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Research Article

Factors Affecting the Willingness to Pay for Improved Electricity Services in Rural Areas of Pakistan

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ABSTRACT

Regulators in many countries provide financial incentives to the electricity distribution companies to improve the quality and standards of the electricity in the rural area in order to promote economic activity. However, in the process, the preferences of rural households are rarely documented. In most of the cases, the incentives policies do not get desired result due to lack of understanding of the rural household's willingness to pay for improved and quality services. The present research has been conducted in order to bridge the gap between policy makers and electricity consumers. In this study, we opted for the choice modeling to appraise those factors which influence household's willingness to pay for improved and better electricity supply. Nearly 58% of the respondents were not satisfied with current electricity delivery services in Kahuta and 77% of respondents were getting financial support from the Benazir Income Support Program in Khanpur. Similarly, nearly 63 % WTP in Kahuta while, 32% are WTP in Khanpur for improved service of electricity supply. Although, respondents had knowledge about the issues caused by the poor and interrupted supply of electricity. Daily load shedding, education, and adoption of energy conservation strategies that affect the WTP behavior and found BISP membership was the distinguishing factor in both locations. The results from this study provide better insight into household's views on WTP and identify more income opportunities needed by the household to overcome the factors which influence WTP for improved supply of electricity.

Keywords: Choice modeling, Willingness to pay, Rural household, Service quality, Load shedding

1. INTRODUCTION

The stable electricity supply is crucial for developing countries that depend heavily on the availability of electricity for their economic prosperity. Blackouts and unstable electricity supply, especially in rural areas in the summer months cause major problems, such as the suspension of electric appliances, farm machinery, and industry. Hence, an improved and uninterrupted supply of electricity has become an important task to accept (Kim, Lim and Yoo, 2019). Often the issue behind these regular disruptions in electricity supply is the lack of a robust and coherent policy and absence of investment framework to ensure that timely and proper investment is being made in the distribution and transmission systems in rural areas (Siddiqui, 2004; Rehman *et al.*, 2018).

Pakistan is a member of the SAARC, is a developing country and its economy heavily relies on agriculture sector (GOP, 2019). However, country's industrial as well as agriculture sectors are showing continuous growth in the short run requiring stable energy supply mainly electricity. On the other hand, Pakistani government faces immense challenges in setting its energy policy to sustain this economic growth (Raza, Wasim and Sarwar, 2020). The swift increase in the electricity demand raised the challenge to provide a

stable and continuous electricity supply (Samad and Zhang, 2018; TET, 2018). In particular, improvement and expansion in providing the electricity supply have appeared as one of the key national tasks, as demand has risen in rural areas in hotter and winter weather due to climate change (Urooj, 2013; Qasim and Kotani, 2014).

In many countries, regulators monitor and encourage the power distribution companies to design and implement the different incentive policies for the development and enhancing the quality of utilities they provide (Rekettye and Pintér, 2006; Skordoulis, Ntanos and Arabatzis, 2020). These kind of policies help to increase the standards including the role and form and regulate the prices and services provided by the power distribution companies. A vital part of many regulatory reviews is the assessment of operations, maintenance, and capital expenditure that should be shown in the revenue required for power distribution companies (Kurtkoti, 2014; Drosos *et al.*, 2020). A very important driver in assessing the suitable level of this spending is the preferred level of requisite service quality and service quality targets which are incorporated in the 'regulatory bargain' (Ntanos *et al.*, 2018).

Regulator decisions are required to be made to ensure the appropriate balance between improved services such as the reduction in load shedding and stable voltage supply and impact on the customer prices since improved services will require a high level of expenditure. The most difficult part for the power distribution companies and the regulator is passing their expenditure proposal to the customer for getting the information about what extent they are willing to pay high prices in return to experience the improved and high services quality (Hensher, Shore and Train, 2014; Batidzirai, Moyo and Kapembwa, 2018; Deutschmann, Postepska and Sarr, 2020).

In the literature very few studies have been undertaken elsewhere in the world to estimate the WTP for improved electricity service consistency. Although, setting an additional price for un-interrupted electricity supply is challenging because generated unit cannot be stored economically while its needs varies according to weather and climatic condition throughout the year. Martzoukos and Teplitz-Sembitzky (1992) stated that power sector is the combination of the multi-products in which output can be indexed by the priority of service and the time of its use, and in difference with other sector, the price determination and allocation across different products is analytically challenging.

Keeping in view of the research gaps, this study is designed to explore local understanding about electricity and willingness to pay (WTP) for improved electricity services and factors that may affect farmers' WTP behaviour. The results of this study are key inputs for decision making by power distribution companies and the regulator in their recommendations for funding of electricity reliability improvement projects.

1.1. Electricity System in Pakistan

Pakistan is the fifth most populous country in the world and almost 63% live in rural areas (GOP, 2019; Economies, 2020). Its characterized by hot summer and cold winters. Its principal industries are agriculture and manufacturing. In 2020 the total installed electricity generation capacity in Pakistan was 37,402 MW (GOP, 2019). Thanks to the emphasis of the previous government on enhancing generation capacity, almost 10,000~12,000 MW has been recently added to the system but now we are in a capacity trap (capacity payments to IPPs). At present, In the generation sector, there is WAPDA for hydropower, five GENCOs for thermal power as the state own generation companies under the umbrella of Gencos Holding Company Limited (GHCL), and there are IPP (Independent Power Producers) for both hydropower and thermal power, SPP (Small Power Producer) and CPP (Capital Power Producer) as the private generation companies supervised by PPIB. The transmission voltage of Pakistan is 132/220/500kV whereas the frequency is 50Hz. NTDC which is a state-own transmission company executes operation and maintenance transmission and substation facilities of 500kV and 220kV and transmission line outgoing feeder of 132kV. The bulk transmission line of 500kV connects with double circuits between Peshawar substation in the north and Hubco power station in the south at a total length of around 1,700km. The looped bulk power system exists in the northern part system where the capital Islamabad and Lahore are located, but the transmission line in some sections is a single circuit. Besides, the loop is not formed in the system of the south side from the Multan. Meanwhile, in the population crowd areas such as Lahore, the 220 kV power system forms a loop.

Some areas are supplied power with a 132kV transmission line because the area is several hundred kilometers away from the bulk transmission line of NTDC, it is managed as an independent power system. The system has tormented both from extra generation capacity and lack of transmission lines, thus in result regular blackout even excess generation capacity. These outages have been chronic for many years, largely due to lack of generation and then lack of policy on infrastructure development of transmission (Rehman *et al.*, 2018; Raza, Wasim and Sarwar, 2020). Therefore, the absence of consistent energy supply policy affected badly the growth of industries in the last two decades (Siddiqui, 2004). Over this period several large firms shifted their capital and industries in other countries. Furthermore, the situation even got worse during the summer when the temperatures have risen and electricity demand increased in the domestic customers (Husain, 2010; Ahmad, Rashid Aziz, 2019).

The main reason was communicated for the power outages and blackouts are lack of funds, or unwillingness on the costumers end to pay the bills for the electricity they use. Usually, distribution companies have the policy to invest the revenues on the maintenance, transmission and distribution, and reservation system of the electricity. There has been a lack of evidence and information on how costly this dysfunctional policy attitude has been for the rural population of Pakistan. Hence, the purpose of this study is to bridge this gap and provide evidence-based information to policymakers for devising a policy to pay for improved services in terms of electricity supply.

2. MATERIALS AND METHODS

2.1. Study Area

The study area of this study is Punjab. Within Punjab, we focus two districts Rawalpindi and Rahim Yar Khan. Both districts are not only differnet in term of geopgrahy, economic wellbeing but also differs in term of provision of electricity services. In Rahim Yar Khan, MEPCO is responsible for power distribution where as IESCO is authorized to provide electricity services in Kahuta area. Rahim Yar is located is the last district of Punjab in South Side, whereas Rawalpini is the last district of the provinces towards North sharing its border with Capital city of Pakistan, Islamabad. A study area map is presented in Figure 2.

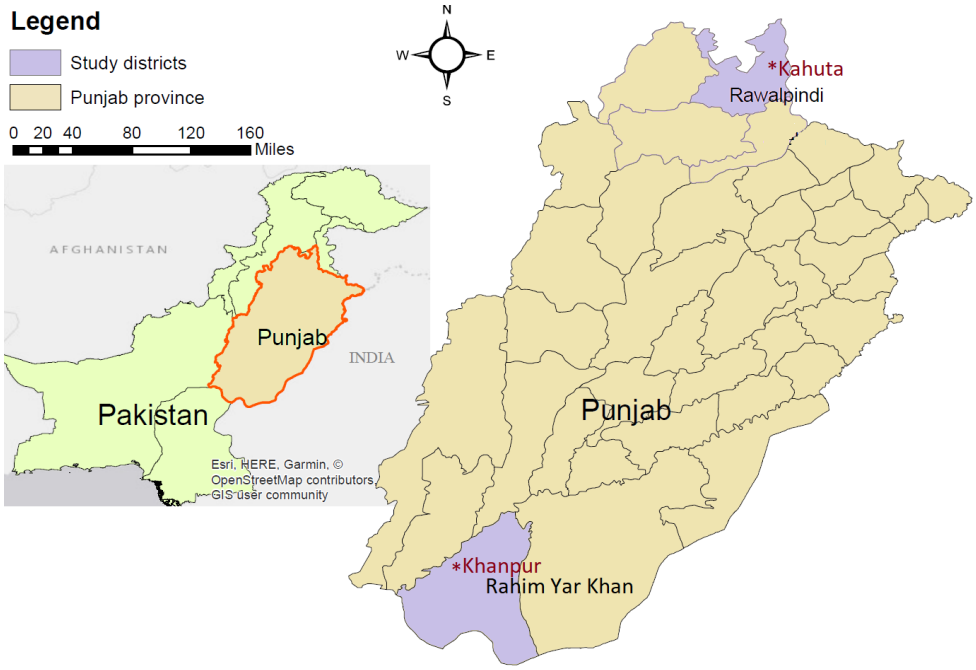

Figure 2. Study area map

2.2. Data Collection

The study adopted a multi-stage sampling technique to select 200 rural households from two study districts, Rahim Yar Khan and Rawalpindi. First of all, the Punjab province was selected as being the most populous and the second biggest in terms of area in the country. Since this study focused on rural residential consumers from Punjab, out of five distribution companies of Punjab, two DISCOs (IESCO and MEPCO) were selected. In third step, Rawalpindi dstrict and Rahim Yar Khan are selected as representative districts from IESCO and MEPCO respectively. It is important to mention that IESCO is considered as most efficient DISCO in Pakistan (minimum T&D losses) and covers the most prosperous area of the country and is also used as the model for tariff determination. On the other hand, MEPCO being the worst performing DISCO (maximum T&D losses) in Punjab and covering one of the poorest areas of South Punjab. In the fourth stage, one tehsil (smaller administrative units within districts) was randomly selected the selected districts, Kahuta in Rawalpindi District and Khanpur in Rahim Yar Khan district. In the fifth and last stage, two union councils/wards each were selected within each tehsil and 200 electricity consumers were interviewed using a fully structured questionnaire.

The questionnaire used for the survey was pre-tested in field to avoid missing any important information. For data collection students from local university were hired and trained for data collection, questionnaire terminologies. In-field training was also conducted during pre-testing. Final survey involves face-to-face interviews with the head of hosueholds. Information on various apeccts of household was asked in addition to their satisfaction and current electricity management system. Further, we also ask for their willingness to pay for improved services. This survey was conducted between December 2018 and February 2019.

2.3. Analytical framework

The main purpose of this study is to estimate the willingness to pay (WTP) of the households and the determinants of WTP. For this purpose, we asked specific choice, "No" or "Yes" elicited specific ready to pay for improved services in terms of electricity. In consideration of the dichotomous nature of the dependent variable and key independent variables, we employed logit model that was extensively used in the literature (Hensher, Shore and Train, 2014; Wu et al., 2018; Atinkut et al., 2020). It is assumed that each household will get benefits from improved services. Therefore, household choice can be written as;

$$WTP_i^* = \beta Z_{ik} + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, Z_{ik} is the vector of k independent variables, β is the vector of Logistic model coefficients and ε_i is the error term. As the latent variable WTP_i^* is unobservable a probability estimation model, is employed in this study to analyze the household' decision.

$$WTP_i = \begin{cases} 1 \; if \; WTP_i^* > 0 \\ 0 \; if \; WTP_i^* \leq 0 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where WTP shows the ^{i}th household will WTP ($WTP_i = 1$) only when the benefits from the improved services will be positive ($WTP_i^* > 0$). On the other hand, ^{i}th household will not WTP ($WTP_i = 0$), if the benefits are not positive $\left(WTP_i^* \leq 0\right)$.

3. RESULTS AND DISCUSSION

3.1. DESCRIPTIVE STATISTICS

Descriptive statistics of the study presented in Table 1 shows that average age of the hoseuhold head was around 51 years in Kahuta and 48 years in Khanpur. Overall, respondents in both cities have similar qualification around 8 years of schooling. The household size of the respondents was also almost similar. The average number of male and female hoseuhold members was around 3 in Kahuta compred to 4 in Khanpur. The average income of the households in Kahuta was more than double of the income in case of repsondents in Khanpur. This is true in the sense that being located close to the captical city of Islamabad, household have more economic opportunities and earn a better livelihood compared to its counterpart in

North of the province, where limited economic opportunities are available.

Table 1: Descriptive Statistics

	Kahuta	Khanpur
Age	51	48
Years of schooling	8	9
Household size	6	7
Number of male HH members	3	4
Number of female HH members	3	4
Monthly Income (Rs.)	52371	23602
Agriculture share in total income (%)	86	22
Livestock share in total income (%)	41	4
Off-farm share in total income (%)	95	25
Remittances share in total income (%)	73	1

In the comparison of socio-economic and demographic data of the two areas of Punjab (Figure 2), it is quite visible that there is a bigger share of government and private jobs (24.3% and 21.6%) in the North as compared to South (10.2% and 11.2%). The possible explanation of this difference can be the proximity to capital/big city, better clout and social networks in the urban areas, and concentration of expatriates in the North. Whilst, there is a high percentage of unskilled labor (29.59%) in the South which can be attributed to low level of literacy, the predominance of an agrarian economy, and limited opportunities for skill development. Household income is more than double in North which validates the stark socio-economic disparities in the Northern and Southern parts of Punjab province.

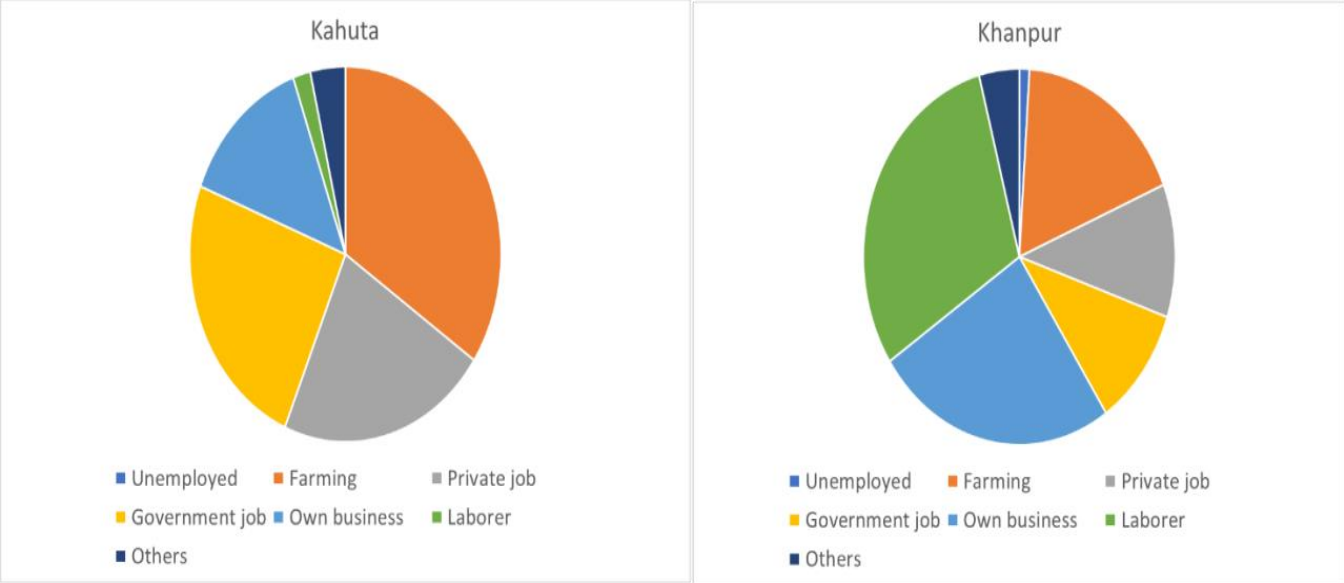

Figure 2. Employment Status of the respondents

Further, descriptive analysis show that BISP beneficiaries are also more in the South (18.4%) as compared to North (2.7%) which is understandable considering the poor economic condition of people in that area requiring support in the form of social safety nets shown in Fig 3.

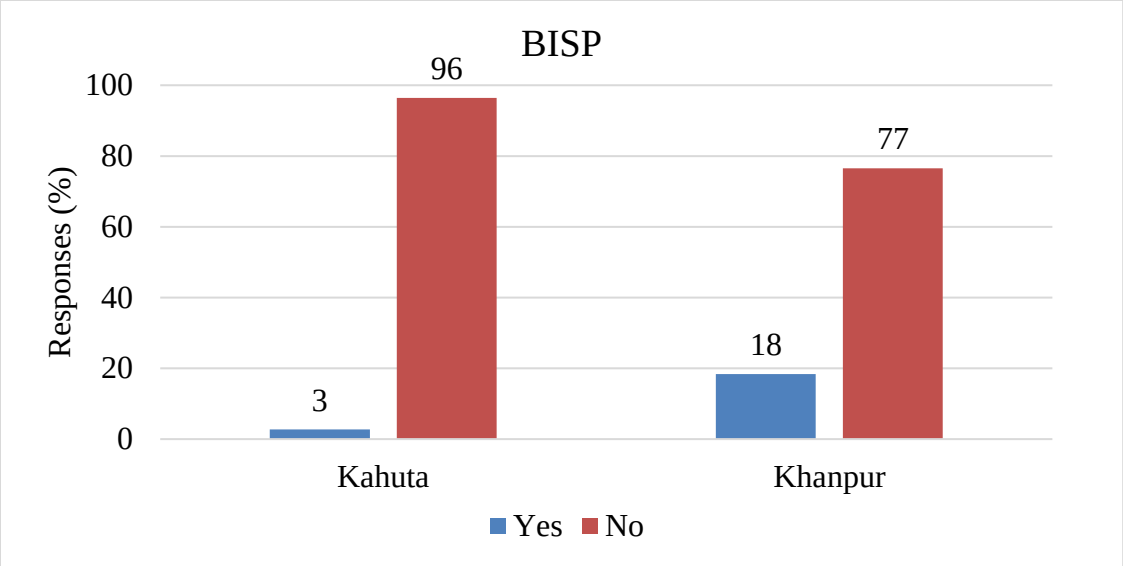

Figure 3: Recipients of Benazir Income Support Programme

3.2. Satisfaction with electricity servicese

In next step, we asked households about their stratification with electricity services and understanding of issues related to electricity provision in their areas. The study results show that more than 61% of the households in MEPCO area in South (60%) are satisfied with electricity service, whereas the rate of satisfaction is very low in IESCO area. The results show that about two-third of the respondents in Kahuta area showed their dissatifcation with electricy services in their area. This implies that that even though IESCO is the best performing DISCO, its customers demand better service delivery. This is likely to be because of awareness and more literacy in the North presented in Fig. 4. On the other hand, consumers in South are reasonably satisfied with the service of MEPCO which not one of the best DISCOs in Punjab, and there are many issues with the quality of the service.

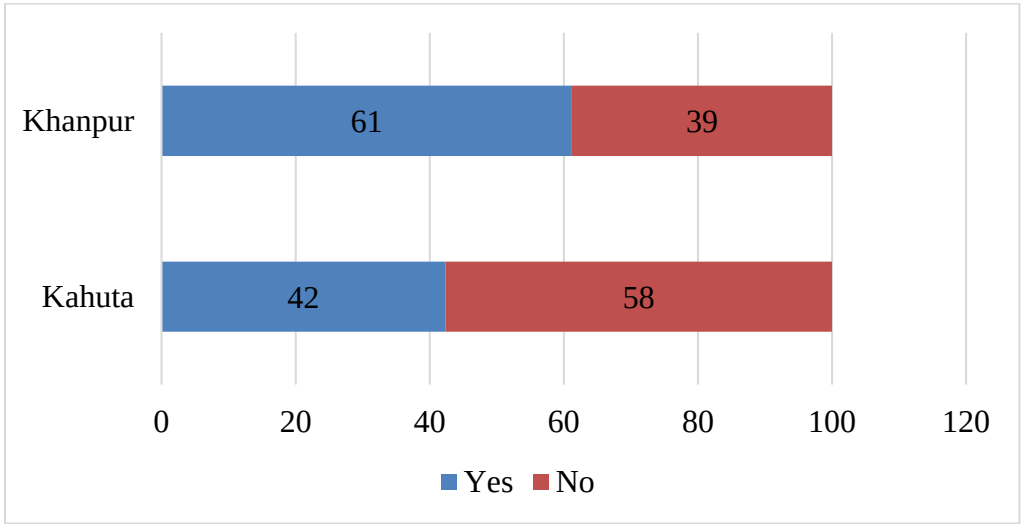

Figure 4: Satisfaction with electricity service delivery

3.3. Understanding & Perception About Electricity Bill

The satisfaction with electricity services may be linked to a number of factors. We further asked respondents about their understanding and perception about electricity bill (Figure 5). A good understanding of the bill

might have some impact on their satisfaction with electricity service. The study results as presented in figure 4 show that majority of the surveyed electricity consumers fully or partially understand their electricity bill. However, the percentage of people who partially understand their electricity bill is more in the North (73.9%) as compared to South (32.7%). This difference can be attributed to the difference in the level of education and awareness level in the Northern and Southern of Punjab. In spite of the fact that a large number of consumers do not understand their electricity bill (23.7% in South and 18.9% in North), there is no initiative from the service providers to enhances the awareness of the consumers.

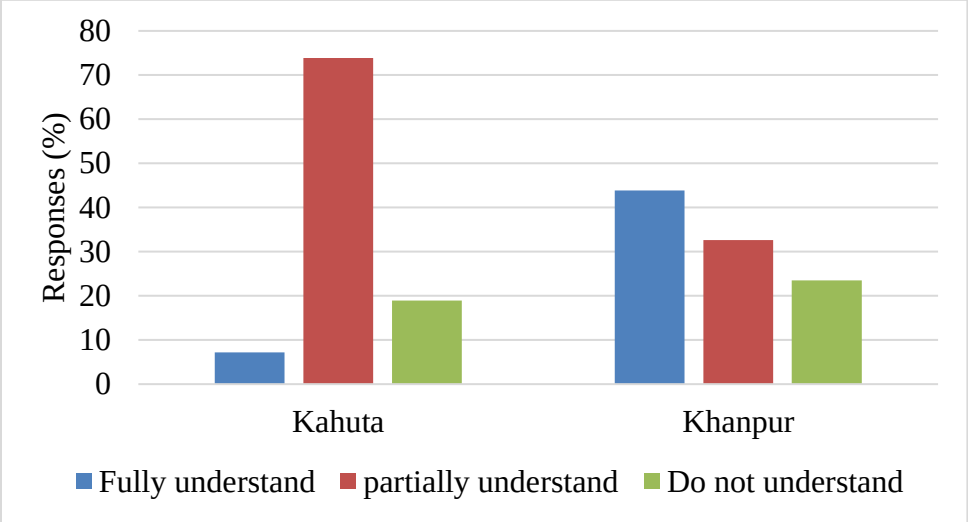

Figure 5. Understanding of electricity bill

Further, we probed hosueholds about their perceptions regarding fairness of electricity price (Figure 6). According to the study results, most of the people in North Punjab (65.8%) think the price of electricity is fair while majority in the South (60.2%) think it is not fair. This again is linked to the disparity of socio economic conditions between the two areas as the consumers in the North are better off and have more purchasing power and ability to pay whereas people in South have limited purchasing power and it is difficult for them to afford exorbitant electricity bills.

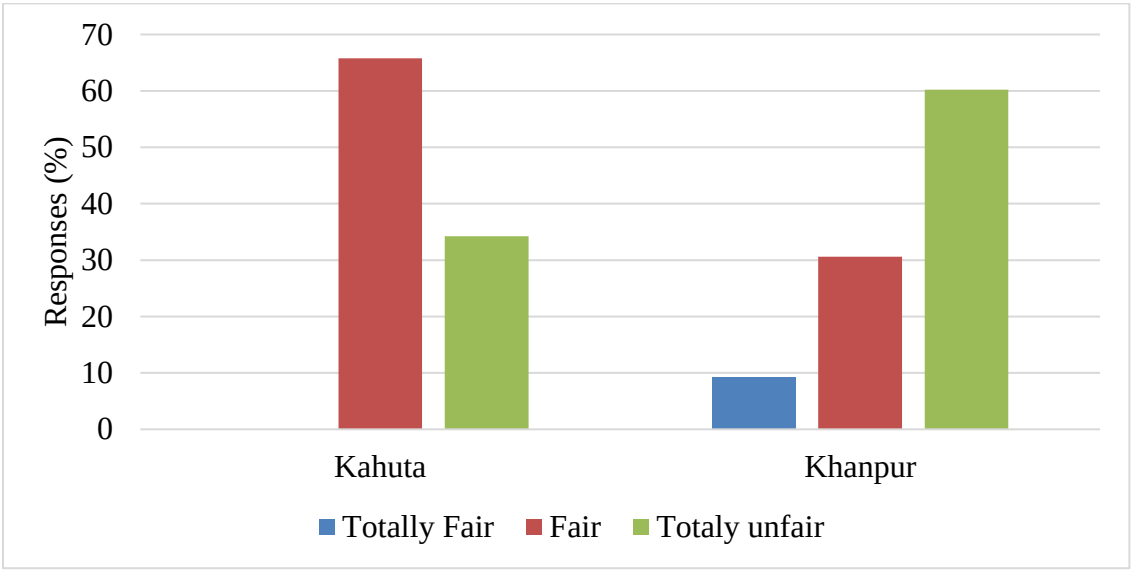

Figure 6. Fairness of electricity price/bill

3.4. Issues related to electricity servicese

In next step, we asked households about particular issues related to electricity supply in their area (Figure 7). According to the study results, majority of the hosueholds in Kahuta area indicate load shedding as one of the biggest issue relate to electricity services. Whereas, only 18% of the respondents in Khanpur reported the problem of loadshedding. Similalry issue of low voltage was raised by a number of respondents in Kahuta. However, few of the hosueholds in Khanpur also reported low voltage in their area. Further, only few of the households also reported hassle and problem in paying their bills or supply supply rectification.

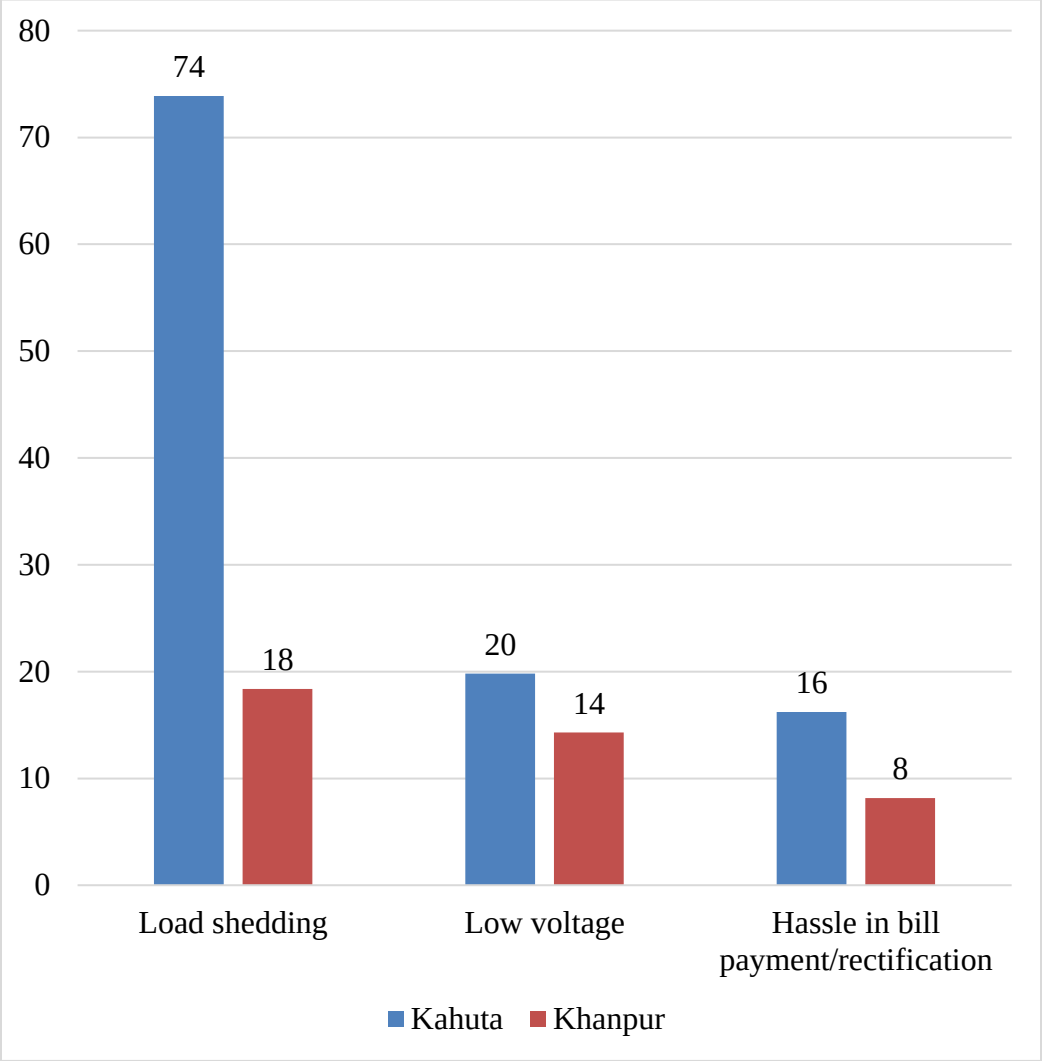

Figure 7. Issues with electricity service delivery

3.5. Willingness to pay for improve services

Regarding willingness to pay for better service delivery, most of the respondents in the North (70%) were positive regarding their willingness to pay more if the quality of electricity service delivery is improved (Figure 8). On the other and only (31%) of respondents were in favor of paying more as a result of improvement in the service presented in Fig. 5. This difference is again due to the disparity in the economic conditions of people in the North and South of Punjab.

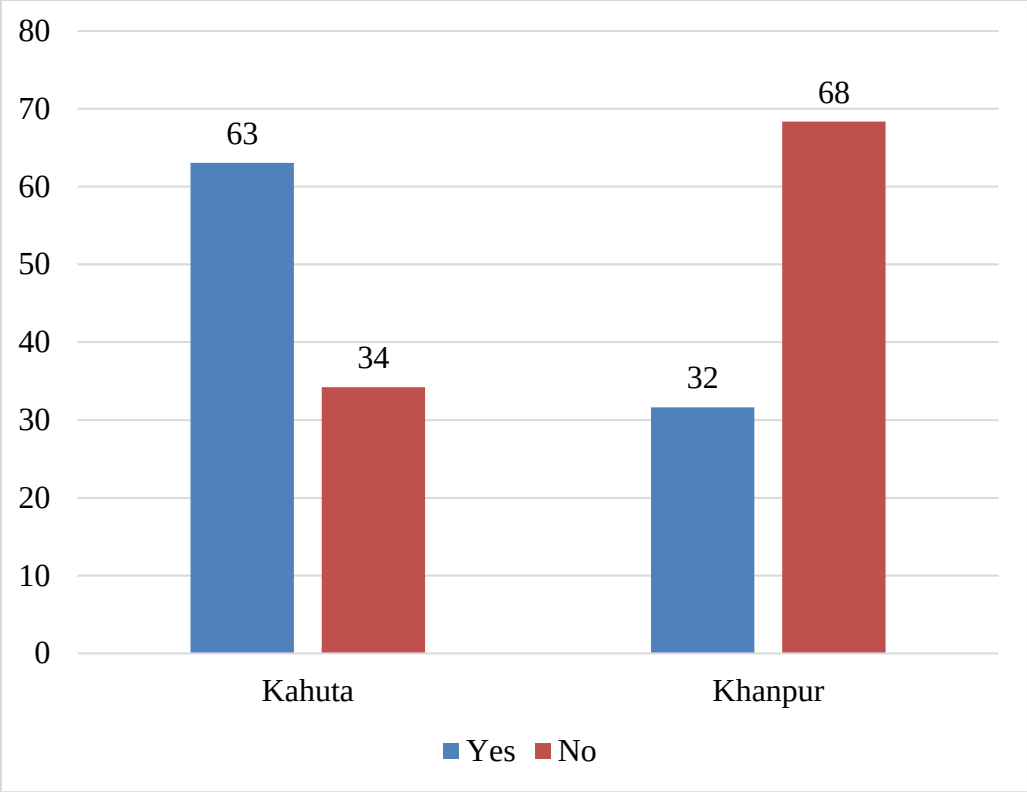

Figure 8: Willingness to pay for improved electricity service delivery

3.5 Determinants of Willingness-to-Pay for Improved electricity services

In the empirical analysis, to quantify explanatory variables affecting rural household's choice of paying more for improved and better service delivery of electricity a logistic regression model was used. The coefficient of logistic regression provides us information about the direction of the effect of the independent variable and the marginal effects that explain the impact of a unit change in the explanatory variable on the dependent variable is shown in Table 2. The findings of logit regression indicated that Kahuta city, daily load shedding hours, average monthly consumption and satisfaction with quality, intention to adopt energy conservation measures, and BISP membership imperative and significant factors in determining the household's WTP behavior. The negative coefficient of household's size indicates that large families reduce the per capita income and this eventually leads to low affordability issues. Therefore, when the rural population will have more sources of income then will consume more energy and that leads to more WTP for improved services. Our results are in line with the findings of (Entele, 2020) and (Gunatilake, Maddipati and Patail, 2012). Our findings recommend that with an increase in household income, the WTP also increases. Education of the household's head (decision maker) expands his/her information on energy conservation strategies and also results of better delivery services, its effect at household level and effect the head decision making in terms of WTP for better services. As (Raza *et al.*, 2019) and (Wang, Ma and Bai, 2019) documented that educated people are more willing to participate in environmental and human-friendly activities. Furthermore, BISP membership coefficient is negatively and statistically significant, which reflects the situation of poverty in the surveyed area. The reason is that BISP members are those females (hosehold head) which are divorced, widowed, and having no means of income and only get amount equivalent to 67$ per month (Oxford Policy Management, 2014). Therefore, mostly people in the Southern part of Punjab are not able to spend on improved services due to high level of poverty in the rural areas. Hence, government should provide any assistance to private sector for estabilishing industry in the rural area that lead to generate employment oppurtunities in these under developed are. Furthermore, government shoud also start some development projects which also create jobs in these areas. Daily load shedding

(hours) found to be significantly and positively influenced the WTP behavior of the rural household. An increase in load shedding hours badly affects the daily life of the people in the shape of financial and social losses (Lodhi and Malik, 2013; Umar and Kunda-Wamuwi, 2019). Electricity has now become an essential need for human beings and if its availability existed with interruptions and low quality, people will ask for better and improved services. Hence, people will be willing to spend more for reliable and good quality service. However, we have seen the load shedding hours significantly influencing the behavior but fairness of bills and non-payment of bills factors have no positive impact on the behavior. These results show that respondents have doubts on the fairness of bill and non-payment of bills is commonly exist in the surveyed area. Therefore, distribution companies MEPCO and IESCO should take necessary actions to build the confidence of the consumers and enhance the efforts to ensure transparency in the bill calculation and take strict actions for increasing the revenues. If these habits will continue then consumers will not ready to pay for improve and reliable supply of electricity. This eventually effects the economic growth of the rural areas.

Table 2: Results of logistic regression: Willingness-to-Pay for improvements in electricity

VARIABLES	**Coefficients**	**Marginal Effects**
Intentions to adopt energy conservation measures	0.832** (0.408)	0.214** (0.101)
City (binary, 1 located in Kahuta and zero otherwise	2.056*** (0.455)	0.5125*** (0.113)
Education (years)	0.261*** (0.049)	0.0647*** (0.012)
Household size (numbers)	-0.0368 (0.073)	-0.0089 (0.018)
Fairness of bill (binary, 1 if electricity is fairly priced and zero otherwise)	0.522 (0.875)	0.132 (0.218)
Non-payment of bills (binary, 1 if bills are not paid often and zero otherwise)	0.55 (0.471)	0.136 (0.117)
Average monthly consumption (kWh)	0.0088*** (0.00317)	0.0021*** (0.0007)
Satisfied with electricity quality (1 if satisfied and zero otherwise)	0.744* (0.429)	0.183* (0.107)
BISP (1 if HH is supported by BISP)	-1.234** (0.528)	-0.307** (0.131)
Daily Load shedding (hours)	0.141* (0.082)	0.0348* (0.020)
Constant	-6.142*** (1.195)	
Observations	208	
LR chi2(10)	121.80	
Prob > chi2	0.0000	
Log likelihood	-83.26	
Pseudo R2	0.42	
Classification Table (value)	78.5	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4. CONCLUSION

This study is conducted in rural areas of two cities having different electricity services being provided by MEPCO and IESCO during December 2019 and February 2020. We interviewed around 200 hosueholds using a semi-structured interviews. The main purpose of the study was to assess local satisfaction with electricity services and examine the factors that affect hoseuholds' willingness to pay for improved services. The study reveals important findings. The findings of this study showed that in rural area of Pakistan majority of the people are aware of low standards and poor quality in electricity supply and willing to pay for the improved and quality delivery while small percentage of the respondents were not aware and not willing to pay. Currently, in Pakistan, almost 63% of the population lived in the rural areas and this portion of the society is experiencing low quality basic utilities. The empirical results revealed that educated household is more willing to pay. Furthermore, intention to adopt energy conservation is also influencing the household WTP behavior. Therefore, policy makers and rural development expert, NGOs should work on the introduction of the energy conservation measures among the rural population.

Furthermore, the results of the BISP membership indicate that high level of poverty in the southern districts of the Punjab province, which reflects the uneven distributions of development funds. This harkens back to the biased and weakness of the development policy which created huge poverty and low quality of life in these areas of the province. As the result of this study showed that infrastructure in southern part is not very good, therefore power distribution companies should invest more to upgrade the infrastructure likewise; people will be more willing to pay in the increase in tariff. Results regarding affordability of increased tariff and willingness to pay for improved services would help power planners to design appropriate tariff structures. Moreover, impartial analysis of differential electricity tariffs and political economy of reforms would open new avenues for future research in this area.

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