Czech University of Life Sciences Prague

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Bachelor Thesis

Consumers' Attitudes to Sustainable Food Consumption

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Le Huyen Trang Phan

Business Administration

Thesis title

Consumers attitudes to sustainable food consumption

Objectives of thesis

The thesis will determine consumers' attitudes influencing their decisions to eat more sustainable. To achieve such goal, the work aims to investigate what alternatives are the consumers willing to try out and the reasons behind their decision towards sustainable and alternative eating with focusing on economic and social aspects of such decisions.

Methodology

The work starts with literature review. It will outline the concept of sustainability. The concept will be related to food and food eating. Various alternative (innovative) models of food consumption will be outlined in the literature review with possible documenting their contribution to sustainability as it is described in academic literature. The empirical section of the work will be underpinned by survey addressing people of various age from various countries. The results of the survey will be used to answer the questions raised in the goal of the thesis.

The proposed extent of the thesis

40-50 pages

Keywords

sustainability, food, consumer choice

Recommended information sources

Baldwin, C. J. (2015). The 10 principles of food industry sustainability. ProQuest Ebook Central https://ebookcentral-proquest-com.infozdroje.czu.cz

Devaney, L., Davies, AR. (2017). Disrupting household food consumption through experimental HomeLabs: Outcomes, connections, contexts. Journal of Consumer Culture 17 (3): 823-844

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Verain, MCD., Dagevos, H., Antonides, G. Sustainable food consumption. Product choice or curtailment? Appetite 91: 375-384

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Declaration

I declare that I have worked on my bachelor thesis titled "Consumer's Behavior Toward Sustainable Food Consumption" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 15. 3. 2022 _____

Le Huyen Trang Phan

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Consumers' Attitudes to Sustainable Food Consumption

Abstract

This Bachelor Thesis discusses consumers' attitudes toward sustainable food consumption. The general aim of the work is to learn about consumers' eating habits and raise their awareness about sustainable food and its importance.

The term sustainable consumption involves the use of products and services which enables consumption to continue indefinitely in a short-term society without compromising the ability of future generations to meet their own needs. Benefits are stable economic growth, enhanced livelihoods of all peoples, reduction of poverty and improved well-being, increased social inclusion, sustained, and enhanced productive base, adequate protection of the environment, enhanced resource efficiency.

The thesis aims to identify and describe sustainable food consumption habits. To achieve this goal, a literature review was conducted. The impact of the food sector on the environment, society, and economy was described in this section. In addition, alternative and sustainable diets were identified and described in detail. Empirical research was conducted to analyze the current eating habits of consumers and their willingness to adapt to a sustainable diet. An online survey was presented to respondents from different countries via a social network. The results of this study showed that the younger generation tends to follow various diets such as vegan or vegetarianism more often than the older generation. Overall, the results provide evidence of a strong willingness to adopt sustainable diets among consumers, but they need the right motivation and information.

Keywords: sustainability, food, consumer choice

Postoje spotřebitelů k udržitelné stravě

Abstrakt

Tato Bakalářská práce probírá postoje konzumentů k udržitelnému stravě a její spotřebě. Hlavním cílem práce je poučit konzumenty o stravovacích návycích a zvýšit jejich povědomí o udržitelném stravě a její důležitosti.

Pojem udržitelná spotřeba zahrnuje použití produktů a služby, které umožňují pokračovat ve spotřebě na krátkou neurčitou dobu ve společnosti, bez možnosti ohrozit schopnosti budoucích generací naplnit své potřeby. Mezi benefity patří stálý ekonomický růst, vylepšené živobytí všech lidí, snížení chudoby a zvýšený blahobyt, zvýšené sociální zařazení, udržitelná a vylepšená výrobní základna, efektivní ochrana životního prostředí a vylepšené zdroje účinnosti. Zdravá, ekologická a uvědomělá strava požaduje vyvážený životní styl.

Cíl práce je určit a popsat návyky spotřeby udržitelné stravy. K dosažení tohoto cíle byla sepsána teoretická část. Dopad potravinářského sektoru na životní prostředí, společnost a ekonomiku byl popsán v této části. K doplnění, alternativní a udržitelná strava byla detailně určena a popsána. Praktická část byla sepsána k analýze aktuálních stravovacích návyků konzumentů a jejich vůli se přizpůsobit k udržitelné stravě. Internetový dotazník byl představen respondentům z několik různých zemích přes sociální síť. Výsledky ukázaly, že mladší generace se přiklání dodržovat různé stravy jako veganství a vegetariánství vice než starší generace. Celkově výsledky ukazují, že konzumenti mají silnou vůli se přizpůsobit udržitelné stravě, ale potřebují správnou motivaci a informace.

Klíčová slova: udržitelnost, jídlo, volba spotřebitele

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1 Introduction

The food system unquestionably has an irreplaceable role in the society because it fulfills human's both biological necessity and socio-cultural factors. It does not matter if a person is old or young, an astronaut or a student, if they live in Africa or in Asia, they may share a little of similar interests, but everyone has one thing in common, they need to eat. Not only does food provide energy for all living beings, but the food sector also employs one-third of the global workforce (Atkins & Bowler, 2001). However, all magic comes with a price. Along with all, they benefit food and the whole food sector, in general, leaving behind a massive ecological footprint and issues in society that cannot be overlooked. Luckily, there are a lot of things that human can do to solve this problem.

The main aim of this bachelor thesis is to point out current issues that are caused by the food system, accordingly, emphasize importance of food alternatives that are available. In the first chapter of theoretical part, this assignment touches on topics such as roles of food in society, food safety and how dietary habits are created. At this point the thesis should introduce a better insight on how people eat, why and what is going wrong. The next chapter gives a brief overview of the problems that are created by the food sector such as climate change, natural resources depletion, pollution, hunger, and obesity. These matters can be divided into economic consequences, ecological issues, and socio-biological issues. The second chapter is intended to stress on the problems that the world is facing. The third chapter brings up food sustainability and answers to the question "What it is and why is it important?". This section also addresses solutions that can improve current world's situation and prevent it from facing serious conclusions further.

The empirical section of the research work consists of an in-detailed clarification and interpretation of the results obtained from the questionnaire. The Results and Discussion section examines the factors that affect consumers' dietary habits, and if people are aware of food sustainability. Secondly, this section aims at their willingness to do something to contribute to the food security, determines reasons why they would not. Such goals will be achieved using online survey, main target of the research are people in the age range from 15 to 65 years old from various countries.

In conclusions, this assignment takes into account the results of the survey to discover and suggest approaches to motivate consumer toward sustainability.

2 Objectives and Methodology

2.1 Objectives

The main purpose of the thesis is to explain consumers' attitudes influencing their decisions to eat more sustainable. To achieve such goals, the work will determine the role of food, describe how human food habits are created, identify the impacts of the food system in the world, and emphasize the solutions for these issues. The work also aims to investigate what alternatives the consumers are willing to try out and the reasons behind their decision towards sustainable and alternative eating with focusing on economic and social aspects.

The results and discussion section is supposed to reveal knowledge, opinions of consumers about sustainable diets, and their eating habits. At the same time, it examines whether they are willing to adjust their dietary habits.

2.2 Methodology

The purpose of the thesis is to gain a more in-depth understanding of the approach of a chosen group of consumers toward sustainable food consumption. The theoretical part of the work is based on the study and analysis of academic and scientific information sources. The data collected are quantitative, primary, and descriptive. The food consuming patterns will be investigated using quantitative research approach – data are expressed by words also known as ethnography. The primary data is collected using online surveys, distributed to respondents via email and social media platforms. Additionally, two-sample proportion tests were performed in order to test hypothesis about relationship between socio-demographic factors and customers' attitudes toward sustainable diets.

The survey addresses people of various age from different countries. It is designed to collect information about the variables that impact consumers' eating habits, decision-making while shopping for food, knowledge about sustainable food, and lastly, their willingness to adapt new food alternatives.

3 Literature Review

Livestock activities account for 45 percent of global land use, 30 percent of freshwater use, 91 percent of deforestation, and 51 percent of greenhouse gas emissions. The leading cause of dead zones in the ocean and species loss. Produces about 15% of the world's total greenhouse gas emissions. In comparison to the previous generation, fish stocks in the ocean have declined by 50% since 1970. (For 1kg of fish to be ready to consume, 10kg are caught). (Henning, 2006)

Not to mention, the soil has lost its natural fertility, because the grounds have been over-farmed. Furthermore, due to the low soil quality caused by monoculture agriculture, farmers are forced to coat it with fertilizer and pesticides. (Baldwin, 2015)

The current food system is unsustainable, wasteful, and inefficient. Partly, it is the consequence of letting shareholders' ROI determine what people consume. By 2025, the world's population is expected to reach roughly 10 billion, requiring a 70% increase in food production. However, half of the world's land, 30% of its water, and half of its fish are already depleted. (FAO, 2017) As a result, either a new planet or a change in food production is required.

3.1 Factors in Food Consumption

This chapter focuses on the main role of food in the human body. It briefly introduces food safety. Lastly, it highlights the demographic, physiological, and socioeconomic elements that affect eating habits and diet quality.

Figure 1 Factors in food consumption (Atkins & Bowler, 2001)

3.1.1 Food and Its Role

"Without food, man can live for most but a few weeks; without it, all other components of social justice are meaningless." (Borlaug, 1970)

According to Maslow's hierarchy of needs, food is one of the basic deficiency needs, which are physiological demands of every living being, for example food, water, air, sleep. Without meeting satisfaction of those needs a body is not able to perform ideally if it functions at all. Food is one of the most important things human body needs in order to survive. It delivers nutrition, which is used to create energy, build, and maintain life (Eklof, 2020).

3.1.2 Food Safety

Food safety is an umbrella term with no consistent definition, it may have different meanings. One of the definitions may be "*Food safety is the set of practices that are implemented in food processing in order to prevent food contamination events that may affect the health of consumers."* (Omar A. Oyarzabal & Barbara, 2020). In general, food is considered safe when it is consumed under normal conditions, in a normal amount and does not cause intense and lifelong health issues for end users. In case the food contains allergens, it is only suitable for regular consumers, not individuals with a tendency to have allergic reactions. It can be said that the whole food chain incl. growing, harvest, preparation, production methods, manufacture, processing, packaging, and how the food is stored is involved in food safety. Van Rijswijk and Frewer had noted that two-thirds of consumers from Germany, Italy, and Spain think that food safety is deeply linked to food quality, which for the consumers means food quality is constructed by its safety and not in the opposite way. Terms that are connected with both "safety" and "quality" are not risky/ harmful, proper production method, proper handling, and healthy (Rijswijk & Frewer, 2008). As for regulations, Henson, and Caswell's four-part commentary on contemporary issues of food safety regulation. In the first part they mentioned criteria for establishing food safety regulations, according to them the regulations and their success/failure can be dependent on the scientific/economic justification (risk assessment, risk management, and risk communication) The second dimension focuses on the relationship between public and private food safety control systems. It carries equitably convincing claims for harmonizing the enticements of public and private quality control systems. In the third part, are approaches to public food safety regulation. They highlighted that the forms of food safety criteria can be target, performance, and specification.

Frequently, the public food safety regulation comes in form of standards. The last part is about strategic response to food safety regulation. This part points out the fact that corporations react to regulations accordingly to expected economic benefits and the costs of compliance connected to food safety. Therefore, regulations play an important role in competitiveness of a sector (Henson & Caswell, 1999).

According to Centers for Disease Control and Prevention there are four easy steps to avoid food poisoning and keep the food safe. Group of consumers that is more sensitive are children, elder, pregnant women, or people with bad health conditions. Firstly, hands and surfaces need to be washed often, especially before and after food preparation, because bacteria that triggers food poisoning, which often appears as diarrhea, vomiting, stomachache, nausea, or fever, can exist in, and spread around a lot of different areas. The hands and utensils should be washed with soap and with water. Second step is to separate contaminates, such as uncooked meat, poultry, seafood, and eggs with ready-to-eat foods (vegetables, fruits). To do so use individual cutting boards, keep apart raw foods' juice from other groceries. Step three is to cook food till internal temperature is sufficiently high to kill the bacteria causing food poisoning, therefore avoid consuming undercooked meat or seafood. To assure the food's safety a thermometer can be used. Last step is to store the food properly in refrigerator considering the fact that room temperature is ideal for foodborne germs to increase (Centers for Disease Control and Prevention, 2020).

3.1.3 Dietary Habits

It is well known that eating attitudes directly influence human health, but then again what shapes people's food habits? Besides personal preferences, multiple demographic and socio-economic conditions have a huge impact on dietary habits, they are linked with many diet quality indicators. Variables such as gender, age, ethnicity, and socio-economic status, which is characterized by education, occupation, and income; are frequently used in analyses for dietary studies. (Atkins & Bowler, 2001)

Gender is a term representing characteristics of men and women from social point of view since they are heavily affected by psychological and social elements. Many epidemiological and medical analyses show that "lifestyle-related" diseases, for instance cardiovascular illnesses, obesity, and diabetes, which are influenced by combination of traditional, financial, educational, and social aspects; all can be affected by gender differences (Hunt, Lewars, Emslie, & Batty, 2007). In comparison to men, women have a tendency to eat more fruit and vegetable,

legumes, and organic, wholefood, on the other hand they eat more sweets. Men are more likely to have higher intake of fat and proteins, to consume more alcoholic beverages, and sweet carbonated drinks. This may be caused by poorer nutritional knowledge. In general, women care more about their body image, in addition, this increases motivation for them to eat more healthily and they are in all likelihood more willing to follow a dietary plan, to be guided and given recommendations. (Konstantinos, Vassilios, & Demosthenes B., 2009)

Nevertheless, it is also proven that eating behaviors and food preferences change throughout the life span. From the first years of human life, the brain connects flavors with experiences. The experience such as being held comfortably while drinking breast milk associates eating with being comforted. As Chris Luckhurst, the head of research at the Marketing Clinic, claimed – Vanilla ice cream is that famous because it is one of a few flavors that actually awakes memories of breast milk, human's first comfort food. So how does aging affect food preference? Infants have 3 times more tastebuds than adults, which is approximately 30 000. This makes children incredibly sensitive to tastes, which is why young children's diets require less seasoning. Oversensitive tastebuds also lead to children's unpleasant encounters with vegetables since they can feel the bitter taste more intensively (Lawless, 1987). There are a lot of physiological changes of a body as human grow older, for example changes of the digestive system, gastrointestinal emptying becomes more slowly, and different hormonal responses. Furthermore, older adults are not open to new tastes. Nutritionists claim that this happens because the brain had got used to the food they ate when they were younger, and unfortunately, it is tough to train the brain effectively at that age. The changes of the digestive system, specifically, decrease of gustatory leads to reducing satisfaction after eating food, which makes people consume less, accordingly it decreases energy, nutrition intake and causes absence of appetite (European Academy of Nutritional Sciences (EANS), 2004).

There are also clear connections between people's dietary choices, ethnicity, culture, and religion. Ethnicity is a combination of biology, culture, language, religion, different health theories, attitudes, and a variety of environmental contacts. Culture has an impact on one's beliefs, values, norms, and manners (Marin, 1995). As for example of how religion affects one's food choice, in India; a country with a rich history, a wide range of ethnic, where most of the population is made up of Hindus or Muslims, for religious reasons they do not eat beef, because they are very respectful toward cows since they are considered a motherly giving animal. Additionally, they rarely eat pork, mainly due to filthy perception, pigs are viewed as dirty animal, it can be and is fed on anything. This habit started because of the warm climate,

consumption of pork actually makes the body warm, so it is not suitable for the hot and humid climate in South Asia. The last reason for Indians not to eat pork is non availability in markets (Sen, 2004). In regard to eating habits that were formed owning to ethnic physical traits, one example is milk market in Asia, back in the nineteenth century it was not very promising since many Asian people have few stomachs enzyme, lactase, which resolve lactose. Consequently, this may cause uncomfortable experiences after milk consumption (Atkins & Bowler, 2001). Traditions play a role in people's food choices as well, for example, an ordinary British person would go with turkey, roast potatoes, stuffing, Christmas pudding, and mince pies for Christmas. A Czech person would choose for example carp, potato salad, Christmas bread and Christmas cookies for the festive menu.

According to CNN, experts ranked ten healthiest cuisines and the list is as following: 1. Greek, 2. California Fresh, 3. Vietnamese, 4. Japanese, 5. Indian, 6. Italian, 7. Spanish, 8. Mexican, 9. South American and finally number 10 Thai cuisine (Corapi, 2010).

Aside from all factors mentioned above, researchers realized that socio-economic status (SES) plays one of the most significant roles in the food preferences. Socio-economic status is frequently reflected, characterized by three indicators: occupation, education, and income. Even though these three factors measure the same concept, researchers claim that they cover different aspects of SES. Education is referred to as one of the important indicators, because it is like a foundation for a healthy lifestyle. It has a great impact on preventive lifestyle behavior, it helps people understand necessity of a healthy diet. Furthermore, with deeper knowledge people have better psycho-social and economic skills, additionally are less likely to fall into marketing traps such as false advertising. The main benefit of education in this case is more readily available to instructive information about human health, leading to better understanding in self-awareness, and approaches to improve one's eating regime (Galobardes, Lynch, & Smith, 2007). Occupation is the next indicator of SES, it directly determines one's social class, physical activities, duties, and labor exposures. The work itself and coworkers create an environment that penetrates intensely into a person's food psyche. For example, sportspersons even in their retirement manage to be accustomed to a nutritious well-balanced diet combined with physical activity and follow a healthy standard of living. Moreover, occupation is the main resource of one's income, which are the economic and material resources that influence range of food choices. People with higher income can afford to buy better quality, heterogeneous items, to have a diverse eating plan. With rising salary consumers presumably choose sugar/fat-rich foods, containing more animal protein products - such as meat and dairy; fruit and vegetables

over products consist of a lot of starch (Westhoek, et al., 2016). Families with lower income tend to only have enough money for basic groceries. The effect of SES on dietary patterns reflects strongly on patients with chronic diseases, which are associated with recommended daily nutrient intakes (Konstantinos, Vassilios, & Demosthenes B., 2009).

Among the factors affecting eating habits, food trends and media should be mentioned. Many foods are commercialized, people's choices can sometime be media driven. Food marketing comes in many shapes such as advertising on social medias, on TV, on the radio or product placement in movies, promotional programs (member cards, loyalty points). Unfortunately, the food that are over advertised are often unhealthy (Friedland, 2008). For example, fast food chains McDonald's, KFC, ready-to-eat food is appealing to people, since it is quick, convenient; it is also inexpensive, accessible, and fast food is designed to appeal human's taste buds. Accordingly, soft drinks such as Coca-Cola and Pepsi contain a large amount of sugar and caffeine, which are both addictive and can cause diabetes, kidney failures, if consumed in a long term of time. (Nestle, 2007)

To conclude this chapter, it is safe to say that people's eating habits are a mixture of physiological, socio-economic, and geo-environmental factors. Humans do not only consume food accordingly to their biological needs, in order to live, survive, but they also eat what they were growing up eating. In this regard, one's diet is heavily influenced by consumer knowledge, self-awareness, residence, and work exposure.

3.2 Major Issues within The Food System

Food is the fuel for human existence, the world's population relies on the food system to produce, offer safe and nutritious food every single day. Throughout human settlements urbanization, globalization and increasing wealth as well as population, in the last decades the demand for food has grown rapidly. Unfortunately, according to concept of global food scarcity there is not enough resources to support the world's population. This phenomenon has led to numerous large-scale problems in the food system, it has not only caused damages for the environment but also populace's health. Importantly, many of the problems can be prevented and decreased. This part's main aim is to address, provide information on these matters and initiatively raise concern.

Scarcity is a term pointing out *"the basic fact of life that there exists only a finite amount of human and nonhuman resources which the best technical knowledge is capable of using to produce only limited maximum amounts of each economic good."* (Samuelson, 1980)

3.2.1 Environmental Impacts

There are five main activities of current food system: agricultural production, processing and packaging, distribution and marketing, consumption, and waste. Every phase of the food system has its own association with the environment and leave environmental footprints. Many of the practices are fundamentally associated with the usage of natural resources in food systems. Mostly the major environmental concerns of the global food system are correlated hands in hands, and one often has an effect on another (Baldwin, 2015).

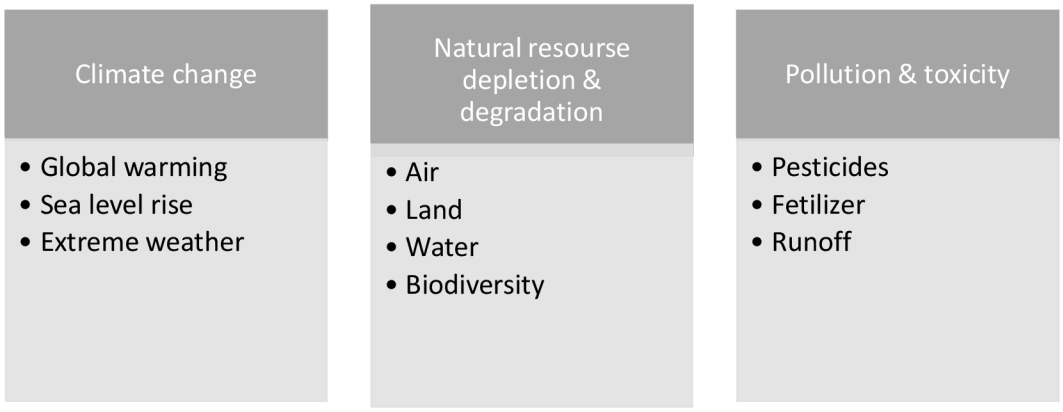


Figure 2 Global environmental problems caused by the food system – Source: (Baldwin, 2015)

Climate change

Definition

Climate change is a term determines the difference in the statistical properties of the climate system that has endured for a few decades or more, which means somewhat over thirty years. These statistical properties essentially consist of averages, variability, and extremes. Climate change can be caused by natural processes, for example changes in the Sun's radiation, volcanoes or large-scale changes in weather patterns, and human effects the accumulation of the derived emissions of greenhouse gases, including carbon dioxide, methane, nitrous oxide, and others; they occur during all food system activities, mostly under the formulation CO_2 (Earth Science Communications Team, 2021).

The effects of climate change

Scientists predict that atmospheric temperatures will keep getting higher in the incoming decades because of greenhouse gases, heat-trapping gases induced by human activities (Earth Science Communications Team, 2021). In this way, the Artic Ocean is estimated to turn out to be ice-free before mid-century. For the economy, extreme weather events, rising sea levels, and higher heats will destroy properties, disrupt supply chain operations and other infrastructure. People's health and productivity will also be affected. In addition, they will negatively affect agriculture, forestry, fisheries, and tourism. With electricity generation becoming less reliable and water supplies becoming scarcer, the demand for energy will rise (Luber & Lemery, 2015). These impacts directly affect human's life, it is account for increasing hunger and water crises, especially in developing countries. Not just number of heat-related deaths will rise but also the spread of pests and pathogens, which cause insect-borne and water-borne diseases, will increase in intensity. The shifts of temperature can change growing seasons, locations, and level of nutrients such as zinc, iron of crops, thereby this fact will affect food supplies and raise its cost (Baldwin, 2015). Flood can wash away fields and livestock. As for tourism, winter activities such as skiing can be decimated because of lack of snow and ice. (Martinich & Crimmins, 2019)

How does food system influence climate change?

The major of food activities (both preproduction and postproduction) such as fertilizing, animal feeding, processing, packaging, distribution, storing and retail, contributes to climate change. Furthermore, food waste, a common action at all phases of the food chain, adds to the crisis as well. According to many researchers about 23,4% of food is vanished in supply chain and food wastage means wasting the resources that were utilized. Mainly in poor countries, food loss is caused during storage, transport, and processing stages. On the other hand, in rich countries, food losses happen at the retail and consumer stages (Agrawal, Future of Food: Exploring Challenges to Global Food Systems, 2021). Between 21% - 37% of total anthropogenic greenhouse gas emissions in the period of time 2007-2016 were induced from agriculture, forestry, and other land uses (Agrawal, Future of Food: Exploring Challenges to Global Food Systems, 2021). This is caused by a growing number of livestock animals and nitrous oxide from excessive fertilizer use. Without any changes, innovations, or improvements, by 2050 the greenhouse gas emissions produced by agriculture are expected to rise by 58% (Arcipowska, Mangan, Lyu, & Waite, 2019).

Solutions

However, food can also be a one of the resolutions for the climate change. Firstly, food production methods have to adjust to the climate challenges. And food policy must take the crisis into consideration. Number of analyses recommend that diversification of the food system by forming integrated farming systems and comprehensive hereditary resources may lower consequences from climate crisis. Healthy plant-based diets can also help to reduce greenhouse gas emissions (Food Systems and Global Change, 2020).

Natural resources depletion and degradation

Definition

Natural resource depletion is a term occurs when resources are being used/consumed more rapidly than they are able to replenish themselves. This phenomenon is caused by overpopulation; poor farming practices; overconsumption and waste; logging and the destruction of ecosystems; mining of minerals and oil; technological and industrial development; erosion; pollution and contamination of resources (The World Counts, 2021). A resource is referred to as natural when they exist without human impacts, it can either be renewable or not renewable. Over 60% of environment services are being depleted and degraded (United Nations Development Programme, 2005). The natural resources that are in decline include (The World Counts, 2021):

- Water – despite the fact that the Earth is 70% out of water only 2,5% is fresh water, but most part is in the form of ice or permanent snow cover. Thereby only a small amount is usable. The Food and Agriculture Organization of the US predict that by 2025, 1.8 billion people will lack clean water.
- Coal – is one of the non-renewable energy resources. Several studies show that there is about 170 years left till this natural source of energy decline, if the rate of mining coal rise, the timeframe will drop.
- Oil – is the key resource for transport sector. By 2010 the BP Statistical Review of World Energy appraises that there is only about 190 million tons of oil left in the established oil reserve. In case global demand continues to increase, the source will only be sufficient for the next 50 years.
- Natural gas – In 2010, experts predict that with current speed of use, there is only reserve of natural gas enough for the next 60 years.

- Fish – Many fishermen noted a drop in their catch. Overfishing is a huge problem, species for instance tuna is close to the line of extinction.
- Phosphorous – its main usage is for plants fertilization. It is obtained from phosphorous rock and guano. Phosphorous's peak is expected to be attained by 2030.

Effects of natural resources depletion and degradation

Recently the agricultural production is waning, and factor efficiency is diminishing because of degradation of natural resources. Resource depletion drastically lowers air quality, and this is a consequence of harmful gases, that are produced from industrial activities and deforestation, which increase natural oxygen producers – trees (Andreas, 2020). As a result of logging and pollution, water shortage plays an important role in increasing famine and food insecurity. Depletion of oil would lead to inadequate businesses, living costs and failure in global transportation. Additionally, deforestation contributes to the increase of greenhouse gases, it also leads to soil erosion and loss of biodiversity. Recession of some minerals such as phosphorus, gasoline, copper, and zinc can be devastating, especially for agriculture, since phosphorus is a mainstream mineral used for plant growth. Furthermore, biodiversity loss is getting more intensive, a lot of species are on the verge of extinction, this is mainly caused by overfishing, logging, and pollution (Rinkesh, 2021).

Impacts of food systems on natural resources depletion and degradation

Food system has significant impacts on natural resources depletion and degradation, by using array of species of animals, marine creatures for food production, demolishing diverse habitats for instance prairie and rainforest for agriculture practices. With current speed of species losses (21-40% of total amount), plant growth will be reduced between 5-10% (Baldwin, 2015). Biodiversity contributes to reduction of climate change, additionally global warming, therefore its loss will be overwhelming.

Solutions

"All our efforts to defeat poverty and pursue sustainable development will be in vain if environmental degradation and natural resource depletion continue unabated." – Kofi Annan

Intended for the issue of depletion of natural resources there are solutions involving reducing deforestation, educate about current situation, long-term risks, encourage the public to conserve

forests and behave efficiently. The education should raise awareness of people as well, emphasize how their daily routines affect the world that they are living in. Cutting down oil, mineral, and material utilization. People and manufactures should be educated on lean consumption/manufacturing, which is matter of recycling, re-using, and reducing wastage techniques. Amount of plastic should be reduced; people can switch from automobiles to public transportation or bicycles. Since humanity is using up many natural resources and many of them are non-renewable, shifting to renewable resources such as solar and wind power is essential. This action will help to reduce environmental pollution, climate change and destruction of natural habitats. Next is protection of freshwater resources, for example wetlands, which are filled with groundwater. This will help maintain the water sources and also aid in controlling marine overfishing and protect coral reefs (Rinkesh, 2021).

Pollution & toxicity

Definition

Environmental pollution is being the biggest crisis that the world is confronting. There are 4 main types of pollutions:

- Air pollution: its sources include burning of fossil fuels for transportation and electricity, the fumes form car exhausts, heavy use of fertilizer, ammonia from agricultural production. The toxic gases like pesticides, herbicides, fungicides, hydrocarbons, nitrogen oxides, and carbon monoxide move up into the atmosphere, then combine with other atmospheric gases generating even more toxic gases (Ecavo, 2021).
- Water pollution: this is the result of fuel, oil or chemical spills, wastewater going straight to watercourses or water drains not to foul water drains, excess of fertilizers and pesticides; excessive usage of water (NetRegs, 2021).
- Land and soil pollution: the leading reasons behind land and soil pollution are a chain of human activities, they lower the quality of Earth's surface both directly and indirectly. For example, deforestation and soil erosion; agricultural activities; mining events; overloaded landfills; industrialization; urbanization; manufactures; nuclear waste; sewage treatment and littering (Kukreja, 2021).
- Noise and light pollution: noise pollution is caused by machines, transport, loud music, construction, wind turbines and broadcast systems (Senate Public Works Committee. Noise Pollution and Abatement, 1972). Light pollution is impacted by industrial civilization, for instance exterior and interior lighting, electronic billboards, outdoor area lighting, offices, industrial units, streetlights, and lit up sport arenas (Khan, 2017).

To date the usage of materials that are toxic to humans, animals, and the environment is very common. These toxicities are made in the process of packaging, agricultural inputs (fertilizer, pesticides, herbicides), fuels, and cleaning products. Pollution and toxicity do not just effect humans, animals, and the environment in short-term but also in the long run.

Damages of pollution and toxicity

"The World Health Organization, in conjunction with the World Bank, estimates that 20% of deaths in the developing world are attributable to environmental factors from pollution." (Blacksmith Institute, 2014)

Pollution comes in shape of dust, smog, and toxic gas emissions. There are several areas that toxins come into contact with the most. Firstly, as for health, being exposed to pollutants increases risk of weakening immune system and causes illness such as cancer, intellectual disability, organ destruction, heart diseases, inflammation of the eyes, respiratory complications (pneumonia, asthma, influenza), diarrhea and vomiting. In addition, noise and light pollution evoke mental health issues such as stress, anxiety, sleeping problems, hearing difficulties and bad temper (Kukreja, 2021). As reported by the Centre for Research on Energy and Clean Air, disability from chronic diseases cost the world's economy $200 billion in 2018, with sick leave and preterm births costing $100 billion and $90 billion. Additionally, health problems cost workdays and lower productivity. Pollution is predicted to cost the world $2.9 trillion, which is 3.3% of its GDP. It also enlarges the gap between rich and poor countries (Myllyvirta, 2020). From education and economic development point of view, since toxic pollution can trigger intellectual disability, mental retardation, which means one's ability to learn and function is reduced (U.S. Department of Health & Human Services, 2019). This fact lowers world's population average IQ level and becomes an obstacle for economic growth of a nation and world-wide. Besides, being destructive to human's wellbeing, toxic pollution also impairs, destroys wildlife and food crops, which leads to food shortages (Blacksmith Institute, 2014).

Food system's impacts on pollution

Concerning the effects that the food system has on pollution, it significantly influences air pollution, land and soil pollution and water pollution. Regarding to air pollution, agriculture production is one of the main resources of air emissions, which consists of odorous, emit methane, ammonia, aerosols, greenhouse gases, and poisonous hydrogen sulfide. These gases are mainly produced by livestock over their burping, flatulence, and waste. Next is farming crops, which causes harms to air contamination by soil plowing and tilling, these activities

produce carbon into the air (US Environmental Protection Agency, 2015). Along with air health, the food production also affects soil, the base for most kinds of agriculture. In agriculture there are many practices that cause negative consequences for the soil. For example, monocropping – growing the same crop on the same land repeatedly, causes soil erosion; synthetic fertilizers reduce soil's microbiological diversity; pesticide accumulation, factory farm waste contaminates the soil (Herring, 2010). Agricultural events that initiate water contamination consist of inadequately situated animal feeding processes; plowing overfrequently, bad timing; and incorrect, or badly planned application of pesticides, irrigation water, and fertilizer. Pollutants that from farming and ranching are sediment, nutrients, pathogens, pesticides, metals, and salts (U.S. Environmental Protection Agency, 2005).

Solutions

Even though it is hard to believe, almost every toxic pollution is finite and reparable. First and foremost a noteworthy fact is absence of funding and mechanical know-how in number of communities.

Legacy pollutants, which are used or produced by industry can be cleared out, and active pollutants can be controlled by means of a combination of regulation, community education, and application of complementary and up-to-date technologies. Focusing on reduction of toxic pollution in the developing countries will decrease poverty, maternal and infant deaths, illiteracy, and so on.

3.2.2 Socioeconomic Impacts

Over the past few decades, economic globalization has intensified the relationship between economy and ecology. Along with numerous negative economic consequences come many social problems that are related to food. Unfortunately, due to industrialization and commercialization the food industry has shifted from fresh local to processed convenience food. The main reasons behind are higher profit for suppliers, as for consumers fast-food saves them a lot of time and money (Lewis, 2021). Importantly, producers manage to make harmful substances, such as artificial trans fats, polycyclic aromatic hydrocarbons, added sugars, etc., tastes good or even addictive. Especially, the food turns out to be a lot cheaper than fresh produce. Unfortunately, sellers are letting investors' return on investment decide what people eat. Thanks to that processed fast food chains, such as Mc Donald's, KFC, Burger King, and

soft drinks brands including Coca-Cola, Nestlé and Pepsi are well advertised. (Bragg, Pageot, Amico, & al., 2020) This trend does not only adversely affect human's health, but it also causes issues of fair pay for farmers. Since the food industry is shifting from farms to factories, farmers do not have a competitive wage. Because of that there is lack of farmers, which increase the price of fresh food, since barely anyone wants to make them. This truth leads to one more factor that pushes consumers away from healthy local food, as they are used to cheap industrial productions. (Lewis, 2021)

Food Security and Food Insecurity

Firstly, food security is a term that was identified by the World Bank in 1986 as *"access by all people at all times to the food needed for a healthy and active life*." (Atkins & Bowler, 2001) According to Food and Agriculture Organization (FAO), there are four pillars of food security, including availability, access, utilization, and stability. Availability is connected with the supply of food, concretely manufacture, distribution, and trading. Next access refers to affordability, allocation of food, at the same time preferences of consumers. Utilization is about the amount of required food to fulfill one's physiological needs in every household (Gregory, Ingram, & Brklacich, 2005). The concept of food security is closely interrelated to food safety because its main goal is not only to assure adequate food accessibility for everyone but also food that is safe from every aspect (chemical, physical or biological) for consumers (Hanning, O'Bryan, Crandall, & Ricke, 2012).

The elements, that heavily influent world's food security, are population growth, fossil fuel dependence, homogeneity in the global food supply, price setting, land use change, global catastrophic risks, and loss of biodiversity.

On the other hand, an important social phenomenon that needs to be addressed is food insecurity. According to Food Bank Association of Iowa, it costs the global economy about $167.5 billion due to illness, lower earnings, and charitable contributions that are linked to food insecurity (Gorkow, 2012). It is signs of poverty and income inequality. Food insecurity is inversely related to food security and responsible for population vulnerability such as hunger and famine. These concepts indicate the results of non-availability of food (Ayalew, 2013). Hunger is connected to poverty, if it plagues mankind for longer period of time, then it turns into famine. The State of Food Security Nutrition in the World 2021 report, which focuses on the consequences of Corona virus, including decreased food intake and increased malnutrition. It says that even without effects of the COVID-19 pandemic, the world was not exactly on a

good road to defeat hunger. At the present, about 690 million people – 8.9% of the world population; are impacted by food insecurity. In 2019, roughly 150 million children in the age range from 0 to 4 were influenced by stunting, 75% of them live in Southern Asia and Africa. Other 47 million of them were impacted by food wasting, or acute undernutrition (United Nations, 2019). Back in time, issues of supply were considered the root of food insecurity. However, this problem goes beyond food production, in fact all of the 4 pillars of food security have its limitations. As a matter of fact, there is enough food to feed everyone adequately. The problem is firstly availability, which is limited partly due to natural resources depletion. Then food accessibility, which is strongly influenced by household income and price of food. Next is stability, it is about assuring consistent supply of food to everyone. Lastly, utilization that controls quantity and quality of food that goes to every family. Since the food is not divided fairly among people, there comes food surplus following by food waste and food loss.

Each year 1.3 billion tons of food are lost are wasted globally; this amount is enough to feed 1.9 billion people that are affected by food insecurity (WWF, 2021). Food lost includes food that was spilled or spoilt before it was consumed (Westhoek, Ingram, van Berkum, Ozay, & Hajer, 2016). Food waste is a particular type of food loss, which the US Department of Agriculture's (USDA) Economic Research Service (ERS), describes as "*food discarded by retailers due to color or appearance and plate waste by consumers*." Food waste is for example the unfinished meal, food scraps from cooking, moreover it can be observed at any stage of the food chain. Almost 14% of food is lost in supply chain (Agrawal, Future of Food: Exploring Challenges to Global Food Systems, 2021). The phenomenon causes wastage of energy, increase amount of waste, it also creates harmful toxins such as methane. It is responsible for the usage of 25% of fresh water and it is also one of the main reasons of water pollution (Food Print, 2021). According to FAO, food waste costs the world about $940 billion annually.

Obesity

Obesity is a medical condition, during which the amount of body fat reaches over 20% more than ideal body weight. It can have negative effects on human health. In fact, obesity has grown three times more since 1975, which is over 1.9 billion adults that are overweight including 650 mil. that are obese (WHO, 2021). There are several causes behind obesity, for example eating disorder, genetic, diet, imbalance between intake of food and physical activities, and other health conditions (Pollack, 2013). Surprisingly, it can also be linked with food insecurity, it is said that the connection is due to high-calorie and unhealthy food consumed by people affected

by food insecurity, in other words, lack of knowledge about healthy diet and access to healthy food (Emily J. Dhurandhar, 2016). Obesity has numbers of health consequences, such as clogging of arteries, heart diseases, diabetes, musculoskeletal disorders, or even cancer. Luckily, it is preventable. From consumers' side, they should reduce amount of intake food and try to balance it with physical activities, have a healthier lifestyle and better diets. The food industry also can reduce obesity by cutting down quantity of fat, sugar, and salt in processed food. Guarantee availability of healthy options with a reasonable price. Especially limits for marketing of unhealthy, fast processed food (WHO, 2021).

Furthermore, obesity is also threatening the economy. It reduces productivity, increases employer insurance premiums and lower the wages. This issue costs the global economy about $2 trillion a year, which is about 3% of the global GDP. To date, about $4 billion is used for research to deal with obesity yearly. (Dobbs & Swinburn, 2015)

Solutions

To resolve food insecurity there are plenty of things that need to be done. Starting by reducing food wastage, this action can save a lot of energy, time, natural resources, and also human labor. Then closing the yield gap, because most of the agricultural land is only achieving 50% of its potential. Next the fertilizer should be used more efficiently. Additionally, to tackle obesity and food insecurity it is essential to conquer climate change and encourage biodiversification. Furthermore, trade policies shall improve in order to lower the threat of commercializing and to support fair food allocating.

3.3 Food Sustainability and Alternatives

The main aim of this sub-chapter is to highlight importance of sustainability in the food industry, explain what it is, how a sustainable food system should look like and what needs to be done to achieve it. Furthermore, it introduces initiatives alternatives food.

3.3.1 Sustainable food industry

The food system is promising with many huge potentials for instance to generate renewable energy, closes natural resources loops including water, deliver valuable, competent resources of enhancing economic development. Not just that it also can reduce amount of waste and nourish the population at the same time. Despite all of these abilities current food system is failing hard (Baldwin, 2015). As stated in previous chapter, the food demand is expected to

have a 60% increase by 2025 due to population growth. Accordingly, food industry will certainly have to deal with unprecedented obstacles.

What is sustainability? The most common definition of this phenomenon was stated by - Brundtland commission, formerly the World Commission on Environment and Development: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* (Commision, 1987)

What does sustainability in the ideal food industry look like? A food system that knows how to produce and consume food that will not "hurt" the Earth and to fit people's needs without taking away this capability from following generations. The United Nations set the Sustainable Development Goals (SDGs) in 2015 in order to provide a meaningful outline for further education and supporting purposes for the next 15 years.

Figure 3 Global goals
Resource: https://www.un.org/en/food-systems-summit/sdgs

Sustainable food habits assure businesses and households to put less stress on this planet and the environment. One of the sustainable food industry's goals is to prevent itself from jeopardizing or wasting natural resources. It also reduces the negative impact to climate change. For example, sustainable farming options are in favor of biodiversity, due to smaller group of customers, variety of fruit and vegetables is limited, which conserves the biodiversity of the land and soil. Furthermore, these sustainable farming choices support local businesses and give local community more job opportunities (Lewis, 2021).

Straightforwardly everyone including consumers and food producers have a significant role in sustainable food chain. Consumers can affect the industry with their shopping and diet habits. Because they decide what to buy, how to cook it, they can plan their meal so there is as little waste as possible (Atkins & Bowler, 2001). Wasting food is in fact wasting all the natural resources, time and energy that was spent to produce it. Though consumers' affection alone is not enough, food producers play a bigger role in this system, they should be more responsibility with producing sustainable nourishment. Consequently, it would be so much easier for consumers to be more conscious about their diets when there are not many unhealthy and unsustainable options to pick from. Besides not just production but packaging and working techniques also need to be improved (Baldwin, 2015). Fortunately, nowadays more and more people are becoming conscious about what they consume, what they should not, what is harmful not only for their bodies but also for this planet. That the reason why they tend to choose bio, eco-friendly brands despite the price differences.

Nevertheless, many producers are aware of this and despite that their practices are still far from the label "sustainable", they indicate themselves so in order to manipulate the customers. They violate definition of the term "sustainable", give out disingenuous impression or false claims to attract more buyers, since there is no official legal definition of the word business wise. This business practice is called "Greenwashing" also known as "Green sheen" (Kenton, 2021). These labels can use a psychology trick like make their label green, which makes people feel like the products are environmentally friendly. As the U.S. Federal Trade Commission (FTC) has listed some examples such as: When a package of a product is labeled "recyclable" consumers cannot tell if the product or the package or both are recyclable. For this matter, the FTC supports the community and protect buyers by implementing regulations that were created to guarantee a competitive, fair marketplace. (Netto, Sobral, Ribeiro, & Soares, 2020)

In conclusions, sustainable food industry helps to reduce human race's gas emissions footprint, renew energy, stop deforestation, slow down - hopefully stop the exploitation of natural resources and certain species of animals, plants. It ensures food security for current and the next generations. Even though the food industry is failing in being sustainable, but actions for improvement have been identified (Halliday, 2017). Businesses need to acknowledge about the long-term effects of their practices. Governments should step in and introduce new regulations to direct its citizens and companies into sustainability choices, encourage people to reduce food waste. Nations should change trade policies, in order to reduce the risk of commercializing, promote diversification, enhance existing infrastructural programs. At this time developments

and the rise in new technologies in supply chain is highly needed. For example, IBM Food Trust – blockchain for the world's food supply – used in mapping supply chain provide food producers better overview of their supply chain, which will help them manage it more effectively and thorough (Baldwin, 2015).

3.3.2 Sustainable diets

"Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy, while optimizing natural and human resources." (FAO, 2012)

The approach is the same as sustainable food industry only that in this case consumers are more involved than producers, they are the ones in charge of what they choose to consume. Food diets can be built from little everyday habits such as buying seasonal food from local producers, cut off on meat, plan meals more thoroughly to avoid wasting food. Consumers can also choose green companies with sustainable practices and packaging. (Baldwin, 2015)

Veganism and Vegetarianism

There are some specific food plans to help reduce greenhouse gas emissions, improve natural resources. For example, plant-based diet, which can be in the form of veganism or vegetarianism. *"Fiddes (1991) rather sees meat consumption as having been symbolic of the human domination of nature. The rise of vegetarianism and the decline in particular of red meat sales are related to health issues and animal welfare, but they may also indicate a more fundamental shift in society's relationship with the environment and with the animal world. In that sense we may well be living at one of the key hinge points in the history of human diet and thinking about the acceptable origins of food."* (Atkins & Bowler, 2001, p. 302) Nowadays, plant-based diets are more and more familiar to the world.

In general, both vegans and vegetarians eliminate meat from their diets. Vegetarians exclude flesh foods including any kind of meat, poultry, fish, animal protein, stock, or fats. Besides traditional vegetarianism, there are several other types, such as Lacto-ovo-vegetarian, they still use dairy products and eggs or Pescatarian, they are still vegetarians but consume fish or other kinds of seafood. Then again, vegans are more meticulous, unlike vegetarians they do not consume any foods that were produced involving the slaughter of animals like eggs, dairy

products, and honey (Eske & Butler, 2019). Even though these diets exclude meat and even dairy products, upon which protein, calcium, iron, zinc, iodine, vitamin A, D, and B_{12} are drawn, if they are well-thought-out, they still manage to nourish human bodies adequately at any stage of the life cycle (Dwyer, 2005). As stated by numbers of studies, plant-based diets have some health benefits. For example, plant-based diets lower levels of cholesterol, support better blood pressure and blood flow, get under control blood sugar, decrease oxidative stress and inflammation, or lessen the chance of chronic kidney disease' creation (Eske & Butler, 2019).

According to a University of Oxford's study, besides health benefits, veganism and vegetarianism also produces many economic benefits. The study calculated 3 types of savings in 3 different scenarios (viz. figure 4). Totally plant-based diets can potentially save the world $20 - $30 trillion (Springmann, 2016).

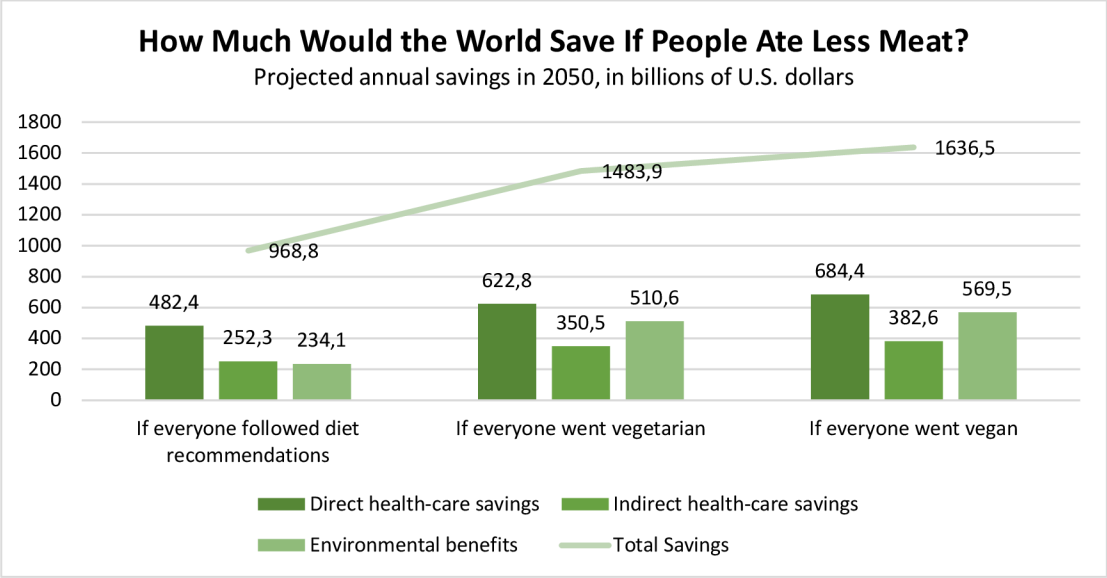


Figure 4 Economic benefits of veganism and vegetarianism (Springmann, 2016)

Mediterranean Diet

This diet was developed by nutritionist Lorenzo Piroddi in 1939. A Mediterranean diet constitutes different skills, understanding and practices of the traditional healthy lifestyle of people from states neighboring the Mediterranean Sea, including France, Greece, Italy, and Spain (Barbara Burlingame, 2012). The Mediterranean diet is defined by dietary habits that has endured for a long period of time. The diet is basically high in fresh or dried fruit and vegetables, legumes, nuts, beans, cereals, olive oil, a reasonable consumption of fish, lower intake of dairy products, saturated fat and meat, and plenty of condiments and seasonings, all complemented

by wine or infusions (HealthUnlocked, 2020). In 2021, Mediterranean diet has won the award of the best diet overall of the year by US News & World Report for the fourth time in a row.

Economically, this diet makes life more quality and increases expenses linked with cardiovascular disease. For example, in Canada and the United Stated alone savings were estimated to be around $34 billion yearly (Springmann, 2016).

Simplified Diet

Though it is not necessary to turn around one's casual diet, it all can start by cutting off high in fat, carbohydrates, and nutrition-poor processed foods. All it takes is to simplify one's diet, "*A minimalist diet is a simplified approach to cooking meals where you balance nutritional needs, ease of preparing, and optimizing your ingredients to have as few as possible while still being able to cook a variety of meals that you love*" stated Ryan Mitchell on October 31,2018 in his article about Minimalism & Diet (Mitchell, 2018). Furthermore, to bring food bio-diversification to the plate, the world should make full use of more varieties of food. The aim is to reduce overconsumption of certain types of food, which are referred to as food staples. According to National Geographic Society organization, a food is considered staple when it is prevailing in a given person's consumption regime, nearly irreplaceable. It can be consumed practically on a daily basis and provides a large segment of one's energy and nutrition intake (Dunn, 1989). Typical staple foods are for example, meat (beef, chicken, pork), fish (salmon, tuna), dairy products (milk, cheese), eggs, tubers (potatoes, cassava, yams, or taros), etc (Su, He, & Sun, 2017). Most of the food staples is exploited. As reported by researchers, there are over 50,000 edible plants in the world, but just 15 of them provide 90% of the population's food consumption. Up to 75% of these are rice, corn, and wheat.

The fact that only 0,03% of potential food resources is being used points out that a huge percentage of the diverse foods presented have been ignored as vocational alternatives to create new food staples to focus on global food security and diminish hunger. Besides some alternatives can have also contribute to solve foodborne illness, obesity, and malnutrition. (Mitchell, 2018). In 2018, the economic burden associated with foodborne diseases alone was $90 billion. On the other hand, by creating a circular economy for food (consumption of local food, decrease food waste, quality food composting), countries can make $2,7 trillion annually by 2050 (Scharff, 2020).

3.3.3 Alternatives to current food staples

As mentioned in previous section, it is necessary to expand the food selection, shifting to more eco and health friendly choices. Therefore, the main aim of this sub-chapter is to introduce several functional food ingredients as alternatives to current food staples such as meat and fish.

Seaweeds

Edible seaweeds, also known as Algae, are almost inexhaustible resources for supply of antioxidants, resolvable nutritional fibers, proteins, minerals, vitamins, phytochemicals, and polyunsaturated fatty acids. Despite the fact that in the western culture seaweeds were simply used as gelling and thickening ingredients within the food, in Asia they have been harvested for culinary or medicinal productions for centuries. In the present, many studies have confirmed their medicinal qualities. Seaweeds are believed to have preventive and healing qualities against degenerative disease. It is also helps fight obesity, inflammation, allergy, tumors, or cancers. Furthermore, it has protective, regenerative properties for organs as well, such as liver, kidneys, or lungs (Mohamed, 2012).

Microalgae are miniature protein-rich organisms discovered in fresh and seawater. They typically include important amino acids, necessary fatty acids, as well as omega-3, omega-6 along with omega-7, as well as vitamins, for instance A, D and E. The nutritional content varies depending on the type of microalgae, but two currently dominate the marketplace for human consumption. The first might be a bunch of species (known as a “genus”) called Chlorella. The second is that the genus Arthrospira, more commonly cited as “Spirulina” (Beall, 2020).

To date, seaweed has created a multi-billion-dollar industry worldwide and it is still growing. Seaweed farming is considered to be sustainable because it improves water quality by absorbing impurities. In contrast to land farming, it does not require, water, feed, or fertilizer, which is not only environmental-friendly but also economic. (Duarte & al., 2017)

There are 7 popular types of algae, including Wakame, Kombu, Nori, Dulse, Hijiki, Irish moss, and Sea lettuce.

Figure 5 Examples of some types of algae
Source: www.tastecooking.com

Insects

Another worth-mentioning phenomenal that is becoming popular in the Western world is entomophagy – a term describing action of eating insects (College of natural & agricultural sciences, 2019). Insects have beneficial properties for the nature, for instance essential part in plant reproduction, waste biodegradation, or natural limitation of damaging pest species. For humans, insects also bring a lot of perks. For example, the most valuable insect products are honey and silk. Besides humans have stimulated insects in some technology and engineering methods. In general, eating insects should be encouraged due to its health, environmental, economic, and social benefits. From the health point of view, bugs are just as alimental as meat (beef, poultry, pork) or even fish, because some of them carry high amount of protein, beneficial fats, high amount of calcium, iron, zinc, vitamin B12, and omega-3s. Furthermore, they are low in carbohydrates. The next benefit of entomophagy is that insect farming is more eco-friendly than traditional cattle farming. To illustrate this fact statistics of cricket and beef production will be used. Cricket harvesting for sustainable protein requires about 2000 times less water, 15 times less land, 12 times less feed, and it produces 100 times less greenhouse gases in comparison to beef production (Sens food, 2020). Not just that insect farming does not involve high-tech, and it does not require high capital for entering the business. Therefore, it would be more accessible for poor inviduals, both as food and work opportunity (FAO, 2013).

Despite all the potential, the global edible insects market is still in the early stages, in 2021 it was estimated to worth around $1 billion and is expected to reach $4.63 billion by 2027. (Meticulous Market Research, 2021)

Currently bugs are consumed by about 2 billion people, they are mostly located in Africa, East Asia, the Pacific, and Australia. For the rest of the world reasons that they do not eat insects can be urbanization – intensive growth of big cities distant people from the nature, more processed food is used (FAO, 2013). Secondly, many people respond to entomophagy with disgust, and this partly can be caused by neophobia – fear of new things (Fritscher, 2021). Or in general, people decline entomophagy because of entomophobia – fear of insects, which can be caused by plenty of reasons, one of them might be the difference of insects' appearance in comparison to a human body (Romm, 2016).

Examples of some popular edible insects: Beetles, Mealworms, Crickets, Locusts, Silkworms, Giant water bugs, Ant eggs which is also called "escamoles" or "Mexican caviar", Termites, Grubs, Grasshoppers, Cicadas, Bamboo worms, Scorpions, etc.

Figure 6 Examples of some edible insects
Source: https://www.thailandunique.com/

4 Results and Discussion

Data Collection and Analysis Based on Survey

The survey (viz. appendix) was created using Google Form and was distributed via social media platforms such as Facebook, Instagram and also email correspondence. The data collection was quantitative. In total, 134 respondents participated in answering it. The survey is completely voluntary, participants could have withdrawn at any point. The questionnaire is also confidential, the answers are only analyzed for author's bachelor thesis. The data was manually entered into Microsoft Excel for graph creation and data analyzing. The results were conducted using Excel Pivot Table and graphs. Collected data was transferred into data for information clarity and transparent for readers.

It is necessary to note that the study has certain limitations, it was conducted with a small group of population, the results might have changed if the size of population was greater.

The survey contains 18 questions. The questions could be divided into 4 sections:

First section, socio-demographic questions that defines the group's structure in terms of gender, age, location, education, occupation status and income.

Second set of questions examine respondents' attitudes toward food sustainability, including factors that motivative or in contrast discourage them from sustainable consumption. Furthermore, the results should show if sustainability has any effect on consumer food choice.

Thirdly, the survey learns about participants' dietary habits if they practice any types of diet.

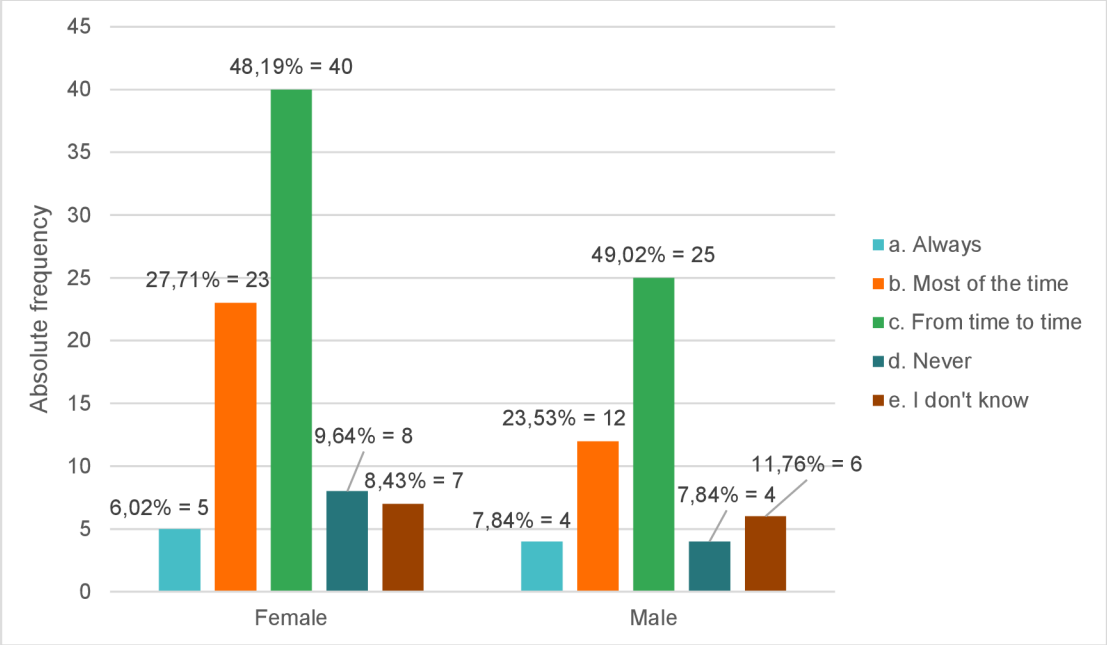
Lastly, data from the questionnaire defines consumers' willingness to add food alternatives to their current diets.

Results and Discussion

Research group consists of 134 respondents. This questionnaire is female predominated with 63,4% (85) versus 36,6% (49) of male respondents. The participants are from the Czech Republic, Denmark, Egypt, Finland, France, Germany, Ghana, India, Iran, Japan, Laos, Poland, Russia, Spain, Thailand, The Netherlands, Turkey, Ukraine, United Arab Emirates, UK, USA, and Vietnam. The vast majority of them live in urban areas – 84% (112) and the rest live in rural areas – 16% (24). People in the age range 20 – 30 are represented the most. Mentioned data will be illustrated with graphs below.

1) Socio-demographic data

The first question of the survey was in order to identify respondents' gender because it is believed that this factor does affect consumers' food choice.



Graph 1 Gender vs Sustainable diet - Source: Author

According to many studies, women are slightly more concerned with sustainability and environmental issues than men (viz. chapter 3.1.3). The total of female respondents is 83 and male is 51. The question that was asked is: Would you say that your diet is sustainable?

Then, the author performs a two-sample proportion test in order to discover if there is a significant difference between the proportion of male and female who practice sustainable diet from time to time.

$$u = \frac{f_1 - f_2}{\sqrt{\frac{\bar{p} \cdot \bar{q}}{n}}};\ \bar{p} = \frac{m_1 + m_2}{n_1 + n_2},\ \bar{q} = 1 - \bar{p}\ ,\ n = \frac{n_1 n_2}{n_1 + n_2}$$

Figure 7 Calculation of the test criterion - Source Khan Academy

α	1 - α	u_α
0,50	0,50	0,6745
0,3174	0,6826	1,00
0,10	0,90	1,6448
0,05	0,95	1,9600
0,0455	0,9545	2,00
0,01	0,99	2,5758
0,0027	0,9973	3,00
0,02	0,98	2,326

Figure 8 Critical values of normal distribution - Source Khan Academy

Thus, it is essential to set a confidence level for the following test and it will be equal to 95%. Hence, the significance level equals 5%. Assuming normal distribution, it is possible to formulate the following hypotheses:

Ho: $\pi 0 = \pi$ ($\pi 0 = 0.38$, where 0.38 is the proportion of men caring) (no difference between genders)

Ha: $\pi 0 \neq \pi$ (there is a significant difference between genders)

A = 0,05

U = 1.25

Ua = 1.96

1.25 < 1.96 => Accept Ho (there is no difference between genders in terms of their practice of sustainable diet).

Based on the outcome of the test, it is possible to conclude that there is no statistical difference between genders.

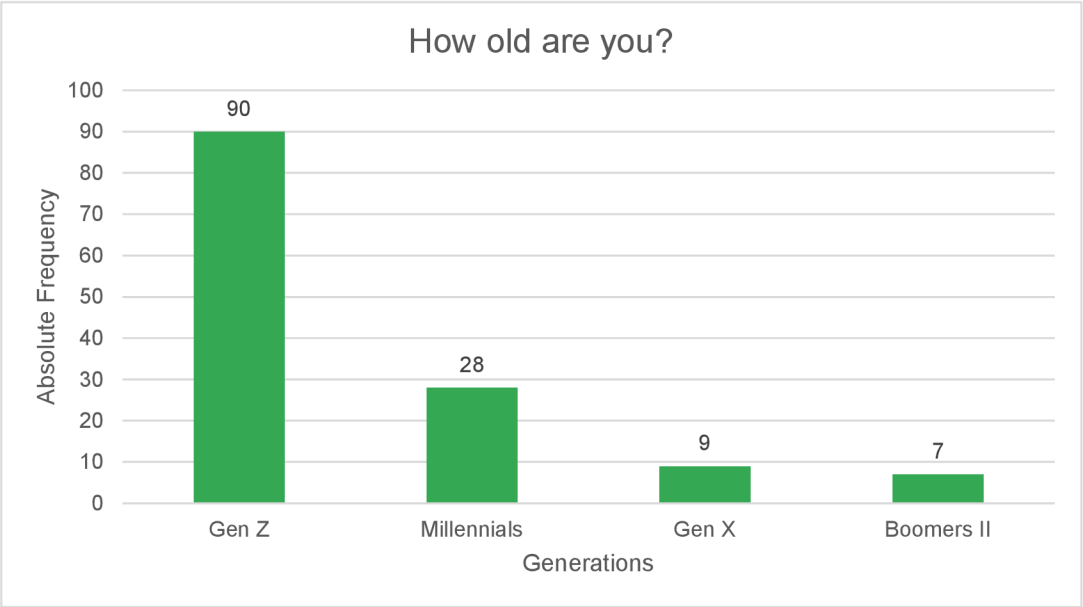
This fact proves that currently, people are aware of the environmental problems., and they try to eat sustainably regardless the gender.

The second and third question was aimed to identify respondents place of residency, in term of country and whether they live in rural or urban areas. In total 21 (16%) of the respondents live on the countryside and 113 (84%) in the cities. All of the countries and absolute frequency will be displayed in the table below.

Place of residency			
	Rural	**Urban**	**Grand Total**
Czech Republic	3	35	38
Denmark	2	4	6
Egypt		2	2
Finland		4	4
France		2	2
Germany	4	12	16
Ghana	2		2
India		2	2
Iran		2	2
Japan		4	4
Laos		2	2
Poland		4	4
Russia		2	2
Spain		2	2
Thailand		2	2
The Netherlands		2	2
Turkey		4	4
Ukraine	6		6
United Arab Emirates		2	2
United Kingdom		2	2
USA		2	2
Vietnam	4	22	26
Grand Total	**21**	**113**	**134**

Table 1 Place of residency - Source: Author

Next, the participants were sort out by age categories. There are 4 generations: Gen Z, Millennials, Gen X and Boomers. Gen Z are people were born from 1997 to 2012. People that were born from 1981 to 1996 are Millennials. Gen X contains people that were born from 1965 to 1980. And Boomers II were born from 1955 to 1964 (Beresford Research, 2022).



Graph 2 Generations - Source: Author.

According to the results. this survey is Gen Z predominated with 90 people (67,2%). There are 28 Millennials (20,9%), 9 Gen X (6,7%) among respondents. And Boomers II are represented by only 7 respondents (5,2%).

Dividing the respondents into young (age range 17 – 39) and older generation (40-65), author runs a two-sample proportion test to discover whether there is a significant difference between the proportion of the younger and older who would definitely add seaweed into their diets.

$$u = \frac{f_1 - f_2}{\sqrt{\frac{\bar{p} \cdot \bar{q}}{n}}};\ \bar{p} = \frac{m_1 + m_2}{n_1 + n_2},\ \bar{q} = 1 - \bar{p}\ ,\ n = \frac{n_1 n_2}{n_1 + n_2}$$

Figure 9 Calculation of the test criterion - Source Khan Academy

It is necessary to set a confidence level for the following test and it will be equal to 95%. Therefore, the significance level equals 5%. Assuming normal distribution, it is possible to formulate the following hypotheses:

Ho: $\pi 0 = \pi$ (no difference between generations)

Ha: $\pi 0 \neq \pi$ (there is a significant difference between 2 generations)

A = 0,05

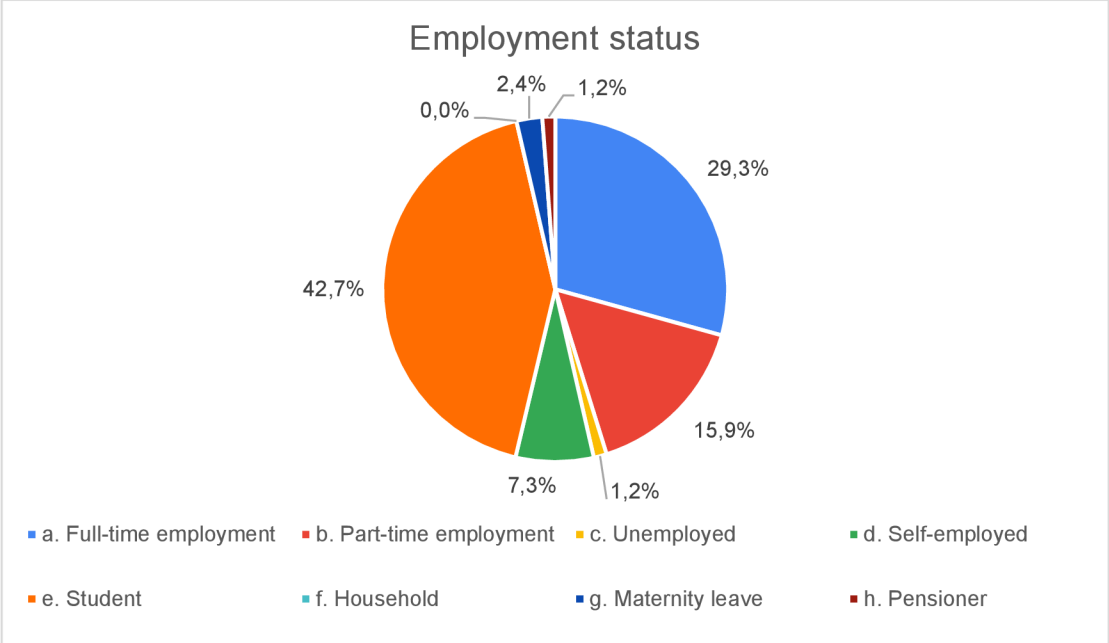
U = 3.6

Ua = 1.96

3.6 > 1.96 => Reject Ho (there is a significant difference between generations in adaptation of new food alternatives).

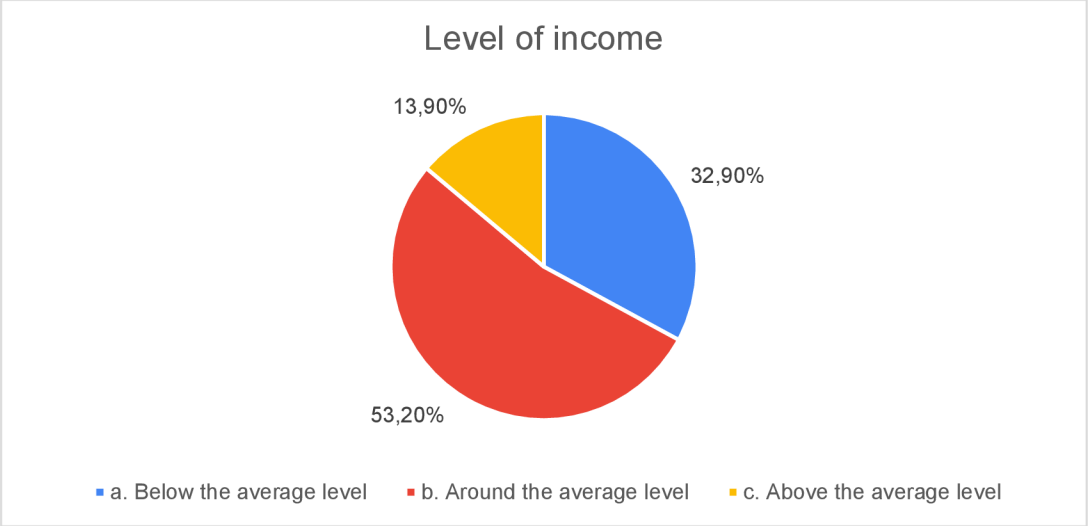
Results of the test reveals that, younger generation is more open-minded toward seaweed, an alternative to food staples. Therefore, there is an age impact in willingness to adapt among chosen respondents.

The following question focuses on occupation status of the respondents. Results revealed that 39 respondents have full-time employment, 21 have part-time job, 2 are unemployed, 10 of them are self-employed, there are 57 students, 3 people on maternity leave and 2 pensioners.



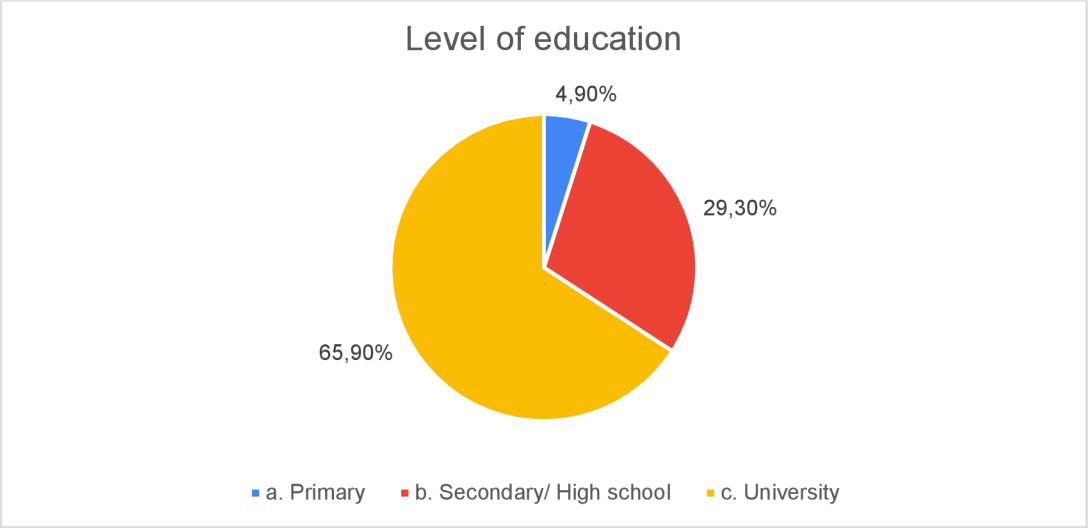
Graph 3 Occupation status - Source Author

The question about income was the only question that was not compulsory to answer and 5 (3,7%) left it blank. Among the rest, there are 42 people that consider their income below the average level, 69 are on the average level and 18 of the are above the average level.



Graph 4 Income - Source Author

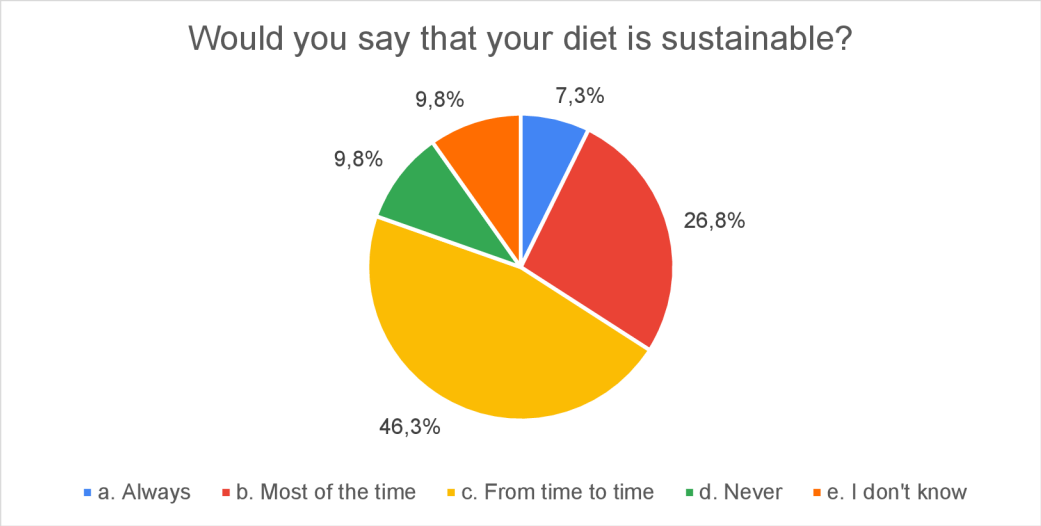
This is followed by an assessment of the respondent's overall level of education. As it can be observed from the graph below, the vast majority has graduated university (88 respondents), 7 of them (4,9%) has primary education and 39 which is 29,3% graduated secondary/ high school. The findings show that this group is an educated one, as it graduated mainly university.



Graph 5 Education - Source Author

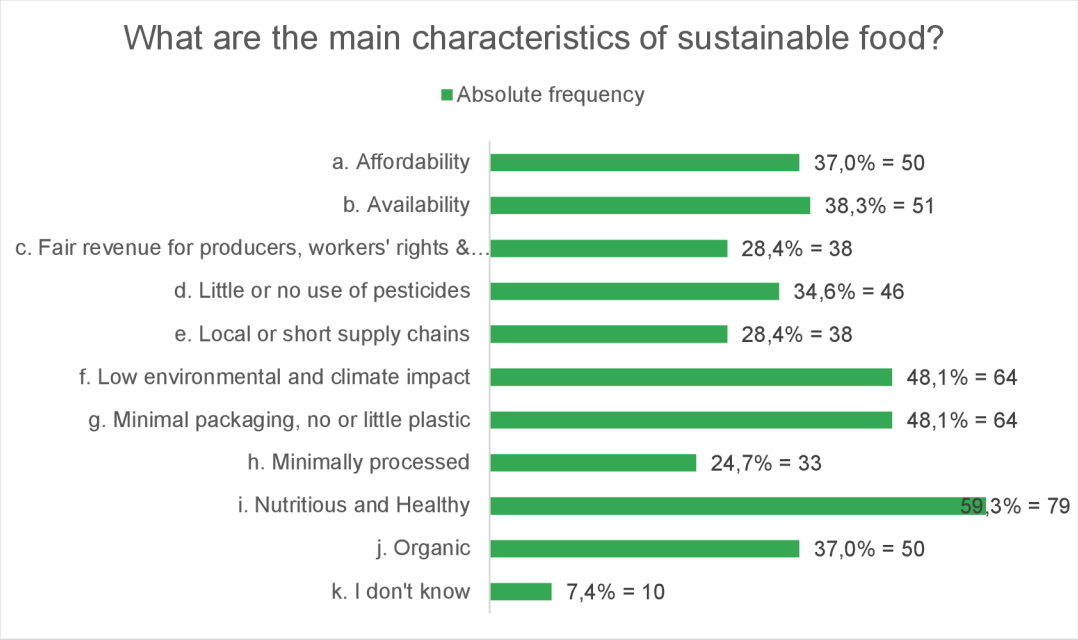
2) Consumers and Sustainable Food

The first question in this section is Would you say that your diet is sustainable?



Graph 6 Sustainable Diet - Source Author

The vast majority - 46.3% of the respondents eat sustainably from time to time, 26,8% most of the time and 7,3% always. This is a positive sign that more and more people are choosing to support more sustainable consumption patterns in their everyday eating habits.

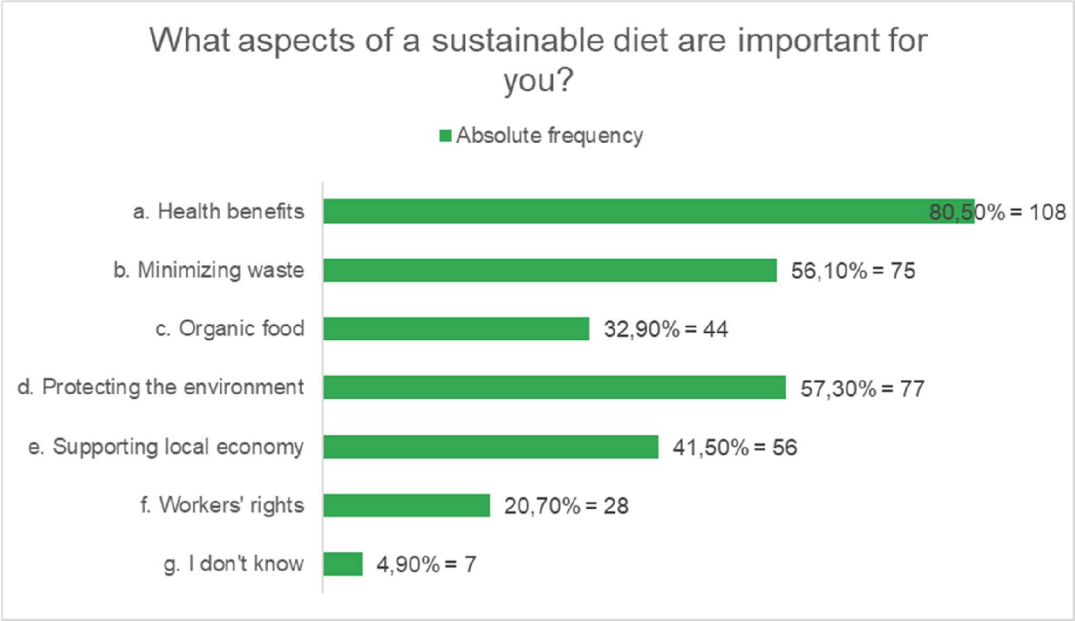


Graph 7 Characteristics of sustainable food – Source Author

The question What are the main characteristics of sustainable food? was asked, in order to explore, whether consumers is familiar with the concept of sustainable food.

Analyzing graph 7, the most mentioned aspects are Nutritious and Healthy with 59,3%, Low environmental and climate impact, and Minimal packaging, no or little plastic, both with 48,1% and only 7,4% went with I don't know. This points out the fact that consumers do not have problems distinguish sustainable food. Despite the fact, the environmental and climate impacts come in second place and the concept of sustainability for consumers is still more self-relevant also known as egoistic motive (Atkins & Bowler, 2001). Sustainability is nonetheless a relevant and growing trend in the food sector.

The following question was What aspects of a sustainable diet are important for you?

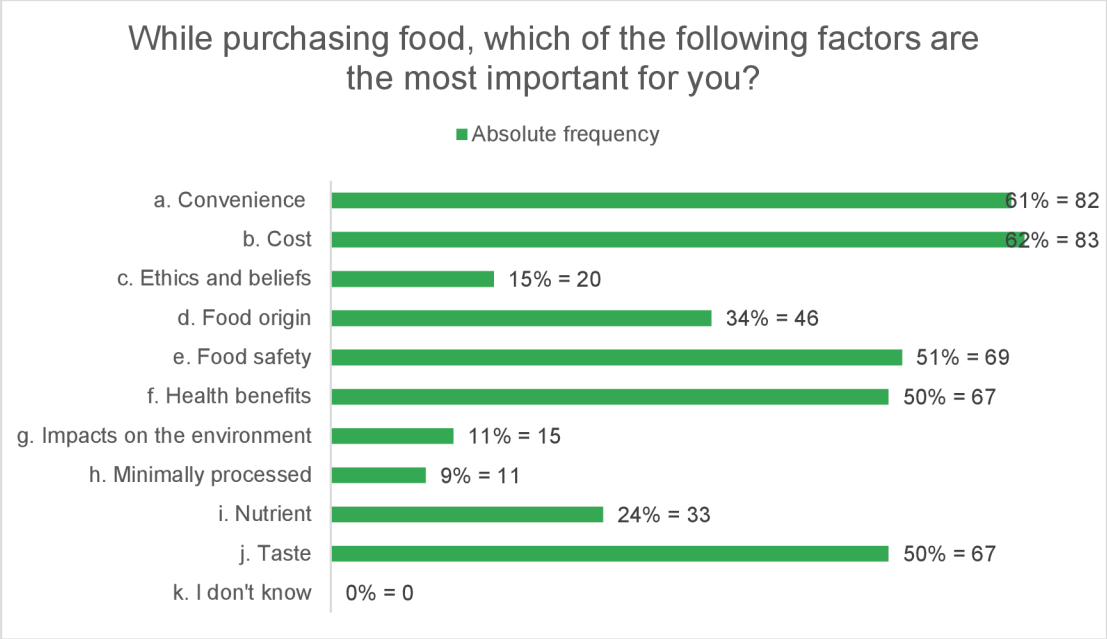


Graph 8 Important aspects of sustainable diet - Source Author

The main purpose of this question is to investigate importance of sustainable diet to consumers, which also reflex their knowledge about the topic.

According to the results, once again health benefits are dominant with 80,5%, following is Environmental impacts with 57,3% and 56,1%. It shows that health mainly motives for sustainable diets; however, other aspects—e.g., supporting the local economy, minimizing waste, paying fair salaries—also play a role.

The next question is While purchasing food, which of the following factors are the most important to you?

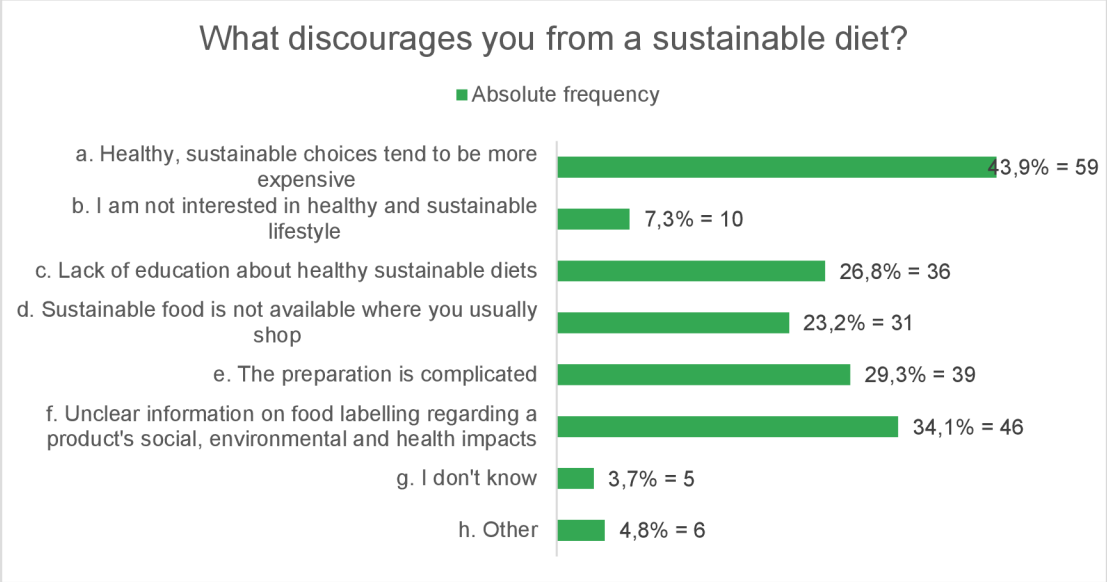


Graph 9 Main factors while food shopping - Source Author

This question examines what drives respondents' food shopping behavior, whether sustainability has any effect on their preference. Understanding what drives your food shopping behavior is crucial to overcoming unsustainable consumption habits.

The most chosen factors are Cost (62%), Convenience (61%), and Food Safety (51%). This time health benefits were not as frequently chosen. The outcomes indicate that a significant majority of the respondents indicated lower prices as the main factor affecting their food shopping behavior. The convenience and ease of access to outlets and products were also seen as important. On the other hand, it seems that environmental or ethical concerns were not particularly important factors when consumers decided what to buy.

The 12th question of the survey was What discourages you from a sustainable diet? This question was asked in order to identify what are the main barriers that prevent consumers from eating sustainably. (viz. graph 10)



Graph 10 Barriers to sustainable diet - Source Author

As the graph illustrates, the main problems that discourage respondents are Cost (43,9%), Unclear information (34,1%), and Complicated preparation (29,3%).

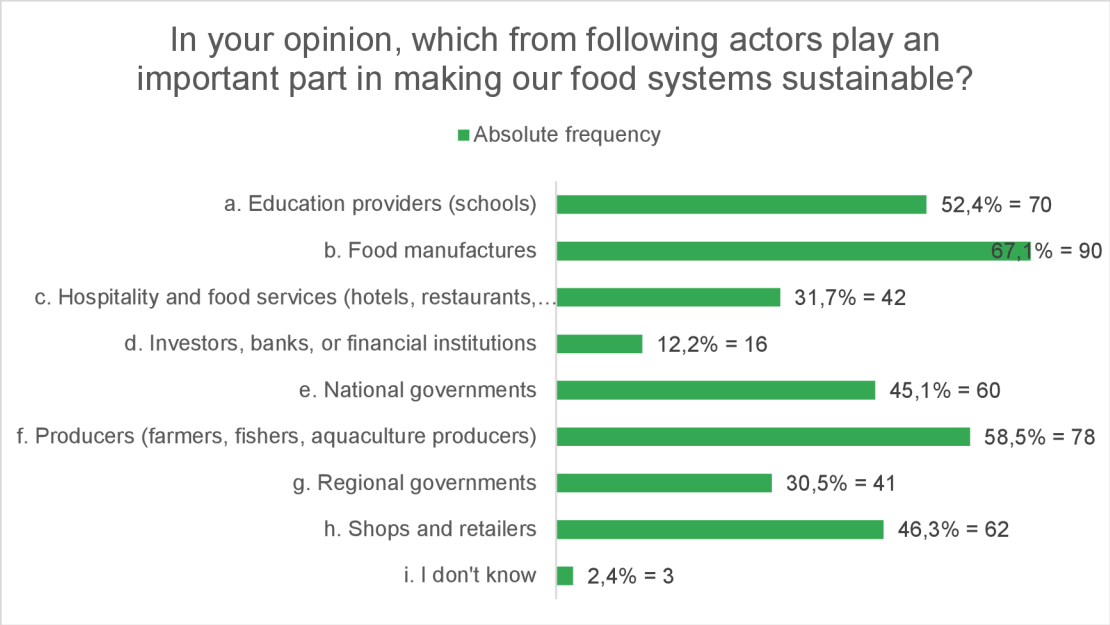
The ranking indicates that, most consumers believe that sustainable food tend to be more expensive. Moreover, the information on the food about its impacts on the environment is not clear enough to convince the consumers. Also, participants have an impression that preparing a sustainable meal is more complicated and time consuming.

The following question What would encourage you to eat more sustainably?

Graph 11 Motivation toward sustainable diet - Source Author

This question is supposed to determine factors that would motivate consumers into eating more sustainable. The questionnaire results show that three characteristics strongly influence willingness of consumers to eat more sustainable are: Affordability with 64%, Less complicated sustainable meals with 54,9%, and Clearer labelling on food with 52,4% are dominating characteristics that would encourage people toward this concept.

The 14th question of the questionnaire focuses on consumers' opinion about important factors that have an impact our food system's sustainability.



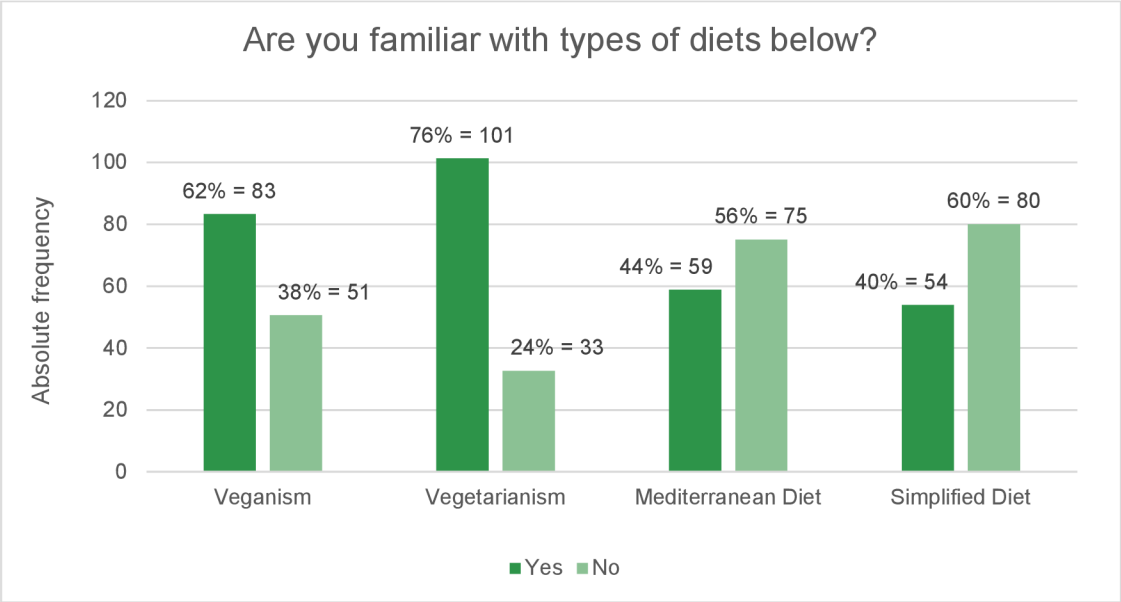
Graph 12 Actors with an impact on food system's sustainability - Source Author

According to the graph, consumers consider food manufactures (67,1%) to be the most important actor, followed by producers, including farmers, fishers, etc. (58,8%) and finally education providing agencies (52,4%).

The food chain and all of its actors have a responsibility to produce the right products and make the information available to the consumer, accordingly, helping them make informed purchasing decisions. Individuals should be given a realistic chance to participate in social or political movements for sustainable consumption.

3) Sustainable Diets

The objectives of this section are diets. Respondents were asked to express whether they are familiar with the listed diets or not. Followed by that is an assessment in form of an open question, where consumers were asked if they practice any of the diets. In case yes, they were asked to tell which one, if no, they were asked to address the reason.



Graph 13 Sustainable diets - Source Author

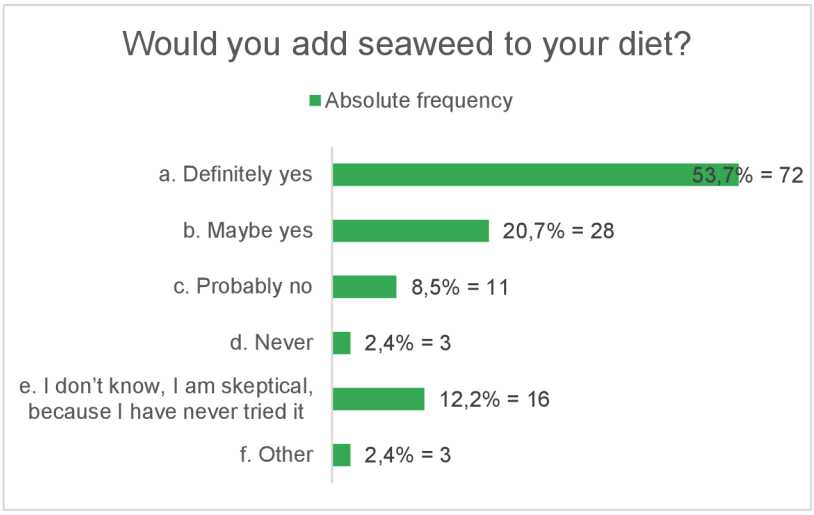
As can be seen in the graph, vegetarianism turns out to be the most well-known diet, veganism is ranked second. Mediterranean and simplified diets are less familiar but still recognized. Additionally, when was the respondents were asked if they have ever tried one of the mentioned diets, 48 (35,8%) answered no and 86 said yes (63,2%).

Conducting the short text answers, the main reasons people refuse to follow these diets are because they do not have any interest, they did not know about them or because they enjoy eating meat too much. Several say that they have not tried but they are interested.

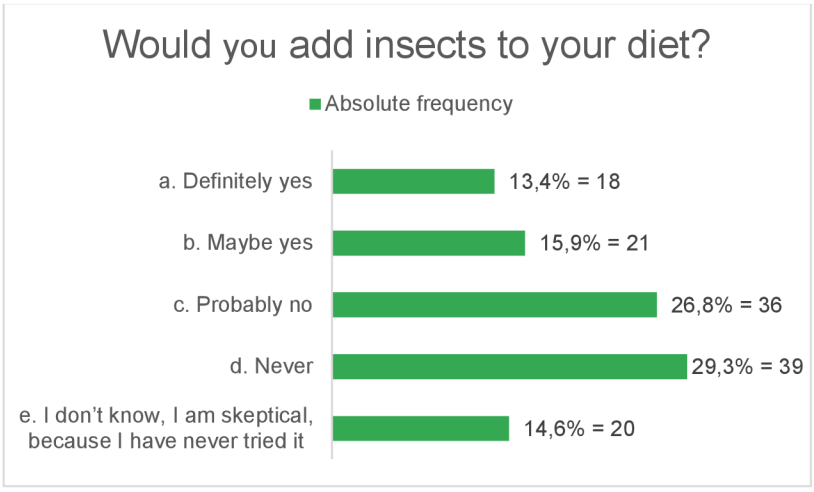
From the group of respondents that said yes, 80% of them are 35 or younger. Many of them follow vegetarianism and several practice veganism, Mediterranean diet, and simplified one. Even though not everyone is following the diets, they say they are cutting down on meat, eating more healthy and balanced meals. Some normally don't pay attention to these concepts, but sometimes when younger family members visit them, they eat vegetarian food together. Which proves that young generations do have impact on the older one on this matter.

4) Behavior Toward Food Alternatives

In the last section, the questions target consumers' attitudes to food alternatives, edible seaweed, and insects. In each question, the health, economic and environmental benefits were explained, so all of the respondents were informed and aware.



Graph 14 Alternative - Seaweed - Source Author



Graph 15 Alternative - Insects - Source Author

The results suggest that seaweed is accepted more among consumers than edible insects. Furthermore, the consumers who have lower levels of anthropocentrism, stronger beliefs in sustainable consumption and stronger beliefs in consumer self-efficacy show higher levels of acceptance towards both novel source of food.

5 Conclusions

Eating foods that are not harmful to the environment are essential for our personal health and the planet's well-being. Consumers can contribute to the environmental management by changing their consumption patterns. Environmental impacts and risks in the food chain are an important driver for behavioral changes and awareness creation. Based on the survey results, it was noted that consumers are aware of sustainable diets, regardless the gender. It was observed that young people are more likely to follow a sustainable diet, and they are more open to alternative foods, such as seaweed and edible insects. The outcomes of this study also provide evidence of a strong willingness to adopt sustainable diets among consumers. Although their intentions are not generalized yet, for many, concept of sustainability is still only aligned with self-serving purposes such as healthy diets.

Nevertheless, the results of the survey suggest that there still are barriers that oppose the promotion of sustainability. For example, optimistic bias, which occurs when people think that they are already doing the right choices. Another challenge is tradeoffs, consumers believe that eating sustainably means scarifying the taste and affordability. This means information still is a major obstacle.

Apparently, the best way to convince consumers that they can eat sustainable, tasty food at an affordable price is to show them that it is possible, and it is happening. This fact once again proves that information is a powerful tool for changes.

The results reveal that consumers are demanding information about the products they consume. They want to be informed more about the environmental impacts of the products they buy and make knowledgeable decisions on sustainability.

In conclusion, in order to improve public awareness about sustainable diets and to promote the trend, there should be more producers and retailers offering a spectrum of sustainable products that meet consumer demands. It is also recommended to have more educational programs about sustainability at schools. Governments should raise taxes for producers of food that threats human's health and the environment. Governments, producers, and manufacturers need to work together with retailers to create an environment that stimulates consumer demand for sustainable food products and helps increase the attractiveness of sustainable food suppliers.

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