Business Readiness on Greenhouse Gas Emission Reduction of Thai SMEs Processed Food Exporting Business in Response to Pre-Cross-Border Greenhouse Gas Tariffs on Imported Goods (Carbon Border Adjustment Mechanism: CBAM)

การเตรียมความพร้อมทางธุรกิจในการลดการปล่อยก๊าซเรือนกระจกของธุรกิจขนาดกลางและขนาดย่อมไทย ประเภทอาหารแปรรูปส่งออก เพื่อตอบสนองต่ออัตราภาษีก๊าซเรือนกระจกก่อนข้ามพรมแดนสำหรับสินค้านำเข้า

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Abstract

The objectives of this study were to: (1) explore the knowledge, understanding, and attitudes of processed food consumers towards eco-labeled or low-carbon products; (2) study the perception, knowledge, and preparation perspectives on participation in greenhouse gas emission reduction within the supply chain; and (3) examine the readiness of Thai SMEs exporting processed food to respond to the CBAM abroad. The research employed mixed methods including both quantitative and qualitative approaches. Quantitative research involved a questionnaire survey of 110 European consumers selected through accidental sampling. For the qualitative research, purposive sampling was employed to select key stakeholders, including 10 entrepreneurs exporting processed food from Thailand for in-depth interviews. For the quantitative research, the study analyzed data from 120 individuals using statistical tools such as mean, standard deviation, t-test, F-test, and multiple regression. The findings showed that most respondents were expatriates, female, aged 21-30 years with a bachelor's degree, employed by companies, and earning a monthly income of more than USD 900. The results revealed that different countries of residence lead to varying average monthly incomes, which in turn affect purchasing behavior towards carbon-labeled products, except; gender, education level, and occupation, the differences of levels of knowledge and understanding did not affect purchasing behavior towards carbon-labeled products. The multiplicative relationship between the purchasing behavior of environmentally friendly products and attitudes towards carbon-labeled products with the purchasing behavior towards carbon-labeled products. Interviews with Thai processed food exporters revealed a consensus that businesses must begin preparing to respond to the CBAM soon, as discussed in the research as well as perform the guidelines to promote the accountability for greenhouse gas emission reduction in SMEs exporting processed food as well.

Keywords: Business Readiness, Thai SMEs Processed Food Exporting Business, Greenhouse Gas Emission Reduction, Carbon Border Adjustment Mechanism (CBAM)

บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อ (1) สำรวจความรู้ ความเข้าใจ และทัศนคติของผู้บริโภคอาหารแปรรูปที่มีต่อสินค้าติดฉลากคาร์บอน หรือสินค้าคาร์บอนต่ำ (2) เพื่อศึกษามุมมองการรับรู้ องค์ความรู้ และการเตรียมความพร้อมเกี่ยวกับการมีส่วนร่วมในการลดการปล่อยก๊าซเรือนกระจกในห่วงโซ่อุปทานและการเตรียมการของ SMEs ไทยที่ประกอบธุรกิจส่งออกอาหารแปรรูป เพื่อตอบสนองต่ออัตราภาษีก๊าซเรือนกระจกก่อนข้ามพรมแดนสำหรับสินค้านำเข้า (carbon border adjustment mechanism) หรือ CBAM ในต่างประเทศ และ (3) เพื่อศึกษาการเตรียมพร้อมของธุรกิจเกี่ยวกับการมีส่วนร่วมในการลดการปล่อยก๊าซเรือนกระจกในห่วงโซ่อุปทานและการเตรียมการของ SMEs ไทยที่ประกอบธุรกิจส่งออกอาหารแปรรูป เพื่อตอบสนองต่ออัตราภาษีก๊าซเรือนกระจกก่อนข้ามพรมแดนสำหรับสินค้านำเข้า โดยใช้การวิจัยแบบผสม ทั้งเชิงปริมาณ โดยการใช้แบบสอบถามผู้บริโภคที่อาศัยอยู่ในยุโรป จำนวน 110 ชุด ใช้การสุ่มตัวอย่างแบบบังเอิญ และการวิจัยเชิงคุณภาพ โดยการสัมภาษณ์เชิงลึก ผู้ประกอบการที่ส่งออกอาหารแปรรูปของไทย จำนวน 10 ท่าน การวิเคราะห์ข้อมูลเชิงปริมาณ ใช้สถิติในการวิเคราะห์ข้อมูล คือ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน ค่า t-test ค่า F-test และการถดถอยพหุคูณ ผลการวิจัยพบว่า ผู้ตอบแบบสอบถามส่วนใหญ่เป็นคนต่างชาติ เป็นเพศหญิง อายุ 21-30 ปี การศึกษาระดับปริญญาตรี ทำงานรับจ้างหรือเป็นพนักงานบริษัทมีรายได้ต่อเดือน มากกว่า 900 ดอลลาร์สหรัฐ ผลการศึกษาพบว่า ประเทศภูมิลำเนาที่แตกต่างกันมีรายได้เฉลี่ยต่อเดือนที่แตกต่างกัน ส่งผลต่อแนวโน้มพฤติกรรมการซื้อสินค้าที่ติดฉลากคาร์บอนที่แตกต่างกัน ยกเว้น เพศ ระดับการศึกษา อาชีพ ระดับความรู้ความเข้าใจที่แตกต่างกันส่งผลต่อแนวโน้มพฤติกรรมการซื้อสินค้าที่ติดฉลากคาร์บอน ไม่แตกต่างกัน และ พฤติกรรมการซื้อสินค้าเพื่อการอนุรักษ์สิ่งแวดล้อมและทัศนคติต่อสินค้าที่ติดฉลากคาร์บอน มีความสัมพันธ์แบบพหุคูณกับแนวโน้มพฤติกรรมการซื้อสินค้าที่ติดฉลากคาร์บอน และสรุปผลจากการสัมภาษณ์ผู้ประกอบการส่งออกอาหารแปรรูปของไทย ซึ่งเป็นชาวไทย เห็นว่าผู้ประกอบการส่วนใหญ่

เห็นพ้องว่าต้องเริ่มการเตรียมพร้อมของธุรกิจเพื่อตอบสนองต่อ CBAM ในอนาคตอันใกล้นี้ ดังที่ได้มีการกล่าวถึงปัญหาในงานวิจัยและเป็นแนวทางการให้มีความรับผิดชอบต่อลดการปล่อยก๊าซเรือนกระจกของธุรกิจ SMEs ส่งออกอาหารแปรรูปด้วยเช่นกัน

คำสำคัญ: การเตรียมความพร้อมทางธุรกิจ ธุรกิจส่งออกอาหารแปรรูปขนาดกลางและขนาดย่อมไทย ประเภทอาหารแปรรูปส่งออก การลดการปล่อยก๊าซเรือนกระจก อัตราภาษีก๊าซเรือนกระจกก่อนข้ามพรมแดนสำหรับสินค้านำเข้า

Introduction

From an environmental perspective, it is crucial to reduce greenhouse gas (GHG) emissions, which adversely impacts all components of the environment and contributes significantly to climate change. The Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5°C Global Warming highlighted the substantial role of anthropogenic GHG emissions in climate change. The agricultural sector alone accounted for approximately 10-12% of total anthropogenic GHG emissions, with significant contributions from energy, heat production, and the agri-food sector. (The Intergovernmental Panel on Climate Change (IPCC), 2018) The proportion of total GHG emissions varied globally, with Asia responsible for approximately 44%, Africa 15%, Europe 11%, North and South America 9% and 17%, respectively (Food and Agriculture Organization of the United Nations: FAO, 2016)

The issue of climate change has become a significant turning point in global trade. The European Union (EU) pioneered the implementation of a pre-border greenhouse gas tax or Carbon Border Adjustment Mechanism (CBAM) on imported goods, following its greenhouse gas emission reduction measures and the establishment of the Emission Trading System (ETS) in 2005. This led to higher production costs within the EU, prompting some manufacturers to relocate outside the EU and re-import their goods. To counter this, the EU introduced the CBAM tax to include the cost of greenhouse gas emissions in the production process of imported goods, aiming to maintain competitiveness and encourage other countries to reduce emissions. (Dobranschi, et al. 2024).

Although the EU is not the primary market for Thai exporters in the CBAM industry, it is imperative for Thai exporters to adapt to these measures promptly. This preparation is not only crucial for maintaining the EU customer base and potentially expanding the market but also for aligning with similar measures being considered by other countries, such as the United States (US). The US, Thailand's top export market, is also contemplating carbon fees in target industries, which could begin as early as 2024. Therefore, Thai exporters in the supply chain of target industries must quickly adjust and prepare for these changes to avoid future impacts (Kasikorn Research Center, 2022). To propose potential practices, the researcher will employ a mixed-methods approach, combining quantitative analysis of market trends and qualitative interviews with stakeholders in the Thai export industry. This methodology will allow for a comprehensive understanding of the implications of CBAM and similar measures, as well as the readiness and responsiveness of Thai exporters to these changes.

The Thai government has introduced the Bio-Circular-Green Economy (BCG) model to foster sustainability and inclusiveness in Thailand's economy, society, and environment. This model leverages science, technology, and innovation to transform Thailand's biodiversity and cultural advantages into competitive advantages, focusing on four strategic sectors: agriculture and food, health and medicine, energy materials and biochemistry, and tourism and creative economy. Agriculture and food are vital to Thailand's economy, employing one-third of the workforce but contributing only 8% of Gross domestic product (GDP). The Thai food industry, aiming to become the "Kitchen of the World," supports both domestic and international consumption, making Thailand the 11th largest food exporter globally and the 2nd largest in Asia (National Science and Technology Development Agency: NSTDA, 2021).

The BCG Economy value chain encompasses various businesses, including agriculture, food, energy, chemicals, health, and medicine. The bioeconomy, originating from the agricultural sector, extends to high-value bio-based products across different industries. Similarly, the circular economy can be applied to almost every business sector, emphasizing resource circulation and efficient waste management. As the agricultural and food sectors emit a significant proportion of greenhouse gases, measures to achieve net-zero emissions are becoming increasingly stringent worldwide. Many Thai agricultural and food exporters, primarily Small and Medium Enterprise (SMEs) (94%), may struggle to adapt due to capital and knowledge constraints. Therefore, SME entrepreneurs must prioritize the Net Zero Emissions trend to remain competitive (Kasikorn Research Center, 2022).

This study aims to examine the awareness, knowledge, and readiness of Thai SME entrepreneurs producing processed food for export concerning the CBAM. While previous research has explored various aspects of supply chain sustainability, few studies have specifically addressed the challenges faced by Thai SMEs in adapting to international carbon regulations. By identifying these gaps in the existing literature, this research seeks to propose comprehensive recommendations to help SMEs enhance their preparedness and successfully adapt to the CBAM, contributing to support their competitiveness in the global market under stricter environmental regulations.

Research Objectives

This study aimed to:

1. explore the knowledge, understanding and attitudes of consumers towards purchasing behavior of carbon-labeled products

2. study the perception perspectives, knowledge and preparations regarding participation in reducing greenhouse gas emissions in the supply chain and preparations of Thai SMEs engaged in processed food export businesses to respond to the pre-border greenhouse gas tax rate for imported goods (carbon border adjustment mechanism) or CBAM in foreign countries.

3. propose recommendations on raising awareness, knowledge and readiness of businesses on their participation in reducing greenhouse gas emissions in the supply chain and preparing Thai SMEs engaged in processed food export businesses to support the pre-border greenhouse gas tax rate for imported goods (Carbon Border Adjustment Mechanism: CBAM)

Literature Review

1. Theory and concepts on sustainable development and BCG Model

The United Nations defines sustainable development as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. That is, the use of resources for the benefit of the present generation should not be wasteful but should be used in a way that always preserves and develops them to their full potential (United Nations, 1987). Therefore, sustainable development is development that can proceed steadily and smoothly without any undesirable conditions resulting from development. This sustainable development is a holistic development, meaning that all related elements must be coordinated and complete. Another characteristic is that it is balanced (Chantha et al., 2017).

The 13th National Economic and Social Development Plan (2023-2027) of Thailand is the first development plan that initiated the process framework under the national strategy in order to determine the direction of national development that should be headed in the future based on the philosophy of the sufficiency economy corresponding to the world's sustainable development goals (Sustainable Development Goals: SDGs).

The BCG Model of Thailand is a combination of the bioeconomy, the circular economy, and the green economy, where the bioeconomy is related to the production of renewable biological resources and the conversion of these resources into value-added products. Circular economy aims to reuse and recycle materials to enhance the value of limited resources. Finally, the green economy requires the economy, society and the environment to be balanced, leading to sustainable development (National Science and Technology Development Agency: NSTDA, 2021). Thailand has continuously studied efforts to reduce greenhouse gases. The supply chain of the food business consists of various processes and activities, starting from the import of raw materials from the agricultural sector to the production or processing process, storage, transportation and distribution of products to the final consumer. The food business is related to other business groups, such as farmers, restaurants, department stores or hotels, etc. (Rong et al., 2011; Parashar et al., 2019). Sustainable supply chain management requires cooperation and coordination from all relevant parties. The food business has a wide supply chain network and many activities from other related businesses. Throughout the supply chain process, food waste is generated, accounting for 2/3 of the total food volume. Food raw materials are lost in activities such as harvesting, transportation and storage, etc. Food is a commodity intended for human consumption. When food is lost within the supply chain, it is a significant loss resulting in dramatic increase of social, economic and environmental costs (Scholz et al., 2015). Food loss is not only a waste of resources, but it also leads to greenhouse gas emissions at every stage of the supply chain. Carbon footprints are created during the food production process and the disposal of unconsumed food (Bhatia et al., 2023).

2. The Carbon Border Adjustment Mechanism (CBAM)

The European Union (EU) is one of the political and economic alliances that is taking the reduction of greenhouse gas emissions seriously. In 2019, the European Commission released a Green Transformation Plan, which set a target to reduce greenhouse gas (GHG) emissions 50-55 percent by 2030 and reach net zero emissions by 2050 in order to keep global temperature below 1.5-2.0 degrees Celsius, as agreed in the Paris Agreement. The CBAM is one of the key measures of the European Green Deal that the EU will implement. The Carbon Border Adjustment Mechanism (CBAM) is one of the Fit For 551 measures under the European Green Deal policy. This measurement aims for achievement of the European Union’s goal regarding to the reduction of net greenhouse gas emissions at least 55 percent by 2030 compared to greenhouse gas emissions in 1990 and reaching Net Zero by 2050. CBAM, implemented by the EU, aims to prevent imports of high greenhouse gas emission products while supporting EU entrepreneurs facing increased production costs under the EU Emission Trading System (EU ETS). It also urges manufacturers in EU trading partners to actively reduce greenhouse gas emissions in line with stringent EU environmental measures (Digital Economy Base, 2022). It will be effective in 2023 and will be fully enforced and expanded to cover more products from 2026 onwards. Therefore, Thai manufacturers and exporters of products to the EU will have to adjust their production to reduce greenhouse gas emissions. Otherwise, there is a cost for requesting a greenhouse gas emission reduction certificate (SME social planet, 2022)

3. Sustainability and SMEs in the Food Industry

Sustainability management in the food industry is important because the food industry has a significant environmental and social impact around the world. Stakeholders in the food industry have also become increasingly involved in addressing these issues, driven by stakeholder pressure. The eight key sustainability domains include life cycle assessment, drivers, barriers and incentives to sustainability, waste management and recycling, food chain logistics, sustainability practices in small and medium-sized enterprises (SMEs), supplier management, partnerships and relationships, and other sustainable supply chain management practices. Large multinationals play a key role in supporting supply chain practices, not only by driving practices but also by allocating critical resources and partnerships across the supply chain. The circular economy has gained increasing attention in recent years, although it is argued that future research should focus on digital transformation efforts, such as through the Internet of Things and blockchain, which have been highlighted as key components supporting increased sustainability across the supply chain (Adams et al., 2021).

4. Concept of Knowledge and understanding

Knowledge and understanding refers to the ability of the brain's mental processes, such as thinking, attention, learning, problem solving, perception, and others, by collecting information through experience, senses, and thoughts. The basic characteristics of intellectual learning include understanding, memory, and application (Valamis, 2020).

5. Theories and concepts of attitude

Sukonthawirot (2017) stated that attitude means thoughts, feelings or beliefs and the tendency to express the behavior of that person. It is a response reaction by estimating whether to like or dislike. It is also a determinant of the actions or behaviors of that person that will have a positive or negative impact on other people, objects and situations in the environment of that person. This attitude can be learned or managed using past experiences. And that attitude can be known or interpreted from what people say informally or formally or from the behavior of those people. Schiffman et al. (2000) defined attitude as a tendency that comes from learning, causing behaviors that like or dislike something. And defined the components of attitude into 3 parts as follows: 1) The part of understanding (Cognitive Component) is knowledge (Knowledge), perception (Perception), beliefs (Beliefs) may vary from person to person. In terms of speed and perception, it is obtained from experience and information related to many sources. And this knowledge will affect beliefs. 2) Affective Component reflects the emotions or feelings of consumers towards a thought or something, such as in terms of liking and feelings towards that thing. 3) Conative Component or Behavior or Doing reflects the tendency to have consumer behavior or the tendency to act or the tendency to buy products from the perspective of attitude components. It can be concluded that attitudes have various components that will result in continuous purchasing behavior. Consumers must have knowledge, understanding, awareness and beliefs related to the product, which will lead to liking and will have a possibility to decide to buy that product.

Relevant research

Moazzam et al. (2023) Examining the factors that shape green purchase behavior: The role of subjective norms, self-efficacy, attitude, and intention. This study explores the factors that affect consumers' decisions to purchase eco-friendly products, emphasizing the significance of subjective norms, self-efficacy, and attitudes towards green buying. Analyzing data from 224 consumers, the findings indicate that these factors play a crucial role in shaping the intention to buy green products, which in turn influences actual purchasing behavior. The study underscores the necessity for strategies that boost consumers' confidence and foster positive attitudes towards eco-friendly options.

Duan, et al. (2023) study on consumers' purchase intentions for carbon-labeled products to investigate the influencing mechanism of the carbon-labeling system on consumers' purchase intentions, particularly among Chinese college students. The study aims to understand how various factors, such as functional value, emotional value, and epistemic value, affect consumers' willingness to purchase carbon-labeled products. The research findings indicate that while public awareness of the carbon-labeling system is low (only 42.07% awareness), there is a strong intention among consumers to purchase carbon-labeled products. Key factors influencing this willingness include functional value, emotional value, and epistemic value, while social value and conditional value do not significantly impact purchase intentions. Additionally, willingness to purchase varies by age, with no significant differences observed based on gender, income, occupation, or education level. The study effectively applied consumption value theory to create a model that explains the motivational drivers behind consumers' purchase intentions, offering insights for both academic and marketing applications.

Ali, et al. (2023) study on assessing the impact of green consumption behavior to purchase intention among millennials: The role of social media. The study employed a cross-sectional questionnaire survey methodology to gather data from 358 university students from various faculties, including social sciences, engineering, and biosciences and 328 completed questionnaires were received. The findings highlight the significant impact of social media on shaping green consumption behaviors and purchase intentions among millennials. It emphasizes that social media platforms serve as vital tools for promoting eco-labeling and eco-branding, which in turn influence consumer attitudes and behaviors towards sustainable products. The findings suggest that effective communication through social media can enhance awareness and encourage environmentally friendly purchasing decisions. Moreover, the research underscores the importance of eco-labeling as a moderating factor that strengthens the relationship between social media influence and green consumption behavior. By providing consumers with clear and accessible information about the environmental benefits of products, eco-labeling can effectively drive the shift towards more sustainable consumption patterns.

Results from the literature review

Sustainable development is defined by the United Nations as meeting current needs without compromising future generations (United Nations, 1987). Thailand's 13th National Economic and Social Development Plan (2023-2027) aligns with this concept and the Sustainable Development Goals (SDGs) (Digital Economy Base, 2022). The BCG Model combines bioeconomy, circular economy, and green economy to promote sustainable practices (National Science and Technology Development Agency, 2021). Research indicates that consumer behavior towards eco-labeled products is influenced by demographic factors, knowledge levels, and attitudes, with the Theory of Planned Behavior suggesting that positive attitudes enhance purchasing intentions (Ajzen, 1991; Chatzidakis et al., 2016). The European Union's Carbon Border Adjustment Mechanism (CBAM) aims to reduce greenhouse gas emissions and will require Thai manufacturers to adapt their practices (Digital Economy Base, 2022). Sustainable supply chain management in the food industry is vital due to its significant environmental impact, necessitating collaboration among stakeholders to minimize food waste and greenhouse gas emissions (Rong et al., 2011; Djekic et al., 2019).

Related Literature and Hypotheses Development

The growing awareness of environmental sustainability has heightened consumer interest in eco-labeled products. Research shows that demographic factors like income and geographical location significantly influence purchasing preferences for these products (Fisher et al., 2012). Additionally, consumers' knowledge of eco-labels and their perceived environmental impacts are vital in shaping purchasing behaviors (Grankvist & Biel, 2007). The Theory of Planned Behavior highlights that positive attitudes and subjective norms significantly affect intentions to purchase carbon-labeled products (Ajzen, 1991). Furthermore, environmentally conscious purchasing behaviors correlate with consumers' willingness to pay more for eco-labeled items (Peattie & Crane, 2005).

From the literature review, the following research framework has been developed:

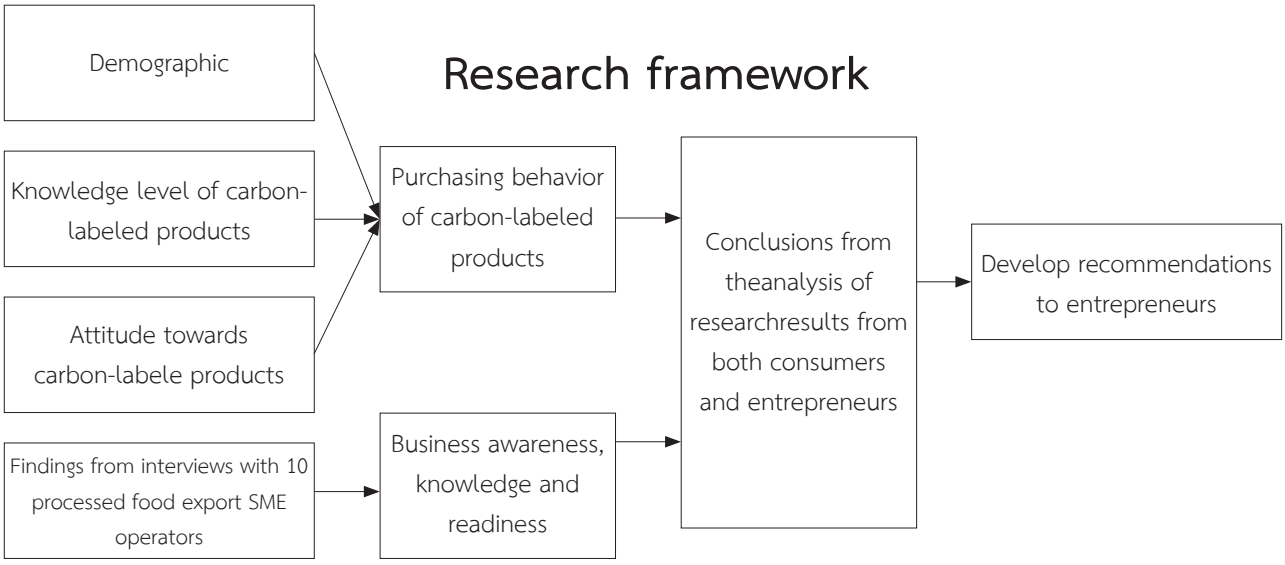

Figure 1 Research framework

Research Methodology

The study employs a mixed-method approach, combining quantitative surveys and qualitative interviews to gather comprehensive data. Quantitative research was conducted by collecting questionnaires of foreign processed food consumers in Europe, utilizing G*power to calculate sample size, employing multiple regression analysis with 3 predictor variables (Faul et al., 2009). The total sample size was 120 individuals selected through convenience sampling. Qualitative research was conducted by in-depth interviews with purposive sampling of entrepreneurs or executives of 10 processed food export businesses in Thailand (10 persons) that export to Europe and have a minimum of 3 years of export experience. The questionnaire was distributed online requesting cooperation from the Department of International Trade Promotion (DITP) in Europe and businesses that export processed food to European countries to distribute to the target customer groups. Qualitative research was conducted by in-depth interviews with entrepreneurs or executives of 10 processed food export businesses in Thailand (10 persons) that export to Europe and have a minimum of 3 years of export experience.

Quantitative data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation, along with multiple regression analysis to identify relationships between variables. Qualitative data were analyzed through content analysis, enabling the insights from the interviews.

Results

1. Quantitative Findings

Research objective 1: The research results of the first objective are quantitative research obtained from the responses of the consumer questionnaires, which were obtained from testing the following three hypotheses:

Hypothesis 1: *Demographic factors affecting purchasing behavior of carbon-labeled products (PBC)*

The statistical tests (t-test and F-test) showed that different countries of origin and different average monthly incomes affect the behavioral trend of purchasing carbon-labeled products (PBC) differently, but respondents with different genders, education, occupations have the same effect on the behavioral tendency to purchase carbon-labeled products.

Hypothesis 2: *Knowledge level affects purchasing behavior of carbon-labeled products (PBC)*

Table 1 Comparison of the differences between the levels of knowledge and purchasing behavior of carbon-labeled products (PBC)

Level of knowledge and understanding	N	%	$\bar{X}$	S.D	t	P-Value
Low score (0-5 คะแนน)	14	12.7	3.53	0.787	1.172	0.089
High score (6-10 คะแนน)	96	87.3	3.88	0.713		

The hypothesis testing using T-test statistics, comparing the difference between the means by the independent variables with 2 groups of answers, namely, high level of knowledge and low level of knowledge, it was found that different levels of knowledge had no effect on purchasing behavior of carbon-labeled products (PBC).

Hypothesis 3: *The Environmentally friendly purchasing behavior (EPB) and the attitude towards carbon-labeled products (ATC) affect the tendency of behavior to purchase carbon-labeled products (PBC).*

Table 2 Multiple regression analysis of the Environmentally friendly purchasing behavior (EPB) and attitude towards carbon-labeled products (ATC) on purchasing behavior of carbon-labeled products (PBC)

Variables	Unstandardized Coefficients	Standardized Coefficients	Beta	t	P-value	Collinearity Statistics	
	B	Std. Error				Tolerance	VIF
(Constant)	1.012	.303		3.340	.001		
Environmentally friendly purchasing behavior (EPB)	.157	.057	.199	2.730	.007	.948	1.055
attitudes towards carbon-labeled products (ATC)	.568	.068	.607	8.344	.000	.948	1.055
R=0.680 R2=0.463 Adjusted R2=0.453 S.E.est=0.539 F=46.105 Sig=0.001							

Dependent Variable: purchasing behavior of carbon-labeled products (PBC)

The most common way to detect multicollinearity is by using the variance inflation factor (VIF) or Tolerance value with the following criteria: The appropriate VIF value should not exceed 4 or 5. Tolerance value > 0.2.

It was found that the value of VIF was equal to 1.055, which is not greater than 5, and the value of Tolerance was more than 0.2, indicating that both sub-variables did not occur multicollinearity.

From the multiple regression analysis, EPB and ATC have a multiplicative relationship with PBC with statistical significance at the 0.001 level, with a multiple correlation coefficient of 0.680, and can predict the PBC by 46.3 percent with a standard error of forecasting of ±0.539.

When considering the regression coefficient of the predictors, it was found that the regression coefficient of the predictors of the variables of EPB and ATC were statistically significant at the 0.007 and 0.001 levels, respectively, which is summarized as the following prediction equation:

PBC = 1.012 + 0.568 (ATC) + 0.157 (EPB)

2. Qualitative results

Research objective 2: The second research objective was qualitative research obtained from interviewing 10 entrepreneurs as follows:

The qualitative research results are derived from in-depth interviews with Thai processed food exporters and international buyers. These insights provide a deeper understanding of the quantitative findings and reveal additional context-specific factors.

From the interviews, entrepreneurs emphasized the importance of carbon emission reduction planning throughout the supply chain, focusing on the upstream to the downstream by creating collaboration between supply chain partners to plan and design a prototype for carbon reduction together in their supply chain. There was support and assistance, especially for upstream farmers, to provide knowledge and support to move forward together. In preparing for the trend where consumers demand products with carbon labels, it was discovered that most entrepreneurs did not make adequate preparations. Only large entrepreneurs started planning their own supply chains and focused on stakeholders in the same supply chain to support them to be able to connect to our supply chain and move forward together. As for planning to cope with and prepare for carbon tax collection, most entrepreneurs agreed that they had started to plan to cope to some extent. If it is an SME business, they usually proceed according to the necessity of consumer demand. Medium and large businesses have already planned and set goals in advance to be in line with both global and national goals. Most entrepreneurs accepted and believed that the production process of environmentally friendly products or low-carbon products is often beneficial to both the company and the world. In terms of business sustainability, environmental sustainability is worthwhile in the long run. Most entrepreneurs agreed that businesses must also adapt and prepare for the carbon tax as well because it takes quite a long time to prepare and must be done gradually. Learning to adapt, on the other hand, is an opportunity for businesses to produce environmentally friendly products and reduce the loss of raw materials in the production process and innovate using by-products to promote business value and business sustainability. However, the qualitative interviews highlighted the importance of sustainability practices and transparent communication in building brand trust and attracting international buyers.

3. Comparative Analysis between Quantitative and Qualitative Findings

The results from both research methods are consistent and supportive of each other as follows:

1. Awareness and Understanding: Mixed Awareness: Many SMEs are aware of the Carbon Border Adjustment Mechanism (CBAM) but lack detailed understanding of its requirements and implications. This aligns with the quantitative finding that knowledge and understanding levels do not significantly affect purchasing behavior.

2. Consumer Expectations: Preference for Sustainable Products, international buyers show a strong preference for products from companies demonstrating environmental responsibility. This supports the quantitative finding that positive attitudes towards carbon labeling (ATC) significantly influence purchase intention.

3. Both methods highlight the importance of attitudes towards carbon labeling (ATC) in influencing purchasing behavior. The qualitative findings about consumer expectations for sustainability align with the quantitative results showing that positive attitudes significantly affect purchase intention.

4. Both sets of findings indicate that knowledge alone does not drive purchasing behavior. The qualitative insights about SMEs' mixed awareness and understanding support the quantitative result that knowledge levels do not significantly impact purchasing behavior.

Discussion

From the research results, there are discussion points as follows:

From the results of testing Hypothesis 1, it was found that different countries of residence have different effects on the tendency of purchasing behavior towards carbon-labeled products (PBC), and respondents with different average monthly income have different effects on the tendency of purchasing behavior towards carbon-labeled products (PBC).

The results of testing the Hypothesis 2 found that different levels of knowledge and understanding did not affect the purchasing behavior towards carbon-labeled products (PBC) differently. Interestingly, the level of knowledge and understanding of carbon-labeled products of consumers did not affect the tendency to buy carbon labeled products. This was because everyone viewed that carbon-labeled products were good, and everyone should help reduce global warming in one form or another. Although some people may still have some knowledge and understanding of such products, the results of this study align with the findings of Diniso et al. (2022) who studied the knowledge and perception of dairy farmers about climate change in the Eastern Cape Province, South Africa. The objective was to assess the knowledge and attitudes of dairy farmers about climate change on dairy farms in the Eastern Cape Province, South Africa. Because dairy farmers in the Eastern Cape Province of South Africa have limited knowledge about climate change and provide conflicting answers to questions requiring knowledge verification, many participants with higher education and more than five years of experience in dairy products incorrectly stated that climate change is not related to global warming. This is also consistent with Indriani et al. (2019) who studied the influence of environmental knowledge on green purchase intention: the role of attitude as a mediating variable. The study found that environmental knowledge did not directly affect consumers' green purchase intention but played a significant role in determining their attitude towards green products. Positive attitude fully mediated the link between environmental knowledge and purchase intention.

And the test results of the hypothesis 3 found the Environmentally friendly purchasing behavior (EPB) and attitudes towards carbon-labeled products (ATC) both affect the likelihood of purchasing behavior towards carbon-labeled products (PBC), This was because consumers who exhibit positive attitudes towards carbon-labeled products and demonstrate environmentally friendly purchasing behaviors are more inclined to choose such products. The results of this study align with findings from Dentsu International and Microsoft Advertising released the research report The Rise of Sustainable Media, in which John Cosley, Senior Director of Brand, Microsoft Advertising, concluded that as marketers, we see that values can create business value. But in this research, we want to show more clearly how important it is. This collaborative research helps us understand and inform businesses worldwide about awareness and attitudes towards carbon in the media supply chain, including the impact on the planet, consumer behavior and purchase intentions. Rapidly changing attitudes and the pressure to urgently address climate change present opportunities for all marketers to help change the industry at large. Also, align with Ali et al. (2023) that highlight the significant impact of social media on shaping green consumption behaviors and purchase intentions among millennials. It emphasizes that social media platforms serve as vital tools for promoting eco-labeling and eco-branding, which in turn influence consumer attitudes and behaviors towards sustainable products. The findings suggest that effective communication through social media can enhance awareness and encourage environmentally friendly purchasing decisions

In terms of entrepreneurs, the interviews showed that most entrepreneurs agreed that the production and distribution of low-carbon products or carbon-labeled products are important and are a trend for consumers to protect the environment at present and in the near future. Therefore, entrepreneurs must be prepared to produce and distribute low-carbon products by giving importance to production throughout the food supply chain. Therefore, large entrepreneurs have started to build relationships and support suppliers in reducing greenhouse gas emissions from the food supply chain, which is consistent with the research results of Tidy et al. (2016) who studied the role of supplier relationship management in reducing greenhouse gas emissions from the food supply chain: Supplier participation in the UK supermarket sector. It was found that supermarkets in the UK have been criticized for many years for their supply chain relationship operations based solely on short-term competitive advantages. If it is accepted that supply chain performance is best achieved through long-term relationships and close engagement with suppliers, it may be a step away from a purely transactional approach to contractual relationships and towards a relationship-based approach characterized by mutual trust and dependence. In addition, entrepreneurs also believe that if we do not adapt to the needs of the world and consumers, consumers may not choose to consume our products. This is in line with research from Dentsu International and Microsoft Advertising, which found that nearly half of consumers are prepared to switch brands and services to more environmentally friendly ones. Additionally, 91 percent of consumers want brands to clearly demonstrate that they are making the right choices for the planet and the environment in everything they do.

And large entrepreneurs have begun to prepare according to the scope of the greenhouse gas emission criteria, which is divided into 3 scopes, starting from Scope 1, direct greenhouse gas emissions from the organization's electricity use first. As for Scope 3: Other indirect greenhouse gas emissions that we cannot control, only one company has started studying. However, all companies know that the organization must assess all three scopes in the future. This is consistent with the study of Chaiwanich (2020) who studied the environmental problem of global warming by greenhouse gas (GHG) emissions from human activities, which is an assessment of the organizational carbon footprint of the Ordnance Engineering Division. It can measure and assess greenhouse gas emissions in all 3 scopes to know how they need to effectively reduce greenhouse gases in each scope. Entrepreneurs who export rice and export future desserts are also studying how to reduce carbon dioxide in their agricultural raw material sources by reducing electricity use first and using raw materials or by-products that used to be waste in various processes to reuse or recycle and convert what used to be waste to be beneficial to reduce the amount of carbon dioxide emissions. This is consistent with the research of Tobarameekul and Worathanakul (2021). who studied the synthesis of zeolite fajasite from rice husk ash as a silica source to quantify the carbon footprint with different heat management options, including dilution temperature and time, and using rice ash as a source of silica instead of using silica from chemical sources can reduce the carbon dioxide emission cycle. In addition, the entrepreneurs of the agarwood community enterprise group also studied the planting of agarwood trees, good management in agarwood forest areas to start reducing carbon by expanding the forest area by grouping together and having better water management. This is consistent with the research of Soralump and Chaichana (2019) who studied the environmental impact by showing the value of the loss and benefit of forests and agricultural areas, not only the financial value, but also the restoration of the environment in the form of carbon dioxide emissions, with more forest areas and more efficient watering in this area.

From the interview with the president of the Thai Feed Mill Association and the president of the Thai Future Food Trade Association, both emphasize the importance of planning to reduce carbon emissions throughout the supply chain, paying attention from upstream to downstream. There is a collaboration of supply chain partners to plan and design a prototype to reduce carbon together in their supply chain partners. There is a push and assistance, especially for the upstream group who are farmers, to provide them with knowledge and support them to move forward together. This is consistent with the research of Munkongtham and Moryadee (2022) who studied the trends in the amount of carbon footprint emissions worldwide. Many organizations around the world have tried to solve this problem by displaying their organization's carbon footprint data in logistics to emphasize the management between demand and supply in terms of trade and investment. The measurement of carbon footprint emission efficiency from warehouse activities is divided into 5 main activities: receiving, storage, exporting, preparation for delivery, and shipping.

Recommendations

Research objectives 3: To propose recommendations for preparing Thai SMEs engaged in processed food export businesses to support the pre-border greenhouse gas tax rate for imported goods (Carbon Border Adjustment Mechanism: CBAM)

From the research results, the researcher has the following recommendations for practical implications. Therefore, relevant agencies should proceed as follows:

For SMEs Exporter

1. The integrated findings suggest that while enhancing knowledge about eco labeling is necessary, addressing financial and technical barriers and improving communication about sustainability efforts are crucial for influencing consumer behavior and meeting international standards such as CBAM.

2. Awareness and Understanding of CBAM

The variability in awareness and understanding of SMEs suggests a need for targeted education and training programs. SMEs require accessible resources that explain CBAM in practical terms and offer guidance on compliance.

3. Consumer Expectations and Market Demand

Preference for Sustainable Products: International buyers, particularly from the EU, demonstrate a strong preference for products from companies that adhere to sustainable practices. This preference is driven by regulatory requirements, corporate social responsibility (CSR) commitments, and consumer demand for eco-friendly products.

Transparency and Communication: Buyers value transparency in the supply chain and clear communication about sustainability efforts. They prefer suppliers who can provide detailed information about the environmental impact of their products, including carbon footprint data and sustainability certifications.

Reputation and Trust: Companies that are perceived as leaders in sustainability tend to enjoy a better reputation and higher levels of trust among buyers. This trust can translate into long-term business relationships and preferential treatment in competitive markets.

4.Consumer Insights: Consumers, especially in Europe and the UK, show a high tendency to purchase carbon-labeled products and are willing to pay a premium for products perceived as environmentally friendly. This consumer behavior underscores the importance of adopting and promoting carbon-reducing practices. Therefore, preparing to produce low-carbon products in response to the European CBAM tax should be seen as an investment in the future rather than a cost. It is essential for the survival and competitiveness of Thai processed food exporters in the global market. Collaboration within the supply chain can help mitigate the investment burden. Immediate adaptation and preparation are crucial to prevent falling behind competitors and to capitalize on opportunities in producing environmentally friendly products.

5. Strategic Responses and Opportunities

Early Adoption of Sustainable Practices: SMEs that have proactively adopted sustainable practices and aligned their operations with international standards are better positioned to comply with CBAM and other regulatory requirements. These companies often view sustainability as a strategic advantage rather than a regulatory burden.

Collaboration and Partnerships: Many SMEs have found success through collaboration with industry associations and government agencies. These partnerships provide access to resources, expertise, and networks that facilitate the adoption of sustainable practices.

Innovation and Differentiation: Innovating in sustainable product development and process optimization can differentiate SMEs in the market. This includes developing low-carbon products, utilizing renewable energy sources, and implementing circular economy principles to attend to customers' needs

Therefore, encouraging a proactive approach to sustainability, fostering industry collaborations, and supporting innovation can help SMEs leverage sustainability as a competitive advantage as follows.

1. Understand Consumer Behavior and Attitudes:

- Recognize that carbon and environmental concerns are increasingly significant for both businesses and consumers globally. Products with carbon labels tend to gain consumer confidence, as reducing greenhouse gas emissions positively impacts the environment and natural resource management.

- Regularly survey the attitudes and purchasing behaviors of target consumer groups. The research indicates that attitudes toward carbon-labeled products and behaviors supporting environmental conservation significantly influence the likelihood of purchasing such products.

- Focus on consumers' priorities, such as the product and waste disposal processes, recycled packaging, and the overall environmental impact of products. Emphasize that purchasing products with carbon labels helps reduce global warming

2. Marketing and Communication:

- Emphasize the environmental benefits of products in marketing communications by highlighting the waste disposal process, recycling capabilities, and any steps taken to reduce environmental impact

3. Adaptation and Innovation:

- Collaborate with leading educational institutions and other stakeholders to innovate and adapt production processes for reduced carbon emissions throughout the supply chain since many entrepreneurs are already striving to achieve zero waste by transforming by-products into valuable resources.

- Recognize the future trend and prepare to produce environmentally friendly or low-carbon products. This aligns with global sustainability goals and is crucial for staying competitive.

For Government Agencies:

1. Support and Regulation:

- Provide clear guidelines, knowledge, and expertise to businesses on reducing greenhouse gas emissions. Set clear standards and communicate which organizations are responsible for controlling emissions in the production process.

- Offer support, particularly to SMEs, in terms of budget, knowledge, and cost-effectiveness since many SMEs lack the resources to measure carbon emissions and prepare for regulatory changes independently.

2. Information Dissemination:

- Improve the dissemination of information about carbon tax collection and environmental standards through government channels. Currently, most entrepreneurs receive this information from social media rather than official government sources.

- Facilitate access to information about carbon measurement and assessment organizations to ensure that businesses understand and comply with regulations.

Future Research Directions

This research has found that reducing greenhouse gas emissions in the Thai SMEs processed food export sector is crucial for complying with international regulations like the CBAM. This knowledge can be applied to enhancing the competitiveness of Thai SMEs by focusing on adopting carbon footprint tracking, energy-efficient practices, and engaging with suppliers to reduce emissions throughout the supply chain.

Further research should be done on issues related to:

1. Consumer Behavior Analysis: Further studies could explore the specific motivations and barriers for consumers in different regions regarding the purchase of eco-labeled products.

2. Longitudinal Studies: Tracking the long-term impact of CBAM on SMEs' operational performance and market competitiveness would provide valuable insights.

3. Technological Innovations: Investigating the role of emerging technologies in reducing GHG emissions within the processed food sector could uncover new opportunities for efficiency and sustainability.

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