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บทความวิจัย

THE IMPACT OF ENVIRONMENTAL CONCERN, CARBON OFFSET EDUCATION AND ATTITUDES ON NEW CARBON OFFSETTING INITIATIVES

Sudarath Tolanuwat*
Kasem Bundit University, Bangkok, Thailand.

*E-mail: sudarath.tol@kbu.ac.th

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ABSTRACT

This study aimed to illustrate the impact of environmental concern and carbon offsetting program knowledge on the willingness to offset flight carbon, which has never been studied in a Thai context. This study also aimed to open a discussion about the willingness to offset flight carbon emissions among Thai passengers traveling by air. This study determined that attitudes towards carbon offset played a role as a mediator between knowledge and willingness to act upon that knowledge, which was determined by using the extended knowledge-attitude-behavior theory. Data was collected from 222 participants via an online questionnaire using purposive selection, and the Partial Least Square Structural Equation Model (PLS-SEM) was used to test the hypotheses. The findings revealed that environmental concern had the strongest impact (ß = 0.296) on the willingness to offset flight carbon, followed by the carbon offsetting program knowledge (0.204). Furthermore, the attitude towards the carbon offset program significantly played as a partial mediator for the relationship between carbon offsetting program knowledge (VAF = 0.412) and the willingness to offset flight carbon, as well as the relationship between environmental concern and the willingness to offset flight carbon (VAF=0.463). The knowledge gained from this study could help the flight industry develop programs and incentives for lowering carbon consumption.

Keywords: Environmental Concern, Knowledge of Carbon Offsetting Program, Attitude toward Carbon Offset, Carbon Offsetting Program, Willingness to Offset

Introduction

Human activities in a post-industrial world, specifically burning fossil fuels, have significantly contributed to harmful greenhouse gas emissions. These emissions have slowly increased the global temperature consistently since before the industry boom (NASA, n.d.). The United Nations is at the forefront of the effort to save our planet. In 1992, its "Earth Summit" produced the United Nations Framework Convention on Climate Change (UNFCCC) as a first step in addressing the potential problems associated with climate change. This was followed by the Kyoto Protocol in 1995 and Paris Agreement in 2015 (Maizland, 2022).

As a result of the accelerated increase of carbon dioxide emissions from the aviation sector in the last decade, in 2016, the International Civil Aviation Organization (ICAO) established the Carbon Offset Reduction Scheme: CORSIA (Timperly, 2020). Since then, many airlines worldwide have launched the carbon offsetting program offering their passengers the ability to eliminate the carbon they emit during flight.

Several researchers have already begun to examine carbon offsetting trends. So far, it has been revealed that many passengers were either not previously aware or had simply chosen to disregard carbon offsetting options (Lu & Wang, 2018). It seems to be admitted that most people do not know about carbon offsetting programs, which often results in a lack of willingness to participate in such a program. However, previous studies about "green products" reveal that attitudes in general significantly affect purchasing intention (Paul et al., 2016; Sharma & Dayal, 2017).

Apart from knowledge and attitude towards green products, environmental concern is used as an essential variable in many studies. The results of Bashaa et al. (2015) study show that environmental concern is the most stated motive for purchasing organic foods. Ajzen and Fishbein (1977) claimed that while it is not the sole indicator, attitude is one of the main variables affecting human behavior.

Furthermore, raising awareness about the effects of environmental deterioration can potentially lead to future generations being more environmentally conscious (Takala, 1991; Stern, 1992) According to Xu et al. (2010) and Yi & Hohashi (2019), there are researchers applying knowledge - an attitude-behavior model which indicated that knowledge and attitude influence behavioral change.

The relationships among the KAB model's three constructs which consist of knowledge, attitude and behavior have been proved and verified in various fields (Lu & Wang, 2018)

Research Objectives

This study is based on the extended knowledge-attitude-behavior model (KAB). Its goal is to evaluate not only the knowledge of the flight carbon offsetting program but also the attitude towards it. According to the model, it would be beneficial to the airlines to encourage participation with customers directly. This begins by raising awareness, however.

The willingness to offset flight carbon in this study is hypothesized to be influenced by three constructs: environmental concern, program knowledge, and attitude. This research consequently aims to investigate the impact of environmental concerns and carbon offsetting program knowledge on the willingness to offset flight carbon behavior of Thai passengers when flying with commercial airlines. Additionally, the influence of environmental concerns and knowledge of carbon offsetting programs will be explored.

For this survey, two research questions were put forth: (1) What is the relationship between environmental concern, carbon offsetting program knowledge, carbon offset attitudes, and Thai passengers' carbon offsetting behavior? (2) Are there any actual changes in behavior with regard to these things?

Literature Review

Knowledge: The knowledge–attitude–behavior model explains that people's knowledge directly affects their attitudes and indirectly affects behaviors through their attitudes Schrader & Kimberly, 2004) Awareness of environmentally-friendly alternatives has been shown to have at least some impact on consumers' attitude towards so-called "green" brands. Inversely, when consumers lack product-related knowledge, they will have less confidence in such products and reduce their green purchasing behavior. (Padel & Foster, 2005; Suki, 2016) Sanlier & Baser (2020) revealed that the relationship between food safety knowledge and behavior is mediated by attitude and that there are direct relationships between knowledge and behavior. However, Ellinda-Patra et al. (2020) stated that knowledge significantly affects food safety attitude and behavior, but attitude does not influence behavior.

Previous studies found that education is one of the important variables that have a significant positive influence on

consumer's intention to purchase "green" products (Vicente-Molina, 2013; Wang et al., 2014). However, there is a study indicates that even though individuals have a good level of knowledge of basic food safety, it is also a fact that they may not turn knowledge into behavior (Wilcock et al., 2004). Based on the above findings, this study would then like to examine such determinants in the Thai context. Hence, the following hypotheses were formulated.

Hypothesis

H1: The knowledge of carbon offsetting programs has a positive impact on the willingness to offset flight carbon.

Environmental concern: Environmental concern can be defined as an evaluation of one's own behavior and weighing it against the supposed environmental consequences. It plays an important role in behavior changes (Fransson & Garling, 1999) Environmental concern also indicates "the degree to which people are aware of problems regarding the environment and support efforts to solve them or indicate the willingness to contribute personally to their solution" (Dunlap & Jones, 2002).

Landry et al. (2018) state environmental concern is a significant variable examined in the pro-environmental literature. Several have revealed that environmental concern influences the intention and purchasing behavior of eco-friendly products (Hu et al., 2010; Hartmann et al., 2012; Samarasinghe et al., 2013) A previous study in India shows that consumers' concern for environmental issues significantly affects their green buying behavior (Datta, 2011) Consumers who possess a significant concern for the environment tend to buy more green products than those who do not (Yadav and Pathak, 2016) Based on the above, another hypothesis was formulated.

H2: Environmental concern has a positive impact on the willingness to offset flight carbon.

Attitude: Attitude toward a behavior is described as the degree to which a person has a favorable or unfavorable assessment for performing a particular action. The higher the degree of a positive attitude towards the behavior, the more intention to perform that particular behavior (Ajzen, 1991; Han et al., 2009). There are studies on friendly environmental products and eco-centric behaviors and/or tendencies that seem to illustrate a correlation between education, attitude, and overall environmental consciousness

(Aman et al., 2012; Albayrak et al., 2013; Yadav & Patak, 2016).

Mostafa (2007) found that a positive relationship between attitude and behavioral intention has been established in many cultures. He also suggests that environmental knowledge is positively linked with attitude toward green products.

Maichum et al. (2016) found that environmental knowledge had no significant effect on the purchase intention for green products. Instead, it had a distinct indirect effect through attitude towards purchasing green products.

The knowledge of such green products among a group of healthcare workers who were surveyed seemed to have a correlation with attitudes and behaviors. (Yi & Hohashi, 2019) Sanlier & Baser (2020) revealed that the relationship between food safety knowledge and behavior is mediated by attitude. Based on the literature review, the hypothesis below was formulated.

H3: Attitude toward carbon offset has a mediating role between knowledge of carbon offsetting program and the willingness to offset flight carbon.

Ahmad & Thyagaraj (2015) indicate that environmental concern, Environmental knowledge would positively influence attitude, which in turn positively influences intention to purchase green brands. There is also a previous study that reveals that attitude toward green products acts as a mediator between environmental concern and green purchase intention (Hartmann & Apaolaza, 2012) Hence, the hypothesis was formulated as:

H4: Attitude toward carbon offsetting has a mediating role between environmental concern and the willingness to offset flight carbon.

Conceptual framework

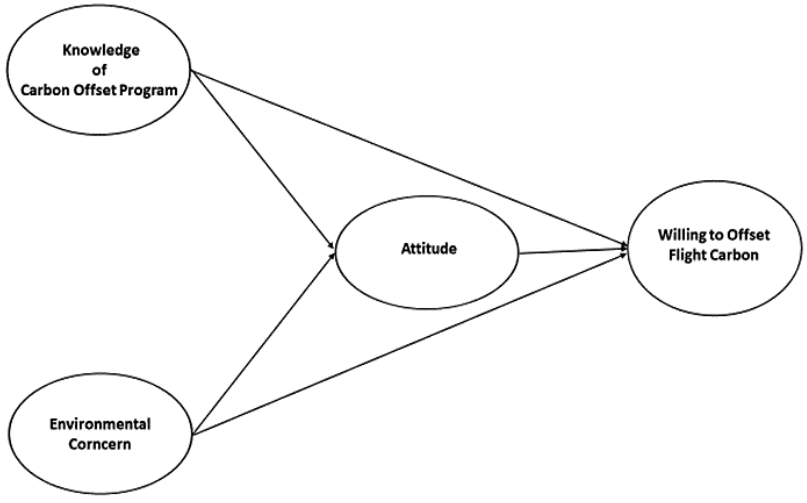

Figure 1 Research Framework

Research Methodology

Participants and procedure

The target sampling for this study were Thai passengers who have experienced flying commercial airlines, specifically on an international flight. Following the recommendation of Hair et al. (2011), minimum sample size estimation method in PLS-SEM is the "10-times rule" method which builds on the assumption that the sample size employed in an empirical study should be greater than 10 times. According to 22 items measurement, then data will be collected at least 220 respondents via online questionnaire using purposive selection technique.

The questionnaire was developed based on a review of the literature. It was validated using Index of Item – Objective Congruence (IOC) technique by three professors in the field before being trialed with 30 samples. The Cronbach's Alpha Coefficient obtained from the data for this set of questionnaires is 0.917. All items were measured using a 5-point Likert scale ranging from "1 - strongly disagree" to "5 - strongly agree".

Measurement

The knowledge of carbon offsetting program is measured by 6 items developed by Kim et al. (2014), IATA (2008); van Birgelen et al. (2011) and Davison et al. (2014). Sample items are: "I can explain the voluntary carbon offset program and its benefits.", and I know what channel can be used to purchase carbon offsets."

Attitude is measured by 6 items, according to a system devised by Kim et al. (2014), Chen (2013), Van Birgelen et al. (2011). Sample items are: "Carbon offsetting air travel is important to our environment.", and "Purchasing offsets to support the voluntary carbon offset program is smart."

Environmental concern is measured by 6 established criteria used in the research of Kilbourne, & Pickett, (2008) Sample items are "I am very concerned about the environment.", and "Antipollution laws should be enforced in a strict manner."

Willingness to participate in the voluntary carbon offset program is measured by 4 items developed by Chen (2013), Davison et al. (2014) and Van Birgelen et al. (2011) The sample items are: "I am willing to pay the offsets to support the voluntary carbon offset program" and "I am willing to support the carbon tax policy on passengers' duty."

PLS- SEM Analysis

The research was tested by using the Partial Least Squares Structural Equation Model **(**PLS-SEM**).** The developed conceptual model was drawn in SmartPLS3 software, which calculated and assessed various parameters**.** These included item loading, reliability, and validity tests using a measurement model evaluation**.** Whereas the structural model assessment evaluated the relationship between independent and dependent variables**.**

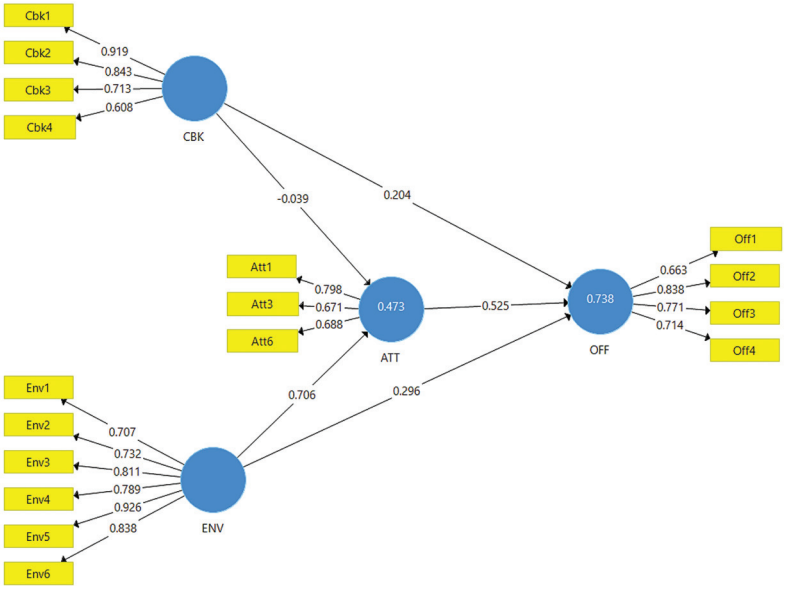

Figure 2 Structural Model using Consistent Pls Algorithm

Measurement Model Evaluation

In the PLS approach, there is an outer model evaluation for reliability measurement, whereas an inner model evaluation is incorporated to measure validity. Table no. 1 shows the outer loading values from 0.663 - 0.926, which are considered to be highly satisfactory at 0.7 or higher (Henseler et al., 2009) and are acceptable at 0.5 while those with less than 0.5 should be deleted (Chin, 1998; Hair et al., 2011) However, Henseler et al. (2009) explained that the value of outer loading between 0.4 and 0.7 should be considered before withdrawal. Dakduk et al. (2017) indicated that validity requires indicator loadings to be 0.6 or more. In this study, the cut-off value is taken for outer loading at 0.6 or greater. The composite reliability (CR) of each construct in the measurement is accepted for confirmatory purposes at a value higher than 0.7 (Hair et al., 2011) All indicators in this study are displayed in table no.1 while those with value of AVE less than 0.5 according to the specific construct of Hari et al., 2011 (AVE > 0.5) will be deleted as shown in table 1.

Table 1 Construct Reliability and Validity

Latent Variables	Indicator Variable	Cronbach's Alpha	Outer Loading	Composite Reliability	AVE
Carbon offset program Knowledge (CBK)	Cbk1	0.857	0.919	0.859	0.608
	Cbk2		0.843		
	Cbk3		0.713		
	Cbk4		0.608		
	Cbk5*		0.015		
	Cbk6*		0.353		
Environmental concern (ENV)	Env1	0.917	0.707	0.916	0.646
	Env2		0.732		
	Env3		0.811		
	Env4		0.789		
	Env5		0.926		
	Env6		0.838		

Table 1 (to)

Latent Variables	Indicator Variable	Cronbach's Alpha	Outer Loading	Composite Reliability	AVE
Attitude toward carbon offset (ATT)	Att1	0.760	0.798	0.764	0.520
	Att2*		0.551		
	Att3		0.671		
	Att4*		0.300		
	Att5*		0.507		
	Att6		0.688		
Willing to offset flight carbon (OFF)	Off1	0.834	0.663	0.836	0.562
	Off2		0.838		
	Off3		0.771		
	Off4		0.714		

Note: *deleted items (outer loading < 0.6)

The √AVE values represent the discriminant validity (Fornell-Larcker, 1981) Table 2 shows that each latent variable does not interrelate, since the value of each construct is higher than the others as shown in table 2.

Table 2 Discriminant Validity (Fornell – Larcker Criterion)

Variable	ATT	OFF	ENV	CBK
ATT	0.788			
OFF	0.621	0.753		
ENV	0.687	0.749	0.804	
CBK	0.294	0.498	0.472	0.780

Note: ATT = Attitude toward carbon offset; OFF = Willingness to offset flight carbon; ENV = Environmental concern; CBK = Carbon offsetting program knowledge

Structural Model Assessment

The structural model assessment is the testing of Multicollinearity which can mislead the findings due to the corelated between or among the variables. According to Hair et al. (2011) independent variables in the model are not correlated with one another, showing no multicollinearity when the VIF value is no greater than 5.00 as shown in table 3.

The assessment includes coefficient determinant (R^2), path coefficient (ß), t-statistics and significance level respectively. R^2 interprets the degree of explained variance of the dependent latent variables. Hair et al., 2011 indicate that the cut off value of coefficient determinant (R^2) should not be less than 0.250, to be able to explain the variance of the dependent variable. Table 4 shows that R^2 value

Table 3 VIF testing result

Variables	VIF
ATT	1.898
ENV	2.232
CBK	1.290

Note: ATT = Attitude toward carbon offset, ENV = Environmental concern, CBK = Carbon offsetting program knowledge

for the developed model is higher than the suggested value.

The R^2 value adjusted at 0.468 for ATT means that the carbon offsetting program knowledge and environmental concern can predict attitudes toward carbon offsetting for 46.80 %. The R^2 adjusted value at 0.734 for OFF means that the carbon offsetting program knowledge, environmental concern, and attitude toward carbon offsetting can predict the willingness to offset flight carbon for 73.40 %, which is displayed in table 4.

Hypothesis Testing

The path coefficient (ß) shows the strength of an effect from independent variables to dependent variables. The value of the path coefficient must be higher than 0.10 with a significant level less than 0.05 and t - statistics should be higher than the critical value at 1.960 (Figure 2). With the PLS-SEM approach, the algorithm and bootstrapping process calculate standard errors, constructs confidence intervals, and performs hypothesis testing. All of the mentioned values are shown in table 5.

Table 4 coefficient determinant (R^2)

Dependent Variables	R^2	R^2 Adjusted
ATT	0.473	0.468
OFF	0.738	0.734

Note: ATT = Attitude toward carbon offset, OFF = Willingness to offset flight carbon

Table 5 Path coefficient, t-statistics, and P-value

Hypothesis	Impact of independent upon dependent variable	β	T value	P value	Hypothesis
H1	CBK----------›OFF	0.204	2.899	0.004	Accepted
H2	ENV----------›OFF	0.296	2.564	0.014	Accepted

ENV = Environmental concern, CBK = Carbon offsetting program knowledge, OFF = Willingness to offset flight carbon

The inner model shows that ENV has the strongest impact on OFF **(0.296)**, followed by CBK **(0.204).** The hypothesis path between ENV and OFF is significant with P-value at 0.014, whereas the hypothesis path between CBK and OFF is significant with P-value at 0.004. In conclusion, both ENV and CBK are significant statistical predictors of the OFF.

According to the research framework, ATT takes a role as a mediator between CBK and OFF, and also between ENV and OFF. Wong (2015) explains that for mediation analysis, the 2 - step procedures has been used by the bootstrapping approach: (a) the significance of direct effect is checked without the mediator (ATT) in the model (Figure 3); (b) the significance of indirect effect is checked with the mediator (ATT) in the model (Figure 4.) This 2 - step procedure has been performed twice as to test the third hypothesis (H3) and the fourth hypothesis (H4).

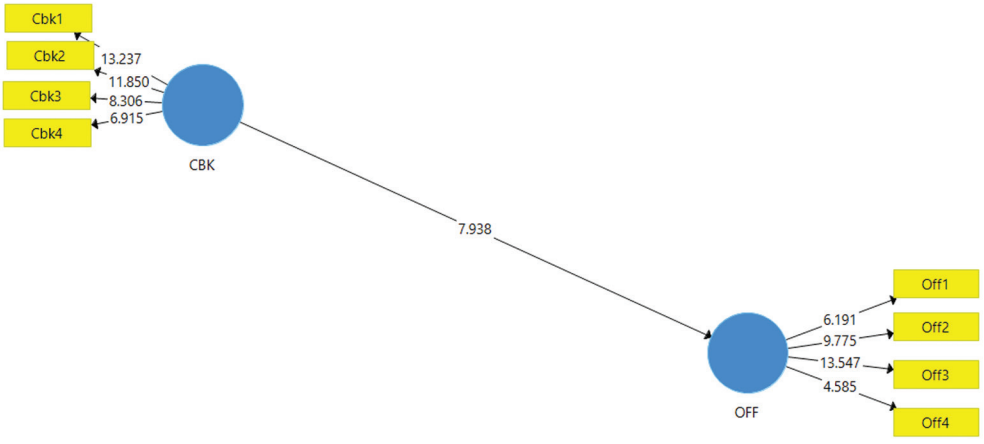

Figure 3 1st step approach without mediator (CBK to OFF)

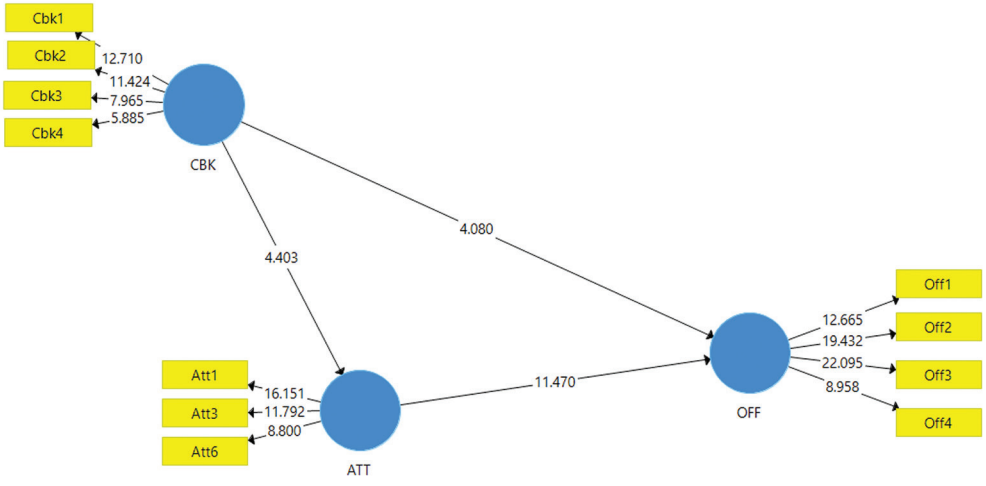

Figure 4 2nd step approach with mediator (ATT as mediator between CBK and OFF)

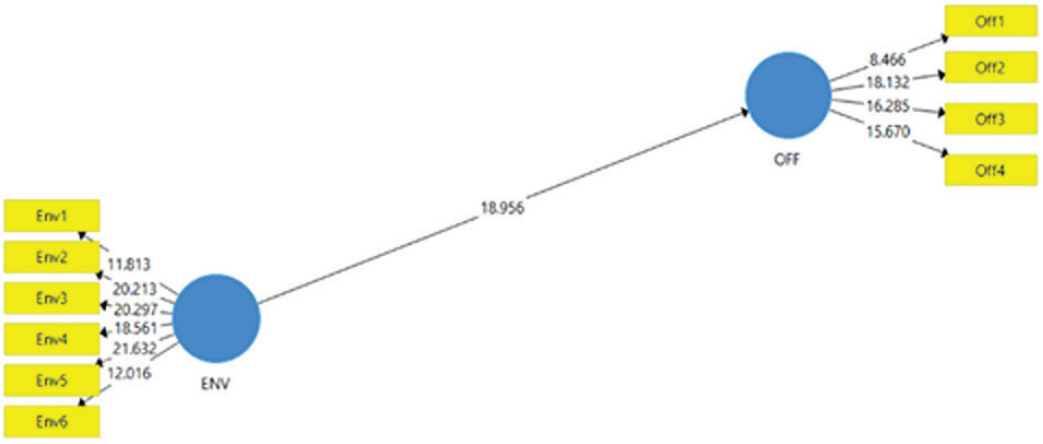

Figure 5 1st step approach without mediator (ENV to OFF)

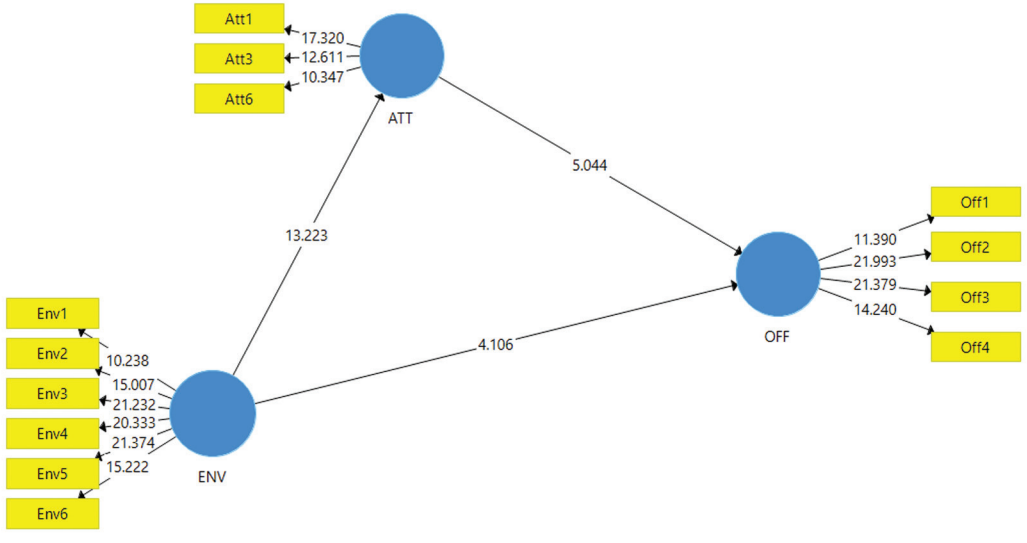

Figure 6 2nd step approach with mediator (ATT as mediator between ENV and OFF)

Table 6 Mediation Analysis

H	Procedure	Path	β	Indirect effect	Stdev.	Total effect	VAF	T value	P value	Hypothesis
H3	Step1: Direct effect (w/o mediator)	CBK----›OFF	0.494			n/a		7.938	0.000	Accepted
	Step2: Indirect effect (w. mediator)	CBK----›OFF	0.292		n/a					
		CBK----›OFF	0.295			0.497	0.412			
		ATT----›OFF	0.694	0.205	0.051			4.087	0.000	
H4	Step1: Direct effect (w/o mediator)	ENV---›OFF	0.766			n/a		08.956	0.000	Accepted
	Step2: Indirect effect (w. mediator)	ENV---›OFF	0.407		n/a					
		ENV---›ATT	0.687			0.758	0.463			
		ATT---›OFF	0.511	0.351	0.087			4.417	0.000	

Note: CBK = Carbon offsetting program knowledge
ENV = Environmental concern
ATT = Attitude toward carbon offset
OFF = Willingness to offset flight carbon

Hair et al. (2011) indicated that the specific variable will be a partial mediator when VAF value exceeds 0.20 while it will be fully mediator when VAF value is greater than 0.80. According to table 6 above, the effect of CBK on OFF via ATT has the VAF value at 0.412, and the effect of ENV on OFF via ATT has the VAF value at 0.463. This means that ATT performs partial mediator to both CBK on OFF (H3) and ENV on OFF (H4).

Result conclusion and Discussion

Discussion

This current research investigates the direct impacts of carbon offsetting education and the environmental concern upon the willingness to offset flight carbon among Thai passengers, and also to examine those relationships when the attitude toward carbon offset program plays a role of mediator. The environmental concern has the strongest impact (ß = 0.296) on the willingness to offset flight carbon, which is in line with previous study of Yahya et al. (2013) that environmental concern significantly influences consumer behavior and also the study of Yue et al. (2020) that environmental concern positively affects green consumption intention. The carbon offsetting program knowledge directly effects (ß = 0.204) upon the willingness to offset flight carbon. There is also an empirical study which revealed that environmental knowledge influences the tourists' intention to behave in an environmentally responsible manner (Abdullah et al, 2019)

Furthermore, the attitude towards carbon offsetting plays a significant role as a partial mediator (VAF=0.412) in the relationship between and the willingness to offset flight carbon. This is in agreement with the study of Iyer (2018) that when there is an increase in the knowledge about e-waste; there is a positive change in the attitude towards e-waste generation which leads to modification in the behavior. Attitude toward carbon offset program also acts as a partial mediator between the relationship of environmental concern and the willing to offset flight carbon (VAF=0.463).

This result agrees with Yadav (2016) and Yadav and Pathak (2016), who stated that young consumers are concerned about the environment would develop a positive attitude towards their participation in environmental safety. Similarly, there is research which claimed that higher concern in green products would result in a positive attitude (Ricci et al., 2018), which finally results into pro -environmental consumer behaviors (Taufique et al., 2017)

Conclusions

This study investigated the relationship between the carbon offsetting program knowledge, environmental concern, the attitudes toward carbon offsetting, and the willingness to offset flight carbon. The findings from this research will be of benefits to airlines and organizations

concerned with their environmental strategies in the future. Airlines should promote the carbon offsetting program to their passengers, for it significantly impacts on the willingness of Thai passengers to participate. Organizations should help promote green initiatives by making policies or promoting incentives to enhance the environmental concern to Thai people. The attitude also acts as a partial mediator for both carbon offsetting education and environmental concern. As such, airlines should find their ways to encourage passengers' participating in their carbon offset program accordingly.

Research Limitation

There are some limitations in this research.

1. The purposive selection technique via online questionnaire using Google to avoid contact from covid-19 pandemic-situation may limit the respondents to just those who get used to technology.

2. The online questionnaire used in the study consists of a close-ended questions and cannot get the information in-depth.

Future Research

Possibilities for future research can be:

1) After the Covid-19 pandemic, data collection should be done face to face so that respondents can ask for clarification with questions they consider ambiguous or confusing.

2) Mixed methods should be incorporated for gathering more in-depth data.

3) Other theories and models apart from the KAB Model can be employed to examine the consumer's intentions.

Ethical Declaration

This research has been approved by Central Research Ethics Committee of Kasem Bundit University**.** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institution with IRB no**.** R011**/**64X**.**

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