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UK Consumers' Preferences for Ethical Attributes of Floating Rice: Implications for Environmentally Friendly Agriculture in Vietnam

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Abstract: Vietnam plays an important role in bearing global food security. However, Vietnamese rice farmers face several challenges, including pressures to develop sustainable livelihoods while reducing the environmental impacts of their production activities. Various Vietnamese agricultural restructuring policies were promulgated to promote the adoption of environmentally friendly practices to generate high value added for rice farmers, but the farmers are reluctant to adopt them because of perceived lack of demand. Decreasing consumption of rice in Asia and increasing demands in Europe shaped Vietnamese rice exporting policies. New trade agreements, such as the UK–Vietnam Free Trade Agreement, offer new target markets for Vietnamese rice farmers. This research provides empirical evidence related to the preferences of UK consumers for ethical attributes for floating rice imported from Vietnam. Floating rice represents a traditional method of rice cultivation that relies on the natural flooding cycle. Its cultivation uses very few agrochemical inputs and provides several other environmental, economic, and social benefits. In an online survey, the study used a choice experiment that asked 306 UK consumers to report their preferences for one kilo of floating rice with three non-market attributes: reduction in carbon dioxide emissions, allocation of profits to the farmers, and restitution of biodiversity. Overall, study participants favored the attributes of floating rice, but reported utility for only the "fair trade" attribute and for a marginal willingness to pay premiums for profit allocations to farmers. Consumers did not find value in either CO_2 emission reduction or biodiversity improvement. Results from the study provide recommendations to develop agricultural programs, distribution strategies, and informational methods to encourage floating rice consumption in the UK.

Keywords: agricultural policy; food policy; valuation of environmental effects; government policy; value chain agri-food; agriculture in international trade; carbon footprint; greenhouse gas reduction; fair trade; biodiversity

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1. Introduction

1.1. Rationale

Endeavors to maintain global food security have many challenges, including how to feed a growing population while balancing environmental ecology and socio-economic aspects of rural agricultural society. Countries that rely on agriculture have instituted national policies and international agreements in attempts to manage these challenges.

Rice is a staple food that has been grown and consumed in Vietnam for millennia. The country's rice production plays a critical role in national and global food security.

Until Doi Moi reform policies were initiated in 1986, Vietnam was a rice importing country. Subsequent to these policies, rice production grew at an annual rate of 2.7% during the period of 1995–2018 [1]. Vietnam is now a major rice exporter. The total export value of Vietnamese agricultural products in 2019 was over USD 41 billion, an increase of 3.2% over the previous year [1], which boosted Vietnam to the 15th largest exporter of agricultural products in the world. Among these agricultural exports, about 7.5% (USD 3 billion) was rice [1]. Total white rice export volume in 2019 was over 6 million tons [1]. Over 50% of Vietnamese rice and 90% of exported rice comes from the Mekong Delta region. Rice occupies almost 60% of the total agricultural area of the Delta and provides the main livelihood for more than 40% of the region's population [1]. In 2019, total rice production in the MD was 26 million tons [1]. Even though agricultural production brought Vietnam over USD 41 billion in 2019, the rice farmers' livelihoods are still jeopardy.

The "Green Revolution" of the 1960s and 1970s prompted most Asian countries to introduce agrochemicals into rice paddy fields [2,3]. Agricultural productivity surged, but these chemicals were also the source of environmental pollution [4]. To reverse the trend in use and overuse of synthetic fertilizers and pesticides, the Vietnamese national government introduced various programs and promulgated various agricultural restructuring policies toward high-quality products and increased value added to encourage farmers to apply integrated pest management, integrated rice-shrimp farming, good agricultural practice standards ("GAP", including VietGAP and GlobalGAP), ecologically engineered rice, and floating rice. However, the farmers are reluctant to adopt them because of perceived lack of demand. Thus, it is important to understand consumer affinity and demand for the products, especially consumers in Europe in general and in the UK in particular under EVFTA and UKVFTA agreements.

The side effects underlying the intensification of rice production in Vietnam, and in nearly all rice-producing countries, have included the overuse of agrochemicals and scale-driven production which generate environmental pollution, biodiversity losses, and crowding out of small farmers [5–8]. Exposure to high levels of the chemicals has grave human health and environmental consequences. Further, a number of studies have indicated that farmers normally shared a smaller proportion of the net value added as compared to other actors in the value chain [9,10]. Thus, it has become a national priority to develop agricultural production methods that reduce environmental damage while simultaneously reallocating value added for rice farmers through the establishment of vertical and horizontal linkages.

Among many efforts to expand the export of rice is the newly implemented Vietnam–UK Free Trade Agreement (UKVFTA), which removes 99% of UK tariffs on rice and other products [2]. The UK is a potentially valuable market for Vietnamese rice. According to the Vietnamese Ministry of Industry and Trade [11], Vietnam exported 3396 tons of rice to the UK in 2020, an increase of 116% compared to 2019; even so, this is a tiny proportion (0.44%) of the total rice volume imported by the UK. So, while the free trade agreement removes the 17.4% tariffs, Vietnam must still compete with India, Thailand, and other well-established rice-producing countries. In non-rice-eating countries, rice may be considered a consumer commodity, and non-price differentiation among products may rely on ethical characteristics such as environmentally friendly production.

The premise for the present study is that rice consumers in the UK assign economic values to ethical non-market attributes of rice that is imported from Vietnam. The study examines the characteristics of consumers, and then identifies some of the ethical product attributes consumers value most. A discrete choice experiment provides evidence of the willingness to pay for rice that is cultivated using a specific environmentally beneficial method. UK study participants were provided with hypothetical scenarios regarding significant ethical attributes of floating rice (reduction of CO_2, equity of profits through the value chain, increase in biodiversity), and then asked for their preferences. Using this method, the responses identify the product attributes that are most preferred and then allow estimations for the willingness to pay for those attributes.

With the overarching goal of investigating preferences of potential UK consumers for attributes of rice imported from Vietnam, the marginal contributions of this study are as follows: First, this paper brings sustainable food consumption, agricultural policy, and global trade into one analytical framework. The study examines mechanisms influencing consumer demand for a sustainably produced imported food product. Ultimately, successful entry into the UK market can revitalize production of a traditional, sustainable method of agriculture and encourage the adoption of other eco-friendly cultivation methods. Second, this paper is the first to consider UK consumer preferences for rice imported from Vietnam, specifically floating rice. Few studies empirically examine preferences among UK consumers for sustainable attributes. Third, this paper explores the potential economic, social, and environmental impacts of Vietnamese efforts to expand sustainable production and export. Each specific ethical attribute of floating rice will have effects across many domains. For example, rural small farmers currently experience unstable, low incomes from traditional rice exports [9,10], and any reallocation of value chain benefits can improve the general livelihoods of rice farmers. More broadly, policies that encourage floating rice production represent social resilience and adaptation in the face of climate change, as Vietnamese rice farmers face an increase in domestic production competition while they encounter decreasing rice demand in Asia but increasing consumption in Europe and the Americas [12–16]. Sustainable agro-environmental policies can reduce overuse of agrochemicals that increase CO_2 emissions and decrease biodiversity [5,7,8,17].

The paper is organized as follows: The next section provides the positioning of the study. Following that, some background information with respect to sustainable rice production in Vietnam and the literature review describes the framework for the study. After that, the methodology of the study, including the construction of the questionnaire and the data collection are described. Finally, the results and extended discussion of the implications of the research are provided.

1.2. Positioning of the Study

Individual consumers often consider sustainable production, including global, local, animal, and human rights issues, to be choice criteria [18–20], and broader trade liberalization policies consider these issues in negotiations as well [21–25]. For many agriculturally based countries, moderating the environmental impact of food production and providing an equitable income for the producers are becoming important national goals [26–28].

At a global level, the Food and Agriculture Organization of the United Nations (FAO) has provided a framework that incorporates three sustainability "pillars":

(1) food security: sustainably increasing agricultural productivity and incomes
(2) adaption: integrating resilience to climate change
(3) mitigation: reducing and/or eliminating greenhouse gas emissions

Explicit and bold targets have been set to reach millions of agricultural households through interventions developed that would incorporate these three pillars [29]. Agricultural programs such as floating rice constitute valuable contributions to this framework.

As mentioned above, the UK–Vietnam Free Trade Agreement (UKVFTA) is now in effect. Many Vietnamese agricultural products can be exported, duty-free, to the UK. Agricultural producers will need to identify factors that may play a role in UK consumer food choices [30,31].

There are many studies that have examined consumer attitudes and preferences toward imported food products. Most of these are related to one or more aspects of "country of origin" of the products. The current study incorporates a focus on product characteristics, and specifically ethical attributes, rather than the imported/country of origin aspect. Further, there are dozens of studies that have considered consumer attitudes toward imported rice, and these have emphasized emerging economies, particularly in Africa. There are no studies that report similar evidence from developed economies or the UK in particular. Many previous studies have assessed rice production in the Mekong Delta, but these studies considered issues related to new technology development and

consumption/distribution in domestic markets. Thus, in addition to filling in gaps within this literature, the study below will provide evidence that may be used in the development of a broad program of rice production and policies that can amend existing Vietnamese agricultural development.

After many years of trade-offs between environmental pollution and rice production targets, "sustainable rice production" has become a Vietnamese national policy goal [32]. Several national and local agricultural policy programs have encouraged farmers to adopt "eco-friendly" production methods. However, the adoption rate of these practices has been limited [33,34], as farmers resist changes that might ostensibly reduce their output. Farmers will produce only what domestic and foreign consumers will buy. Thus, to encourage the adoption of environmentally beneficial farming methods that can contribute to global environmental protection, revitalize biodiversity in paddy fields, and ensure a fair share of profits to farmers, it is important to understand consumer affinity and demand for the products.

Achieving these goals depends on consumer acceptance of the products. When consumers are provided with information about some of the specific beneficial externalities of sustainable agricultural production, what choices do they make? The current research provides evidence to help understand the preferences and tastes of consumers in the UK that can be used to guide Vietnamese rice production and export strategies in the future. The study first identifies characteristics of UK consumers who prefer floating rice. The study then also identifies the values that consumers assign for the non-market, environmentally beneficial attributes of the rice, specifically (1) a reduction in CO_2 emissions, (2) a fair trade component whereby a share of a premium retail price is reallocated to the rice farmers, and (3) an increase in biodiversity of species that inhabit the rice fields. Results provide empirical evidence that can be used by policy decision makers, rice producers, processors, and consumers to establish a food product that embodies the responsibilities of environmental protection and economic equity.

The positioning of this current study is summarized in Table 1 below:

Table 1. Positioning of this study.

Paper	Biodiversity	CO_2	Fair Trade	Floating Rice	UKVFTA
Miller et al. [18]			✓		
Smith [27]			✓		
Ribeiro-Duthie, et al. [35]			✓		
Nguyen and Howie [33]	✓			✓	
Vu and Quyen [34]	✓			✓	
Dragusanu, et al. [36]			✓		
Caputo et al. [25]		✓			
Onozaka et al. [23]		✓			
Didier and Lucie [28]			✓		
Campbell [37]	✓				
Hoi [31]					✓
Current study	✓	✓	✓	✓	✓

1.3. Background and Literature Review

1.3.1. Floating Rice Production in the Mekong Delta

Floating rice represents a unique, traditional, and nearly agrochemical-free farming method. The cultivation of floating rice relies on the natural, annual cycle of flooding of tributaries of the Mekong River [38]. The floods bring fish and alluvial deposits into the rice fields, which supplements the soil with nutrients, reduces agricultural pests, and increases biodiversity in the paddy fields. Floating rice is a variety that can elongate its culm quickly to adapt to increases in water levels during the flooding season. The plants grow just fast enough to keep their heads on top of the rising flood waters, appearing to float (see Appendix B for a picture of floating rice). The rice is harvested after the floodwaters recede. Because the cultivation of floating rice relies on the rainy and flooding season, there is

a single harvest per year. Traditionally, floating rice is grown in seasonal rotation with vegetables. Figure 1 provides a map of areas in the Mekong Delta where floating rice is produced.

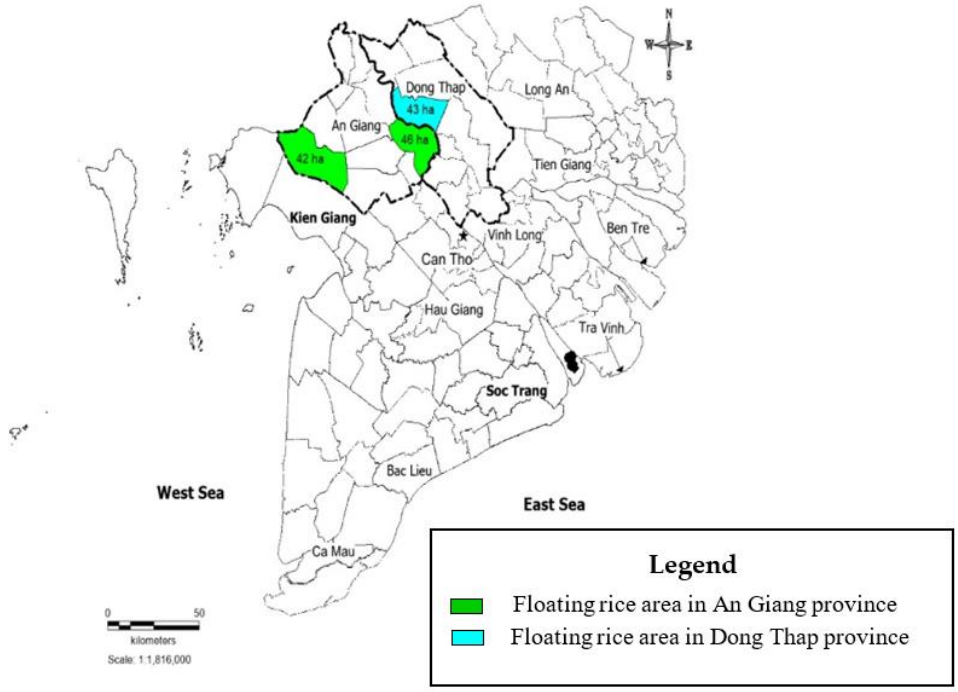

Figure 1. Distribution of floating rice area in the Mekong Delta. Source: Authors, adapted from Nguyen and Howie, 2018.

The Mekong Delta is among the most vulnerable deltas in the world and is seriously affected by rising sea levels [12,13]. The Vietnamese Ministry of Natural Resources and Environment [39] estimated a worst-case sea-level increase of 73–75 cm by the end of the 21st century. A 50 cm sea-level rise would inundate nearly a third of the Delta plain [40]. As a signatory to the Paris Climate Agreement, the Vietnamese government has developed a broad economic and environmental strategy that combines adaptation, mitigation, and sustainable development [41]. Since floating rice naturally adapts to changes in water levels, it can be part of a broader effort to maintain food production in the face of regional climate uncertainties [33].

Floating rice cultivation offers a number of environmental and ethical benefits. One is the reduction of carbon dioxide emissions. Rice cultivation at the global level is responsible for 8–10% of global agricultural CO_2 emissions [42]. Agriculture consumes fossil fuel through the manufacture and use of internal combustion mechanization. Chemical inputs, including fertilizer and pesticides, are also petroleum-based [43]. Floating rice production can reduce CO_2 because it requires less petroleum derivates. An indirect and beneficial outcome is the reduction in use of petroleum-derived fertilizers and pesticides [44].

A second potential benefit is that of fair trade. The primary purpose of a fair trade system is to provide prices that deliver a basic livelihood for farmers or other producers [36]. Fair trade certifications may also satisfy other goals, by requiring improved working conditions, the initiation or development of effective producer or worker organizations, and longer-term relations among value chain intermediaries. Often fair trade also suggests the use of environmentally friendly production practices. "Rice is an emerging [fair trade] product" [45], such that the fragrance and flavor characteristics of some rice varieties have facilitated fair trade certification [27,46], earning a premium price. Studies have provided evidence that farmers can receive significantly higher gross margins for specialty rice varieties that are produced using environmentally friendly methods [35,47]. This enables

smallholders to earn a higher income and improve their livelihoods without jeopardizing their family's food security.

A third ethical benefit of floating rice cultivation is that of biodiversity. Biodiversity is associated with the diversity of plant and animal species that live in a given place [48]. The loss of biodiversity is considered the main environmental indicator of sustainability and ecosystem health [49,50]. Intensive agricultural practices, including a dependency on chemical pesticide and fertilizer applications, have been among the primary causes of global biodiversity loss [51,52]. Floating rice fields provide habitats for wildlife species that include plants, fish, amphibians, reptiles, mollusks, crustaceans, and insects [34,53], many of which can be captured, collected, or farmed as sources of food, income, and medicine [54]. Traditionally, rural people in Vietnam (especially in poor households) have caught fish from paddy fields and irrigation channels, accounting for a large proportion of their diets. This biodiversity also plays an important role in the biological control of pests or other organisms that cause disease, damage crops, and impair other agricultural production [55]. Field research has provided considerable evidence that there are more flora and fauna species in the floating rice fields than in high-yield conventional rice fields [33,34,53]. Additionally, floating rice cultivation preserves local varieties of rice as genetic resources [33,56]. Several studies have also provided evidence that floating rice cultivation can also help to improve topsoil fertility, since the flooding deposits nutrient-rich sediment [33,57].

From an agricultural economics standpoint, the resources for planting, weeding, fertilizing, and spraying are negligible, which reduces the costs of labor and other inputs. Farmers often rotate rainy season floating rice with profitable dry season vegetable crops that use less water and use also the long-stemmed rice straw as mulch [58]. Even though the ostensible yield of floating rice is low when compared to that of high-yielding rice varieties, comprehensive cost–benefit analyses of floating rice suggest that the net economic benefit of all production activities in floating rice fields (floating rice—chili rotation, floating rice—cassava rotation) is much higher when compared to conventional intensive rice farming systems [33,58].

Thus, besides functioning as food supply, the farming methods used to produce floating rice offer environmental and economic benefits. However, most Mekong Delta rice farmers have shifted to high-yielding rice varieties that can produce two or three crops per year. Farmers are skeptical that a rice variety that produces a single crop per year and requires the longest growing season would provide sufficient income and household food security. Farmers have reduced the cultivated area for floating rice from about 500,000 ha in 1974 to less than 200 ha in 2015 [58,59]. It is likely that neither farmers nor consumers recognize the values of the sustainable cultivation independently from those associated with conventional rice production.

These specific attributes of a food as simple as rice, along with the growing interest from consumers toward the sustainability of the food they buy, leave ample space for rice producers to differentiate their products under the quality of sustainability. The current study assesses UK consumer preferences and willingness to pay for rice that is climate-, biodiversity-, and fair trade-friendly.

1.3.2. Vietnamese Rice Exports to UK and European Union

Vietnam is considered a "rice bowl" for domestic and global food security. Since 2010, Vietnam's rice export has been more than 6 million tons a year and valued at approximately USD 3 billion (see Figure 2). An agricultural restructuring program reduced the land area for rice, replacing it with aquaculture land in the coastal region and with fruit production inland [1,60]. However, the total turnover from rice exports increased with the share of high-quality rice at a higher price.

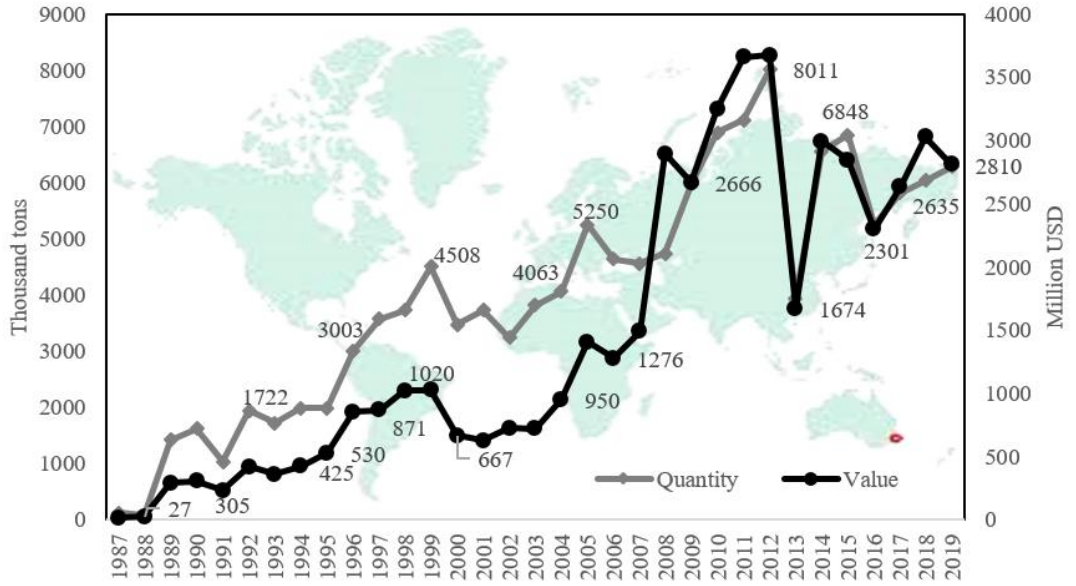

Figure 2. Vietnam rice exports from 1987 to 2019. Source: Data from 1987 to 2017 from FAOstat and data from 2018 to 2019 from GSO [1].

The current primary markets for Vietnamese rice export are Asian countries, including the Philippines, China, and Malaysia, but also African nations such as Côte d'Ivoire and Ghana. Asian countries are the largest consumers of rice, although as those economies develop economically, dietary habits have changed and the demand for rice in Asia has been declining [15,16]. Chinese consumers have reduced their rice consumption, replacing it with meat-laden dishes [61,62]. Rice consumption per capita in Japan has also reduced by over 50% between 1962 and 2016 [63]. These same trends are also observed in major rice-consuming countries such as Thailand and Indonesia. In contrast, rice consumption per capita is increasing in Europe and the United States [14,64,65]. Major rice producers are thus looking for potential markets in European countries and the Americas.

Vietnam recently adopted policies (especially Decision 899/QĐ-TTg, promulgated in 2013) that encourage farmers and enterprises to cultivate higher-quality rice varieties for export to developed countries. The primary target markets for Vietnamese rice export have thus shifted to countries with higher-quality standards such as those in the European Union. Figure 3 shows that the total Vietnamese rice export to 28 European countries nearly doubled from 2017 to 2019. The UK is the world's ninth-largest rice importer, consuming a total of 660,000 tons in 2019, buying rice from India (22 percent), Pakistan (18 percent), Spain (11 percent), Italy (10.9 percent), and Thailand (9.2 percent).

Vietnamese rice accounted for 0.24 percent of the UK's total rice imports. However, this represented an increase of 633% from 271 tons in 2017 to more 1716 tons in 2019. The first rice under the UKVFTA arrived in London in January 2021; the total rice export from Vietnam is expected to increase significantly. It is projected that the rice consumption will further increase because of the diversification of traditional diets from immigrants.

1.3.3. European and UK Consumer Preferences for Eco-Friendly Rice

Food consumption is responsible for a significant proportion of a household's total environmental impact [67]. The European Environmental Agency stated that to achieve sustainability goals, " . . . society will need to fundamentally rethink global production and consumption systems, the underpinning economic models and standards of life, and their unequal global distribution" [68].

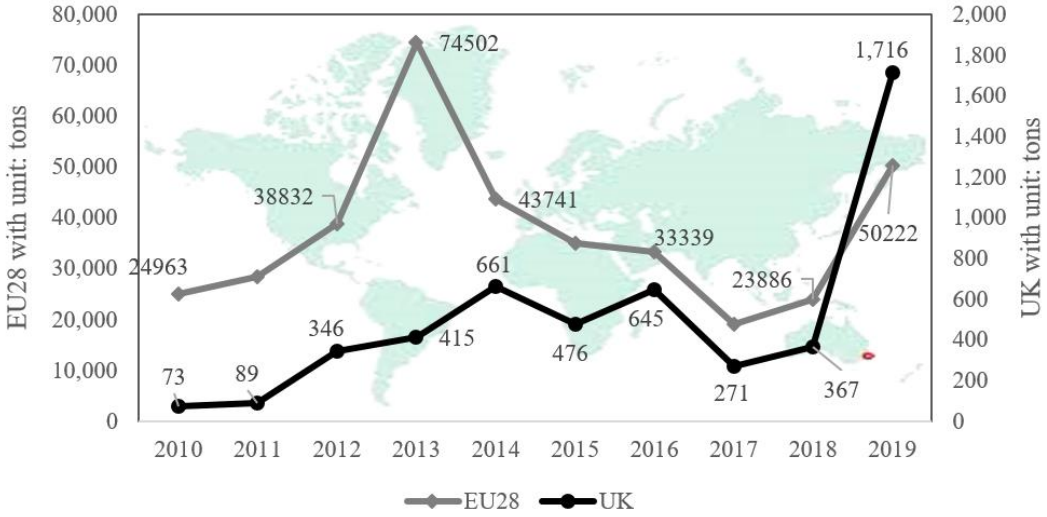

Figure 3. Import quantity of Vietnamese rice to the EU and the UK. Source: European Commission, 2020 [66].

As in other developed economies, UK consumers tend to seek food products that are higher quality, safer for consumption, and less damaging to the environment and they are willing to pay more for these products [18,69,70]. There are environmental benefits to the cultivation and consumption of the floating rice varieties, and an empirical assessment of the value that consumers assign to those benefits can inform Vietnamese government policies to guide agricultural decisions and to determine how to promote the exported product to UK consumers.

A strategic, multi-pronged, and multinational effort is necessary to enable and encourage consumers to adopt foods that are sustainably produced. On one hand, to embrace ethically produced foods, consumers must be aware of and care about the environmental and social effects of their own consumption behavior [71–73]. On the other hand, consumers often lack understanding of the influence that their food consumption habits can have on the environment, and this limits their ability to carry out ethical purchase behaviors [74,75]. People may be reluctant to pay a price premium for environmentally friendly products, preferring instead to buy those products if the environmental attributes are cost neutral [76]. However, evidence also indicates that some consumers are willing to pay more for environmentally superior food products [23,25,77].

Among the ways an individual consumer can mitigate climate change impacts is to engage in a climate-friendly lifestyle. For example, consumers have expressed willingness to pay a premium for products that generate low CO_2 emissions [24,25,71], and CO_2 labeling has been deployed and accepted in many European countries [71]. Still, while European consumers may be aware that a reduction of carbon dioxide (CO_2) can mitigate some of the impacts of climate change [71], several studies indicate that European consumers value other ethical attributes (e.g., eco-friendly packaging, animal welfare, organic) more so than a product's climate friendliness [74,75,78].

Another consideration is consumers' attitudes toward equity in the value chain—that is, whether farmers and producers receive their fair share of profits. There are dozens of fair trade certified products offered to consumers [79]. Studies suggest that European consumers may be willing to pay a premium for products that help to reallocate benefits for producers or farmers [80,81]. This willingness appears to vary across product categories [82,83].

Additionally, in many developed countries, imported food consumption is responsible for a significant biodiversity footprint [84]. International trade chains accelerate the degradation of habitat that is far removed from the place of consumption. However, the importance of international trade as a driver of threats to species is poorly understood [85] and

few studies consider consumer dispositions about the impacts of imported food products on biodiversity.

The study focuses on consumer valuation of three ethical product attributes associated with floating rice cultivation: a reduction in CO_2 emissions, fair trade, and increase in biodiversity.

2. Materials and Methods

2.1. Study Design and Data Collection

2.1.1. Study Design

The current study is part of ongoing research related to sustainable agricultural production in the Vietnamese Mekong Delta. The purpose of the broader project is to provide empirical evidence about the costs and benefits of eco-friendly rice cultivation methods (including floating rice) for both farmers and consumers. Results from the research can provide solutions for sustainable agricultural restructuring and adaptation of rice production activities to meet consumer preferences (i.e., specialty rice varieties, eco-friendly rice, organic rice), especially consumers in the potential UK market.

Table 2 shows the rice imports of the top 9 of 28 European countries. The United Kingdom is the largest overall rice importer with about 19.5% (equivalent to 447 thousand tons) of the total. Now that the UK–Vietnam Free Trade Agreement (UKVFTA) is in effect, the UK is of particular interest as a case study site for investigating the consumer preferences.

Table 2. Total imports of rice to EU countries. Unit: thousand tons.

No.	Countries	2016	2017	2018	2019	Share in 2019 (%)	Growth Rate (%)
1	UK	380.851	477.769	359.889	447.357	19.50	4.11
2	Belgium	212.520	400.426	365.830	361.709	15.77	14.22
3	France	296.028	287.652	272.019	301.924	13.16	0.49
4	Netherlands	252.524	255.365	259.531	301.630	13.15	4.54
5	Italy	195.021	182.976	137.189	179.927	7.84	−1.99
6	Spain	96.217	71.307	142.279	162.103	7.07	13.93
7	Portugal	147.329	92.333	120.326	144.674	6.31	−0.45
8	Germany	197.696	154.296	151.795	107.970	4.71	−14.03
9	Others	179.305	184.691	215.548	286.633	12.50	12.44
	Total	1957.491	2106.815	2024.406	2293.927	100.00	4.04

Source: European Commission [66].

Extensive exploratory research identified appropriate ethical attributes of floating rice. This included an extensive literature review and a focus group with Vietnamese experts in environment, agricultural economics, and agronomy. This enabled the identification of three primary non-market rice attributes to evaluate. The levels for the fourth product attribute included in the survey, retail price to the consumer, were determined based on observations at three supermarkets in the UK.

The first attribute was presented as the reduction of CO_2. Four levels of CO_2 reduction were offered. As mentioned earlier, the Mekong Delta is among the deltas in the world most seriously affected by climate change. Floating rice cultivation produces lower CO_2, since the use of synthetic fertilizers and fuel are greatly reduced.

A second attribute was the equitable allocation of benefits to rice farmers. Three levels of economic benefits were offered. A number of studies have indicated that farmers normally shared a smaller proportion of the net value added as compared to other actors in the value chain (processors, exporting companies, and other middlemen) [9,10]. Fair trade consumers in developed countries such as the USA and UK are concerned with the allocation of benefits to producers, or fair trade [80].

The third ethical attribute was improvement in biodiversity. As mentioned, the use and overuse of agrochemicals to improve Vietnamese agricultural productivity has led to serious deterioration in the agroecosystems in the Mekong Delta and a reduction in

birds, aquatic, and vegetation species [37]. The cultivation practices used for floating rice can contribute to an increase in threatened species in the paddies, and earlier research has identified biodiversity as an important attribute to some European consumers [50,86]. For this study, participants were offered three different levels of increase for threatened species. The levels for each of the product attributes are provided in Table 3.

Table 3. Attribute levels of floating rice used for choice experiment.

Attribute	Notations	Description	Levels
Reduction of CO_2	*CO_2*	Produce lower amount of CO_2. This variable has four levels.	−12%, 17%, −25%, and −34%
Allocation of benefits	*BEN*	The benefit will be reallocated to farmers based on three levels.	+20%, +40%, and +60%
Increase of threatened species	*SPEC*	Contribute to an increase in threatened species as floating rice is considered as home for many aquatic species.	Status quo; 1.5 times and 2 times
Price	*PRICE*	It indicates the final selling prices of floating rice per kg.	GBP 2/kg, GBP 3/kg, GBP 4/kg, and GBP 5/kg

The questionnaire design was based on these attributes and their levels, using a different individual attribute level across a series of alternatives for one kilogram of floating rice. An orthogonal design resulted in 25 choice sets and for simplicity, these choice sets were randomly blocked into five versions of the questionnaire. Thus, every study participant was asked to answer five choice sets. The questionnaire also included measures of respondent demographics, beliefs about the environment, beliefs about sustainable (organic) food products, and shopping behaviors. From these psychometric scales, the study derived factors for latent individual characteristics and estimated the degree to which these factors are associated with the preferences and willingness to pay for the floating rice attributes.

Once the questionnaire was developed, a professional editing company checked for appropriate English; the final versions were distributed to experts at Can Tho University who assessed the items for validity and to ensure that all versions of the questionnaire would be understandable to respondents.

2.1.2. Primary Data Collection

Responses to the questionnaire were gathered through online interviews with 306 UK consumers through the SMART SURVEY™ system, an online survey tool. Study participants first read a detailed description of floating rice cultivation and the relevant attributes (Appendix A). To mitigate the hypothetical bias, a picture of a floating rice field was provided to each consumer. The data from the responses allowed estimation of UK consumers' preferences and willingness to pay for the attributes of floating rice through discrete choice modelling [87].

2.1.3. Secondary Data Collection

The current study collected secondary data about Vietnamese rice exports from 2010 to 2019 to the EU and UK from Eurostat, a database of European Commission; and rice production and export values during the period of 1987–2019 collected from FAOSTAT and Vietnamese General Statistical Office (GSO). Additionally, the study relied on an intensive literature review of over 150 papers published in ISI or Scopus indexed journals.

2.2. Conceptual and Analytical Framework

Willingness to pay is a concept that assumes that individuals obtain utility from characteristics of goods rather than from goods themselves [88]. According to the Lancaster's

theory, a product that a consumer buys contains various attributes [88]. The consumer would obtain different levels of satisfaction from each product depending on its combination of characteristics, and the willingness to pay decision is determined by the appraisal of bundles of attributes. The present study adhered to this theory by asking consumers to assign the value of one kilo of floating rice across multiple characteristics that are related to environmental and ethical attributes [89,90].

Consumers' willingness to pay for a bundle of (floating rice) attributes was assessed by applying the microeconomics framework of private, public, and impure goods, more recently established as the "theory of impure public goods" [89,91]. In the present context, floating rice is considered an impure good which includes both private and public characteristics [89,91]. It functions as a healthy food supply (private characteristics) and indirectly offers other environmental attributes—those that are beneficial to the public—like the reduction of CO_2, biodiversity conservation, and the fair allocation of value chain profits.

To estimate consumers' valuation of each of the ethical attributes, combinations of different levels were offered together with one monetary attribute (price) in the choice set, among which the study participants expressed preferences [92]. The choices then reflect the indirect utility of consumers for different attributes via the different scenarios. The indirect utility function (U_{ij}) is expressed as

$$U_{ij} = V_{ij} + e_{ij} = \beta X'_{ij} + e_{ij} \quad (1)$$

In which

V_{ij} are the deterministic component of latent utility of the ith respondent for the jth alternative $(j = 1, \ldots, C)$ in a choice set;

e_{ij} which is *iid* (independently and identically distributed) and follows a Type I (or Gumbel) distribution captures unobservable behavior;

β is the parameter to be estimated;

X'_{ij} presents the attributes of floating rice (including one monetary attribute or selling price). In addition, to specify the choice model considering consumers' heterogeneity, it is necessary to identify attitudinal and perceptual dimensions and socio-demographic variables that affect choice behaviors. The items shown in Figures 5 and 6 were used in exploratory factor analysis to construct the unobservable proxy indicators that represent attitudinal and perceptual variables.

Thus, the probabilistic response function of the alternative j is given as

$$P_{ij} = \exp\left(\beta X'_{ij}\right) / \sum_{J \epsilon C} \exp\left(\beta X'_{ij}\right) \quad (2)$$

By assuming that the distribution of e_{ij} is independent and identical distributed and follows an extreme value Type I indicates the multinomial logit model (MNL) imposes a condition known as the independence of irrelevant alternatives (IIA property). The IIA property indicates that the ratio of probabilities of making a decision between two alternatives in a choice set is unaffected by the introduction or removal of other alternatives. Thus, prior to specifying the indirect utility function, it is necessary to test the assumptions about the distribution of error terms. The IIA property can be tested by using the Hausman and McFadden test. If the IIA property is violated, the alternatives are the conditional logit model, the random parameter logit model, or the latent class model.

As mentioned, the main purpose of this choice experiment is to indirectly measure the non-market values of floating rice attributes. The most common of these measures is based on the marginal rate of substitution. The implicit price or the marginal willingness to pay (MWTP) for each ethical attribute of floating rice is estimated through the following expression:

$$MWTP = -\frac{\partial v_{ij} / \partial \beta_i}{\partial v_{ij} / \partial \beta_{ma}} = -\frac{\beta_i}{\beta_{ma}} \quad (3)$$

In which β_i is the coefficient of the non-market attribute and β_{ma} is the coefficient of the monetary attribute. The following section provides the results from the analysis of the data.

3. Results

3.1. Socio-Demographic Characteristics of UK Consumers

Table 4 provides the socio-demographic characteristics of the study participants. The average income of study respondents is approximately GBP 2766/month, with significant variation among respondents. The majority of participants had more than 16 years of education; more than 76% of respondents had at least an upper secondary school education. The average age of the study respondents was 48. Male and female respondents share a similar proportion. Within total sample, 102 respondents were married. The average household size was 2.89 persons.

Table 4. Socio-demographic characteristics of respondents.

Variables	Unit	Mean	S.D	Min	Max
Income	GBP 1000/month	2766.624	2086.465	499	11,749.5
Education					
Primary school		0.026	0.159	0	1
Secondary school		0.212	0.409	0	1
Upper secondary school		0.258	0.438	0	1
Professional qualification		0.170	0.376	0	1
University degree		0.268	0.443	0	1
Higher education		0.066	0.247	0	1
Age	Years	48.509	16.517	21	80
Gender	Dummy (1 = male)	0.486	0.500	0	1
Married	Dummy (1 = yes)	0.336	0.473	0	1
Household size	Persons	2.859	1.245	1	5
Rice consumption	Kg/person/month	0.798	0.588	0.2	5
Current price	GBP/kg	2.437	1.073	1	6

Source: Data from 306 observations; data appendix available from authors.

The average rice consumption per capita was 0.798 kg/month (equivalent to 9.576 kg/person/year). The respondents usually paid GBP 2.437 for one kilogram of rice. Rice consumption varied greatly among respondents.

3.2. Consumer Awareness of Country of Origin of Rice

In order to provide policy-makers and rice exporting/importing companies with empirical evidence about consumers' perceptions on the traceability of rice products, Figure 4 shows that a majority of the respondents (about 52%) were not aware of the origins of rice that they most often bought. About 45% of consumers identified a country where they believed their rice came from, of which 13% of respondents believed that they bought rice grown in Thailand. Figure 4 shows the proportions of perceived countries of origin. Among 306 study respondents, the perceived market share of Vietnamese rice is 5%, which is significantly higher than the aggregate share of Vietnamese rice exported to the UK (approximately 0.24%).

3.3. Consumers' Beliefs about the Environment and Organic Products

The graph in Figure 5 provides a summary of the responses to the survey items that measured beliefs about the environment and about organic products. Survey respondents held generally favorable beliefs about the environment, including strong agreement with the statement that the humans are severely abusing the environment. Respondents also expressed favorable beliefs about the potential benefits of organic products but were neutral regarding the "better taste" of organic products.

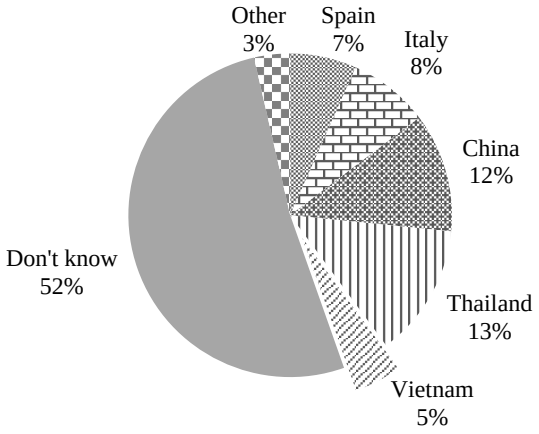

Figure 4. UK consumer perceptions of purchased rice country of origin. Source: Data from 306 observations; data appendix available from authors.

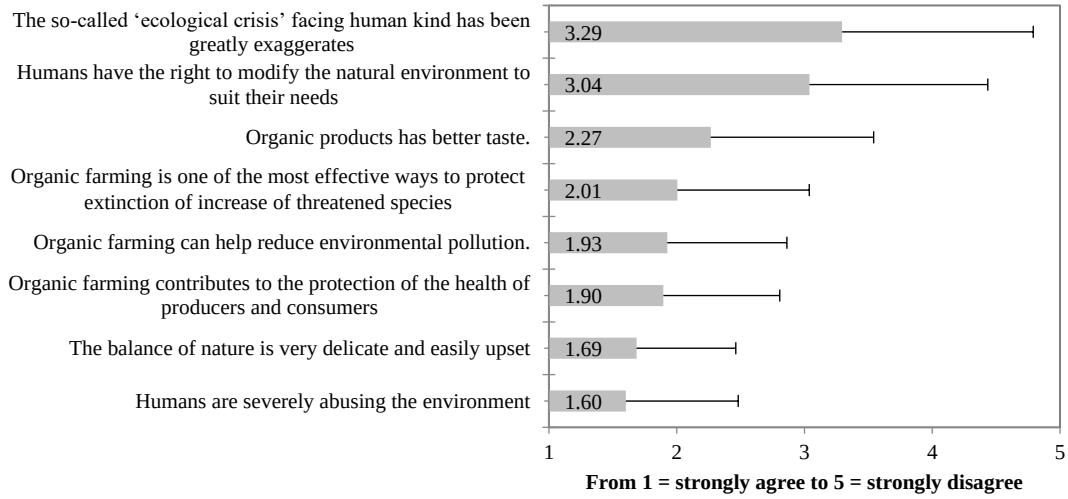

Figure 5. Beliefs of UK consumers about environment and organic farming. Source: Data from 306 observations; data appendix available from authors. The error bars show standard deviations.

3.4. Shopping Behaviors

Study participants did not explicitly express price sensitivity when shopping (Figure 6). At the same time, respondents were relatively neutral about purchasing organic products. Previous research [15,16] has suggested that convenience or ready-made meals are preferred by consumers in non-rice eating countries, particularly the USA and the UK. In this sample, however, respondents reported quite neutral behaviors with respect to fast food/ready-made food consumption.

3.5. Identifying the Attitudinal and Perceptual Dimensions

As mentioned, to capture the heterogeneity of UK consumers, the study employed exploratory factor analysis to reduce the number of indicators and allow the construction of new latent variables [93,94]. The three main factors are provided in Table 5. The latent variables were used in a multinomial logit model (MNL) to identify the influence of individual consumer traits on their product choices. The factors were identified as

- Organic product beliefs (Factor 1): This construct refers to the perceptions that organic practices are beneficial to the environment, public health, biodiversity revitalization, and mitigation of environmental pollution.

- Responses to price (Factor 2): This construct implicitly refers to price sensitivity and shopping habits of consumers.
- Environmental concerns (Factor 3): This construct represents the perceptions of humans' impact on the environment.

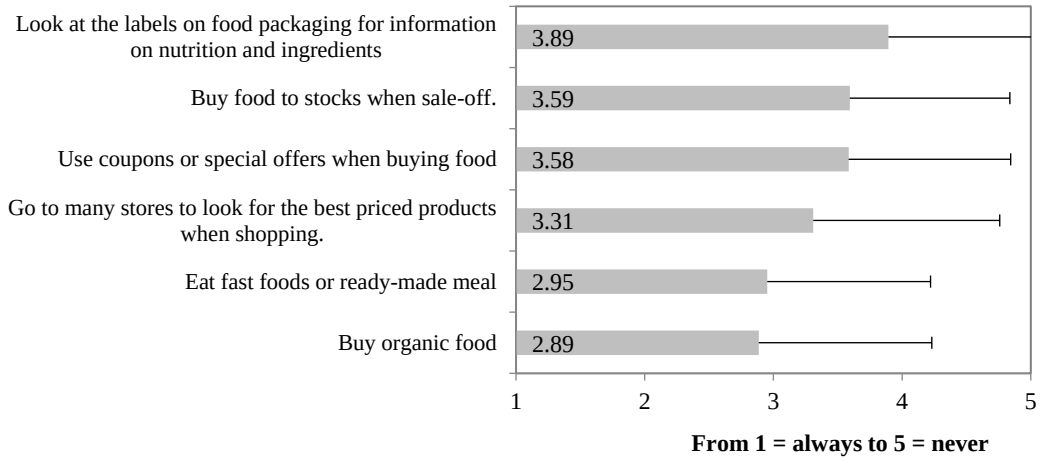

Figure 6. UK consumers' behaviors related to food. Source: Data from 306 observations; data appendix available from authors. The error bars show standard deviations.

Table 5. Exploratory factor analysis loadings for 11 attitudinal and perceptual indicators (n = 306).

Items	Component		
	Factor 1	**Factor 2**	**Factor 3**
Organic farming can help reduce environmental pollution	0.88		
Organic farming contributes to the protection of the health of producers and consumers	0.86		
Organic farming is one of the most effective ways to protect extinction of increase of threatened species	0.82		
Organic products have better taste	0.74		
The balance of nature is very delicate and easily upset	0.62		
Use coupons or special offers when buying food		0.82	
Go to many stores to look for the best-priced products when shopping		0.78	
Buy food to stock up when on sale		0.78	
Look at the labels on food packaging for information on nutrition and ingredients		0.60	
The so-called ecological crisis facing humankind has been greatly exaggerated			0.85
Humans have the right to modify the natural environment to suit their needs			0.81
KMO value: 0.791	Bartlett's test: χ^2 value = 1058.739 Sig. = 0.000		
Reliability test	0.85	0.76	0.71

Note: The reliability tests for each component were greater than 0.7, indicating that the latent constructs are acceptable and reliable [95]. Source: Data from 306 observations, data appendix available from authors.

3.6. Consumer Preferences and Willingness to Pay for Floating Rice

To test the assumption of IIA property, the study employed Hausman and McFadden test and the results are summarized in Table 6. The test statistics show that the values of χ^2 statistics are significantly smaller than the Chi-square critical value at 1% of significant level, indicating that the IIA property is not violated; thus the MNL is appropriate to capture the consumers' preferences.

Table 6. Testing the assumption of IIA restriction.

Alternative	Test Statistics (χ^2)	$\chi^2_{(10,0.01)}$	Probability
Rice A excluded	8.0329	21.7	0.5308
Rice B excluded	10.5339	21.7	0.3090

Source: Results from Hausman and McFadden test; data appendix available from authors.

To obtain unbiased estimation as well as to make comparison of the mean willingness to pay for floating rice attributes in MNL models (with and without latent variables), the model also included the economic characteristics (income) as well as the three attitudinal and perceptual variables derived from the exploratory factor analysis. The results of MNL models are presented in Table 7.

Table 7. Multinomial logit model (n = 306) estimates of UK consumers' utility functions for floating rice attributes.

Variables	MNL with Product Attributes Only		MNL with Product Attributes and Latent Variables	
	Coeff.	Standard Error	Coeff.	Standard Error
Constant	0.394 **	0.167	44.913 ***	0.165
$CO_2$17	−0.034	0.094	−5.591 ***	0.091
$CO_2$25	0.010	0.119	−2.599 ***	0.115
$CO_2$34	0.212 *	0.109	19.486 ***	0.104
BEN40	0.400 ***	0.093	37.611 ***	0.091
BEN60	0.469 ***	0.095	46.651 ***	0.094
SPEC1.5	−0.145	0.091	−15.511 ***	0.092
SPEC2	−0.238 **	0.098	−22.584 ***	0.097
Price	−0.155 ***	0.039	−15.019 ***	0.038
Ln(income)			6.822 ***	0.002
Factor 1			1.811 ***	0.013
Factor 2			0.371 ***	0.013
Factor 3			0.900 ***	0.016
Log-likelihood	−1625.899		−1680.876	
Observations	1530		1530	

Note: *, **, and *** indicate the significant levels of 10%, 5%, and 1%, respectively. See Tables 3–5 for more details on the notations of variables in utility function. Source: Data from 306 observations; data appendix available from authors.

The results for the "product attributes only" model are shown in Table 7. The price coefficient is negative and significant ($p < 0.001$), indicating price sensitivity of respondents. However, among the significant variables, it is the smallest coefficient. Variables identifying the distribution of benefits through the value chain, including farmers, are significant and positive at both levels. Both levels offered for increases in biodiversity (SPECx) had a negative utility for consumers, but only the 2X level was significant ($p < 0.05$). Study respondents expressed preference for carbon emission reduction levels only the at the baseline (12%), although the preference for the maximum reduction of 34% approached statistical significance. The constant term in the logit model is positive and significant ($p < 0.05$), suggesting that study participants found utility in floating rice attributes, regardless of their individual traits.

The "product attributes with latent variables" model results parallel those found in the "product attributes only" model, in that the constant term and product attribute levels were significant and in the same directions. Each of the individual characteristic factor variables and the income variable were significant and positive.

The estimates for the implicit prices for each attribute level of floating rice (mean willingness to pay) from both models (with and without latent variables) are presented in Table 8.

Table 8. UK consumers' marginal willingness to pay for floating rice.

Attributes	MNL		MNL with Latent Variables	
	MWTP	**95% Conf. Interval**	**MWTP**	**95% Conf. Interval**
$CO_2$17	−0.2225	(−0.4067; −0.0383)	−0.3723	(−0.5565; −0.1881)
$CO_2$25	0.0674	(−0.1674; 0.3022)	−0.1731	(−0.4079; 0.0617)
$CO_2$34	1.3653	(1.1513; 1.5793)	1.2974	(1.0834; 1.5114)
BEN40	2.5574	(2.3746; 2.7402)	2.5043	(2.3215; 2.6871)
BEN60	3.0237	(2.8371; 3.2103)	3.1061	(2.9195; 3.2927)
SPEC1.5	−0.9331	(−1.1123; −0.7539)	−1.0327	(−1.2119; −0.8535)
SPEC2	−1.5319	(−1.7248; −1.3390)	−1.5037	(−1.6966; −1.3108)

Source: Calculated by using Equation (3); data appendix available from authors.

The marginal willingness to pay for each of the two models are almost identical. On average, in the MNL models with and without latent variables, study participants expressed willingness to pay a premium of GBP 1.2974/kg and GBP 1.3653/kg, respectively, for a 34% reduction of carbon relative to the baseline reduction level. The MWTP for the allocation of benefits to farmers were the highest among the attributes. On average, the MWTP for allocation of 40% benefit to farmers were GBP 2.5574/kg in the MNL and GBP 2.5043/kg in the MNL when the latent variables were included. The MWTP for reallocation of 60% benefit to rice farmers increased to GBP 3.0237–GBP 3.1061/kg.

The following section elaborates on and discusses these results and provides some recommendations for decision makers.

4. Discussion

4.1. General Discussion

These results point toward several implications for decision makers throughout the value chain. Prior research has suggested a trend toward agricultural and food policy actions that consider ethical practices (public goods) as well as product quality (private goods) [96,97]. Reorienting the agricultural resources of rural Vietnam to maintain its own food security but also to grow its export market will require compatible, not competing, goals. This will include informing and persuading consumers of both the public and private qualities of floating rice.

Food products that are perceived to be "sustainable", "safe", and "socially responsible" are attractive to consumers in developed and emerging economies [72,98]. Those consumers express their environmental concerns and values through purchases of food that not only satisfies the private utility of hunger but also fulfills the societal utility of reduced environmental or other ethical harm [99,100]. In the present context, consumer purchase of the bundle of attributes associated with floating rice is an incentive for farmers to produce the rice.

One consideration that tends to favor Vietnamese floating rice exports is that current policies on agricultural restructuring that have focused on value added and sustainable development can improve the demand for and production of high-quality rice. Global demand for rice is shifting toward higher-quality varieties [101]. In particular, the demand for traditional rice varieties (with special flavors and high-quality) is increasing in East Asia and Europe as tastes and preferences change and incomes increase [102,103]. Consumers in the UK, especially the elderly, are preparing and consuming rice more frequently [104,105].

The reputation of Vietnamese rice in the global market has also improved. In the first ten months of 2020, the volume of high-quality and high-value rice varieties accounted for about 80% of the total Vietnamese rice export [106]. In recent years, Vietnamese rice varieties have been judged to be among the finalists in the World's Best Rice Contest. An organic rice variety from Soc Trang Province, labeled ST25, was crowned the best in the world in 2019. These are good first steps toward improving the country's rice quality and enhancing the market opportunities in developed countries.

Given the optimistic outlook for both global demand and domestic supply, one significant opportunity for the Vietnamese rice export market is the recently implemented UK–Vietnam Free Trade Agreement and European–Vietnam Free Trade Agreement. Previously, Vietnamese rice exported to the UK had been subject to tariffs of approximately 17%. Under the current terms of the UKVFTA, the UK initially gives Vietnam a total duty-free quota of 13,358 tons per year (equivalent to about 2% of the UK's imports); this quota will be reassessed after three years of its implementation. This agreement provides a significant competitive price advantage over other regional suppliers, such as India, Pakistan, and Thailand, none of whom have comparable trade deals with the UK.

To take advantage of these international trade trends, the results from the current study add specific consumer insights. One out of twenty respondents in our study identified Vietnam as the country source of their rice, which is significantly higher than the actual share of Vietnamese rice exported to the UK (less than 1%). It is possible that the study participants purchased more than their share of Vietnamese rice. A majority of participants were unaware of the country of origin of the rice they purchase; there is some evidence that in non-rice eating countries, country of origin is not an important attribute in consumer decision-making [15,107]. In other product categories, geographic origin may be a factor in food preferences if the origin is somehow associated with quality [108,109]. Nonetheless, these responses suggest some degree of awareness among UK consumers.

Survey respondents held generally favorable beliefs about the environment and generally positive opinions about organic products and farming. This is consistent with many previous studies that suggest that choice behaviors are influenced by consumer perceptions about the environment and about organic products [24,71,110,111]. However, respondents strongly agreed with the positive public attributes benefits from organic cultivation (protecting threatened species, reducing pollution) and public health, yet they held neutral opinions regarding the "better taste" of organic products (a private attribute).

Study participants tended toward low-involvement shopping. They reported, on average, that they tended not to pay much attention to food nutrition and ingredient labeling information. The responses also indicated relative neutrality or insensitivity toward food price, since they did not stock up on sale products, use coupons, or shop at different stores for lower prices.

Factor analysis application to the raw psychometric data reduced the number of variables into three factors. The latent variables derived from the factor analysis, labeled "beliefs about organics", "responses to price", and "human environmental impact", were all significantly and positively related to consumers' preferences for floating rice in the MNL when included with all of the ethical product attributes.

The roles of the latent individual trait factors in predicting utility are also consistent with previous research. Beliefs and perceptions about organic products have been identified and applied extensively in prior investigations [71,111,112]. In the present study, favorable beliefs about the public and private benefits of organic products represent the largest coefficient of the three individual traits. The "responses to price" variable indicated an insensitivity to price and was thus also positively related to utility for floating rice. Price, of course, is a very important determinant affecting consumer choices [15,113]. Agreement on the third factor, "environmental concerns", would imply a belief that humans can mitigate the negative impacts on the environment through their own activities. This construct has also been identified in many previous studies [71,111,112,114].

The analysis through MNL provided consumers' priorities for the ethical attributes of the product and an estimation of how individual consumer traits are related to the overall utility for floating rice. Study participants were willing to pay for any option that was offered through which exporting companies would reallocate profits or benefits to farmers. The result in our study is consistent with price expectations identified in other fair trade studies [115,116]. It is likely that UK consumers generally acknowledge and accept the price premium associated with equitable distribution of profits through the value chain.

The UK is the largest market in the world for fair trade products and over 80 percent of UK consumers recognize the concept [117].

When assigning utility to a reduction of CO_2 emissions, study respondents preferred either the reference/baseline level of 12% or the maximum of 34% reduction of carbon emission through the life cycle of floating rice (from cultivation to end consumers in the UK). Respondents tended to be either pessimistic or optimistic in their preference for reduction of carbon emissions. The Climate Change Act of 2008 [118] established an emission reduction target for 2020 at about 37% below the 1990 level. Researchers suggested that this was an overly optimistic target [119], given the difficulties of decarbonizing such a large economy. It is possible that UK consumers do not believe that the processes involved with floating rice products could contribute to a 17–25% decrease of carbon emissions through its whole life cycle and only express their preference at the baseline and maximum levels. Those who are very optimistic with the reduction targets could be willing to pay for it as an incentive to encourage actors in the floating rice value chain to reduce carbon emissions.

The participants in this study were not willing to pay for any increase in threatened species derived through floating rice cultivation. Degradation of biodiversity is often attributed to industrial agricultural practices, especially when large-scale production supplants natural ecologies. Awareness of biodiversity issues varies considerably across countries [50], but a relative minority of consumers can define it [85,120]. The lack of understanding, particularly within the agroecology of rice farming, may also be a challenging concept for consumers who are geographically distant from the paddies.

Results of the MNL utility models are consistent with those of previous research in suggesting that UK consumers find value in environmental and social sustainability attributes for food products. Earlier studies have also found that the fair trade attribute has higher consumer acceptance than other ethical attributes [121]. Study participants were willing to pay more for any additional allocation of value chain benefits. On average, in the MNL models with and without latent variables, study participants expressed willingness to pay a premium for only the maximum level of carbon reduction and were not willing to pay for any improvement brought about for biodiversity.

Earlier studies have found that consumers' preferences and willingness to pay for biodiversity or reduced CO_2 are relatively lower when they are offered as a choice among other ethical attributes [109,122,123]. Prior research provides evidence that consumers value biodiversity if it is local [122,124], and that consumers may pay for CO_2 reductions if the actions are local [123]. Consumers may not grasp the significance of reductions in CO_2 or of improvements in biodiversity, especially when considered in the context of non-animal agricultural food production. Consumers may be aware of these ethical issues, but they may not be confident that their individual actions can have any influence or they may not have confidence that companies are adhering to the claims [85].

At a broader level, these results suggest that international trade of floating rice would be consistent with the "3 Pillars" of sustainability. Consumer demand in Western cultures would very likely encourage confidence from farmers that they could at least sell what they produce. This would manifest in sustainably increasing agricultural productivity and incomes. Because the cultivation methods are adaptable to wet/dry conditions in the Mekong Delta, production is resilient in response to climate change. Further, the significant reduction of the use of petroleum products—fertilizers, pesticides, diesel—mitigates greenhouse gas emissions.

4.2. Recommendations for Decision Makers

Most research related to willingness to pay for sustainable food attributes suggests the value of labeling. There is a great deal of evidence that "eco-labeling" is effective as a means of conveying specific contextual information to consumers [125]. For example, product labels that claim "organic" certification are perhaps the most globally recognized in the food market. Each major economy in the world has its own organic production standards and its own icon or label to identify those products. However, floating rice is technically not

produced "organically" under the standards of the UK or other Western markets. Dozens of sustainability labels for food products have been introduced to communicate sustainability information to consumers and to promote the adoption of ethical consumption [126] and most research examines consumers' willingness to pay for the presence or absence of the labels. However, research also suggests that many consumers may be confused by an overwhelming variety of sustainability labels [127,128]. Because the consumers in this study were not offered a "label", but rather were presented with narrative and visual information describing how floating rice is cultivated and about its environmental benefits, the recommendations derived from the results extend beyond simple labeling and will require a comprehensive set of policies and practices.

Floating rice producers and regulatory agencies must thus carefully evaluate the adoption of innovative environmental-friendly certification labels. Beyond labels, however, communicating the higher non-market values of floating rice through the value chain will be of utmost importance. Vietnam will have an opportunity to conserve and expand floating rice production, not just because it is an old tradition, but because it is a farming system that is adaptable to climate change and that produces nutritious foods more sustainably than intensive rice production systems. In doing so, floating rice cultivation can provide global consumers with a valuable food product and rural farmers with better economic and social livelihood [129].

To develop any success of floating rice in the UK, a consumer information program is recommended. As mentioned earlier, the UK and most European countries are not heavy "rice consumers". Rice may be considered a low-involvement decision, making it difficult to compete in what may be considered a commodity market space. Still, because none of the other major rice exporters currently have a free trade agreement with the UK, these ethical attributes may provide non-market competitive advantages [130]. Thus, in addition to promoting the experience attributes of taste and the credence attributes of nutrition, these results endorse informing consumers of the ethical benefits of floating rice.

Study participants were provided a detailed description of the process of cultivation for floating rice, but the implementation of fair trade certification would involve many actors. The goal of any fair trade certification is to contribute to sustainable social and economic development by offering trading conditions that are transparent and equitable through the value chain. One important condition is strengthened producer organizations, usually in the form of an agricultural cooperative, which facilitates market access. In Vietnam, local middlemen play a central role not only in trading rice, but also in providing smallholders with access to financing, infrastructure, and essential services. Fair trade programs reposition and empower small farmers by creating more tangible links between the farmers and their markets [131] and by improving the ability of rural farmers to achieve higher economic returns [132]. Any of the benefits provided by intermediaries would have to be replaced if those middlemen were bypassed. The formal setup of cooperatives generally provides access to market information, credit, and extension services [133]. Thus, any fair trade certification would be facilitated by cooperatives or other farm-level organizations [134] at the production end, with more exclusive distribution at the retail end.

Previous research has suggested considerable variation in terms of how consumers value carbon emission reduction [135], and the present results add to this discussion. Only recently have studies considered consumer valuation of carbon certification for agri-food products [135]. For either CO_2 reduction or biodiversity improvement, consumers may not have made the connections between these environmental issues and human wellbeing. It is possible that British consumers do not consider "climate change" to be an immediate concern [136], or that the study participants considered the carbon reduction attribute offered in our study to be inconsequential, since it would offer miniscule benefits to the global climate but not direct benefit to a specific person or place [137]. The willingness to pay for carbon labels on agri-food products remains unclear [135].

Although the biodiversity benefit was not valued by study participants, any efforts to differentiate floating rice from other rice varieties might include narratives related to

specific flora or fauna species. While awareness of biodiversity may be growing, few brands have been able to position themselves around biodiversity. Previous research has suggested that consumers may respond to a specific species [138,139], but as mentioned earlier, these valuations are related to proximal impacts. A broader message that offers the important ties between biodiversity, climate change, and human wellbeing may influence awareness and attitudes beyond floating rice products, as evidence indicates that when information is provided regarding these connections, consumers are more likely to economically support food products that mitigate the impacts [140].

5. Conclusions

The results of this study allow us to identify some theoretical and practical implications that are associated with the relationships between ethical attributes of floating rice production, including greenhouse gas reduction, equitable allocation of profits to farmers, and increase in rice paddy biodiversity. From the standpoint of the global supply chain, the consumers in imported countries like the UK are willing to pay high premiums for fair trade or profit allocations to farmers. However, they did not find value in either CO_2 emission reduction or biodiversity improvement as these attributes would have a local impact and the rice farmers and local government must be responsible for them. These results suggest that to achieve global sustainability goals, shared responsibilities during production and consumption systems through trade agreements are necessary. The study also found that beliefs and perceptions about organic products and environmental concerns are positively correlated with the choice decisions. These results also encourage cultivation practices that reduce the use of agrochemicals, improve biodiversity, and reduce carbon emissions. This information can inform policy decisions that allocate resources on the production side and frame communications strategies through the value chain to consumers.

Floating rice represents an increasingly marginalized production system, one which is quality- and environment-intensive rather than production-intensive. On one hand, intensified rice production in the Mekong Delta increased rice yields that have not only fed the country for decades but have also enabled Vietnam to become one of the largest rice exporters in the world. On the other hand, intensive production of lower-quality rice for export has placed the rural farmers at a disadvantage in the value chain. A lack of differentiation among competitors and more economically powerful distribution intermediaries have reduced the ability of the farmers to compete against other rice-producing nations in the global market.

New international trade relationships, in this case between Vietnam and the United Kingdom, can at once encourage the production of a healthy food source as well as a new source of income for Vietnamese rural farmers.

As with any research, some limitations can be reported here. First, given the hypothetical nature of the experiment and the social desirability connected to sustainability, consumers might be inclined to overestimate their stated willingness to pay for environmentally favorable attributes [141]. Detailed instructions for the respondents somewhat mitigated this potential bias. In addition, it is crucial to observe their revealed willingness to pay [142,143]. A second limitation of the present study is that respondents were presented attribute choices that are sustainable outcomes of the cultivation and production processes involved. Previous research has suggested that consumers may prefer food characteristics such as taste or appearance over those involving environmental protection [144]. Further research may include the choices consumers make when taste, "quality", or texture are included along with the credence attributes related to sustainability. As mentioned earlier, country of origin may also influence purchase decisions for low-involvement products. Studies examining consumer beliefs and attitudes toward agricultural production from proximal and distal sources would also be appropriate. Most study participants did not know the origin of their rice, and some consumers overestimated their consumption of Vietnamese rice. Thus, further examination of the variation of willingness to pay across ethical attributes, as well as country of origin, would also be valuable, as would the identi-

fication of consumer segments and the best communication and distribution strategies to target each of those [145]. Additionally, further research should consider how preferences and price sensitivities might be influenced [146,147]. Consensus of research, including this study, would suggest that consumers are uninformed about how their purchase decisions can have an impact on greenhouse gas emissions, biodiversity, and human survival.

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Abbreviations

EVFTA	EU–Vietnam Free Trade Agreement
FAO	Food & Agriculture Organization
GAP	Good Agricultural Practice
GSO	General Statistics Office of Vietnam
IIA	Independence of Irrelevant Alternatives
MD	Vietnamese Mekong Delta
MNL	Multinomial Logit
MWTP	Marginal Willingness to Pay
SD	Standard Deviation
UKVFTA	UK–Vietnam Free Trade Agreement

Appendix A. Scenario for Investigating UK Consumer Preferences on Floating Rice

Floating rice in Vietnam in particular and in Asia in general is produced based on natural flood which brings rich soil, and the floating rice uses few agricultural machines (it means lower emission of greenhouse gases) and little agrochemicals. Floating rice production contributes to the lower emission of CO_2 of global warming, while modern agriculture brings environmental threats to species. We need to develop a new system to support these farmers who are producing floating rice under limited financial incomes through the benefits of consumers' buying their rice.

Part 1: Consumers' purchase of rice

Q6. How much is the price of rice that you often buy?

£0.5/kg or less	£1/kg	£2/kg	£3/kg	more than £4/kg

Q7. How many kilograms of rice does your family usually buy a month?

1 kg or less	2 kg	3 kg	4 kg	more than 5 kg

Q8. From which country do you usually buy rice?

Spain	Italy	China	Thailand	Vietnam
I do not know		Other (please specify) ( )		

Part 2: Preferences on floating rice

Imagine that you can find an eco-friendly floating rice product that reduces carbon dioxide—a significant factor of global warming, and supports floating rice farmers with cooperation and supervisory of the international NPO. This rice product is the same as taste and quality as other imported rice.

We would like to learn about your preferences on the rice options below (A, B, or C rice in the following tables).

Please note that every product has some associated attributes. For example, in Choice set 1 below, Rice A contributes to a 25% reduction of CO_2 emission by using a lower amount of agrochemicals and fuels compared with your usually bought rice. Rice A also contributes a 20% reallocation of benefits based on premium price to rice farmers. Rice A also doubles the population of threatened species and the rice originates from Asian countries. The price of Rice A is GBP 2/kg.

Among Rice A, Rice B, and the normal rice, please select only one kind of rice that you prefer.

Choice set 1

Attributes.	**Rice A**	**Rice B**	**Rice C**
CO_2 reduction	−25%	−34%	I would not choose to purchase rice A or B. I want to purchase the same rice as usual.
Allocation of benefit to farmers	20%	40%	
Level of harm to threatened species	2 times	Status quo	
Price	£2/kg	£3/kg	
I would choose: (select only one option)	☐	☐	☐

Appendix B. A Picture of Floating Rice Field

Figure A1. Source: https://laodong.vn/media/lua-mua-noi-tu-dong-ruong-den-ban-an-575012.ldo (accessed on 16 June 2021).

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