrates this link ("How Culture and Climate Influence Food Habits Evolution," 2024): modern iterations of age-old methods supporting social relationships and cultural legacy have evolved from local food cooperatives and community-supported agriculture (CSA) ("Traditional Food Systems," 2024). These developments draw attention to the fact that sustainable food consumption is a group effort shaped by social behaviors and cultural narratives defining a society rather than just a personal choice (Weder, Golob, and Podnar, 2025).

Parallel with this change in reaction to world issues, cultural myths around food are changing (Global Gastros, 2024). Growing awareness of the resilience and sustainability of indigenous food systems reveals itself in a comeback of interest in them (FAO and Alliance of Biodiversity International and CIAT, 2021). Agroforestry and seed saving are among the indigenous techniques being reintroduced as people strive to reestablish their connection to their heritage and solve contemporary environmental challenges (Kuhnlein et al., 2013). This concept emphasizes the need to keep cultural variety as the foundation of sustainable food systems (Swiderska et al., 2022).

Combining ideas from environmental science, cultural studies, and sociology can help us to grasp better how daily life incorporates sustainable practices and how best they should be encouraged (Onwezen, Bartels, and Antonides 2013). Apart from their environmental advantages, this point of view supports the premise that sustainable diets are closely related to cultural identity, social cohesiveness, and economic justice (Biesbroek et al. 2023).

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Social and cultural factors highlight how deeply food choices are embedded in identity and tradition. Yet beyond these influences, ethical concerns, particularly animal welfare, add another layer of complexity, reflecting the moral expectations consumers place on food systems.

2.3 Ethical Concerns and Animal Welfare in Sustainable Food Consumption

Discussions on sustainable food consumption now center on ethical issues and animal welfare since consumers want their food choices to reflect both moral perspective and environmental responsibility (Fraser, 2008; Vermeir & Verbeke, 2006). Growing awareness of the conditions in which animals are kept, and the ethical consequences of intensive farming methods helps to propel this shift of viewpoint (Sandøe & Christiansen, 2003).

Food production ethics address not just environmental impact but also animal treatment throughout the supply chain (Fraser, 2008). Many experts contend that contemporary agricultural methods consistently undermine animal welfare by confining animals to restricted surroundings and stressful situations, therefore generating substantial moral problems regarding the humanity of such systems (Sandøe & Christiansen, 2003; Rollin, 2004). Free-range and organic farming, which are believed to provide animals better living conditions, have drawn increased interest in this ethical argument (McEachern & Warnaby, 2010).

An essential component of moral food production, animal welfare significantly affects consumer behavior (Broom, 2011). Studies indicate that consumers are more ready to pay a premium for products that satisfy greater welfare criteria, so that ethical issues could influence purchase decisions as significantly as environmental ones (Wilks & Phillips, 2014; Hartmann & Siegrist, 2017). Certifications and labels verifying humane treatment of animals have thus become crucial signals in the market since they let customers match their diets with their values (Hartmann & Siegrist, 2017).

Even if more individuals are supporting better welfare standards, their actual application and validation remain difficult (Rollin, 2004). Development of universal standards that are both scientifically accurate and ethically reasonable might be challenging depending on animal welfare (Sandøe & Christiansen, 2003; Rollin, 2004). These difficulties underline the need for stronger mechanisms and open certification procedures that could close the gap between moral values and actual behavior (Broom, 2011).

Often influenced by personal ideals, media portrayal, and social practices, consumer perceptions of ethical and animal welfare issues are complicated and vary (Hartmann & Siegrist, 2017). Many buy more depending on their opinion that their food is produced in a way that reduces animal suffering than on cost or convenience (Wilks & Phillips, 2014). Although in the food sector, taste, nutrition, and sustainability still have secondary importance, ethical credentials are increasingly becoming front stage (Fraser, 2008).

Ethical consumption varies geographically and culturally: Different societies and areas have somewhat different ethical issues with animal treatment (Hartmann & Siegrist, 2017). Transparency and humane treatment are becoming increasingly important in Western civilizations as customers want more responsibility from food producers (Hartmann & Siegrist, 2017). On the other hand, in many underdeveloped nations, ethical issues could be subordinated to food security and affordability since access to enough nutrients still causes a significant concern (FAO, 2021).

Through their efforts, technological developments also significantly aid in increasing animal welfare by using sensors and data analytics, precision livestock farming (PLF), for example, monitors animal health and well-being in real time, allowing farmers to address issues, including disease outbreaks or stress, before they become more critical (Neethirajan, 2020). These developments serve consumers as well as farmers by increasing productivity and sustainability, and so improving animal welfare (Neethirajan, 2020).

To handle the ethical issues in food production, governments and companies are creating progressively thorough policies and certification systems (European Commission, 2020). Knowing how public health, environmental sustainability, and animal welfare are linked, the European Union's Farm to Fork Strategy, for example, incorporates clauses letting member states increase animal welfare requirements (European Commission, 2020).

2.4 Hunger concern Hunger and Their Connection to Sustainable Food Consumption

Driven not only by food shortages but also by systematic problems in distribution and access, hunger is nevertheless a frequent worldwide problem (FAO et al., 2024). Despite record food production, chronic hunger and food insecurity persist due to inequitable distribution, excessive waste, and unsustainable consumption. (FAO et al., 2021).

Hunger arises when people face either physical or financial barriers to accessing enough nutritious food (Food Forward NDCs, 2023). According to the Food and Agriculture Organization (FAO), the key causes of this problem are factors outside individuals' control, such as poor infrastructure, broken markets, and economic disparities (FAO, IFAD, UNICEF, WFP, & WHO, 2021). If applied correctly, sustainable food consumption measures like minimizing waste, buying locally, and improving affordability and access may go a long way in countering these negative factors (Ritchie & Roser, 2023).

In the world, about one-third of the food produced, i.e., 1.3 billion tons yearly, is lost or thrown away (FAO, 2021). This waste occurs along the supply chain and aggravates food scarcities. Also, exerting more pressure on natural resources than is needed (FAO, 2021).

The global food system is, thus, predominantly based on industrial agriculture, which is usually criticized for emphasizing high yields over social and environmental sustainability (Gliessman, 2018). Practices such as monocropping, overusage of synthetic fertilizers, and deforestation promote soil degradation, water scarcity, and biodiversity loss, thereby threatening long-term food security (FoodPrint, 2018).

2.4.1 Case Study: Climate Issues of Guatemala and Sustainable Solutions

There are increased incidences of poverty and hunger in Guatemala, especially among the indigenous people and small-scale farmers, because of severe droughts and heavy storms (Reuters, 2022). These climatic shocks have altered agricultural productivity and have denied access to food to millions of families (Reuters, 2022).

To equip farmers to adapt to multiple impacts of climate change, some agencies of the government as well as international agencies have been providing training on sustainable agriculture (FAO, 2021). Drought-tolerant crops, agroforestry, and water conservation are means of building resilience, food security, and sustainability (FAO, 2021). These interventions link together environmental solutions to environmental degradation and hunger-from which the Guatemala Humanitarian Response Plan 2021-2022 has been cited as an example (FAO, 2021).

2.4.2 Difficulties eating Sustainable Food

Although sustainable food systems could help to reduce hunger, various factors prevent their general acceptance (Ritchie & Roser, 2023). Lower-income populations often find sustainably produced food unaffordable. (Ritchie & Roser, 2023). Moreover, many deprived areas lack fresh and healthy foods resulting from poor infrastructure and delivery networks (FAO et al., 2023).

Furthermore, cultural dietary preferences are necessary since conventional diets might not satisfy sustainable choices (Garnett, 2013). Changing to a plant-based diet, for instance, can run against opposition in areas where animal intake is firmly rooted in cultural standards (Garnett, 2013). Dealing with these challenges calls for concerted policy initiatives promoting sustainable development using reasonably priced technologies and education, while granting access and affordability (FAO, 2021).

2.4.3 Global initiatives and policy

Only with correct regulations and worldwide cooperation will sustainable food consumption help to lower hunger (FAO, 2023). Zero Hunger, United Nations Sustainable Development Goal 2, emphasizes the need to eradicate hunger, achieve food security, enhance nutrition, and advance sustainable agriculture by 2030 (FAO, 2021).

The Farm to Fork Strategy highlights one such initiative within the Green Deal of the European Union: it seeks to make food systems fair, healthy, and ecologically benign (European Commission, 2020). Reducing food waste, supporting organic farming, and ensuring fair pay for farmers, which help to both decrease poverty and encourage sustainability, as well as help to lower hunger, are the main strategies underlined in the initiative (European Commission, 2020; European Commission – Food Safety Portal). Among local-level community-based projects gaining popularity are food cooperatives and urban gardening (FAO, 2021). Besides providing cheaper fresh food, these initiatives work towards strengthening local food systems (FAO, 2021).

Sustainable food consumption can reduce hunger by applying the following holistic approaches, combining social, economic, and environmental aspects (FAO, 2018):

- Better storage, transportation, and distribution methods help to lower food waste at all supply chains (FAO, 201).
- Encouragement of small-scale farmers and local markets helps to promote food security and limit the environmental burden of long-distance travel (Gliessman, 2018).
- By supporting sustainable agriculture, one can promote methods including agroecology, organic farming, and precision farming to boost output while also safeguarding natural resources (Garnett, 2013).

Developing policies and programs offering reasonably priced, sustainably produced food reasonably accessible for everyone should help underprivileged people most especially (Our World in Data, 2023).

While hunger emphasizes global inequalities in access and distribution, food security and food safety bring the discussion closer to the foundations of a resilient food system. Together, they form the baseline conditions without which sustainability cannot be achieved.

2.5 Food Security and Food Safety: Foundations for Sustainable Food Consumption

Food security and food safety form the basis of having a fair and resilient food system (Capone et al., 2014). Food security is concerned with having a continuous and uninterrupted supply of food sufficient to sustain an individual for a healthy life (Godfray et al., 2010), while food safety concerns safeguarding food from any hazard of ingestion and intervention due to mishandling and improper storage (Nestle, 2007). Being one of the main aspects of food availability and food quality, they essentially guarantee adequate nutrition necessary for public health and well-being (Capone et al., 2014).

2.5.1 How food security and food safety interact

Food safety significantly impacts and is interconnected with food security. In low-income countries, limited access to adequate food safety standards and nutritious food leads to an increase in vulnerabilities of populations to foodborne hazards, therefore aggravating food poverty (FAO, 2021). By contrast, food insecurity may drive individuals to consume unsafe or contaminated food if they cannot afford anything better, thus compromising food safety (Nestle, 2007).

Agritech blockchain applications in Kenya exemplify the complex relation between food safety and food security, wherein the IBM Food Trust type of system can be used to track from farm to table the supply chain of food and dairy products such as milk, ensuring that there is transparency and traceability in the supply chain (Kamilaris et al., 2019; IBM, 2025). It thereby creates food security by connecting farmers directly with the market, cutting contamination risks, and allowing the farmers to earn higher prices (Kamilaris et al., 2019).

For instance, the Stop Wasting Food Movement in Denmark has been able to reduce food waste in households by 25% through its awareness campaign and partnerships with retailers, thereby serving as an example of successful Nordic food waste reduction policies (Stop Wasting Food Movement, 2025). Therefore, food security is guarded by these policies while simultaneously being promoted by increasing food availability and decreasing the food that might expire or be contaminated (Ministry of Food, Agriculture and Fisheries of Denmark, 2024).

2.5.2 Challenges of Food Safety and Food Security

The unequal access to technology and resources between nations only exacerbates food security and safety issues, especially among fragile agricultural systems. (FAO, 2023). A developing country may have no adequate infrastructure or economic basis for the implementation of adequate food safety regulations or checks on the regular supply of nutritious food (FAO & WHO, 2003).

The adverse effects of climate change, such as floods, rising temperatures, and changes in precipitation regimes, severely threaten agricultural production and supply chains (Rayalu, 2024). Floods disrupt the food distribution system, leading to shortages and price volatility; higher temperatures would be conducive to food-borne diseases (Godfray et al., 2010).

Many people in Sub-Saharan Africa depend largely on illegal food markets; however, they can lack appropriate safety rules, which significantly endanger customers (FAO, 2021). Dealing with these difficulties calls for coordinated actions, including better market infrastructure and application of stronger food safety laws (FAO, 2021).

2.5.3 Technological Innovations Driving Food Safety and Security

Blockchain technology is a modern example of how new technologies have improved food safety and security (Kamilaris et al., 2019). It has been applied, for instance, to increase supply chain traceability, enabling consumers and authorities to confirm the safety and source of their food (Kamilaris et al., 2019).

Comparable developments in food preservation, such as vacuum sealing and high-pressure processing, enhance shelf life while preserving nutritional value, so lowering food waste and improving food security (FAO, 2021). Apart from handling immediate safety issues, these technologies help food systems to be long-term resilient (Food Standards Agency, 2023).

Precision agriculture, which maximizes agricultural output and lowers resource use by using sensors and data analytics, is another intriguing trend increasing food security and sustainability by raising crops efficiently and lowering environmental effects (Neethirajan, 2020).

2.5.4 Government Action and Global Policy in Advancing Food Security and Safety

Governments are essential for the establishment of food safety policies, the promotion of resilient and productive agricultural practices, and ensuring equitable access to healthy foods (Garnett, 2013).

One of the most notable examples of policy-induced food security is India's National Food Security Act (NFSA), which aims to provide subsidized food grains to approximately two-thirds of India's population, thereby making affordable and safe meals accessible (Government of India, 2013). While food security concerns regarding enhancement exist, concerns about the safety and quality of food grains persist, necessitating an integrated perspective on food safety alongside food availability (FAO, 2021).

Organizations including the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) are addressing worldwide issues at the international level and so-so promoting access to safe and nutritious food (FAO, 2021) using programs including the Codex Alimentarius, which sets worldwide food safety criteria, and the Global Alliance for Improved Nutrition (GAIN).

2.5.5 Consumer Behavior and Confidence

Consumer confidence in food security and safety is deeply embedded in it. Individual choices the consumers make directly affect food security and safety. When consumers are satisfied that food is safe, dependable, and always of high quality, they make choices to secure their health and well-being (Vermeir & Verbeke, 2006).

Efforts at labeling and education can significantly change customer behavior. For instance, the Traffic Light Labeling System in the United Kingdom guides consumers towards safer and better options by showing the nutritional quality of food using color-coded labeling (Hartmann & Siegrist, 2017). Furthermore, motivating safe and sustainable food consumption in supermarkets is a nudge, including positioning healthier alternatives at eye level (FAO, 2021).

Building upon the theoretical foundations and empirical insights presented in the literature review, the following research seeks to explore the practical relevance of sustainability-related attitudes and demographic factors in shaping actual food consumption behavior among young Hungarian residents. To address this objective, a structured methodological approach was developed, combining validated measurement scales and non-parametric statistical techniques. The next section outlines the data collection process, the construction of key variables, and the analytical methods applied.

3. METHODOLOGY

3.1. Data Collection

The data were collected using an online questionnaire designed to explore young Hungarian residents' sustainable food consumption habits, attitudes, and willingness to act. The survey included both previously validated question blocks (e.g., on sustainable behavior and attitudes) and original items developed specifically for this study (e.g., on willingness to pay and food waste attitudes).

A total of **247 valid responses** were collected. After data cleaning and handling of missing values, **246 cases** were used in the statistical analyses.

3.2. Variable Construction

To ensure the reliability and validity of the constructs measured, several questionnaire items—particularly those related to sustainable food behavior and attitudes—were adapted from a previously validated instrument developed by Hilary Serene et al. (2024), which focuses on assessing knowledge, attitudes, and practices toward diet sustainability (Frontiers in Sustainable Food Systems, DOI: 10.3389/fsufs.2024.1432057).

The questionnaire contained multiple Likert-scale items grouped into thematic blocks:

- **Behaviour-related statements** (5 items): assessed practical sustainable consumption behavior.
- **Importance-related statements** (17 items): captured attitudes toward the importance of sustainable food choices.
- **Food waste-related statements** (5 items): measured attitudes about food waste and avoidance behavior.

Cronbach's alpha was calculated for each block to assess internal consistency:

As the reliability coefficients exceeded the commonly accepted threshold of 0.7, composite indices were created by computing the mean scores of the items in each block: **Behaviour_index**; **Importance_index**; **Foodwaste_index.**

In addition, socio-demographic variables were also collected, such as age, gender, income level (five categories, later recoded into three), and type4 of residence (urban vs. rural).

3.3 Statistical Methods

Given the ordinal nature of most variables (Likert scales), **non-parametric statistical tests** were applied:

- **Spearman's rank-order correlation** was used to examine the relationship between continuous or ordinal variables (e.g., age vs. behavior index; attitude vs. behavior).
- **Kruskal–Wallis test** was used to examine differences in behavior across more than two groups (e.g., income levels).

The analyses were performed using **IBM SPSS Statistics 29**.

3.4 Hypotheses

Based on the reviewed literature, a number of hypotheses were formulated to examine the relationships between sustainability-related attitudes, food waste perceptions, and socio-demographic factors in shaping sustainable food consumption behavior.

H1: There is a statistically significant positive relationship between the perceived importance of sustainability and sustainable food consumption behavior.

In the literature review it was emphasized the attitude–behavior gap (Vermeir & Verbeke, 2006), stating that even though many consumers claim to care about sustainability, they often fail to act accordingly. This implies that the strength of sustainability-related attitudes (importance) can be a predictor of actual behavior, aligning with Lang and Heasman's (2004) view that food decisions are shaped by deeper values. Additionally, Reisch et al. (2012) stress that sustainable food behavior emerges from a mix of environmental awareness and perceived importance. Thus, this hypothesis builds on the idea that those who value sustainability more strongly are more likely to act sustainably.

H2: There is a statistically significant positive relationship between attitudes toward food waste and sustainable food consumption behavior.

Nicastro et al. (2021) and De Laurentiis et al. (2018) report that consumer behavior significantly contributes to food waste. Additionally, Aschemann-Witzel et al. (2015) highlight that motivation and management skills play key roles in reducing household food waste. These studies suggest that individuals who are attitudinally opposed to food waste are likely to engage in more sustainable behavior overall, including food purchasing and consumption practices. Hence, positive food waste attitudes are expected to align with broader sustainable behavior.

H3: There is a statistically significant positive relationship between age and sustainable food consumption behavior.

It was revealed that demographic trends indirectly — for instance, Neff et al. (2019) found younger individuals misinterpret food labels more often, contributing to avoidable waste. This suggests older individuals may possess more food management knowledge or be more cautious, leading to more sustainable behavior. Similarly, lifestyle and life experience differences tied to age are implicated in Garnett's (2013) work on food traditions and changing practices. Thus, a weak but positive relationship between age and sustainable behavior is theoretically expected.

H4: There is a statistically significant difference in sustainable food consumption behavior across income groups.

As mentioned in the literature review, there are economic barriers to sustainability. Vecchio & Annunziata (2015) and Lombardini & Lankoski (2013) note that consumers with lower income often prioritize affordability over sustainability, while higher-income individuals are more willing to pay for sustainable products. Also, FAO (2018) and

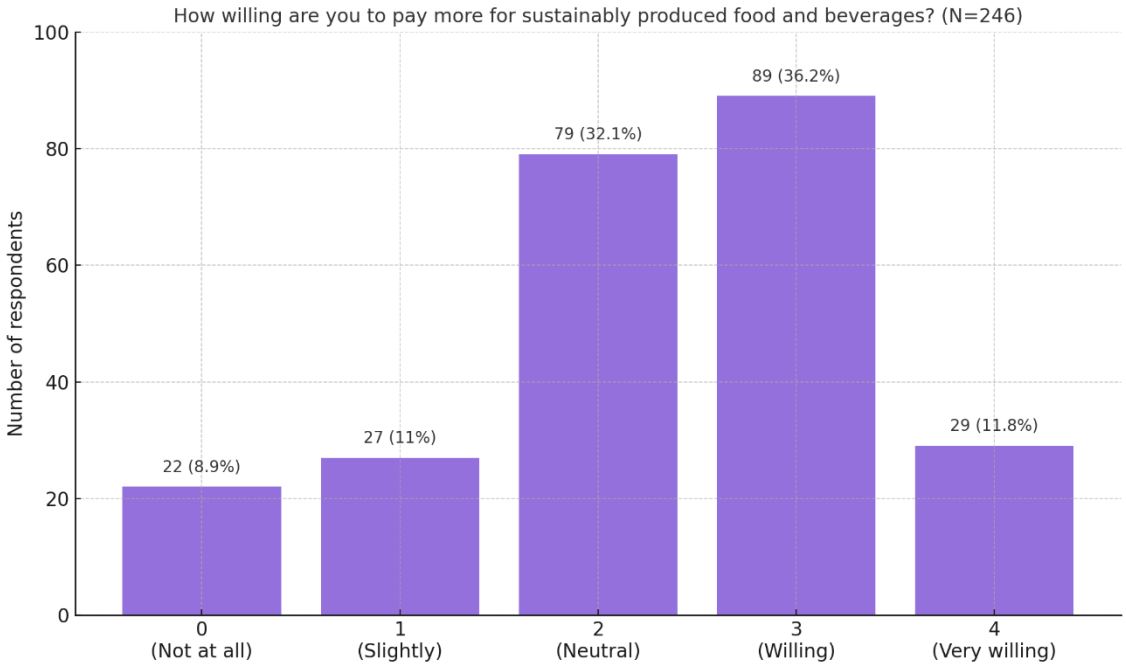
Gustavsson et al. (2011) link income to waste, consumption patterns, and access to sustainable options. Therefore, this hypothesis stems from the understanding that economic resources may enable or restrict sustainable consumer choices, resulting in differences across income groups.

4. Results and Evaluation

4.1. Descriptive Results on Attitudes Toward Sustainability and Willingness to Pay

The descriptive results reveal a clear preference for sustainable production among respondents. When asked how important it is that the products they consume are produced sustainably, a large majority (76.5%) selected either 3 or 4 on a 0–4 Likert scale, indicating high importance. The most frequent response was 3 ("important"), chosen by nearly half of all participants (47.6%), while only 0.4% rated it as not important at all. This positively skewed distribution confirms that sustainability is a widely shared value in the sample. These findings support the subsequent analysis exploring whether such attitudes are reflected in actual sustainable food consumption behavior.

Figure 1- Distribution of Respondents' Attitudes Toward the Importance of Sustainable Food Consumption

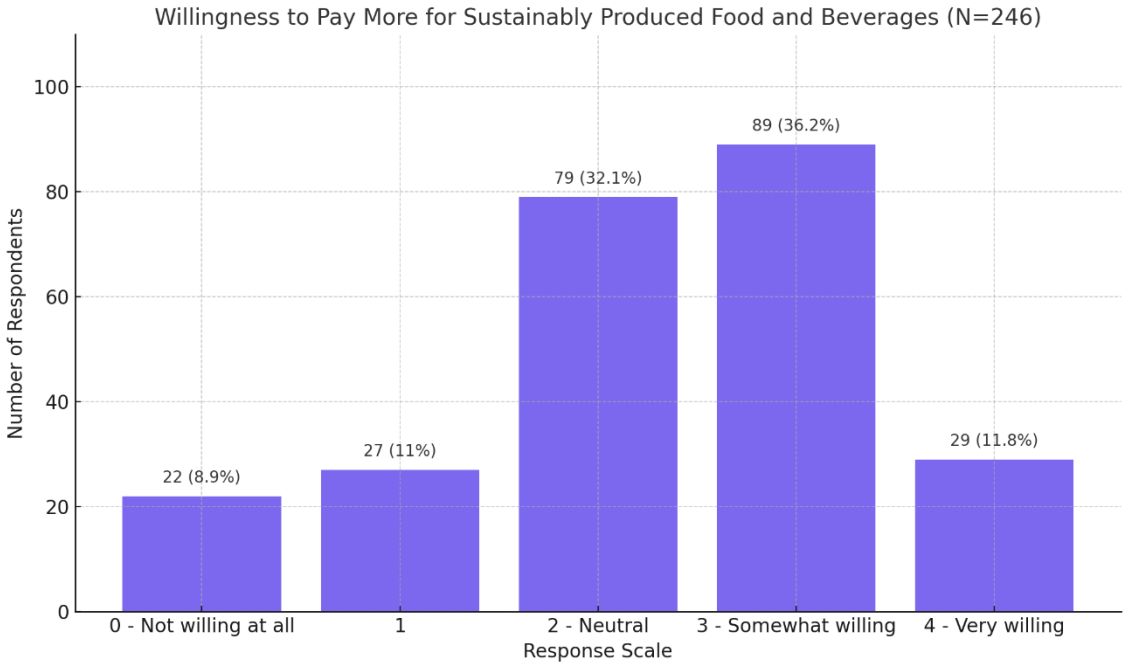


(Source: Own data collection, 2025)

The importance to eat sustainable food

In contrast, the willingness to pay extra for sustainably produced food and beverages was somewhat more moderate. While the most common rating was 3 out of 4 (selected by 36.2%), suggesting a fairly high willingness, the distribution was more varied. Approximately one-third of respondents (32.1%) gave a neutral response (2), and 19.9% indicated low or no willingness to pay extra (scores 0 and 1). Only 11.8% expressed the highest willingness (score 4). This pattern suggests that although sustainability is valued, translating that value into concrete financial commitment is more measured. Factors such as affordability or perceived value-for-money may moderate this relationship.

Figure 2- Willingness to Pay More for Sustainably Produced Food and Beverages



(Source: Own data collection, 2025)

Willingness to pay more for sustainable food and drinks

These initial descriptive findings underline the importance of further statistical analysis to determine whether stated attitudes (e.g., importance of sustainability) are matched by actual behavioral indicators, such as sustainable food consumption patterns.

4.2. Sample Characteristics

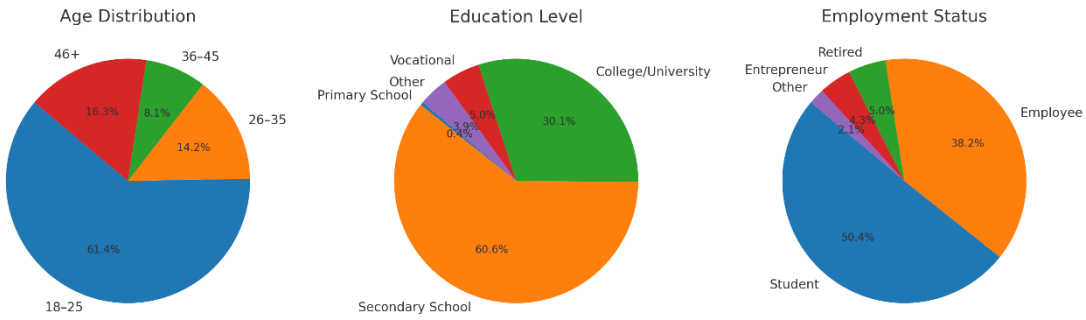


Figure 3- Demographic Profile of Respondents: Age, Gender, Education, and employment status.

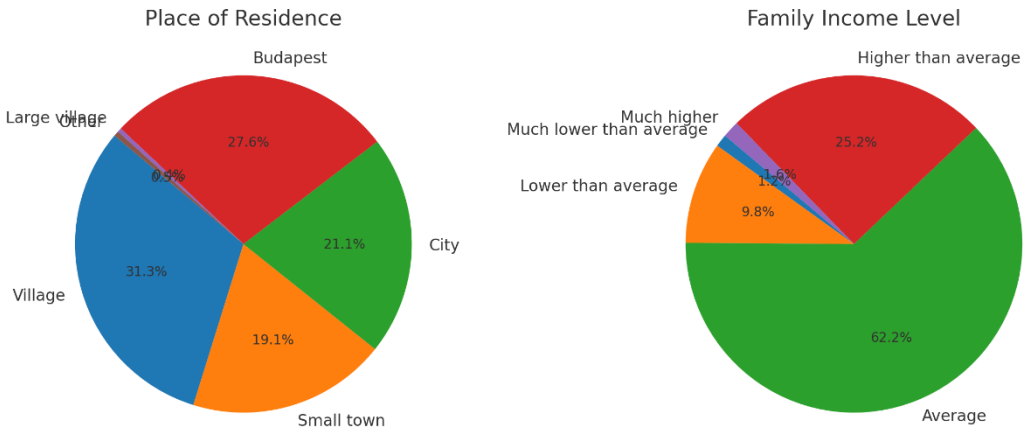
(Source: Own data collection, 2025)

Demographics

The sample (N = 246) primarily consisted of young, educated individuals, with 61.4% aged between 18–25 years and over 50% identifying as students. In terms of educational background, 60.6% completed secondary school, and 30.1% held a college or university degree, indicating a relatively well-educated respondent group. Most participants perceived their household income as average (62.2%) or above average (25.2%), and only

a minority reported lower income levels. Regarding place of residence, the sample reflected a balanced distribution across rural (village: 31.3%) and urban areas (Budapest: 27.6%), supporting comparisons between different living environments. These demographic characteristics align with the study's focus on young Hungarian residents and provide important context when interpreting attitudes and behaviors related to sustainable food consumption.

Figure 4- Demographic Profile of Respondents: Place of residence and Family income level.



(Source: Own data collection, 2025)

4.3 Reliability analysis

To ensure the internal consistency and reliability of the composite indices used in the analysis, Cronbach's alpha was calculated for each multi-item scale. Cronbach's alpha is a widely used statistical measure that evaluates how closely related a set of items are as a group. It serves as an indicator of internal reliability—that is, the extent to which the items collectively measure the same underlying construct. Values above 0.7 are generally considered acceptable, with values above 0.8 indicating good or high reliability.

Based on the Cronbach's alpha value (0.87), the statements related to consumer behavior were aggregated into a single index, named *Behaviour_index*.

Case Processing Summary

		N	%
Cases	Valid	246	100,0
	Excluded[a]	0	,0
	Total	246	100,0

a. Listwise deletion based on all variables in the procedure.

Figure 5- Reliability of Behaviour_index (Cronbach's Alpha Test Result)

Reliability Statistics

Cronbach's Alpha	N of Items
,870	15

Figure 6- Reliability of Importance_index (Cronbach's Alpha Test Result)

The internal consistency of the 17 items measuring perceived importance related to sustainable food consumption was assessed using Cronbach's alpha. The resulting alpha value was 0.859, which indicates a high level of internal reliability.

Reliability Statistics

Cronbach's Alpha	N of Items
,859	17

Figure 7- Reliability of Importance_index (Final Composite Measure)

Since all cases were valid (N = 246; no missing data), and the items showed strong internal consistency, it was appropriate to aggregate them into a single composite measure.

Consequently, I created the variable *Importance_index* by calculating the average score of the 17 items, allowing for further analysis (e.g., correlations, group comparisons) with a reliable and unified indicator of perceived importance.

The questions related to importance reflect the affective component of consumer attitudes toward sustainable food consumption. They measure how strongly individuals value various sustainability aspects, such as local origin, environmental impact, or ethical production, and therefore contribute to understanding their underlying priorities.

A Cronbach's alpha for the five items related to food waste was 0.787, indicating acceptable internal consistency.

Reliability Statistics

Cronbach's Alpha	N of Items
,787	5

Figure 8- Reliability of Foodwaste_index (Cronbach's Alpha Test Result)

Therefore, the items were aggregated into a single variable called *Foodwaste_index,* which was used in further analyses as a composite measure of respondents' behavior and attitudes related to food waste.

In the following analysis, I examine whether individuals who consider sustainability important actually behave more sustainably.

4.4 Corrrelations

To explore the consistency between attitudes and actual behavior, a Spearman's rank-order correlation was conducted between the *Importance_index* (reflecting how important respondents consider sustainability aspects) and the *Behaviour_index* (indicating their self-reported sustainable consumption behavior).

This analysis provides insight s into whether individuals who value sustainability also act accordingly in their food purchasing decisions.

Correlations

			Importance_index	Behaviour_index
Spearman's rho	Importance_index	Correlation Coefficient	1,000	,622**
		Sig. (2-tailed)	.	<,001
		N	246	246
	Behaviour_index	Correlation Coefficient	,622**	1,000
		Sig. (2-tailed)	<,001	.
		N	246	246

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 9- Correlation between Importance_index and Behaviour_index

The Spearman's rank-order correlation revealed a strong, statistically significant positive relationship between the perceived importance of sustainability (Importance_index) and actual sustainable behavior (Behaviour_index) ($\rho = 0.622$, $p < 0.001$, $N = 246$).

This finding suggests that respondents who consider sustainability important are more likely to act accordingly in their food consumption behavior, indicating a high level of attitude–behavior consistency.

Additionally, I examined whether food waste-related attitudes (Foodwaste_index) are associated with broader sustainable consumption behavior (Behaviour_index).

A positive correlation would indicate that individuals who reject food waste in principle also act more sustainably in practice.

Correlations

			Behaviour_index	Foodwaste_index
Spearman's rho	Behaviour_index	Correlation Coefficient	1,000	,425**
		Sig. (2-tailed)	.	<,001
		N	246	246
	Foodwaste_index	Correlation Coefficient	,425**	1,000
		Sig. (2-tailed)	<,001	.
		N	246	246

Figure 10- Correlation between Foodwaste_index and Behaviour_index

The result showed a moderate, positive and statistically significant correlation ($\rho = 0.425$, $p < 0.001$, $N = 246$).

This indicates that respondents who express stronger opposition to food waste are more likely to engage in sustainable food consumption behavior in general.

Using the Behaviour_index, I conducted a Spearman's rank-order correlation to determine whether there is a relationship between age and sustainable consumer behavior.

The Spearman's rank-order correlation was chosen because the data did not meet the assumptions of normality and were either ordinal or treated as ordinal-like (e.g., Likert-scale indices). Spearman's correlation is a non-parametric method that is appropriate for identifying monotonic associations between two variables when at least one of them is not normally distributed or when the measurement level is ordinal.

Correlations

			Age	Behaviour_index
Spearman's rho	Age	Correlation Coefficient	1,000	,176**
		Sig. (2-tailed)	.	,006
		N	246	246
	Behaviour_index	Correlation Coefficient	,176**	1,000
		Sig. (2-tailed)	,006	.
		N	246	246

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 11- Correlation between Age and Sustainable Consumer Behavior

The results of the test indicate that there is a statistically significant, weak positive correlation between age and the sustainable consumer behavior index ($\rho = 0.176$; $p = 0.006$, i.e., significant at the 0.01 level).

This suggests that older respondents tend to exhibit slightly more sustainable consumer behavior.

4.5 Non-parametric group comparison

In the thesis, I examined whether there are differences in the average level of sustainable consumer behavior across income categories. For this purpose, I applied the Kruskal–Wallis test, where the dependent variable was sustainable food consumption behavior, and the independent variable was income.

Ranks

	Income level	N	Mean Rank
Behaviour_index	1	2	50,25
	2	24	138,31
	3	153	116,17
	4	62	140,48
	5	5	95,40
	Total	246	

Figure 12 Behaviour_index across Five Income Categories (Kruskal–Wallis Test)

Test Statistics[a,b]

	Behaviour_index
Kruskal-Wallis H	9,105
df	4
Asymp. Sig.	,059

a. Kruskal Wallis Test

b. Grouping Variable: Income level

Figure 13 Mean Ranks of Behaviour_index across Five Income Categories

The Kruskal–Wallis H test was selected to compare differences in sustainable behavior across multiple income groups, because this test is suitable when the dependent variable is ordinal or not normally distributed, and the independent variable is categorical with more than two groups. Given that the sustainable behavior index was derived from Likert-type items and that the income variable included multiple categories, the Kruskal–Wallis test was appropriate for assessing whether statistically significant differences existed between these groups.

Based on the Kruskal–Wallis test, no statistically significant difference was found in the average of the sustainable consumer behavior index across the different income levels ($H = 9.105$; $df = 4$; $p = 0.059$).

However, the median ranks suggest a slight trend indicating that individuals with above-average income tend to exhibit somewhat more sustainable behavior.

The lowest (1) and highest (5) income categories had very small sample sizes ($N = 2$ and $N = 5$, respectively), making their mean ranks statistically unreliable. Therefore, I merged the categories with very small sample sizes.

A new grouping was created: “below average” (1–2), “average” (3), and “above average” (4–5).

I then re-ran the Kruskal–Wallis test to achieve greater statistical reliability and stronger results.

After merging the extreme income categories into three broader groups for better statistical reliability, the Kruskal–Wallis test was performed again.

Figure 14- Behaviour_index across Recoded Income Groups (Three Categories)

Ranks

	Income level	N	Mean Rank
Behaviour_index	1	25	132,50
	2	153	115,57
	3	67	136,42
	Total	245	

Figure 15- Mean Ranks of Behaviour_index across Recoded Income Groups

Test Statistics[a,b]

	Behaviour_index
Kruskal-Wallis H	4,537
df	2
Asymp. Sig.	,103

a. Kruskal Wallis Test

b. Grouping Variable: Income level

The results showed no statistically significant difference in the sustainable consumer behavior index across the income groups ($H = 4.537$; $df = 2$; $p = 0.103$).

However, the mean ranks still suggest a slight tendency for individuals with above-average income to engage in more sustainable consumption behavior.

Hypotheses and Statistical Test Results

Table 1- Summary of Hypotheses, Statistical Tests, and Results

Hypothesis	**Tested Relationship / Comparison**	**Statistical Test**	**Result**	**Conclusion**
H1	Perceived importance of sustainability ↔ Sustainable behavior	Spearman's correlation	$\rho = 0.622$, $p < 0.001$	**Accepted**
H2	Food waste attitude ↔ Sustainable behavior	Spearman's correlation	$\rho = 0.425$, $p < 0.001$	**Accepted**
H3	Age ↔ Sustainable behavior	Spearman's correlation	$\rho = 0.176$, $p = 0.006$	**Accepted**
H4	Behaviour_index across income groups	Kruskal–Wallis test	$H = 4.537$, $p = 0.103$	**Rejected**

5. Conclusion

In this diploma thesis, we aim to investigate the relationship between sustainable food consumption and individual attitudes, food waste perceptions, as well as some other socio-demographic variables among young Hungarian people who have lived in Hungary for less than 18 months. At least 246 valid questionnaires were used in the study. It collected mass data with scales obtained by multiple trustworthy experts and confirmed when the α index of Cronbach's Alpha ($\alpha > 0.7$) was beyond its requisite minimum.

The findings confirm the importance of attitude in shaping sustainable food consumption behaviors. The research has shown that importance exists between the attitude a person attaches to sustainability (Importance_index) and their actual behavior (Behaviour_index), which is both strong and positive ($\varrho = 0.622$, $p < 0.001$). We have a high level of consistency between attitudes about how one should behave.

Similarly, attitudes toward food waste are also related inversely to levels of sustainable behavior. Foodwaste_index correlates positively with behavioural_index in a moderate way ($\varrho = 0.425$, $p < 0.001$), suggesting that people who reject food waste in principle behave more sustainably.

Age was weakly correlated with both sets of indicators, but statistically significant, so that the older were a bit more likely to act sustainably and value sustainability.

Income level did not differ significantly in durable behavior, neither in the five-class nor in the condensed three-class version but displayed a slight trend of individuals with above-mean income.

Taking together, the results demonstrate the importance of values and attitudes in stimulating sustainable food behavior. This highlights the potential value of pro-sustainability attitude-boosting awareness raising and schooling interventions, especially among younger age groups, if more generalized attitude driven change is to be attained.

The present study used, in part, the Sustainable Diet Questionnaire (SDQ) proposed by (Hilary et al., 2024) among Hungarian university students, without cultural validation or a proper face and construct validation process. A few items may have reduced validity of their context because of cultural and dietary variances (for example, aquaponic fish). It is also because the sample was composed primarily of young, highly educated students that these results may not be generalizable to the entire Hungarian population. Lastly, because all the evaluations were self-reported, social desirability bias might have biased the response.

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7. LIST OF TABLES AND FIGURES

8. Appendices

Table 2- Survey validated Questions (Hilary et al, 2024)

To what extent do you consider that each of the following contributes to a sustainable diet?		Not at all important	Slightly important	Moderately important	Very important	Extremely important
A1	Low environmental impact	0	1	2	3	4
A2	Respectful of biodiversity	0	1	2	3	4
A3	No additives	0	1	2	3	4
A4	Fewer ingredients	0	1	2	3	4
A5	Organic food production	0	1	2	3	4
A6	Diet with plenty of fresh products	0	1	2	3	4
A7	Diet rich in vegetables and fruits	0	1	2	3	4
A8	Diet with traditional foods from own culture	0	1	2	3	4
A9	Locally grown products	0	1	2	3	4
A10	Affordable foods	0	1	2	3	4
A11	Easy-to-follow diet	0	1	2	3	4
A12	Choosing foods with less packaging	0	1	2	3	4
A13	Reducing consumption of red meat (e.g., beef, lamb, mutton) and processed meat (e.g., sausages, hot dogs, nuggets)	0	1	2	3	4
A14	Increasing consumption of plant proteins (e.g., beans, nuts, tofu, chickpeas, lentils)	0	1	2	3	4
A15	Consuming fish produced by aquaponics	0	1	2	3	4
A16	Reducing consumption of packaged water	0	1	2	3	4
A17	Reducing food waste	0	1	2	3	4

For each behaviour listed below, select a statement that most applies to you.		I'm not interested in doing this at the moment	I'm thinking about this, but I need more information	I would like to do this, but other things are stopping me	I have started to do this some of the time	I'm doing this confidently most of the time
P1	Choose low environmental impact food	0	1	2	3	4
P2	Choose food respectful of biodiversity	0	1	2	3	4
P3	Chose food with no additives	0	1	2	3	4
P4	Chose food with few ingredients	0	1	2	3	4
P5	Choose organic food	0	1	2	3	4
P6	Consume plenty of fresh products	0	1	2	3	4
P7	Consume plenty of vegetables and fruits	0	1	2	3	4
P8	Consume traditional foods from your own culture	0	1	2	3	4
P9	Choose locally-grown products	0	1	2	3	4
P10	Choose food with less packaging	0	1	2	3	4
P11	Reduce consumption of red meat (e.g., beef, lamb, mutton) and processed meat (e.g., sausages, hot dogs, nuggets)	0	1	2	3	4
P12	Increase consumption of plant proteins (e.g., beans, nuts, tofu, chickpeas, lentils)	0	1	2	3	4
P13	Choose fish produced by aquaponics	0	1	2	3	4
P14	Reduce consumption of packaged water	0	1	2	3	4
P15	Reduce food waste	0	1	2	3	4

Students' Declaration on the Use of Artificial Intelligence (AI)

1. General Information

Name of Student: Epifanio Augusto Tunguila Imbinga

Neptun Code: QDCXFO

Level of Study (mark the appropriate option with an X):

☒ BSc/BA ☐ MSc/MA ☐ Doctoral (PhD) ☐ Other: ……

Course Title/Code*: AGRICULTURE ENGINEERING

Title of the Work: Sustainable Food Consumption among Young Hungarian Consumers: An Analysis of Attitudes, Behavior, and Socio-Demographic Factors

2. Declaration on the Use of AI

I, the undersigned, being fully aware of my ethical responsibility, make the following declaration:

(Please choose one of the following options!)

☐ A) I did NOT use any artificial intelligence system or service.

(If this option is selected, filling out the following tables is not required.)

☒ B) I USED an artificial intelligence system or service.

(Please complete the relevant tables.)

3. Details of the Use of Artificial Intelligence

TABLE I – Assistant-level or minor use (e.g. translation, language proofreading, brainstorming, etc.)

(In such cases, attaching the exact prompts and responses is not required.)

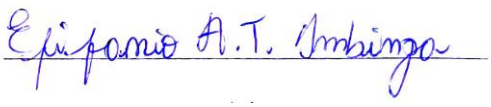
Purpose of Use	Name and Version of AI Tool Used	Section Affected (if not applied to the entire text)
language proofreading and translation	ChatGPT5	Methodology, results and conclusion
brainstorming	ChatGPT5	methodology

I declare that any content generated by AI has been critically reviewed, edited, and integrated by me into the submitted work.

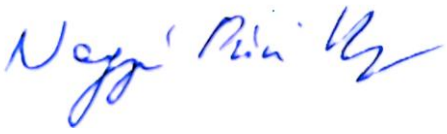
I take full responsibility for every part of the work, for its originality, and for its scientific accuracy.

I acknowledge that the Hungarian University of Agriculture and Life Sciences may verify the submitted work using an AI detector and may initiate proceedings if this declaration proves to be false or incomplete.

Date:2025.10.20.



Signature of Student



Signature of Supervisor / Consultant

STUDENT DECLARATION

Signed below, Epifanio Augusto Tunguila Imbinga, student of the Szent István Campus of the Hungarian University of Agriculture and Life Science, at the BSc Course of Agriculture Engineering declare that the present Thesis is my own work and I have used the cited and quoted literature in accordance with the relevant legal and ethical rules. I understand that the one-page-summary of my thesis will be uploaded on the website of the Campus/Institute/Course, and my thesis will be available at the Host Department/Institute and in the repository of the University in accordance with the relevant legal and ethical rules.

Confidential data are presented in the thesis: yes no*

Date: 2025.10.20.

Epifanio A.T. Imbinga

Student

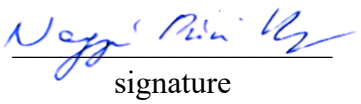
SUPERVISOR'S DECLARATION

As primary supervisor of the author of this thesis, I hereby declare that review of the thesis was done thoroughly; student was informed and guided on the method of citing literature sources in the dissertation, attention was drawn on the importance of using literature data in accordance with the relevant legal and ethical rules.

Confidential data are presented in the thesis: yes no *

Approval of thesis for oral defense on Final Examination: approved not approved *

Date: 2025.10.20.



signature

***Please, underline the correct choice!**