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No Palm Oil or Certified Sustainable Palm Oil? Heterogeneous Consumer Preferences and the Role of Information

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Abstract: Public concerns about the adverse effects of palm oil production and consumption have contributed both to the development of certification standards for sustainable palm oil and to the promotion of palm-oil-free products. While research on consumer preferences for palm oil is growing, potential trade-offs between these two options—products containing certified palm oil versus palm-oil-free products—are still largely unexplored. Focusing on this research gap, a discrete choice experiment involving chocolate cookies was implemented as part of a web survey among consumers in Germany. Results indicate that consumers on average prefer palm-oil-free cookies, although a latent class analysis identifies several consumer segments that differ in terms of preferences, attitudes, and characteristics. Many respondents are highly price-sensitive. After the provision of additional information, stated preferences for certified palm oil increase, but four out of five consumer segments still prefer palm-oil-free products. Prevailing health concerns and a potential lack of trust in certification might explain this choice behavior. As alternatives to palm oil are not necessarily more sustainable, initiatives supporting the uptake of certified sustainable palm oil should be further strengthened. Targeted information campaigns might be a suitable instrument to raise awareness and increase knowledge about palm oil.

Keywords: certification; choice experiment; consumer behavior; deforestation; food; label; latent class analysis; RSPO; stated preferences; sustainability

1. Introduction

The expansion of oil palm cultivation can contribute to socio-economic development but often has significant adverse social and environmental effects [1]. Particularly in Indonesia and Malaysia, which together account for around 84 percent of global palm oil production [2,3], huge areas of tropical forests have been cleared and peatlands have been drained and burned for oil palms [4–7]. Among other problems, land-use change processes related to the expansion of oil palm cultivation induce biodiversity loss [8–10] and greenhouse gas emissions [11,12]. Moreover, land tenure conflicts and exploitation of workers, as well as problems related to the livelihoods of smallholders and indigenous communities, have been reported [13,14].

Addressing problems related to unsustainable palm oil production, two main trends can be observed in the market: the development of sustainability standards for palm oil, and the replacement of palm oil with alternative oils and fats [15,16]. The most popular voluntary sustainability standards for palm oil have been developed by the Roundtable on Sustainable Palm Oil (RSPO) and are updated on a regular basis [17]. The RSPO supply chain certification is advertised to consumers in the form of product labels and claims. For instance, if a final food product contains only palm oil that has been

certified and segregated from uncertified palm oil along the whole supply chain, it can be labeled as “RSPO certified”. Generally, palm oil labeled as “RSPO certified” should be 100% certified. In practice, RSPO currently requires a certified content of at least 95%, a justification, and compensation in the form of RSPO credits for any remaining non-certified content [18]. If a certain amount of certified palm oil is bought and used as an ingredient, but mixed with uncertified palm oil along the supply chain, an “RSPO mixed” label can be used. According to the “mass balance” approach, it has to be ensured that the total amount of “RSPO mixed” palm oil does not exceed the total amount of actually certified palm oil; it is not guaranteed that the labeled final product actually contains any certified palm oil [18,19].

With respect to the replacement of palm oil, it has been argued that there is currently no technically suitable and economically viable alternative that would be more sustainable. Palm oil is not only particularly versatile with respect to different uses [20], but also the most productive among relevant vegetable or exotic oils and fats, meaning that it requires less land for the same amount of output [20–22]. Still, comprehensive life cycle assessments are required to take into account trade-offs between land use and other aspects, such as greenhouse gas emissions or water use [23].

Currently, 19 percent of the global palm oil production is RSPO-certified, but not even half of the certified volumes are taken up by the market, so there is a significant demand gap [24,25]. Interestingly, products that contain RSPO-certified palm oil are often not labeled accordingly. This indicates that consumer goods manufacturers and retailers might rather tend to hide palm oil as an ingredient than to advertise certified sustainable palm oil, assuming negative attitudes toward palm oil in general [26–28]. Buying products that contain only certified sustainable palm oil has been rated as most effective among different actions aimed at reducing the adverse effects of palm oil production [29]. As the second-largest import market for palm oil globally [3], the European Union has acknowledged responsibility for deforestation linked to imported commodities and products and called for action to support sustainable consumption [30,31]. Palm oil has been prioritized by the Amsterdam Declarations Partnership (ADP), a small group of European countries aiming at eliminating deforestation from agricultural supply chains [32,33].

The focus of this analysis is on Germany, as this country is a member of the ADP, consumes a large share of palm oil volumes imported to Europe, and supports sustainability certification of palm oil via the Forum for Sustainable Palm Oil (FONAP) [34]. Acknowledging the influence of political consumerism [35], this article shall contribute answers to the following research questions:

- Do consumers tend to prefer products containing certified sustainable palm oil or rather palm-oil-free products, if they care at all?
- Which socio-economic or attitudinal factors might influence consumer preferences for palm oil?
- How does the provision of information to consumers affect their preferences?

This article proceeds as follows. Section 2 provides a literature overview of relevant scientific articles on consumer attitudes and preferences toward palm oil and defines the research hypotheses to be tested in this study. The methods used for data collection and analysis are described in Section 3. The results of the analysis are presented in Section 4 and discussed in Section 5. Finally, conclusions are drawn in Section 6.

2. Conceptual Framework and Research Hypotheses

2.1. Consumer Attitudes, Preferences, and Behavior in the Context of Sustainability

According to the theory of planned behavior, the most relevant factors that influence behavioral intentions are attitudes, subjective norms, and perceived behavioral control [36,37]. In line with this concept, economic choice theory suggests that attitudes and perceptions influence preferences, which have an effect on behavioral intentions. These latent, unobservable constructs are influenced by information on product attributes, markets, and external factors. Using a decision protocol, consumers

make choices based on the principle of utility maximization under the consideration of a restricted budget and other potential constraints [38]. This framework has been further developed for the more specific case of behavioral intentions toward sustainable consumption behavior. The sustainability of a product is a so-called credence quality that can hardly be assessed by consumers before or even after consumption and, therefore, leads to information asymmetry [39]. Sustainability certification and product labeling are used to reduce this information asymmetry [40,41].

Vermeir and Verbeke [41,42] identified positive effects of involvement with sustainability, certainty (or confidence), and perceived consumer effectiveness (PCE) on attitudes. Involvement is influenced by values, needs and motivations, while certainty (or confidence) is derived from information and knowledge [41,42]. PCE refers to people's perception of their ability to contribute to alleviating social or environmental issues with their consumption decisions [41,43]. Attitudes again influence the intention to buy sustainable food, but not necessarily actual purchase behavior. In addition to personal factors, contextual factors such as situational (e.g., time, availability), economic (e.g., budget), or institutional (e.g., general availability) constraints might act as barriers to pro-environmental behavior [41,42,44]. The actual use of sustainability labels in purchase decisions depends not only on consumers' motivation and understanding with respect to sustainability, but also on knowledge, previous experience, and trust with respect to the respective certification systems and labels [40,45,46].

2.2. Development of Hypotheses Based on a Literature Overview

Various studies on consumers' perceptions, attitudes, and preferences toward palm oil have been conducted in different countries. The majority of studies use quantitative approaches based on web-based surveys [16,26,29,47–52] or face-to-face surveys [28,53,54]. Only few use qualitative approaches [55] or mixed methods [29,56]. Some studies focus on palm oil in general, others consider (certified) sustainable palm oil and/or no palm oil. A further distinction can be made with respect to whether a study takes health and/or sustainability aspects into account.

Aguilar et al. [55] and Guadalupe et al. [54] study consumers' awareness and perceptions of palm oil as an ingredient, without considering certification. Both studies have methodological limitations. Aguilar et al. [55] use means-end laddering in interviews with only 25 respondents. They find that respondents are unaware of palm oil as a product ingredient, seem to be concerned about social and environmental issues, but perceive palm oil as "natural", which is interpreted as valuable for health. The small sample size and the exploratory character of the study do not allow for drawing conclusions on the attitudes of a wider population. Guadalupe et al. [54] conduct a face-to-face survey using a short questionnaire. Based on identified negative perceptions of Spanish consumers with respect to health and environmental effects of palm oil, the authors recommend replacing palm oil. In opposition to scientific evidence, health issues related to palm oil consumption seem to be accepted as facts, while sustainability advantages of palm oil in terms of productivity are neglected by the authors. Respondents' willingness to pay (WTP) is assessed with a simple closed-ended question, which bears the risk of substantially biased results.

Preferences for palm-oil-free products have been studied with different approaches and methods [16,47,48,50–52,57]. The results suggest that consumers lack knowledge about palm oil [47,51] and tend to be concerned about sustainability and/or health effects of palm oil [48,50,52,57]. Such concerns or general perceptions of palm oil do not always influence preferences and behavioral intentions, though [16,47]. Borrello et al. [47] and Hartmann et al. [50] conclude that consumers' perceptions of "palm-oil-free" products as healthier results from a so-called "health halo effect", meaning that "free from" product claims suggest the absence of unhealthy ingredients [58].

Different specifications of sustainability have been used in studies on preferences for (certified) sustainable palm oil, such as "tiger-friendly" palm oil [53], "deforestation-free" palm oil [28], sustainable palm oil in general without a specific certification [16,56], and RSPO-certified palm oil [26,49]. The study by Gassler and Spiller [49] is particularly interesting, as it is based on a discrete choice experiment with consumers in Germany that distinguishes between preferences for 100% RSPO-certified and

mixed RSPO-certified palm oil. The results indicate that consumers derive utility from both labels, but segregation is preferred. However, the study does not consider trade-offs between products that contain RSPO-certified palm oil and palm-oil-free products. The largest consumer segment identified in the latent class analysis preferred opting out rather than choosing a product with conventional palm oil, and more than 15 percent of the sample chose the opt-out option in all choice tasks. It remains unclear whether the reason might be a rejection of palm oil, a distaste for the respective product category, or other factors influencing preferences. Moreover, psychometric factors were measured by only one statement, respectively.

The study by Vergura et al. [16] seems to be the only one so far that examined consumer attitudes and preferences for products with sustainable palm oil as compared to “palm-oil-free” products and products without any palm-oil-related claim. The respondents showed a higher risk perception toward prepackaged cookies showing a “with sustainable palm oil” claim as compared to products with a “palm-oil-free” claim. The product evaluation was also better for “palm-oil-free” products. However, no significant differences with respect to stated WTP could be identified, not even compared to products without any claim. Respondents were assigned to different treatment groups and directly asked to indicate their willingness-to-pay, so the elicitation method as well as the rather small convenience sample (191 respondents split up into six groups) might have played a role in this case.

To gain first qualitative insights into attitudes and preferences with respect to palm oil in general as well as certified palm oil and palm-oil-free alternatives, we conducted several online and face-to-face focus group discussions with consumers in Germany prior to this study. The majority of participants indicated to prefer palm-oil-free products for different reasons, such as assumed negative health effects of palm oil consumption, or a lack of trust in certification. Still, the discussions also revealed some reasons why consumers might not pay attention to palm oil or labels when shopping for groceries, such as a lack of time to read the list of ingredients (see reference [59] for detailed results).

Considering the findings from previous studies and the focus group discussions, research hypotheses on palm-oil-related consumer attitudes and preferences to be tested in this study have been developed. Although further research is needed, several studies indicate that consumers prefer both certified sustainable palm oil and alternatives to palm oil over conventional palm oil, if they have a choice (e.g., [47,49,57]). Furthermore, based on the findings by Vergura et al. [16], it might be expected that consumers prefer palm-oil-free products over products containing RSPO-certified palm oil. The study by Gassler and Spiller [49] as well as the focus group discussions [59] suggest that consumers prefer products with an “RSPO certified” label over products with an “RSPO mixed” label. Based on preparatory research for this study in German supermarkets, it was found that RSPO-labeled products usually also carry labels of other certification systems. While studies focusing, for instance, on preferences for Fairtrade and EU organic labels exist (e.g., [60,61]), there is a lack of research on consumers’ preferences for RSPO certification for the case that a product carries such labels in addition. This aspect deserves further investigation.

Referring to the conceptual framework presented in Section 2.1, it is expected that different socio-demographic and psychometric criteria might influence consumer preferences. Mixed results were found with respect to socio-economic characteristics. Some studies did not find any statistically significant effects [47,53,57]. In contrast, other studies identified significant effects of variables such as age, gender, education, or income—but the results are inconsistent and difficult to compare across studies [26,48,50,51]. Concerning psychometric factors, knowledge on palm oil has shown significant effects on attitudes and preferences for palm oil [47,51,62]. Attitudes toward palm oil differ between countries and are not necessarily negative (e.g., [28,56]). PCE was identified as a significant driver of preference heterogeneity in the study by Gassler and Spiller [49], but measured not as a tested scale but using a single item. Verneau et al. [52] found that sustainability concerns increased consumers’ intention to consume palm-oil-free products, whereas Borrello et al. [47] identified a negative effect of sustainability concern on the purchase frequency. Engaging in information-seeking behavior related to food and palm oil, in particular, was also found to be a relevant predictor [47,48,50,52]. Some studies

have investigated the influence of additional factors, such as health concerns or interest [47,50] or trust in the food system and in product claims [49]. Further research is required to validate evidence from previous studies. Interestingly, there seems to be no prior research on attitudes toward sustainability certification as a potential driver of preferences for certified palm oil.

Attitudes and preferences might be influenced by information provided to consumers. Disdier et al. [57], for instance, found that the provision of additional information on environmental and health effects of palm oil increased respondents' stated WTP for palm-oil-free products. Similarly, Bateman et al. [53] show that marketing information can be used to boost WTP for (tiger-friendly) palm oil. In line with these studies, it is expected that consumer preferences for both "palm-oil-free"-labeled and RSPO-certified products increase if consumers are provided with additional information on palm oil and certification.

To summarize, the following research hypotheses on consumers' attitudes and preferences shall be tested in this study:

Hypothesis (H1). *Consumers, on average, prefer palm-oil-free products and products containing certified sustainable palm oil over unlabeled products that contain conventional palm oil.*

Hypothesis (H2). *Consumers, on average, prefer palm-oil-free products over products containing RSPO-certified palm oil.*

Hypothesis (H3). *Consumers, on average, prefer products with an "RSPO certified" label over products with an "RSPO mixed" label.*

Hypothesis (H4). *Consumer preferences for product attributes and ingredients (such as palm oil) are heterogeneous and differ according to socio-demographic and psychometric aspects.*

Hypothesis (H5). *The provision of information on palm oil and certification will positively affect preferences for both palm-oil-free products and products containing certified sustainable palm oil, as compared to conventional palm oil.*

3. Materials and Methods

3.1. Discrete Choice and Latent Class Approach

According to the characteristics theory of value by Lancaster [63], the utility of a good is determined by the utility consumers obtain from the combination of its characteristics. These characteristics can be described as product attributes and their respective levels. McFadden's [64] random utility theory adds that an individual's utility function consists of a non-stochastic part that can be estimated based on revealed preferences, and a stochastic part that includes unobserved aspects. The conditional logit (CL) model as a basic form of choice models is based on the assumption of independence of irrelevant alternatives (IIA) [38,64]. The IIA assumption refers to Luce's choice axiom postulating that the odds ratio between two alternatives does not change if, for instance, a third alternative is added [65,66]. It has been shown that the IIA is likely to be violated in choice experiments that involve an opt-out ("no choice") option, as respondents who would rather opt out are more likely to choose the least unattractive option instead of choosing randomly in forced-choice situations [67,68]. A latent class approach instead allows for explaining preference heterogeneity without requiring the IIA assumption to hold [69]. Latent class analysis assigns respondents to latent segments, which are estimated based on psychographic and socio-demographic variables, so that the members of a segment are relatively homogeneous in their characteristics [69,70].

Following Boxall and Adamowicz [69] and Swait [70], the probability $\pi_n(i)$ that individual n of the sample chooses alternative i among different alternatives k of a choice set C is defined as:

$$\pi_n(i) = \sum_{s=1}^S \pi_{ns} \pi_{n|s}(i), \quad (1)$$

where π_{ns} is the probability that individual n belongs to segment (or latent class) s , and $\pi_{n|s}(i)$ is the probability that individual n belonging to segment s chooses alternative i . This product of probabilities can be further expressed as:

$$\pi_n(i) = \sum_{s=1}^S \left[\frac{\exp(\alpha \lambda_s Z_n)}{\sum_{s=1}^S \exp(\alpha \lambda_s Z_n)} \right] \left[\frac{\exp(\mu_s \beta_s Z_i)}{\sum_{k \in C} \exp(\mu_s \beta_s X_k)} \right], \quad (2)$$

where Z_n is a vector of individual-specific characteristics that may include psychometric attributes and/or socio-demographic attributes, λ_s is the respective segment-specific parameter vector, Z_i is a vector of attributes of alternative i , β_s is the vector of segment-specific utility parameters, and α and μ_s are scale parameters that both have to be set equal to 1 (otherwise it would not be possible to estimate the segment-specific utility parameters).

Apart from the selection of relevant attributes, a major difficulty of latent class analysis lies in determining the number of classes. This decision can be based on different criteria, such as absolute or relative model fit, parsimony, and interpretability, often leading to ambiguous conclusions [71].

3.2. Choice Design

Chocolate cookies were chosen as product example because they are rather popular, inexpensive, usually available in German supermarkets, and often contain palm oil. Moreover, no particular brand is associated with this type of product. Table 1 shows the product attributes and their levels that have been included in the choice experiment, as well as the coding of the respective variables. The chocolate content was included as a product attribute because this aspect is a relevant feature of chocolate cookies that is prominently advertised on the packages. Dummy coding was used instead of effects coding for the categorical variables in order to facilitate the interpretation of coefficients in relation to the respective reference level and the calculation of meaningful values for WTP after estimation. In general, it is also possible to transform the parameter values to another coding scheme after estimation [72]. The levels of the price attribute and the chocolate content attribute are based on a preparatory market survey conducted in German supermarkets and discounters, considering variations in other product attributes. Two different RSPO labels have been considered. One-hundred percent RSPO-certified palm oil (“RSPO certified”) indicates that all of the palm oil used for the product has been certified, while the “mixed” version (“RSPO mixed”) allows for blending with uncertified palm oil.

Table 1. Product attributes, levels, and coding.

Product Attribute	Levels	Variable Coding
price (€ per 200 g unit)	0.79, 1.49, 2.49, 3.99	continuous
vegetable oil	conventional palm oil, “mixed” RSPO-certified palm oil, 100% RSPO-certified palm oil, “palm-oil-free” labeled	dummy coding; reference level: conventional palm oil
EU organic certification	yes, no	dummy coding; reference level: no
Fairtrade certification	yes, no	dummy coding; reference level: no
chocolate content	20%, 40%	dummy coding; reference level: 20%

RSPO—Roundtable on Sustainable Palm Oil.

An unlabeled D-efficient choice design was created using the software Ngen 1.2 (ChoiceMetrics Pty Ltd, Sydney) [73]. To obtain priors for the choice design, a pilot study was conducted with a convenience sample of 57 respondents. The final D-efficient choice design generated two blocks of eight choice sets, respectively. Each choice set consisted of two product alternatives and one opt-out option (“I choose neither of the two alternatives.”), as shown in the example in Figure 1, which has

been translated from the German original. The RSPO labels were used in their German versions shown in Figure 1; “gemischt” meaning “mixed”, and “zertifiziert” meaning “certified”. Permission to use the different labels for the purpose of the study was granted in advance. The data analysis was performed using Stata 16 (StataCorp LLC, College Station, Texas).



Figure 1. Example of a choice task.

3.3. Questionnaire Design

The questionnaire was structured into different parts. First, respondents had to answer questions related to their socio-economic characteristics. The second part comprised questions related to shopping behavior and preferences, focusing on the example of chocolate cookies as well as on sustainability certification. Respondents were, for instance, asked to assess different statements concerning their perception of sustainability certification. Next, respondents had to complete the first part of the choice experiment. They were randomly assigned to one of the two choice blocks consisting of eight choice sets. The order of choice sets within the block was also randomly determined. Prior to the first task, a so-called “cheap talk script” was presented to the respondents. Cheap talk scripts have originally been introduced by Cummings and Taylor [74] as an ex-ante calibration method for mitigating hypothetical bias that might result in an overstated willingness to pay [75]. The script used in this study has been inspired by cheap talk scripts applied in previous studies (e.g., [76,77]). The translated version of the script is provided in Appendix A. In contrast to the study by Gassler and Spiller [49], no additional background information on palm oil and the different certification systems was provided prior to the choice experiment in order to imitate a real shopping situation.

The next part of the questionnaire concerned knowledge and attitudes. Respondents were asked to provide a self-assessment of their knowledge on palm oil adopted from Schmitt et al. [62]. Attitudes were measured using several statements on palm oil that had been derived from the focus group discussions [59]. Before the second part of the choice experiment, background information on palm oil and the different labels of RSPO, Fairtrade, and EU organic was provided. The translated version of the text is provided in Appendix B. A comprehension question was used to test understanding of the information provided. The correct answer was provided to all respondents. As Howard et al. [78] found that the effectiveness of cheap talk scripts might diminish over time, a brief reminder script was used. Respondents were allocated to the choice block they had not yet answered in the first part. Afterward, respondents were asked to evaluate statements related to psychometric scales that had been adapted from previous studies, measuring concern about sustainability issues [45] and PCE [43]. The last part involved statements with respect to respondents’ information-seeking behavior.

The questionnaire was pretested at different stages. Cognitive pretests were conducted to identify and revise potentially problematic questions and items. The technical implementation of the online survey was pretested to verify functionality and usability.

4. Results

4.1. Characteristics of the Sample

The survey was implemented in April 2020 with a quota-based sample of 1000 respondents, recruited from the online panel of a market research organization, which also provided the web implementation of the questionnaire. Quotas were determined based on official statistics of the German population with respect to age, gender, education level, employment status, household size, net household income, and geographic distribution according to federal states [79]. The age range was set to 18–70 years, as this is a typical range available in online panels that allows for meeting quota requirements [80]. Table 2 shows the distribution of selected characteristics of the sample in comparison to the German population. The indicated mean and median age were approximated based on the year of birth. Intervals are indicated for some attributes, as the available statistics used different age ranges (e.g., 20–64 years or 15 years onwards). People with higher education levels are overrepresented, but otherwise, the sample is well aligned with population statistics.

Table 2. Selected socio-demographic characteristics of the sample.

<i>n</i> = 1000		Sample	Population ¹
Age	year of birth (range)	1948–2001	1948–2001
	age (mean/median)	46/47	45/46
Gender (%)	female	50.3	49.54
	male	49.5	50.46
	diverse	0.2	no official data
Education level (school) (%)	no school leaving diploma or still in school	0.8	4–7
	primary or lower secondary school	12.2	22–30
	secondary school or equivalent	37.7	23–27
	higher education entrance qualification	49.3	32–40
University/college degree (%)	yes	26.1	18–20
	no	73.9	80–82
Monthly net household income (%)	<€1300	20.8	19.4
	€1300–2599	38.5	37.4
	€2600–4499	28.4	28.3
	≥€4500	12.3	14.9
Geographic location (%)	North	17.8	18.0
	East	17.4	17.3
	South	29.5	29.3
	West	35.3	35.4

¹ The population statistics are based on Destatis' extrapolations from the most recent census data for Germany (2011) to the most recent valuation date (31 December 2018) [79].

4.2. Principal Component Analysis

Principal component analysis (PCA) was conducted to summarize several 7-point Likert scale items to factors to be included in the choice analysis. Two scales were adopted, slightly modified and translated to German from the literature: concern about sustainability issues [45] and PCE [43]. The English versions of all items included in the PCA are presented in Appendix C. The number of retained factors was determined based on the consideration of different criteria: Kaiser criterion, scree plot, parallel analysis, percentage of explained variance, and the interpretability of the factors [81]. Oblique factor rotation according to the Promax method was applied if more than one factor was identified due to the underlying assumption that the factors are related [81]. This assumption was confirmed by analyzing the correlation between the resulting factors. Table 3 shows the results and the indicators for sampling adequacy and reliability.

Table 3. Principal component analysis (PCA) results.

Scale/Set of Items	Kaiser–Meyer–Olkin (KMO) Measure	Retained Factors	No. of Items	Cronbach’s Alpha
trust in certification, perceptions of palm oil, interest in product information	0.863	certification support	4	0.813
		certification skepticism	4	0.733
		informed consumption	7	0.848
		palm oil objection	4	0.663
concern about sustainability issues	0.962	sustainability concern	15	0.949
perceived consumer effectiveness (PCE)	0.698	PCE	5	0.791

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy clearly exceeds 0.5, which is regarded as the minimum threshold of acceptance [81,82]. The item-specific measures of sampling adequacy (MSAs)—which are not shown here for the sake of brevity—also exceed this threshold, with no MSA value below 0.6. The factor “certification support” is associated with statements that express general support toward sustainability certification, while “certification skepticism” comprises statements that express skepticism with respect to the reliability and effectiveness of sustainability certification. The factor “informed consumption” summarizes statements that are related to the perceived importance of information and respondents’ information-seeking behavior. The factor “palm oil objection” includes statements that express rejection of palm oil. Reliability is measured by Cronbach’s alpha, which should exceed 0.6 (better: >0.7) [81,83]. Based on this criterion, all retained factors are sufficiently reliable, although “palm oil objection” just meets the threshold.

4.3. Results of the Choice Analysis

Among the sample, 44 respondents always chose the opt-out option in both parts of the choice experiment. Asked for their reason for always opting out, the majority of respondents indicated to dislike chocolate cookies in general. It was decided to exclude these observations from the analysis because they would not provide any useful insights on preferences for the product attributes. Thus, the sample size for subsequent analyses was reduced to 956. The choice data were analyzed using Stata 16. The Hausman test [84,85] confirmed that a conditional logit model was inappropriate due to the violation of the IIA assumption. Thus, mixed logit (ML) models were estimated using the mixlogit module for Stata [86] to check for preference heterogeneity. All product-related variables were specified as having random effects. One model was estimated based on the data for the first part of the choice experiment, and one model for the second part after information provision. The results are presented in Table 4.

With respect to the hypotheses developed in Section 2.2, **H1**, **H2**, and **H3** can be confirmed for part 2 of the choice experiment, as the variable *palm-oil-free* has the largest coefficient, followed by *RSPO certified* and *RSPO mixed*. All three coefficients are positive and highly significant, meaning that the respective claims are all preferred over conventional palm oil. For part 1, the three hypotheses can only be partly confirmed, considering that *RSPO mixed* is not significant. On average, respondents in both parts preferred cheaper cookies with 40% *chocolate* content, and derived utility from *EU organic* and *Fairtrade* certification. However, the standard deviations of several coefficients indicate that there is indeed preference heterogeneity (**H4**). Moreover, there are significant differences between the two parts, indicating that information provision might affect preferences. Particularly the coefficients of the two *RSPO* labels and for the *palm-oil-free* claim all strongly increased compared to the reference level, supporting **H5**. The large negative coefficient for the *opt-out* variable indicates that respondents on average tend to prefer a cookie product. However, a relevant disadvantage of dummy coding is that the alternative-specific constant for the *opt-out* option is confounded with the reference level of the product attributes [87]. To test the coding effect on the *opt-out* coefficient, the models were estimated

again using effects coding. The results showed that the *opt-out* coefficient was larger but still negative and highly significantly negative in both parts (−2.696 vs. −2.337).

Table 4. Mixed logit results for both parts of the choice experiment.

<i>(n</i> = 956)	Part 1		Part 2	
	mean	coeff.	(std. err.)	coeff.
opt-out	−4.267 ***	0.164	−3.137 ***	0.154
price	−1.324 ***	0.053	−1.263 ***	0.051
RSPO certified	0.146 *	0.063	0.928 ***	0.066
RSPO mixed	0.036	0.061	0.464 ***	0.062
palm-oil-free	0.451 ***	0.076	1.799 ***	0.086
EU organic	0.412 ***	0.038	0.357 ***	0.038
Fairtrade	0.754 ***	0.066	0.626 ***	0.068
40% chocolate	0.798 ***	0.055	0.640 ***	0.053
standard deviation	coeff.	(std. err.)	coeff.	(std. err.)
opt-out	3.283 ***	0.186	3.338 ***	0.147
price	1.098 ***	0.048	1.060 ***	0.044
RSPO certified	0.151	0.093	0.034	0.098
RSPO mixed	0.260 *	0.113	0.032	0.164
palm-oil-free	0.078	0.167	1.110 ***	0.101
EU organic	0.005	0.140	0.014	0.088
Fairtrade	0.532 ***	0.095	0.700 ***	0.091
40% chocolate	−0.818 ***	0.065	0.733 ***	0.073

Note: ***, **, * denote significance at $p < 0.001$; $p < 0.01$; $p < 0.05$, respectively.

In the next step, latent class analyses were conducted to explore preference heterogeneity in more detail. The *lclglogit2* module for Stata developed by Yoo [88] as an update to *lclglogit* [89] was used for this purpose. This module uses the expectation-maximization (EM) algorithm according to Bhat [90]. In addition to the factors resulting from the PCA described in Section 4.2, a variable for the self-assessed knowledge on palm oil as well as socio-demographic variables for age, gender, household income, and educational level were included in the model as individual-specific characteristics. Separate models for the two parts of the choice experiment were estimated with varying number of classes (2–7).

The model fit was evaluated based on the Bayesian information criterion (BIC) [91] and the consistent Akaike information criterion (CAIC) [92], with the lowest values indicating the best model fit. Nylund et al. [93] have shown that the Akaike information criterion (AIC) [94] is less accurate and tends to overestimate the number of classes. Table 5 shows the information criteria, the log-likelihood at convergence (LL), and the number of parameters (n.p.) for the different models. For comparison, Table 5 also includes the respective statistics for the conditional logit (CL) and mixed logit (ML) models that do not include individual-specific variables. The results suggest a six-classes solution for part 1 and a five-classes solution for part 2.

Table 5. Model fit comparison.

Classes	n.p.	Part 1				Part 2			
		LL	AIC	CAIC	BIC	LL	AIC	CAIC	BIC
1 (CL)	8	−7031	14,077	14,124	14,116	−7414	14,844	14,891	14,883
1 (ML)	16	−5832	11,697	11,792	11,775	−6107	12,246	12,340	12,324
2	30	−6294	12,648	12,824	12,794	−6676	13,411	13,587	13,557
3	52	−5734	11,572	11,877	11,825	−5858	11,820	12,125	12,073
4	74	−5631	11,410	11,844	11,770	−5694	11,536	11,970	11,896
5	96	−5524	11,232	11,795	11,699	−5599	11,390	11,953	11,857
6	118	−5411	11,058	11,750	11,632	−5529	11,294	11,986	11,868
7	140	−5372	11,024	11,845	11,705	−5462	11,203	12,024	11,884

CL—conditional logit, ML—mixed logit, n.p.—number of parameters, LL—log-likelihood at convergence, AIC—Akaike information criterion, CAIC—consistent Akaike information criterion, BIC—Bayesian information criterion.

Table 6 shows the results of the latent class analysis for part 1 of the choice experiment. The indicated class share is the mean posterior probability of class membership over all respondents. The latent classes have been labeled to describe the characteristics and preferences of their members. The coefficients for the membership variables have to be interpreted in relation to class 6, which is the reference class for the estimated model determined by Stata. In general, a significant positive (negative) coefficient of a membership variable means that—all else being equal—an increase in that variable increases (decreases) the likelihood of membership of the respective class, as compared to the reference class. To get a complete picture, the models have been estimated several times to obtain results for all possible reference classes. The variables that showed insignificant coefficients for all groups in all estimated model variants are highlighted in light-grey color. For part 1, this concerns the gender dummy *female* and the factor for *palm oil (PO) objection*.

The characteristics of the identified latent classes are described in the following paragraphs. The “palm oil avoiders” in class 1 have high preferences for *PO-free* products and insignificant preferences for the two forms of RSPO certification (*RSPO certified*; *RSPO mixed*). The coefficients for *Fairtrade* certification and *40% chocolate* are highly significant and positive. “Palm oil avoiders” express a higher involvement with respect to information-seeking behavior compared to the reference class, as indicated by the level of *informed consumption*. This is also the case if the reference class is set to the “plain cookie eaters” or the “chocolate lovers”. Members of class 1 tend to express a lower level of *certification skepticism* and *PO knowledge* compared to the reference class. The “plain cookie eaters” (class 2) are the largest segment comprising nearly one-third of all respondents. They are highly price-sensitive and clearly reject *RSPO mixed*, *PO-free*, and *EU organic* labels. As none of the attributes is associated with positive utility, they seem to prefer cheap, plain cookies. With respect to the membership variables, this segment is not clearly distinguishable from the “cheap shoppers”, although the product preferences are quite different. The only significant variables are *age* and *high income*, but the significance of both coefficients is not very high. Analyzing variants of the model it was found that it is less likely that individuals with high *PCE*, *sustainability concern*, or *informed consumption* are in the class of “plain cookie eaters” compared with the class of “concerned consumers”, for instance.

Class 3 has been labeled “palm oil neutrals” because the coefficients for all three palm-oil-related variables are insignificant. The members show highly significant preferences for *EU organic* and *Fairtrade* certification. Compared to the reference, they are more concerned about sustainability issues, tend to support sustainability certification, and believe in sustainability certifications’ effectiveness. They are also more likely to engage in informed consumption behavior. However, they rate their *PO knowledge* lower than the members of class 6. This group seems to be much more involved and interested in sustainable consumption behavior than the reference class. The “chocolate lovers” (class 4) are the smallest segment. They show a strong preference for higher chocolate content, while the coefficients for all other product attributes are insignificant. They are only slightly price-sensitive and are more likely to have a higher household income than the “cheap shoppers”. Among the psychometric membership variables, only the positive *sustainability concern* is significant.

The “concerned consumers” in class 5 are characterized by highly significant preferences for cookies with *RSPO certified*, *PO-free*, *EU organic*, and *Fairtrade* labels. It is the only segment with significant preferences for RSPO-certified cookies, but they still prefer the palm-oil-free alternative. The appreciation for these credence attributes is also reflected in the lack of price-sensitivity. Compared to the reference class, this segment seems to care most about sustainability and certification, as the coefficients for *certification support*, *certification skepticism*, *sustainability concern*, and *informed consumption* indicate. *PCE* has no significant coefficient in this model variant, but comparisons with other reference segments showed that respondents with high *PCE* values are more likely to be “concerned consumers” than “palm oil neutrals” or “plain cookie eaters”. Higher income increases the likelihood to be a member of this class. The reference group of “cheap shoppers” (class 6) is very price-sensitive. However, its members show significantly positive and relatively high preferences

for higher chocolate content as well as *RSPO mixed* and *Fairtrade* certification. It is the only class that associates a positive utility with *RSPO mixed* certification, while the coefficient for *RSPO certified* remains insignificant. These counterintuitive preferences cannot be rationally explained. Compared to classes 2 to 5, “cheap shoppers” are more likely to be older and less likely to have a high income.

Table 6. Latent class analysis for part 1 of the choice experiment.

Latent Class	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Label	Palm Oil Avoiders	Plain Cookie Eaters	Palm Oil Neutrals	Chocolate Lovers	Concerned Consumers	Cheap Shoppers
class share	13.5%	31.7%	19.7%	7.4%	16.4%	11.4%
product variables: coefficient (standard error)						
opt-out	0.849 *** (0.211)	−10.291 *** (0.917)	−2.734 *** (0.279)	−1.481 ** (0.537)	−1.523 *** (0.326)	−2.704 *** (0.393)
price	−0.584 *** (0.096)	−2.588 *** (0.208)	−0.823 *** (0.077)	−0.362 * (0.156)	−0.109 (0.096)	−3.161 *** (0.399)
RSPO certified	0.131 (0.178)	−0.448 (0.277)	0.201 (0.134)	−0.257 (0.310)	0.438 ** (0.145)	0.524 (0.293)
RSPO mixed	−0.211 (0.203)	−1.409 *** (0.368)	0.151 (0.139)	−0.611 (0.346)	0.037 (0.147)	0.791 ** (0.304)
PO-free	0.966 *** (0.182)	−1.264 * (0.517)	−0.116 (0.161)	−0.428 (0.528)	0.943 *** (0.195)	0.567 (0.387)
EU organic	0.151 (0.125)	−0.837 ** (0.289)	0.507 *** (0.097)	−0.192 (0.290)	0.723 *** (0.106)	0.266 (0.196)
Fairtrade	0.804 *** (0.174)	−0.760 (0.399)	0.644 *** (0.130)	−0.353 (0.371)	1.496 *** (0.187)	0.860 * (0.333)
40% chocolate	0.913 *** (0.172)	−0.212 (0.321)	0.006 (0.123)	3.187 *** (0.510)	0.565 *** (0.129)	1.473 *** (0.249)
membership variables: coefficient (standard error)						
age	−0.021 (0.013)	−0.027 * (0.010)	−0.068 *** (0.013)	−0.035* (0.014)	−0.051 *** (0.013)	
female	0.151 (0.182)	0.168 (0.143)	0.297 (0.181)	0.31 (0.192)	0.100 (0.175)	
high education	0.058 (0.272)	−0.208 (0.225)	−0.121 (0.276)	−0.302 (0.314)	−0.323 (0.272)	
medium education	−0.636 * (0.268)	−0.093 (0.203)	−0.556 * (0.276)	0.013 (0.293)	−0.161 (0.260)	
high income	0.406 (0.298)	0.557 * (0.241)	0.600 * (0.284)	0.738 * (0.303)	0.891 ** (0.281)	
medium income	0.296 (0.237)	0.091 (0.189)	0.121 (0.235)	−0.060 (0.251)	0.467 (0.231)	
cert. support	0.324 (0.203)	0.275 (0.157)	0.764 *** (0.205)	0.432 (0.218)	0.944 *** (0.204)	
cert. skepticism	−0.379 * (0.191)	−0.216 (0.150)	−0.572 ** (0.193)	−0.178 (0.204)	−0.470 * (0.181)	
PO objection	0.052 (0.197)	0.133 (0.165)	−0.112 (0.194)	−0.090 (0.213)	0.053 (0.189)	
PO knowledge	−0.283 * (0.130)	−0.189 (0.103)	−0.384 ** (0.126)	−0.162 (0.135)	−0.123 (0.125)	
PCE	0.430 (0.263)	0.010 (0.194)	−0.053 (0.259)	−0.108 (0.272)	0.396 (0.248)	
sust. concern	0.454 (0.246)	0.298 (0.184)	0.579 * (0.243)	0.570* (0.266)	0.885 *** (0.250)	
informed cons.	0.667 * (0.271)	−0.349 (0.211)	0.896 ** (0.271)	−0.048 (0.295)	0.581 * (0.274)	
_constant	0.498 (0.279)	1.354 *** (0.237)	0.817 ** (0.286)	0.036 (0.332)	0.208 (0.289)	

Note: ***, **, * denote significance at $p < 0.001$; $p < 0.01$; $p < 0.05$, respectively. PO—palm oil.

Table 7 shows the latent classes after information provision (part 2). Based on the coefficients and class shares, the results were compared with part 1 to identify relevant changes. The results suggest that the “palm oil neutrals” have split up into other segments. The “palm oil avoiders” gained class

share, although not as much as the “concerned consumers”. The class share of the largest segment, the “plain cookie eaters”, has only marginally changed. However, its members now express significant and strong preferences for the *RSPO certified* attribute, while still no positive utility is derived from any other product attributes. It has to be considered that this group is still highly price-sensitive, so the support for *RSPO-certified* palm oil does not automatically translate into the willingness to pay a high premium for this attribute. Except for the “chocolate lovers”, all segments now express significantly positive preferences for the *RSPO certified* label.

Table 7. Latent class analysis for part 2 of the choice experiment.

Latent Class	Class 1	Class 2	Class 3	Class 4	Class 5
Label	Palm Oil Avoiders	Plain Cookie Eaters	Concerned Consumers	Chocolate Lovers	Cheap Shoppers
class share	21.2%	31.6%	27.5%	7.2%	12.5%
product variables: coefficient (standard error)					
opt-out	1.216 *** (0.178)	−8.456 *** (0.572)	−1.517 *** (0.205)	0.272 (0.315)	−2.642 *** (0.386)
price	−0.677 *** (0.083)	−2.278 *** (0.138)	−0.191 ** (0.060)	−0.394 *** (0.106)	−2.731 *** (0.472)
RSPO certified	1.171 *** (0.175)	0.515 ** (0.183)	1.039 *** (0.096)	0.213 (0.270)	0.662 * (0.284)
RSPO mixed	0.006 (0.218)	−0.114 (0.194)	0.482 *** (0.096)	0.594 * (0.280)	0.397 (0.275)
PO-free	2.717 *** (0.193)	0.116 (0.233)	1.537 *** (0.129)	0.745 * (0.340)	0.980 * (0.466)
EU organic	0.236 * (0.099)	−0.295 (0.171)	0.456 *** (0.060)	−0.558 ** (0.208)	0.034 (0.167)
Fairtrade	0.664 *** (0.142)	−0.861 *** (0.239)	0.894 *** (0.109)	−0.068 (0.253)	−0.063 (0.346)
40% chocolate	0.325 ** (0.122)	−0.602 ** (0.220)	0.181 * (0.080)	2.847 *** (0.299)	0.870 *** (0.224)
membership variables: coefficient (standard error)					
age	−0.004 (0.011)	−0.037 *** (0.010)	−0.043 *** (0.010)	−0.020 (0.014)	
female	0.306 * (0.154)	0.205 (0.134)	0.163 (0.144)	0.137 (0.185)	
high education	−0.136 (0.231)	−0.010 (0.203)	−0.208 (0.222)	0.188 (0.313)	
medium education	−0.257 (0.218)	−0.147 (0.187)	−0.025 (0.206)	0.176 (0.298)	
high income	−0.030 (0.251)	0.306 (0.211)	0.554 * (0.224)	0.487 (0.274)	
medium income	0.226 (0.204)	−0.010 (0.176)	0.112 (0.191)	−0.124 (0.246)	
cert. support	0.483 ** (0.177)	0.352 * (0.152)	0.830 *** (0.170)	0.594 ** (0.217)	
cert. skepticism	−0.314 (0.160)	−0.150 (0.141)	−0.470 ** (0.152)	−0.254 (0.198)	
PO objection	0.383 * (0.170)	0.208 (0.157)	0.377 * (0.163)	−0.019 (0.216)	
PO knowledge	−0.152 (0.111)	−0.180 (0.097)	−0.190 (0.104)	−0.079 (0.132)	
PCE	0.464 * (0.226)	0.130 (0.184)	0.435 * (0.205)	−0.015 (0.264)	
sust. concern	0.282 (0.216)	−0.065 (0.178)	0.650 ** (0.209)	0.166 (0.265)	
informed cons.	0.615 ** (0.224)	−0.281 (0.187)	0.195 (0.207)	−0.223 (0.267)	
_constant	0.660 ** (0.239)	1.110 *** (0.203)	0.866 *** (0.208)	−0.464 (0.320)	

Note: ***, **, * denote significance at $p < 0.001$; $p < 0.01$; $p < 0.05$, respectively.

A very strong positive change in the *RSPO certified* coefficient can be observed for the “palm oil avoiders”, so the label of this class might be questioned now. However, they still show clearly stronger preferences for *PO-free* cookies, which even increased compared to part 1. A higher *PO objection* value increases the likelihood of being a “palm oil avoider” compared to the reference. In general, this class is not against sustainability certification, as indicated by the significant coefficients for the respective labels. The coefficient for *certification support* is now significantly positive for classes 1 to 4. This means that respondents who support certification are less likely to be members of the “cheap shoppers”, who still are the most price-sensitive class.

While in part 1, the “cheap shoppers” preferred *RSPO mixed* over *RSPO certified*, these preferences have now been reversed, and the coefficient for *RSPO mixed* is not significant anymore. The only class that now unexpectedly prefers *RSPO mixed* over *RSPO certified* are the “chocolate lovers”. While this class still cares most about the chocolate content, they seem also indifferent between buying cookies and opting out. The “concerned consumers” are still the least price-sensitive and show the highest preferences for *EU organic* and *Fairtrade* certification. Despite the psychometric variables that reflect support for sustainability certification as compared to the reference class, “concerned consumers” still prefer *PO-free* over *RSPO certified* cookies. This is in line with the positive coefficient for *PO objection*.

The results of the latent class analysis confirm that preferences with respect to palm oil and other relevant attributes are heterogeneous among consumers. Before information provision, the large majority of more than 70 percent of the sample does not derive any significantly positive utility from certified sustainable palm oil, while 30 percent prefer palm-oil-free cookies. After information provision, all respondents except for the smallest segment derive utility from *RSPO-certified* palm oil, but still the majority prefers palm-oil-free cookies. In both parts, only one segment prefers mass balance (*RSPO mixed*) over segregation (*RSPO certified*). The considered socio-economic and psychometric characteristics can be considered potential sources of preference heterogeneity. It has to be considered that the membership variables’ coefficients and their significance would differ if another class was used as reference.

4.4. Willingness to Pay

With respect to the interpretation of coefficients, it has to be emphasized that only the relative magnitude of utility (ordinal utility) matters, while the absolute coefficient values are not directly interpretable [66,95]. More meaningful odds ratios can be calculated by exponentiating the coefficients [71]. (Marginal) WTP can be calculated as the (negative) ratio of the respective attribute coefficient and the price coefficient. The *llogit2* module for Stata provides a post-estimation command for calculating class-specific WTP [96]. However, WTP should only be calculated for variables that show significant coefficients [66]. This restriction makes a comparison of WTP values across classes difficult. For the sake of brevity and interpretability, WTP has been calculated for the mixed logit models presented in Table 4, using the post-estimation command developed by Hole [97]. Table 8 shows the mean WTP and the 95% confidence intervals (CIs) for part 1 (before information provision) and part 2 (after information provision). The mean WTP for *RSPO mixed* in part 1 is italicized because the respective coefficient was not significant.

Table 8. Willingness to pay (WTP) for chocolate cookie attributes (mixed logit, preference space).

(€/200 g Cookies)	Part 1		Part 2	
	Mean	95% CI	Mean	95% CI
<i>RSPO certified</i>	0.11	[0.02–0.20]	0.74	[0.63–0.84]
<i>RSPO mixed</i>	<i>0.03</i>	[-0.06–0.12]	0.37	[0.27–0.46]
<i>PO-free</i>	0.34	[0.24–0.44]	1.43	[1.30–1.55]
<i>EU organic</i>	0.31	[0.26–0.37]	0.28	[0.23–0.34]
<i>Fairtrade</i>	0.57	[0.49–0.65]	0.50	[0.40–0.59]
40% chocolate	0.60	[0.53–0.68]	0.51	[0.43–0.58]

The values can be interpreted in terms of price premiums compared to the reference level. For instance, in part 1, respondents are on average willing to pay a premium of €0.11 for a 200 g package of cookies that contain 100% RSPO-certified palm oil, as compared to cookies with conventional palm oil, all else being equal. After information provision, the premium rises to €0.74 on average. For palm-oil-free cookies, the results indicate a much higher average WTP: €0.34 before and €1.43 after information provision. To set these values into context: cookies without any label but with 40% chocolate content cost around €0.79 in German discounters.

5. Discussion

5.1. Interpretation and Comparison of Results

This article contributes to the literature on consumers' attitudes and preferences concerning palm oil by quantitatively assessing preferences for products containing either segregated or mass balance RSPO-certified palm oil, uncertified palm oil, or no palm oil. Overall, the results indicate that consumers in Germany prefer palm-oil-free products over products that contain certified sustainable palm oil. This finding is in line with the results of the study by Vergura et al. [16]. Confirming the findings by Gassler and Spiller [49], the "RSPO certified" label is, on average, preferred over the "RSPO mixed" label. However, although this study also conducted a latent class analysis based on a choice experiment involving a chocolate product with a quota-based sample in Germany, the results differ considerably. Gassler and Spiller [49] derive a mean WTP of €0.85 for "RSPO certified" and €0.43 for "RSPO mixed" palm oil per 100 g package of chocolate bars. In the present study, the mean WTP after information provision is €0.74 and €0.37, respectively, but it has to be considered that these premiums refer to a 200 g package of chocolate cookies. These differences might partly result from differences in the choice design, as Gassler and Spiller [49] focus only on RSPO certification and the price, whereas the present study includes additional relevant product attributes. Particularly interesting is that the WTP for palm-oil-free cookies is higher than for RSPO-certified cookies, both before and after information provision.

The aspect of information provision has not been tested by Gassler and Spiller [49], as all respondents received information on palm oil and certification prior to the choice experiment. The present study shows that information provision does indeed influence preferences, supporting findings from previous research [53,57]. The identified premiums before information provision are much lower than afterward. It can be argued that the WTP before information provision better reflects a real purchase situation in which there is usually no additional information provided at the point of sale. Moreover, it is more realistic to consider additional product attributes that are advertised on the package besides palm-oil-related claims. The significant price premiums for Fairtrade and EU organic certification are slightly reduced after information provision. This might be explained by the fact that both schemes are more popular in Germany than RSPO. While 86 percent of the sample indicated in the survey that they had never heard of RSPO before, this share was much smaller for EU organic (37%) and Fairtrade (10%). The brief information provided to respondents probably did not considerably increase knowledge about these schemes. The small reduction in the price premiums for these labels might be attributed to the increased relative importance of RSPO certification, as respondents had to deal with trade-offs.

This study also confirms previous findings related to the prevalence of preference heterogeneity (e.g., [47,50,52]). Particularly attitudinal characteristics, such as support of sustainability certification or concern about sustainability issues, are relevant for segmentation. Contradicting other studies [26,28,48,49], gender was not found to be a relevant factor, and also education does not seem to matter much. While Gassler and Spiller [49] found that the oldest segment was also the least price-sensitive, the present study indicates the opposite. Interestingly, after information provision, subjective knowledge on palm oil was not a significant factor for distinguishing classes from the reference anymore. This makes sense, as this aspect was assessed before information provision, which can be expected to reduce differences

in knowledge. The inclusion of additional product attributes might be a relevant reason why the latent class analysis resulted in more classes compared to the study by Gassler and Spiller [49].

With respect to the indicated class shares, it needs to be considered that they represent the mean posterior probability of class membership. While some individuals have a very high probability of membership for one of the classes based on their preferences and characteristics, others are more difficult to allocate. To assess the allocation precision, it is useful to calculate the average of the maximum posterior membership probability over respondents [89], also known as the index of relative entropy [98]. For part 1, this value is 89 percent, for part 2, it is 93 percent, indicating high overall precision. To analyze the changes in class composition from part 1 to part 2, it is possible to assign each respondent to the class for which his or her maximum posterior probability of class membership had been estimated.

5.2. Limitations of the Study

This study had several methodological limitations. There might be relevant product attributes that influence consumer preferences but were not considered in this study, such as the product brand. The product brand was found to be irrelevant in the study by Vergura et al. [16] that also focused on cookies. In Germany, chocolate cookies are typically offered by supermarkets' and discounters' own brands. Thus, it could be assumed that the brand does not play a major role for this product category.

For the "palm-oil-free"-labeled cookies, it was not further specified which alternative oil or fat should be assumed as an ingredient, and no information on the advantages and disadvantages of different alternatives was provided to reduce the cognitive burden. While purchasing RSPO-certified palm oil might be an option for consumers who are concerned about the sustainability of conventional palm oil cultivation, potential health concerns might probably not be resolved in this way. Although there is still a lack of robust scientific evidence on the adverse health effects of palm oil consumption [99–101], many consumers still perceive palm oil as unhealthy. Potential health concerns have not been assessed in this study, but previous research suggests that such concerns might positively influence preferences for "palm-oil-free" products (e.g., [48,50,52]). It might be assumed that providing additional information on these aspects would have an influence, probably reducing relative preferences for the "palm-oil-free" attribute.

The omission of potentially relevant product attributes or information might have led to an overestimation of the utility of the considered aspects [45]. Referring to the behavioral framework described in Section 2.1, additional aspects might influence preferences but have not been considered here, such as the (perceived) product availability, different values, or social norms [41,42]. As explained in Section 3.3, the psychometric instruments used in the analysis were assessed in different parts of the questionnaire. For instance, knowledge on palm oil was assessed before additional information was provided, while the scale on sustainability concerns was assessed toward the end of the survey, in order to reduce social desirability bias in the choice experiment. It has to be considered that the structure of the questionnaire and the timing of questions certainly have an influence on the results.

It has to be considered that the coding of variables as well as assumptions on the distribution of effects have an influence on the size of the coefficients, which also affects the resulting marginal WTP values and their interpretation. It has, therefore, been suggested to test the sensitivity of results using various model specifications in preference space or willingness-to-pay space [102]. For the sake of brevity, WTP was only estimated for the mixed logit models in preference space here. Considering the latent class models, some classes indicated a very high WTP for palm-oil-related attributes, particularly after information provision. The "palm oil avoiders", for instance, would supposedly be willing to pay a premium of around €4 to get palm-oil-free cookies, all else being equal. Considering the price level of a package of chocolate cookies, this value seems unrealistically high. This might be attributed to the fact that this study assessed stated preferences, not revealed preferences. Hypothetical bias and social desirability bias might contribute to the so-called attitude–behavior gap [41,103,104]. Although a "cheap talk" script was used to reduce hypothetical bias, this issue might not have been completely

eliminated. In this regard, the study by Gassler and Spiller [49] was more incentive-compatible than this study, as it involved a randomly determined real purchase for one-third of the sample.

5.3. Recommendations

Preferences for palm-oil-free products as compared to products containing RSPO-certified palm oil identified in the present study are problematic in so far as palm-oil-free products contain alternative oils or fats that are not necessarily more sustainable, considering efficiency in terms of land use and productivity [20–22]. Guadalupe et al. [54] suggest that the food industry should replace palm oil to meet consumers' preferences. Taking the relative advantages of palm oil compared to alternatives into account, this advice should not be supported. Instead, public and private efforts to source sustainably produced commodities should be strengthened. While sustainability certification is an important instrument to achieve sustainability targets, it will most likely not be sufficient and needs to be complemented by other policy measures [105,106]. The governments of Germany and other European countries already declared their commitment to support the development of sustainable and deforestation-free supply chains [34,107]. Other palm oil importing countries should be encouraged to follow this example, in order to reduce the risk of leakage effects [108,109]. Reductions in the overall consumption of palm oil and other vegetable oils in the European Union and other countries would be required to reduce the risk of further conversion of rainforests [110].

Policy interventions suitable for supporting sustainable consumption involve the provision of information and incentives [44]. Consumer involvement might be stimulated by focusing on the communication of positive socio-economic and environmental effects of consuming certified sustainable palm oil [41]. However, the results of this study indicate that providing information on RSPO certification to consumers might not be sufficient to convince them to buy certified products, if palm-oil-free alternatives are available. Considering previous research, consumers' preferences for palm-oil-free products might be attributable to concerns about potential health issues of palm oil consumption, and/or a lack of trust in sustainability certification. Therefore, it would be recommendable for policymakers to implement a general information campaign that explicitly focuses on explaining misconceptions with respect to adverse health effects and on communicating the benefits of palm oil compared to alternative oils. Information campaigns have also been suggested in previous studies [49,57].

However, Disdier et al. [57] have argued that such campaigns might be difficult to implement, as many aspects would need to be communicated to provide full information. It will probably not be sufficient to provide information at the point of sale. Lange and Cormans [51] have shown that providing information to consumers does not automatically mean that consumers read and process this information. Results from focus group discussions indicate that consumers are often in a hurry when shopping for groceries and tend to focus on product information that can be quickly processed [59]. Thus, initiatives such as the German FONAP should be further encouraged to inform consumers in situations in which they are actively looking for information. FONAP, for instance, has been involved in the International Green Week, a popular annual trade fair organized in Berlin, which is not only visited by business actors, but also by many consumers.

The results of the latent class analysis suggest that the consumption preferences of different consumer groups might be influenced by various aspects. Knowledge on the issue is one relevant factor that also might be interlinked with different attitudinal variables that are more or less pronounced in different groups. In general, more research is needed on the relationships between different influence factors, particularly on the direct and indirect effects of knowledge on attitudes. Many studies trying to quantify consumer preferences for certain product attributes have been conducted in a fictitious online or laboratory setting. Incentive-compatible experiments and real-life observations are expensive and difficult to implement, but would reduce potential biases and provide more realistic results with respect to revealed preferences. Previous field experiments focusing on preferences for Fairtrade certification are interesting examples [111,112]. As food manufacturers and retailers would also benefit

from improving consumer acceptance of certified palm oil, it might be a good idea to involve them in research projects to exchange insights and improve access to data.

To raise awareness of certified sustainable palm oil, private sector stakeholders should consider increasing the use of RSPO labels on product packaging, also to counterbalance the prevalence of palm-oil-free claims. Further research should focus on other types of products, particularly non-food products. In this regard, it has to be considered that within the European Union the type of vegetable oil used as an ingredient has to be declared only for food products [113], which might have a relevant influence on awareness among consumers.

6. Conclusions

This study contributes to research on consumer attitudes and preferences by considering trade-offs between conventional palm oil, certified sustainable palm oil, and alternatives to palm oil advertised through “palm-oil-free” labels. A discrete choice experiment was implemented as part of a web-based survey in Germany to investigate these trade-offs as well as potential sources of preference heterogeneity. The results suggest that, on average, consumers prefer palm-oil-free cookies over cookies with palm oil certified according to RSPO standards, which again is preferred over conventional, uncertified palm oil. After providing further information on palm oil and certification, preferences for RSPO-certified palm oil are stronger, but palm-oil-free alternatives are still preferred. A latent class analysis identifies different consumer segments that can be characterized according to their preferences and certain socio-demographic and psychometric attributes. This analysis reveals that a large share of respondents does not care much about palm oil if they are just presented with the product and no additional information. Therefore, previous studies providing detailed information before assessing preferences might have produced overestimated results. These findings are particularly relevant for policymakers, manufacturers, and retailers that aim to increase the uptake of certified sustainable palm oil as one measure to resolve sustainability issues linked to global supply chains. Considering attitudinal factors, information campaigns might be targeted to certain consumer segments that still lack knowledge and could be convinced of the benefits of certified palm oil compared to alternatives. Further research should apply incentive-compatible methods to reduce biases and focus also on non-food products that may contain palm oil.

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Appendix A. Cheap Talk Script

The following cheap talk script was presented to the respondents prior to part 1 of the choice experiment (translated from German; bold formatted parts as in the original survey):

“Please read the following information carefully:

In the following, please imagine yourself situated in a supermarket, aiming to buy **a package of chocolate cookies**. There are two different products available. These **differ** according to the following **characteristics: price, ingredients, and certification**. The **price** is indicated below the product and refers to a **package size of 200 g**.

Studies have shown that people act differently in surveys compared to “real” decisions. For instance, some people indicate in surveys that they are willing to buy a product at a certain price, although they would not pay that price in the supermarket.

Please imagine that your decision is constrained by your usual grocery shopping budget. If you choose a product, your budget available for other groceries is reduced by its price. You also have the

option to choose neither of the two products that are presented to you, if they are both not appealing to you. **Please make your choice as you would choose a product in a real shopping situation.**

Appendix B. Information Provided after Part 1 of the Choice Experiment

The following information on palm oil and the different certification labels was presented to the respondents after part 1 of the choice experiment (translated from German, bold formatted parts as in the original survey). For the explanation of the labels, each label was presented next to its description. These images (as shown in Figure 1) are omitted here for the sake of brevity.

“Please read the following information carefully! This information is relevant for the subsequent tasks.

Palm oil is predominantly produced in Indonesia and Malaysia. For some palm oil plantations, rainforests have been cleared. The loss of rainforests is problematic for the environment and the local species. Deforestation contributes to climate change.

The Roundtable on Sustainable Palm Oil (German: “Runder Tisch für nachhaltiges Palmöl”; **RSPO**) is an organization of different actors (e.g., environmental conservation agencies, private companies) that have developed sustainability standards particularly for palm oil. The implementation of these standards aims at having positive effects on the palm oil production, meaning amongst other aspects:

- reduced consumption of resources (soil, water, energy) and reduced utilization of fertilizers and pesticides, for instance
- reduced pollution of water and air; reduced greenhouse gas emissions
- improved conservation of ecosystems
- safe and adequate working conditions
- improved income security for producers

RSPO labels on final products differ according to whether certified palm oil is separated from uncertified palm oil along the whole supply chain (transportation and processing):

RSPO certified: The product contains certified sustainable palm oil. “Certified” means that the product contains only palm oil that has been certified according to the RSPO sustainability standards. There should not be any blending with uncertified palm oil.

RSPO mixed: “Mixed” means that certified and uncertified palm oil are allowed to be mixed. It is not clear how much of the palm oil contained in the “mixed” labeled product is actually certified. According to the RSPO, the product contributes to the production of sustainable palm oil.

Apart from these RSPO labels, some of the chocolate cookies presented to you in the previous decision situations also showed the following labels:

palm-oil-free: This product does not contain any palm oil, but instead contains an alternative oil or fat. Vice versa, this means for the decision situations presented to you that a product *not* carrying this label does contain palm oil.

EU organic: This product has been certified according to organic standards of the European Union. At least 95% of the ingredients have been produced in organic agriculture.

Fairtrade: This product has been certified according to Fairtrade standards that aim at contributing to fair trade conditions. Amongst other aspects, a minimum price is guaranteed to producers, and an additional premium is awarded to the community to finance social projects.”

Appendix C. Survey Items Included in the Principal Component Analysis

Tables A1–A3 show all items that have been included in the PCA described in Section 4.2. The items were presented in German, but here the English translation is shown. All items were assessed by the respondents on a labeled 7-point Likert scale (1: strongly disagree; 2: disagree; 3: somewhat disagree; 4: neither agree nor disagree; 5: somewhat agree; 6: agree; 7: strongly agree). The items were presented in different blocks within the survey, and the order of items was randomized. For the sake of comprehension, Table A1 shows the items ordered according to the factors identified in the PCA

(see also Table 3 in Section 4.2). For some (negatively worded) items, the coding was reversed prior to conducting the PCA.

Table A1. Survey items: statements developed by the authors.

Instructions: Please indicate your agreement/disagreement with the following statements. (7-point Likert scale)		
No.	Item	Retained Factor
1	When I trust a sustainability label, I am willing to pay more for a product carrying this label.	certification support
2	Sustainability certification is the first step in the right direction.	
3	I usually try to buy products carrying a sustainability label.	
4	Products with sustainability label are usually more sustainable than products without such a label.	
5	I don't trust in sustainability certification because the standards and criteria are not transparent to consumers.	certification skepticism
6	I don't think that sustainability certification really contributes to sustainability.	
7	Sustainability labeling is only a marketing strategy of the industry.	
8	I tend to trust uncertified products by small, regional producers more than certified products by large, multinational corporations.	
9	I tend to consider the ingredients of food products more frequently than I consider the ingredients of other products that I buy.	informed consumption
10	When I frequently purchase a product, I tend to look for information on its ingredients.	
11	I would appreciate it if there was a more explicit mandatory labeling requirement for products containing palm oil.	
12	I have searched for information about which alternatives to palm oil might be better.	
13	I have searched for information about palm oil prior to participating in this survey.	
14	I don't care whether a product contains palm oil or not, as long as it tastes good. (coding reversed)	
15	Palm-oil-free products are not any better than products containing palm oil. (coding reversed)	
16	Palm oil is not necessarily bad, it depends on the production conditions. (coding reversed)	palm oil objection
17	Palm oil is unhealthy.	
18	Palm oil is cheap and therefore it can't be high-quality.	
19	Palm oil can't be sustainable because it has to be transported long distances.	

Table A2. Survey items: perceived consumer effectiveness (PCE).

Instructions: Please indicate your agreement/disagreement with the following statements. (7-point Likert scale)	
No.	Item
1	It is useless for the individual consumer to do anything about environmental problems. (coding reversed)
2	When I buy products, I try to consider how my use of them will affect the environment.
3	When I buy products, I try to consider how my use of them will affect other people.
4	Since one person cannot have any effect upon the exploitation of natural resources, it doesn't make any difference what I do. (coding reversed)
5	Each consumer's behavior can contribute to sustainability by purchasing products sold by socially responsible companies.

Note: This scale has been adopted and slightly modified from reference [43].

Table A3. Survey items: concern about sustainability issues.

Instructions: Please indicate to what extent you feel concerned about the following topics in the context of food. (7-point Likert scale)	
No.	Item
1	The use of child labor in food production
2	Deforestation of rainforests for food production
3	Starvation and malnutrition in the world population
4	The use of pesticides in food production
5	The abuse of animals in food production
6	Environmental damage caused by food production
7	Food waste
8	Overexploitation of natural resources for food production
9	Poor working conditions for food producers
10	Low wages for food producers
11	Packaging that is not recyclable
12	The amount of packaging used for food products
13	Greenhouse gas emissions caused by food production
14	Energy consumption in food transport
15	Energy consumption in food processing

Note: This scale has been adopted and slightly modified from reference [45].

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