Path Model: Effect of Knowledge, Personality and Behavior Intentions toward Climate Change Adaptive Behavior

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Abstracts: This study was aimed at modelling of climate change adaptive behaviour from basic model theory Responsible Environmental Behaviour (REB) by Hines, and to know the effect of knowledge about climate change (CC), personality, behavior intention toward CC adaptive behavior. A survey method was used by involving 481 Cadets at The School of Meteorology Climatology and Geophysics (STMKG) as sample in this study. There were 4 instruments in this research for measuring knowledge about CC (24 items, reliability .923), personality (25 items, reliability .933), behavior intention (34 items, reliability .976) and CC adaptive behavior of cadets (24 items, reliability .964). Data was analyzed by descriptive statistical, path modelling analysis and inferential statistics. The results revealed that path model at CC adaptive behavior have the significant suitability model. CC adaptive behavior significantly direct and indirect affected knowledge about CC, personality, and behaviour intention, but unaffected indirectly by knowledge about CC. Based on those findings, it can be concluded that variations in CC adaptive behavior of STMKG cadets are affected by variations in knowledge about CC, personality, and behaviour intention. It means that Path model can used to predict CC adaptive behavior based on knowledge about CC, personality, and behavior intention.

Keywords: Climate Change, Meteorology, Adaptation, Personality, Adaptive Behavior.

1. INTRODUCTION

In the last 21st century, climate change (CC) and global warming is the main environmental issue in the world, including in Indonesia. Based on data on disasters, Indonesia as part of The Asia Pacific region has experienced the highest number of disasters and is the most at-risk country [1], and also one of the vulnerable CC countries [2]. The climate change phenomenon has the greatest threats to all sectors of human lives, such as agriculture, health, energy, tourism, forestry, and water resources [3]. To face and minimalize the negative impact of climate change, all countries in the world have to create strategies. There are two strategies must implemented by countries to antedate, avoid, and reduce climate change impact, namely mitigation and adaptation [4]. On 2014, Intergovernmental Panel on Climate Change (IPCC) stated that adaptation is the alteration process to real condition or expected climate change and its effects, pursuing to decrease or prevent horrible effects or abuse the positive value affect.

In context, the CC adaptation strategy, studied by Mengtian et al. (2021) informs that adaptation behavior toward CC is vital for reducing its impact and individual welfare losses [5]. It means in line with the statement of IPCC (2007) changing human behavior can relieve CC, so everything human activities play an important role to eliminate the effect of global warming and CC. Effectively, the individual needs guidance and support for CC adaptation, the reason why governments and stakeholders have to determine effective ways to motivate individuals to adapt to CC [6]. Similar studies about important human behaviors to adapt to CC explained by some researcher [7,8,9,10,11,12,13,14,15,16,17].

Theoretically, behavior is defined as everything that a person does both verbally and non-verbally, which can be seen or observed directly [18]. The other statement about behavior delivered by Rachel et al. (2015) is an action or anything a person does in response to internal or external events, the other definition of behavior is physical events that occur in the body and are controlled by the brain[19]. Furthermore, to explain the definition of CC adaptive behavior can use the Protection motivation theory (PMT) approach, risk appraisal, and adaptive appraisal [20,21]. Adaptive appraisal is an individual’s cognitive process when evaluating their capacity to reduce a particular risk. Synthesis from PMT, CC adaptation behavior is defined as individual action to avoid risk/ the negative CC impact [22].

In actual situations and conditions, human behavior will influence some factors. Ajzen & Fishbein (1985) in the
theory of planned behavior describe that any 4 factors influence behavior, namely behavior intention, attitude, subjective beliefs, and perceived behavioral control [23]. The other theory is responsible environmental behavior by Hines, Hungerford, & Tomera (1987) show that behavior (responsible environmental behavior/ REB) influenced some factors, such as intentional acts, personality, and knowledge of issues [24]. Synthesis from two theories (planned behavior and responsible environmental behavior theory) that CC adaptation behavior influenced many factors. Challenging base on the result of synthesis theory is determined factors that have direct and indirect effects on CC adaptation behavior. Therefore, this study uses the synthesis theory as research propose to create a model of CC adaptive behavior (as a responsible environmental behavior) based on knowledge, personality, and behavior intention. The hypothetical model based on REB Theory can be seen in Figure 1 below:

![Figure 1: Hypothetical model research](image)

In the model of CC adaptive behavior above shows the antecedent variable of adaptive behavior, such as knowledge and personality, is an exogenous variable. This means that the variable fundamentally has a direct and indirect effect on CC adaptive behavior (responsible environmental behavior). The first exogenous variable is knowledge about CC. According to the state by Bennet (1974) knowledge is a human essential need that determines one’s behavior [25]. On the other side, some experts said that knowledge is all that a person knows about a particular subject that is obtained through various processes and has factual, conceptual, procedural, and metacognitive dimensions [26,27,28,29,30,31,32,33,34,35]. So knowledge of CC defined as all that is known by a person about CC through various processes according to the underlying dimensions, namely: factual, conceptual, procedural, and metacognitive.

The second exogenous variable that also influences the CC adaptive behavior is personality. In the reality of human life, personality is a principle component which differentiates one individual from another. The concept of personality contains the meaning of "social image" which a person uses in playing his / her role. Linear with the concept, Ryckman, (2004) states that personality is an organised and dynamic set of characteristic which an individual possess that distinctively impacts his or her cognition, motivation and behaviour [36]. Furthermore, definition of personality is as a collection of certain traits in an individual which is defined as the accuracy of a person's relatively stable characteristics in responding to and interacting with other people and their environment [37]. Previously, the other statement about personality delivered by Allport (1961) that "Personality controls the unique thinking and behavior patterns of an individual" [38]. Related context with behaviour, some experts mentioned that personality traits would be affected human behaviours [39,40]. To measure the personality as exogeneous variable, Goldberg (1993) suggest The Big Five Personality Theory [41], This Theory is reinforced by Durupinar (2009) claims that there are five dimensions of personality, namely openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism [42]. Openness to experience explains an imaginative and creative personality. Conscientiousness describes how much the individual can be controlled and shows caution. Extraversion elaborates a sociable personality, agreeableness represents someone who is very friendly, generous, and tends to work, and neuroticism is associated with emotionally stable behavior.

The last variable in the model, role as an intervening variable and also influences the CC adaptive behavior is behavior intention. Some experts state about behavior intention, their definition explain that behavior intention is the possibility or an indication of how someone wants / is willing to try and instill user trust in information so that it creates
satisfaction in itself [24,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58]. So based on this explanation, behavior intention will determine a person’s behaviour to adapt to climate change. In operational context, Tjiptono (2011) and Japrianto (2006) argue that there are four dimension for behavior intention variable, that is word of mouth, effective management of environmental resources, protecting from the dangers of environmental damage, and maintaining the environment [59,60].

2. MATERIALS AND METHODS

2.1. Study Site and Sampling

This research was conducted on several cadets at the Faculty of Meteorology, Faculty of Climatology, Faculty of Geophysics, and Faculty of Instrumentation School of Meteorology Climatology and Geophysics (STMKG). Previously, the trial was conducted on several cadets. This research is a quantitative method through a survey conducted on cadets and the data analysis technique used is path analysis. This research will create the model path of climate change adaptive behaviour (Z) based on knowledge about CC (X1), personality (X2) and behaviour intention (Y), and also will examines the direct effect and indirect effects between exogenous and endogenous variables. The variables in question are knowledge about CC (X1), personality (X2), behavior intention (Y), and CC adaptive behavior of cadets (Z).

2.2. Data and Analysis Method

There are four instruments used in this research, namely to measure the CC adaptive behavior of cadets (24 items, reliability .964), behavior intention (34 items, reliability .976), knowledge about climate change (24 items, reliability .933) and personality (25 items, reliability .933). The population of this study was all cadets at the STMKG. The sampling technique used simple random sampling involving 481 cadets as the research sample. Modelling process will calculate path coefficient used least square error method to create path structure equation. Test for significant model used Anova (f-test) and individual test (t-test) for significant individual coefficient. As a prerequisite test, a normality test was carried out using the Kolmogorov Smirnov test (K-S test), linearity, Pearson correlation (product moment pearson), and homogeneity tests using the Levene test.

3. RESULTS AND DISCUSSION

3.1. Descriptive statistics and data preparation

Table 1. displays descriptive statistics for all research variables. All variables show the maximum value on the highest item score, meaning that positively some STMKG cadets have highest score, its mean that cadets of STMKG have good CC adaptive behaviour, high level ability of knowledge about CC, accurate of personality and high behavior intention. Furthermore, Table 1 also shows the average values, according average value describes that majority cadets of STMKG have indicated high positive image about CC adaptive behavior, knowledge of CC, personality and behaviour intention.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>481</td>
<td>3</td>
<td>24</td>
<td>19.95</td>
<td>3.388</td>
<td>11,481</td>
<td>6,172</td>
</tr>
<tr>
<td>X2</td>
<td>481</td>
<td>50</td>
<td>125</td>
<td>85.19</td>
<td>10,854</td>
<td>112,026</td>
<td>1,893</td>
</tr>
<tr>
<td>Y</td>
<td>481</td>
<td>78</td>
<td>170</td>
<td>148.63</td>
<td>9.907</td>
<td>396,276</td>
<td>-0.076</td>
</tr>
<tr>
<td>Z</td>
<td>481</td>
<td>47</td>
<td>120</td>
<td>95.28</td>
<td>15.083</td>
<td>227,498</td>
<td>-0.800</td>
</tr>
</tbody>
</table>
3.2. Path Model and Hypothesis Test

The prerequisite test for data analysis including path analysis modelling was carried out on normality, homogeneity, significance, and linearity between cadets CC adaptive behaviour, behaviour intention, knowledge about CC and personality. The result is that all sample data come from normal distribution populations that have homogeneous variances, significant for linearity tests. After the data has been obtained from the various required tests, the next step in modelling and testing the causality model is to carry out a path analysis. Based on the theoretical hypothetical model, a path analysis diagram will be obtained and the coefficient value for each path is calculated.

Calculation of the path coefficient of X1 to Z, X2 to Z, X1 to Y, X2 to Y, and Y to Z. The calculation results can be seen in Figure 2 below:

Knowledge about CC (X1)

\[ \beta_{3,1} = 0.163 \]

\[ \beta_{4,1} = -0.143 \]

Behavior Intention (Y)

\[ \beta_{3,2} = 0.583 \]

\[ \beta_{4,2} = 0.259 \]

Personality (X2)

CC Adaptive Behavior (Z)

\[ \beta_{3,4} = 0.589 \]

Figure 2: The Calculation result path coefficient in model research

From the calculation result path coefficient (Figure 2) obtained all path coefficient for two equations structure path model, the equation can be seen below:

- Equation structure path model 1: \( Y = 0.163X_1 + 0.583X_2 + e_1 \)
- Equation structure path model 2: \( Z = -0.143X_1 + 0.259X_2 + 0.589Y + e_2 \)

The next step is to calculate F and t value for goodness fit test model. The calculation results can be seen in Table 2. below:

<table>
<thead>
<tr>
<th>Model</th>
<th>Standardized Coefficients Beta</th>
<th>t-Stat</th>
<th>Sig.</th>
<th>R</th>
<th>R Square</th>
<th>F-Stat</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Const.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X1</td>
<td>0.163</td>
<td>5.129</td>
<td>.000</td>
<td>.613</td>
<td>143.7</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>0.583</td>
<td>4.503</td>
<td>.000</td>
<td>.376</td>
<td>143.7</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
<td>Const.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X1</td>
<td>0.163</td>
<td>2.268</td>
<td>.024</td>
<td>.613</td>
<td>143.7</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>-0.143</td>
<td>4.719</td>
<td>.000</td>
<td>.376</td>
<td>143.7</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>0.259</td>
<td>7.020</td>
<td>.000</td>
<td>.579</td>
<td>218.4</td>
<td>.000</td>
</tr>
</tbody>
</table>

The goodness fit test use F-stat or p-value (sig). Table 2 shows that respectively F value for model 1 and model 2 are 143.7 and 218.4 with p-value for all model sig. = .000, it mean The model 1 and 2 have suitable significant to predict CC adaptive behavior base on knowledge about CC, personality, and behavior intention. According determination coefficient R square model 1 = .376, model 2 = .579, e1 = .789, and e2 = .649, it mean model 2 better than model 1 with 1453.
ability model to describe variance of CC adaptive behavior = 58%. Regarding path coefficient value, the exogenous variable with highest influence toward CC adaptive behavior is behavior intention. Moreover, path coefficient value will used to explain about direct effect and indirect effect exogenous variable toward endogenous variable through t-test (Table 3). The model 1 has two path coefficients, the first coefficient (p3,1) of 0.163 with tcal = 4.503> t table (0.05; 481) = 1.645; p <0.05, which means that knowledge about CC has a significant direct effect on the behavior intention of cadets STMKG. The second path coefficient (p3,2) is 0.583 with tcal = 16.102> ttable (0.05; 481) = 1,645; ρ <0.05, which means that personality has a significant direct effect on the behavior intention of cadets STMKG. The model 2 has three coefficients as value for direct effect and two coefficients for indirect effect. The first coefficient at model 2 (p4,1) is -0.143 with tcal = -4.719> table (0.05; 481) = 1.645; p <0.05, which means that knowledge about CC has a significant direct effect on the CC adaptive behavior of cadets STMKG, the second coefficient (p4,2) of 0.259 with tcal = 7.020> ttable (0.05; 481) = 1.645; ρ <0.05, which means that personality has a significant direct effect on the CC adaptive behavior of cadets STMKG, the third coefficient (p4,3) of 0.589 with tcal = 15.652> t table (0.05; 481) = 1.645; ρ <0.05, which means that knowledge about CC hasn’t significant indirect effect on the CC adaptive behavior of cadets STMKG through behavior intention, the last coefficient (p4,31) of 0.096 with tcal = 0.764< t table (0.05; 481) = 1.645; ρ <0.05, which means that knowledge about CC hasn’t significant indirect effect on the CC adaptive behavior of cadets STMKG through behavior intention.

<table>
<thead>
<tr>
<th>No</th>
<th>Direct effect</th>
<th>Indirect effect</th>
<th>tcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X₁ → Z</td>
<td>X₁ → Y → Z</td>
<td>-4.719</td>
</tr>
<tr>
<td></td>
<td>-0.143</td>
<td>0.163 x 0.589 = 0.096</td>
<td>0.764</td>
</tr>
<tr>
<td>2</td>
<td>X₂ → Z</td>
<td>X₂ → Y → Z</td>
<td>7.020</td>
</tr>
<tr>
<td></td>
<td>0.259</td>
<td>0.583 x 0.589 = 0.343</td>
<td>7.932</td>
</tr>
<tr>
<td>3</td>
<td>Y → Z</td>
<td></td>
<td>15.652</td>
</tr>
<tr>
<td></td>
<td>0.589</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>X₁ → Y</td>
<td></td>
<td>4.503</td>
</tr>
<tr>
<td></td>
<td>0.163</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>X₂ → Y</td>
<td></td>
<td>16.102</td>
</tr>
<tr>
<td></td>
<td>0.583</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. DISCUSSIONS

According to the results of path modelling and hypothesis testing show that the path model CC adaptive behavior has suitable significant based on knowledge about CC, personality and behavior intention. For the results of hypothesis testing show that majority hypothesis getting significant, except hypothesis knowledge about CC hasn’t significant indirect effect on the CC adaptive behavior of cadets STMKG through behavior intention. This means that cadets’ CC adaptive behavior is influenced by variations in antecedent factors such as knowledge about CC, personality and behavior intention.

The findings of this study are supported other studies, such as the structural equation model 1 is in line with research in entrepreneurship, where the result study in this filed stated that the path model explains the personality variable as an exogenous variable that has a significant positive influence, both simultaneously and partially on interest or desire to behave as a dependent/exogenous variable [61,62,63,64]. The structural equation model 2 similar with other studies that yield information that positive linear knowledge determines environmentally responsible behavior [65,66,67,68,69,70,71,72,73,74]. The structural equation model 2 also supported by Ipikasari et al. (2020) researched to high school students where the result was that students' knowledge of ecological concepts had a strong positive ability in determining students' environmentally responsible behavior [75].

The novelty from the results of this study shows that there is a significant effect of knowledge about CC, personality and behavior intention on the CC adaptive behavior of STMKG cadets’ directly and indirectly. When compared with other relevant studies, there are similarities and differences.
CONCLUSION

Based on these findings, it can be concluded that the path model CC adaptive behavior has suitable significant based on knowledge about CC, personality, and behavior intention. Moreover, the other point conclusion if we want to improve the CC adaptive behavior of STMKG cadets, the antecedent factors used in this study such as knowledge about CC, personality and behavior intention need to be considered based on the empiric findings. This estimates that in order for STMKG cadets to have CC adaptive behavior as a provision in shaping the character of the community who cares about the importance of CC adaptation, then the things that need to be considered are strengthening personality and knowledge about CC of lecturers so that lecturers can maximize their role not only in terms of teaching, but also educating and shaping the behavior intention of cadets by implementing the integration of environmental.

Therefore, it could be concluded that the variation or ups and downs or positivity and negativity of the CC adaptive behavior of STMKG cadets’ is influenced by variations that are also raised by antecedent factors such as knowledge about CC, personality, and behavior intention. Therefore, it needs to be empowered through various learning strategies for environmental and CC adaptation.

REFERENCES


