



## Research article

## On the predictors of pro-environmental behaviors: integrating personal values and the 2-MEV among secondary school students in Tanzania

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## ABSTRACT

The role of personal values in understanding pro-environmental attitudes and behaviors has received considerable attention from psychological researchers. However, little is known about the mutual interaction of personal values and the Theory of Ecological Attitudes (2-MEV) in explaining pro-environmental behaviors (PEBs). To explore the mediating factors with which pro-environmental behaviors are explained via environmental attitudes and personal values, this article reports the study findings from secondary school students. Specifically, the article indicates the extent to which a unified model of personal values and the Theory of Ecological Attitudes (2-MEV) explain self-reported PEBs. The cross-cultural validity of the 2-MEV for measuring environmental attitudes (EA) among the selected respondents is as well investigated. A cross-sectional survey of 408 secondary school students was used for data collection. As expected, principal component analysis with a varimax rotation confirmed the two-factor structure of the 2-MEV measuring EA with two uncorrelated factors of Preservation and Utilization. Interestingly, multiple regression analyses indicated that a combined model of personal values and the 2-MEV provides a more explained variance of self-reported PEBs compared to when any of the two predictors is used independently. Overall, altruistic value provides the largest predictive power over egoistic and biospheric values in mediating EA. In turn, the general model that includes personal values and the 2-MEV indicates that Preservation makes the largest and unique contribution in explaining recycling, biodiversity protection, environmental activism, and general PEBs. Conversely, the Utilization factor provides the largest negative explained variance for management of environmental pollution behavior. These findings remain unaltered even when the age of respondents and social desirability responding are statistically controlled. The implications regarding these study findings are discussed.

## 1. Introduction

The question of what influences an individual to (not) act ecologically has long been investigated and widely documented (e.g., Bamberg and Möser, 2007; Hines et al., 1987; Kollmuss et al., 2002). However, as Gifford and Nilsson (2014) noted, unfolding what shapes pro-environmental behaviors (PEBs) is such a complex and unexhaustive topic. In that regard, different frameworks have been proposed to explain the determinants of PEBs. Broadly, understanding PEBs in pro-social contexts (benefiting others) relies on the Norm-Activation Model (NAM) as proposed by Schwartz (1977) and the social altruistic value becomes the primary activating predictor. On the other hand, considering self-interest as a primary determinant of PEBs dictates an

application of the rational choice models such as the theory of planned behavior (Ajzen, 1985, 1991). Moreover, the value-belief-norm theory has been proposed and employed to explain determinants of PEBs in a more comprehensive manner (Stern, 2000). Yet, with a particular focus on personal values, the values basis theory provides an appropriate framework to explain specific values and different kinds of PEBs (Stern and Dietz, 1994).

The value basis theory provides the fundamental attributes in explaining pro-environmental attitudes and behaviors (Dietz et al., 2005). As defined in their broad context, personal values have been described by Schwartz (1992) as trans-situational goals with different levels of importance that provide guiding principles for an individual or a group to make personal choices. According to de Groot and Thøgersen

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(2019), Schwartz's definition of personal values includes three key elements. First, values that represent desired or undesired outcomes. Second, values are such abstract constructs and therefore provide context-specific situations. Third, values provide an evaluative model for people's events and behaviors. Likewise, de Groot and Thøgersen provide reasons for personal values to be more important in studying attitudes and behavior than other determinants. In particular, they contend that the total number of values is comparatively smaller to explain PEBs than other useful determinants such as beliefs, attitudes, intentions, and norms. And that "values provide an economically efficient instrument for describing and explaining similarities and differences between persons, groups, nations, and cultures" (p. 168).

Further, environmental values described by Bogner and Wiseman (2006) imply "closely related attitudes" (p. 248) or "higher-order factors" of preservation and utilization. In their context, environmental values differ from environmental attitudes as the latter belong to the first-order factors in measuring environmental attitudes. Strictly speaking, we use Schwartz's (1992) definition to describe personal values as trans-situational goals with varying levels of importance that an individual attach to his/her personal decisions. In environmental context, the personal values described here provide guides upon which people make environmental choices particularly in interacting with the environment. Therefore, we use personal value as an evaluative model to indicate how it explains one's behavior when subjected to environmental parameters (de Groot and Thøgersen, 2019). Although in a psychological context, values have been described as beliefs about the desire of an individual towards preferential choices (de Groot and Thøgersen, 2019; Schwartz, 1992), some other researchers have examined personal values and beliefs as separate factors where the former is a potential determinant of the latter and both of them may pose different influences on environmental behaviors (e.g., Aguilar-Luzón et al., 2020; De Groot and Steg, 2007; Stern et al., 1999). Although, personal values and beliefs are potential determinants of environmental behaviors (Aguilar-Luzón et al., 2020), the discussion of personal beliefs is beyond the scope of this article. For consistency, we use preservation and utilization as dimensions of environmental attitudes rather than the personal values.

Some researches provide empirical support suggesting that personal values are reliable and valid predictors of different environmental behaviors such as recycling and energy saving (Agissova and Sautkina, 2020), ecological consumer behavior (Ling and Xu, 2020), environmental activism (Riepe et al., 2021) as well as general pro-environmental behaviors (Karp, 1996) among others. Nonetheless, mixed results have as well been reported elsewhere (Tamar et al., 2020). The psychometric features regarding the stability and factor structure of personal values are well-known (Chan, 2020). Most studies that have tested the influence of personal values on attitudes and PEBs used the New Ecological/environmental Paradigm (NEP) scale (e.g., Agissova and Sautkina, 2020; Brende et al., 2015; Chen, 2015). However, the unidimensional structure and its limited explanatory power on PEBs have raised critiques (Liu and Chen, 2019; Lundmark, 2007) necessitating the need for a more robust model.

To narrow down the existing literature gap, we investigated the mediating factors with which pro-environmental behaviors among secondary school students are explained via environmental attitudes and personal values. Specifically, the study sought to examine whether personal values (biospheric, altruistic, egoistic) can adequately explain ecological attitudes and self-reported PEBs. Further, we investigated whether a combined model of the personal values and environmental attitudes (EA) explains more variance in self-reported PEBs than when a single model is used. The EA was examined through the lens of the Theory of Ecological Attitudes. This theory (referred hereafter as the two-major environmental values; 2-MEV) measures environmental attitudes on higher-order factors of Preservation (PRE) and Utilization (UTL) (Bogner and Wiseman, 1999, 2006; Wiseman and Bogner, 2003). The former focuses on the biocentric view inclined in the protection and conservation of ecological resources whereas the latter stresses an

anthropocentric perspective that prioritizes exploitation of the ecological resources and human dominance over nature. Nevertheless, the factor structure of the 2-MEV is still debatable across countries (Castéra et al., 2018; Milfont and Duckitt, 2004, 2006). To achieve the general purpose of the study, the following research questions were investigated;

1. Can the factor structure of the original 2-MEV be replicated in the present study? If so, are the PRE and UTL attitudes of the 2-MEV orthogonal or correlated factors?
2. What is the level of self-reported scores of respondents for each of the items in environmental attitudes and PEBs?
3. Are there differences in demographic (gender, type of school, and school location) statistical means on composite scores of personal values, the 2-MEV, and different types of self-reported PEBs?
4. Does each of the personal values predict preservation and utilization attitude as well as each of the self-reported PEBs?
5. To what extent does each of the predictors (personal values and the 2-MEV) account for the total explained variance of the self-reported PEBs?
6. After controlling for possible effects of age and social desirability responding (SDR), will the set of predictors (biospheric, altruistic, egoistic, PRE, and UTL) still make a significant amount of the variance in self-reported PEBs?

The results of the present study are expected to shed new light on the efficacy of integrating the personal values and the 2-MEV to explain social psychological factors in understanding different types of pro-environmental behaviors and their associated social structural factors when possible moderating factors are held constant. We believe that the results of the present study will be useful not only for psychological researchers but also for policymakers and environmental educators in redefining the social interaction with the environment in a sustainable manner. It should be noted, however, that the personal values referred to in our study focus on individuals' priorities and how these priorities vary among individuals concerning environmental behavior and attitude (Tadaki et al., 2017).

## 2. A review of literature

### 2.1. Contextualizing the theory of ecological attitudes (2-MEV)

The 2-MEV was developed to explain the measurement of environmental attitudes with initial validation conducted in four European countries; Germany, Switzerland, Denmark, and Ireland (Bogner and Wiseman, 1999). This initial validation included a total sample of 4500 secondary school students with ages ranging from 11 to 18. The results suggested that the 2-MEV measures attitudinal factors on two dimensions referred to as secondary or higher-order factors and five primary factors. Specifically, the PRE higher-order factor measures three primary environmental factors of Intent of Support, Care with Resources, and Enjoyment of Nature. On the other hand, the UTL higher-order factor measures two primary environmental factors of Human Dominance over nature and Altering Nature. For interpretation purpose, high scores on PRE factor (<3 on 5-point Likert scale) indicates an individual with conservation and protection (ecocentric view) of ecological resources as opposed to UTL factor in which high scores indicate an exploitative (anthropocentric) perspective of the ecological resources (Johnson and Manoli, 2011).

Subsequent validation of the 2-MEV model has accumulated considerable evidence from children (Johnson and Manoli, 2011; Maurer et al., 2020), adolescents (Opel & Bogner, 2020; Schumm and Bogner, 2016), adults (Munoz et al., 2009; Oerke and Bogner, 2010) as well as in cross-cultural perspectives indicating adequate psychometric features. As of recent, more than 30 language versions of the 2-MEV scale have been validated worldwide (Cuadrado et al., 2021). Despite a considerable validation of the 2-MEV, Milfont and Duckitt (2004) although confirmed

the two-factor structure of the original model, the PRE and UTL factors were highly correlated as opposed to an orthogonal relationship proposed in the original formulation (Wiseman and Bogner, 2003). Therefore, the correlation pattern between PRE and UTL factors may still need cross-cultural validations.

## 2.2. The explanatory power of the 2-MEV over pro-environmental behavior

Substantive studies have investigated the relationship between the 2-MEV with PEBs. For example, Boeve-de Pauw and Van Petegem (2013) examined the role of the 2-MEV in predicting environmental behaviors in three samples taken from Guatemala, Flanders, and Vietnam (aged 10–13). The findings of their study revealed cross-cultural variations of the 2-MEV in its explanatory power over self-reported PEBs. As such, they recommended the need for context-specific consideration when employing the 2-MEV to understand environmental behaviors. Nonetheless, PRE attitude was consistent in predicting self-reported PEBs in all the three countries whereas weak explanatory power was found for UTL over PEBs in Flanders and Vietnam while a strong association of UTL was observed in Guatemala. These results conform to those of Milfont and Duckitt (2004) in which PRE positively predicted PEBs while UTL had no substantial impact on PEBs. On the other hand, PRE and UTL were weakly correlated in all of the studied samples (Flanders  $r = .110$ ; Vietnam  $r = .034$ ; Guatemala  $r = .125$ ). Related findings have also been reported in the recent efforts to enhance green education actions among the Greek sixth-graders (Maurer et al., 2020).

Subsequently, an experimental study to examine the effect of environmental education program was conducted by Sellmann and Bogner (2013) in German secondary school students (15–19 years of age) focusing on climate change as a topic of interest. Three tests were administered before, and the retention assessment of the program indicated a slight improvement for PRE from pre- (mean = 30.42) to post-test (mean = 31.19) with a slight decrease at the retention test (mean = 30.98). On the other hand, the UTL factor was fairly constant over four to six weeks from pre (mean = 17.82) to post-test (mean = 16.34) and the retention test (mean = 17.06). The PRE was positively associated with connectedness with nature over the three assessments with the correlation coefficients ranging from  $r = .44$  to  $r = .63$  ( $p < .01$ ). A negative correlation between UTL and connectedness with nature was as well consistent over the three points of assessment with Pearson correlations ranging from  $r = -.35$  to  $r = -.27$ ;  $p < .01$ . The results suggested that the magnitude of an individual's connectedness with nature was primarily dependent on personal attitudes.

In a similar vein, Liu and Chen (2019) found that the 2-MEV has superior power over the NEP scale in explaining PEBs of 490 students (9–12 years) in China. These results were consistent with Manoli, Johnson, Buxner, and Bogner's (2019) study who observed that the NEP failed to provide variation between high and low PRE/UTL scores among the studied 4<sup>th</sup> and 5<sup>th</sup> graders in the United States of America (USA) whereas the 2-MEV accurately differentiated the two-dimensional scores of PRE and UTL in the 2-MEV.

Altogether, the 2-MEV has shown a substantial explanatory power over PEBs from theoretically grounded and experimental studies. Broadly, the factor structure of the model seems to be consistent on two-factor solutions yielding two separated factors of PRE and UTL. Nevertheless, mixed findings have been reported regarding the correlation pattern of the PRE and UTL higher-order factors of the 2-MEV. That is, while the original model suggests two uncorrelated factors (Wiseman and Bogner, 2003), subsequent validations by Milfont and Duckitt (2004, 2006) produced two highly correlated factors. This variation may affect the attitudinal influence of the 2-MEV over the PEBs suggesting the need for further cross-national validation. While there is a line of argument suggesting that the correlation could be caused by a statistical

artifact due to item wording direction, little effort has been employed to support or refute this claim.

## 2.3. The value basis theory and the context of pro-environmental behaviors

Personal values have been described as the relevant starting point when one needs to change environmental behaviors (de Groot and Thøgersen, 2019). Regarding the role of personal values in environmentalism, two main perspectives have been proposed and tested. First, the consideration of the three personal values (biospheric, altruistic, and egoistic) as independent and distinct psychological constructs has been questioned (de Groot and Steg, 2008). Second, the role of personal values in influencing environmental attitudes and behavior provides mixed results indicating a direct influence on both attitudes and behavior on one hand (Balundé et al., 2019) and having a limited direct influence on PEBs on the other hand (Agissova and Sautkina, 2020; Karp, 1996). Notwithstanding, the distinction of the personal values has been empirically supported from different cross-cultural studies confirming that they can be considered as independent constructs with different mediating power on both attitudinal and behavioral choices (Chan, 2020; Wang, van der Werff, Bouman, Harder and Steg, 2021).

The specific role of each personal value has been researched with evidence suggesting that social altruistic value has a positive predictive power of both pro-environmental attitudes and behaviors (Dietz et al., 2005; Xu et al., 2021). Likewise, altruistic and biospheric values have sometimes been described as possessing a similar role in environmentalism (Stern and Dietz, 1994; Stern, 2000) as some other empirical support has confirmed (Milfont et al., 2006). On the contrary, individuals with egoistic preferences (e.g., desire for wealth, power, and personal interest) have been regarded as environmentally exploitative and less protective of nature. As a result, the egoistic value is considered as a negative predictor of both pro-environmental attitudes and behaviors (Schultz et al., 2005). Conversely, studies by De Dominicis et al. (2017) found that egoistic value can also influence ecological actions when the outcomes have personal benefits suggesting the need to re-emphasize the role it plays in shaping environmentally responsible behaviors.

Generally, the mediating role of personal values over pro-environmental attitudes and behavior remains inconclusive. This has some support from empirical literature suggesting that cross-cultural variation does exist (Chwialkowska et al., 2020). As such, a need to integrate a more culturally-specific perspective for behavior change has been proposed (Lou and Li, 2021). Moreover, mixed research findings have reported socio-demographic variation regarding personal values and environmentalism (Ling and Xu, 2020). Notwithstanding, a more general perspective holds that women tend to possess more ecological (particularly in private sphere behaviors such as utility saving and recycling) values such as biospheric and altruistic than men do as contrasted to their less egoistic value (Briscoe et al., 2019; Stern and Dietz, 1994). This line of argument has, however, been challenged as it indicates that men tend to be more ecological than women in public sphere behaviors (e.g., environmental activism) and that they are more environmentally literate than women (Xiao et al., 2019; Xiao and Hong, 2018). To sum up, the determinants of EA and PEBs are diverse and may not be the same across nations. As Lou and Li recommend, one needs to evaluate the relevant mediating factors to promote behavioral change in a particular cultural context.

## 3. Methods

### 3.1. Respondents and procedure

Data were collected from six schools located in the Dodoma region, the central part, and the political hub of the United Republic of Tanzania.

Among these schools, three are located in rural and three others in urban areas. Besides, three schools belong to the lower secondary education level while the others are high schools. All the schools were simple randomly selected in both urban and rural areas. The study was conducted in three sub-regions (districts) of Dodoma; Chamwino, Mpwapwa, and Kondo. Two schools from each sub-regions were simple randomly selected whereas a convenient sample in each school was used during the data collection. Initially, 420 questionnaires were physically distributed to respondents on their school campuses. However, 408 respondents (152 girls, 256 boys) only were considered for subsequent analysis as they provided the necessary required information. Respondents' ages ranged from 15 to 26 years (Mean = 18.19, SD = 1.369).

### 3.2. Materials

In responding to the research questions of the present study, four kinds of survey questionnaires were employed. First, 20 items of the 2-MEV (including two new items i.e., donation of money to support environmental organization should be encouraged, I feel so happy to watch TV programs about the conservation of nature) were adapted to collect data on EA (Bogner and Wiseman, 2006). Second, 16-items of the General Ecological Behavior (GEB) scale were adapted to measure self-reported PEBs (Kaiser et al., 1999). Of these items, four behavioral types were examined; recycling, management of environmental pollution, environmental activism, and biodiversity protection. Third, 10 items of the Balanced Inventory of Desirability Responding (BIDR) were employed to measure Social Desirability Responding (SDR) (Bobbio and Manganelli, 2011). Respondents rated these three scales on five-point Likert scales from 1-strongly disagree to 5-strongly agree.

The fourth scale measured personal values from the adapted value items used by de Groot and Steg (2008). The value items included two biospheric items, two altruistic items, and three egoistic items. Respondents rated each of the value items on a five-point Likert scale from 1-not at all like me to 5-very much like me. Some of the items in the used scales were modified to suit the context and cultural relevance of the present study.

### 3.3. Data analysis

To examine the underlying constructs and items' loadings of the 2-MEV (question 1), the Principal Component Analysis (PCA) was performed. The Kaiser-Meyer-Olkin (KMO) of sampling adequacy and Bartlett's Test of sphericity were computed and interpreted accordingly to support the PCA. To examine the factor structure, an eigen value greater than one was considered in the preliminary analysis followed by simulated eigen values using parallel analysis with a minimum loading set at .30 for each item (Pallant, 2016). Internal consistency reliability was calculated using Cronbach's alpha of coefficient with a value close to .70 set as the minimum acceptable level (Nunnally, 1978). Nevertheless, (Hair et al. (2006)) propose that values less than .70 can be acceptable if the items within a construct are less than 10. Equally, Taber (2018) provides a considerable range of alpha values in different studies suggesting that even low alpha values can still be useful in some study contexts.

### 3.4. Comparing mean differences of respondents

Before computing the mean differences between groups (question 3), composite scores were calculated for each scale based on five points of the Likert scale. This was followed by examining the compliance of data to the assumptions of the parametric tests, that is, the independent samples *t*-test. An independent samples *t*-test was used to assess the mean differences of respondents based on their demographic variables of gender, school type, and school location (urban and rural). Besides, an effect size using eta-squared ( $E^2$ ) was calculated to determine the magnitude of the differences between the compared variables. Likewise,

descriptive statistics were computed to assess the score level of respondents on each item (question 2).

### 3.5. Assessing the predictive power of independent variables

The predictive power of independent variables to the outcome variables was examined using multiple regression analyses (questions 4 & 5). First, the relationship between personal values and the PRE as well as UTL was assessed. Second, the explanatory powers of personal values and the 2-MEV over different types of PEBs and on overall self-reported PEBs were examined. Moreover, for adjusting response biases (Wiseman and Bogner, 2003), respondents' filled questionnaires were controlled for ages and Social Desirability Responding using hierarchical regression analysis (question 6).

### 3.6. Ethical clearance

Before conducting the present study, a research clearance letter from the Directorate of Research and Innovation of the University of Rwanda-College of Education was granted to the first author. The same clearance letter was used to seek local permission from the Permanent Secretary of the Ministry of Education, Science and Technology to approve data collection in Tanzania. The permission for data collection in the selected schools in Tanzania was provided and it was used to obtain informed consents from all respondents who participated in the study. Besides, permissions to use all the adapted research tools in this study were requested by the first author and granted by the corresponding authors of the articles in which the tools are published.

## 4. Results

### 4.1. Factor structure of the 2-MEV

The KMO of sampling adequacy indicated acceptable values for the used sample (KMO = .758) and Bartlett's test of sphericity was significant ( $R^2 = 576.144$ ,  $df = 105$ , and  $p < .0005$ ). Eigen values' assessment revealed a two-factor structure with the 15 items (Table 1). Examining the relationships of the PRE and UTL using Oblimin rotation for correlated factors indicated a weak negative correlation ( $r = -.196$ ) suggesting that the two extracted factors are not strongly correlated. Therefore, a varimax rotation analysis was conducted. Reverse coding of UTL items did not change the strength, it only changed the direction of the relationship from negative to positive ( $r = .196$ ). Broadly, two uncorrelated factors confirmed the original structure of the 2-MEV. However, five items did not meet the psychometric requirement and were excluded from the analysis (question 1).

The total explained variance of the 2-MEV was 29.303%. The PRE factor explained 15.767% of the variance with eight items whereas the UTL factor accounted for the remaining 13.536% of the variance with seven items. Based on these results, it seems reasonable to conclude that the 2-MEV measures EA on two correlated higher-order factors of preservation and utilization of ecological resources as proposed in the original development of the 2-MEV model. As such, the two factors of PRE and UTL have theoretically separated components that are not necessarily related constructs of EA (Bogner and Wiseman, 1999).

### 4.2. Respondents' level of environmental attitudes

The study findings revealed that respondents had more biocentric (PRE) attitudinal preferences than the anthropocentric (UTL) attitude towards the environment. Similarly, respondents reported a higher PRE attitude and they expressed a considerable endorsement on the importance for human beings to live in tune with the environment for life sustainability ( $M = 4.22$ ,  $SD = 1.02$ ). Besides, respondents reported substantial concern for the environment on the items related to industrial pollution ( $M = 4.12$ ,  $SD = 1.311$ ) and enjoyment to watch TV programs

**Table 1.** Demographic variations on the measured variables (N = 408).

Category	Demography	N	Mean	SD	t-value	Sig.	E <sup>2</sup>
PRE	Girls	152	28.55	4.538	9.007	p < .0005	.167*
	Boys	256	32.66	4.410			
UTL	Girls	152	21.40	4.297	-5.812	p < .0005	.077*
	Boys	256	18.59	5.351			
PRE	Rural	318	30.94	4.932	1.522	p = .129	.006
	Urban	90	31.82	4.639			
UTL	Rural	318	19.55	5.169	-.634	p = .526	.001
	Urban	90	19.94	5.152			
PRE	Lower sec.	180	30.37	5.202	2.842	p = .005	.020*
	High school	228	31.74	4.525			
UTL	Lower sec.	180	21.11	5.085	-5.283	p < .0005	.071*
	High school	228	18.48	4.930			
Biospheric	Girls	152	8.05	1.564	1.071	p = .285	.003
	Boys	256	8.39	3.699			
Altruistic	Girls	152	7.71	1.736	3.559	p < .0005	.030*
	Boys	256	8.30	1.565			
Egoistic	Girls	152	10.68	2.365	.947	p = .344	.002
	Boys	256	10.91	2.375			
Biospheric	Rural	318	8.45	3.286	-2.290	p = .023	.013*
	Urban	90	7.61	2.113			
Biospheric	Lower sec.	180	7.87	1.901	2.329	p = .020	.013*
	High school	228	8.58	3.738			
Altruistic	Rural	318	8.18	1.594	-2.286	p = .035	.013*
	Urban	90	7.73	1.816			
Altruistic	Lower sec.	180	7.66	1.871	4.599	p < .0005	.095*
	High school	228	8.42	1.372			
Egoistic	Rural	318	10.94	2.389	-1.796	p = .073	.008
	Urban	90	10.43	2.274			
Egoistic	Lower sec.	180	10.79	2.408	.299	p = .765	.0002
	High school	228	10.86	2.346			
PEBs	Girls	152	54.40	5.942	5.157	p < .0005	.061*
	Boys	256	57.84	6.816			
PEBs	Rural	318	56.72	6.845	.927	p = .354	.002
	Urban	90	55.98	6.190			
PEBs	Lower sec.	180	54.82	6.300	4.763	p < .0005	.053*
	High school	228	57.93	6.712			

Note: SD = standard deviation, N = number of respondents, E<sup>2</sup> = eta squared (the level of the magnitude for the group means difference), PEB = pro-environmental behavior, \* = the compared groups differ significantly. The mean difference is significant at p = ≤.05.

about the conservation of nature (M = 4.03, SD = 1.004). On average, each PRE item exceeded the minimum cut-off point (3.0) for an ecological sensitive person suggesting that they had a more preservation perspective than an exploitative one (Bogner and Wiseman, 2006). This was also true for the total PRE mean score (M = 3.89, SD = 1.148).

On the other hand, respondents were of the view that nature should be protected against construction projects (M = 2.76, SD = 1.47) and that society should worry about the overutilization of ecological resources (M = 2.42, SD = 1.13) and clearing of vegetation for farming activities (M = 2.37, SD = 1.46). The highest concern was expressed on the threat posed by environmental pollution indicating the lowest mean score on its item proposing the need to do away with environmental pollution (M = 1.96, SD = 1.396). Unexpectedly, respondents reported higher scores (>3.0) than the expected minimum cutoff point on three items of the UTL factor. That is, respondents reported greater support for an item that prioritizes the protection of plants and animals that have economic importance than those that are not (M = 3.35, SD = 1.42). Likewise, respondents were of the view that human beings should modify the environment the way they wish (M = 3.50, SD = 1.29), and that humans are more superior to any

other creature (M = 3.27, SD = 1.38). Nonetheless, the overall score indicated that respondents had less exploitative perspective (M = 2.80, SD = 1.39) than the preservation one (question 2).

### 4.3. Self-reported pro-environmental behavior of respondents

Descriptive results indicated that respondents reported an adequate level of PEBs (above 3.0). Higher mean scores were on items related to participation in environmental activities (M = 4.38, SD = .893), reading about environmentally-related contents (M = 4.18, SD = 1.040), taking care of plants (M = 4.13, SD = 1.051), and disposing of empty bottles in a recycle bin (M = 4.02, SD = 2.27). On the contrary, three items recorded lower scores than the overall mean. Specifically, items related to bringing back unused medicine to the pharmacy (M = 2.74, SD = 1.41), use of chemical insecticides (M = 2.62, SD = 1.35), and use of chemical detergents (M = 2.37, SD = 1.28). Generally, the total mean score was higher than the minimum cutoff point (M = 3.54, SD = 1.29) suggesting that respondents had a general behavioral concern for the environment. Specific to each behavioral type, environmental activism had the largest

mean score ( $M = 12.5$  of 15 or 83.3%,  $SD = 2.23$ ) followed by biodiversity protection ( $M = 14.94$  of 20 or 74.7%,  $SD = 2.83$ ). The lowest mean score was on environmental pollution management ( $M = 15.42$  of 25 or 61.7%,  $SD = 3.57$ ) while recycling had an average composite score of 13.71 or 68.6% ( $SD = 3.20$ ).

#### 4.4. Demographic variations on personal values, environmental attitudes, and PEBs

An independent samples  $t$ -test revealed that respondents did not differ significantly on egoistic value against school level and school location as well as on gender basis (Table 1). This was also true for the school location against PRE, UTL, and self-reported PEBs. However, respondents in rural schools reported significantly higher scores on social altruistic than those in urban schools (Rural  $M = 8.18$ ,  $SD = 1.594$ ; Urban  $M = 7.73$ ,  $SD = 1.82$ ). The magnitude of the difference was, though, very small [ $F(408)$ ,  $p = .035$ ,  $E^2 = .013$ ] suggesting that only 1.3% of the variance could be explained by the rural-urban location of schools in altruism (question 3).

On the other hand, boys outperformed girls on PRE (boys  $M = 32.66$ ,  $SD = 4.41$ ; girls  $M = 28.55$ ,  $SD = 4.54$ ,  $p < .0005$ ), overall self-reported PEBs (boys  $M = 57.84$ ,  $SD = 6.82$ ; girls  $M = 54.40$ ,  $SD = 5.94$ ,  $p < .0005$ ), and on altruism (boys  $M = 8.30$ ,  $SD = 1.57$ ; girls  $M = 7.71$ ,  $SD = 1.74$ ,  $p < .0005$ ). Conversely, girls reported a significantly higher UTL attitude than boys (boys  $M = 18.59$ ,  $SD = 5.35$ ; girls  $M = 21.40$ ,  $SD = 4.297$ ,  $p < .0005$ ). Concerning PRE and gender, the magnitude of the difference was large ( $F(408)$ ,  $p < .0005$ ,  $E^2 = .167$ ) proposing that 16.7% of the variance in PRE is explained by sex. On the other hand, the magnitudes of gender difference on UTL and PEBs were moderate ( $E^2 = .077$  and  $E^2 = .061$ ) indicating that 7.7% and 6.1% of the variance in UTL and self-reported PEBs, respectively could be explained by sex. Contrariwise, the magnitude of the difference of gender about altruistic value was very small ( $E^2 = .03$ ) implying that only 3% of social altruistic could be related to sex as a variable. This interpretation is based on Cohen's (1988) guidelines concerning eta-squared statistical values (.01 = small effect, .06 = moderate effect, and .14 = large effect) each of which is multiplied by 100% to estimate the magnitude of the group differences.

Subsequently, students in high schools expressed greater concern for the environment than lower secondary schools as they scored significantly higher on PRE, overall PEBs, and on altruistic value while students in lower secondary schools scored relatively higher than their counterparts on egoistic value suggesting that they were more of the anthropocentric perspective than those in high schools (question 3). On the contrary, there was no statistically significant difference between boys and girls on the biospheric value (Table 1).

#### 4.5. The relationship between personal values and the 2-MEV

To examine the predictive power of the personal values over PRE and UTL factors, two regression analyses were conducted for each factor (question 4). The first model that includes biospheric value, social altruistic, and egoistic value revealed that only social altruistic value contributed significantly to the model in predicting PRE (Beta = .224,  $p < .0005$ ,  $R^2 = .072$ ). As such, 7.2% of the variance in PRE could be attributed to social altruistic value as a predictor. Likewise, the second model that includes the same personal values was significant for all variables indicating a negative prediction of biospheric and altruistic values to UTL, and a positive prediction for the same factor by the egoistic value (Beta = .120,  $p = .016$ ). In this regard, the same social altruistic value explained the largest variance with a negative relationship (Beta = -.138,  $p = .006$ ). The total explained variance of the model was relatively lower than the first model ( $R^2 = .042$  or 4.2%,  $p < .0005$ ).

#### 4.6. Determinants of self-reported PEBs

Before the assessment of each variable's explanatory power, violation of the assumptions for the multiple regression analysis was scrutinized. In

each case, the independent variables included in each model as predictors were weakly correlated. Tabachnick and Fidell (2013) recommend that highly correlated variables ( $r \geq .8$ ) should not be included in the same model. In this study, the maximum value was  $r = .253$  between the biospheric and social altruistic values suggesting that our data did not violate the assumption of multicollinearity. Besides, all of the tolerance values were greater than .10 proposing that multiple correlations with other variables were low, hence, free from multicollinearity (Pallant, 2016). In support, all values for the Variance Inflation Factor (VIF) were less than 10.

Normality tests indicated that data did not deviate from the assumptions as the residual plots indicated similar values between the predicted and the observed values (Figure 1). Similarly, there was a diagonal straight line from the bottom left to the top right of the residual plots. Skewness and kurtosis were within the acceptable range (Skewness = .073, Kurtosis = 3.095).

For the detection of outliers, the scatterplot of the standardized residuals indicated that there were no serious outliers as the residuals were roughly distributed rectangularly with the most scores concentrating around the zero points (Pallant, 2016). All the cases in the scatterplot had standardized residuals falling within the acceptable range (3.3 to -3.3).

A series of multiple regression analyses were conducted to examine the explanatory power of each predictor variable over each of the self-reported PEBs; recycling, pollution management, environmental activism, and biodiversity protection. The first model of prediction included personal values (biospheric, altruistic, and egoistic), PRE, and UTL as predictors whereas recycling was regarded as a dependent variable. In this case, only two predictors; the PRE and UTL indicated considerable prediction (Table 2). Nonetheless, PRE made the largest unique contribution to this model (Beta = .257,  $p < .0005$ ). The total explained variance was 10.9% in recycling suggesting that for every 1-unit increase of standard deviation (SD) in PRE there is an increase of .257 units of SD in recycling behavior.

In the second model that included the same predictors against pollution management as a dependent variable, UTL was the only predictor with both unique contributions to the model and a significant explanation of pollution management behavior (Beta = -.294,  $p < .0005$ ). As such, the model explained 10.1% of the variance signifying that for

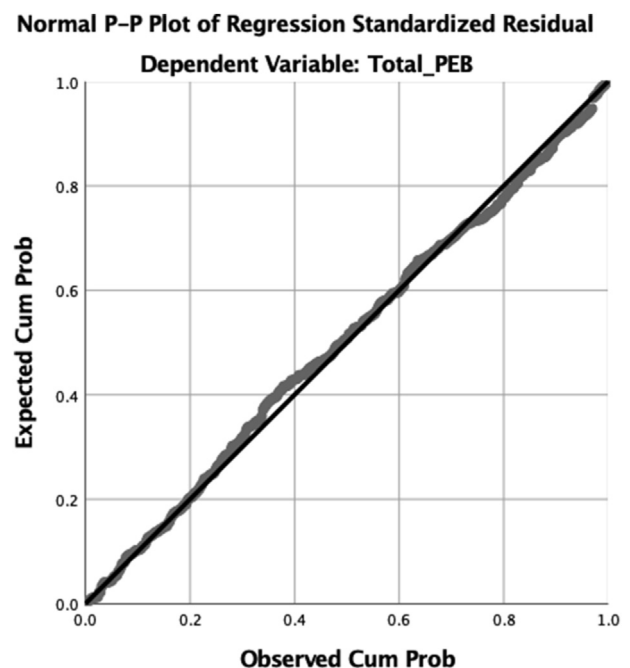


Figure 1. Homoscedasticity assessment indicates the variance of residuals about the predicted and the observed self-reported PEBs.

every 1-unit increase of SD in utilization attitudes, there is a possibility of dropping .294 SD units in pollution management behavior.

On the other hand, biodiversity was significantly predicted by three independent variables. In order of their importance; PRE (Beta = .318,  $p < .0005$ ), altruistic value (Beta = .164,  $p = .001$ ), and UTL (Beta = .139,  $p = .005$ ) accounting for total explained variance of 14.3%. Biospheric and egoistic values were not making substantial explanation of biodiversity protection behavior. That is activating PRE attitude could be the most efficient means of promoting biodiversity protection behavior among secondary school students.

For environmental activism, two predictors made a significant contribution; social altruistic (Beta = .111,  $p = .018$ ) and PRE (Beta = .452,  $p < .0005$ ). This model explained 22.3% of the variance in predicting environmental activism. Table 2 provides more detailed statistical values on each predictor and the outcome variables.

Generally, standard multiple regression analysis indicated that the present model that includes PRE, UTL, biospheric, altruistic, and egoistic values as the independent variables/predictors explains 28% (R-square;

coefficient of determination) of the variance in the overall self-reported PEBs. Of these five predictors, the PRE factor makes the largest significant unique contribution to the model (Beta = .428,  $p < .0005$ ) whereas UTL makes the second-largest but negative contribution to the same model (Beta = -.140,  $p = .002$ ). Meanwhile, the altruistic value makes the third (positive) significant predictive contribution (Beta = .122,  $p = .007$ ) whereas the biospheric and egoistic values appeared to have a nonsignificant prediction of pro-environmental behaviors (question 5).

We tested the strength of each model to explain self-reported PEBs when used alone or in a combined framework. The results indicated that when the 2-MEV is combined with the personal values, the explained variance increases from 26.5% (when the 2-MEV is used independently) to 28%. On the other hand, when personal values are used independently as predictors of PEBs, the explained variance is relatively lower ( $R = .247$ ,  $R^2 = .061$ ,  $F = 8.77$ ) than that of the 2-MEV ( $R = .515$ ,  $R^2 = .265$ ,  $F = 73.17$ ) and of the combined model. Thus, to obtain a good behavior change, both social altruistic value and the preservation attitude should be encouraged simultaneously. Equally, lowering of the utilization

**Table 2.** Explanatory powers of the value orientations and the 2-MEV over self-reported PEBs (N = 408).

Predictors and predicted variables	Beta	t	Sig.	R <sup>2</sup>	Adjusted R <sup>2</sup>	p-value	F
Dependent variable: PRE				.072	.066	$p < .0005^*$	10.515
Biospheric	.049	.989	$p = .323$				
Altruistic	.224	4.506	$p < .0005$				
Egoistic	.088	1.818	$p = .070$				
Dependent variable: UTL				.049	.042	$p < .0005^*$	6.990
Biospheric	-.125	-2.479	$p = .014$				
Altruistic	-.138	-2.736	$p = .006$				
Egoistic	.120	2.430	$p = .016$				
Dependent variable: REC				.109	.098	$p < .0005^*$	9.804
Biospheric	.021	.427	$p = .670$				
Altruistic	.062	1.235	$p = .218$				
Egoistic	.020	.408	$p = .683$				
PRE	.257	5.072	$p < .0005$				
UTL	-.098	-1.965	$p = .050$				
Dependent variable: PM				.101	.089	$p < .0005^*$	9.000
Biospheric	.015	.294	$p = .769$				
Altruistic	-.026	-.510	$p = .610$				
Egoistic	-.066	-1.352	$p = .177$				
PRE	.039	.773	$p = .440$				
UTL	-.294	-5.834	$p < .0005$				
Dependent variable: BP				.143	.132	$p < .0005^*$	13.382
Biospheric	-.047	-.964	$p = .336$				
Altruistic	.164	3.319	$p = .001$				
Egoistic	.031	.649	$p = .516$				
PRE	.318	6.397	$p < .0005$				
UTL	.139	2.819	$p = .005$				
Dependent variable: ACT				.233	.223	$p < .0005^*$	24.382
Biospheric	.002	.039	$p = .969$				
Altruistic	.111	2.377	$p = .018$				
Egoistic	-.080	-1.781	$p = .076$				
PRE	.452	9.598	$p < .0005$				
UTL	.013	.289	$p = .289$				
Dependent variable: PEBs				.280	.271	$p < .0005^*$	31.208
Biospheric	-.001	-.029	$p = .977$				
Altruistic	.122	2.693	$p = .007$				
Egoistic	-.039	-.898	$p = .370$				
PRE	.428	9.383	$p < .0005$				
UTL	-.140	-3.114	$p = .002$				

Note: correlation is significant at  $p \leq .05$ , \* = p-value is statistically significant.

PRE = preservation, UTL = utilization, PM = pollution management, REC = recycling, BP = biodiversity protection, ACT = environmental activism, PEBs = pro-environmental behaviors.

attitude could likely mediate pollution management behavior. Promoting either of these predictors alone may not yield better results than a combined model.

To examine whether the age of respondents and SDR affected the model, a second analysis was performed using a hierarchical multiple regression (question 6). In this regard, age and composite scores of SDR were entered in block 1 while the predictor variables (PRE, UTL, biospheric, altruistic, and egoistic values) were entered in block 2. After controlling for age of respondents and the SDR, model 2 that included SDR, age, personal values (biospheric, altruistic, and egoistic values), and the 2-MEV (PRE, UTL) indicated that only three variables made significant unique contributions to the model. In order of their importance, these variables are PRE (Beta = .410,  $p < .0005$ ), altruistic value (Beta = .115,  $p = .011$ ), and UTL (Beta = -.118,  $p = .014$ ). Neither age (Beta = .045,  $p = .318$ ) of respondents nor SDR (Beta = -.049,  $p = .289$ ) made a statistically significant contribution to the model. Likewise, the biospheric (Beta = -.004,  $p = .925$ ) and the egoistic (Beta = -.036,  $p = .418$ ) values did not make a meaningful prediction to the model confirming that the original analysis was still valid and appropriate even after controlling for possible confounding variables of age and SDR.

In addition, bivariate analyses between SDR and the predictor variables indicated weak negative correlations between SDR and PRE ( $r = -.232$ ,  $p < .0005$ ), PEB ( $r = -.213$ ,  $p < .0005$ ) as well as altruistic value ( $r = -.135$ ,  $p = .006$ ). On the other hand, there were weak positive correlations between SDR and UTL ( $r = .366$ ,  $p < .0005$ ) as well as the egoistic value ( $r = .106$ ,  $p = .032$ ). These results suggest that SDR did not pose a considerable effect on the self-reported responses expressed in personal values, environmental attitudes, and PEBs of the present sample as all its Pearson correlations with variables of interest was  $r < \pm .80$  (Pallant, 2016).

## 5. Discussion

The primary purpose of this study was to examine the predictive power of personal values and environmental attitudes on pro-environmental behaviors amongst secondary school students. Under this broad aim, the study investigated the applicability of the 2-MEV scale in predicting self-reported pro-environmental behaviors and whether combining the 2-MEV with personal values explains more variance of self-reported PEBs. The combined effect of the 2-MEV and personal values (biospheric, altruistic, and egoistic) were also analyzed and compared on a demographic basis. The findings confirmed the two-factor structure of the higher-order uncorrelated factors (PRE and UTL) of the 2-MEV. This finding is aligned with other earlier researches (e.g., Bogner and Wiseman, 2004, 2006; Cuadrado et al., 2021; Wiseman and Bogner, 2003) and inconsistent with a few others particularly on the correlation between PRE and UTL (e.g., Liu and Chen, 2019; Milfont and Duckitt's, 2004, 2006). The latter authors found that PRE and UTL were strongly correlated factors as opposed to Bogner and Wiseman's findings as well as our study findings. Additionally, Milfont and Duckitt argued that the correlation variation could be explained by item wording between the PRE and UTL factors.

To test if item wording has impact on the correlation between PRE and UTL, items within the UTL were reverse coded to maintain the same wording direction as in the PRE. Yet, the factor structure and strength of the correlation remained unaltered. Instead, the correlation direction changed from  $r = -.196$  to  $r = +.196$  suggesting that item wording could only alter the direction but not the strength or the structure of the model. Meanwhile, our study findings corroborate with those reported in Boeve-de Pauw and Van Petegem's (2013) study who also observed marginal correlations between PRE and UTL in three countries; Flanders ( $r = .110$ ), Vietnam ( $r = .034$ ), and Guatemala ( $r = .125$ ).

Further exploration was conducted in the existing literature to examine whether the relationship between PRE and UTL can be explained by demographic variables such as age cohort. This was motivated by the fact that Milfont and Duckitt (2004) used a sample that

mainly focused on adults (16–48 years; mean age = 20) whereas the earlier formulation of the model based on children (9–12 years) and adolescents (Johnson and Manoli, 2011; Wiseman and Bogner, 2003). However, a German sample involving pre-service and in-service teachers (mean age = 44.17) by Oerke and Bogner (2010) confirmed the same structure with uncorrelated factors ( $r = -.20$ ). Equally, Castéra et al. (2018) confirmed the same structure from a sample of 10651 teachers in 30 countries. On the contrary and, in support of Milfont and Duckitt, the findings from Liu and Chen (2019) in China originated from children (9–12 years) of the same age as the original authors. Yet, the correlation of PRE and UTL still indicated mixed findings. Therefore, age cohort does not seem to influence either the factor structure of the 2-MEV model or the correlation pattern of the PRE and UTL higher-order factors of the same model in measuring EA.

Apart from the above, Bogner et al. (2015) found a negative correlation between age and the PRE. On the contrary, the present study found a positive weak significant correlation between age and PRE ( $r = .315$ ,  $p < .0005$ ) as well as a positive correlation with social altruistic value ( $r = .171$ ,  $p = .001$ ) and a negative correlation with UTL ( $r = -.242$ ,  $p < .0005$ ). Conversely, there was a nonsignificant correlation between age and other nonsignificant predictors of self-reported PEBs; the biospheric ( $r = .077$ ,  $p = .122$ ) and egoistic values ( $r = .072$ ,  $p = .146$ ). The results suggest that age as a confounding variable could have a weak moderating role over environmental behavior by indirectly activating significant predictors of PEBs that in turn may affect the behavioral choices of an individual ( $r = .227$ ,  $p < .0005$ ). The effect of age on the development of EA and behavior has been explained by earlier researchers (e.g., Otto et al., 2019). This may explain the slight variation among the studied participants. A more detailed discussion has as well been documented (See Wiernik et al., 2013). Consequently, the relationship between age and environmentalism is still an interesting topic in environmental research (Casaló and Escario, 2018).

Furthermore, previous research has suggested that response patterns of self-reported questionnaires in EA or behavior can be influenced by SDR resulting in inflated responses (Oerke and Bogner, 2013; Wiseman and Bogner, 2003). This necessitated the need to administer an SDR scale together with self-reported survey questionnaires. The results indicated that SDR plays a limited influence over predictors of self-reported PEBs ( $r = -.213$ ,  $p < .0005$ ) and has a marginal negative correlation with age ( $r = -.137$ ,  $p = .006$ ). These results are in line with some other previous studies (e.g., Kormos and Gifford, 2014; Milfont, 2008; Vesely and Klöckner, 2020) proposing that SDR may not pose a serious response bias on self-reported surveys in the measurement of environmental attitudes and behaviors. Conversely, these results contradict Stöber's (2001) study that revealed a considerable correlation between SDR and the oldest individuals (18–89 of age). Therefore, it seems reasonable to argue that the effect of SDR should not be completely neglected in self-reported surveys. Instead, the actual measurement of behavior could rather provide alternative explanations (Riepe et al., 2021).

Additionally, the present study revealed that boys reported significantly higher scores than girls on PRE, general PEBs, and altruistic values whereas girls reported relatively higher UTL and egoistic value than boys. This proposes that boys seem to be more ecologically sensitive than girls. While this result contradicts the widely documented evidence regarding gender and environmentalism (e.g., Briscoe et al., 2019; Desrochers et al., 2019; Xu et al., 2021), Xiao and Hong (2018) also found closely related findings in China whereas Vicente-Molina et al. (2018) observed that men were likely to be more ecologically sensitive towards their behavioral change than women among the University students in Spain. Nevertheless, the contexts and the nature of the sample studied are slightly different in each of these studies. More research on gender variation in environmentalism may still add a considerable contribution on this debate.

Given the above, gender variation in environmentalism has been explained from different perspectives. For example, one possible explanation originates from 'nature ecofeminists maintaining that there is a



useful biological and psychological association between women and the environment (Stephens et al., 2010). They argue that women can be closer to the environment than men due to their domestic roles as mothers and taking care of the family and the environment at large while men are more associated with the mastering of nature. Likewise, based on socialization theory, it was expected that girls would be more altruistic and therefore more environmentally concerned than boys (Eagerly, 2009; Xu et al., 2021). On the contrary, our sample was limited to domestic roles for girls as they equally spend much of their time at school as boys do. Therefore, the variation in domestic gender roles may not be a mediating factor in our study.

Furthermore, a study conducted by Chan et al. (2019) in 32 countries found cross-cultural gender variations in environmental concerns. Chan and colleagues recommended the need to extend the measurement of gender difference from the individual-level variables to societal-level factors. Variations among individuals could also be an attribute of socio-economic variation (Castéra et al., 2018). Thus, one variable may not be sufficient to explain differences of people in their demographic features such as gender. Longitudinal and experimental studies could be useful to add more evidence regarding gender and environmental concerns particularly in under researched areas such as in Sub-Saharan Africa, including Tanzania.

A general evaluation of the predicting model revealed that social altruistic value made the largest unique prediction of both the PRE and UTL. While PRE was only significantly predicted by altruistic value, the UTL was explained considerably by all of the three personal values with social altruistic emerging as a unique predictor (Table 2). Besides, the PRE factor was the predictor with the largest unique contribution to the prediction of recycling ( $\beta = .257, p < .0005$ ), biodiversity protection ( $\beta = .318, p < .0005$ ), environmental activism ( $\beta = .452, p < .0005$ ), and the overall self-reported PEBs ( $\beta = .428, p < .0005$ ). These results suggest that for every 1-unit increase of SD in the PRE there will be an increase of .257 units of SD in recycling behavior, .318 SD units increase in biodiversity protection, .452 SD units increase in environmental activism, and .428 SD units increase in overall self-reported PEBs. The overall model also explained the largest explained variance (28%) in self-reported PEBs over other minor models. On the other hand, pollution management behavior was explained by the UTL (Beta =  $-.294, p < .0005$ ) implying that for every single unit of SD that decreases in the UTL there will be a .294 units of SD increase in pollution management behavior.

Generally, the present study results are in line with other earlier research (Liu and Chen, 2019; Milfont & Duckitt, 2004; Opel and Bogner, 2020) in reemphasizing the need to integrate the 2-MEV in understanding environmental attitudes and behaviors. Additionally, the present results provide support for combining personal values with the 2-MEV to explain PEBs because a combined model provides more explained variance than a single theoretical framework. Although Liu and Chen found support for the 2-MEV over the NEP in predicting behaviors, their study expressed relatively lower explained variance (21.7%) than our study findings (28%) suggesting that combining personal values and the 2-MEV could be more appropriate in predicting behaviors.

Notably, a study conducted by Boeve-de Pauw and Van Petegem (2013) in three countries, revealed mixed findings. Specifically, PRE was significant in predicting PEB in all the three countries (Vietnam  $\beta = .730$ , Guatemala  $\beta = .610$ , and Flanders  $\beta = .422$ ) whereas UTL had no significant prediction of PEB in Flanders, it was significant in Guatemala ( $\beta = .23$ ), and Vietnam ( $\beta = .043$ ). To this end, our findings indicate that PRE provides stronger prediction of environmental activism ( $\beta = .452$ ) and overall PEBs ( $\beta = .428$ ) than Boeve-de Pauw and Van Petegem's findings in Flanders. In the same vein, UTL provides stronger prediction of overall PEBs ( $\beta = -.140$ ) in our findings than the same UTL reported in Vietnam and Guatemala. Consistently, our study findings indicate more explanatory power of UTL on recycling behavior than that of Cuadrado et al. (2021) who studied recycling and energy saving behaviors in Spain. However, one of the recent studies in Hungary conducted by Mónus

(2021) among secondary schools' and university students ( $N = 338$ ) revealed relatively higher explained variance of the 2-MEV (PRE-38.1%, UTL-2.5% and eco-crisis-4.8%) than our study findings.

While the PRE seems to be consistent in predicting PEB in different cultural contexts, the level of its predictive power remains open for discussion as it varies across populations. On the contrary, the predictive power of UTL on PEB provides mixed findings. This provides another evidence for the need of cross-cultural validation studies. To our knowledge, there is no study that attempted to compare the predictive power of a combined model of personal values and the 2-MEV. Our study findings provide promising direction regarding the proposed model. However, one would ask whether the same strength of prediction revealed in this study will remain consistent or vary in different cultural contexts? Indeed, this is an important area of future research.

Finally, our findings provide support for the unique role of altruistic value in understanding both the ecological attitudes and self-reported PEBs in agreement with previous research (e.g., de Groot & Thøgersen, 2019; Xu et al., 2021; Schwartz, 1977). However, our study did not find support for biospheric value in explaining ecological attitudes and self-reported PEBs contrary to some other earlier studies (e.g., Tamar et al., 2020; Stern, 2000). Likewise, the egoistic value was positively correlated with the UTL (Beta =  $.120, p = .016$ ) but did not make a considerable prediction of other outcome variables. The study results, therefore, support what Stern et al. (1998) have pointed by stating that "environmental concern and action is only one arena of behavior that values might affect".

## 6. Limitations of the present study

Having discussed the study results, it is worth mentioning some of the limitations. First, the study relied on self-reported personal values, attitudes, and PEBs that may not necessarily reflect individuals' actual practices as Lange and Dewitte (2019) have explained in their review. Notwithstanding, in a meta-analytic review conducted by Kormos and Gifford (2014), they found a positive association and large effect size ( $r = .46$ ) between self-reported PEBs and objective environmental behaviors suggesting that self-reported responses provide considerable results.

Second, the sample we used is representative of secondary school students that may not necessarily be a representative sample of other remaining populations in the country. Therefore, a generalization of the study findings could be done with caution. Future research may focus on a large and more generalizable sample that includes other community members with wide representativeness of children, adolescents, and adults. Yet, the present study provides fundamental insights as to the first attempt to test the used model from the Tanzanian context upon which future research may develop significant outcomes.

Third, the present study measured self-reported PEBs without including behavioral intentions and identities that have been described as more robust than attitudes in explaining PEBs (Ajzen, 1991; Milfont et al., 2020). Likewise, other social precursors of behaviors such as norms and beliefs as described in the value-belief-norm (VBN) theory (Stern et al., 1999; Stern, 2000) were not measured together with other variables in the present study. Thus, information regarding personal, moral, and social norms remains broadly underrepresented in our study. Nevertheless, values are the basis for individuals to decide on their pro-environmental actions (Winkler-Schor et al., 2020) and values have been regarded as the relevant factors to start with when one is interested in changing environmental behaviors (de Groot & Thøgersen, 2019). Future research may benefit from examining the moderating roles of other determinants such as norms and how they interact with the 2-MEV in explaining PEBs.

## 7. Conclusions and recommendations

Based on the results of the present study, the following conclusions can be deduced; first, our model that includes attitudinal factors of

personal values (biospheric, altruistic, and egoistic) and the Theory of Ecological Attitude (preservation and utilization) suggest that a combined model of personal values and the 2-MEV provides more predictive power than either of the measured independent variables. However, PRE seems to be consistent in positive prediction of PEBs across cultures while the UTL provides mixed findings. Our study findings suggest that enhancing PRE and altruism is important to promote PEBs while the lowering of UTL could be useful in mediating the management of environmental pollution among secondary school students. This information could be useful to enhance social altruistic values and the preservation attitudes as potential mediators of pro-environmental behaviors of recycling, biodiversity protection, environmental activism, and general environmental behaviors.

Second, the present study confirms the two-factor structure of the 2-MEV denoting that environmental attitudes can be measured using two uncorrelated higher-order factors of Preservation and Utilization of ecological/environmental resources as originally proposed (Bogner and Wiseman, 2006; Wiseman and Bogner, 2003). As such, this study provides a novel contribution regarding the cross-cultural validity of combining personal values and the 2-MEV to explain PEBs particularly in the Eastern African region where there is a dearth of literature on environmental psychology regarding the use of the proposed theoretical framework.

Third, the common assertion holding that women/girls tend to be prosocial and more ecological than boys/men (e.g., Bouchard et al., 2020; Eagerly, 2009; Van der Graaff, Carlo, Crocetti, Koot and Branje, 2018) seems to have less empirical support in the present study. Thus, boys reported significantly higher scores on both preservation and social altruistic whereas girls reported higher exploitative attitudes than boys by scoring higher on the utilization than their counterparts. Besides, there was no gender difference on biospheric and egoistic values both of which were not significant predictors of self-reported PEBs in the present study (Table 1). This result provides an opportunity for reexamining the mediating factors of gender differences in environmental attitudes and behaviors in the African context. Thus, our study provides useful data to inform school managers and decision-makers about the need to encourage girls to have more environmental engagement.

Finally, self-reported responses are weakly correlated with SDR indicating that the scales used for measuring EA, personal values, and self-reported PEBs are less likely influenced by social desirability responding. This is also true for a demographic variable of age both of which failed to provide a considerable moderating role over other predictor variables under statistical control. Reasonably, this provides useful information required for survey research in future studies. Nonetheless, the effect of the confounding variables such as SDR and the age of respondents should not be completely overlooked in self-reported surveys.

Broadly speaking, the study results provide an opportunity for policymakers, researchers, and environmental educators on the key areas that need subsequent attention in activating behavioral types regarding recycling, pollution management, environmental activism, and biodiversity protection behaviors. Remarkably, our findings provide empirical support for the need to reemphasize the moderating role of personal values and the 2-MEV in shaping pro-environmental behaviors amongst secondary school students in Tanzania.

## Declarations

### Author contribution statement

Josephat Paul Nkaizirwa: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Florien Nsanganwimana & Catherine Musalagani Aurah: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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## Data availability statement

Data will be made available on request.

## Declaration of interests statement

The authors declare no conflict of interest.

## Additional information

Supplementary content related to this article has been published online at <https://doi.org/10.1016/j.heliyon.2022.e09064>.

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