ORIGINAL ARTICLE

Pro-environmental behavior and public understanding of climate change

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Abstract The aim of this article is to examine whether awareness, knowledge and risk perception of climate change have significant influence on attitudes and pro-environmental behaviour. The study found that awareness, knowledge and risk perception of climate change positively influence the formation of favourable attitudes future action climate change. In addition, this paper also found mediated relationship through attitudes between awareness, knowledge, risk perception and pro-environmental behaviour. The paper argues that people are more likely to accept pro-environmental behaviours only if they have sufficient understanding of the adverse impacts of no action. This study offers decision makers field data to formulate relevant environmental policies and strategies in Malaysia.

Keywords Public awareness · Knowledge · Risk perception · Attitudes · Climate change and pro-environmental behaviour

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1 Introduction

A healthy natural environment requires a good deal of public awareness of environmental issues (Leiserowitz 2007; Stern 2006; Doss and Morris 2001). To date, much research has addressed a plethora of climatic issues, however, the role of public attitudes in addressing the problems associated with future climate change have only recently been acknowledged (Whitmarsh and Lorenzoni 2010; Liverani 2009; Leiserowitz 2007; Kollmuss and Agyeman 2002). In this regard, Schultz and Oskamp (1996) and Patchen (2006) argued for the importance of public knowledge and attitudes as central elements for better natural liveable environments. Leiserowitz (2007) focused on the public perception of climate change and stressed the significance of realizing public perception as it can significantly affect future development and policies regarding the environment. Attitudes are important dimensions that replicate how individuals view their surrounding environment and what regard they have for environmental issues. Favourable attitudes assist an individual in performing a significant role to preserve the environment. In order to combat the adverse effects of climate change pro-environmental behaviour minimizes negative human-caused impacts on the environment (Stern 2006). Doss and Morris (2001) focused on the perceptions of ethnic communities, the way they think and behave in relation to climate change, as well as their values and aspirations, which they argued have a significant role to play in addressing climate change. However, it is also important to emphasize the fact that every human being has the capacity to make a difference in fighting climate change. Given generally high levels of climate change awareness, recent work has called for interdisciplinary approaches to understanding biophysical impacts and the human dimensions of climate change (Moser 2006). In recent years, numerous research initiatives have described the gap between environmental awareness, knowledge, and real presentation of pro-environmental behaviour (Kollmuss and Agyeman 2002). One would expect from such previous researches that educating public on environmental problems would spontaneously result in greater pro-environmental behaviour towards climate change as a result of a more positive outlook on climate change issues (Burgess et al. 1998). People generally familiar climate change problems with a limited understanding of its processes, and sometimes express concern regarding associated environmental degradation. However, how address the problems with fundamental awareness and knowledge relatively less pronounced (O'Connor et al. 1999; Lorenzoni and Pidgeon 2006; Whitmarsh and Lorenzoni 2010). Therefore, there is a need to develop a clearer understanding of the characteristics of awareness and knowledge on climate change that are observed globally in recent times. According to Liverani (2009), individual behaviour is the core of the climate change challenge as individuals are the drivers of larger procedures of change and policy decisions are taken by individuals.

Research conducted by Pew Global (2006) regarding global awareness of environmental issues found that developing countries had lower levels of awareness compared to developed countries, despite being directly affected by climate change. Malaysia is no exception. A study conducted in 2007 by World Wildlife Fund-Malaysia and partners found that only (45 %) of adults and students in Malaysia are aware of the causes of environmental problems (Ahmad et al. 2012). This indicates that a large number of people do not understand environmental problems or they are not aware of environmental issues. Relatively few studies have sought to determine the exact state of public pro-environmental behaviour in Malaysia. To date, no study has been conducted in Malaysia that examines whether awareness, knowledge and risk perception of climate change have a positive impact on attitudes and its mediating effects on pro-environmental behaviour towards climate change. A healthy future environment requires greater public understand of environmental problems and practical steps

towards pro-environmental behaviour. To this end, this research proposes a unique model, which is first of its kind to have been conducted in Malaysia, to outline the present understanding, awareness, risk perception, attitudes and pro-environmental behaviour of Malaysian society.

2 Proposed research model

The following (Fig. 1) is a research model proposed to identify the relationship among dependent and independent variables as derived from a review of the relevant literature. Here, the pro-environmental behaviour in society (i.e. dependent variable) is the function of attitude towards climate change, which in turn is a function of awareness of climate change, knowledge of climate change and perception of climate change components (i.e. independent variables).

3 Methodology

3.1 Site selection

Malaysia consists of 13 states, however this research focused solely on the state of Selangor (Fig. 2) for several reasons, among them is that it consists of the largest population and economy in terms of gross domestic product (GDP) in Malaysia (DOSM 2012). In addition, Selangor contributes to the nation's rapid development as it is largely regarded as Malaysia's industrial hub (DOSM 2012).

3.2 Sampling technique

Convenience sampling method was employed in this study because of the large population. This sampling technique was chosen because it is fast, budget friendly and facilitates easy data collection. To minimise the sampling bias this study attempted to identify all types of respondents such as students, teachers, professionals, farmers, and non-professionals within the study area.

3.3 Sample size

A total of 400 questionnaires were distributed over a study area consisting of a total population of 5,411,324 with nine administrative districts as shown in Table 1.[1]

3.4 Research instrument and data collection

A pilot test was conducted with 30 respondents in Kuala Lumpur to ascertain any misinterpretation of the questions. The questionnaires were divided into 3 sections, namely A, B & C. Section A consists of the demographic information of the respondents. Section B includes a selection of general questions about C. Section C consists of questions constructed to

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[1] Conferring to Hoe (2008), a sample size of 200 possesses sufficient statistical strength for data analysis. However, if the sample size is too large, e.g., beyond 400, the SEM statistical analysis might be too sensitive, constructing goodness-of-fit measures indicate poor fit (Hair et al. 2010).
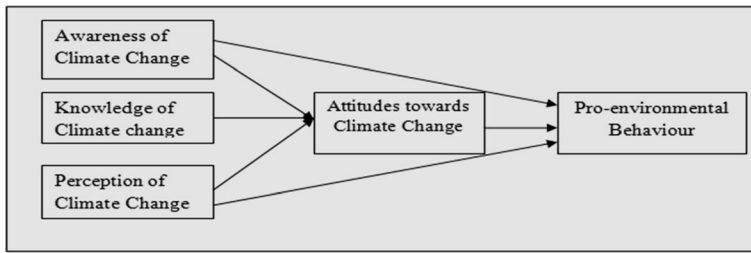
Fig. 1 Proposed research model for understanding awareness, knowledge and perception of climate change in Malaysia

gauge the awareness of climate change, knowledge, perception, attitudes towards climate change, and pro-environmental behavior. The constructs were measured using a 5-point scale with an anchorage from strongly disagree to strongly agree (5). The questionnaires were distributed and collected through the face-to-face approach.

4 Results and discussions

4.1 The socioeconomic characteristics of the respondents

Table 2 reports the main socioeconomic characteristics of the respondents.

4.2 Public awareness of global climate change

Variation was found in the level of public awareness of climate change in Asia. Japan, as the most developed nation in this region, showed the highest level of awareness (99 %), while
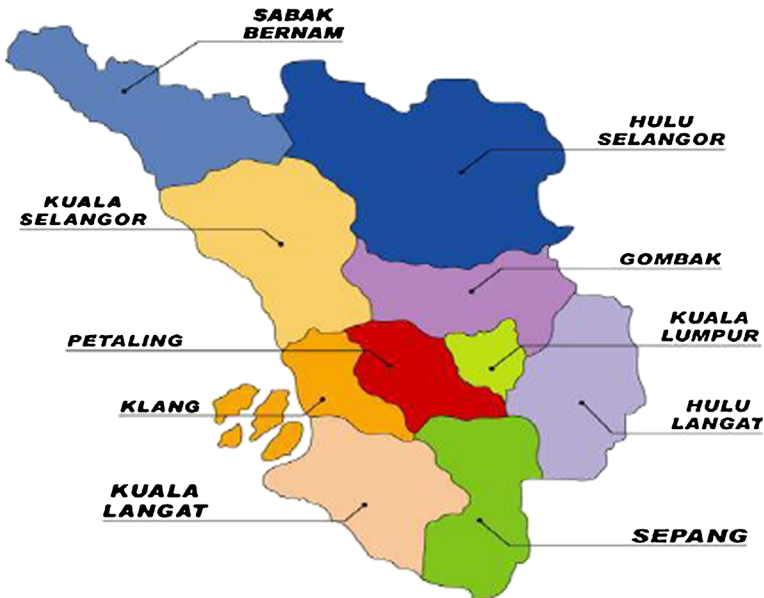

Fig. 2 Map of study area, in Malaysia http://www.bing.com/images/

Table 1 Total human population of the Malaysia study area

Districts	Total population	Sample size
Petaling	1,782,375	70
Hulu Langat	1,141,880	50
Klang	848,149	50
Gombak	682,996	50
Kuala Langat	222,261	50
Sepang	212,050	40
Kuala Selangor	210,406	40
Hulu Selangor	205,049	40
Sabak Bernam	106,158	40
Total	5,411,324	400

Jabatan Perangkaan Malaysia (2011)

the percentage of people having heard of the problem of global change remains significantly low for less developed nations such as Pakistan (12 %) and Indonesia (35 %). The results of this study revealed that (74 %) of the respondents are aware of climate change. Of the respondents aware of climate change (70 %) considered it a serious problem. The findings also revealed that (67 %) and (72 %) of those aware of climate change acknowledged that it might affect human life and the natural environment in Malaysia respectively (Table 3).

Table 2 Socio-economic characteristics of the Malaysian respondents

Basic information	Group	No of respondents	Percentage
Gender	Male	237	69
	Female	148	31
Age	18–30	112	29.09
	31–45	216	56.10
	46–60	59	15.32
	61 and above	13	3.37
Race	Malay	212	55.06
	Indian	88	17.66
	Chinese	68	22.85
	Others	17	4.41
Education level	Secondary	20	5.19
	Higher secondary	90	23.37
	Diploma	125	32.46
	Bachelor	95	25.19
	Post graduate	55	14.28
Income of respondents (RM/month)[a]	2,000 and less than 2,000	35	9.09
	2,001–4,000	184	47.8
	4,001–6,000	83	21.55
	6,001–8,000	43	11.68
	>8,000	40	10.38
	Total	385	100

Field Survey 2013
[a] 1 USD = RM 3.29

Table 3 Public awareness of climate change in Malaysian society

Items of the questionnaire	Disagree (%)		Agree (%)		
	SD (%)	DA (%)	SA (%)	A (%)	SA (%)
I am aware of climate change	6	20	10	44	20
I am aware that climate change is a serious problem	12	18	20	40	10
I am aware that climate change affects human life	9	15	26	33	8
I am aware that climate change might affect the natural environment in Malaysia	13	15	30	10	32

Field Survey 2013

SD strongly disagree, *DA* disagree, *SA* somewhat agree, *A* agree and *SA* strongly agree

4.3 Public knowledge of global climate change

Respondents were asked several carefully weighted questions that explored their knowledge of the adverse effects of climate change (Table 4).

The results show that (53 %) of the respondents are aware of climate change. Seventy-one percent of respondents felt that the temperature is increasing while, (60 %) mentioned unpredictable rainfall patterns. The majority of the respondents (92 %) agreed that rapid increases in greenhouse gases are causing climate change in Malaysia while (77 %) of the respondents agreed that carbon dioxide emission are one of the major causes of climate change in Malaysia.

4.4 Pro-environmental behaviour practices by an individual

Pro-environmental behaviour has become necessary to combat the adverse effects of climate change. It is clear that the government is not solely responsible to tackle climate change; rather all citizens are equally responsible. Being aware of this, every individual should have pro-environmental behaviour to reduce carbon releases in Malaysia. There are numerous ways of practicing pro-environmental behaviour by an individual (Table 5) to reduce the adverse impact of climate change.

Table 4 Public knowledge of climate change in Malaysian society

Items of the questionnaire	Disagree (%)		Agree (%)		
	SD (%)	DA (%)	SA (%)	A (%)	SA (%)
I know climate change occurs in the country	17	30	21	25	10
I feel the temperature is increasing	10	19	25	30	16
The rainfall pattern is unpredictable	2	38	20	28	12
Rapid increases in greenhouse gases are causing climate change in Malaysia	3	5	30	10	52
Carbon dioxide emission are one of the major causes of climate change in Malaysia	10	13	10	10	57

Field Survey 2013

Table 5 Possible adaptation measures towards climate change in Malaysia

Items	Frequency	Percentage (%)
Buy car with a smaller engine size	6	1.59
Change to a more fuel efficient car	10	2.6
Make fewer car journeys	11	2.85
Walk or cycle more	20	5.19
Use public transport	24	6.23
Install low energy light bulbs	22	5.71
Install renewable energy, e.g. solar panels, wind turbines	10	2.6
Switch off lights	38	9.87
Turn appliances off at the plug when not in use	47	12.20
Use more environmental friendly chemicals in the home	32	8.31
Reduce the amount of waste you produce	23	5.97
Recycle as much as possible	22	5.71
Reuse bottles and containers	13	3.37
Replace broken appliances with more energy-efficient ones	20	5.19
Others	27	7.02
No adaptation	60	15.6
Total	385	100

Field Survey 2013

4.5 Tests for confirmatory factor analysis (CFA)

CFA was performed simultaneously on the entire set of measurement items prior testing of the structural equation model. The process of evaluating the measurement model resulted in deleting terms based on factor loadings less than 0.40 (Field 2009). Following the CFA tests, all seven dimensions had adequate model-to-data fit: normed chi square value below 2.41; CFI value above 0.95; and RMSEA value less than 0.080. These tests also evaluated the reliability and construct validity. Cronbach's Alpha measures the reliability coefficient, which indicates the consistency of the entire scale (Hair et al. 2010), or the overall reliability of the questionnaire (Field 2009). The results from this study showed all six dimensions had reliability values above 0.70 which indicated that the questionnaire was reliable and consistent (see Table 6 below). According to Hair et al. (2010), a standardized factor loading should be 0.40 or higher, ideally 0.70 or higher, provides strong evidence of convergent validity.

4.6 Test for structural equation modeling (SEM)

Structural equation modeling (SEM) examined the relationship among awareness of climate change, knowledge of climate change, risk perception of climate change, attitudes towards climate change and pro-environmental behaviour (Fig. 1). The model had an adequate fit to the data: chi square per degree of freedom $(10.83/4) = 2.707$, less than 3; CFI=0.929, greater than 0.90; $p=0.017$, less than $p \geq 0.005$; and RMSEA=0.077, less than 0.10 but greater than 0.088 (Hair et al. 2010).

Table 6 Construct validity of confirmatory analysis in the study of Malaysian awareness, knowledge, risk perception, attitudes and behavior

Items	Stand. loadings	Reliability
Awareness of CC (Normed χ^2=2.30, CFI=0.985, RMSEA=0.077)		
I am aware of climate change	0.73	0.816
I am aware that climate change is a serious problem	0.63	
I am aware that climate change affects human life	0.76	
I'm aware that climate change might affect the natural environment in Malaysia	0.79	
Knowledge of CC (Normed χ^2=1.56, CFI=0. 995, RMSEA=0.051)		
I know climate change is happening in the country	0.57	0.83
I feel temperature is increasing	0.78	
Rainfall pattern is unpredictable	0.79	
Rapid increases in greenhouse gases are causing climate change in Malaysia	0.66	
Carbon dioxide emission are one of the major causes of climate change in Malaysia	0.71	
Risk perception of CC (Normed χ^2=1.46, CFI=0.984, RMSEA=0.046)		
Climate change is a danger to public health	0.64	0.82
Climate change impacts on agricultural production	0.62	
Due to climate change fresh water shortages will occur	0.80	
My standard of living will decrease	0.63	
Attitudes towards CC (Normed χ^2=1.19, CFI=0.999, RMSEA=0.030)		
The environment in Malaysia is in danger because of global climate change	0.55	0.80
Current global warming is a natural not manmade phenomenon	0.81	
Climate change damages the natural environment and wildlife in Malaysia	0.69	
I'm willing to pay a certain amount to reduce the impact of climate change	0.60	
Pro-environmental behaviour (Normed χ^2=2.41, CFI=0.956, RMSEA=0.080)		
I am not willing to change my lifestyle to counteract global warming and CC	0.60	0.81
I am willing to implement pro-environmental methods for my peers	0.62	
It is my responsibility to encourage my neighbours to adopt climate change	0.64	
I have made major efforts to adopt climate change last year	0.68	
I'll do everything that can reduce the impact of climate change	0.55	

As shown in Fig. 3, the R square for the two dependent (endogenous) variables were pro-environmental behaviour=0.70 and attitudes towards climate change=0.66, which indicated
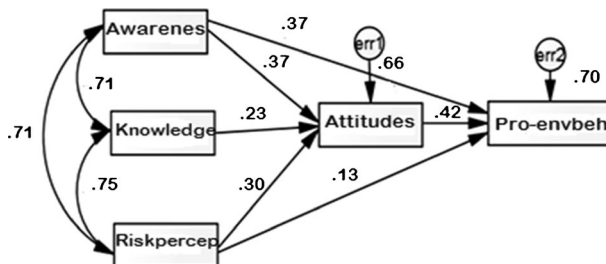

Fig. 3 Structural equation modeling of internet addiction and academic performance in Malaysia

Table 7 Hypothesised path coefficients

Hypothesized paths		Coefficient (β)	P-value (sig.)	Remarks
H1	Awareness → attitudes towards CC	0.371	0.000	Supported
H2	Knowledge → attitudes towards CC	0.230	0.000	Supported
H3	Risk perception → attitudes towards CC	0.301	0.000	Supported
H4	Attitudes towards CC → Pro-environmental behaviour	0.421	0.000	Supported
H5	Awareness → Pro-environmental behaviour	0.371	0.000	Supported
H6	Risk perception → Pro-environmental behaviour	0.131	0.108	Unsupported

that a large percentage of the variance in the dependent factors was explained by the independent (exogenous) factors. All hypotheses were supported in the SEM based on the significant level (p=<0.001) except hypothesis six (Table 7).

The SEM model shows that three factors, such as awareness of climate change (β=0.371), knowledge of climate change (β=0.230) and risk perception of climate change (β=0.301), have positive and significant influence on attitudes towards climate change. The SEM results also show that attitudes towards climate change have positive and significant influence on proenvironmental behavior (β=0.42).[2]

5 Conclusions and recommendations

The findings indicate that a number of Malaysians have heard of climate change issues and challenges, but have little knowledge of impacts or consequences. To promote greater knowledge of such issues, several approaches were identified as practiced at the individual level. The analysis of the study shows a significant relationship among awareness, knowledge, risk perception, attitudes and pro-environmental behaviour as people might change their behaviour through the identified pathways. This means people with high levels of awareness about climate change vulnerability are more likely to act towards reducing the impact of climate change. People with pro-environmental knowledge are willing to behave more environmentally friendly to lessen the impact of climate change. This study offers decision makers fundamental insights regarding public awareness, behaviour and attitudes about climate change that potentially assist in promoting responsive policies and strategies.

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[2] There are numerous studies indicating that awareness, knowledge and perception influence public positive attitudes (Natura 1995; Jim and Xu 2002). Lin (2012) found that attitudes toward global warming influence citizens' pro-environment behavioural intentions.

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