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Organization Perceptions, Agriculture Operations, and Government Policies toward Sustainable Solutions: A Holistic Approach to CO2 Emissions in Malaysian Context of Food Industry

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ABSTRACT

With limited energy, land, and water resources, meeting the expanding demand is made more difficult by population growth and rising food consumption. In a near future, climate change will affect agriculture and cause natural resources going into scarcity. Thus, it is critical to scrutinize the Malaysia domestic system that could support decision-making to practice sustainability. The main drivers behind this research are agriculture industry is closely related to the basic needs of humans, and the agricultural demands for human consumption are foreseen to exceed the supply in the near future. While striving to fulfill the demand of this generation, it is crucial for the food industries to find a resolution to achieve a balance in juggling the demand, as well as environmental protection and greenhouse gas emissions management. There are numerous empirical studies pinpointed the existence of government initiatives act as a catalyst to stimulate the involvement of industry players to work on greenhouse gas reduction aspirations. Even though the studies of greenhouse gas emissions have been adopted rapidly recently, however studies have shown limited understanding toward CO2 emissions management from the organization view, especially food industry in Malaysia. Hence, the study for greater industry-specific research on agriculture industry is absolutely essential. This research provide an examination on the interaction between organization perception, agriculture industry operation, government initiative and the CO2 emissions management in Malaysia's food industry. The pilot test analysis results exemplified that agriculture industry operation have a significant relationship toward the implementation of CO2 Emissions Management. This research uncovers critical insights through a comprehensive survey, highlighting the necessity for firms to integrate CO2 emission-related considerations into their corporate strategic planning processes. It emphasizes that corporate strategic plans must align CO2 emission reduction objectives with overarching corporate goals. Furthermore, to effectively tackle the challenges posed by CO2 emissions and climate change, corporations should prioritize sustainability measures across all facets of their operations. These findings are particularly valuable for organizations in the food industry and beyond, providing guidance on essential factors to emphasize in efforts to reduce CO2 emissions and mitigate the impacts of climate change.

Keywords: Organization Perception, Agriculture Industry Operation, CO2 Emissions, Food Industry, Government Initiative

INTRODUCTION

Today, greenhouse gas emission is built around the planet we live on. The heat trapped inside the atmosphere leads to global warming issue and resulted in exasperated climate change. Climate models anticipate that hot weather will become more frequent and intense under future warming, and at an increasing rate with each additional increment of warming. Ultimately, these weather conditions is affecting the plantation and food production (Jones, 2022). Generally, climate change has been the most critical environmental issue, creating extensive economic, social, and ecological impacts worldwide over the past decades. The rise of industrial globalization, economic development, population incremental, and financial development have caused CO2 emissions continue to increase. The inclination in CO_2 emissions is considered the main reason for climate shift and global warming problem today (Rahman & Alam, 2022). Technology revolution brings benefits to industrialization and economic growth. On the other hand, it causes some irretrievable damage to the environment and results in climate change. The global population is rising extremely and climate change will affect agriculture, cause natural resources going into scarcity, and eventually violate the basic human rights (McDonnell, 2020). On account of the fact, under the Paris Agreement's worldwide climate change aim, many countries have pledged to reduce human environmental impacts and attain carbon neutrality by the mid-21st century (Ou et al., 2024).

An United Stated study revealed that food processing and supply distribution are part of the largest contributors to climate evolution, and food loss from the whole food chain exasperate issue. (Qin & Horvath, 2022) In fact, a vast array of historical, natural philosophy, social, cultural, and political environment factors in agriculture produce divergent forms of farm characteristics in terms of capacity, structure, activities, productivity, and processing methods, which in turn result in diverse industry emissions issues today (Sumberg & Giller, 2022). According to a previous study conducted in Vietnam, if the policies were put into place, environmental sustainability may be attained through lower emissions. Using sustainable energy sources, promoting technological advancements, supporting climate-conscious agriculture, together with supporting prudent forest management are a few of the strategies (Raihan et al., 2024). Nevertheless, an example from Wuwei, Northwest China, revealed that agriculture in Wuwei continues to be a carbon source even after optimization (Wu et al., 2025). These demonstrated that the pathway towards net zero is still hazy for a variety of causes and origins.

Furthermore, a case study data built from the meteorological station Malaysia, Department of Statistics Malaysia and World Development Indicators confirmed that temperature and electricity consumption are significantly affect rice, coffee and vegetable production negatively. Furthermore, temperature, electricity usage, specifically fossil fuel consumption exhibited a negative and significant influence on agriculture value added, which is food further processed or manufacture industry. Overall, these findings are strongly supported the adverse effect of climate change on various agricultural products in Malaysia (Akhtar & Masud, 2022). This finding is important and warrants more investigation. Owing to the above, this ascertain an earnest and insistent necessity to look into the important influences in organization perception, agriculture industry operation, government initiative that impacting CO_2 management in Malaysia food industry. It is also vital to analyze the features of the organization perception and agriculture industry operation, including the social and behavioral science elements. This will assist the research study to pin down the factors influencing the implementation of CO_2 emissions management.

LITERATURE REVIEW

CO_2 Emissions in Food Sector in related to Agricultural Industry

The reason to concentrating in the organization perception, agriculture industry and government initiative are because past researchers have conducted the CO_2 related studies in other countries. In certain circumstances, reporting about environmental, social, and financial sustainability is found desirable, but it may not be feasible in many of the organizations because of a lack of inputs. This situation implies that these measures receive less attention in an organization today. The empirical study showed barriers come from the top management team's viewpoint regarding marketing actions in sustainability (Sharma et al., 2021). In additional, according to Tan et al. (2023), organizational size and environmental volatility have a significant impact on the adoption of Hybrid Project Management in FinTech Malaysia and sustainability in Quality 4.0.

Humans are using experience as input to recognize risks and form a response mechanism from it. Nevertheless, even though we are informed with relevant information, together with the problem existent, we are still weak in responding to global warming effects and failing to feedback in time to drive changes. Mitigating behaviour is not seriously considered as human being tend to ignore of the environmental problem, and the individual behaviour remain stagnant. The influences from an organization is important to stimulate a change. For instance, in regards to the energy and water and other building function related resources, a property manager can lead by example through buying green energy and installing equipment with good efficiency to lower usage rates. Also, they can communicate to the residents and demonstrate how they are all part of solution. The larger the residential buildings, the higher the amounts of resources used. Property manager is able to influence the buying selection in materials to reduce the environmental impacts. From the past studies, it proven that there is a need to have different workplace environment or culture and certain decision makings in order to leads to different behaviour of the employees. The challenge of controlling the environmental repercussions of one's actions stems from limited knowledge and incompetence to relate from one to another. In opposite, the shift to effective communication and risk averse behaviour are essential to mitigating the climate problems. A more in-depth examination of individuals' worldviews and the consequent behavioral differences was attained in past research. The outcome manifested positive behavioral action in the built environment could lead to a significant impact on this sector and mitigate the unnecessary miscellaneous issues. Overall, the study contributes to a clearer understanding of the complex relationships between environmental attitudes and environmental behaviour (Wilkinson & Zalejska Jonsson, 2021). At Sierra Leoneon SSF, the best strategy to maintain low CO_2 emissions is to prioritize food and income security. In other words, food security and CO_2 reductions are complementary rather than antagonistic (Okeke et al., 2024).

The past results demonstrated a sturdy connectivity between CO_2 emissions and agriculture sector. A recent Dutch case study explicated the necessary actions to lower greenhouse gas emissions and shield low-lying areas from rising flood risks with the climate issues today. Neither current agricultural systems nor through the creation of new agricultural systems are appropriate for farming in areas with high groundwater levels or flooding, stricter regulation of groundwater levels is needed. (Wils et al., 2025). A case study in Bangladesh revealed that agricultural economic, energy structure and emissions factor are accountable for the decrease of CO_2 emissions (Hossain & Chen, 2022). Besides that, a study in Brazil also proven CO_2 emissions associated with a thorough set of agricultural products in the the country, where an estimated 911 Metric tons of CO_2 associated with agriculture in 2019, 81% of that associated with planted pastures according to their recent study (Danilo, 2022). A research in India has proven a ozone pollution has significantly caused the reduction in crop productivity globally. The wheat crop in the green revolution belt is strongly affected by air pollutants compared to climate crisis, which poses food security not only at regional level but also globally (Kaur, 2022). As a consequences, supporting a circular bio-economy is imperative for the food sectors today to accommodate and feed more than 9 billion of people in 2050 later while boosting the United Nations Sustainable Development Goals (Duarte et al., 2022). The studies from the past researchers strongly proven that the agricultural is one of the main drivers causes the increase in CO_2 emissions. This draws the attention of this research to excavate in specific on the agriculture industry.

Another past research evaluated the GDP contributions of the industrial, manufacturing, agricultural, and service sectors as well as their effects on biodiversity outcomes in MENA economies between 1991 and 2020. The results proven environmental damage is greatly decreased by technical developments and the use of renewable energy, and multinational enterprises from rich nations disseminate advantageous environmental practices to local businesses in developing nations (El Khoury et al., 2025). Human and most of the living organism rely on crop as one of our energy fount. When the agriculture food growth is not on par with the population growth, it will form a scarcity situation. Worst of all, the constant surge in greenhouse gas emissions is likely to jeopardize agriculture productivity. Ultimately, it will post imminence threat to all the lifeforms on earth. Previous study indicated food supply chains had outstripped farm gate processes to become the biggest greenhouse gas component of agri-food systems emissions in 2019 with 2.2 Gt CO_2eq. It is also projected to increase more than half to 3.5 Gt CO_2eq in the following years which becoming greater than emissions from land-use change. This has important reverberations for food relevant industries to look into the national mitigation strategies, considering mainly on decreasing of non-CO_2 gases within the farm gate and on CO_2 alleviation from land use change (Tubiello et al., 2022). The priority of CO_2 emissions in the agriculture food industry is crucial and it required more attention as it is the main root cause of greenhouse gas production that created such a climate change situation.

The attention for technological solutions was sparked because of the concerns about issues related to climate change and de-carbonization targets. On the ground of this development, it led us to observe the gaps in legislation and enforcement. For instance, the transport industry shows a persistent and considerable tendency to increase their adaptability to these technologies issues in order to increase the level of sustainability of their actions. The Ukrainian government's legislative agenda and efforts to reduce carbon emissions are moving in the same direction. The speed at which the carbon footprint of a unique mode of transport is falling, by air, has sparked optimism in many parts of Ukraine. De-carbonization goals cannot be successfully achieved without the participation of volunteers. To successfully reduce carbon emissions, comprehensive coordination among the relevant legislative and executive branches is necessary. In contrast, two important caveats could lead to de-carbonisation. The first is that proper reporting and indexing systems will help to weight and focus efforts on de-carbonisation. A second strategic approach such as "step-by-step" or "knowledge bridging" should be announced for regional and organizational alignment (Mishchenko et al., 2023).

According to the results of an analysis of the causes reducing greenhouse gas emissions in Saudi Arabia, the number of people who use the internet, percentages of population growth, GDP growth, and forest rents are all important factors that affect carbon oxide emissions (Guermazi et al., 2025). This research assists policymakers in Saudi Arabia and around the world in identifying factors that moderate GHG emissions and designing targeted responses appropriately. To shift to a low carbon society, policymakers, businessman, finance and civil organizations stakeholders are increasingly attentive to develop advance emissions pathways and associate closely to physical climate risks which will potentially emanating from increasing temperatures. Researchers forecast transition risks situation in 2030, where the risks are associated to temperature pathways arises from economy mitigation costs, carbon cost increases, decrease in fossil fuel demand and coal plant capacity. Whereas in 2050, physical risks will stemming from serious heatwaves, drought, heat stress and decrease in crop duration (George et al., 2022). This added tension in the food industry and it accelerate the global attention on the development of CO_2 emissions in the agriculture food industry.

Problem Statement

In the Asia-Pacific Disaster Report 2019, droughts found to be the severe disaster from the climate change and it has continued affect millions of people in Southeast Asia countries. The record from 2011 to 2020 showed Cambodia, Indonesia, the Lao People's Democratic Republic, and Malaysia have the large numbers of people affected by droughts (United Nations, 2022). This ascertain the direction of this paper to examine the CO_2 emission management in Malaysia, as greenhouse gas emission is the root cause of climate change that caused the emerge of natural disasters.

Southeast Asian countries are prone to exposed to quick temperature rises and abrupt changes in rainfall patterns, which tend to caused land degradation and crop failures. In the last 20 years, there were more than 50 natural disasters occurred in Malaysia, which have threaten the lives and livelihood, particularly those in the agriculture sector. The economy in Malaysia sustained a total damage of about RM8 billion due to major floods and dry spells from 1998 to 2018 (Bank Negara Malaysia, 2020). This emphasized the seriousness of the situation in the country. It prompted the necessity of researchers to look into CO_2 emissions management in Malaysia and propose possible solutions to mitigate climate change.

The adverse weather phenomenon is projected to be more volatile amid the rise in global warming. This ascertained that agricultural and food supply disruptions issue will only be more frequent and severe in the future if no precautions steps are taken today. The performance of the Asia Pacific countries analyzed varies significantly across the The Agricultural Growth Enabling Index (AGEI), the results found some common relative strengths and weaknesses. For instance, Malaysia's government found willing to spends on public services, such as research & development in agricultural field, land stewardship on the rights and access, financial support to farmer, the existence and quality of agricultural infrastructure, compared to other Southeast Asian countries (OECD, 2017). With the advent of the digital era, new funding channels that are easier for financially strapped businesses to access are being made possible by technology-driven fundraising systems. Nevertheless, the significance of these new mechanisms in promoting environmental, social, and governance practices among micro, small, and medium-sized businesses is still unknown because Malaysia is still in the early stages of their development (Ong et al., 2024). The COVID-19 epidemic caused a record drop in global CO_2 emissions. Some studies suggested utilizing the COVID-19 recovery plans to advance the climate agenda at the same time is seen as a calculated move to guarantee a sustainable future for the post-pandemic world (Nguyen et al., 2025). Nonetheless, it is always advised to take necessary precautions before a negative situation happens. Thus, it is worthy to investigate the causes of CO_2 emission management in Malaysia's agriculture industry in specific before the next epidemic occur.

Significant of study

CO_2 emissions are found to be positively interconnected with economic growth in the short term. However, these emissions in fact has a little impact on development of economy in a long run. CO_2 emission rise at the beginning of economic development, but eventually it grows slow as time pass by. Due to the complication of the correlation between CO_2 emissions, urbanization that resulted from economic development, local government shall be more vigilant in regional governance, especially in economic and urban planning and design, diversity in consideration, and adhere to circular, green and low-carbon development (Zhang et al., 2022). Furthermore, according to a previous study in Pakistan, it suggested policymakers should encourage more financial investment in greener technology and digitization, and the government should also think twice on its energy mix and prioritize alternative electricity sources (Wei et al., 2024). Generally, the factors affecting the CO_2 emission management is vague and circumlocutory in some ways. Thus, it is critical to scrutinize rigorously from different perspectives.

In the analytic forecast, power sector emissions is anticipated to remain around the same energy level from 2021 to 2024. In reality, to meet the Net Zero Emissions forecast by 2050, it has to start declining sharply. Today's policy settings are still insufficient to reduce greenhouse gas emissions. Therefore, massive changes is essential to drive the reduction. For instance, to de-carbonizing the huge power grids system, the changes in energy efficiency and low carbon supply for the electricity sector are both vital and necessity. Based on the studies, the electricity demand growth across the region is driven by both industrial development and the growth in utilization and electrification of cooling, cooking and mobility. Notwithstanding renewable energy helps to fulfill a big portion of the new demand and resulted in carbon emissions intensity reduction, but the total emissions still grow significantly (IEA, 2022). Irrigation is one of the land-management strategy with prominent environmental consequences. However, the global energy usage and carbon emissions arising from irrigation are still unclear (Qin et al., 2024).

Global industrialized countries had set ambitious on climate targets yet they acknowledged the challenge now is the existing mechanisms for CO_2 pricing are insufficient to help them attain the expected sustainability ambition. In this multi-faceted energy market model, it includes expansion in solar grid system and electricity trading. In addition, diverse policy approaches to restraint emissions by gradually get rid of emission-intensive technologies, investing on renewable energy, or limiting CO_2 pricing (Grimm et al., 2022). There is contradiction between the success elements for sustainable development and sustainable entrepreneurship, despite some research defining sustainable entrepreneurship as a business model founded on the United Nations' Sustainable Development Goals (Sithambalam et al., 2024). Some study proven parallel initiatives focusing on accelerating forest protection can help reduce agricultural GHG emissions while also promoting climate-smart farming practices and sustainable agricultural expansion (Li et al., 2025). Despite many countries and companies are embarking their sustainability journey by committing to the Net Zero Emissions target in 2050, the industry is lacking of a structure and concrete plan to drive this sustainability effort. This is one of the critical factors that deceleration the pace in pursuing the net zero pathway. According to Qiaoyang & Talib (2024), Malaysia is one of the top 10 countries with the highest citation count within the ESG field. This ascertained the direction of this paper to scrutinize in Malaysia context.

Materials and Methods

Research Framework

Integrating the literature and hypotheses described as below, the research framework is shown in Figure 1.

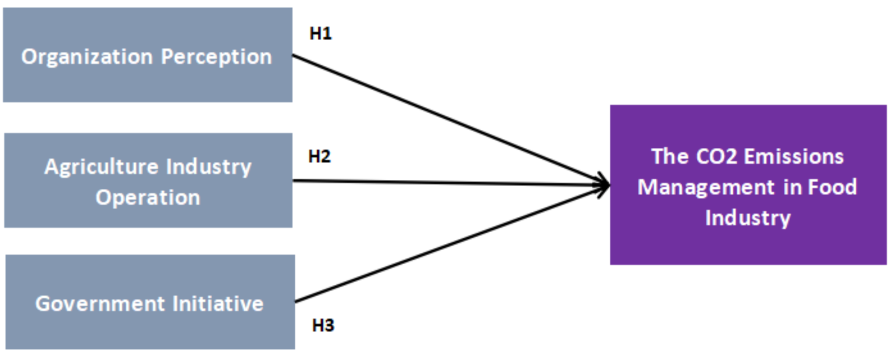

Figure 1 : Research Framework

"Agriculture" involves a wide variety of historical, biophysical, social, cultural and political environments factors which resulted in a difference way of farm characteristic, in term of its capacity, structure, activities, productivity, processing methods and etc (Sumberg et al., 2022).

"Industrial" is referring to the manufacturing business (Kähkönen & Lintukangas, 2022). In this context, we will be focusing on food industry in specific.

"Operation" implies all activities involved in the process which facilitate the consumers and it is among the key activities that relate to the organization (Rahma & Moin, 2022).

"Agriculture and food industry" is representing the largest goods producing in the value chain (Grimsby & Kure, 2019).

"Government initiative" includes strategic human resources management and financial management. Besides that, it also involved decentralization, transparency, and economic growth. The agreement is established on an equilibrium of the interests of political forces and the competing benefits (Alberts et al., 2021).

"CO2 emission" stand for carbon dioxide emission. It means the emission of carbon in the atmosphere resulting from activities that are linked to human activities or others. CO2 emission is identified as one of the greenhouse gas emission, which induced climate change disrupts human and nature balance. Production companies are one of the key factors causing CO2 emissions (Dincer et al., 2022).

Hypotheses

The triple bottom line theory is categorized sustainability into 3 key pillars, which are environmental, economic, and social. The United Nations Environment Program (UNEP) exemplified the green economy concept will help to improve social equity by reducing ecological imbalance and biodiversity risks. Furthermore, the establishing a green economy ensures the coexistence of society and nature. Today, the TBL theory is broadly adopted by different business organizations (Chang et al., 2023). Therefore, this study intend to find out more from the diverse environmental perspective of this model, especially on the implications on agriculture.

In addition, TBL model provide the systems for collecting and interpreting data, so that the complexity of this model does not create an impasse, overloading managers seeking to carry out reforms. In brief, adopting enterprise systems will benefit the three dimensions of TBL and the company's performance, motivating companies to adopt sustainable practices in letter and spirit. The attainment of companies depends on their planning and positioning in society and the market (Nogueira et al., 2023). This ascertained it is worthy to scrutinize on how agriculture operation, organization perception, and government initiative make impact on CO2 emissions management.

Hypothesis 1 : There is a positive influence on organization perception towards the CO2 emissions management in food industry.

Hypothesis 2: There is a positive influence on agriculture industry operation towards the CO2 emissions management in food industry.

Hypothesis 3: There is a positive influence on government initiative towards the CO2 emissions management in food industry.

Methodology

This research adopted both quantitative and qualitative methodologies, which is then analyzed by descriptive methods, complemented with explanatory approaches. The purpose of adopting descriptive analysis is to provide the analysis of some external relations matters and the relationship among the population quantity. Whereas the explanatory approach is to reveal internal relations of things and the interconnection among explanatory variables. Moreover, we use positivism as a conceptual framework for this case study rather than interpretivist approach. We developed the hypothesis testing and followed a probabilistic way to analyse thing objectively because we believe the empirical nature to study facts.

The unit of analysis is focus on the organization. The population of this study is concentrated in agriculture industry. To obtain a complete and all-inclusive list of the food industry population in the Malaysian context, we have conducted extensive research on the legitimate platform in the country, which can provide an unambiguous and updated list of the food industry players. In this research, we adopted the food manufacturing company list from the list of certified companies under the Veterinary Health Mark (VHM), which is a legitimate platform that approved agriculture companies for the domestic and export markets. The VHM list is issued by the Department of Veterinary Services (DVS) Malaysia.

Demographic characteristics of the respondents in the pilot test relate to are they working in the food/ agriculture related industry, what type of food/ agriculture industry they are working with, which department you are working with, what is your current position, how long you work in the company, and ethnicity. These demographic questions are important to justify the characteristics of the audience. All this information was collected using multiple choice questions where respondents were supposed to tick mark on the most appropriate answer from the given list of answers, if there is no answer from the selection, they may tick on others and further justify. In this study, a total of 24 responds were received in this pilot test.

Table 1: Demographics and Descriptive Statistic

Industry	Frequency	Percent
Non-food industry	1	4.2
Food industry	23	95.8
Food Type	Frequency	Percent
Beef, Chicken	1	4.2
Beef, Chicken, Fish, Vegetable/ Fruits	4	16.7
Beef, Chicken, Fish, Vegetable/ Fruits, Dairy Products	1	4.2
Beef, Chicken, Fish, Vegetable/ Fruits, Dairy Products, Processed Foods	1	4.2
Beef, Chicken, Fish, Vegetable/ Fruits, Processed Foods	3	12.5
Chicken	5	20.8
Chicken, Processed Foods, Ingredients, edible oil and feed	1	4.2
Food ingredients	1	4.2
Food Transport	1	4.2
Frozen bakery	1	4.2
Insurance	1	4.2
Processed Foods	2	8.3
Restaurant	1	4.2
Vegetable/ Fruits	1	4.2
Department	Frequency	Percent
Administration	1	4.2
EHS	1	4.2
ESG/ Sustainability	7	29.2
FSQR	1	4.2
Innovation	1	4.2
IT	1	4.2
Management	1	4.2
Marketing	3	12.5
Operation	2	8.3

QA	2	8.3
Sales	1	4.2
Sales Marketing	1	4.2
Supply Chain	2	8.3
Position	Frequency	Percent
Business Owner	2	8.3
Director Level and Above	4	16.7
Executive Level	5	20.8
Manager Level	12	50.0
Professional	1	4.2
Period of Working	Frequency	Percent
Less than 1 year	2	8.3
1 and less than 5 years	10	41.7
5 and less than 10 years	8	33.3
More than 10 years	4	16.7

The unit of analysis is group, focus on organization. In this quantitative research, we will apply a survey research design by asking a sample of food industry's in charge personnel, the questions about the "organization perception", "agriculture industry operation", "government initiative", "CO2 emissions" and the response is collected in the questionnaire through Likert scale. The survey result will then analyse through Exploratory Factor Analysis to study the correlation of these independent variables "organization perception", "agriculture industry operation", "government initiative", toward the dependent variable "CO2 emissions Management in Food industry"

The main objective of this study is to determine the factors influencing CO2 emissions management of food industry in Malaysia context. Specifically, analyse the relationship between the "organization perception", "agriculture industry operation", and "CO2 emissions" in Malaysia's food industry.

Results and Discussions

In this study, the survey data was first collected and processed using SPSS, followed by analysis through the multivariate analysis method, specifically the Partial Least Squares (PLS) approach, which is based on Structural Equation Modeling (SEM). The study model was then evaluated using the SmartPLS 4 software tool, ensuring a thorough and precise assessment of the relationships among variables.

Table 2: Item Loadings

Constructs	Item	AIO	CO2EM	GI	OP
Agriculture Industry Operation (AIO)	AIO1	0.796			
	AIO2	0.910			
	AIO3	0.970			
	AIO4	0.943			
	AIO5	0.945			

	AIO6	0.885			
CO2 Emission Management (CO2EM)	CO2EM1		0.953		
	CO2EM2		0.971		
	CO2EM3		0.956		
	CO2EM4		0.933		
	CO2EM5		0.925		
Government Initiatives (GI)	GI1			0.872	
	GI2			0.815	
	GI3			0.860	
	GI4			0.854	
	GI5			0.891	
Organization Perception (OP)	OP1				0.806
	OP2				0.902
	OP3				0.838
	OP4				0.584
	OP5				0.899

The outer loadings of the indicators show how well each observed variable represents its respective construct, with most values exceeding the 0.7 threshold, confirming strong indicator reliability.

In this study, construct validity is assessed by examining both the convergent and discriminant validity. The above Table 2 presents the constructs AIO (Agriculture Industry Operations), CO2EM (CO2 Emissions Management), GI (Government Initiatives), and OP (Organizational Perception). The results indicate that the Average Variance Extracted (AVE) values for all constructs exceed the threshold of 0.5, signifying strong convergent validity. When the value is 0.5 or higher, this means as the acceptable value of average variance extracted (AVE).

Table 3: Reliability and Convergent Validity

	Cronbach's Alpha	RhoA	Composite Reliability (CR)	AVE
AIO	0.958	0.963	0.966	0.828
CO2EM	0.972	0.972	0.978	0.899
GI	0.913	0.932	0.933	0.737
OP	0.871	0.915	0.906	0.663

Likewise, Table 3 shows the reliability and convergent validity assessment of the constructs AIO (Agriculture Industry Operations), CO2EM (CO2 Emissions Management), GI (Government Initiatives), and OP (Organizational Perception). The results indicate that the Average Variance Extracted (AVE) values for all constructs exceed the threshold of 0.5, signifying strong convergent validity. An AVE value greater than 0.5 suggests that more than 50% of the variance in the construct's indicators is explained by the underlying construct itself, ensuring that the measurement model adequately captures the intended concept. This confirms that the selected indicators effectively represent their respective latent variables, supporting the model's robustness. Furthermore, the high AVE values reinforce that the constructs exhibit strong internal consistency, meaning that the observed variables within each construct share a significant amount of variance. These findings contribute to the reliability and validity of the study, establishing that the measurement model is well-structured and suitable for further structural model evaluation.

Table 4: Discriminant Validity: Fornell-Larcker Criterion

	AIO	CO2EM	GI	OP
AIO	0.910			
CO2EM	0.889	0.948		
GI	0.574	0.492	0.859	
OP	0.771	0.689	0.682	0.814

The Fornell-Larcker criterion is used to compare the square root of the Average Variance Extracted (AVE) with the latent variable correlations to assess discriminant validity. In this study, convergent validity was evaluated using AVE and composite reliability, ensuring that the constructs adequately explain the variance of their respective indicators. Table 4 shows that the square root values of AIO (Agriculture Industry Operations), CO2EM (CO_2 Emissions Management), GI (Government Initiatives), and OP (Organizational Perception) are greater than their highest correlation with any other construct, confirming that discriminant validity is achieved. This indicates that each construct is distinct and measures a unique aspect of the model.

Table 5: Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)

	AIO	CO2EM	GI	OP
AIO				
CO2EM	0.918			
GI	0.580	0.483		
OP	0.827	0.710	0.727	

The Heterotrait-Monotrait Ratio (HTMT) was employed to assess the correlation between latent variables. As shown in Table 5, all variables AIO (Agriculture Industry Operations), CO2EM (CO_2 Emissions Management), GI (Government Initiatives), and OP (Organizational Perception) exhibited values less than 1 and close to 1, indicating a strong yet acceptable distinction between these constructs. Since HTMT values below 1 confirm the presence of discriminant validity, these results suggest that the model meets the necessary validity criteria. Therefore, it can be concluded that acceptable discriminant validity is achieved, with most values falling within the recommended thresholds.

Structural Model Assessment

Figure 2 below exemplified the structural model for this study, depicting the relationships between the key constructs: Organizational Perception (OP), Agriculture Industry Operations (AIO), Government Initiatives (GI), and CO_2 Emissions Management (CO2EM). The path coefficients (represented by numerical values on the arrows) indicate the strength and direction of the relationships between constructs.

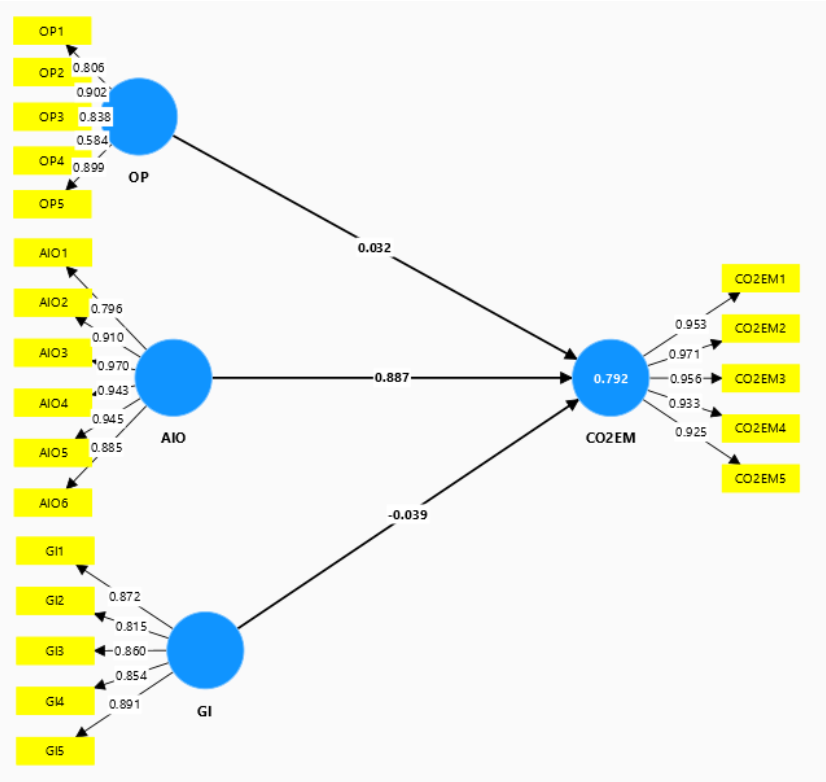

Figure 2 : Structural Model

Among the relationships tested, AIO has the strongest influence on CO2EM, with a path coefficient of 0.887, indicating a significant positive impact. OP shows a weak positive effect on CO2EM, with a coefficient of 0.032, suggesting that organizational perception alone does not significantly drive CO2 emissions management. GI has a slight negative influence on CO2EM, with a coefficient of -0.039, indicating that government initiatives may not directly contribute to effective CO2 emissions management in the food industry.

Table 6: Path Coefficients and Hypotheses Testing Results

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P-Values	Results
OP->CO2EM	0.032	0.092	0.224	0.143	0.886	Not Supported
AIO->CO2EM	0.887	0.841	0.187	4.738	0.000	Support
GI->CO2EM	-0.039	-0.053	0.144	0.272	0.786	Not Supported

Table 6 shows the Path Coefficients statistic. The results indicated that construct AIO is significant. The P-Value of construct AIO is less than 0.0, which is significant. Additionally, the t-value of AIO is greater than 2.00, which is 4.738. This simply indicates a greater difference between AIO -> CO2EM being compared, which further ascertained it more likely to be statistically significant.

Based on the path analysis is shows that:

H1: OP (β=0.032, t=0.143, $p>0.05$) does not has direct influences CO2EM.

H2: AIO (β=0.887, t=4.738, $p<0.05$) directly influences CO2EM.

H3: GI (β=-0.039, t=0.272, $p>0.05$) does not has direct influences CO2EM.

The hypothesis testing results provide key insights into the factors influencing CO2 emissions management in the food industry.

Hypothesis 1 (H1) proposed that organizational perception has a positive influence on CO2 emissions management in the food industry. However, the findings indicate that this hypothesis is not supported, suggesting that organizational perception alone may not significantly drive effective CO2 emissions management. Other factors, such as regulatory frameworks or industry standards, might play a more substantial role.

Hypothesis 2 (H2), which examines the positive influence of agricultural industry operations on CO2 emissions management, is supported. This confirms that operational practices within the agricultural sector contribute significantly to emissions reduction efforts, emphasizing the importance of emissions control strategies in food production.

Hypothesis 3 (H3) proposed that government initiatives positively influence CO2 emissions management in the food industry. However, this hypothesis is not supported, indicating that government efforts alone may not be sufficient to drive significant changes in emissions management. This could be due to factors such as weak policy enforcement, lack of industry compliance, or the need for stronger incentives and collaboration between government bodies and businesses.

Overall, these findings highlight the critical role of agricultural operations in reducing CO2 emissions while suggesting that organizational perception and government initiatives, on their own, may not be as impactful. This underscores the need for an integrated approach that combines industry practices, policy support, and corporate engagement to drive meaningful sustainability outcomes in the food sector.

Table 7: R^2 Result

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P-Values
CO2EM	0.792	0.815	0.070	11.247	0.000

In this study, bootstrapping with 5,000 samples was conducted to assess the structural model, and the results in Table 7 indicate that the R Square (R^2) value is 79.2%. This suggests that 79.2% of the variation in CO2EM (Carbon Dioxide Emissions Management) is explained by the OP (Organization Perception), AIO (Agriculture Industry Operation), and GI (Government Initiatives) constructs. Since R^2 values range from 0 to 1, with higher values indicating stronger explanatory power, an R^2 of 79.2% signifies a strong model fit, demonstrating that these three constructs collectively account for a significant proportion of the variation in CO2 emissions. The remaining 20.8% represents unexplained variance, which may be attributed to other factors not included in this model.

Table 8: F^2 Results

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P-Values
AIO->CO2EM	1.515	1.698	1.437	1.054	0.292
GI->CO2EM	0.004	0.060	0.133	0.029	0.977
OP->CO2EM	0.002	0.085	0.179	0.009	0.993

F Square (F^2) is defined as effect size (>=0.02 is small; >=0.13 is medium; >=0.26 is large). From Table 8 below, it shows that: Construct OP, AIO, and GI effect size are greater than 0.26, which indicates that the effect size are large.

The results of the pilot test provide valuable insights into the relationships between the independent variables and CO2 emissions management (CO2EM). Specifically, the analysis revealed that organizational perceptions (OP) did not exhibit a statistically significant positive influence on CO_2 emissions management, as indicated by a beta coefficient of $\beta=0.032$, a t-value of 0.143, and a p-value greater than 0.05. In contrast, agriculture industry operations (AIO) demonstrated a strong and positive influence on CO_2 emissions management, evidenced by a beta coefficient of $\beta=0.887$, a t-value of 4.738, and a p-value less than 0.05. This suggests that effective practices within the agriculture sector play a crucial role in enhancing CO_2 emissions management strategies. Lastly, government initiatives (GI) similarly did not show a significant positive influence on CO_2 emissions management, with a beta coefficient of $\beta=-0.039$, a t-value of 0.272, and a p-value exceeding 0.05. Overall, these findings highlight the varying impacts of the independent variables on CO_2 emissions management, particularly underscoring the importance of agriculture industry operations in driving effective emissions management practices.

In a more thorough examination, this study reveals that a robust corporate strategic planning process must incorporate CO_2 emission-related challenges to foster sustainability and address climate change effectively. By ensuring that CO_2 emission reduction goals are intertwined with corporate objectives, organizations can create a more cohesive and impactful approach to sustainability. The emphasis on sustainability measures across all business operations is crucial for mitigating climate change. The insights gained from this research serve as a valuable resource for organizations, the food industry and other business sectors, as they seek to identify and implement strategies aimed at reducing CO_2 emissions and promoting environmental stewardship.

In summary, this research has shed light on the intricate relationship between organizational perceptions, agriculture industry operations, and government initiatives as independent variables influencing CO_2 emissions management. The pilot test results revealed a noteworthy positive influence of agriculture industry operations on the implementation of effective CO_2 emissions management strategies. This finding underscores the importance of operational practices within the agriculture sector as a critical component in mitigating environmental impacts.

Conclusion

The study is conducted through a quantitative approach, panel data analysis. The study evaluated whether the main hypothesis of the research project has a significant positive correlation between agriculture industry operation, organization perception, government initiatives and CO_2 emissions management. The pilot test analysis results exemplified that agriculture industry operation have a significant relationship toward the implementation of CO_2 Emissions Management. This study uses a thorough survey to find important insights. The findings of this research highlight the critical need for firms to embed CO_2 emission considerations within their corporate strategic planning processes. Companies must integrate emission reduction objectives into their broader corporate goals to drive meaningful sustainability efforts. Moreover, tackling CO_2-related challenges necessitates a holistic approach, where sustainability measures are applied across all business operations. These insights serve as a valuable reference for food industry players and other businesses, enabling them to identify and emphasize key strategies to lower carbon emissions and play a proactive role in addressing climate change.

The quantitative survey was distributed to over 200 food-related companies in Malaysia, garnering a response rate of nearly 10% in the pilot test study, which simply implies that there is an opportunity for deeper exploration. In order to enhance the robustness of this study, this research will further conduct through qualitative surveys with selected companies to gain richer insights and a more nuanced understanding of their experiences and practices regarding CO_2 emissions management. This next phase of research will allow for a comprehensive examination of the factors at play, ultimately contributing to more effective strategies for reducing CO_2 emissions in the sector. This research is designed to provide a better insight into the practical implementation of CO_2 emissions in food industry in Malaysia context to support sustainable development in the due course.

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