The Relationship of Perceived Consumer Effectiveness, Subjective Knowledge, and Purchase Intention on Carbon Label Products—A Case Study of Carbon-Labeled Packaged Tea Products in Taiwan

Ta-Ching Liang 1, Rospita Odorlina P. Situmorang 2*, Mei-Chi Liao 3 and Shu-Chun Chang 3,*

1 Department of Leisure & Recreation, National Formosa University, Huwei Township 632, Taiwan; taching@nfu.edu.tw
2 Department of Forestry, National Chung Hsing University, Taichung City 402, Taiwan; pita_80s@yahoo.com
3 Graduate Institute of Bio-Industry Management, National Chung Hsing University, Taichung City 402, Taiwan; mei758172@gmail.com
* Correspondence: kimichang@dragon.nchu.edu.tw

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Abstract: In view of global warming issues, the Taiwan government has implemented environmental-related policies and measures for sustainable development through promoting “carbon labeling” in recent years. Many studies related to carbon labeling have been conducted after its promotion, but the studies on the relationship of subjective knowledge or perceived knowledge on carbon labeling, perceived consumer effectiveness (PCE), and willingness to buy the products are still limited. Therefore, this study aimed to examine the relationship of subjective knowledge on carbon labeling, consumer perception, and willingness to buy carbon label products, with a case study of packaged tea products in Taiwan. The respondents were Taiwanese adults aged 18 years old and over, who have experience of buying packaged tea. The research was conducted by survey method using non-probability sampling method at convenience retail stores i.e., 7-Eleven and Family Mart. The result showed that (1) the consumers with high subjective knowledge have high willingness to purchase packaged tea products with carbon labels, consumers with high PCE have high subjective knowledge of carbon labeling, and consumers with high PCE have high willingness to buy carbon-labeled packaged tea products; (2) there is a positive linear relationship of subjective knowledge and PCE toward purchase intention of carbon label; and (3) a significant positive correlation between subjective knowledge, PCE, and willingness to buy packaged tea beverage products with carbon labels for the female respondents.

Keywords: carbon label; Taiwanese consumers; perceived knowledge; PCE; packaged tea products; relationship

1. Introduction

In 1979, the First World Climate Conference (FWCC) revealed that human activities are the main factor of excessive carbon dioxide emission causing global warming and global climate change that attracted attention of countries [1,2]. After this international conference, the countries agreed to develop international bodies upon a common goal to reduce greenhouse gas emissions to combat climate change such as the United Nations Framework Convention on Climate Change (UNFCCC) in 1990, the Kyoto Protocol in 1993, and the Paris Agreement in 2015. In 2001, the third assessment report of the Intergovernmental Panel on Climate Change (IPCC) have mentioned that effects of climate change have increased the global average temperature by 0.6 + 0.2 °C over the 20th century, increased
the ocean temperature, caused ice and polar ice melting, and raised sea level [3]. Hence, the IPCC suggested that all the signatory countries should promote greenhouse gas reduction activities and adopt sustainable development.

As a response to the global climate change issue, many countries have introduced policies related to environment in order to reduce their national greenhouse gas emission level. One of the kind of policies is promotion of carbon label (CL) on various products that can be used to monitor the total greenhouse gas emission level in certain products [4,5]. Carbon label or carbon emission label describes the carbon dioxide (CO\textsubscript{2}) emission released throughout the life-cycle of a product or service (carbon footprint certification) by manufacturing [6]. Carbon label was firstly introduced in 2007 when British retailer Tesco decided to label its products with CO\textsubscript{2} emission information during its manufacturing and transportation [7,8]. After that, carbon labeling systems have emerged in many locations, and today, the carbon labeling is considered as the same as the labeled organic products and fair-trade verification. Carbon labeling is a way to inform consumers about the environmental impacts of products through providing information on the product characteristics [9,10]. Carbon labeling has function to allow consumers to make more environmentally friendly choices to minimize their ecological footprint made by their purchases and to facilitate companies to build an environmentally friendly image on their products [11,12]. Swallow and Furniss [13] argued that carbon labeling has become a must-have label on food products to attract ethical consumers nowadays.

In Taiwan, the carbon label certificate has been applied since September 2010. Taiwan is recognized as the 11th country in the world to apply a carbon footprint label on products. In a 2014 report, the Taiwan government had certified 205 products with a carbon label [14]. Through this long experience, carbon labeling has been well known for Taiwanese consumers and used as one of the considerations to purchase products, particularly on food products.

Environmental knowledge has an important role to form sustainable behavior including on purchasing behavior [15]. Knowledge can be divided into subjective knowledge and objective knowledge. Subjective knowledge is regarding what individuals think they know or perceived knowledge, while objective knowledge is what is actually memorized [16]. In this study, subjective knowledge on a carbon label is what the individual thinks they know about the carbon label. In the context of eco-friendly product purchasing, subjective knowledge more influences on actual environmental behavior compared to objective knowledge [16]. Subjective knowledge influences the consumer’s likelihood on food choices [17]. Fan et al. [18] and Wu and He [19] who evaluated the carbon label product purchasing found a significant correlation between environmental knowledge and willingness to purchase carbon-labeled products.

Environmental knowledge is a driving factor that influences people’s sensitivity to environmental problems around them and leads them to make choices and decisions to solve the problems [15,20]. Perceived consumer effectiveness (PCE) is considered as one of the measurement methods to measure perceived sustainable behavior [21,22]. Initially, PCE is considered as a measurement on the specific-domain belief that afford people to make a different solution or decision to problems which can be applied to different aspects. However, PCE is widely applied to measure the environmental behavioral control and to predict environmentally conscious behavior [21,23]. Regarding the study on PCE and eco-purchasing behavior, Zhao et al. [22] and Wesley et al. [24] found the significant correlation between PCE and eco-purchasing. Kim [25] also added that PCE has an important role as a moderating variable to evaluate the relationship between environmental attitude and behavior intention.

Even though the studies evaluating environmental knowledge, PCE, and purchase intention on eco-friendly products have been conducted by many scholars, the researches on this topic are still fragmented. This means that the researches examining this topic comprehensively are still limited. In addition, the researches that specifically discuss the carbon label topic are very few. To address this research gap, we were interested to conduct a study to evaluate the relationship of subjective knowledge, perceived consumer effectiveness, and willingness to buy carbon-labeled products. In this
study, the packaged tea products were chosen as the sample product to evaluate the relationship between the three factors (subjective knowledge, PCE, and purchase intention).

Packaged tea beverages are one of the three top rankings among a total of 15 food products applying carbon footprint-labeled products, purchased by consumers in Taiwan as it was reported in 1 August 2015 by the Taiwan Environmental Protection Agency (TEPA). Wang [26] conducted a study on Taiwanese consumers and assessed several products that were found to be important to be certified with carbon labels according to the consumers’ preference. This study found that food and beverages represented by packaged tea beverages were greater than other products such as toiletries (represented by shampoo) and electronic products (represented by digital cameras). This study also revealed that packaged tea beverages have undergone preliminary treatment, processing, and manufacturing regarding a process of certified carbon labels. According to the past research, Taiwanese consume about 2.8 bottles of 600 cm$^3$ packaged beverages per person per day, which shows that the consumption frequency of packaged beverages in Taiwan is very high [27]. In addition, the industry of packaging tea beverages is well developed in Taiwan, therefore, the use of a carbon label to differentiate and add value to the brand in a competitive market is important. Hence, considering the importance of the packaged tea products for Taiwanese consumers and considering the research gap related subjective knowledge, PCE, and purchase intention, this study has the following purposes to examine: (1) the difference level of consumers’ subjective knowledge, PCE, and purchase intention on carbon-labeled packaged tea products; (2) to reveal the relationship of consumers’ subjective knowledge, PCE, and willingness to purchase carbon-labeled tea products; and this research also (3) evaluates the effect of female consumers’ PCE as a moderating factor that connects knowledge and purchase intention on carbon-labeled products. Female respondents in this study became a focus because based on previous researches, men and women have different lifestyles where women are more inclined to sustainable low-carbon consumption [28,29].

2. Research Methods

2.1. Sampling and Data Collection

The respondents in this study were Taiwanese adults aged 18 years old and over, who have previous experience of buying packaged tea. The research was conducted on local Taiwanese by survey method using questionnaires as a research instrument. The locations of the survey were the convenience retail stores i.e., 7-Eleven and Family Mart, considered as the main retail channels of packaged tea beverage products in Taiwan. In a research conducted by Wu [27], it was mentioned that the 7-Eleven and Family Mart convenience stores had total sales value of NT$ 51.3 billion for packaged beverages which indicates that these stores are the main market channel for packaged beverages in Taiwan. Sampling technique in this study was a nonprobability sampling method. Nonprobability sampling refers to the method of selecting samples based on the researcher’s subjective judgement rather than random selection or probability theory [30].

The data compilation was done from 1 February 2016 to 28 February 2016. Since the level of confidence in this study was 95% ($Z = 1.69$) with the percentage error of no more than 5% ($\epsilon = 0.05$), the required valid questionnaires in this study were estimated to be at least 384 samples. In order to reach the required number of valid samples after eliminating invalid questionnaires, this study distributed 450 questionnaires to respondents and collected 411 valid questionnaires (91.3%). The survey was conducted at the four convenience stores (two 7-Eleven stores and two Family Mart stores) located in Taichung City, Taiwan. The distribution of respondents was based on gender ($F = 51.3\%, M = 48.7\%$), age (18–20 years old = 14.1\%, 21–30 years old = 57.4\%, 31–40 years old = 15.1\%, and above 40 years old = 13.4\%), and educational level (elementary = 0.5\%, junior–senior = 8.7\%, bachelor = 55.5\%, master–doctoral = 35.3\%).
2.2. Research Hypotheses

Regarding subjective knowledge which refers to perceived knowledge, some scholars stated that eco-label knowledge positively correlates with people behavior to solve environmental problems which can be implemented by their food choices [31]. More specific to carbon labeling, Fan et al. [18], Wu and He [19], and Sharp and Wheeler [32] found that consumers’ knowledge on carbon labels have positive correlation with eco-purchasing. Jin [33] mentioned that high knowledge on carbon labeling correlates with attitude shown by their purchase intention on low carbon-labeled products. Hence, in this study, we develop the first hypothesis, i.e.,

**Hypothesis 1 (H1).** There is a significant correlation between consumers’ subjective knowledge of carbon labels and purchase intention of carbon-labeled packaged tea beverage products. The higher subjective knowledge on carbon labels resulted in the higher the willingness on carbon-labeled packaged tea purchase.

To develop environmental awareness, environmental knowledge is a key factor to stimulate people awareness on environmental problems, and perceived consumer effectiveness (PCE) is linked to the measurement of people’s consciousness to make choices to solve environmental problems. Previous study found that eco-label knowledge positively correlates with people behavior to solve environmental problems which can be implemented by their food choices [16,31]. Hence, we developed the second hypothesis, i.e.,

**Hypothesis 2 (H2).** There is a significant correlation between subjective knowledge and PCE. The higher the subjective knowledge of carbon labels supposes to be the higher PCE on carbon-labeled packaged tea products.

Relating PCE and purchase intention, previous studies found significant correlation between PCE and eco-purchasing [22,24]. Zhao et al. [22] emphasized that PCE on carbon labels refers to the extent to which consumers believe in their low-carbon PEC consumption behavior on environmental benefits, and their study also found that PCE is positively correlated with attitudes on purchasing low-carbon products. Based on this finding, we constructed the third hypothesis, i.e.,

**Hypothesis 3 (H3).** There is a significant correlation between PCE and purchase intentions of carbon-labeled packaged tea products. The higher PCE on carbon label, the higher the purchase intentions of carbon-labeled packaged tea products.

Still related to PCE, Zhao et al. [22] positioned PCE as an intermediate factor which influence the factor of purchasing behavior of environmentally friendly products. Lynch [28] and Laroche et al. [29] argued that women are more willing to pay the eco-friendly products by consumption of low-carbon products. Based on these previous studies, we developed the fourth hypothesis, i.e.,

**Hypothesis 4 (H4).** Female consumers’ perceived effectiveness has a positive relationship between subjective knowledge of carbon labels and the purchase intention on carbon-labeled packaged tea products.

The relationship of Hypotheses 1–3 can be seen in Figure 1, and the relationship between female consumers’ perceived effectiveness on subjective knowledge on carbon labels and the purchase intention is shown in Figure 2.
2.3. Data Analysis

The questionnaire was comprised of four sections. First section was about the respondent’s information consisting of socio-economic characteristics. The second section was about the subjective knowledge on carbon labels which consisted of nine questions. The third section was perceived consumer effectiveness (PCE) containing 12 questions. Lastly, the questions related to purchase intentions consisting of eight questions were included in the fourth section. The answers of each question were categorized in six scaled levels (example 1 = strongly disagree, 2 = disagree, 3 = slightly disagree which means negative perception, expression, and intention; 4 = slightly agree, 5 = agree, 6 = strongly agree which means positive perception, expression, and intention) [34]. The respondents answered by grouping into two groups (low and high) of each variable (SK (subjective knowledge), PCE, and PI (purchase intention)) based on the negative or positive perception, expression, or intention of the questions. To examine the difference level of consumers’ subjective knowledge, PCE, and willingness to purchase carbon-labeled packaged tea products, the Chi-square test analysis was used to examine this purpose as shown in Hypotheses 1–3, and regression analysis was used to examine the relationship of Hypotheses 1–3 (model 1) and Hypothesis 4 (model 2).

3. Results and Discussion

3.1. Result

Before examining the correlation of each variable, the validity and reliability of the samples were examined using Kaiser–Meyer–Olkin (KMO) and calculating the Cronbach’s Alpha. For reliability test, the standard factor loading should be greater than 0.3. From all the questions (criteria) of each variable (SK, PCE, PI), there was one criteria of subjective knowledge variable, two items of PCE, and one item of purchase intention where their factor loading were less than 0.3. Hence, they were deleted during the statistical analysis to ensure the validity of the structure. After deleting these four items, the overall result of the three dimensions using factor analysis were 53.678%, 61.389%, and 62.172% for each subjective knowledge, PCE, and purchase intention. The results of Kaiser–Meyer–Olkin test, factor loading and Cronbach’s Alpha are presented in Table 1. The KMO test shows that all the results are greater than 0.8 which means that the data are a good fit. The Cronbach’s Alpha of each variable is also greater than 0.7, which means that data are reliable.
Table 1. Goodness of fit and reliability test of criteria of each variable.

| Variables                        | KMO Test | Items                                                                 | Factor Loading | Cronbach's Alpha |
|----------------------------------|----------|-----------------------------------------------------------------------|----------------|------------------|
| Subjective Knowledge (SK)        | 0.85     | 1. CL (carbon label) indicates saving energy and eliminating carbon.  | 0.64           |                  |
|                                  |          | 2. Guiding manufacturer to reduce carbon content in products.          | 0.70           |                  |
|                                  |          | 3. Reducing ecological damage.                                        | 0.68           |                  |
|                                  |          | 4. CL can identify environmentally friendly products.                 | 0.75           |                  |
|                                  |          | 5. CL guides consumers in purchasing environmentally friendly products.| 0.70           | 0.88             |
|                                  |          | 6. CL helps to choose products with low carbon.                       | 0.74           |                  |
|                                  |          | 7. Increasing satisfaction in purchasing environmentally friendly products.| 0.77           |                  |
|                                  |          | 8. CL indicates as trustworthy products.                              | 0.63           |                  |
|                                  |          | 9. Improve producers’ knowledge about carbon label.                   | 0.32           |                  |
| Perceived consumer effectiveness (PCE) | 0.93     | 1. Personal behavior causes environmental change.                    | 0.72           |                  |
|                                  |          | 2. I believe that I have ability to solve environmental problems.     | 0.80           |                  |
|                                  |          | 3. Consumers’ behavior affects society.                               | 0.82           |                  |
|                                  |          | 4. Buying environmentally friendly products (such as low-carbon products) can protect the environment. | 0.78           |                  |
|                                  |          | 5. Energy saving and carbon reduction behavior can combat global warming. | 0.80           |                  |
|                                  |          | 6. When buying a product, it will affect environment or other consumers. | 0.70           | 0.93             |
|                                  |          | 7. Personal remedial action is effective to solve pollution problems.  | 0.80           |                  |
|                                  |          | 8. Your contribution influences on environmental problem solving.     | 0.81           |                  |
|                                  |          | 9. You believe that your personal behavior can control things.        | 0.50           |                  |
|                                  |          | 10. You are confident that your action positively affects the environment. | 0.46           |                  |
| Purchase Intention (PI)          | 0.90     | 1. I have the possibility to buy packaged tea beverages with carbon labeling. | 0.77           |                  |
|                                  |          | 2. I will buy packaged tea beverages with low-carbon label.           | 0.83           |                  |
|                                  |          | 3. I will spend more money to buy products with carbon labels.        | 0.78           |                  |
|                                  |          | 4. I am interested to buy products with carbon label.                 | 0.70           | 0.90             |
|                                  |          | 5. I have intention to buy packaged tea beverages with carbon labels. | 0.85           |                  |
|                                  |          | 6. Packaged tea beverages with carbon labels are my first consideration. | 0.80           |                  |
|                                  |          | 7. Based on the above points, I will purchase products with carbon labels in future. | 0.54           |                  |
The following analysis is to examine significance of different SK and PI, PCE and SK, and PCE with PI. The average scores of question items (Table 1) are grouped into low and high categories. The results are presented in Table 2.

### Table 2. Crosstab and chi-square analysis to examine H1, H2, H3.

| Hypothesis | Variables | Categories          | Low  | High | Total | p-Value |
|------------|-----------|---------------------|------|------|-------|---------|
|            | Purchase intention (PI) | high             | f (%)| 56   | 161   | 217     | 0.001 * |
|            |            | low                | f (%)| 139  | 55    | 194     |          |
| H1 SK      | Subjective knowledge (SK) | high            | f (%)| 57   | 161   | 218     | 0.001 * |
|            |            | low                | f (%)| 137  | 56    | 193     |          |
| H2 PCE     | Purchase intention (PI) | high            | f (%)| 49   | 169   | 218     | 0.001 * |
|            |            | low                | f (%)| 146  | 47    | 193     |          |

Note: * = Statistical significance set at 0.05.

The chi-square test analysis on the correlation of different variables as shown in Table 2 results in that the subjective knowledge of carbon labels is significantly different between the two groups (p-value smaller than 0.05), which mean that H1 is accepted. The consumer with higher subjective knowledge on carbon labels have the higher purchase intention on carbon-labeled packaged tea products. A total of 74.2% of consumers that have high SK intend to buy packaged tea beverages that provide carbon labels. In contrast, only 28.4% consumers who have low SK intend to purchase the carbon-labeled packaged tea beverages. The chi-square test on the correlation of PCE and subjective knowledge on the carbon labels showed a significant difference (p-value = 0.001) between the two categories, which means that H2 is also accepted. The crosstab between PCE and SK in Table 2 show that the consumer with high PCE on carbon labels has the higher subjective knowledge on carbon labels (73.9% of the respondents who have higher PCE also have high subjective knowledge on carbon labels). Regarding the correlation of PCE with purchase intention, there is a significant difference between the high and low perception of each PCE and purchase intention shown in Table 2 (p-value < 0.05). The crosstab analysis showed that those who have high perceived effectiveness on carbon labels also have the high intention to buy carbon-labeled packaged tea beverages.

To examine Model 1 (relationship of subjective knowledge, PCE, and purchase intention), the further analysis was regression analysis presented in Table 3. The significance on F test (0.000) and t test (0.000) shows the significant correlation between them (p-values are smaller than 0.05), which means that all the independent variables (SK, PCE) significantly influence the purchase intention. The R value (coefficient correlation) is 0.678, which denotes a positive correlation and uphill linear correlation of SK and PCE toward purchase intention. The regression coefficient for subjective knowledge ($X_1$) is 0.235 and PCE ($X_2$) is 0.506 which means that 0.235 SK and 0.506 PCE are needed to obtain one purchase intention of carbon-labeled packaged tea products.
Table 3. Regression analysis on purchase intention affecting factors (Model 1, and Model 2 for female respondents).

| Model   | Independent Variables          | R Value | R²   | Significance | F Test | Standardized Coefficient | t Test |
|---------|-------------------------------|---------|------|--------------|--------|--------------------------|--------|
| Model 1 | Subjective knowledge          | 0.678   | 0.46 | 0.253        | 0.00   | 0.00                     | 0.00   |
|         | PCE                           |         |      |              |        |                          |        |
| Model 2 | Subjective knowledge          | 0.697   | 0.486| 0.000        | −0.470 | 0.00                     | 0.00   |
|         | PCE’s female respondents       |         |      |              | −0.470 | 0.00                     | 0.00   |
|         | Moderating interaction of PCE on SK and PI | | | | 1.232 | 0.00                     | 0.00   |

For the second model (Hypothesis 4) which correlate females’ PCE toward subjective knowledge and purchase intention as the dependent variable, the t-test result showed a significant correlation between females’ PCE with subjective knowledge and purchase intention ($p < 0.001$), which means that Hypothesis 4 is accepted. Therefore, perceived consumer effectiveness (PCE) of female consumers’ functions as a moderating factor or intermediate factor positively affects to develop purchase-intention behavior that correlates with their knowledge on the carbon label. The correlation of gender towards SK, PCE, and PI can be seen in Table 4. The result shows the significant difference of subjective knowledge, perceived consumer effectiveness and purchase intention of male and female respondents where the female respondents have a higher mean score of knowledge, perceived effectiveness and purchase intention on carbon labels of packaged tea products.

Table 4. Independent t-test between gender towards SK, PCE, and PI on carbon-labeled packaged tea products.

| Variables | Mean Score | Significance |
|-----------|------------|--------------|
|           | Male       | Female       |              |
| SK        | 34.379     | 35.82        | 0.034        |
| PCE       | 35.24      | 37.16        | 0.004        |
| PI        | 25.45      | 26.98        | 0.003        |

3.2. Discussion

This study produces several findings. First of all, this study examined the correlation of subjective knowledge (SK) on carbon labels and purchase intention (PI) of carbon-labeled packaged tea products, and the result of the study shows a significant correlation between subjective knowledge of carbon labels and the purchase intention of carbon-labeled packaged tea products (H1 accepted). The consumers who have higher subjective knowledge on the carbon labels have the higher willingness to purchase carbon-labeled packaged tea beverages. Subjective knowledge of the carbon label denotes the level of understanding of consumers towards importance of carbon labels as presented in Table 2. The people who have higher understanding on carbon labels were indicated by their recognition of the carbon label (footprint logo), the meaning of numbers provided in the label connected to the level of carbon contained in the products, and the function of certified products with carbon labels toward reducing greenhouse gas emission [8,35]. As this study found that the higher subjective knowledge on the carbon label also correlated with the higher willingness to purchase carbon-labeled tea products, this finding is also supported by previous study conducted by Liu et al. [8], Sharp and Wheeler [32], and Heo and Muralidharan [36]. Their studies found that consumers’ knowledge on eco-friendly products and carbon labels is connected to purchasing behavior. The consumers with higher environmental knowledge prefer to buy low-carbon products [32]. Heo and Muralidharan [36] also added that if there is a purchasing choice on non-carbon-labeled products and carbon-labeled products with equal price or slightly different price, the consumers with the better knowledge on carbon labels prefer to buy the products with a low-carbon label.
The second finding is a significant correlation between subjective knowledge and perceived consumer effectiveness on a carbon label; the consumers with high subjective knowledge also have high PCE. PCE is linked to people’s consciousness to solve environmental problems including their attitudes to reduce greenhouse gas emissions through green consumption behavior. The cognition or knowledge on carbon labels is in line with PCE which means that knowledge on carbon labels influences the people’s consciousness toward environmental issues and their society. In the past studies, knowledge on environmental issues positively correlates with a pro-environmental attitude, and in the case of eco-labels which can include carbon labels, Peschel et al. [16] and Taufique et al. [31] also found that eco-label knowledge also positively correlates with people’s behavior to solve environmental problems which can be implemented by their food choices. Similar to this finding, Jin [33] also found that cognition indicating subjective knowledge on carbon labeling is also correlated with attitude shown by their purchase intention on low carbon-labeled products. In a different object of study, Moorman et al. [17] argued that subjective knowledge influences consumers’ behavior related to food choice. However, in general, people’s knowledge on carbon labels is still low if compared to other eco-labels because of the limited information and promotion on carbon labels [37,38].

Third, PCE positively correlates with purchase intention on carbon-labeled packaged tea products. The higher PCE on carbon labels results in the higher purchase intention on products with carbon labels represented by packaged tea products. As Ellen et al. [23] mentioned, PCE is a measurement tool to predict people’s attitudes on environmental problems such as the climate change problem; the different level of PCE also results in a different intention to purchase products with carbon labels. Consumers with high PCE on carbon labels have high belief in their actions to reduce consumption of high-carbon products. They are conscious that their consumption impacts on the environment and society, and they also are conscious that they should make contributions to solve the global warming problem by taking real action to reduce green gas emissions including by their green consumption choices. Previous studies also have similar findings such as Zhao and Zhong [39], Li et al. [40], and Zhao et al. [41]. Their studies found that PCE is considered as a key factor of purchase behavior on carbon labels and PCE is positively correlated with attitudes on purchasing low-carbon products. PCE on carbon labeling refers to the extent to which consumers believe in their low-carbon PEC consumption behavior on environmental benefits.

After all the paired variables were examined (H1, H2, and H3), we conducted regression analysis to examine the correlation of subjective knowledge, perceived consumer effectiveness, and purchase intention all together, and the results are presented in Table 3 (Model 1) which shows that all subjective knowledge and PCE positively influence purchase intention. It also can be stated that the consumers who have higher knowledge on the carbon label, also have high perception to save the environment by reducing carbon emissions, and have higher intention to purchase products certified with carbon labels and to lower carbon emissions as their responsibility to protect the environment. Upham et al. [42] stated that the key issue in carbon labeling is whether the consumers will purchase products with a carbon label as conscious decision-making. It implies that carbon label purchasing can indicate the consumers’ intention to reduce emission through their own behavior. In the list of PCE variables in Table 1, it presents that the respondents (consumers) mostly agree (above 70%) that the personal behavior on purchased products affect society and environment. In Zhao et al.’s [22] study, which related green purchase behavior, a significant correlation of knowledge and PCE toward purchasing behavior was found. The positive correlation indicated that the consumers who have higher knowledge and PCE on environmentally friendly products also have higher purchasing behavior on environmentally friendly products.

The following finding is the significant role of PCE as a moderator factor to connect subjective knowledge on carbon labels and purchase intention on packaged tea products with certified carbon labels as presented in Table 3 for the second model. The result shows that PCE of female respondents is an important factor to form purchase behavior on carbon-labeled products based on their cognition or knowledge on carbon labels. Positive value of correlation coefficient (1.232) indicated that the
higher PCE, the higher influence on consumers’ behavior to purchase products with a low-carbon label. 
Zhao et al. [22] positioned PCE as an intermediate factor which influences the factor of purchasing 
behavior of environmentally friendly products. PCE on carbon labels refers to the extent in which 
consumers believe in their low-carbon PEC consumption behavior on environmental benefits. PCE is 
a psychological factor that leads people’s behavior in interpreting environmentally friendly choices 
based on social and environmental considerations. Difference of gender shows the significant difference 
in subjective knowledge of carbon labeling, PCE, and purchase intention. Women respondents have 
higher knowledge, perceived perception, and purchase intention on carbon labeling on tea beverages 
than men. This study, also in accordance with the Lynch [28] study, found that women are more 
inclined to sustainable low-carbon consumption. In fact, mostly women are willing to pay more for 
eco-friendly products than men [29]. This is because females are more environmentally concerned 
than men, which was proved in several studies [29,43,44].

4. Conclusions

The key issue in carbon labeling is whether the consumers will purchase products with 
carbon-labeled products as conscious decision-making. Hence, it is important to study the correlation 
of personal behavior and the psychological aspect on society and environment purchase behavior 
that includes personal knowledge, demographic background, and perceived consumer effectiveness. 
This study found the significant correlation between consumers’ subjective knowledge and perceived 
consumers’ behavior, subjective knowledge and purchase intention, and perceived consumers’ behavior 
toward purchase intention on carbon labeling of packaged tea beverages. All these variables influence 
each other where the higher subjective knowledge, the higher perceived consumer effectiveness on 
purchase behavior on carbon labeling of packaged tea beverages. The perceived consumer effectiveness 
(PCE) as moderator factor to connect subjective knowledge also significantly influences the purchase 
intention on carbon-labeled packaged tea products for female respondents. The female respondents 
have the higher subjective knowledge, perceived consumer effectiveness (PCE), and purchase intention 
of carbon labeling compared to male respondents. The results of this study contribute to academic 
research on carbon labeling. This research can also provide reference for companies on marketing 
strategies of carbon labeling of products and for the government in order to promote carbon-labeling 
policies and encourage consumers on low-carbon consumption. This study accessed the consumers’ 
perceived knowledge and intention on carbon labeling. However, this study did not include 
individual factors such as educational level, environmental education background or past history, 
and economic income which are believed that they influence the consumers’ knowledge on carbon 
labels, PCE, and willingness to purchase carbon label products. Therefore, this study suggests the 
evaluation of socio-economic factors on subjective knowledge, PCE and purchase intention of carbon 
labelled products in future studies.

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