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MOTIVES FOR AND BARRIERS TO CONSUMERS' BEHAVIOR TOWARDS ADOPTABILITY OF SOLAR ENERGY: A CASE STUDY OF DISTRICT PESHAWAR

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ABSTRACT
This study seeks to analyze various factors that affect consumers' behavior towards adaptability of solar energy in district Peshawar. For the purpose, utilizing the survey of 373 respondents from Peshawar, logistic regression model was employed to investigate which technical factors and regulatory & institutional factors act as barriers or drivers in adoptability behavior of consumers towards solar energy. In results, it is concluded that the technical factors including: lack of skillful technicians and complexity in usage of the solar system act as barriers which have adverse and statistically significant impacts on the adoptability behavior of consumers towards solar energy. Moreover, among various technical drivers, the technology of net-metering remains the most significant driver to motivate individuals towards solar adoption. In terms of regulatory and institutional factors, encouraging private sector participation and strengthening regulation and legal framework remains drivers in enhancing solar adoption. Although, lack of institutions and government support for financial support, in-adequate policy and bureaucratic processes of registration and installation of solar energy have been found as barriers which negatively affect adoption of photovoltaic systems. Based on the results, it is recommended that both regulatory reforms as well as technological innovations through research and development must be supported to promote eco-friendly and sustainable solar energy.
Keywords: Classification: Consumers' Behavior; Solar Energy; Regulations and Institutions

INTRODUCTION
Energy resources are considered as important ingredients for economic development in the contemporary economies. All human's wants including: schooling, medical services, municipal services, defense and agricultural & industrial production etc. need considerable energy supply for proper functioning (Ali et al., 2020). Energy role in determining economic development is non ignorable. An efficient energy system is required to foster various economic variables such as; increase in employment, production of good and services, reduction in inflation and income inequality and increasing consumer welfare (Akbar et al., 2020).Without sufficient energy resources, a country cannot flourish (Irfan et al., 2019; Akbar et al., 2020). The global electricity access rate increased from 83% to 90% during 2010-2019 with average electricity point of 0.876 annually. The world still confronts about 660millions people with no access towards electricity. Besides of the significant efforts towards accessibility of electricity and improvement of efficiency in energy, the globe is still deprived of secured, affordable and sustainable energy at all (International Energy Agency, 2019). High cost of electricity generation and payment of import bills are alarming scenarios for the policy makers to reduce the import bills paid for the import of electricity tariff, oil and natural gas. Population grows at the exponential level that causes to increase in fuel demand for transportation which generates carbon emissions as recorded 195.71mns tons in Pakistan (Economic Survey of Pakistan, 2019). Thus using non-renewable energy is an effective cause of hurdles in achieving environmental sustainability and reduced global warming i.e. Sustainable Development Goal (SDG) Goal No. 13: The Climate Action & SDG Goal No. 15: Life on Land. Keeping in view the drawbacks of fusel fuel energy, the world is in

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search of modules to produce electricity other than the conventional system: i.e. following renewable energy system by adopting solar photovoltaic (Solar PV) power generation, biomass and wind energy system. United Nation has a continuous focus on achieving Goal. No 7 which is related to, sustainable and reliable source of energy.

Among different kinds of renewable energy, roof-mounted solar photovoltaic system is the most acknowledged choice in the world. Solar PV system has the ability to reduce the impacts of change and local pollution, provision of energy security and socio-economic benefit (Slocum et al., 2021; Masud, 2009). Solar energy consumption can contribute to reduce greenhouse gap emission; helping policy makers to reduce import bill for fuels; providing energy security and creating job especially in rural areas (Savacool, 2012; Huang, 2010; Slocum et al., 2021). Theocharis et al. (2005) defined solar PV system with the advantage of minimal cost of maintenance and transmission lines, absence of regional restrictions and free electricity production. As per the renewable global status report (2020), the global growth of solar photovoltaic system is 12% whereas the overall world production of solar electricity is 627GW in 2019. China being the biggest contributors to the solar production in the world produces 204.7 GW electricity (26%) followed by USA (12%), India (9%), Japan (6%), Vietnam and Spain each with (4%), Australia, Germany, Ukraine and Republic of Korea each with (3%) share in the Solar PV Production system. Rest of the world generates about 27% of the total production of solar PV system (REN21 2020). Like other developing countries, Pakistan has not significantly contributed in solar energy market. Because it is still dependent on the unsustainable fossil energy means. As about 80% of the total energy supply is being produced from the crude oil, 11% by hydrel plants, 6% by coal plants, 1% by low pressure gas (LPG) whereas solar PV energy systems contributes nearer to 0.3% (Zafar et al., 2018). Nine out of ten developing countries are mostly ecological affected region. In the global index, Pakistan is included in the list of nations whose populations are most negatively impacted by the effects of global warming (Eckstein et al., 2019).

Existing literature focuses on investigation of various factors which are responsible in determining decision of consumers' behavior towards adoptability of solar PV system and its effects through economic feasibility perception (Khalid, & Junaidi, 2013), barriers/obstacles and policy (Khalil and Zaidi, 2014; Khattak et al., 2006) and the impact of information and awareness towards adoptions of solar PV system (Qureshi et al., 2017). Some studies like: Painuly (2001); Oscar et al. (2007); Butler (2008); Byrne and Kurdgelashvili, (2011); Ciarreta et al., (2011); Harish, (2013); Dulal et al., (2013); Schelly, (2014); Chen, (2014); Lolla et al., (2015); Raza et al., (2015); Zarozny et al., (2016); Heiskanen and Matschoss (2017); Seetharaman et al., (2019); believe that regulations, government initiatives & policies and institutional performance can motivate consumers towards adoptability of solar PV system. Researchers also advocate technical factors including: technological innovation, technical knowledge and awareness, availability of infrastructure, technical reliability and efficiency of solar PV system in determining individuals' behavior towards adoption of solar PV system (Painuly, 2001; Gossling et al., 2005; Hall & Bain, 2008; Mirza et al., 2009; Sulaiman et al., 2014; Sidiras and Koukios, 2014; Chen et al., 2014; Seetaharaman et al., 2019; Alam et al., 2020). Following the existing literature, this study has the objective to analyze that to what extents technical factors and regulatory & institutional factors are responsible for this non-impressive adoptability rate of solar energy system in the case of Peshawar, a metropolitan city of Pakistan. For the purpose, valid 373 responses were collected through survey data in district Peshawar during the months of May-Jun in the year of 2022.

Roger's Innovative Model as Theoretical Framework

Roger's innovation decision model Everett. M. Rogers (1962) devises in to describe how a social system or specific population diffuses an idea, product or a technology in uncertainty. Communication channel of the Roger's innovative theory guides individuals over time by utilizing various channels over time. Like, the potentials adopters start acquiring knowledge about the new technology when they get interested in it. The acquired knowledge guides the potentials adopters to either accept or reject the new innovation. This model is applied to impact adoptability behavior of consumers

The detail of Roger's communication model modified by the author can be found in Fig.1 below.

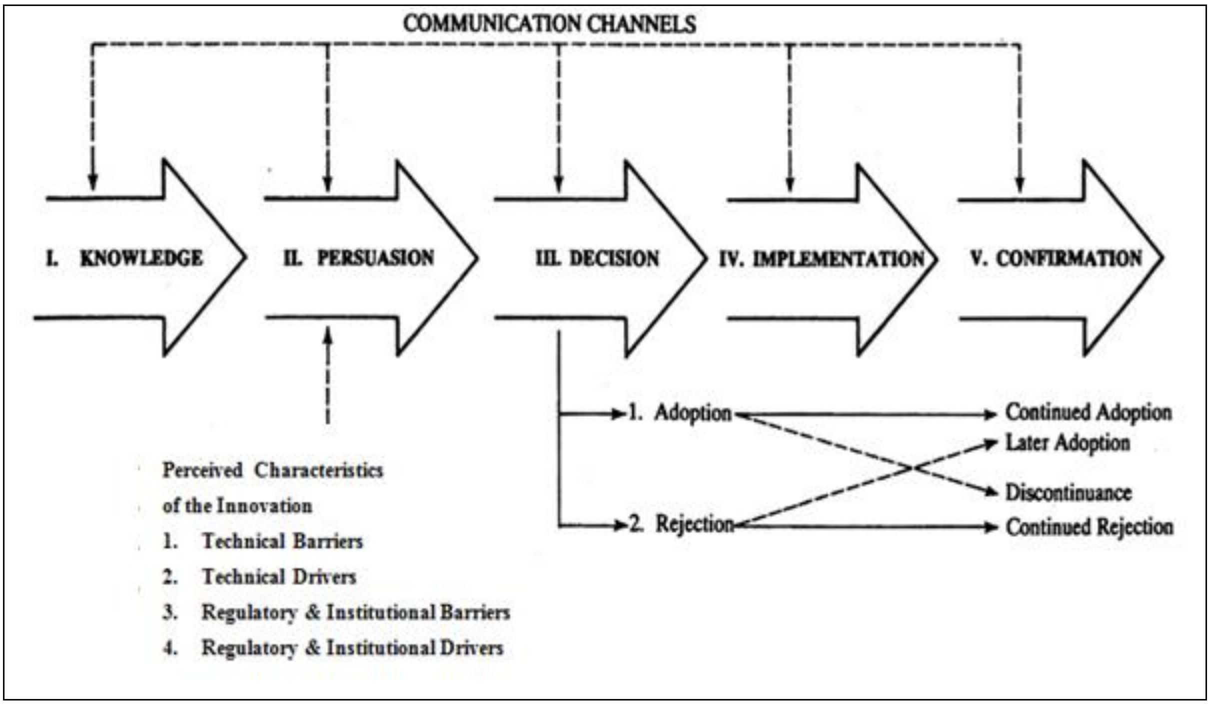

Fig. 1 Communication Channels of Roger's Innovative Decision Model

REVIEW OF LITERATURE

Technical Factors

There have been many technical factors discussed in the current literature that play .00critical role in determining consumers' behavior towards adoptability of solar PV system. Iordanis and Evgenia (2015) discussed the main barriers towards adoptability of solar energy and wind technology in Greece to successfully combat CO2 challenges to fulfill targets set out in its CO2 reduction policy by 2050. The study was based on the rationale of technological innovation system (Edquist, 1997; Freeman, 1087), the so called socio-technical regimes (Geels, 2004; Smith et al., 2005); and national innovation system (Nelson, 1993; Lunvall, 1992). These theories investigate the diffusion of new technologies by analyzing technological transitions that result from the interaction of institutions during technological regimes. In results, lack of grid station connectivity, large physical infrastructure with a low expected return on private investment, and lack of technical permit issuance for solar and wind energy installations were identified as technical barriers to installation of renewable and sustainable energy in Greece. The same results have also been supported by Kasselouri et al. (2007); and Interview Chaviaropoulos (2009). In the study of Kiriaki (2015), light was shed on the perceptions, knowledge, and attitudes of adolescents towards the adoption of renewable energy. A survey of 234 students has been conducted in two high schools in a typical Greek provincial town. He explored that existing well-equipped laboratories and technical knowledge of renewable energy are the main drivers that can boost the adoption of renewable energy in Greece. In the studies of Painuly (2000); Rebani and Barham (2011); Ahmad et al. (2014); Zyadin et al. (2014), it has also been found that lack of technical awareness results in the spread of distortion among the individuals who have intentions towards solar adoption, which leads to paralyzing the initial stage of adoption decision towards solar PV system. Qurashi et al. (2017) analyzed various factors responsible for the adoption of solar photovoltaic technology system for households in Lahore, Pakistan. Based on Roger's innovative decision model, it has been found that one of the biggest reasons of non-adoption of solar is lack of qualified technicians and trustworthy vendors. However, approximately 44% of respondents agreed that the installation of solar PV is not technically difficult because the premises already have electricity wiring for other alternative energy system such as UPS, generators, and so on. The same results have been supported in the studies of Muntasser (2000) and Wamukonya (2003). In addition, insufficiency in the supply of electricity, a drop in performance efficiency during cloudy weather, and inflexibility in using all appliances are the key barriers identified in the study of Quraishi et al. (2017).

Using integrated model, Alam et al., (2021) have done research to recognize the potential factors that affect behavior of the local housing residents towards adoptability of solar PV system in Malaysia. From the sample of 382 residences, the integrated model concluded that 54% of the variance is explained by the user households of solar PV system in Malaysia. The overall results confirm that the adoptability of solar PV system can be predicted by Roger's diffusion innovative model. Following the results of Ahmad et al., (2011); Alam et al., (2007); Chong, (2006); Agarwal and Prasad (1997) and Premkumar et al., (1997), the study of Alam et al., (2021) study has also confirmed that trailability, ease of use, and compatibility are the key drivers that significantly affect consumers' intention towards adoption of solar technology. Using the path coefficient of structural equation modeling, Seetharaman et al., (2019) have concluded that breaking the barriers like: lack of R&D, complex technology, lack of infrastructure, difficulty in operation and management can significantly improve individuals' behavior towards adoptability of renewable energy. Irfan et al., (2019) discovered barriers in respect of Pakistan in the way of solar PV adoption. The technological barriers identified by the respondents, includes unreliable local technology, dependency on foreign technology equipment's and spare parts, technical deficiency for measuring solar radiation intensity; and dependency on foreign companies in case of hybrid solar setup. Their conclusions are also consistent with the results obtained in the studies of Ahmed et al., (2017) and Ali et al., (2019). Mirza et al., (2009) have also discovered barriers related to technology and information in the adoption of solar PV system in Pakistan. The authors highlighted that information and technical barriers include a shortage of trained staff in the renewable energy setup, a lack of sufficient demonstration projects in the community and a lack of awareness regarding the benefits & cost of the solar technology (For similar results, see; D'Agostino et al., 2011; Yuan et al., 2011; Palit, 2013; Karakaya and Sriwannawit, 2015). Zyadin et al. (2014) analyzed empirically the major factors responsible for the promotion of renewable energy. In a survey of 122 respondents who have attained UK and Cyprus based course, the study concluded that renewable energy is perceived moderately throughout the globe. Moreover, irrespective of their geographical affiliation, survey participants have highlighted lack of public awareness regarding solar technology usages and their benefits are the key barriers in adoption of solar energy. There have been many researchers who explored the impacts of technical factors in adoptability behavior of solar energy like: Ohunakin et al., (2014) for Nigeria, Zhai and Williams (2011) for United States; Irfan et al., (2021) for Pakistan; Vasseur et al., (2013) for Japan and Netherlands; Jayaramam et al., (2017) for Malaysia. Extracting technical factors from the available literatures, this study tests the hypothesis that whether, technical factors either barriers or drivers have statistically significant impacts on adoptability behavior of consumers towards solar energy.

Regulatory Factors

Individuals' intentions toward the installation of solar photovoltaic systems can be significantly influenced by a number of variables, the most important of which are governmental initiatives and regulatory changes. The journey towards environmental protection and precautions for global warming is started from the seriousness of the government, NGOs, national and international institutions at different level. Policy measurement for adoption of solar electricity remains one of the popular actions towards environmental sustainability (Movilla et al., 2013; Brudermann et al., 2013; Vasseur et al., 2013; Jeong, 2013). Inefficient and inadequate national policy is often termed as barrier in the way of solar panel adoption. For example: the inconsistency in national program for renewable energy in Netherlands and United States discourage entrepreneurs from investment of solar PV system (Movilla et al., 2013). Effective renewable energy policy, well-coordinated policy mix, overcoming bureaucratic boundaries, improving ease of doing business, and offering cash incentives as policy support remained supportive determinants for foster diffusion of solar energy system (Karteris and Papado-poulos, 2013; Sarzynski et al.,2012). Iordanis and Evgenia (2015) discussed the main barriers in deployment of solar and wind technology in Greece. System function theory is used to explain technological transitions through survey method. In result, they found that there are some barriers that affect resource mobilization for the deployment of solar PV system. Delayed issuance of permits, lack of spatial planning for redesign of renewable energy, lack of awareness and expertise in authority remain barriers in diffusion of PV system. They also found that examination of feasibility and suitability of renewable energy sites by authority is usually delayed due to the complexity problem of bureaucracy in permit issuance (Interview Tsipouridies, 2019; Mitchell et al., 2011). In Pakistan based study conducted by

Irfan et al. (2019), it is also concluded that besides other factors, regulatory performance and institutional dedications are important for promotion of sustainable and renewable energy. Seetharaman et al. (2019) has also highlighted some regulatory barriers as constrain for solar PV adoption. Factors like lack of national policies for green energy promotion, inadequate fiscal incentives, administrative hurdles in processing permits related to renewable energy promotion, impractical government commitment and lack of standard certification remains important concerns that increase the project start up time period leading to de-motive individuals to invest renewable energy related projects (Also see Gold Smiths, 2015; Sun and Nie, 2015; Zhang et al., 2014; Ahlborg & Hammar, 2014; Stockes, 2013 for similar results).

Wang et al., (2017) stated that government agencies in prosperous countries can boost the adoption rate of renewable energy resources for consumers by enforcing a robust policy for renewable energy resources. As a result, government policy and propaganda may have a significant impact on the adoptability of solar PV technology in the lower developed countries. Likewise, subsidy program by the Chinese government in the year of 2013on energy-efficient household appliances has boosted the sale of similar energy-efficient devices. In the study of Karakaya and Sriwant towit (2015), besides other factors, management and policy factors are also determined that render a clear understanding regarding the issues in adoption of solar PV system. Appropriate business strategy by the planning division, lack of knowledge exchange system between policy division and researchers are the main factors that can increase adoption rate of solar PV system. In addition, they quoted many literatures which have concluded that eliminating policy barriers can have significantly positive impact on the behavior of public to adopt solar system. Likewise, Brudemann et al., (2013) for Spanish; Basseur et al., (2013) for Netherlands incorporated consistency in national subsidy schemes an important factor in diffusion of PV system. Inefficient feed-in tariff scheme can impede the adoption of PV system (Huenteler et al., 2012; Papado-Poulos, 2013). Brudermann et al., (2013) conceptualized the existence of non-cooperative building experts; the regional government decision process and lengthy process of permit issuance have negatively impacted adoption behavior of PV system. In same manner, Zhang et al., (2012) believed that the lack of system to engage stockholders in policy process remain one of important barrier in adoption of PV system. Similarly, In Bolivia based study, Pansera (2012) emphasized on removing the adoption of innovative policy strategy and suggested for closed coordination among the stakeholders. Ansari et al., (2013) also concluded that non-existence of sufficient number of institutions for training, and political commitment to support solar energy are responsible for non-adoption of solar PV system in India. Summarizing the outcome of these researchers, the study also attempts to test that whether, regulatory & institutional factors have statistically significant impacts on motivating consumers towards adoption of solar energy.

By analyzing the existing literature review provided above, it has been concluded many studies highlighted various factors affecting adoptability behavior of individuals towards solar energy. Whereas it is believed that as to the best of our knowledge, no study has been found that comprehensively investigates the consumers’ behavior towards adoption of solar PV system while considering different drivers and barriers related to institutional & regulatory and technical factors with respect to Peshawar, a metropolitan city in Pakistan. Hence this study is pioneered in analyzing various barriers and drivers related technical factors and particularly the role of government and institutions in adoption of solar PV system.

METHODOLOGY

Sampling Procedures and Techniques

The study employed questionnaire method for primary data collection as presented in appendices. It employed the method of simple random sampling for sample collections from population. For adequate number of sample, many researchers have defined their rule of thumbs to select adequate sample size for efficiently identifying the correct factor structure. Like, Gaur and Gaur (2009) considered 200-300 sample size as enough for identifying the correct factor structure and to address the research objective. Whereas Hari et al., (2010) recommended 100 or more sample size as valid sample Tabachnic (2007) argued that the sample size should be at least 300 for reliable study results. Field (2005) recommended 300 and above sample size; Hinton (2004) suggested 200 number of sample size; Steven (1996) proposed sample size of 100-300 as adequate numbers of samples for factor analysis. The present study yields 373 numbers of respondents which are adequate number of samples sizes according to Kaiser-

Meyer-Olkin (KMO). Because its test statistic is greater than the threshold value of 0.50 Bartletts test of Sphericity (Bartlett, 1954) has also confirmed the sampling adequacy as the calculated value of BTS test is statistically significant at P<5% (Tabachnick and Fidell, 2012). The outcomes of the KMO statistic and BTS methods for detecting the adequate numbers of samples are shown in below table 1:

Table No. 1 Tests for Sample Adequacy

Tests	Values
KMO measure of sampling	0.71
Bartlett's test	2148.5
D.f	120
Significance level	0.000

Following Painuly (2001), the questionnaire is boldly divided into two parts of items: demographic items and factors items. There were 05 items related to demographic whereas the remaining 16 items were related to technological and regulatory & institutional factors. Through demographic items, different questions related to gender, income, education level, adoption status of solar were asked. On the other side, the respondents were asked for different factors that could have a significant impact on the decision of consumer towards adoption of solar PV system. Factor related questions were developed in nature of five point Likert scale whereas demographic items were either Yes/No questions or with available choices. In order to test the internal scale consistency so called reliability, Cronbach's alpha coefficient (CAC) of reliability is employed (Moser and Kalton, 1989; Whitley, 2002; Robinson, 2009). Reliability of the model has also been confirmed by the Cronbach's Alpha (CAC) where its value is higher than the threshold value of 0.70.

Table No. 2 Lists of codes of variables and their descriptions

Codes of Variables	Descriptions	Expected Sign
Lak-Techncian	I believe that skilled technicians for solar system are not available in the market.	—
Complex	Usages of solar system is complex and complicated	—
Unforsn-Troub	There is threat to solar PV system from unforeseen troubles like storm or snowballs etc.	—
Net-Meterng	I like solar system to adopt because it can be connected with grade station	+
Realibility	Technology of solar PV system is reliable	+
Maintnce-Fre	Solar system is maintenance free	+
Return-Warnty	There is return warranty on poor performance of solar PV system	+
Mobility-Char	I prefer solar system because it can be shifted from one place to another	+
Lak-Financ-Insti	There is lack of financial institutions to support solar PV system	—
Lak-Adeqt-Polcy	There is lack of adequate policy to attract consumers towards solar energy	—
Inadqt-Govt-Suprt	Government provides inadequate financial support for adoption of solar PV system	—
Buructric-Proc	Lenghty bureaucratice procedures remains main hurdle in adoption of solar PV system	—
Regu-Legl-Fram	There is legal and regulatory framework to support adoption of solar system	+
Intr-Trad	Government supports free trade in solar PV system	+

Priv-Sec-Partcptn	Private sector participation can enhance adoption of solar PV system	+
Pric-Contrl	Pricing control authority can makes solar PV available at attractive prices	+

Methodology

The binary logistic regression model, which assumes the logistic distribution function, was used in this investigation. Once the response variables are translated into Logit, this model employs the maximum likelihood method (Carson, 2008). It calculates the chances of consumers' adoptability of solar energy PV system. The Logit model takes place after the transformation of dependent variables into the natural log of odds [Logit]. Y_i symbolizes dichotomous dependent variable which assumes q for solar adopter and 0 for non-adopter of solar. A value of 0 is assigned which indicates that the respondent is non-user of solar energy, and a value of 1 indicates that individual is user of solar eneryg system. The model is given as below:

$$Y_i = \log(odd\ event) = \log \frac{prob\ (event)}{prob(non\ event)}$$

$$Y_i = \beta_1 + \beta_2 \sum_{i=1}^{n} TECH_{Barriers-i} + \beta_3 \sum_{i=1}^{n} TECH_{Drivers-i} + \beta_4 \sum_{i=1}^{n} REGU_{Barriers-i} + \beta_5 \sum_{i=1}^{n} REGU_{Drivers-i} + ei$$

In the above equation, in addition, $TECH_{Barriers}$ is abbreviated form for technical barriers; $TECH_{Drivers}$ for technical drivers; $ENV_{Drivers}$ for Environmental drivers; $REGU_{Barriers}$ for Regulation & Institutional barriers and $REGU_{Drivers}$ represents the drivers of regulatory and institutional factors. βi are the coefficient of explanatory variables where residual terms are shown by $e_{i.}$

RESULTS

The descriptive statistics which describes the nature of the data is explained in Table 3 as follows:

Table No. 3 The descriptive statistics for demographic item

Demographic Variables	Categories	Frequency	Percentage	Mean	S.E
Gender	Female	69	18.5	0.81	0.388
	Male	304	81.5		
Income Level (In Rs.)	21000-50000	55	14.7	2.49	0.974
	50001-70000	152	40.8		
	70001-90000	91	24.4		
	More than 90000	75	20.1		
Education level	6-10 years	16	4.3	3.40	0.572
	11-16 year S	190	50.9		
	more than 16 years	167	44.8		
Sector	Household	150	40.2	1.90	0.838
	Business Sector	108	29		
	Government Sector	115	30.8		
Adoption Status	Solar Adopter	191	51.2	0.52	0.500
	Solar Non-adopter	182	48.79		

Testing Goodness of Model Fit for overall Model

The Pearson's chi-square statistic has been applied as shown in the below Table 4. According to the results of Pearson's test for model fitness, all the variables are statistically significant at 1% level of significance. It interprets that the model is good to fit indicating that the results of the regression model cannot be considered spurious (Kabir et al., 2013). Table 5 displays the outcomes of the binary logistic model.

Table No. 4 Testing Goodness of model fit for over all model

Items/Variables	Chi-Square	Items/Variables	Chi-Square
Lak-Techncian	37.57*** (0.00)	Lak-Financ-Insti	24.37*** (0.03)
Complex	52.66*** (0.00)	Lak-Adeqt-Polcy	24.31*** (0.00)
Unforsn-Troubl	15.57*** (0.00)	Inadqt-Govt-Suprt	20.2*** (0.001)
Net-Meterng	63.99*** (0.00)	Buructric-Proc	50.56*** (0.00)
Realibility	27.095*** (0.00)	Lack-Legl-Fram	83.00*** (0.00)
Maintnce-Fre	84.28*** (0.00)	Free-Trad	51.392*** (0.00)
Return-Warnty	67.018*** (0.00)	Priv-Sec-Partcptn	76.977*** (0.00)
Mobility-Char	27.023)*** (0.00	Pric-Contrl	86.433*** (0.00)

Notes: a): *** shows significance level at 5% critical values respectively.

Table No. 5 Technical and Regulatory & Institutional factors affecting solar adoptability

Factors	Variables/Items	B	S.E.	p-value	Exp(B)
Technical Barriers	Lak-Techncian	-0.36	0.15	0.01	0.69
	Complex	-0.74	0.17	0	0.48
	Unforsn-Troubl	-0.37	0.15	0.01	0.45
Technical Drivers	Net-Meterng	0.78	0.2	0	2.17
	Realibility	0.22	0.15	0.16	1.24
	Maintnce-Fre	0.45	0.15	0	1.57
	Return-Warnty	0.18	0.2	0.38	1.19
	Mobility-Char	-0.64	0.21	0	0.53
Regulatory and Institutional Barriers	Lak-Financ-Insti	0.35	0.17	0.04	1.41
	Lak-Adeqt-Polcy	-0.16	0.16	0.32	0.86
	Inadqt-Govt-Suprt	0.06	0.16	0.72	1.06
	Buructric-Proc	-0.58	0.18	0	0.56
Regulatory and Institutional Drivers	Lack-Legl-Fram	2.2	0.61	0	9.01
	Free-Trad	-1.52	0.63	0.02	0.22
	Priv-Sec-Partcptn	0.81	0.27	0	2.25
	Pric-Contrl	0.65	0.27	0.02	1.91
	Constant	-8.28	1.64	0	0

Result Discussion

Technical Barriers

The results of Table 5 indicate that all variable of technical barriers are, at 5% level of significance, statistically significant. The variable "Lak-Technician" which indicates lack of skillful technicians has positive association towards adoption of solar energy system with the odd value of 0.69. It interprets that individuals are 0.69 times more likely to adopt solar PV system if there is one level increase in the variable of "Lak-Technician". Similarly, complexity in the use of solar technology is another barrier in solar adoption drawn from the given analysis. Table 1 further shows that the as variables of "Complex" and Unforsn-Trouble increase, solar adoption also falls factor-wise by 0.48 and 1.45 respectively.

Technical Drivers:

In table 5, the variable that shows the availability of net metering facility (Net-Meterng) has positive (odd ratio=2.17) and statistically significant (p-value=0.00) impacts on adoptability behavior of individuals towards solar PV system. Hence, the respondents are more likely to defuse solar technology, if the government expends net metering facility in the study area. In addition, the variables of reliability in solar system (reliability_5) and availability of return warranty in case of poor performance (Return_Warnty) has positive however statistically insignificance (p-value>5%) impacts on solar system. Solar system is considered more attractive because it does not require maintenance on regular basis. The result shows that the maintenance free variable is highly significant variable (p=0.000) that positively affect adoptability behavior of consumers towards solar PV system. Solar system has the advantage of mobility from one place to another place. However, the results indicates the variable "Mobility_Char_8" shows negative and statistically significant (p=0.000) relationship between mobility characteristic of solar system and adoptability of solar photovoltaic system. The results may be due to the threats of thieves and other unforeseen situations like rainy days thunderstone and storm.

Regulatory and Institutional Barriers:

Lack of financial institutions (Lak-Financ-Insti) remains the most effective barriers among the regulatory and institutional barriers. The odd value of "Lak-Financ-Insti" is 1.41 with p-value<5% level of significance; meaning that it has positive and statistically significant impacts on adoption of solar PV system. One reason of these results is due to non-reliant on the financial institutions in the rural area of Peshawar. The odd value of Lak-Adeqt-Policy is 0.86 with p-value=0.004. This concludes that due to the lack of adequate policy, solar PV system may not be attractive technology to the consumers. Adding more variables in the regulatory barriers, due to the long process of the official formality so called bureaucratic procedure (Buructric-Proc), the adoption remains the main hurdle in the way of solar adoption. While comparing the thresholds values of level of significance at 5% alpha value, result also declare that the role of government support financially in promotion of solar PV system is statistically insignificant. The Buructric-Proc is statistically significant with zero p-value at the odd ratio equivalent to 0.56. This shows that due to rise in one level of bureaucratic procedure, the odd of being solar adoption reduces by 0.56 times.

Regulatory and Institutional Barriers

In results, we come up with different variables which act as barriers in adoption of solar PV system. Among them, Lak_Financ_Insti and Buructric_Proc are statistically significant at 5% threshold value of significance. However, the barrier of Inadqt_Govt_Suprt and Lack_Adeqt_polcy are found statistically insignificant at 5% level of significance. The Odd ratio of Lak_Financ_Insti is 1.41 which is higher than unity. This can be inferred that respondents are 1.41 times more likely to the adoptability of solar energy if government intends to relax legal and regulatory framework by one unit. The same results have also been verified Song et al. (2019) and Wang et al. (2017). The respective Odd ratios of Lak_Adeqt_Polcy and Buructric_Procare are 0.86 and 0.56 whereas each of these values is less than unity. Hence it shows adverse relationship between Lak_Adeqt_Polcy (lack of adequate policy) & Buructric_Proc (lengthy bureaucratic procedure) and adoptability behavior of solar PV system. By this analysis, it is concluded that the odd of solar adoption is less likely to happen if each of these variables increases by one level (See Wang et al., 2017 for similar results). According to Zhang et al. (2014), absence of government policies to integrate local demand for renewable energy with the global market creates uncertainty, and insufficient confidence by the market agents which acts as barriers in deployment of solar. Lak_Financ_Insti remains the most effective variable and Buructric_Proc is the least effective variables among the regulatory and institutional barriers.

Regulatory and Institutional Drivers

Lack of legal framework was predictable to adversely affect the adoptability of solar PV system. However, interestingly, it has been found that the variable, Regu-Legl-Fram is highly significance at p-value=0.000 with odd ratio 9.01 which is higher than unity. This can infer that respondents are more likely to adopt solar PV system if government intends to relax legal and regulatory framework by one unit. The same results have also been verified Song et al. (2019); Saeed et al. (2013) and Wang et al. (2017). The Table.1 shows that allowing international trade in solar products have adversely affected adoptability of solar photovoltaic system in Pakistan. The conclusion is translation of significance p-value and odd ratio e.g., 0.22 which is less than one. Table 1 depicts that the variable "Pri-Sec-Parcptn" has highly statistical significance p-value e.g., 0.000 with odd ratio=2.25. The result supports private sector participation in enhancing motivation of consumers to adopt solar PV system. In last, the result of pricing control authority (p-value=0.02 and odd ratio=1.91) shows positive and significance role in promotion of solar system. This means that the more control on price hike of the authority, the individuals will be more 1.91 times likely to adopt solar PV system. The existing researches like: Wassie et al. (2021); Scarpa and Willis (2010) have found congruent results to our finding that individuals still cannot afford expensive technology.

CONCLUSION AND RECOMMENDATIONS

There exists lack of studies to evaluate the impacts of various factors affecting consumers' behavior towards adoptability of solar PV system. This study has attempted to analyze the importance of various factors that individuals consider while deciding for the acquisition of solar energy. Using factor analysis and logistic model based on the survey of 373 respondents, it has been concluded that respondents are less likely to adopt solar PV system due to the technical barriers which are namely: the non-availability of skillful technicians, and occurrence of unforeseen situations which cause damages of solar energy system. For the items of technical drivers, the study concluded that individuals are more motivated towards solar PV system if the power division confirms availability of net metering facility to the potential consumers. The role of regulation and institutions are also discussed in the research. It has been concluded that there are some factors including: lack of financial institutions for financing clean energy projects; absence of adequate policies for promotion and legalization of solar energy and bureaucratic hurdles in making registration of solar projects more complicated are the main barriers which discourage individuals to adopt solar energy. However, the results urged that for Pakistan, the concept of international trade has negative impacts on solar adoptability. In the lights of these finding, it is recommended to the government to make reforms in the structure of subsidy policy; ensuring political commitments and to provide financial supports through institutional and regulatory measures. Installation of net metering should also be promoted with supportive tariff rates for renewable energy to attract private sector participation.

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