**An Empirical Study of the Reasons for Resistance to Green Innovations**

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**Abstract**

Energy efficient technologies contributed substantially to reducing greenhouse gases emissions and meeting rapid growth of energy demand. Lebanon is facing a serious problem in meeting the population’s excessive demand of electricity this fact urged consumers to lower electricity consumption and seriously rely on alternative energy sources. One of the mature technologies is the Solar Water Heater (SWH), which is considered a key element in shaping households’ demand for electricity and reducing electricity bills. In this paper, SWHs are considered as an environmental innovation. In the Lebanese market, SWH have received considerable attention through implementation of various national initiatives to boost the up-take of this type of micro-generation technology. Regardless of various initiatives, adoption of this technology still has low levels in several Lebanese regions. The aim of this study is to identify and analyze consumers’ resistance to green innovations; particularly studying solar water heaters. The paper relies on the Innovation Resistance Theory to better identify the resistance process that consumers pass through. Data were collected from 50 households in the North region of Lebanon through self-administered questionnaire. The results were analyzed using Cronbach’s alpha for reliability and linear regression analysis. The current study indicated that value and tradition factors had significant impact on consumers’ resistance to innovations. Finally, the author calls for research on resistance of other kinds of green innovations in order to validate the ability of Innovation Resistance theory to explain resistance of energy efficient technologies.

Keywords— Consumers, Innovation Resistance Theory, Green innovations, Solar water heaters.

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1. **Introduction**

The environmental challenges facing the globe became a serious concern of most countries, businesses, and consumers. On a micro level, households require great amount of energy to fulfil their everyday needs. In an overview of the major consumers of electricity, the residential sector had the highest percentage, 29.2%, and their electricity consumption divided in to heating 30%, followed by water heating 21% (International, 2009). Thus, households’ reliance on sustainable ways to heat water can lower demand for conventional energy sources and consequently preserves the environment.

The European Association of Development Agencies considered eco- innovation as a tool to reduce environmental harms and contribute to economic growth, and as a measure of relevant factors that introduce new ideas (or products) and reduce environmental burdens. Despite the marketing efforts to encourage consumers’ investments in environmental innovations, the interest in these efforts remains low in both developed and developing countries; this is referred to as resistance to eco-innovations. Electricity failures, increasing pollution, and low adoption of eco-innovative technologies were few of many reasons to perform this research.

Micro generations; are technologies that produce heat or power on a very small scale in comparison to typical fossil-fuelled power station. Although green innovations (such as hybrid or electric vehicles) and green detergents are available in market since many years, Bonini and Oppenheimer (2008) pointed out that they still lack an important share in consumer markets.

Since consumers’ reliance on conventional energy is negatively influencing the environment, a need has aroused to find a sustainable substitute for energy. SWH is a technology, which relies on solar radiations to heat water and is either for individual households or for utility buildings and firms. In a survey of 1850 Lebanese households, it was found that 80% were found to use electric heaters while only 13% used solar heaters to heat water (Shehadeh, 2014). To provide a better understanding of households’ behavior towards the up-take of renewable technologies, SWH technologies were studied in this paper.

The SWH market in Lebanon has reached 18.1 million in 2011, with Mount Lebanon, Nabatieh, and Bekaa occupying the biggest shares among the eight governorates, and the North governorate was lagging far behind (Lebanese Center for Energy, 2012).

Consumers’ resistance is one of the major barriers to innovation adoption (Ram, 1987), thus it highly influences the up-take of innovations through either inhibiting or delaying the adoption. This paper applies Innovation resistance Theory and factors from other empirical studies in the resistance literature to investigate factors influencing consumers’ resistance towards eco-innovations. Next, a survey was conducted to test the ability of these variables to explain resistance to SWHs in the Lebanese market. As a result, a better understanding of the resistance reasons would be derived to help overcome the barriers and increase adoption levels in the future.

1. Problem of the Research

Over the past two decades, a greater attention of consumer resistance to innovation was formed yet few empirical studies examined resistance factors and consumers’ perception (Park & Chen, 2007). Understanding factors causing consumers to resist certain innovations can provide a starting point to overcome the barriers and increase reliance on renewable energy in developing countries thus decrease carbon emissions, and reliance on electricity from the grid.

According to Jean-Paul Sfeir the reason behind why Lebanon still lags behind other neighboring countries is the high installation costs. An individual unit of SWH costs between $1,487 of size 266 liters (Arab Sustainability Association, 2012), therefore many low wage households are not able to afford. The project team of the Lebanese Center for Energy Conservation performed a survey among 1850 and found that 94% of the households are aware of the benefits of SWHs however only 15% of households use them to heat water. This fact reveals that there is still resistance among Lebanese consumers to adopt eco-innovations. Several studies addressed different types of energy efficient technologies (SWH being one of them) and showed how reliant they are in reducing electricity bills. On the other hand, no previous studies targeted Lebanese consumers’ and their resistance to eco-innovations, and no clear views explained factors influencing consumers’ resistance. As an example of these studies: (Green Line Association, 2007), (Houri & Korfali, 2005), (Lebanese Center for Energy, 2012). An understanding of the factors causing resistance to up-take innovations should take place.

The SWH market in Lebanon grew relatively quickly over the past five years yet only 3% of Lebanese households adopted these units in the past years due to absence of regulations and poorly designed financial incentives (Beheshti, 2010). Although many households adopted SWHs there is still an enormous number of consumers who resist these technologies and refuse to purchase it. Understanding the reasons behind resistance is very important to consider before understanding reasons for adoption (or non-adoption).

1. Research Question

There is an increasing need to better understand the factors which lead consumers to resist new technologies, especially that of an environmental nature. However, the field of resistance to eco-innovations is under researched and this study aims to find the barriers leading to consumers’ resistance. A adopting a new idea or technology might require consumers to change day-to-day routines, and conflict with their prior beliefs or lifestyle (Ram & Sheth, 1989). As a result, consumers will automatically resist new technologies or ideas without objectively assessing the various benefits. Indeed consumers’ resistance became a critical barrier for companies aiming to promote eco-innovative products yet is still an under-researched area with few differentiations of different types of resistance behaviors. Accordingly, our research question is as follows:

*What are the factors responsible for determining the consumers' resistance to micro-generations (SWH)?*

Obviously, this paper is organised as follows:

The first section discusses the variables used, which come from Innovation Resistance theory. The second section includes hypotheses derived from the theory and from other empirical studies in the field of resistance to innovations. The last section discusses possible explanations of the findings, and finally the fourth section concludes and provides recommendations for future research.

1. **Literature Review**

Understanding the consumers’ behavior and relevant influential factors are essential to uncover the factors of resistance. Many studies dealt with the notion of consumer resistance. For example, Gatignon and Robertson (1989) studied rejection from the behavioral aspect, whereas (Penaloza & Prica, 1993) classified consumer resistance to organizational goals, tactics of resistance, and consumer’s relationship with marketing agents dimensions. On the other hand, Rogers (1995) focused on the adoption of innovations and the factors that speedup the adoption process. Previous researchers argued that studying the process of innovation resistance may be even more important than studying adoption (Ram, 1987)and that both resistance and adoptions can co-exist during the life of an innovation (Ram & Sheth, 1989). Based on previous empirical research several strategies were employed to overcome resistance and speed up the adoption process. This study is trying to apply the Innovation Resistance Theory (see Fig. 1) to eco-innovations, and check its application on SWHs

**Consumer Resistance to Innovations**

**Functional Barriers**

**Psychological Barriers**

**Usage**

**Value**

**Risk**

**Tradition**

**Image**

Fig. 1: Innovation Resistance Theory

Now is the time to respect consumers’ resistant behavior, understand their psychology of resistance, utilize their knowledge, and promote innovations rather than thrusting preconceived innovations (Sheth, 1981).

Resistance of several types of innovations either prevents consumers from potential changes or conflicts with previous beliefs of consumers (Watson, 1971). Previous researchers stated that the main reason for the slow diffusion or failure of innovative products is consumer resistance and that understanding consumers’ inner motives and their resistance to green innovations can result in overcoming barriers. Few researchers argued that green products could conflict with consumers’ belief structures or daily habits and routines (Ram, 1987), (Ram & Sheth, 1989), (Bagozzi & Lee, 1999), (Szmigin & Foxall, 1998). For example, Faiers and Neame (2006) studied the attitude of householders towards solar systems and identified ambiguity of innovations as a barrier to adoption. In another study of residential heating systems Mahapatra and Gustavsson (2008) found that economic aspects and functional reliability were the most important factors for the homeowners when considering a new heating system over the old one.

However, few researches studied the eco-innovation and consumer characteristics to explain the resistance phenomenon Kleijnen, Lee, and Wetzels (2009) identified three segments of resistance to innovations. First level is the low resistance consumers (did not adopt but will purchase soon and they have low functional and psychological barrier). Second level is the medium resistance consumers (who postpone adoption because they are not fully convinced with the value and usage). Last level is high resistance consumers (completely reject adoption and have poor image and higher functional risk). Partly in line with this, rejection of potentially successful eco-innovations could be because the product is viewed as new, complex and unknown (Alexander, John, & Wang, 2008).

Another study of the diffusion of micro generation technologies, showed that homeowners’ willingness to pay is not primarily based on rational cost–benefit evaluations yet rather to be influenced by subjective perceptions of the technologies’ characteristics, people’s personal background and social environment (Claudy, Michelsen, & O’Driscoll, 2011). Similarly, Paladino and Baggiere (2008) found that friends’ encouragement was a significant predictor. Most of the studies in the field of consumer resistance are conceptual in nature, because not much empirical evidence provided the different resistance behaviors.

Ram’s model of innovation resistance determined three sets of factors; Perceived Innovation Characteristics’, Consumers’ Characteristics, and Characteristics of Propagation Mechanisms. This model was widely used for investigating consumers’ resistance to different innovations (Rogers, 1995). Lee and Yu (1994) modified Ram’s model of innovation resistance and they excluded the characteristics of propagation claiming that it is a barrier to diffusion of innovation—coming from social perspective— rather than being source of innovation resistance.

Few researchers stated that the causes of resistance to innovation stem from one or more of the adoption barriers; namely usage, value, risk, image, and traditional barriers (Ram & Sheth, 1989). The Innovation Resistance Theory (see Fig. 1) explains that consumer resistance to innovations consists of functional barriers and psychological barriers. Usage, value and risk barriers constitute functional barriers, whereas tradition and image barriers refer to psychological barriers. Functional barriers are likely to arise if consumers perceive considerable changes from adopting an innovation, while psychological barriers are often caused by conflict with consumers' prior beliefs (Ram & Sheth, 1989). The barriers for innovation resistance differ from one product to another; for that reason, this model is applied to check the factors causing resistance to SWH in Lebanon. Lebanese households’ resistance to environmentally friendly products or green innovative technologies is critical because they might be very satisfied with their current equipment and resist substitutes or might not value the environmental problems.

1. Hypothesis

According to the Innovation Resistance Theory and other empirical studies, the following hypotheses are derived to understand the consumers’ resistance to eco-innovations, in particular SWHs.

The first category of barriers is the functional barrier and it includes the usage barrier that deals with the usability of an innovation and the changes it requires from the consumers. When an innovation is not compatible with consumers’ existing practices and habits, this indicates a current barrier (Ram & Sheth, 1989).

H1: The usage barrier determines the consumers' resistance to eco-innovative technologies.

The value barrier is another functional barrier and is defined to reflect the monetary value of an innovation. An innovation is not considered worthwhile for customers if it does not offer great performance to price in comparison to its substitutes (Ram & Sheth, 1989).

H2: The value barrier determines the consumers' resistance to eco-innovative technologies.

The third functional barrier is the risk barrier and is the degree of risks an innovation entails. Risk barrier includes uncertainty in inheriting an innovation defined as: physical risk (or harm to a person or his property), economic risk (making wrong decision and immediately adopt an innovation instead of waiting for a better version), functional risk (the ability of an innovation to function properly) and social risk (social fear from others’ views) (Ram & Sheth, 1989).

H3: The risk barrier affects the consumers' resistance eco-innovative technologies.

The second part of the theory deals with psychological barriers that includes, the tradition barrier defined as the change that an innovation may cause in the daily routines of a consumer. These changes might either be important for consumers or not because other important factors, such as family values and social norms are taken into consideration (Ram & Sheth, 1989). These authors proved tradition and image barrier and claimed that the first occurs when consumers’ behavior contrasts existing values thus leads to tradition barrier.

H4: The tradition barrier determines the consumers' resistance to eco-innovative technologies.

The second psychological barrier is the image barrier and is related to stereotyped identity of innovations, such as the country of origin or the brand of an innovation.. This barrier is in this case the innovation itself.

H5: The image barrier determines the consumers' resistance to eco-innovative technologies.

1. **Methodology**

As discussed earlier, the study was performed to investigate various factors influencing consumers to resist eco-innovative technologies. For this purpose, a face-to-face survey was conducted with Lebanese households. A questionnaire included a five point Likert scale questions ranging from strongly disagree (1) to strongly agree (5) for functional, and psychological characteristics and other categorical and continuous scales for demographic factors. The survey targeted 50 households from North Lebanon, and the collected data was analyzed using statistical software, SPSS.

The researcher used convenience non-probabilistic sampling and targeted respondents relative to their contribution to the topic under study.

It is important to check the available approaches to serve as a basis for research design. The deductive research approach was applied and the hypotheses were tested in an appropriate objective manner thus utilizing driving factors of Innovation Resistance Theory to understand the consumers’ resistance to eco-innovations. Based on both theoretical and empirical findings, this research aims to better explain the previous Innovation Resistance Theory when dealing with eco-innovations.

To increase the number of responses, the questions were designed in an easy and understandable manner. The survey was performed on a number of days from different locations in the city to ensure the credibility and variety of sources. Moreover, the secondary data applied were gathered through websites, research articles, and journals.

1. **Empirical Data and Analyses**

After the data collection was completed, the analysis of collected results started to provide an explanation for each factor. The analyzed data covered five resistance barriers; namely usage, value, risk, tradition and image barriers. The results show 54% males, 46% females, of which 34% age between 35 years old and 55 years old. Among the 50 households surveyed only 4% of them had SWH these responses were removed from analysis to focus only on consumers who resist SWHs (Table1). The results also showed that 64% of households valued the notion of saving environment, yet only 40% knew that SWH reduce the greenhouse gasses emissions.

Table 1: Demographics

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristics | Category | N | % |
| Gender | MaleFemale | 2723 | 5446 |
| Age | 26-3536-55Greater than 55Other | 11171012 | 22342024 |
| Yearly Family Income (U.S Dollars) | Less than 15,00015,000-25,00025,000-35,000Greater than 35,000 | 431123 | 862246 |
| Owning SWH | YesNo | 248 | 496 |

The Cronbach’s alpha was used to assess reliability of factors in explaining the variables and the results showed that usage, value, risk, tradition, and image barrier had 0.710, 0.671, 0.649, 0.690 and 0.689 respectively. The reliability level for these variables is 0.691, and multiple regression equation was used to explain the relation between the independent and the dependent variable. The multiple coefficient of determination; R square is 0.483, this value indicates that 48.3% of variance in the variable consumers’ resistance is explained by the model. The linear regression results are presented in (Table 2).

Table 2: Linear Regression

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Beta** | **p** | **Condition Index (CI)** |
| Value Barrier | .740 | .000 | 16.253 |
| Tradition Barrier | .280 | .025 | 5.146 |
| Usage Barrier | .254 | .045 | 8.576 |
| Risk Barrier | .047 | .682 | 5.424 |
| Image Barrier | .011 | .926 | 6.832 |

The linear regression analysis indicated that the highest Beta value is 0.740 which is for value barrier, and second highest is 0.280 for tradition barrier, and 0.254 for usage barrier. These independent variables are accepted to explain the dependent variable having a significance value of 0.000, 0.025, 0.045 respectively. However, risk, and image barrier of beta coefficient, 0.047, and 0.011 respectively did not prove to be highly significant.

The condition index was calculated to check for the co linearity problem. All the CI values for the five barriers are below 15; instead the value barrier which was slightly above 15. These values show that this study has no serious problem with co linearity.

1. **Results and Discussions**

The results show that H2 and H4 (related to value and tradition barrier respectively) are highly supported, and H1 (representing usage barrier) is moderately supported thus has a moderate effect on consumer’s resistance. This paper studied the psychological and functional barriers as classified by (Ram & Sheth, 1989), and the results showed that value barriers significantly explain consumers’ resistance to SWHs, thus indicating that there is still doubt about the ability of eco-innovations in proving their reliability and their ability to save money. This result is broadly in line with Claudy, Michelsen and O’Driscoll (2011) findings. Furthermore, households are resisting SWHs because they believe that their conventional water heater is very reliable and satisfy their daily needs and that the price of SWHs does not meet their performance. Similarly, Kleijnen, Lee, and Wetzels (2009) identified medium resistance consumers who are not completely convinced and resist innovations because of the value barriers. The other two functional barriers proved to have either a moderate effect, value barrier, or no effect, the usage barrier. The value barrier deals with the social aspect of consumers’ and their fear of been seen in a negative way in the eyes of neighbors and surroundings. The second barrier- that is weakly supported- is the usage barrier showing that the compatibility does not significantly drive households yet it has a certain impact on consumer resistance to SWHs and that other severe factors which cause such decision. These results are partly in line with Mahapatra and Gustavsson (2008) and Alexander, John, and Wang (2008). Thus, these researchers dealt with usage barrier, which was explained as the product’s reliability and complexity. However, the survey did not include the economic risk, which might explain consumer resistance.

The image barrier, one of the psychological barriers, dealing with the country of origin or brand name did not prove to have a moderate effect on resistance. Consumers do not resist SWHs because of their country of origin brand name, yet they resist these units for the lack of promotional campaigns and awareness, or unmet performance. When the consumers’ behavior contradicts their social norms and family values, the tradition becomes a barrier to purchase and use eco-innovations-which proved to be the case in this paper. The daily lifestyles of consumers become hard to change with time because they get used to particular acts and products and might resist any new product or innovation for the reason that it will contradict their norms. Similarly, Watson (1971), Bagozzi and Lee (1999), Ram and Sheth (1989), Szmigin and Foxall (1998), and Paladino and Baggiere (2008)found that resistance to innovation is caused by its conflict with consumers’ beliefs, daily routines, habits, friends, and regular purchases decisions.

1. **Conclusion**

The author used the Innovation Resistance Theory, which classified the barriers facing consumers to functional and psychological barriers. The current research dealt with the Lebanese households’ resistance to eco-innovations-SWHs.

Results showed that the value and tradition barriers play significantly influence consumers’ resistance to SWHs. The value barrier is one of the functional barriers, while the tradition barrier belongs to the psychological level barrier. This indicates that consumers’ still believe that their current traditional values are satisfactory, and that SWHs are still unreliable and cannot function without relying on other energy sources, such as electricity.

The involvement of government, private sector, and local Non-Governmental Organizations helps to develop the market of renewable energy in Lebanon through enhancing, promoting, and supportive legislations. For that reason further studies should identify the barriers through qualitative research followed by a quantitative survey on a larger sample of households from different Lebanese districts to prove the set of barriers. Despite of the fact that this research addressed functional and psychological barriers only, further research should perform an in depth analyses to better identify other unstudied factors. Future work should also test the relation between socio-demographic variables and awareness of green innovations, and the accurate cognitive involvement of consumers from the diffusion of the eco-innovations. The findings will be a tool for marketers to raise awareness and stimulate higher interest for new technologies of environmental aspect. The study was performed among one category of micro-generations for the limitation of time, and money, yet this research will be followed by a study dealing with several types of micro-generations to assess the different barriers and a stepping-stone to coming research in the field. Understanding barriers to adoption and drawing relations between consumer and eco-innovation characteristics is a building block for the diffusion of other micro-generations not only SWHs.

From a theoretical perspective, future studies should involve Innovation Resistance Theory to explain consumer resistance of different kinds of green innovations. Moreover, we should take in to consideration other financial and technology related factors in order to better understand resistance process. Since one of the factors affecting the resistant behavior is related to the monetary aspect, more incentives should be provided for households of different income levels and regulations should be implemented to accomplish the desired results. In other words, a deep study of how could any kind of incentives; such as state backed financing, provide a solution for the resistance to eco-innovations. The next study should provide a clarification of the role that the government and the commercial banking sector can play through applying national financing mechanisms in order to boost the adoption of eco-innovations in Lebanon. As a conclusion, combining both capacity building and awareness campaigns with appropriate financing schemes will positively contribute to higher adoption rates of green innovations.

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