MODELLING PUBLIC INTENTION TO REDUCE NON-REVENUE WATER: AN EXPANDED VERSION OF THE THEORY OF PLANNED BEHAVIOUR

Shelley Ong Tze Xien¹, Chong Shyue Chuan², Sia Bik Kai³

¹Department of Economics, Universiti Tunku Abdul Rahman, Kajang, Selangor, 43000, Malaysia, stxien@gmail.com
²Department of Economics, Universiti Tunku Abdul Rahman, Kajang, Selangor, 43000, Malaysia, chongsc@utar.edu.my
³Department of Economics, Universiti Tunku Abdul Rahman, Kajang, Selangor, 43000, Malaysia, siabk@utar.edu.my

*Corresponding Author email: stxien@gmail.com

ABSTRACT

The study seeks to determine the public’s Non-Revenue Water (NRW) reduction behavioural intention in Malaysia. It endeavours to expand the social-psychological behavioural model which is the theory of planned behaviour (TPB) by adding the determinants of environmental knowledge, environmental concern, the respondents’ gender, age group, ethnicity, marital status and education level to predict the public’s behavioural intention to engage in NRW reduction practices. A self-structured questionnaire with the face-to-face interview was employed to gather responses from 800 citizens who are currently living in the state of Selangor, the Federal Territory of Kuala Lumpur, Pahang, and Johor. Following the subsequent hierarchical linear regression models, the final model has explained 51.3% of the variance in behavioural intention to take part in NRW reduction practices. The study’s findings identify that the factors of attitude, subjective norm, perceived behavioural control, environmental knowledge, environmental concern, and gender significantly influence the NRW reduction intention. Moreover, the study reveals that ethnicity and education differences have significant influences on the expanded TPB in terms of NRW reduction. This study furthers to the present theory and experience by offering advantageous perception about the application of environmental knowledge and environmental concern on the public’s NRW reduction intention.

INTRODUCTION

It is a fact that water resource is the most critical and irreplaceable natural asset, as it serves the purpose of supplying water for agricultural needs, recreation, various industrial demands, social and economic development, and public health (Lamm, Lamm, & Carter, 2015). There is a growing need to support and change the sustainable behaviour in conserving the available water and reducing water consumption due to the uprising water stress happening worldwide. For Malaysia, as well as many other developing countries, sustainable management of water resources has become one of
the most vital objectives for the water utilities and the indicator of Non-Revenue Water (NRW) has been implemented as the index to quantify water loss (Chan, 2009).

A high level of NRW indicates that the water utility is not performing well and negatively impacted due to insufficient of governance, investment, and technical and managerial expertise to ensure sustainable water management (Kingdom, Liemberger, & Marin, 2006). Reducing NRW in the water services industry not only saves water, but it also prompts the attaining of future water industry’s efficiency and development. NRW can be described as the water loss changes between the volume of water embedded into the water distribution system and the volume of water invoiced towards the customers in authorized metered and illegal water consumption (Chan, 2009). Malaysia’s NRW matter is not merely a technological matter; nonetheless, it also correlates with the water utility’s poor management and governance (Teo, 2014). The lack of public participation seemed to contribute as one of the main obstacles for the water utilities in sustaining better water management (Chan, 2009). By increasing the awareness of water-related issues among the public, the citizens may be more receptive to reduce water consumption, enhance water conservation and perform NRW reduction actions by reporting any water loss issues to the water utility and engaging in NRW reduction programs. NRW issues should be the responsibility of all water-related stakeholders, from water governance authorities (federal and state governments), water utilities, water contractors, various industries, media specialists, water-related non-profit organizations, and most importantly, the citizens.

In order to address this prominent gap, this study intends to meet the following research objectives:

1. To ascertain whether the factors; attitude (ATT), subjective norm (SN), perceived behavioural control (PBC), environmental knowledge (EK), environmental concern (EC), the public’s gender, age group, ethnicity, marital status and education level are associated with the NRW reduction behavioural intention (INT) among Malaysia consumers

2. To examine the public’s socio-demographic variables differences in examining the factors of expanded Theory of Planned Behaviour (TPB) (which are ATT, SN, PBC, EK and EC) towards Malaysia consumers INT

This study will shed some light on how the public perceives the NRW reduction in relation to the psychological determinants in their behavioural intention. Understanding the determinants that impact the NRW reduction behaviour may help the water-related stakeholders to encourage pro-environmental actions to reduce the NRW level, lessen water consumption, and support water conservation among those living in Malaysia.
LITERATURE REVIEW AND RESEARCH HYPOTHESES
NON-REVENUE WATER IN MALAYSIA

Malaysia is a country that implements a federal representative democratic constitutional monarchy and the authority power is distributed between the federal parliament and the 13 state assemblies. However, water matters have been managed continuously under the provision of state governments, which defined that the revenue earned and decision making of the water management, are controlled by the state water utilities, respectively (Padfield, Tham, Costes, & Smith, 2016). Some of the states manage their water resources better than others that have higher debt with the federal government, and their revenues are not able to cover their operating cost of water management (Lai, Chan, & Roy, 2017; Munisamy, 2009).

However, the NRW rate in Malaysia remains high, ranging from 19.6% to 63.1%, with a national average of 35.3% in 2017 (Malaysian Water Association, 2019). The Malaysian government had targeted the NRW rate of 25.0% by 2020 and has yet to reach the targeted NRW rate. The water tariff rate in Malaysia is considered low (MYR 1.28/ m3) as compared to Singapore (MYR 8.19/ m3) and Indonesia (MYR 3.36/ m3) (Lee et al., 2018). It has been revealed that Malaysian citizens have perceived the water price as low and do not bother reporting any water loss issues, reduce their water consumption, or even enhance their water conservation.

If the citizens are conscious of the significance of water conservation and NRW reduction, they can reduce water loss issues (such as pipe leakages, bursts, water thefts, illegally connected pipes, and faulty water meters) by reporting to the water-related authorities. This action can bring the attention of water loss to the water utility, and the issues can be solved in a shorter time. Therefore, promoting public consciousness of the significance of NRW reduction is vital for managing water resources more efficiently.

THEORY OF PLANNED BEHAVIOUR

TPB was considered in this current study to explain the behavioural intention changes regarding socio-psychological causes, and investigate the influencing effects and the public’s INT. The theoretical framework of TPB had focused on the significant impact of the three behavioural intention dimensions which are ATT (Fornara, Pattitoni, Mura, & Strazzera, 2016; Lowe, Lynch, & Lowe, 2015), SN (Biswas & Roy, 2015; Lowe et al., 2015; Rex, Lobo, & Leckie, 2015) and PBC (Lin & Hsu, 2013). By following the fundamental concept of TPB, this study had investigated the determinants of the public’s ATT on NRW reduction (which characterized the public willingness to respond favorably or unfavorably to NRW reduction), the public’s SN (which described the approval or disapproval obtained from the public’s important individual or group of people), and the public’s PBC (which defined the public’s perceived difficulty in dealing with the availability and accessibility of NRW reduction) (Ajzen, 2011; Fishbein & Ajzen, 1972; Taylor & Todd, 1995). The more
positive the citizens’ beliefs, the higher the levels of citizens’ SN and perception of
behavioural control towards the NRW reduction. As such, the greater public’s
intention to engage in NRW reduction practices will be higher. Also, several studies
that examined environmental and water conservation behaviour have comprised
other variables to strengthen TPB’s forecasting capability (Lam, 2006; Rex et al., 2015).

According to the literature review of this section, the hypotheses will be proposed as
follow:

H1: There is a statistically significant relationship between the citizens’ ATT and their
behavioural intention toward reducing NRW.

H2: There is a statistically significant relationship between the citizens’ SN and their
behavioural intention toward reducing NRW.

H3: There is a statistically significant relationship between the citizens’ PBC and their
behavioural intention toward reducing NRW.

**Environmental Knowledge and Environmental Concern**

When the consumers start to have an interest on public participation in water
conservation, they are more likely to take actual action towards NRW reduction once
they know more about the current water issues, and NRW-related benefits and
information (Aregay et al., 2017; Dolnicar, Hurlimann, & Grün, 2012). EK is
determined as the ecological understanding level that a person should have towards
existing environment-related matters (Vicente-Molina, Fernández-Sáinz, & Izagirre-
Olaizola, 2013). These studies are aligned with the outcomes that EK is positively
 correlated with the environmentally responsible behavioural intention (Bagheri,
Bondori, Allahyari, & Damalas; Dolnicar et al., 2012). If citizens have more
information on existing water issues, the public’s intention to engage in NRW
reduction practices.

EC is explained as the emotional and commitment level of a person towards ecological
issues (Said, Ahmadun, Paim, & Masud, 2003). Various studies have proved that EC
is a significant variable and is important in influencing the citizens’ environmental
behavioural intention (Mostafa, 2006, 2009; Yadav & Pathak, 2016). In the context of
reducing NRW, when the citizens have a high level of EC and believe that combating
water loss issues is advantageous to the environment and themselves, they will tend
to form the appropriate behavioural intention to engage in more NRW practices will
increase.

According to the literature review of this section, the hypotheses will be proposed as
follow:

H4: There is a statistically significant relationship between the citizens’ EK and their
behavioural intention toward reducing NRW.
H5: There is a statistically significant relationship between the citizens’ EC and their behavioural intention toward reducing NRW.

**Socio-demographic Profile**

Various studies on pro-environment and green purchasing have mentioned that the demographic characteristics (such as gender, age, income level, marital status, and education level) are significant factors that affect the respondents’ intention to participate in pro-environmental actions (Han, Hsu, & Lee, 2009; Rezai, Mohamed, Shamsudin, & Teng, 2011). Furthermore, it was reported that female respondents had a greater environmental intention and pro-environmental behaviour (Fielding & Head, 2012). On the other hand, it was found out that the gender factor had an insignificant relationship in measuring the water conservation behavioural intention (Chan & Nitivattananon, 2007; Clark & Finley, 2007). Based on the age group perspective, some studies suggest that the age factor as an influence on environmental behaviour (Burton, 2014; Wiernik, Dilchert, & Ones, 2016). However, a study has revealed that age does not have any significant relationship with water conservation behaviour (Trumbo & O’Keefe, 2001). From the education level aspect, the respondents with a higher level of education are found to be significantly impacted by the green purchase behavioural intention (Bryunina & Safaei, 2011).

According to the literature review of this section, the hypotheses will be proposed as follow:

H6: There is a statistically significant relationship between the citizens’ gender and their behavioural intention toward reducing NRW.

H7: There is a statistically significant relationship between the citizens’ age and their behavioural intention toward reducing NRW.

H8: There is a statistically significant relationship between the citizens’ ethnicity and their behavioural intention toward reducing NRW.

H9: There is a statistically significant relationship between the citizens’ marital status and their behavioural intention toward reducing NRW.

H10: There is a statistically significant relationship between the citizens’ education level and their behavioural intention toward reducing NRW.

Based on the theoretical framework and objectives of this study, the research model (Fig. 1) will be proposed as follow:
METHODOLOGY

This study used a quantitative research method and employed cross-sectional research, which means the research data were collected at one point in a time duration that justified these study findings in the NRW reduction society of Malaysia. This study portrayed the current status of the public’s behavioural intention towards reducing NRW level in the states of Selangor, the Federal Territory of Kuala Lumpur, Pahang, and Johor, Malaysia. This study targeted the public (aged 21 and over) who are currently living in the states of Selangor, the Federal Territory of Kuala Lumpur, Pahang, and Johor, Malaysia. In total, 800 copies of questionnaires were collected via the face-to-face interview method with structured questionnaires at the time duration of September to October 2018. The non-probability sampling method, which is quota sampling, was applied in this study sample design, because the public’s NRW reduction practice was not systematically documented, and therefore random sampling was not desirable.

During the process of reviewing the study’s questionnaire, the researchers spent much time and effort in related fields, to enhance the validity and reliability of the questionnaire. First, the study questionnaire was designed with two sections; section A consisted of the demographic profile of the respondents (such as gender, age group, ethnicity, marital status and education level) and section B consisted of the conceptual independent variables (such as ATT, SN, PBC, EK and EC) and the dependent variable (which is NRW reduction behavioural intention (INT)). The questionnaire design was constructed from several relevant studies by implementing the concepts of TPB (Ajzen, 2011; Taylor & Todd, 1995), the expansion of additional factors of EK (Bang,
Ellinger, Hadjimarcou, & Traichal, 2000; Mostafa, 2006), EC (Aman, Harun, & Hussein, 2012; Dunlap & Van Liere, 2008), and the demographic profile of the respondents. Cronbach’s alpha values were varied from 0.761 to 0.966 which implied a high level of internal consistency; therefore, it has ascertained the reliability of the study instrument as shown in Table I.

Table I: Summary of Reliability Analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Items</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT</td>
<td>4</td>
<td>0.869</td>
</tr>
<tr>
<td>ATT</td>
<td>6</td>
<td>0.892</td>
</tr>
<tr>
<td>SN</td>
<td>4</td>
<td>0.929</td>
</tr>
<tr>
<td>PBC</td>
<td>6</td>
<td>0.945</td>
</tr>
<tr>
<td>EK</td>
<td>5</td>
<td>0.966</td>
</tr>
<tr>
<td>EC</td>
<td>5</td>
<td>0.761</td>
</tr>
</tbody>
</table>

The data collected from this study were analysed using the Statistical Package for the Social Sciences (SPSS) version 23. Besides, descriptive analysis, the Pearson correlation coefficient, hierarchical linear regression analysis, the F-test, reliability, and one-way analysis of variance (ANOVA) were used to analyse the research data. Means and standard deviations explained the research data, and hierarchical linear regression examined the effect of the variables of the expanded TPB. In further analysis, the research data were examined and fulfilled all the assumptions of hierarchical linear regression regarding multicollinearity, independence of residuals, homoscedasticity, linearity, and normally distributed errors.

RESULTS AND FINDINGS

This following section explains the findings of this study. The first part of the findings interprets the respondents’ demographic statistics. As reported in Table II, 50.50% of respondents were male and 49.50% were female, which is proportionately equal. Next, 39.00% of respondents were of age 21-40 and 61.00% were of age 41 and above. For ethnicity, 49.25% of the respondents were Malay, 30.63% were Chinese and 20.13% were Indian. 72.38% of the respondents were married, while 27.63% of the respondents were single and others. Lastly, for education level, 60.13% of the respondents graduated from secondary school and below, and 39.88% of the respondents had an education level of pre-university and above.

Table II: Demographic Characteristics of the Respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>404</td>
<td>50.50</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>396</td>
<td>49.50</td>
</tr>
<tr>
<td>Age</td>
<td>21-40 years old</td>
<td>312</td>
<td>39.00</td>
</tr>
<tr>
<td></td>
<td>41 years old and above</td>
<td>488</td>
<td>61.00</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Malay</td>
<td>394</td>
<td>49.25</td>
</tr>
<tr>
<td></td>
<td>Chinese</td>
<td>245</td>
<td>30.63</td>
</tr>
<tr>
<td></td>
<td>Indian</td>
<td>161</td>
<td>20.13</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single and others</td>
<td>221</td>
<td>27.63</td>
</tr>
</tbody>
</table>
The summary of the descriptive statistics for the variables is explained in Table III. The mean and standard deviation for INT and ATT ranged from 0.873 to 3.543, suggesting that the public had a good probability of behavioural intention to perform NRW reduction actions and favoured towards the intention to reduce the NRW level. For the SN, the mean and standard deviation were 3.112 and 1.022, respectively, which was interpreted as the public’s belief towards the important individual or group of people will encourage them to have INT. For PBC, the mean and standard deviation were 4.102 and 0.817 respectively, which was interpreted as the public’s perception of the difficulty of enacting the INT. For EK and EC, the means and standard deviations were 1.860 and 1.066, and 4.104 and 0.537, respectively, which was interpreted as the public had a low level of knowledge towards NRW-related issues, but a high level of concern towards the environmental and NRW-related impacts.

Table III: Descriptive Analysis and Pearson Correlation Analysis of the Constructs in the Research Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT</td>
<td>3.106</td>
<td>1.063</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATT</td>
<td>3.543</td>
<td>0.873</td>
<td>0.589</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>3.112</td>
<td>1.022</td>
<td>0.533</td>
<td>0.388</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>4.102</td>
<td>0.817</td>
<td>0.316</td>
<td>0.182</td>
<td>0.268</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EK</td>
<td>1.860</td>
<td>1.066</td>
<td>0.322</td>
<td>0.203</td>
<td>0.149</td>
<td>0.262</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EC</td>
<td>4.104</td>
<td>0.537</td>
<td>0.263</td>
<td>0.208</td>
<td>0.133</td>
<td>0.181</td>
<td>0.247</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.505</td>
<td>0.500</td>
<td>0.048</td>
<td>-0.061</td>
<td>-0.004</td>
<td>0.083</td>
<td>0.014</td>
<td>-0.090</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td>0.610</td>
<td>0.488</td>
<td>-0.014</td>
<td>-0.045</td>
<td>-0.026</td>
<td>-0.026</td>
<td>0.059</td>
<td>-0.032</td>
<td>-0.002</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>1.709</td>
<td>0.781</td>
<td>-0.110</td>
<td>-0.129</td>
<td>-0.096</td>
<td>-0.081</td>
<td>0.004</td>
<td>-0.055</td>
<td>-0.007</td>
<td>-0.009</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td>0.724</td>
<td>0.447</td>
<td>0.052</td>
<td>0.011</td>
<td>0.045</td>
<td>0.016</td>
<td>0.025</td>
<td>0.040</td>
<td>0.003</td>
<td>0.469</td>
<td>-0.051</td>
<td>-</td>
</tr>
<tr>
<td>Education Level</td>
<td>0.399</td>
<td>0.490</td>
<td>0.110</td>
<td>0.110</td>
<td>0.140</td>
<td>0.102</td>
<td>0.003</td>
<td>0.080</td>
<td>-0.036</td>
<td>-0.364</td>
<td>-0.017</td>
<td>-0.279</td>
</tr>
</tbody>
</table>

Note: *Five-point scale(1=Never to 5=At Every Opportunity); bFive-point scale(1=Strongly Disagree to 5=Strongly Agree)

Based on Table IV and V, Model 1 had included the three main variables from TPB, which were ATT, SN and PBC had significantly revealed that the behavioural intention to perform NRW reduction practices. Furthermore, the β for TPB determinants proved that the public with a more favourable ATT and higher SN and PBC had greater behavioural intention to engage in NRW reduction practices. As a whole, Model 1 had interpreted a 47.7% variation in INT with the three main determinants of TPB (consisting of ATT, SN and PBC).

Model 2 had included the additional variables of EK and EC, hence this model had significantly interpreted public INT by additional determinants of EK and EC. The
model had increased R2 by 0.030, which revealed that when TPB determinants were controlled, EK and EC explained 3.0% of the variation in INT. Model 2 had interpreted a 50.7% variation in INT with the five determinants of TPB (that consisted of ATT, SN, PBC, EK and EC).

Lastly, Model 3 had included the additional variables of respondents’ demographic profile (gender, age group, ethnicity, marital status, and education level), hence this model had significantly interpreted INT. The model had increased R2 by 0.006, which revealed that when TPB determinants were controlled, the respondents’ demographic profile explained 0.06% of the variation in INT. Overall, Model 3 had interpreted a 51.3% variation in INT with the expanded TPB (consisted ATT, SN, PBC, EK, EC and the respondents’ demographic profile). However, the only significant determinant of respondents’ demographic profile was gender (p ≤ 0.05). It also revealed that this study’s final model had no issue with multicollinearity where all tolerance and VIF values were higher than 0.487 and lower than 5, respectively.

**Table IV:** Hierarchal Linear Regression Models in Examining the Effect of the Constructs on Intentions to Reduce Non-Revenue Water (n = 800)

<table>
<thead>
<tr>
<th>Model</th>
<th>R2</th>
<th>R2 change</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.477</td>
<td>0.477</td>
<td>241.701</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>0.507</td>
<td>0.030</td>
<td>163.064</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>0.513</td>
<td>0.006</td>
<td>82.986</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Note:** Model 1=Core TPB Variables (ATT, SN and PBC), Model 2=Model 1+EK+EC, Model 3=Model 2+Demographic Factors (Gender, Age, Ethnicity, Marital Status and Education Level)

**Table V:** The Variables in Hierarchal Linear Regression Analysis of Non-Revenue Water Reduction Behavioural Intention (n = 800)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>ATT</td>
<td>0.531</td>
<td>0.034</td>
<td>0.436**</td>
<td>0.487</td>
<td>0.034</td>
</tr>
<tr>
<td>SN</td>
<td>0.337</td>
<td>0.030</td>
<td>0.324**</td>
<td>0.330</td>
<td>0.029</td>
</tr>
<tr>
<td>PBC</td>
<td>0.195</td>
<td>0.035</td>
<td>0.150**</td>
<td>0.136</td>
<td>0.035</td>
</tr>
<tr>
<td>EK</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gender</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Age Group</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Marital Status</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.018</td>
</tr>
<tr>
<td>Education Level</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.066</td>
</tr>
</tbody>
</table>

**Note:** *p≤0.05, **p≤0.01, β=Standardized Regression Coefficients

The current study revealed that there were significant differences in the public’s ethnicity regarding all constructs of this study in examining the public’s INT, except for the factors of PBC and EC (Table VI). In examining the INT, it was found that Malay and Indian citizens were significantly impacted by higher ATT and SN.
compared to the Chinese citizens. Also, Indian, and Malay citizens were significantly impacted by higher EK compared to Chinese citizens.

Table VII: Ethnicity Differences Between All Variables in the Research Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Ethnicity (Mean)</th>
<th>F</th>
<th>P</th>
<th>Group Comparison Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Malay G1</td>
<td>Chinese G2</td>
<td>Indian G3</td>
<td></td>
</tr>
<tr>
<td>ATT</td>
<td>3.729</td>
<td>3.231</td>
<td>3.562</td>
<td>26.181</td>
</tr>
<tr>
<td>SN</td>
<td>3.254</td>
<td>2.907</td>
<td>3.078</td>
<td>8.978</td>
</tr>
<tr>
<td>EK</td>
<td>1.912</td>
<td>1.682</td>
<td>2.004</td>
<td>5.414</td>
</tr>
<tr>
<td>EC</td>
<td>4.135</td>
<td>4.080</td>
<td>4.065</td>
<td>1.317</td>
</tr>
</tbody>
</table>

Note: *p<0.05 and **p<0.01

In examining the public INT, the current study revealed that there were significant differences among the public’s education level regarding all constructs of this study except for the factors of EK (Table VII). In examining the public INT, it was concluded that citizens who completed pre-university education and above were significantly impacted by higher ATT, SN, PBC and EC compared to the citizens completed secondary school and below. For other demographic factors (such as gender, age group and marital status), it was found that there were insignificant differences among the public regarding all constructs of this study.

Table VII: Education Level Differences Between All Variables in the Research Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Education Level (Mean)</th>
<th>F</th>
<th>P</th>
<th>Group Comparison Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Secondary school below G1</td>
<td>Pre-university and above G2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATT</td>
<td>3.465</td>
<td>3.660</td>
<td>9.739</td>
<td>0.002** G2&gt;G1</td>
</tr>
<tr>
<td>SN</td>
<td>2.995</td>
<td>3.288</td>
<td>16.064</td>
<td>0.000** G2&gt;G1</td>
</tr>
<tr>
<td>PBC</td>
<td>4.034</td>
<td>4.205</td>
<td>8.459</td>
<td>0.004** G2&gt;G1</td>
</tr>
<tr>
<td>EK</td>
<td>1.857</td>
<td>1.863</td>
<td>0.006</td>
<td>0.939 Not Significant</td>
</tr>
<tr>
<td>EC</td>
<td>4.069</td>
<td>4.157</td>
<td>5.199</td>
<td>0.023* G2&gt;G1</td>
</tr>
</tbody>
</table>

Note: *p<0.05 and **p<0.01

DISCUSSION AND CONCLUSION

To validate the relationship between INT among the public in the mentioned states and the determinants influencing it, the TPB was implemented along with the additional variables of EK, EC, and public demographic features (which are gender, age, race, marital status and education level).

Several conclusions are identified from this study. First, the findings reveal that there are positive and significant associations of ATT, SN, PBC, EK, EC and respondents’ gender in explaining the INT (which means all hypotheses have been accepted in this study except for H6, 7, 8, 9, and 10). Second, the additional of EK, EC and demographic constructs have significantly predicted the INT when controlling the TPB, which is the
addition of 3.0% (EK and EC) and 0.6% (demographic characteristics) variation respectively towards the behavioural intention. Third, the exploration of the differences of demographic factors (which are gender, age group, ethnicity, marital status, and education level) and their effects on INT, concludes that ethnicity and education differences significantly influence INT only.

This study found that the public ATT, SN and PBC are significant predictors in measuring the INT. ATT is considered as the most substantial predictor that impacts the respondents’ behavioural intention in practicing water conservation and NRW reduction actions, which is aligned with prior environment-related studies (Fornara et al., 2016; Lam, 2006; Lowe et al., 2015). Water-related authorities should educate or provide necessary information to the public on the importance of being environmentally friendly in reducing NRW through campaigns, seminars, talks, exhibitions and brochures, to increase their positive perception and likelihood of engaging in NRW reduction practices.

The second significant predictor influencing INT is the SN, and this relationship has received substantial support from several previous pro-environment and water conservation studies (Biswas & Roy, 2015; Lowe et al., 2015; Rex et al., 2015). There are signs of the public norm’s importance towards what other people feel, especially those who are close to them, relating to their INT. In this study, if the public perceives that people important to them also consider NRW reduction to be essential, they will tend to view NRW reduction practices as less complicated and beneficial because the social norm has made NRW reduction more acceptable from their point of view. Water-related authorities should promote the way people or companies implement NRW reduction practices in their daily routine and communicate about the existence of a water conservation community and NRW reduction benefits to society.

Moreover, PBC is also a significant factor in measuring INT in this study. This result is aligned with environment-related behavioural studies (Lin & Hsu, 2013). NRW reduction practices should obtain support from the various water-related stakeholders such as water governance authorities, water utilities, the water conservation community, non-profit organisations and media to reduce NRW and water consumption and make it easy for the public could find it easy to participate in NRW reduction behaviour.

This study also broadened the body of research that utilised theoretical frameworks to understand the influence of essential understanding and consideration in creating greater intention to engage in NRW reduction practices. The positive significant relationship between EK and INT was also supported by various pro-environmental behavioural studies (Aman et al., 2012; Bagheri et al.; Dolnicar et al., 2012). It was also found that the construct of EC that significantly influenced INT was also supported by various pro-environmental behaviour studies (Mostafa, 2009; Said et al., 2003; Yadav & Pathak, 2016). Public understanding and concern towards NRW reduction
and water conservation must be enhanced to sustain NRW management. Public education can be a proactive approach to advice the public via spreading the environmental protection knowledge, actual value of water, current water utilities’ conditions and the NRW reduction advantages. Furthermore, the government should consider including environmental protection matter in the primary education syllabus, to educate the future generation in managing the valuable water resources more efficiently.

In the aspect of demographic profile differences and their effects on INT, this study found that there are no significant differences between gender, age group and marital status and the variables in the expanded TPB. These findings are aligned with the previous environmental study which stated that the respondents’ gender and age were relatively insignificant factors (Lam, 2006). However, the female respondents had a more positive ATT, the higher level of SN, and higher environmental consciousness towards the NRW reduction practices. The males, on the other hand, have slightly higher levels of PBC and EK. This was supported by pro-environmental studies (Fielding & Head, 2012). Marital status resulted as an insignificant variable in the expanded TPB, but it was contradicted with the finding of previous environmental purchasing study (Mills & Schleich, 2012). Moreover, this study reveals that there is a significant difference among ethnicity towards the INT. The Malay and Indian respondents had more positive ATT and higher levels of SN and EK as compared to Chinese respondents, while the factors of PBC and EC do not show any ethnicity differences. In the aspect of respondents’ education level, it was also revealed as an insignificant variable in the expanded TPB and supported with the finding of a previous environmental purchase study (Fielding & Head, 2012). This study has shown that respondents with higher education levels have a more positive ATT and higher levels of SN, PBC, and EC as compared to those who completed secondary education and below.

This present study also attempts to provide more information that could assist the various water-related stakeholders (such as the water governance authorities, water utilities, water regulators, water contractors, and non-governmental organizations) to understand their target audience (i.e. the public) better, particularly in terms of the determinants of the expanded TPB and on how various public demographic profiles tend to engage in NRW reduction practices.

The first limitation of this study is the geographical area, which is restricted to the states of Selangor, the Federal Territory of Kuala Lumpur, Pahang, and Johor, Malaysia; future research can be designed to include every state in Malaysia, as every state has its water utility. Secondly, the outcomes concluded from the current study focused on the NRW reduction behavioural intention rather than the actual NRW reduction behaviour itself. Therefore, there is a gap between behavioural intention and substantial behaviour. The future direction of this study can be expanded to
examine the public’s actual NRW reduction behaviour. As for recommendations for future research, those who are interested in consumers’ NRW reduction behaviour field should include other factors that impact the behaviour (such as willingness to pay and habit), demographic features (such as level of earnings, and amount of household members) and external factors (such as climate change, law and regulation, and technology used). In short, sustaining an effective NRW reduction management requires a full commitment and participation from all water-related stakeholders.

Acknowledgements
This research was funded by TRANSDISCIPLINARY RESEARCH GRANT SCHEME (TRGS) from Ministry of Education Malaysia, grant number of 4492/004 with the research project titled of Efficient and Sustainable Management of Non-Revenue Water Through Near-Real-Time Monitoring Utilizing Fiber Laser Based Acoustic Sensors and Conventional Instrumentation System Coupled with Data Analytic Processes.

References:


