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***Research paper***

# A Measurement Model for River Conservation Behavior Using Confirmatory Factor Analysis (CFA)

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**Abstract**

River conservation represents important environmental behavior for a sustainable environment. This research is to measure the validity and reliability of the instrument for measuring river conservation behavior model. The research instrument was administered to 373 respondents who were selected trough cluster sampling in 10 polluted rivers in the Terengganu state, Malaysia. Confirmatory Factor Analysis (CFA) was used to validate the measurement model for items in the behavioral instrument. The findings of the study have dropped 36 items and retained 48 valid and reliable items to measure eleven constructs that affected the resident's behavior. These behavioral instruments can be used to obtain a community profile as an indicator to improve the behavior of the residents towards river conservation.

***Keywords***: *River conservation; Environmental behavior; Polluted river; Confirmatory factor Analysis (CFA).*

## 1. Introduction

Water is a very important part of the environment. In Malaysia, the sub-index of the environment is one of the areas of quality of life that does not show progress. Water pollution has been of major importance in Malaysia as it affects the quality of river water. The percentage of river water quality declined to 51 per cent in 2010 compared to 64 per cent in 2007 [1]. The results of the monitoring carried out by the Department of Environment clearly show that the quality of river water in this country is at an anxious level.
Rivers are very prone to pollution due to the varied human activities that contribute to pollution; for example, generation of domestic wastewater, industrial effluent and runoff from solid waste disposal sites [2]. Terengganu Department of Environment Malaysia reported that the Water Quality Index for each station in the upstream Hiliran river is identified mainly from villages, supermarkets, IWK plants, workshops, crackers, batik, fish markets, restaurants and restaurants [3]. According to officials from the Terengganu State Irrigation and Drainage Department, RM3.3 million is allocated for the cost of treating and restoring the Hiliran river.
Additionally, according to officials from the Terengganu State Irrigation and Drainage Department, the irresponsible attitude of the local community by throwing rubbish into the river and making garbage traps as a place to dispose of garbage is absolutely unnecessary. Surveys conducted in residential areas around the river in Terengganu found that there was still a lot of junk piles stuck in the rocks in the river besides garbage scattered at the landfill.
Hence, following the attitude of the people who like to take easy steps with the drainage of sewage residues from their homes such as washing water, faeces and garbage directly into the river contributes to the pollution. It is time for people to change their mentality so they do not throw away trash evenly.

## 2. Basic Model of Behavior

The Theory of Planned Behavior shown in Fig. 1 is a theory that describes human behavior. The theory of planned behavior assumes that the level of desire can reveal motivational factors influenced by a behavior. The amount of positive and negative effects perceived in determining global attitudes toward behavioral. Indirect attitude determines behavior, but only indirectly through the intention of behavior [4].
These elements are important that need to be addressed in designing programs to build or alter human behavior. Therefore, the objective of this study is to examine the factors that influence the behavior of the residents living in the polluted river basin area in the State of Terengganu. The Confirmatory Factor Analysis (CFA) was used to test validity of constructs.

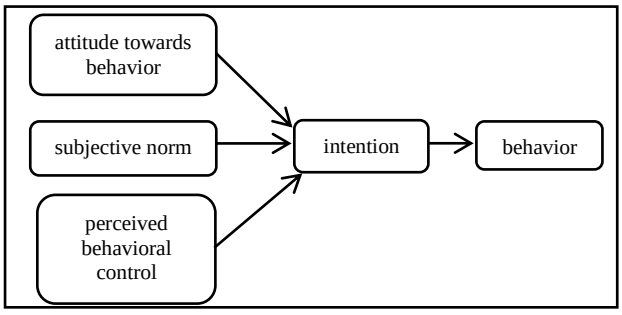


**Fig. 1:** Theory of Planned Behaviour (TPB)

A number of researchers related to environmental behavior were conducted by [5-11]. In conclusion, this study suggests that there should be a new model introduced if the environmental issue is a major backup in altering individual behavior towards the environment. The study suggests that there should be new variables if

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they go beyond awareness and knowledge. Furthermore, the CFA measurement model that consists of knowledge, values, religions, attitudes, perceived behavioral control, self-efficacy, subjective norms, media exposure to environmental message, recycling facilities, intentions and behaviors have been designed to determine factors that influence behavior residents in the polluted

## 3. Methodology

Researchers have chosen polluted rivers in the state of Terengganu as a location. It is based on the status of river water quality for polluted rivers in Terengganu state which is monitored by the Department of Environment [12]. The sample of this study consists of 373 respondents were selected using cluster sampling. The way for determining of sample size is based on [13].

Questionnaire is using 7 point Likert scale with value 1 (very disagree) to 7 (strongly agree). Whereas for frequency questions, 5 point scales were used 1 (never), 2 (rarely), 3 (moderate frequent), 4 (often) and 5 (very frequent). This questionnaire contains 90 items. Two statistical software which is Statistical Package of Social Science 21.0 (SPSS 21.0) and Analysis of Moment Structure 22.0 (AMOS 22.0) have been used for the data analysis process. The statistical method used to validate questionnaire items is CFA. CFA analysis can test the extent to which variables measured in small quantities can represent existing constructs [14]. The CFA will produce a measurement model that acts as a measurement of the logically and systematically defined variable sets that represent the constructs involved in the model, thereby constructing a structural model to test the hypothesis of the study [14]. Thus, the analysis of this measurement model involves model fit and construct validity.

## 4. Results and Discussion

Respondents are residents living in ten polluted river areas in the State of Terengganu. A total of 373 sets of questionnaires were distributed to respondents. After the normality test, 363 sets of questionnaires were received for analysis. Table 1 shows the respondents' profile for this study.

**Table 1:** Demographic Profile of Respondents (n = 363)

| Demographic Factor | | Frequency (n) | % |
|---|---|---|---|
| Age | 16 to 19 | 37 | 10.2 |
| | 20 to 29 | 91 | 25.1 |
| | 30 to 39 | 95 | 26.2 |
| | 40 to 49 | 78 | 21.5 |
| | 50 to 59 | 45 | 12.4 |
| | ≥ 60 | 17 | 4.7 |
| Sex | Male | 161 | 44.4 |
| | Female | 202 | 55.6 |
| Educational level | No formal education | 3 | 0.8 |
| | Primary school (UPSR) | 24 | 6.6 |
| | Lower Malaysian certificates (SRP/PMR/) | 66 | 18.2 |
| | Malaysian education certificates (SPM/SPVM/MCE) | 174 | 47.9 |
| | Sekolah Menengah Tinggi (STPM/HSC) | 25 | 6.9 |
| | Diploma | 43 | 11.8 |
| | Degree | 24 | 6.6 |
| | Master/ PhD | 4 | 1.1 |
| Job categories | Government sector | 33 | 9.1 |
| | Private sector | 77 | 21.2 |
| | Self employed | 80 | 22.0 |
| | Housewife | 92 | 25.3 |
| | Student | 33 | 9.1 |
| | Retiree | 7 | 1.9 |
| | Unemployed | 41 | 11.3 |

Researchers used Cronbach's alpha and Construct Reliability to see consistency between items. Subsequently, the CFA was conducted to determine the items in the behavior aspect of measuring and validating constructs to be measured and how well the constructs describe the variables in the construct. The reliability coefficient is important and produces good value, but it does not guarantee that a construct is measured accurately [14]. In [14] emphasizes that the CFA results combined with construct validity tests will provide a better understanding of the quality of the measures used. In [15] stressed that before testing the significance of the relationship in the model structure, model measurements should have satisfactory level of validity and reliability. According to [14], the reliability needs to meet three aspects which is the Cronbach alpha value exceeds 0.70, the construct reliability (CR) exceeds 0.60 and the average variance of the extract (AVE) exceeds 0.50 as shown in Table 2. The results show all construct meets the criteria for reliability greater than 0.70, the AVE value exceeds 0.50 and the construct reliability (CR) exceeds 0.60.

**Table 2:** The result of CFA for measurement model

| Constructs | Items | Standardized Factor loading ( > 0.5) | Average Variance Extracted (AVE ≥0.5) | Construct Reliability (CR ≥ 0.6) | Cronbach Alpha (> 0.7) |
|---|---|---|---|---|---|
| Knowledge | Item 1 | 0.73 | 0.504 | 0.753 | 0.774 |
| | Item 2 | 0.71 | | | |
| | Item 3 | 0.69 | | | |
| Values | Item 5 | 0.82 | 0.730 | 0.890 | 0.790 |
| | Item 6 | 0.92 | | | |
| | Item 7 | 0.82 | | | |
| Religions | Item 2 | 0.77 | 0.512 | 0.758 | 0.780 |
| | Item 4 | 0.64 | | | |
| | Item 5 | 0.73 | | | |
| Attitude | Item 1 | 0.71 | 0.509 | 0.805 | 0.851 |

| | | | | | |
|---|---|---|---|---|---|
| | Item 2<br>Item 3<br>Item 4 | 0.71<br>0.76<br>0.67 | | | |
| Perceived behavioral control | Item 1<br>Item 2<br>Item 4 | 0.71<br>0.91<br>0.72 | 0.617 | 0.827 | 0.892 |
| Self-efficacy | Item 1<br>Item 3<br>Item 4<br>Item 5<br>Item 6<br>Item 7 | 0.68<br>0.81<br>0.86<br>0.90<br>0.73<br>0.73 | 0.622 | 0.907 | 0.924 |
| Subjective norms | Item 3<br>Item 4<br>Item 5<br>Item 6<br>Item 7<br>Item 8 | 0.74<br>0.84<br>0.80<br>0.78<br>0.71<br>0.73 | 0.590 | 0.896 | 0.936 |
| Media exposure to environmental message | Item 2<br>Item 3<br>Item 4<br>Item 5<br>Item 6 | 0.70<br>0.80<br>0.72<br>0.77<br>0.77 | 0.567 | 0.867 | 0.870 |
| Recycling facilities | Item 1<br>Item 2<br>Item 3<br>Item 4<br>Item 5 | 0.84<br>0.91<br>0.88<br>0.85<br>0.77 | 0.725 | 0.929 | 0.917 |
| Intention | Item 1<br>Item 2<br>Item 3<br>Item 4 | 0.80<br>0.81<br>0.89<br>0.81 | 0.686 | 0.897 | 0.936 |
| Behavior | Item 2<br>Item 5<br>Item 6<br>Item 7<br>Item 8<br>Item 9 | 0.62<br>0.71<br>0.85<br>0.83<br>0.83<br>0.76 | 0.594 | 0.897 | 0.903 |

Discriminant validity shows the extent to which a construct is truly distinct from other constructs. The results of assessment discriminant validity through the comparisons of square of correlation among two construct (see Table 3) with AVE of each construct showed that the square of correlation among all two constructs is less than AVE for each constructs. Therefore, the results support the discriminant validity among the constructs.

**Table 3:** Correlation matrixs

| V | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| K | .50 | | | | | | | | | | |
| V | .04 | .73 | | | | | | | | | |
| R | .35 | .02 | .51 | | | | | | | | |
| A | .37 | .07 | .48 | .51 | | | | | | | |
| P | .13 | .27 | .18 | .35 | .62 | | | | | | |
| SE | .03 | .28 | .07 | .27 | .58 | .62 | | | | | |
| SN | .19 | .05 | .28 | .34 | .45 | .30 | .59 | | | | |
| ME | .00 | .06 | .00 | .04 | .06 | .10 | .04 | .57 | | | |
| RF | .00 | .09 | .00 | .01 | .09 | .17 | .03 | .13 | .73 | | |
| I | .11 | .15 | .14 | .31 | .45 | .42 | .42 | .08 | .11 | .69 | |
| B | .02 | .10 | .00 | .04 | .08 | .17 | .03 | .45 | .12 | .09 | .59 |

K (knowledge), V (values), R (religions), A (attitudes), P (perceived behavioral control), SE (self-efficacy), SN (subjective norms), ME (media exposure to environmental message), RF (recycling facilities), I (intention) and B (behavior)

In [14] states that while specified and validate the scale items for each variable, it is essential to specify the measurement model. In this stage, each latent construct to be included in the model is identified and the measured indicator variables (items) are assigned to latent constructs. Goodness of fit indices are used to test for model fit. In [14] suggests to use 3 to 4 fit indices in order to provide adequate evidence of model fit. Three types of goodness of fit (GOF) indices namely absolute fit measures, incremental fit measures and parsimony fit measures.

GOF measures such as Chi-Square, is one of the long standing indicators of overall goodness-of-fit which is sensitive to sample size to the extent that a large sample may indicate a significant Chi-Square when it should not have been significant [14]. Also, according to [14], the Goodness of Fit Indicator (GFI) and the Adjusted Goodness of Fit Indicator (AGFI) generally with the possible range from 0 to 1 and values greater than .9 indicates better fit and meaningful model even when the Chi-Square is significant. Another measure is the Root Mean Square Error of Approximation (RMSEA) which a measure greater than .1 indicates a poor fit, values ranging between .08 to .1 indicate mediocre fit, and values ranging between .03 and .08 are indicate better fit model. Further, the Comparative Fit Index (CFI), Normed Fit Index (NFI), and Tucker Lewis Index (TLI) indicates a good fit to the model at about .9 or greater, with 1 indicating a perfect fit for the model [14]. According to [16, the uses of at least three fit tests were recommended. In [16] recommends at least four tests, such as chi-square; GFI, NFI, or CFI; NNFI; and SRMR. Moreover, [14] suggest that reporting $\chi 2$ value and degree of freedom, along with CFI and RMSEA will often provide sufficient unique information to evaluate.

Based on the GOF indices shown in Table 4, measurement model test presents a relative good fit between the data and the proposed measurement model. The results of assess the measurement model

indicated that the model fit the data; $\chi 2/DF = 2.072$, CFI = .913, TLI = .904, RMSEA = .054. The results indicated that Goodness-of-fit indices such as the CFI and TLI significantly pass its cutoff value .90. In addition, the RMSEA was 0.054, which fall between the recommended range of acceptability (.03 and .08). Thus shows that measurement model has a good fit with the data.

**Table 4:** Goodness of Fit Indices

| Fit Indices | DF | P | CMIN/DF | CFI | RMSEA |
|---|---|---|---|---|---|
| Values | 1025 | 0.000 | 2.072 | 0.913 | 0.054 |

Fig. 2 shows the measurement model of resident's behavior in the polluted river. According to [7], factor loading exceeding 0.50 is needed to ensure that an item measures what it should be measured. It is found that the factor loading for each latent variable is greater than 0.50, which is in the range of 0.62 to 0.92. Correlation analysis between variables was carried out to examine the existence of relationships between factors, namely knowledge, values, religions, attitudes, perceived behavioral control, self-efficacy, subjective norms, media exposure to environmental message, recycling facilities, intention and behavior which correlation coefficient is less than 0.90 [7] ensuring adequate internal consistency among measured items. It shows every dimension to measure what should be measured and the relationship between factors is positive. The construct validity of the overall measurement model was assessed in terms of convergent and discriminant validity.

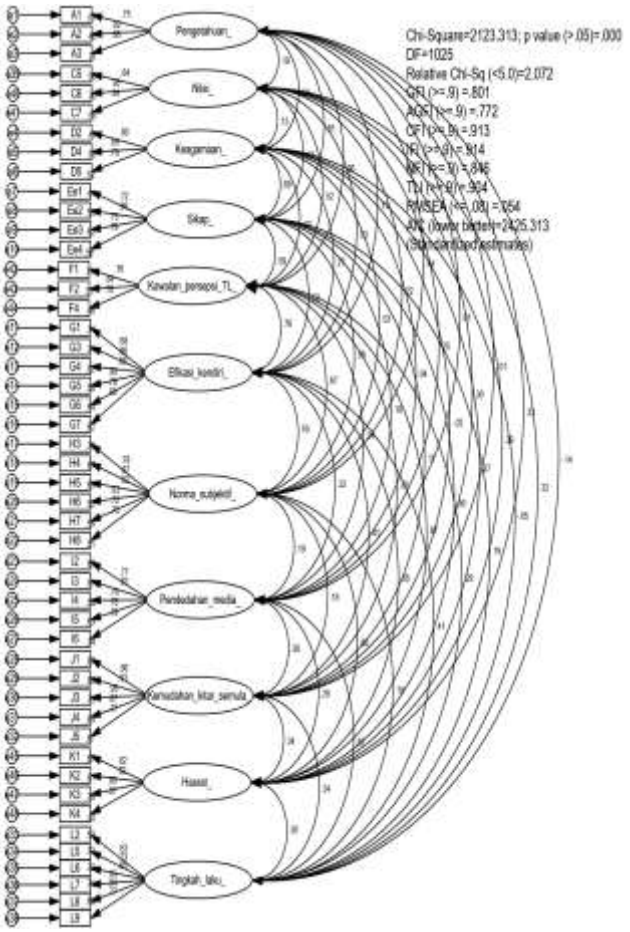


**Fig. 2:** Measurement Model

## 5. Conclusion

The main purpose of this study was to measure the validity and reliability of the instrument for measuring behavior model among residents in the polluted river areas. The analysis shows that there are ten factors that affect the residents behavior which is knowledge, values, religions, attitudes, perceived behavioral control, self-efficacy, subjective norms, media exposure to environmental message, recycling facilities and intentions. Correlation analysis between variables was performed to examine the existence of relationships between constructs where the coefficient of correlation between variables was less than 0.90. This showed that each variable measures different things [14]. Therefore, be summarized that this measurement model conforms to the characteristics of a good fit suitability model in identifying and validating important aspects especially factors that affect the resident's behavior in the polluted river areas. However, this study can still be improved in the future, taking into several other aspects that drive behavior that is not included in this study.

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