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Factors Affecting Intention to Use of Small-scale Renewable Energy Technologies in District Sialkot, Pakistan

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Abstract

Due to existing energy shortage; there is need to adopt renewable energy technologies. Low awareness and acceptance are major barriers to development of renewable energy technologies. The present study was conducted to explore factors affecting intention to use of small-scale renewable energy technologies in Pakistan at household level. This present study was conducted in Sialkot District and non-probability sampling technique was used to select the respondents. There were 160 respondents participated in this study. The theoretical model in this research was developed based on Technology Acceptance Model, Theory of Reasoned Action, and Innovation Diffusion Theory by Rogers and Theory of Planned Behavior. Major findings of this study highlighted that socio-economic factors, facilitating conditions perceived ease of use, perceived usefulness, knowledge, persuasion, and subjective norms are significant determinants of intention to use small-scale renewable energy technologies. The study recommended that government and other stakeholders should use strategies to create awareness and sensitized the people about benefits of adopting small-scale renewable energy technologies and setting up awareness centers at local and national level for encouraging people to adopt small scale renewable energy technologies.

Keywords: Intention, Renewable energy technology, Technology Acceptance Model

Introduction

Energy is a backbone of human actions. The accomplishment of human civilization has been accomplished through the progressively effective and extensive output of different forms of energy to lengthen human capabilities and creativity (Asif, 2011). Over the last thirty years, the use of power had grown especially in developing, developed and under developing countries. The storage of petroleum has reduced in up to date years. OPEC (organization of Petroleum Exporting international locations) estimated the storage of oil shall be used out the long run of century, In addition, the globe warming erode constantly. Make excellent use of Renewable energies is an urgent dilemma (Feng, 2012). Fuel from fossil led economic growth, through its emission of CO_2 into atmosphere, is regarded as a major force behind global warming. Increased concern related to energy security suggests that in the future energy will be produced from renewable energy resources. In addition, different academics and institutions from the globe have started to envisage renewable energy determined future world in the mission for a sustainable energy (Stern 2006; IPCC, 2007).Adoption of renewable energy technologies is vital part to mitigate climate change and to promote social and sustainable development (SAIBU, 2016). Pakistan is situated on such a geographical region where potential for all renewable energy resource exists for example wind, solar, biogas and hydel. By employing different type of technologies more than 80 million ton per

annum production of biomass has a big potential to generate enough bio energy. In addition, available dung from 72 million animals can produce substantial biogas to generate electricity. Fortunately, Pakistan is also gifted with solar isolation of 5.5 Wh m^{-2} d^{-1} and speed of wind 5-7 Wh m s^{-1} that persisted in the coastal areas of Sindh. Similarly, Province of Baluchistan has approximately 20, 000 MW wind power potential (Ghafoor et al., 2016). Pakistan has 4 major source of renewable energy. These are biomass, solar, wind and hydro, in addition, these resources can provide potential solution to the current energy crises in Pakistan (Shahbaz et al., 2012). The existing gap between supply and demand of electricity in Pakistan is around about 5000-8000 MW with a steady increase of 6% to 8 % annually. Hence, more renewable energy resources are needed to overcome the current issue (Raheem et al., 2016). Pakistan depends on fossil fuels to meet its energy supplies and the state is spending more than 11 billion dollars on import of petroleum products every year. Renewable energy resources are very important in Pakistan's perspective as there is an acute shortage of fossil fuels. Considering the potential of renewable energy in the country, the Government of Pakistan is doing its utmost to explore and promote renewable energies and energy efficiency strategy and encouraging domestic and foreign investment in this lucrative sector (Riphah Institute of Public Policy, 2013). Due to energy crises in Pakistan, there is urgency to introduce renewable energy technologies (Mirza et al., 2009). Pakistan needs to move forward on the adoption of renewable energy technologies in order to meet its energy needs for effective socio-economic development (Khan, 2009). As compare to traditional energy resources for example fossil, crop residues, latest renewable energy technologies are cleaner and efficient, there is a dire need to adopt renewable energy resources that may help in achieving sustainable development (He, 2014). To tackle with global challenges, there is dire need that existing energy system should undergo transformation from fossils to renewable energy resources and efficient energy technologies (Mirza et al., 2009). In Pakistan there is low awareness about small-scale renewable energy technologies among people. This study is conducted to understand which factors will influence people to adopting small-scale renewable energy technologies at household and commercial level. There is very little awareness about renewable energy resources until now. Media and governments are still negligent in this field to promote awareness to adopt small scale energy resources in the household. Literature reviewed in this regard revealed the fact that there is very little work done in this regard. Current study is conducted to dig out the factors affecting the household's intentions to use small-scale renewable energy resources. The study is restricted to the city of Rawalpindi and to household level.

Review of Literature

Many studies have used diffusion of innovation theory to explain the adoption of technological innovation. Diffusion is defined as "the procedure through which an innovation is communicated through different channels over time among members of a society" (Rogers, 2003). According to Rogers there are five stages in adoption process (knowledge, Persuasion, Decision, Implementation and Confirmation), 49 to 87 percentage of variance of the rate of the adoption is explained by means of these five stages (Rogers, 2003a).Theory of Reasoned Action proposed that behavior of an individual is determined through his attitude in the direction of the outcome of that behavior and by way of the opinions of others inside his social environment (Davis, 1989). Theory of Reasoned Action explains there are two determinants of an individual's intention; one is "attitude toward the behavior". The second determinant is social pressure that an individual perceived on his/her. This feature is called "Subjective norm" (Ajzen and Fishbein, 1977). Technology Acceptance Model is originally based on Theory of Reasoned Action asserts when a person have

always a specific reason to act (Venkatesh et al., 2003) this model explain various variable that effect user to adoption of a technology and these variable are Perceived Ease of Use and Perceived Usefulness that shapes attitude toward a technology. According to Technology Acceptance Model Perceived ease of use and 'perceived usefulness' will affect attitude 'toward usage' and 'intention to use' (Davis, 1989a).Theory of Planned Behavior explain that "attitude toward behavior, subjective norms, and perceived behavioral control shape an individual's behavioral intentions and behaviors" (Ajzen, 1991).

Research Model and hypothesis for the study

The research hopes to understand household's intention to use small-scale renewable energy. This study used research model developed based on Technology Acceptance model, Theory of Reasoned Action, Theory of planned behavior and diffusion of innovation theory with a variable named as Facilitating conditions. This model is developed from the above discussed theories and reviewing available literature. The construct which are used to describe model are explained below:

- **Perceived ease of Use**

It is defined as "the level to which an individual believes that new technology he will use would increase his/her performance of job" (Davis. 1989b).

- **Perceived Usefulness**

It is defined as "the degree to which a person believes that current technology under study will not be complex" (Davis, 1989c).

- **Facilitating conditions**

"These are conditions to which a person believes that current organizational structure will support the system of use" (Venkatesh et al., 2003a).

- **Socio- economic variables**

In this research age, education, gender, occupation and monthly family income were taken into consideration. Attitude are effected by different social and economic factors (Zhang and Prybutok, 2004)

- **Knowledge**

Knowledge about technology that how it works, perceived benefits and effects will affect people's acceptance and intention to use technology. Correlation between knowledge and acceptance to technology has been found (Achterberg, 2014; O'Garra et al., 2008)

- **Subjective norms**

It is defined as" a person's Perception about the particular behavior, which is affected by the decision of significant of others (e.g., Friend, Parents, colleagues"(Amjad and Wood, 2009).

- **Persuasion**

The individual is interested and gets more information about technology and make a decision either to adopt or reject technology/Product (Rogers, 1962a).

These theories have been studied, proved and applied by many scientists and experts, who stated that "Behavioral intention to use", can be used in predicting intention to use technology for future studies (Jacobsson, 1996). Research model is shown in Fig. 1

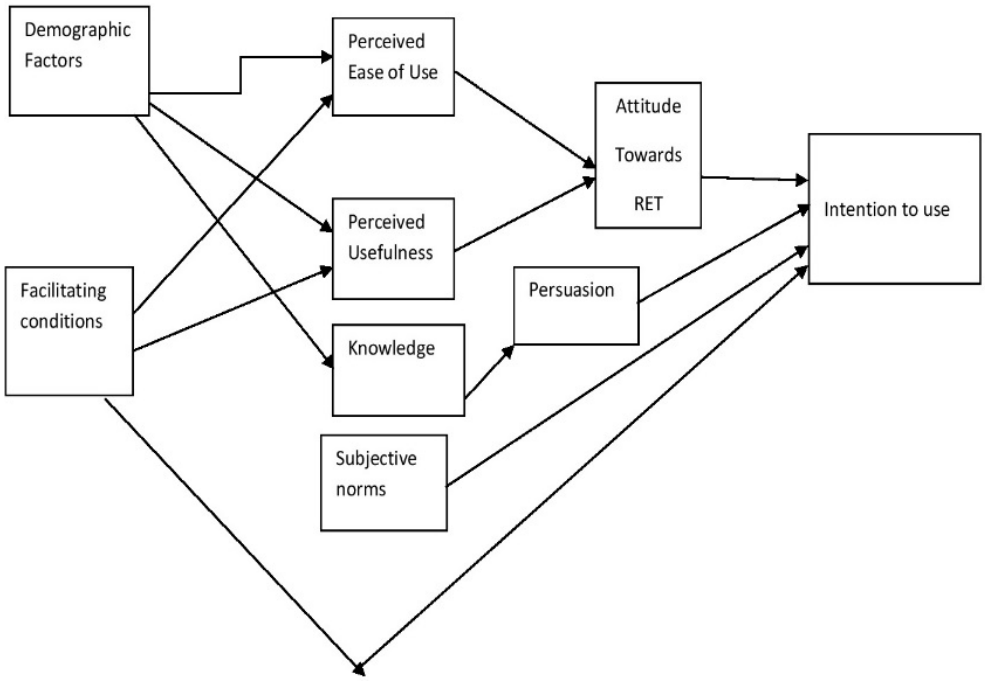

Figure 1.Proposed research model.

Hypothesis 1= Socio-economic factors have positive affect Perceived ease of use
Hypothesis 2=Socio-economic factors will affect the Perceived usefulness.
Hypothesis 3=Socio-economic factors will affect knowledge
Hypothesis 4=Facilitating conditions affect perceived ease of use
Hypothesis 5=Facilitating conditions affect intention to use.
Hypothesis 6=knowledge have positive effect on intention to use
Hypothesis 7=Perceived ease of use affect intention to use
Hypothesis 8= Perceived Usefulness affect intention to use
Hypothesis 9= knowledge has positive effect on persuasion.
Hypothesis10=Interest has positive effect on intention to use
Hypothesis 11=Perceived ease of use affect attitude toward RET
Hypothesis 12=Perceived usefulness affect attitude toward RET
Hypothesis 13=Attitude toward RET affect intention to use RET

Methodology

The present study was conduct in Sialkot city. Two urban areas were selected from the city. The researcher selected 160 respondents by using convenient sampling technique. To get a household's intention to use renewable energy technologies at household level, the researcher selected 80 household from each area. The researcher selected from each household, one individual ranging from age between 15 to 80 years among members of household. For data collection door to door approach was applied to get required sample. Finally, 160 individuals were interviewed using structured questionnaire including 80 individuals from each area.

All items that were used in questionnaire to measure variables were based on previous studies and on the basis of review of literature. Items that were used to measure perceived ease of use and perceived usefulness and intention to use RET were taken from (Davis, 1989). Items used for measuring facilitating conditions were taken from (Venkatesh et al., 2003). To measure variable knowledge, items were taken from (Achterberg et al., 2010; O'Garra et al., 2008). The data was analyzed through using SPSS. The linear regression was applied to test the hypothesis. Average variance extracted was applied to assess the reliability of variables used in the study.

Results and Discussion

Table 1: Socio-economic characteristic of the respondents

Gender	Frequency	Percentage
Male	40	25.0
Female	120	75.0
Age		0.0
15-30	25	15.6
31-45	80	50.0
46-60	40	25.0
61-75	15	9.4
Education		0.0
Primary	17	10.6
Secondary	14	8.8
Matric	25	15.6
Intermediate	35	21.9
Graduation	60	37.5
Master and above	8	5.0
Occupation		0.0
Private job	50	31.3
Own business	45	28.1
Government job	24	15.0
Agriculture	5	3.1
student	15	9.4
house wife	21	13.1
Monthly family income		0.0
10000-25000	45	28.1
26000-40000	55	34.4
41000-55000	30	18.8
56000-6000	18	11.3
61000 & Above	12	7.5

The results showed that majority of the respondents were male. Most of the respondents belong to age category of 31-45 years. The educational level of the most respondents was

graduation. Most of the respondents were doing private jobs. The monthly family income of the most of the respondents was 26000-4000.

Table2: Description of discriminate variables

Socio-economic Factors	Average variance extracted
Perceived ease of use	0.674
Perceived usefulness	0.534
Facilitating conditions	0.602
Knowledge	0.764
Persuasion	0.549
Subjective norms	0.538
Intention to use	1

To assess the reliability of variables, the average variance extracted was applied. If value is greater than o.5 its means all variables are reliable. Hence, table 2 shows that values of all variables are greater than 0.5. Here we concluded that all variable were reliable. Average variance extracted value was taken from discriminate validity test.

Table 3: Results of hypothesis testing

Hypothesis	**β**	**R^2**	**Results**
H_1	0.101	0.318	Significant
H_2	0.495	0.210	Significant
H_3	0.177	0.478	Significant
H_4	0..008	0.091	Not Significant
H_5	0.021	-0.163	Not significant
H_6	0.143	0.380	Significant
H_7	0.151	0.319	Significant
H_8	0.143	0.380	Significant
H_9	0.143	0.380	Significant
H_{10}	0.143	0.380	Significant
H_{11}	0.251	0.505	Significant
H_{12}	0.071	0.283	Significant
H_{13}	0.071	0.283	Significant

Regression analysis was performed to test hypothesis. A linear regression was done to estimate coefficients β. Table provides the results of hypothesis testing with values of Standardized Coefficient, R^2 . The findings of table revealed that findings of the results reject the hypothecs that facilitating conditions affect perceived ease of use. This result is consistent with the finding of (Tambotoh et al., 2015), who found that facilitating conditions does not affect intention to use. This result is consistent with (Mahadeo, 2009) who found that facilitating have no effect on intention to use. Results represents that attitude toward renewable technologies is most strong predictors for intention to use. Theory of Reasoned Action by (Ajzen and Fishbein, 1977a) which defined that attitude toward technology is determinant of user's intention to use technologies. Attitude of users is determined by user's perception of ease of use and usefulness. If users will find small scale renewable energy technologies simple, useful and easy to use then positive attitude will developed

toward intention to use small scale renewable energy technologies at household. These findings are also important for organization manufacturing renewable energy technologies in making small-scale renewable energy technologies from consumer perspective.

Socio-economic factors were found strong predictors of perceived ease of use and perceived usefulness. This result is consistent with (Islam, 2011) who found that socio-economic factors are most powerful determinants which user's perception ease of use and usefulness. The results showed that socio-economic factors determine user's knowledge of renewable technologies. The knowledge about renewable technology determines the intention of people to use renewable technologies. This result is consistent with the findings of (o'Garra et al., 2007) they found positive correlation between knowledge of technology and user's acceptance and intention to use technology. The results showed that persuasion is determined by used user's knowledge. Persuasion is strong predictor of people intention to use renewable technologies. According to theory Diffusion of innovation by (Rogress, 1965) who stated that persuasion is most significant factor in determining user's intention to use technology/innovation.

In addition, significant relationship between variables proved a new model that how people will adopt renewable energy technologies, which factors will influence them to use small scale renewable energy at household level. The model is presented in figure 2.

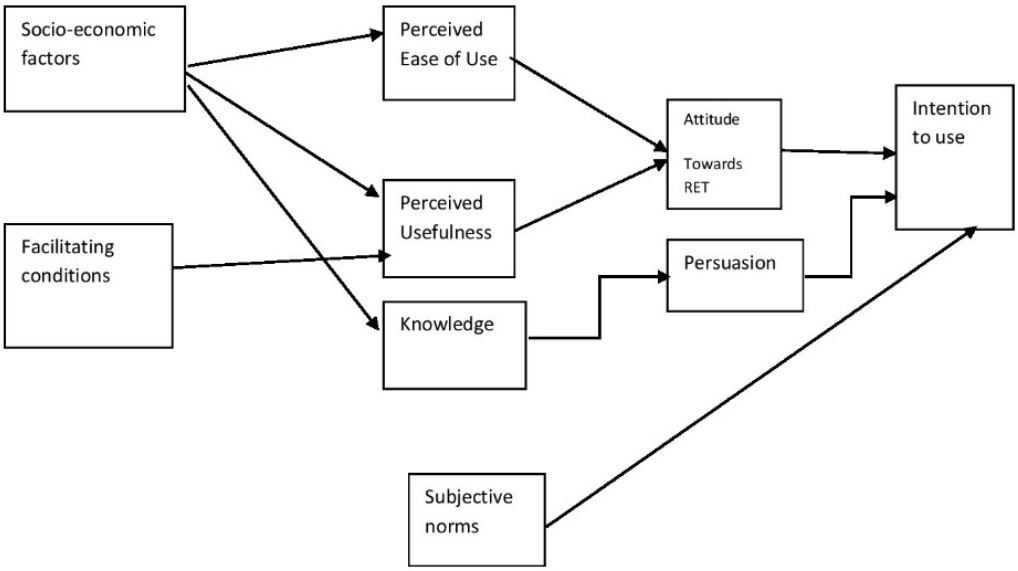

Figure 2. Model developed on the basis of findings

Conclusion

In this study we proposed a model to understand people and consumer's intention to use small scale renewable energy technologies. This model was developed based on Theory of Reasoned Action, Technology Acceptance Model, Diffusion of Innovation, theory of planned behavior and reviewing existing literature. We found that knowledge, persuasion, perceived ease of use, perceived usefulness, socio-economic factors and subjective norms are significant factors that affect intention to use small scale renewable energy technologies. The study was limited only to Rawalpindi city. The respondents were non user of small scale renewable energy technologies. These finding are important for stakeholders and organizations for investment decision in small

scale renewable energy technologies. The study recommended that government and other stakeholders should use strategies to create awareness and sensitize the people concerning benefits of adopting small-scale renewable energy technologies and setting up of awareness centers at local and national level for encouraging people to adopt small scale renewable energy technologies. These findings are fruitful for those organizations that are striving for promoting the small–scale renewable energy resources and also it would be a source of inspiration for the policy makers to devise the policies that may be beneficial for the households and society at large.

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