Food Sustainability

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Abstract

Food is inseparably connected to humans' lives. The accelerated growth of the global population is systematically depleting all renewable natural resources on the planet. Water scarcity and pollution are becoming serious challenges for current food production systems. Changes in the global economy, climate, crop and animal production, consumer behaviours, and governmental policies have all affected food systems. In this context, sustainability is becoming a key issue for the production of foods. This chapter will define food sustainability and describe the effects of food production systems on the environment and society. Topics such as food waste, local food movements, carbon/water footprints and pollution will be discussed. Besides, the importance of coordinated efforts among governments, industries, and consumers will be highlighted to adopt sustainable food production systems.

Keywords

Sustainability · Carbon footprint · Consumer behaviour · Food security · Pollution · Public health · Water footprint

1.1 Introduction

Food sustainability is defined as the manufacturing of foods with a productivity level that is considered enough to feed the human population and, at the same time, to keep the accessibility to fertile land, freshwater, nutrients, macro and microfauna, and a suitable climate (Morawicki & González, 2018). Food is inextricably linked to humans' lives. People not only acquire sustenance straight from the wild but also learn to raise animals and produce plants as society progresses. Overall, changes in the global economy, climate, crop and animal production, consumer behaviours, and governmental policies have all affected food sustainability. The accelerated growth of the global population is systematically depleting the renewable natural resources on the planet. As an example of this, water scarcity is becoming a serious challenge for current food production systems (Mancosu et al., 2015). Reducing water usage, electricity/energy consumption, and distances of transportation have been identified as possible mechanisms of action in sustainable food production (Sim et al., 2007).

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To achieve a successful food production system within the framework of sustainability, coordinated efforts among governments, industries, and consumers must take place in society. In this chapter, the definition, importance, benefits, and limitations of sustainable food development will be discussed. From the sustainability of foods in the era of globalization to the emergence of local food movements, this chapter will describe the effects of food production systems on the environment and society. Several factors including the global economy, public health issues, environmental concerns, and consumer behaviours will be covered in this chapter.

1.1.1 Concepts and Definitions of Food Sustainability

To understand food sustainability, a close look at food systems must take place. Food production, processing, transportation, and consumption are all components of food systems. The politics and economics of food production, its sustainability, the amount of food waste, the effects of production on the environment, and the influence of food on public health are all issues connected to food systems (von Braun et al., 2020). During the last decades, the global food system has contributed significantly to climate change-related greenhouse gas emissions, as well as other significant environmental problems such as soil erosion and pollution (Turner & Turner, 2007). As governments around the world become more aware of the seriousness of these problems, they are also facing other significant challenges related to food security and nutrition as they must ensure that enough food is available to satisfy the rising food demand in the societies (Ericksen, 2008). In summary, more consumers will require better foods that have lower environmental and social effects.

The food system is a macro concept, and food sustainability is its derivative. Food sustainability's long-term goal is to generate sufficient food for maintaining human populations. To achieve this, the core factors to ensure sustainable food production systems are having fertile land, freshwater, low-toxicity level fertilizers, stable climates, and less consumption of energy (Morawicki & González, 2018). In other words, sustainable food is food that is grown or farmed in such a manner that its negative impacts on the environment and the communities are minimized. Foods that are ecologically friendly and utilize resources in the most optimal way possible are referred to as sustainable foods. The goal of sustainable food is to lower the carbon and water footprints of the production and manufacturing processes (Seiber, 2011). Minimizing humans' influences on the global environment can be achieved by selecting sustainable food production systems, and this is becoming a challenging issue for governments, industries, and consumers around the world.

1.2 Food Sustainability in the Era of Globalization

1.2.1 Main Challenges in Food Production on a Global Scale

Food production systems vary greatly from region to region around the world. This is one of the main reasons for avoiding singular models in food sustainability. In general, the northern hemisphere of the globe has higher food production quantities than the lower hemisphere. This difference in food production quantities can pose different challenges when adopting various sustainability policies. One of these challenges is to minimize food waste around the world. Food waste is defined as the reduction in the quality of edible foods that are intended for human consumption. It is estimated that 30% of the total food production in the world goes to waste (Rezaei & Liu, 2017). Food waste generation varies in different parts of the world and this problem is becoming a critical concern in regions where food insecurity is prevalent.

A study made by Gustavsson et al. (2011) of food systems around the world showed that food production (total per capita) was higher in the European and North American regions compared to that of the Sub-Sahara African and South/Southeast Asian regions (900 vs. 460 kg/year).

A more extreme difference between these two regions was recorded for the food waste per capita parameter, in which higher quantities were observed for North American and European consumers compared to those of sub-Sahara African and South/Southeast Asian consumers (95–115 vs. 6–11 kg/year) (Gustavsson et al., 2011). On the other hand, higher differences were also found in the total per capita food loss during production in North America and Europe compared to that of Sub-Saharan Africa and South/Southeast Asia (280–300 vs. 120–170 kg/year).

In general, total food waste and losses in industrialized countries (such as the USA or countries in Europe) were as high as compared to those in developing countries (Africa and Asia) relative to their total production volumes. However, differences arise when comparing the type of food waste in each region. In developing countries, almost 40% of the food waste takes place at some stage of the industrial processing chain (post-harvesting, manufacturing), while almost 40% of the food waste occurs at the market and/or consumer levels in industrialized countries (Gustavsson et al., 2011). In other words, when production exceeds demand, food will be discarded and become waste in industrialized countries. Food waste has serious negative impacts on society and the environment. It is estimated that the value of food waste per year around the world is US$ 1 trillion. Food waste can raise food prices in supermarkets and decrease the capacity of low-income buyers to access foods (Rezaei & Liu, 2017).

1.2.2 The Relationship Between Climate Change and Food Production

Climate change's relative importance to food production and security varies from region to region around the world. For instance, the climate in Southern Africa is one of the most significant drivers of food insecurity. Temperatures are expected to continue increasing which can cause extreme weather conditions for this region. Changes in temperature and rainfall could cause some areas in the African region to become warmer and wetter, while other areas to become warmer and drier (Mpandeli et al., 2018). Climate change can have significant direct and indirect effects on food production and even threaten public health. By having immediate effects on the annual precipitation rates, extreme weather events, and the rising average annual temperatures, climate change can rapidly modify our current food production system models. In the long term, climate change can affect the production of plants and animals, which might have to adapt to warmer weather conditions (Vermeulen et al., 2012). These effects can be accompanied by risks of food contamination due to the growth of bacteria, viruses, parasites, harmful algae, fungi, and toxic pollutants (Tirado et al., 2010). Changes in local fauna and flora can also affect the usage of pesticide and veterinary drug residues in animal and plant products. The contamination of foods by heavy metals and organic pollutants can occur due to drastic changes in weather conditions. Climate changes can affect food production by having massive redistributions in the cultivation of crops, a decrease in cultivated plant varieties, the constant erosion of soils, and massive migration of different animal species. However, climate change can also be the cause of reduction in the environmental concentration of pesticides in the long term due to the volatization and degradation of pollutants under higher amounts of precipitation and erosion (Delcour et al., 2015).

Overall, changes in the current food production system can be associated with risks in food safety and food security. Current production models in developing countries are very fragile and vulnerable to changes in the environment. Climate change can lead to the emergence of food-related diseases and malnutrition. On the other hand, the risks associated with climate change are highly variable as some countries will experience an increase in food production volumes in the upcoming decades, while others will suffer from food insecurity (Vermeulen et al., 2012). Therefore, individual national policies should be developed to cope with the variable effects of climate change on food production

systems. For instance, climate change will dramatically affect the food production system in Vietnam (Rutten et al., 2014). The delta structure on the long coast of Vietnam is highly sensitive to flooding and extreme weather conditions. These make the Vietnam population extremely vulnerable in terms of food security and food safety due to the drastic changes in the environment. At the same time, another key factor in play to explain the complexities of climate change is understanding the macroeconomic structures of Vietnam and its population. The gross domestic product (GDP) of Vietnam has rapidly increased over the last decade, averaging 6–8% annually. As a consequence of this, increases in greenhouse gas (GHG) emissions have been seen in the country as well, of which almost half of the emissions are attributable to agriculture (the main production crop is rice) and land usage. It is expected that the production yield of key crops will be diminished due to the rapid effects of climate change (Rutten et al., 2014). There are scenarios similar to what is happening in Vietnam in various countries around the world. National and international organizations must plan future activities to mitigate the effects of climate change on food production systems.

1.2.3 Climate Change on Food Safety and Security

Climate change directly affects the weather parameters (such as temperature and humidity) in global and specific regions. These changes can have a drastic effect on the growth of bacteria, viruses, and pathogens. Also, water and soil pollution can occur with significant changes in the environment. In addition, temperature, humidity, and precipitation changes can lead to the flowing of fertilizer nutrients into water sources (rivers, lakes, oceans), becoming a "catalyst" for the blooming of algae around the world. Therefore, climate change might promote the proliferation of pathogenic microorganisms and the appearance of foodborne diseases in several countries. Non-refrigerated foods are the most susceptible to spoilage (due to the growth of bacteria and fungi) under the current climate change conditions (Misiou & Koutsoumanis, 2021).

For animal production systems, climate change can cause an increase in the appearance of zoonotic diseases. Moreover, pathogenic microorganisms can adapt to new environmental conditions, which can change their survival rates. Therefore, increases in the dosage of veterinary drugs will be necessary, which may lead to increases in drug residues in animal-derived foods. This can lead to acute and chronic risk problems associated with human health. Moreover, drug residues are the leading cause of pathogens' resistance in the long term (Caminade et al., 2019). Changes in rainfall patterns and soil erosion can dramatically change the movement of pesticide residues in the environment. Floodings and changes in the courses of rivers can produce sediment pollution, which can contaminate soils, farmlands, pastures, and the environment in general. This leads to finding biological and chemical hazards in foods, which are combined with the uncertainties of the overall production yields from farmers. All these factors contribute to challenging the supply of food to vulnerable communities. Populations in places that experience food insecurity are at risk of malnutrition and several food-related diseases (Vermeulen et al., 2012).

1.2.4 Local Food Movements

It is generally believed that locally produced foods have lower negative environmental impacts than foods grown, harvested, and transported from long-distance locations (Striebig et al., 2019). However, the size of the environmental effects is dependable on the type of transportation. As a rough estimation, faster and low-capacity transportation methods tend to have greater environmental effects (such as transporting premium food products by plane). Moreover, the type of food can also add variability to the carbon footprint impact; for instance, highly perishable foods such as vegetables, fruits, meats, and seafood require transportations that are equipped with refrigeration, which can have

greater negative effects on the environment compared to other transportation methods (Konieczny et al., 2013). On the other hand, food products with lower water activity such as grains or dried legumes can be transported in containers that require less expensive conditioning (usually these need to be controlled for relative humidity).

Another factor that needs to be considered when evaluating local foods is the climate and seasonality of different countries. Consumers nowadays are demanding seasonal foods all year round. However, the production of foods is seasonal and depends on the climate conditions. In countries located in the northern and southern parts of the hemisphere, far away from the equatorial region, fruits and vegetables tend to have lower yields during cold seasons. In some cases, it is not possible to grow fruits and vegetables on open farmland. Producers tend to use greenhouses for production, or retailers buy transported foods from other warm regions, but such approaches lead to increased environmental pressure. Fruits and vegetables grown in greenhouses need to be supplemented with light and heat to achieve the ideal growth state. The use of greenhouses to grow crops in large areas in winter can lead to the consumption of a large amount of energy and greenhouse gas emissions.

1.3 Consumer Behaviours Towards Sustainability

Consumers have their own perceptions of food sustainability, which frequently incorporate different notions such as social responsibility, animal wellbeing and/or welfare, fair trade and/or labour, local agriculture, and organic and/or natural food production systems (Peano et al., 2019). Consumers are progressively being more aware of sustainability issues related to food production systems, including having different perceptions about the types of packaging used (paper, cardboard, metal, plastic, or glass) and the information that these packagings reflect (for instance, products labelled as friendly with the environment) (Otto et al., 2021). Food mileage, the distance that food has to travel from the production site to the consumption location, is another concept that is frequently associated with food sustainability by consumers. In some cases, consumers can express concerns about high mileage foods as they associate transportation with pollution (Naspetti & Bodini, 2008). Food sustainability, in broader terms, is defined as the production of foods at a level that is adequate to support the population (Morawicki & González, 2018). However, this definition can vary according to the different perceptions of consumers. In general, concepts such as fertile land, clean water, responsible usage of nutrients, and favourable climate conditions as the foundations of long-term food production have been promoted as pillars of food sustainability.

1.3.1 Factors That Affect Consumers' Behaviours

Behaviours around food choices are complex and dynamic (Köster, 2009). Several factors affect the selection of foods by consumers, such as the sensory properties and extrinsic cues shown by the product. The traditional sensory evaluation of foods focuses on intrinsic factors such as appearance, aroma, taste, texture, and aftertaste (Lawless & Heymann, 2010). However, consumers' expectations of foods based on extrinsic cues, such as the information that is paired with the product (for instance, sustainability or animal welfare), are drastically different compared to the expectations of these products based exclusively on intrinsic sensory attributes (Napolitano et al., 2010). In some cases, consumers who have very limited knowledge about agricultural practices can support sustainability based on their constructed perceptions of production systems. That is, their decisions can be solely explained by trends shown in regular media outlets (TV or online news) and social media. This creates a conceptual dissonance between the actual production practices and the general perception of consumers. For instance, consumers might want to see an increase in positive animal welfare in farms that produce

animal products. However, they might not know that increasing these animal activities can generate an increase in greenhouse gas emissions and a higher depletion of natural resources (Garnett et al., 2013), depending on the practices that are implemented in the farms. Food perception can be deeply affected by the type of information that is shown to consumers. In some cases, these perceptions can also affect the overall acceptability of the products (Jiang et al., 2021).

1.3.2 Consumer Behaviours Affecting Food Waste at the Retailers' Level

Food waste in middle or high-income countries is mainly associated with the lack of coordination among different participants in the supply chain. The disagreements in sales and purchases of products by farmers and retailers may result in substantial amounts of food being wasted. Quality standards such as rejecting foods with imperfections (shape or appearance) may cause higher rates of food waste at processing facilities. Consumers might also reject the products at the retailers' locations due to imperfections and lack of sensory appeal (Göbel et al., 2015). Another major food waste factor at the retailers' point of sale is related to the perception of offering "visual abundance" to consumers. Retailers at supermarkets tend to continuously restock fresh produce and other perishable food items to create the impression of abundance that can incentive the increased purchasing behaviours of consumers. However, this practice can lead to food waste if the items are not purchased before the closing time of the stores (de Moraes et al., 2020). However, retailers, nowadays, have been adopting different strategies to divert food waste from landfills. Concerns of consumers and retailers for the environment are the key drivers for the movement of food waste reduction. However, these policies need to offer the required training and education to be successful (Goodman-Smith et al., 2020). Other causes of food waste at the retailers' level include the lack of communication, lack of operational controls, inappropriate work procedures, lack of integrated computerised systems, inadequate demand forecasting, unexpected excess in production, lack of waste measurements, inadequate packaging, and the short shelf life of some products (de Moraes et al., 2020).

The current globalized food systems make the distance between producers and consumers larger; that is, consumers, nowadays, are not aware or they lack the complete knowledge of the current agricultural production practices. In this context, retailers are becoming the main channels for food exposure and information. To maintain the homogeneity of the process and, at the same time, to keep uniform quality control measurements, retailers have sought to standardise food products. For instance, retailers have standard measurements regarding the weight, shape, and size of fresh produce. This can generate food waste at the recollection of these products since these are rejected for not meeting the required standards. These practices have created the artificial perception by consumers that this fresh produce (those that do not have the required size or shape) is of inferior quality in terms of safety and taste (Makhal et al., 2021). In this regard, several solutions have been implemented to deal with food waste caused by sub-optimal products at the retailers' level. The production of derivate products from those sub-optimal raw materials is commonly used by producers who want to avoid waste and gain some profit in the process. Fruits and vegetables that do not meet the standards can be transformed into juices and other processed products. Some sub-optimal products can be sold in "fresh market" places, where consumers are looking to buy fresh foods directly from the producers (Hermsdorf et al., 2017). Usually, the artificial perception of having a perfect shape and size is minimized when the products can be sold directly from the farmers that grow these products. The implementation of alternative processing and commercialization pathways are required to minimize waste in current food production systems, especially for fresh foods that have a shorter shelf life.

1.4 Effect of Food Production on Sustainability

Sustainable agriculture practices are paired with sustainable food production systems. In general, much of the food waste is created in the final steps of agricultural production (for instance, crop harvesting or animal slaughtering) and the beginning of the food processing systems (quality selection and packaging). It is estimated that around one-third of food is lost or wasted globally, which equals approximately 1.3 billion tons per year (Timmermans et al., 2014). However, there are profound discrepancies in how this food waste is generated, which largely depends on the region or country where the food production is located. In this regard, food waste in low-income countries largely occurs in the early and middle stages of the food supply chain. This means that lower quantities of food are wasted at the consumer level. However, in middle and high-income countries, food is largely wasted in the consumption stage, which means that consumers are more responsible for food waste than food industries (Gustavsson et al., 2011). Other important factors affect sustainability within food production systems, including carbon and water footprints and pollution.

1.4.1 Environmental Issues

With the rapid increase of the human population, the steady growth of the global economy and international trade, and the rapid expansion of human cities, the forests, wetlands, and earth's soils have been progressively deteriorating more than ever. The ever-increasing commercial needs of different countries have been coupled with the rapid generation of trash and waste around the world. Today's societies demand a rapid production of foods, which is affecting the land use patterns and employment of natural resources in each country. Modern production systems are replacing grasslands with dense crops, substituting native woodlands with edible or grazing plants to supply populations with the food they need. This situation is happening in several regions of the world, and each country is currently dealing with some of the negative consequences of these practices (floods, fires, soil dryness). A similar effect occurs in the ocean. Sealife is being overfished as never before and the live coral coverage on coral reefs has been greatly reduced. However, the food demand of the growing global population is still increasing, especially for meat and fish. Therefore, there is a substantial resource unbalance between the current food production systems and the natural sustainability of the environment (García-Oliveira et al., 2022).

1.4.1.1 Carbon Footprint (CF)

Carbon footprint (CF) refers to the total amount of greenhouse gas emissions (GHG), which are derived from the manufacturing of products or the provision of services. In food production, the carbon footprint is defined as the total GHG that is generated during the agricultural practices and post-harvesting processes. The GHG includes carbon dioxide, methane, nitrous oxide, and fluorinated gases (East, 2008). The measurement of CF has been recognized as a central indicator of GHG emissions from different companies, organizations, communities, and countries (Wright et al., 2011). Besides, CF has become a selling factor for food and beverages companies, which are becoming aware of the importance of this label in the mind of consumers.

In animal husbandry, the impact of ruminants on the carbon footprint should not be underestimated. Higher measurements of CF have been found in the production of major ruminant species including cattle, sheep, and goats (Henderson et al., 2018). Ruminants emit large amounts of methane through hiccups and small amounts of methane through flatulence. Ruminants have four stomachs, where feeding is digested. Ruminants consume forage or grains. After initial chewing and swallowing, the food returns to the mouth again to be chewed in a process that is called "regurgitation". This approach allows them to digest the feeding better. Ruminants' stomachs are full of bacteria that help digestion; however, a byproduct of this process is the production of large amounts of methane (Jentsch et al., 2007).

In food production systems, other causes of higher CF include transportation, industrial activities, waste management, and other manufacturing activities. Besides, there are also indirect or secondary CF emissions that are derived from the whole lifecycle of products and services associated with the food production systems. For instance, some food products are not immediately consumed, and they have to be stored in certain conditions to maintain their shelf-life. The storage (for instance, freezing or refrigeration) of those products can increase the CF in those production models (Kenny & Gray, 2009). Food industries around the world are investing large amounts of money in estimating the total CF that is emitted by their production systems. This can help to create CF reduction models that can be aligned with the industry and government goals in terms of carbon emissions. Moreover, food companies are also aware of the importance that consumers are giving to the CF labels in products. This can also be viewed as a point of differentiation of these companies from the rest of the market.

1.4.1.2 Water Footprint (WF)

The water footprint (WF) is defined as the water volume used to produce a unit of a specific product or service (m^3/t). Also, WF is defined as the volume of water per year that is consumed in a specific area by an individual or community (m3/yr.) (Lovarelli et al., 2016). For most parts of the world, water security, which is linked to climate change, is a growing problem. It undermines food security as food production systems depend on water inputs. After the industrial revolution, rivers and underground reserves started to be depleted due to urban and industrial transformations in various locations around the world. Driven by maximizing profits, several countries relied on growing crops that require higher water inputs; therefore, the WF was higher than the natural water replenishments, which led to droughts and changes in the environment. These problems can be seen in both developed and developing countries as water is a vital natural resource for humans, which is also used for the production of foods. Currently, policies are heavily focused on carbon footprints; however, water footprints should also be analysed and measured. As food security is still a glooming concern, industries and governments around the world should invest in technologies to countermeasure higher WF in food production systems (Hoekstra & Mekonnen, 2012). Consumers are demanding products that can be friendly to the environment. That is, consumers are pushing industries to adopt different production practices. For instance, the meat industry has been under pressure to optimize its production to reduce CF and WF (Muthu, 2019). Other industries are following the same path. Although they are prioritizing CF, WF is intrinsically connected with carbon emissions. Therefore, an integral approach (including CF, WF, food waste, pollution, and other environmental factors) is recommended when measuring sustainability in different food production models.

1.4.1.3 Pollution

With the development of Western industrialization in the twentieth century, rapid agricultural developments have been shaping current food production systems. Since the 1970s, developed countries have rapidly optimized modern agriculture based on mechanization, industrial transformation, and energy conversion as its main drivers (Evans & Lawson, 2020). The large-scale usage of machinery, fertilizers, pesticides, and herbicides increased the land and labour productivity, which caused a rapid expansion of the population. However, a series of undesirable consequences were also the results of these rapid expansions, including environmental pollution, soil erosion, ecological damage, simplification of animal and plant species, and loss of germplasm resources. Increased applications of chemical fertilizers and pesticides not only pollute the soil environment and crops but also affect humans' health and food safety (Campagnolla et al., 2019). It is estimated that agricultural practices are responsible for 19–29% of the global greenhouse gas emissions. Moreover, agriculture pollutes 70% of the freshwater resources in the world. In the last decades, governments have been introducing different legislations regarding

sustainable food production systems. However, their outcomes varied largely from region to region (Zhang et al., 2021). These policies need to be supported by environmental research that can measure and optimize the different agricultural practices to avoid long-term damages to the environment and society.

1.5 Public Health

Food sustainability and public health are inextricably linked (Ogden et al., 2014). Weight gain and obesity are the results of more calories consumed than expended in activities such as sports. The majority of foods cause weight gain, but the main culprit can be attributed to high-calorie foods. The growing obesity pandemic poses another challenge to the sustainability of agriculture. For instance, the consumption of considerable amounts of meat products is strongly correlated with the occurrence of several diseases such as obesity, diabetes, and heart-related disease. In this regard, reducing meat consumption and increasing the levels of dietary protein obtained from high-protein plant foods (legumes, cereals, and tubers) are associated with different human health and ecological benefits (Ripple et al., 2013).

Overweight and obesity have major implications for humans' health and the environment. Being overweight reduces physical activity and personal mobility, which results in a continuous accumulation of fat. In addition to expanding food production to adapt to the growing population, agriculture is under the pressure of producing extra food, which is associated with the overweight population. This not only puts pressure on non-renewable arable land resources but also increases the severity of other environmental problems, such as water resources. In this regard, consumers are becoming more aware of how food is a crucial factor in health and the environment. More consumers are now demanding healthier foods that can also be environmentally friendly. This is challenging current food production systems and now some industries are aiming for drastic changes in their production models.

Consumers' environmental demands are also reflected in animal husbandry. In addition to the health effects, diets have also different effects on the environment. With the effects of globalization, consumers' consumption of animal protein has increased. This phenomenon drove farmers to raise more livestock and produce more animal products. This increase in animal production has led to increases in soil erosion, water depletion, pollution, impacts on biodiversity, and interference with nitrogen and carbon cycles (Milford et al., 2019). Changes in food production are driven by consumers' demands; therefore, industries and governments need to implement policies that can show consumers the benefits of sustainable agricultural practices that are coupled with the production of healthy and nutritious foods.

1.6 Conclusion

Sustainability has been a key focus of governments and industries as food production systems are facing huge challenges in providing better foods for humans that can also be better for the environment. Some of these changes are driven by technological innovations. However, this must be aligned with adequate policies and legislation. For instance, developed countries should implement policies regarding reducing food waste in the later stages of the food production chain, requiring retailers and restaurants to take action to minimize and reuse waste. On the other hand, consumers also need to act regarding their lifestyles and behaviours. For instance, consumers need to learn more about how to buy and prepare foods, learn how to buy in moderation, and reduce excessive demand for food if it is not needed. Conversely, policies and comprehensive support are needed to improve technology and help farmers grow healthy and sustainable foods. However, a coordinated effort among governments, industries, and consumers is required to adopt this food production model.

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