

Perspective

Enhancing Food and Nutrition Literacy: A Key Strategy for Reducing Food Waste and Improving Diet Quality

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Abstract: Excessive food purchases, improper storage, incorrect food preparation, and the disposal of non-expired products contribute significantly to household food waste. Food and nutritional literacy can, therefore, be linked to household food waste and not just to diet quality. Consumers with high food literacy appear to better organize their food shopping and waste less than people with low food literacy. Different studies have demonstrated the association between high nutritional literacy, healthy eating habits, and a high amount of food waste, represented by highly perishable products. The relationship between a high-quality diet and food waste is mainly attributable to the consumption of fruit and vegetables, while an unhealthy diet is associated with fewer leftovers due to the high consumption of ultra-processed foods with a long shelf life. Social and economic conditions influence the effects of literacy on the production of domestic food waste. Many studies have reported that low-income individuals rarely waste food, while richer ones tend to produce more leftovers. The challenge for the scientific, educational, and health policy sectors is to promote the consumption of fresh, healthy, and inexpensive foods, especially in the most disadvantaged segments of the population, and at the same time, provide the knowledge necessary to limit the production of household waste.

Keywords: nutrition literacy; food waste; food literacy; awareness campaign



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1. Introduction

Food waste and loss represent a worldwide problem and one of the most critical economic, ecological, and ethical challenges of recent years [1–3]. According to the Food and Agriculture Organization (FAO) data [2], about one third of the food produced for human consumption is lost or wasted, with implications in terms of food security, pollution, sustainable development, and resource consumption [1,2]. The use of food waste and loss terms is common in describing total wastage within the various stages of the food supply chain [3]. Although there is no single definition, the FAO defines Food Loss as “the loss of food as a decrease in the weight or quality (nutritional value) of food originally produced for human consumption”, while Food Waste refers to “food suitable for human consumption, which however is not consumed because it is discarded at the end of the food chain, and basically occurs in the stages of sale and consumption, often due to incorrect consumer behavior or conditions dictated by the markets” [3,4].

Domestic food waste plays a central role in multidisciplinary debate: identifying the obstacles to preventing food waste is the first concern for policy makers, researchers, and other agri-food sector operators [5]. Food waste has become a priority on the National Agenda of the United Nations and represents a key issue in achieving the United Nation Sustainable Development Goals (SDGs) and the European Green Deal targets, in terms of sustainable food production and consumption [6,7]. Reducing food waste is an ethical imperative; saving just one-fourth of discarded food could potentially provide sustenance for 870 million hungry people [8].

Identifying the causes that lead to food waste is essential to develop effective interventions to reduce food waste at the consumer level, such as educational policies, communication strategies, and evidence-based recommendations [9]. In recent years, the need to educate citizens about environmental issues and the sustainability of food system has become increasingly evident, and food and nutrition literacy has become a critical area of research, covering a range of topics, such as nutrition education, food labeling, and dietary behavior change [10]. According to Evans [11], empowering citizens is the first step to preventing household food waste. Inducing personal knowledge and responsibility can be a viable approach to allow consumers to understand the problems of food waste and provide the necessary tools to tackle them [12]. This paper aims to underline the role of food and nutrition literacy, which no longer concerns only food and nutritional facts, but also the set of issues about individual, collective, and environmental well-being, in the transition towards a sustainable and ethical food system [13,14]. In fact, if the importance of food and nutrition literacy in promoting healthy eating habits has been widely described, the relationship with domestic food waste remains poorly investigated and ambiguous [12].

This perspective is organized as follows: in Section 2, the issue of food waste and loss is introduced and described; in Section 3, the determinants underlying domestic waste are illustrated, including lack of food and nutrition literacy, which are defined. In Section 4, the investigation in the literature about the role of socio-economic conditions in determining the success of literacy is, therefore, presented. Starting from the analysis and gap of this controversial topic, Section 5 reports the strategies and future directions for how scientific, communication, and educational actions, pointed at consumers, can evolve to encourage the reduction of domestic food waste and the transmission of knowledge for improve dietary choices.

Using the Scopus and Web of Science databases, we selected the most recent articles from peer-reviewed journals on the topics covered using different combinations of keywords (including “Food literacy” AND “Food waste” OR “Food loss”; “Nutrition literacy” AND “household food waste”; “Food literacy” AND “economic conditions”). Government and technical reports contributed to identifying these relationships and developing the authors’ point of view.

2. Food Waste through the Supply Chain

Food loss or waste can occur at various stages along the entire food chain, including production, handling and storage, processing, distribution, and sale and consumption [15,16], as schematized in Figure 1. The main factors contributing to wastage are agricultural production patterns, financial and management conditions, distribution channels, marketing, and consumer habits [15,17]. It is possible to state that in middle- and high-income countries, waste happens significantly at the sale and consumption stages [18], while in low-income countries, food loss occurs mainly at the initial steps of the supply chain. This does not mean that in high-income countries food is not wasted at production and distribution stages; particularly regarding products of vegetable origin, production often exceeds demand, generating massive waste [4]. Products with unfit shapes or dimensions or damaged packaging are not sold on the market due to the strict “aesthetic” requirements of stores [19]. Additionally, the abundance of similar products from different brands can lead to some of them reaching their expiration date before being sold [4]. However, the main contribution to food waste is households. According to the Food Waste Index Report 2021, roughly 931 million tons of food waste was generated in 2019 around the world, of which 61% came from households, 26% from food service, and 13% from retail [20] (Figure 2). In the European Union, around 87.6 million tons of food is wasted each year, and the most discarded products along the whole food supply chain are fruits, vegetables, and cereals [21,22], as reported in Figure 3.

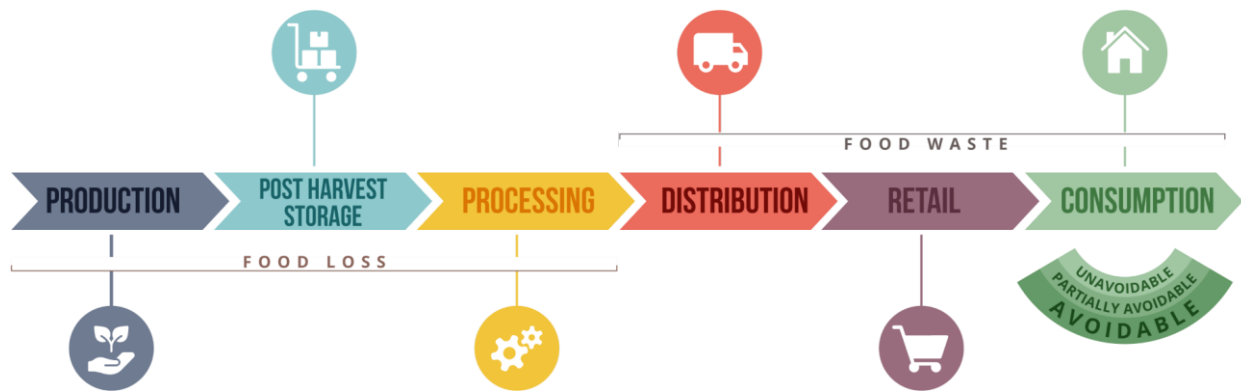


Figure 1. Food loss and waste through the food supply chain.

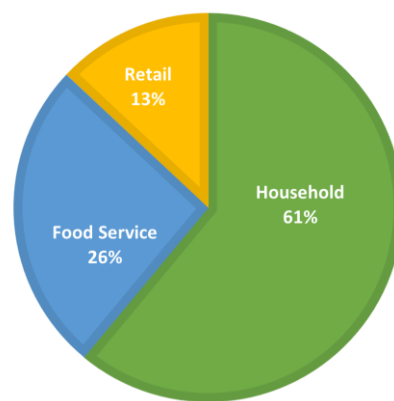


Figure 2. Global food waste generated at different stages, expressed as percentage.

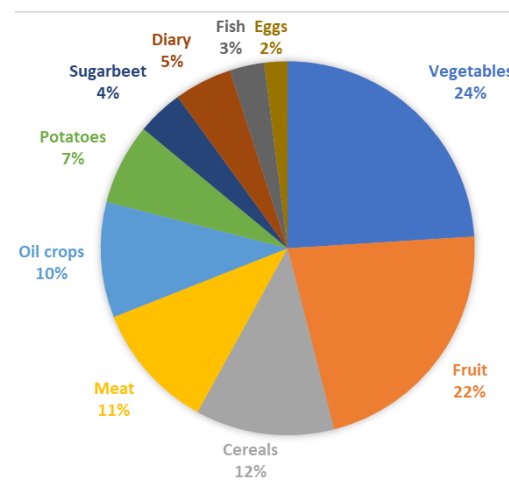


Figure 3. Food waste generated in the European Union by food group.

The household food waste can be divided into avoidable (food discarded but still edible), possibly avoidable (foods that some persons consume, and others do not, or that could be consumed after appropriate preparation), and inevitable (waste such as meat bones, egg peels, etc.) (Figure 1) [23,24]. Preventing and reducing food waste should be centered around preventing avoidable food waste, as it can be clearly seen.

To combat food waste, it is necessary to identify, measure, understanding, and come up with solutions that incorporate complex processes such as recycling, recovery, and, above all, prevention at the final consumption stage [15]. Consumers are the endpoint of the food supply chain and present a complex set of food-related behaviors [25]. Thus, the

household leftovers phase is particularly difficult to influence, as it involves interacting factors such as economic and social ones, as well as cultural pressures and individual preferences [21].

3. Determinants of Household Food Waste and Role of Food and Nutrition Literacy

To reduce the generation of household food waste, it is essential to comprehend the numerous drivers and causes involved [26]. The tendency to throw food away is influenced by demographic and economic characteristics, such as income, the age of the consumer, the level of education, and the number of family/cohabite members [27]. According to Grasso et al. [28], there is an inverse relationship between age and the quantity of household food wasted: younger individuals are more likely to produce leftovers than older individuals. Furthermore, families with children tend to waste more fresh food than adult-only families of an equal size [29]. Zareimanesh et al. [30] showed that women have more healthy eating habits, which involve cooking and food preparation, resulting in less food waste than men. Indeed, financial aspects and standard of living can influence the amount of domestic food wasted: the food considered more expensive is wasted less, and individuals with higher disposable money waste more food than poorer households [29].

Food is wasted at home for several reasons, such as inadequate meal planning and food expenditure [31], the inability to correctly interpret labels, the difficulty in managing leftovers [18], and the tendency to prepare and serve too much food, and to throw perishable but still fresh products away [32].

Some behaviors, such as going to a grocery store without a shopping list, can push buyers to impulsively purchase unnecessary and potentially wastable products [33]. Household food waste is also promoted by the availability of larger food packages in supermarkets, often with advantageous prices intended to encourage the purchase of unnecessary quantities of products [26,27,33].

The European Commission stated “lack of awareness, lack of shopping planning, confusion about *best before* and *use by* date labels, lack of information on how to use leftovers, as the key causes’ of food waste generation” [11,21]. In any case, different studies [33–35] have shown that much of the domestic food wasted is due to the preparation of excessive amounts of food and the leftovers from previous meals.

Filling the knowledge gap on food supply and consumption, and the ability to obtain and use health and nutrition information, are premises for changing attitudes towards household food waste [36,37]. In this regard, the role of the food and nutrition literacy in the genesis and prevention of food waste is an emerging theme in scientific and social research, since consumers’ information and education are crucial instruments to influence their behaviors [29–40].

Food and Nutrition Literacy: Definitions and Measures

In recent years, there has been a growing focus on the concepts of food and nutrition literacy [10]. These concepts have evolved from the broader domain of health literacy, reflecting the necessity for individuals to orient themselves in the complex issues of food and nutrition through specialized knowledge and skills [41]. Although there is no commonly agreed definition, the term *nutrition literacy* can be defined as “the degree to which individuals have the ability to obtain, process and understand nutritional information and skills necessary to make appropriate dietary decisions” [12,42]. Nutrition literacy, which refers to Nutbeam’s tripartite model [43], can be well described as the capacity to access, understand, and apply nutritional information at three distinct levels: functional, interactive, and critical nutrition literacies (Figure 4). Functional nutrition literacy refers to consumers’ skills and abilities to obtain, understand, and apply nutrition information. Interactive nutrition literacy refers to a consumer’s ability to participate in the communication of dietary information, and to share and discuss it. Critical nutrition literacy refers to the consumer’s ability to evaluate nutritional information and understand the relationship between food and the environment [44].

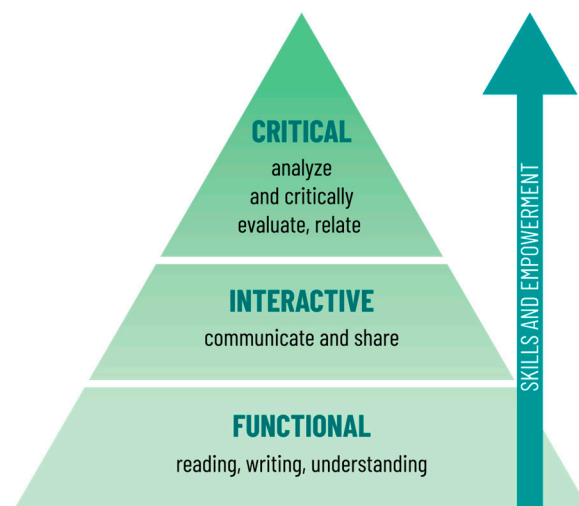


Figure 4. The nutrition literacy components.

The nutrition literacy definition often overlaps with that of *food literacy*, which is more strongly associated with the knowledge, skills, and behaviors related to foods and meals [42]. Food literacy is defined as “an intertwined set of interconnected skills and abilities, which are fundamental for planning, managing, selecting, preparing and consuming food correctly” [36]. According to Vidgen’s and Gallegos’s conceptualization, food literacy consists of 11 components organized under four domains: planning and managing, selecting, preparing, and eating [36,45]. All mentioned skills increase the freedom of food choices, strengthen critical abilities relating to food selection and consumption, and allow for the connections between food, society, and health, considering the wider impacts of individual and community choices [42]. On the other hand, inadequate literacy represents the lack of knowledge regarding the purchase, conservation, preparation, and service of food [25]. Together with the spread of new eating habits and the progressive loss of basic culinary skills, “illiteracy” causes incorrect consumer behaviors within the food system [25].

Low food and nutrition literacy is associated with a certain reluctance to embrace positive changes in attitudes and perceptions towards food, and the inability to manage information relating to the qualitative and quantitative choice of foods and their consumption [26,36]. Furthermore, some studies have shown that consumers with a higher degree of food and nutrition literacy can better estimate portions and cook more spontaneously using what is left in the refrigerator, a practice that takes time, culinary knowledge, and skills [26,46].

In recent times, efforts have been made to create tools for assessing food and nutrition literacy among adults in Western societies. These tools are designed to evaluate individuals’ proficiency in comprehending texts or figures and responding to associated questions [47]. Although different tests to measure nutrition literacy have been validated, the scarcity of an international and comparative scale to measure food literacy limits evidence-based progress in this field [47,48]. In existing food literacy surveys, psychometric properties are usually assessed using Classical Test Theory methods, and for this reason, Thompson et al. [45], in 2022, developed The Food Literacy Questionnaire (IFLQ-19), a reliable 100-question tool based on 11 theoretical domains and components of the model of Vidgen and Gallegos [36].

As regards nutrition literacy, the Critical Nutrition Literacy Scale (CNL), derived from the Nutritional Literacy Scale, was developed to measure the ability to critically analyze nutritional information, reducing barriers to healthy eating [12]. The CNL is composed of two scales that measure two aspects of critical nutritional literacy: “commitment to eating habits” and “taking a critical position towards nutritional indications and their sources” [48]. The Nutrition Literacy Assessment Instrument (NLit) is one of the most complete tools since it is designed to evaluate literacy within the nutritional context and the ability to apply knowledge and skills that concern the measurement of food quantity [12,42]. More exactly,

the NLit contains six subscales (nutrition and health, household food measurements, food label, energy sources in food, food groups, consumer skills), each of which includes 9 to 16 items [12].

The General Nutrition Knowledge Questionnaire (GNKQ) is one of the most widespread and validated instruments to identify areas of weakness in people's understanding of healthy eating [49]. The GNKQ was developed in the 1990s and has been modified over time, being adapted to use in different national contexts, including, for example, nutritional recommendations [49].

4. Socio-Economic Conditions Mediate Food and Nutrition Literacy Effects

Although food and nutritional literacies are increasingly recognized as factors intended to influence eating patterns, their effects on the ability to choose and prepare food in sustainable ways are influenced by demographic/ individual factors, cognitive/ psychosocial factors, and household or external resources [50]. Overall, the outcomes of literacy are regulated by cultural and economic values, which inspire individual and collective choices, and by the efficacy of the food chain that affects the availability of healthy and fresh foods [13]. So, beyond intrinsic characteristics, nutrition and food literacy are influenced on extrinsic factors that can increase or inhibit an individual's ability to develop and practice good habits and influence the acquisition of nutritional and culinary knowledge [42,51]. Table 1 summarizes the results of original research articles on the effects of food and nutrition literacy in relation to diet quality, household food waste, and environmental sustainability.

4.1. Relation between Literacy and Quality Diet

Studies have demonstrated that adequate food and nutrition literacy contributes to making healthful products more enjoyable and, consequently, increases adherence to a healthy diet in adults and children, reducing the risk of overweight and obesity [44,49,52,53]. Different studies (Table 1) have demonstrated a relation between overweight and a low level of education [54,55]. For example, in 2022, Aureli and Rossi, using an adapted General Nutrition Knowledge Questionnaire (GNKQ), displayed a relationship between a low adherence to the Mediterranean diet and a lower nutrition literacy among the adult Italian population [49]. In detail, the interviewees who obtained a lower score from the Adherence to the Mediterranean Diet questionnaire corresponded to those who had obtained a lower percentage (36.7%) of correct answers to GNKQ. Likewise, those with the highest level of adherence to the Mediterranean diet obtained the highest nutrition knowledge scores (41.7%) [49]. Taylor et al. reported that low nutrition literacy was associated with high adherence to the Western diet, while good nutritional literacy predicted greater adherence to Mediterranean diet, highlighting how family income is directly associated with adherence to this healthy dietary pattern [51]. A study conducted by Li (2022) on Chinese adolescents evaluated the determinants of nutritional literacy and found that ethnicity, area of residence, parental education level, and Body Mass Index are related to nutritional literacy [52]. Other studies have indicated that a poor diet quality is linked to inadequate health literacy scores in low-income rural populations [12,53]. Low-income adults, in fact, tend to purchase food of poor nutritional value, and this may contribute to the observed lower quality of diet, compared to higher-income consumers [51,56]. These results may be due to the lack of availability and accessibility to healthier foods, such as fresh fruits and vegetables [15,57]. Fresh products often have a higher price than high-fat, sugar, and salt alternatives, and this concerns, above all, less well-off family units [53,58].

The link between adherence to a healthy diet and economic possibilities does not only concern the possibility of purchasing foods of higher nutritional quality, but also concerns access to nutritional information. Even the mere perception and belief that healthy foods are expensive and less easily available represents an obstacle to healthy eating that negatively influences food-purchasing decisions [59]. This is amplified in rural /remote areas and those of lower socio-economic status and household income [59]. People from low-income or marginalized backgrounds may, therefore, face additional challenges in

accessing nutritious foods and understanding good dietary practices, and it is necessary to address these disparities by implementing interventions specifically designed for these populations [10]. A study conducted by Eicher-Miller et al. [60] demonstrated the effect of “Food Stamp Nutrition Education”, a nutrition education program aimed at low-income participants. The single-blind randomized trial was conducted in 24 counties of the state of Indiana, USA, and was composed of a representative mix of urban and rural areas, involving 219 adult women at risk of food insecurity. The experimental group attended five lessons covering topics such as food safety, food labels, purchasing behavior, meal planning, nutrition, and wellness. The results showed that the risk of food insecurity and food insufficiency in the experimental group were significantly improved, compared to the experimental control [60] (Table 1).

4.2. Relation between Literacy and Household Food Waste

The link between socio-economic conditions, literacy, and diet quality has been widely demonstrated, while the relationship between family income, literacy, and household food waste is still debated. Although according to Porpino et al. [61], the strategies used by poorer people to save money result in more food waste, other studies have identified a link between limited economic conditions and greater attention to the management of leftovers [30,50]. Different researchers [30,35] have shown that individuals and families with a low monthly income have a superior level of food literacy, and they demonstrate better food budget management (Table 1). According to this finding, low-income families tend to consume more home-cooked meals and waste less food [58,59]. For the same reasons, low-income people show considerable “anxiety” about purchasing healthier foods that are often not loved by children and, therefore, potentially wasted [58], and they shift preferences towards packaged foods with a longer shelf life. Thus, mainly large poor families tend to waste less food, as this is equivalent to wasting money [39]. This may be exacerbated by limitations that may exist in storing and cooking fresh food such as refrigerators that do not adequately maintain temperatures and the lack of more modern and faster cooking equipment [40].

Therefore, it is not only the food costs that drive food purchases, but also the risk of waste inherent in healthy perishable foods [9,61,62]. Confirming this hypothesis, Conrad’s 2018 study reported an association between good-quality diets and increased amounts of food waste among American adults [42]. Given that most household wastes come from fruit and vegetables [15,57,63], it is possible that those intent on following a healthful diet tend to buy and consume fresh foods more frequently and produce greater waste due to the cleaning and preparation phase [57]. Additionally, in all socio-economic classes, in recent decades, the rise in basic income, together with the increasing availability of products such as meat, dairy, and of ultra-processed foods, have caused an increase in calories consumed daily [44,64]. Excessive food consumption can also be considered a form of food waste, and overeating has, on food systems, the same negative effect that discarded food, as was first hypothesized in 2000 by Smil [18,64,65]. In 2016, a quantitative indicator, the Metabolic Food Waste (MFW), was developed for the first time, corresponding to the amount of food that leads to excess body fat and its impact on the environment [65]. Paradoxically eating more than necessary could be considered a strategy to avoid wasting food: the social pressure to reduce food waste can lead someone to ignore their satiety cues and overeat, resulting in weight gain [40] (Table 1). Although obesity and food waste are treated as different problems, they are related, as both are exacerbated by an overabundance of food [40,65]. This demonstrates the importance of knowing the effects on the social, environmental, and economic aspects of overnutrition and all other forms of food waste [55,66]. The European Commission states that “the knowledge of the basic principles of nutrition and adequate nutritional information on food would contribute significantly to enable consumers to make informed choices” [67].

4.3. Relation between Food/Nutrition Literacy and the Environment

Regarding the topic of environmental sustainability, food and nutrition literacy involves the development of critical thinking and awareness of the connection between food consumption and the environment. Good literacy can help reduce the human impact on the planet through prudent food choices [13,41]. This occurs owing to two phenomena: the choice of a healthy main food based on vegetable and unrefined vegetable products, and the reduction of domestic foods.

The outputs of good literacy, therefore, cause less erosion of resources at every stage of the food supply chain: soil, water, and energy, and greenhouse gas emissions, which mainly contribute to climate change. The greenhouse gas emission (GHG), linked to food waste, is a growing concern because it occurs throughout the supply chain when food is harvested, transported, processed, packaged, stored, and finished but never consumed [3,40]. As reported by Poore and Nemecek, food wastage is responsible for around 6–8% of total global GHG emissions [68] (Table 1). As is known, the greatest consumption of resources and the greatest GHG emissions are caused by the production of meat foods, although they are wasted in smaller amount than fruit, vegetables, and cereals [2,21,22]. Zhu et al. [69], in 2017, reported that food loss and waste emissions from the supply process were equivalent to 6.45 ± 4.82 Gt of CO₂, and that the contribution to these emissions varies between food categories (Figure 5).

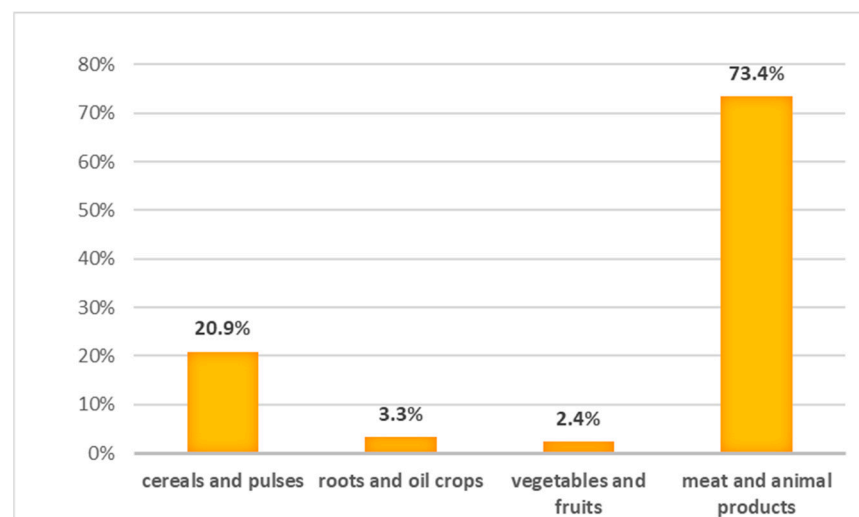


Figure 5. Food loss and waste emission of CO₂ in four group categories (expressed as percentage of CO₂ eq).

A recent study examined the link between the food literacy of South Korean university students and ecological eating behavior towards sustainability. The study showed that the knowledge of interpreting healthy food labels was associated with ecological eating behaviors such as eating fresh foods, buying local products, lessening meat consumption, and reducing food waste, especially in women. On the contrary, two other components, namely, food preparation skills and social and conscious eating, had no positive impact on ecological eating behavior [70]. A similar result was obtained in a cross-sectional study involving young adults in the city of Ankara (Turkey), which determined a relationship between food and nutritional literacy and sustainable eating behaviors [71]. A significant correlation was found between the depth of knowledge, attitude, and behavior linked to food and nutritional knowledge and the tendency to embrace more sustainable eating habits: among these were the reduction of meat consumption, the choice of seasonal eating, and reducing food waste (Table 1).

Therefore, it is clear that, on a global scale, scientists and politicians continue to work towards strategies that address food waste at every stage, adopting a sustainable production and consumption approach and, more recently, a circular economy approach [3].

Table 1. Summary of original research articles related to food and nutrition literacy and diet quality, food waste, and the environment.

| Author | Year | Main Results |
|-----------------------------|------|--|
| Al Tell et al. [44] | 2023 | Relation between nutrition literacy, diet behavior, and the use of food label. |
| Aureli and Rossi [49] | 2022 | Positive relation between nutrition literacy and adherence to Mediterranean diet. |
| Li et al. [52] | 2022 | Correlation between Body Mass Index and nutrition literacy. |
| Zoellner et al. [53] | 2011 | Relationship between health literacy with Healthy Eating Index scores and sugar-sweetened beverage consumption. |
| Hsieh et al. [54] | 2020 | Correlation between obesity and education level among the elderly. |
| Trieste et al. [55] | 2021 | Correlation between education in the nutrition field and attention to nutritional properties of products. |
| Taylor et al. [51] | 2019 | Good nutrition literacy associated with greater adherence to Mediterranean diet. |
| French et al. [56] | 2019 | Direct associations between household income and quality of household food purchases. |
| Rees et al. [59] | 2022 | Positive effect of the 7-week cooking course on meal preparation skills and mental health. |
| Eicher-Miller et al. [60] | 2009 | Risk of food insecurity reduced after nutrition education program. |
| Porpino et al. [61] | 2015 | Association between strategies to save money and more food waste in low-income households. |
| Zareimanesh and Namdar [30] | 2022 | Inverse association between the level of food literacy and income level in rural areas. |
| Smith et al. [35] | 2014 | Low-income American adults are more likely to cook food at home than wealthy women. |
| Conrad et al. [66] | 2021 | Association between good-quality diets and increased amounts of food waste. |
| Franco et al. [64] | 2022 | Food overconsumption must be considered a form of food waste. |
| Serafini and Toti [65] | 2016 | Development of the Metabolic Food Waste Index. |
| Poore and Nemecek [68] | 2018 | Quantifying the impact of food waste on total global greenhouse gas emissions. |
| Zhu et al. [69] | 2023 | The main contribution to loss and waste emissions from the supply process derived from meat and animal products. |
| Lee et al. [70] | 2022 | Knowledge of interpreting food labels was associated with ecological eating behaviors. |
| Mortaş et al. [71] | 2023 | Relationship between food and nutritional literacy and sustainable eating behaviors. |

5. Improving Consumer Behavior to Reduce Food Waste: A Future Perspective on Public Education and Information Strategies

Over the years, practices and policy initiatives to promote a healthy diet and reduce food waste have tended to focus on each issue in isolation [40]. Nowadays, in the complex battle for understanding and minimizing food waste, education could help consumers to choose healthy and, at the same time, inexpensive products and cook them in palatable ways [40,66]. If health messages encouraged consumers to improve the quality of their diets and increase the consumption of under-consumed foods (e.g., fruits, vegetables, whole grains), this could lead to more food waste, so there is a need to coordinate nutritional recommendations with messages for reducing food waste [66]. Improving people's knowledge of nutrition and cultivating "food citizenship" will require government programs and institutional interventions dedicated to both aspects. The aim of the various literacy strategies in this context is to improve both humans' and the planet's well-being [70]. It is clear that food and nutritional literacy does not exclusively imply the ability to make individual decisions about nutrition and food but is considered one of the most significant dimensions for evaluating the effectiveness of nutritional policy interventions in public health. Furthermore, it can help promote economic, social, and environmental sustainability through public initiatives [13].

5.1. School-Based Interventions

Food and nutrition literacy is based on knowledge acquired by consumers and on past experiences with food, so from the point of view of educational policies, interventions for both aspects should be implemented [69,70,72]. Work should be done to support positive experiences with food and to raise awareness of the consequences of food waste, especially early in life, which is a crucial phase for the development of eating habits [68,73,74]. A positive association between food literacy and correct eating habits was observed in children who demonstrated a greater ability to obtain health benefits through a balanced and healthy diet following their attendance at an educational program of food literacy [75]. In recent years, in fact, school intervention programs have focused on nutrition education. This was in response to the increasing rate of obesity affecting children and, especially, adolescents in Western countries [75,76]. Today, the challenge of school interventions is to promote knowledge of the food system as a whole and in relation to the environment, with interventions that translate scientific evidence into practical actions.

Unfortunately, children and adolescents have scarce opportunity to be educated about the effects of nutrition on the society, environment, and food waste [76–78], as school-program interventions are uncommon or focused on nutrition aspects but not on the food system as a whole [78]. Sociocultural and learning settings, such as family, school, and other social supports can aid in the improvement and promotion of specific knowledge by promoting cooking and nutritional skills [46,51]. These backgrounds can encourage healthy eating habits through positive dietary practices. For example, young students can be involved in specific training programs, practical activities, and games that can involve them dynamically: experiences in gardening, sowing, harvesting, and cooking food; creation of cookbooks with healthy recipes; sensorial testing with never-tried foods [47,79]. These activities, even if developed with a view to reducing food waste in school canteens, can become an opportunity to promote sustainable eating habits even in domestic contexts [79]. For example, Slow Food Denver has developed a multidisciplinary program, in middle school and high school, that integrates gardening, science, cooking, and social studies to increase students' food literacy. In over 20 years of activity, children who joined the program demonstrated a growing interest in fresh fruit and vegetables, an overall healthier relationship with food, a deep respect for the environment, and a newfound joy in creating and sharing meals with others [75]. Children who develop interactive and critical food and nutrition literacy skills find it easier to manage their own food choices and interact with others about nutritional information [47]. These kinds of interventions in the early years of life are recommended to harness children's learning capacity and have a better chance of stabilizing healthy behaviors in adulthood, as reported by Doustmohammadian et al. [47].

5.2. Public Communication

From the point of view of information and collective communication, awareness campaigns represent one of the most widespread instruments for the prevention and reduction of food waste [70,80]. There is a wide variety of successful education campaigns throughout Europe and USA, aiming to reinforce the significance of food waste prevention [61]. They instruct consumers about the appropriate handling of food, providing suggestions on shopping, shelf life, storage [79], preparation, and recovery of food [80], combined with efforts to increase the acceptability of imperfect food [26]. In 2007, the UK embarked on a major campaign entitled "Love Food Hate Waste" led by "The Waste and Resource Action Program" (WRAP). The project, characterized by the promotion of recipes to transform leftovers, attractive marketing, and tips and strategies to prevent food waste, has helped to save 137,000 tons of food since 2007 [81]. In the United States, national awareness events to report are "Save the Food" and "Food: Too Good to Waste", both having websites for practical advice to reduce household waste, and they are broadcast via other channels such as television, radio, and social media [81].

To be most effective, information and awareness-raising initiatives should always address specific knowledge gaps that lead to food waste. For example, consumers must

be addressed towards smaller but more frequent purchases, as the preference for large amounts of food purchases leads to more food waste [82]. Regarding food preservation, there is a need to assist consumers with strategies of freezing and storage practices for fresh food and leftovers [26]. The information should be targeted at specific groups of populations in close cooperation with businesses, such as retailers and the hospitality sector, using various media [70,74]. So, it is important to consider the competencies that are relevant to target groups, such as children, elderly, underprivileged population, as well as the opportunities that are made available to each to develop skills and make use of internal and external resources [42].

Furthermore, to mobilize social change, individuals should not be treated as objects to control but should be actively involved. Nutritional competence, in fact, is not only the ability to use concepts and information about food and nutrition, but also the ability to disseminate information, to participate in social activities, and promote healthy diet in the community [26,47]. To this end, the integration of campaign websites with social media platforms can offer the opportunity for users to engage as a “follower” or by sharing content, which can generate discussions and debates and facilitate a change in attitudes. For the same purpose, it may be useful to promote participation in contests or challenges linked to the information campaign, in which citizens become protagonists of the initiative itself. Social media offers a powerful platform to promote food and nutrition literacy by providing widespread access to educational resources, fostering community engagement, influencing consumer behaviors and behavior change [10].

5.3. Dietary Guidelines and Food Label

The scientific world is actively involved in promoting waste reduction, and the task of science and health policies must be to combine nutritional and leftover data and identify the effects of household food waste prevention interventions [40,73,83]. The effects of interventions to reduce food waste at the consumer level are difficult to measure and show high variability and heterogeneity in the types of interventions and their specific objectives as well as in their monitoring methods. Despite these limitations, researchers and other practitioners may find the results useful in designing and implementing new actions, as well as evaluating or scaling up existing ones [84]. For example, currently, the inclusion of sustainability topics in Dietary Guidelines is in progress in several countries, in addition to nutrition and health-related issues [85]. As recently reported by James-Martin et al. there are 37 countries that mention environmental sustainability in their Dietary Guidelines. Among the most virtuous countries, Belgium and Sweden have mentioned the highest number of guiding principles related to healthy and sustainable diets in their documents [86].

Regarding food waste, updates to the guidelines in addition to suggesting nutritional information, frequencies, and combinations of foods, should indicate how to prepare them to reduce waste, focusing attention on the nutritional properties of those edible parts that are usually discarded. Many vegetables have edible peels and stems with nutritional properties that are mistakenly thrown away during the preparation phases. In this context, improving cooking skills is identified by Pearson, et al. [31] as a strategy for reducing household food waste, especially as regards the preparation of recipes made with leftovers from other meals [87].

In recent years, nutritional labels on food packaging have increasingly become the focus of research [87]. Legislation and public health initiatives have recommended changes to label characteristics to improve the understandability of nutritional information for consumers [83,88,89]. In particular, the back-of-pack nutritional information has been shown to be difficult to access, understand, and evaluate, mainly in populations at risk of limited health literacy [85].

In this regard, Fordyce-Voorham [90], in 2011, integrated the capability to read and understand nutritional labels in the notion of food literacy, and, recently, Trieste et al.

demonstrated that food literacy scores are associated with a higher attention to the nutrition facts labels [55].

Although consumer understanding difficulties mainly concern the interpretation of correct portion sizes, as well as recommended daily percentage values [85], information on food packaging should also include clarifications on the expiry date and preparation and storage methods. Furthermore, consumers should also be adequately informed about the fact that the consumption of canned, frozen, or deep-frozen foods can be part of a healthy diet model [66,69,87,88]. So, future dialogues between scientists, policymakers, and other stakeholders are needed to promote a common food policies framework and to provide solutions to face the planetary and people health challenge [85].

6. Conclusions

Food waste and losses are a global problem at the center of intense debate in the scientific, social, and environmental worlds. The food system records continuous losses from production to the final consumer. Efforts to reduce food wastage are aimed at each point of the food chain and include technological, logistical, food transport, and conservation strategies, as well as education initiatives aimed at the consumer. Different studies have confirmed how public information and education are fundamental to teach consumers to make healthy food choices, which have also been from the point of view of environmental sustainability [49,66].

While there have been confirmations of the effects of health literacy and its “spin-offs” food and nutritional literacy on healthy eating patterns’ adherence, the effects of that knowledge on household food waste production remain ambiguous. In fact, the impacts of literacy, and the extent to which this occurs, are mediated by social and economic determinants [42,53]. The financial aspect influences food choices, which are healthier in people with high standard of living, who tend to waste more. On the contrary, disadvantaged families, especially if large and resident in rural areas, are inclined to purchase unhealthy, processed, and cheaper foods, showing a lower tendency to have leftovers. Furthermore, excessive attention to not wasting food can also lead to overnutrition, with the consequence of worsening the quality of the diet and increasing the risk of becoming overweight.

Promoting healthy eating is, therefore, no longer enough, and all education and information strategies must increasingly integrate nutritional aspects with those of environmental, economic, and ethical sustainability. Therefore, tailoring activities, information, and messages to improve food and nutrition literacy may be a viable approach, rather than providing general lists of one-size-fits-all measures [31].

The development of adequate profiling methods and evaluation of the areas of food literacy could allow for the design of more effective educational strategies and prevention campaigns especially in countries with heterogeneous income population classes [55]. This literacy process should start from schools, which represent the first place of the learning and development of sustainable food consciousness, mainly owing to practical and experiential activities. In addition to the pedagogical activity, the information aimed at the correct management of food purchases, meals, and the reuse of leftovers also passes through public awareness campaigns, which, over the years, have proven to be cornerstones among food waste reduction strategies. In this light, government policies should combine scientific evidence with practical suggestion to reduce domestic waste, improving institutional products with new sustainability objectives.

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