Willingness to engage in energy conservation and CO_2 emissions reduction: An empirical investigation

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Abstract. Africa's response to climate change has largely been focused on adaptation rather than mitigation. The reason for this is based on the fact that the continent contributes very little to global CO_2 emission. Again, mitigation policies like carbon tax as being practised in developed countries may be costly and difficult to implement in a continent where most economies are fragile. Using behavioural change as an adaptation approach, we examined the opinion of Ibadan city residents towards energy conservation and CO_2 emissions reduction. A total of 822 respondents were sampled across the three residential neighbourhoods of the city. Results from the study showed that female and male respondents differed in their opinion towards energy conservation. However, the female respondents tended to record higher mean scores on majority of the items used to capture energy conservation behaviour than their male counterparts. Also, those with higher level of education seemed to be more conscious of the environmental consequences arising from energy use at home than those with lower educational background. However, very slight variations were recorded in the mean value score across the different age groups, those respondents above 50 years scored a bit higher than other age groups.

1. Introduction

The rapid change in global climate experienced over the last couple of decades has been largely attributed to human activities [1].Behavioural change at household level has the potential of reducing carbon dioxide emissions and could impact positively on national CO_2 emissions reduction if well designed interventions are put in place [2] .Policy makers are now realizing that the dominant physical, technical and economic models of energy use are incomplete, hence they are now looking unto behavioural scientists for a better understanding of the dynamics involved in energy use and how they can proffer policies and programmes that are more effective [3];[4]. Majority of the policy on climate change has been focused on long term options such as inducing new low –carbon energy technologies and the creation of cap- and-trade regimes for emissions [5].However, the authors noted that behavioural oriented policies and interventions could act as short-term option for reduction of CO_2 emissions. Harris et al. [6] have argued that one major reason that could be adduced to the ineffectiveness in energy saving policies has been a focus on energy efficiency technologies instead of energy conservation. Similarly, Lutzenhiser [7] observed that energy pundits have focused mainly on energy efficient technologies and that this is a great mistake. The author noted that human behaviour should have be analysed because the success or failure of any energy efficiency technology to a large extent will be influenced by human behaviour. Energy conservation involves behavioural change and

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consciousness in energy use by consumers. In Nigeria, the demand for energy has increased drastically without a corresponding supply. Hence, energy conservation and rationalization is a necessary step that needs to be adopted in order to address this disconnect. Even though energy conservation and efficiency may not be regarded as resource per se, its adoption in a country like Nigeria can significantly help in reducing the supply challenge [8]. It is in recognition of this that the National Centre for Energy Efficiency and Conservation was established by the Federal Government [9].For a developing country like Nigeria where majority of the households are living below the poverty line, investments in to energy efficient technologies as a policy towards reduction in energy use and CO_2 emissions may be difficult to achieve for now. Hence, behavioural approach which may not require much investment may be the right path to toe in reduction of energy use by households. This study examines the opinion of households in Ibadan city, Nigeria on energy conservation and CO_2 emissions reduction measures and their willingness to engage in them.

2. Attitude towards energy saving

Changes in behaviour can contribute in reducing the magnitude of climate change. Also, psychological factors acting in conjunction with other influences will determine the level of acceptance and implementation of public policies on reducing climate change and adoption of low carbon technologies [2**].** Study on energy use behaviour is somewhat difficult to handle because people most times do not make payment before use, rather they pay afterwards for the services rendered by energy utilized by devices. In this regard, if people refuse to make a conscious decision on consuming energy, they cannot be expected to make a conscious decision to save it [10]. It has been observed that energy conscious attitudes do not necessarily translate to energy conservation behaviour. For example, Verhallen and Raaij [11] noted that attitudes may lead to good intentions but that certain factors such as social norms, lack of knowledge, behavioural change and some institutional impediments may act as a barrier in putting the intention in to actual behaviour. Energy saving consciousness is defined as interest someone has in energy use and environmental issues, opinion on energy consumption, energy saving efforts, recognition of energy conservation techniques and interest in information on energy saving [12]. Despite the fact that energy saving is majorly viewed as an environmental issue, other personal motivation factors such as saving money and the desire to decrease dependence from energy producing countries could influence energy conservation behaviour of people [13].

3. Methodology

Using a structured questionnaire, 822 households were randomly chosen across the three residential neighbourhoods (low, medium high) of Ibadan city. The choice of the three residential areas was based on the fact that samples drawn from them are true representation of the entire population as people from all social class reside in these residential areas. The questionnaire comprised of two sections. The questions in section A focused on the demographic characteristics of the respondents while section B consisted of six (6) items measured on a five point likert scale ranging from 1 strongly disagree to 5 strongly agree. The items were used in measuring the level of willingness to engage in energy conservation and CO_2 emissions reduction. These items were adapted from scales used by past studies [14]; [15].The data was keyed in to the SPSS software and a discriminant analysis was conducted to see how respondents were distinguished based on these items. The rationale for the use of discriminant analysis is borne out of the fact that the study involves test of group mean differences among social groups such as gender, educational background and age group. The group mean here, shows the level to which the respondents agreed or disagreed on each of the six statements used in capturing energy conservation and CO_2 emissions reduction. Discriminant analysis is an appropriate statistical technique for testing for equality of group means and building a predictive model of group membership based on a set of observed discriminating variable [16].It is a linear combination of two

or more discriminating variables (discriminant function) that discriminate best between groups. The relationship is expressed as the ratio of between-group to within-group variances. The linear combination is derived from the following equation:

$$Z = W_1X_1+W_2X_2+W_3X_3..... +W_nX_n$$

Where Z = the discriminant score
W = the discriminant weights (discriminant coefficients)
X = the independent discriminating variables

In order to address the aim of this study, some hypotheses were posed. The hypotheses are listed as below:

Hypothesis 1a:
There are no significant differences among male and female on willingness to engage in energy conservation and CO_2 emissions reductions at home.

Hypothesis 1b:
There are no significant differences among people with different ages on energy conservation and CO_2 emissions reductions at home.

Hypothesis 1c:
There are no significant differences among people with different educational qualification on energy conservation and CO_2 emissions reduction.

4. Results and discussion

The description of the six items used in measuring the willingness of households to engage in energy conservation and CO_2 reductions are presented below:

- If I practice energy saving, it will help in solving the weather problems arising from global warming (EC1)
- It is necessary for households to engage in energy saving in order to reduce CO_2 emissions to the atmosphere (EC2)
- I feel the necessity of saving energy in my daily life (EC3)
- I am interested in issues relating to the environment (EC4)
- I make sure that all lights are switched off whenever I leave the house (EC5)
- I think my household consumes very little energy (EC6)

The summary of the results presented in table 1 shows that items EC2 had the highest total mean score value of 3.3909 followed by EC6 (3.3477) and EC3 (3.0641). What this suggests therefore is that the respondents agreed that energy conservation could help in reduction of CO_2 emissions (EC2), that the quantity of energy they consume at home is very little (EC6) and feel obliged to engage in energy conservation in their daily lives (EC3). In contrast, the total mean value for the other two items ECI and EC5 were low, meaning that the respondents disagreed that energy conservation at home will help in solving the weather problems arising from global warming (EC1). Also, energy conservation behaviour of the respondents in terms of switching off lights whenever they are not at home could be said to be very poor based on the low total mean value recorded on item EC5. What this suggests therefore, is that most of the respondents do not switch off their lights while leaving their homes. This is one of the major challenges the country is currently facing with respect to energy conservation, most people do not take the issue as something important. Looking at the items that differentiate the opinion of male and female respondents on energy conservation and CO_2 emissions reduction, four out of the six items were significant enough. The following are the items and their values: EC2 ($\Lambda = 0.985$, $F = 12.444$, $P< 0.05$), EC3 ($\Lambda = 0.991$, $F = 6.983$, $P <0.05$), EC5 ($\Lambda = 0.992$, $F = 6.884$, $P < 0.05$) EC6 ($\Lambda = 0.990$, $F = 7.913$, $P <0.05$) . Based on the group mean values, female respondents scored higher than male respondents in items EC2, EC3 and EC6. It could therefore be said, that female respondents had more urge at engaging in energy conservation than the men and were also more concerned about the

environmental consequences arising from energy. However, male respondents recorded higher mean value than females for item EC6 which also shows their level of effort in conserving energy. Thus, hypothesis 1a is rejected.

Table 1 Results summary for willingness to engage in energy conservation based on gender category.

ITEM Code	Total Means (Std. dev)	Groups Mean (Std.dev)		Wilks' Lambda (Λ)	F	Sig.
		Male	Female			
EC1	2.4377 (1.73760)	2.4689 (1.34455)	2.4136 (1.99057)	1.000	0.202	.653
EC2	3.3909 (1.46274)	3.1864 (1.29029)	3.5492 (1.56661)	0.985	12.444	.000
EC3	3.0641 (1.28268)	2.9294 (1.25189)	3.1685 (1.29779)	0.991	6.983	.008
EC4	2.5845 (1.96040)	2.6102 (2.51466)	2.5646 (1.38945)	1.000	0.108	.743
EC5	2.4180 (1.43471)	2.2684 (1.37306)	2.5339 (1.47175)	0.992	6.884	.009
EC6	3.3477 (1.62007)	3.1667 (1.62764)	3.4880 (1.60193)	0.990	7.913	.005

For group mean values based on educational category, results in table 2 show that only two items EC6 ($\Lambda = 0.976$, $F=7.799$, $P < 0.05$) and EC4 ($\Lambda =0.990$, $F = 3.167$, $P <0.05$) were significant enough in differentiating the opinion of the respondents. Therefore, hypothesis 1b is rejected .In other words, the respondents differed in their opinion. However, no significant differences exist in the respondents opinion on EC1 ($\Lambda =1.000$, $F = 0.019$, $P >0.05$), EC2 ($\Lambda = 0.997$, $F = 0.903$, $P >0.05$), EC3 ($\Lambda = 0.999$, $F = 0.333$, $P> 0.05$) and EC5 ($\Lambda = 0.996$, $F = 1.116$, $P >0.05$). Looking at the group mean value of the items that differentiate the opinion of respondents on energy conservation and CO_2 emissions reduction, results reveal that those respondents with higher level of education (post-secondary) tended to be more interested in issues relating to the environment than those with primary and secondary education. In contrast, those with primary education scored higher in item EC6, which suggests that they were more inclined to the view that their households consume very little energy.

Table 2 Results summary for willingness to engage in energy conservation based on educational group category.

ITEM	Total means (Std. dev)	Groups Mean (Std.dev)			Wilks' Lambda	F	Sig.
		Primary	Secondary	Post - secondary			
EC1	2.4598 (1.82936)	2.4167 (1.44338)	2.4301 (1.27175)	2.4660 (1.91989)	1.000	0.019	.982
EC2	3.3622 (1.50744)	3.1667 (1.33712)	3.5484 (1.16578)	3.3340 (1.56273)	0.997	0.903	.406
EC3	3.0283 (1.28783)	3.0000 (1.12815)	3.1290 (1.13469)	3.0113 (1.31728)	0.999	0.333	.717
EC4	2.6583 (2.09357)	2.4833 (1.24011)	2.5917 (1.37887)	3.1613 (4.33462)	0.990	3.167	**.043**
EC5	2.4063 (1.43479)	3.0000 (1.41421)	2.3441 (1.32283)	2.5717 (1.37887)	0.996	1.116	.328
EC6	3.2646 (1.61887)	3.8333 (1.26730)	3.8280 (1.47164)	3.1528 (1.62949)	0.976	7.799	**.000**

There are no significant differences among the different age category with respect to the six items used in measuring their perception on energy conservation and CO_2 emissions reduction. Hypothesis 1c is thus, accepted. However, some slight variations were recorded based on their group mean value report (Table 3). Those respondents above 50 years old recorded the highest mean value in five items EC1 (2.6923) , EC2 (3.7115) , EC3 (3.3077),EC4 (2.8269) and EC5 (2.7885) while those within the age bracket 41-50 year recorded the highest mean value in item EC6 (3.5110) .That those above 50 years scored a bit more in five items than other age categories suggests that the elderly were likely to be more concerned about the environmental consequences arising from energy use . Also, it shows that they tended to be more engaged in energy conservation measures than the younger ones. This finding lend support to earlier study by Clancy & Roehr [17] who in their study reported that the elderly people engaged in energy saving behaviour than the younger ones.

Table 3 Result summary for willingness to engage in energy conservation based on age group category.

ITEM	Total Mean (Std.dev)	Groups Mean (Std.dev)				Wilks' Lambda	F	Sig.
		18-30	31-40	41-50	>50			
EC1	2.4324 (1.79952)	2.5087 (1.42494)	2.3224 (1.30141)	2.4185 (2.42703)	2.6923 (1.43539)	0.997	0.735	.531
EC2	3.4129 (1.48347)	3.2428 (1.25708)	3.4720 (1.83770)	3.4185 (1.28166)	3.7115 (1.33338)	0.993	1.579	.193
EC3	3.0931 (1.27688)	3.1214 (1.30841)	3.0421 (1.24588)	3.0705 (1.29135)	3.3077 (1.24520)	0.997	0.655	.580
EC4	2.6502 (2.06710)	2.5549 (1.32667)	2.5561 (1.37862)	2.7709 (2.98824)	2.8269 (1.45145)	0.997	0.654	.581
EC5	2.4565 (1.43911)	2.4451 (1.43204)	2.3925 (1.43240)	2.4493 (1.38604)	2.7885 (1.69586)	0.995	1.069	.362
EC6	3.3739 (1.61660)	3.4451 (1.55655)	3.1402 (1.70857)	3.5110 (1.53819)	3.500 (1.69775)	0.990	2.265	.080

5. Conclusion

This paper has shown how different age, gender and educational groups differed in opinion towards energy conservation and CO_2 emissions based on six items that were used to assess their views. Findings revealed that significant differences exist between male and female respondents, females tended to be more committed towards energy conservation than their male counterpart. Also, those respondents with higher level of education were more concerned about the environmental consequences arising from energy use than those with lower level of education. However, Bachus and Van Ootegen [13] have cautioned against using this as basis for measuring real engagement in energy conservation. According to the authors, people may lend support to environmental issues but in reality make little effort towards energy conservation at home. In terms of age groups, not much variation was recorded in mean value among the different age groups. However, the elderly seem to have scored a little above other age groups in all the six items, which suggests that they are likely to be more conscious about issues relating to energy use and environment than the younger ones.

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