

Sustainable food consumption and Nature conservation processes. Educational considerations

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Received: 15 March 2023 | Accepted: 1 June 2023 | Published: 9 June 2023

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Keywords: biodiversity; environmental education; Sustainable Consumption and Production (SCP); sustainable development; sustainable diets.

Abstract. *The topic of an agricultural production that respects natural ecosystems is currently very relevant, as it is being tackled by international agencies such as FAO and IPCC, focusing on the double link between*

biodiversity conservation processes and sustainable agriculture, creating a virtuous circular process. In this context, the adoption of sustainable eating habits, which heavily relies on educational processes, is indispensable. Our contribution describes the relationship between nature conservation and food consumption within a sustainability framework, while also reflecting on the potential impact of educational projects on sustainable food consumption items through a literature analysis. To minimize the impact of food consumption on nature, we propose some considerations on Sustainable Consumption and Production (SCP) environmental education concerning: the potential of SCP nodes in the environmental conceptual education network; the potential of SCP environmental education in the framework of food availability; the pro-environmental behavior research concerning SCP.

1. Introduction

We live in the age of the Anthropocene, a historical phase where our planet is particularly marked by environmental and humanitarian emergencies with broadly anthropogenic origins (Crutzen & Stoemer, 2000). As highlighted by the scientific community, climate changes have caused and are still causing widespread adverse impacts to nature and people, which is why there is an international call for urgent enforcement actions (IPCC, 2022). Even if climate change plays an increasingly important role in the decline of biodiversity¹, its main driver is human use of land primarily for food production: human activity has altered about 70% of ice-free lands. This has had severe consequences for animals and plants, because when land is converted for agriculture, some species may lose their habitat and face extinction (United Nations, 2022).² The

¹ “Biodiversity or biological diversity means the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems”. This is the main definition of “biodiversity”, given by the UN in 1992 in “Convention on Biological Diversity” (UN, 1992; <https://www.cbd.int/convention/>).

² United Nations, Climate Action, 2022. <https://www.un.org/en/climatechange/science/climate-issues/biodiversity>, accessed February 2023.

increasing impact of climate change is also threatening the viability of rural agricultural livelihoods, posing unprecedented challenges and disrupting migration patterns; the World Bank has estimated that climate change could force 216 million people in six world regions to migrate by 2050.³

The environmental system and the anthropic system are inextricably interconnected. The quantity and quality of relationships that support the structures and processes of both indicate the complexity of the natural-human macrosystem. Industrial activities geared toward production supporting human well-being (e.g., the food industry) can paradoxically greatly reduce not only biodiversity but also the very human well-being they strive to achieve. Environmental and social changes can, in fact, result in cascading negative impacts on the production processes themselves. The *Intergovernmental Panel on Climate Change – IPCC (2022)* highlights both the strong interaction between the natural, social and climate systems and the widespread adverse impacts on nature and people of human-induced climate change. The evidence of these negative processes supports the emerging trend in national and international government documents to transition human society towards Sustainable Development.

A commonly accepted definition of Sustainable Development was reported in the World Commission on Environment and Development report (Brundtland, 1987) as “development that ensures that the needs of the present generation are met without compromising the ability of future generations to realize their own needs”. In this paper, we describe the logical links between two central concepts of sustainable development processes: food consumption and nature conservation. We then reflect on the possible impact of educational programs on sustainable food consumption.

2. Sustainable food consumption and production pattern

As reported by Ahmed & Shanks (2019), relevant strategies to achieve Sustainable Development are those supporting sustainable consumption and production of human food. The concept of sustainable diet is addressed and expressed in various ways in the literature (Auestad & Fulgoni, 2015; Steenson & Buttriss, 2020). An inclusive definition was provided by the FAO (2011):

³ Food and Agricultural Organization of the UN (FAO) 2022. <https://www.fao.org/rural-employment/resources/detail/es/c/1599229/>, accessed February 2023.

“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”.

The key components of a sustainable diet are clearly represented in FAO 2012 (Figure 1).

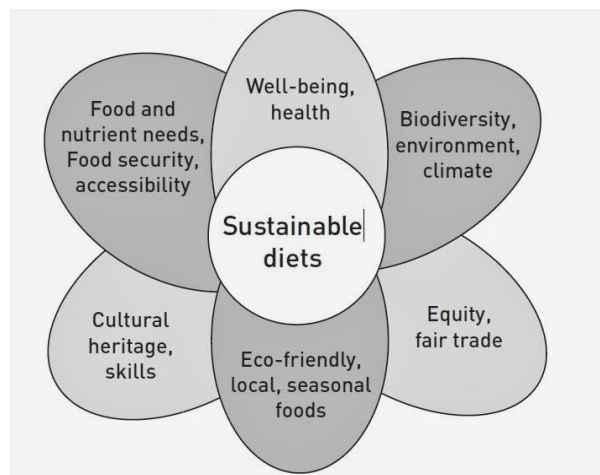


Figure 1. Schematic representation of the key components of a sustainable diet (FAO, 2012).

A preliminary clarification should be made concerning the extremes of the consumption-production relationship. In business terms, the outcome of a production process is the “product”. It represents the *fulcrum* around which all of a company’s activities revolve, including production, research, innovation, marketing, distribution, sales, communication, and promotion (Foglio, 1997). In other words, the product represents the concreteness of the company’s philosophical choice. Sustainable development production strategies could be incorporated into the complex production process *via* proper ecological choices of raw materials, processing procedures and packaging. A product achieves a significant market penetration if it meets the consumer’s needs (Foglio, 1997).

Thus, it is clear why consumer choices are seen as central in strengthening sustainable production.

The patterns of consumption and production were discussed by the United Nations Conference on Environment and Development (Rio de Janeiro, 1992). Chapter 4 of Agenda 21 states: "... the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries ...", claiming that "... sustainable development will require both efficiency in production and changes in consumption patterns; ... in many cases this will require reorientation of existing production and consumption patterns that have developed in industrial societies and are in turn emulated in much of the world." Furthermore, the Rio Declaration on Environment and Development⁴, approved by the United Nations during the UNCED in Rio de Janeiro (1992), established a link between development and sustainable consumption. Principle 8 states: "To achieve sustainable development and a higher quality of life for all peoples, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies" (UNCED, 1993). In the last thirty years, the concern over Sustainable Consumption and Production (SCP) patterns has been acquiring national and international prominence. Many environmental issues, interpreted within a systemic view, have been linked to the SCP, as evidenced by the long series of international conferences related to on-going climate changes and SCP matters (Wang et al., 2019).

A systemic link between SCP and sustainable development issues is clearly detectable in "The Agenda 2030 for Sustainable Development" of the United Nations (2015), an action plan aimed at fostering global sustainable development by 2030. This document, consisting of 17 Sustainable Development Goals (SDGs), focuses attention on SCP, particularly in Goal 12 (*Responsible Consumption and Production - Ensure sustainable consumption and production patterns*), but also in Goal 14 (*Life below water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development*), and in Goal 15 (*Life on land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*).⁵ It should be remembered that 2030 Agenda has become from the very beginning, a milestone tool for

⁴ The *Rio Declaration on environment and development* adopted 27 principles to guide the future development. These principles define the right of people to development, and their responsibilities to safeguard the common environment.

⁵ United Nations, 2015. <https://sdgs.un.org/goals>, accessed February 2023.

international discussions focused on defining problems and resolutions related to the three pillars of sustainable development: environment, society and economy. A valuable contribution to these global efforts has been already given since 2016 by the Group of Twenty (G20)⁶ through adapting the G20's Action Plan to the 2030 Agenda for Sustainable Development, aimed at contributing to the Agenda's goals (OECD & UNDP, 2019). Thus, the increasingly ambitious challenge of being able to meet the food needs of the world's population, which will supposedly reach 9.7 billion people by 2050 (UN, 2017), necessarily requires the implementation of proper strategies to ensure sustainable food security, conservation of natural ecosystems, reduction of food loss and waste.

Food loss and waste are considered huge problems in the SCP framework and many initiatives have been carried out to reduce them (FAO, 2019a; Cattaneo et al., 2021). Already in May 2015, under the Presidency of Turkey, the G20 agriculture ministers highlighted the extent of food loss and waste reduction as “a global problem of enormous economic, environmental and societal significance” and encouraged all G20 members to strengthen their collective efforts to prevent and reduce food loss and waste. The FAO, through a ‘Technical Platform on the Measurement and Reduction of Food Loss and Waste’, assesses this process at a regional and global scale and supports countries in taking action to prevent and reduce the problem.⁷

Over time, SPC has increasingly become a holistic concept, referred to integrated models designed to achieve optimal control of both natural ecosystem limits and all the stages of a product's life cycle, from production to transportation to consumption. This concept is closely related to pressing global issues, such as climate change containment and mitigation, biodiversity preservation, the availability of water as a primary resource, food and nutrition security, and the right to food.

Since SPC refers to a complex Coupled Human-Natural System (HNS),⁸ food production and consumption can be influenced by multiple aspects: availability,

⁶ The Group of Twenty (G20) is the premier forum for international economic cooperation. It plays an important role in shaping and strengthening global architecture and governance on all major international economic issues.
<https://www.g20.org/en/about-g20/>

⁷ <https://www.fao.org/platform-food-loss-waste/en/> accessed April 2023

⁸ For literature concerning systemic vision applied to Coupled Natural-Human Systems see Pickett, et al (2005); for the more commonly used Coupled Human and Natural Systems (CHANS) concept, see Liu et al. 2021

accessibility, and choice of food resources, which in turn are influenced by geography, demographics, income, socio-economic status of the population, urbanization, religion, culture, globalization, and not least consumer attitudes (Kearney, 2010). In this framework, *consumption*, as a component of the coupled SCP conceptual system, has become increasingly important over the years as a driver of production quality within a sustainable vision. This aspect emerged in 1995 when, at the “Oslo Ministerial Roundtable Conference on Sustainable Production and Consumption” the concept of sustainable consumption was defined as: “an umbrella term that brings together a number of key issues, such as meeting needs, enhancing the quality of life, improving resource efficiency, increasing the use of renewable energy sources, minimizing waste, taking a life cycle perspective and taking into account the equity dimension. Integrating these component parts is the central question of how to provide the same or better services to meet the basic requirements of life and the aspirations for improvement for both current and future generations, while continually reducing environmental damage and risks to human health” (Norwegian Ministry of the Environment, 1995).

In recent years, as pointed out in the FAO report (2019b) *The State of the World's Biodiversity for Food and Agriculture*, there has been a growing interest in practices and approaches compatible with biodiversity conservation, although levels of coverage and protection are often still inadequate. Furthermore, the report indicates that 80% of the 91 observed countries use one or more biodiversity-friendly practices and approaches such as organic farming, integrated pest management, conservation agriculture, sustainable soil management, agroecology, sustainable forest management, agroforestry, diversification practices in aquaculture, an ecosystem approach to fisheries and ecosystem restoration. This suggests that a movement towards cultural innovation is now underway.

3. Food biodiversity and public health

In the past few decades, scientific literature has often shown significant evidence of the growing costs of global food diets on natural ecosystems, social systems, and public health (see, for example, Verbeke, 2007). Natural ecosystems provide the human population with numerous resources and services, with food playing a very important role. The term *Biodiversity for Food and Agriculture* has been used by the FAO (2019b) to refer to plants and animals (wild and domestic), and microorganisms that provide direct benefits to human beings such as agriculture products, livestock, animal feed, fuel, fiber, as well as indirect benefits through the processes supporting food production, thanks to the myriad of organisms

called “associated biodiversity”. Examples of “associated biodiversity” include pollinators, predators of crop pests, the vegetation of hedgerows and field margins, and the invertebrates and microorganisms that help maintain soil and its fertility. Plants, animals, and microorganisms also provide other invaluable services to human beings, such as soil fertilization, air and water purification, and crops and livestock pest and disease control.

The dependence of human beings on nature is of course clearly visible in the area of food production. The growing concern around the loss of agro-biodiversity has fueled global efforts to improve conservation actions through a number of international documents and agreements. The Convention on Biological Diversity (CBD 1992) aimed at halting the loss of plant and crop diversity. The 2002 Global Strategy for Plant Conservation (GSPC) already required the conservation of at least “70% of the genetic diversity of crops and other major socioeconomically valuable plant species” (Galluzzi et al., 2010). Instead, our diet is currently based on a limited number of species, which has profound effects on the same species and the ecosystems. In this respect, the FAO highlighted that “While more than 6000 plant species have been cultivated for food, fewer than 200 make substantial contributions to global food output, with only nine accounting for 66 percent of total crop production in 2014”. Global livestock production, on the other hand, is based on about 40 animal species, with only a small group providing the vast majority of meat, milk and eggs, while 26% of the 7745 reported local livestock breeds is threatened with extinction (FAO, 2019b).

Similarly, the percentage of stocks fished at biologically unsustainable levels has increased since the late 1970s, from 10% in 1974 to 35.4% in 2019. On the other hand, the fraction of fishery stocks within biologically sustainable levels has decreased to 64.6% in 2019 (1.2% lower than in 2017). Global consumption of aquatic food (excluding algae) has increased of 3.0% (average annual rate) since 1961, compared with the population growth rate of 1.6%. The per capita consumption of aquatic food grew from an average of 9.9 kg in the 1960s to a record high of 20.5 in 2019 (FAO 2022).

Finally, according to the director of IUCN’s Biodiversity Group (IUCN, 2014)⁹, the growing food market is placing unsustainable pressure also on numerous

⁹ Global appetite for resources pushing new species to the brink - IUCN Red list, 2014; <https://www.iucn.org/content/global-appetite-resources-pushing-new-species-brink-iucn-red-list>, accessed February 2023.

protected species such as Pacific tuna (*Thunnus orientalis*),¹⁰ Chinese pufferfish (*Takifugu chinensis*),¹¹ American eel (*Anguilla rostrata*),¹² and Chinese cobra (*Naja atra*),¹³ making it increasingly necessary to place restrictive limits on the sampling of these species and to implement appropriate measures to protect their habitats.

These patterns of production and consumption inherently lead to a reduction in global biodiversity, but the loss of biodiversity should not be understood merely as the loss of an asset to be protected for its ethical and intrinsic value. From a purely utilitarian and anthropocentric perspective, less biodiversity also means, for example, that plants and animals are more vulnerable to pests and diseases, ultimately leading to reduced livelihoods and negative impacts on human health. Indeed, our diet relies on a dwindling number of species, both plant and animal, which, together with factors such as overfishing, deforestation, uncontrolled mining, changes in land use and management, pollution, population pressure and climate change, threaten food security for the entire world population (IUCN, 2014).¹⁴

We can contextualize these threats geographically. Africa is mainly affected by poaching and overexploitation, and Central Asia and Europe by deforestation, land-use change, and agricultural intensification. Overexploitation, pests, diseases, and invasive species, on the other hand, are increasingly common in Latin America and the Caribbean, while the Near East and North Africa are increasingly affected by overexploitation, and Asia by deforestation (FAO, 2019). The knowledge of indigenous and local peoples about the specificity of local

¹⁰ *Thunnus orientalis* has most recently been assessed for The IUCN Red List of Threatened Species in 2021, listed as Near Threatened under A2bd criteria. <https://www.iucnredlist.org/species/170341/170087840>, accessed February 2023. (For more information about IUCN Red list criteria see <https://www.iucnredlist.org/resources/categories-and-criteria>).

¹¹ *Takifugu chinensis* has been assessed for The IUCN Red List of Threatened Species in 2011, listed as Critically Endangered under A2bd criteria. <https://www.iucnredlist.org/species/170341/170087840>, accessed February 2023.

¹² *Anguilla rostrata* has been assessed for The IUCN Red List of Threatened Species in 2013, listed as Endangered under A2bd criteria. <https://www.iucnredlist.org/species/170341/170087840>, accessed February 2023.

¹³ *Naja atra* has been assessed for The IUCN Red List of Threatened Species in 2011, listed as Vulnerable under A2d criteria. <https://www.iucnredlist.org/species/170341/170087840>, accessed February 2023.

¹⁴ Global appetite for resources pushing new species to the brink - IUCN Red list, 2014; <https://www.iucn.org/content/global-appetite-resources-pushing-new-species-brink-iucn-red-list>, accessed February 2023.

biodiversity and its sustainable management, which has developed through daily observation handed down from generation to generation, is currently considered a valuable resource (FAO, 2012). Many culinary traditions using local food resources exemplify this concept by protecting the land through sustainable production. One paradigmatic example is the well-known Mediterranean diet,¹⁵ whose nutritional properties and environmental and social values are recognized all over the world. The Mediterranean diet, inspired by local culinary traditions, includes knowledge and practices that respect local biodiversity at all stages of production and consumption (Dominguez & Barbagallo, 2007). For the FAO (2011), the Mediterranean diet “is more than just a set of foods, it promotes social interaction because the common meat is the basis of social customs and festivities shared by a given community; it is grounded in respect for the environment and biodiversity and ensures the preservation and development of traditional activities and crafts related to the fishing and farming communities of the Mediterranean” (FAO, 2012). In 2010, UNESCO¹⁶ nominated the Mediterranean diet for inscription on the Representative List of the Intangible Cultural Heritage of Humanity¹⁷, describing it as follows:

The Mediterranean diet constitutes a set of skills, knowledge, practices and traditions ranging from the landscape to the table, including the crops, harvesting, fishing, conservation, processing, preparation and, particularly, consumption of food. The Mediterranean diet is characterized by a nutritional model that has remained constant over time and space, consisting mainly of olive oil, cereals, fresh or dried fruit and vegetables, a moderate amount of fish, dairy and meat, and many condiments and spices, all accompanied by wine or infusions, always respecting beliefs of each community. However, the Mediterranean diet (from Latin *dieta*, Greek *δίατα* “way of life”) encompasses more than just food. It promotes social interaction, since communal meals are the cornerstone of social customs and festive events. It has given rise to a considerable body of knowledge, songs, maxims, tales and legends. The system is rooted in respect for the territory and biodiversity and ensures the conservation

¹⁵ The term “Mediterranean diet” was coined in 1951 by Americans Ancel Keys, a physiologist at the University of Minnesota, and Margaret Haney, his wife and a biologist at the Mayo Foundation (Moro, 2014; Dixon, 2015).

¹⁶ UNESCO - Commissione Nazionale Italiana per l'UNESCO; <https://www.unesco.it/it/patrimonioimmateriale/detail/384>, accessed February 2023.

¹⁷ The Mediterranean diet was definitively inscribed by UNESCO on the Representative List of the Intangible Cultural Heritage of Humanity in 2013; <https://ich.unesco.org/en/RL/mediterranean-diet-00884>, accessed February 2023.

and development of traditional activities and crafts linked to fishing and farming in the Mediterranean communities of which Soria in Spain, Koroni in Greece, Cilento in Italy and Chefchaouen in Morocco are examples.

The Mediterranean diet is also considered a balanced dietary regimen for the prevention of numerous chronic-degenerative diseases (Bosetti et al., 2013; Toledo et al., 2013; Tsivgoulis et al., 2013; FAO et al., 2022).

4. Education and information programs

Despite the growing interest in environmental protection and sustainable development among Western consumers, substantial behavior change is still rare (Richter & Klöckner, 2017). In this framework, as well established by the educational literature, Environmental Education plays a central role in promoting environmentally sustainable behavior (e.g., Hungerford & Volk, 1990).

Environmental Education, in general, is about cultural interactions guided by principles of environmental ethics. By building ecological knowledge, sharing environmental values and promoting environmental awareness, Environmental Education aims to develop pro-environmental attitudes and skills (Ardoin et al., 2020). In other words, implementing new educational processes concerning SCP could equip citizens with the necessary knowledge and skills to become active, informed and engaged participants in promoting sustainable and biodiversity-friendly consumption and production patterns.

Below we propose some considerations concerning three questions related to SCP environmental education.

1. On the potential of SCP nodes in the environmental conceptual education network. SCP environmental education is a complex process. From an educational and training point of view, it could be useful to identify some systemic themes to highlight the multiple relationships emerging in the overall SCP conceptual structure. Some themes, in fact, can be seen as effective conceptual nodes within the complex educational conceptual network. The “reduction of food loss and waste” is a good example of an effective conceptual node in the SCP educational network. It can be seen as an educational vector that could facilitate the achievement of more general environmental educational aims such as improving food security and nutrition,

reducing greenhouse gas emissions, alleviating pressure on water and land resources.

2. On the potential of SCP environmental education in the framework of food availability. SCP environmental education, if practiced as a stable and continuous process well integrated within civil society, could help future citizens and policymakers make informed food choices in view of rapidly changing environmental and social situations that strongly and quickly affect the availability of sustainable food.
3. On pro-environmental behavior research concerning SCP. To minimize the environmental impact of food consumption, it is crucial for Environmental Education research to focus on identifying barriers to pro-environmental behavior concerning SCP. Two areas requiring further exploration are identified here. The first concerns SCP literacy (Richter & Klöckner, 2017) and, more generally, ecological literacy that fosters pro-environmental behavior (Orr, 1992; Jordan et al., 2009; McBride et al., 2013). SCP literacy applied to sustainable food choices should be strongly supported by an appropriate information campaign about the relevant aspects. For example, it seems to be crucial to provide consumers with accurate information about SCP Environmental Certifications and their ability to track sustainable production. In this regard, businesses, such as restaurants or markets, are starting to provide information about the sustainable products they offer, also joining sustainable labeling programs or certified platforms (Dolmage et al., 2016). The second concerns the multitude of psycho-sociological factors that affect both environmental attitudes and the so-called “attitude-behaviour gap”.¹⁸ The question of what shapes pro-environmental behavior should be of particular interest for SCP environmental education. Kollmuss & Agyeman (2002) analyze the main factors that have been found to impact pro-environmental behavior, whether positively or negatively. These include demographic factors, external factors (e.g., institutional, economic, social and cultural influences) and internal factors (e.g., motivation, pro-environmental knowledge, awareness,

¹⁸ It is in fact observed that attitudes towards sustainable consumption quite often deviate from actual consumption behaviour. This inconsistency is called “attitude-behaviour gap” or “attitude-intention-behaviour gap”. For further information see Terlau & Hirsch, 2015.

values, attitudes, emotion, locus of control, responsibilities and priorities). In this regard, Richter & Klöckner (2017) draw attention to motivational, situational, and socioeconomic factors, while Molinario et al. (2020) focus on the importance of childhood. There appears to be a correlation between childhood nature experiences, exposure to pro-environmental social norms during childhood experiences, and the development of connectedness with nature and biospheric values in adulthood.

5. Conclusions

Numerous questions still need to be addressed regarding the broader concept of SCP, particularly in relation to food. There is certainly a need to promote dietary behaviors anchored to local traditions that protect the environment and human health, as is the case with the Mediterranean diet.

The complexity of the SCP system requires multiple interventions to maintain high product quality in terms of sustainability. These interventions include the adoption and dissemination of specific certifications, the sharing of information about best practices, and the adoption of citizen science practices to make people active agents of societal changes in favor of sustainable approaches (Vorley, 2018). Concerning the importance of local dissemination, as underlined by the FAO et al. (2021), it would be useful to create multi-stakeholder platforms, also relying on already existing consumer networks, in order to facilitate discussions and support decision-making and planning processes at the local level. These platforms could be used to explore and agree on common strategies to improve territorial food systems.

The adoption of sustainable food behaviors is closely linked to understanding the ecological dynamics that support biodiversity protection. Therefore, it is essential to encourage educational experiences concerning sustainable food, human health protection and biodiversity conservation. In this regard, many platforms with educational purposes are available on the web today (Fiore et al, 2014; Sangiorgio et al., 2017), using innovative pedagogical tools such as serious games, to engage citizens and promote effective educational practices (Sangiorgio et al., 2014; Ouariachi et al., 2018).

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Funds

This research received no specific grant from any funding agency in the public, commercial, or no-profit sectors.

Competing Interests

The authors hereby state that there are no financial or non-financial competing interests.

Citation

Bartoccioni, F., Lorenzi, C., & Sangiorgio, F. (2023) Sustainable food consumption and Nature conservation processes. Educational considerations. *Visions for Sustainability*, 20, 7419, 567-584. <http://dx.doi.org/10.13135/2384-8677/7419>



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