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ARE RURAL HOUSEHOLDS WILLING TO PAY FOR CLEAN ENERGY? EVIDENCE FROM SOUTH WEST NIGERIA

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Abstract. Modern energy services such as electricity offer social, economic and health benefits, particularly for rural households that depend wholly and solely on traditional fuels. Insight into rural household preferences and willingness to pay for clean energy is a key variable for suppliers to become more competitive in the retail market and for government to design energy policies. Therefore, this study was carried out to assess consumers' willingness to pay for renewable energy source(s) in Kajola Local Government Area of Oyo State. A multistage sampling procedure was employed to sample 200 household in the study area. Data was analysed using descriptive statistics, Likert scale and the logit model. Results showed that a majority of the respondents were willing to pay for improved hydro-electricity (71%) and solar lamps (58.5%) while about 13% and 27.5% of them were willing to pay for solar PV and biomass respectively. Further, the logit models revealed that bid, age, sex, marital status, household size, per capital expenditure and year of education were the prime drivers of respondents' willingness to pay for clean energy. The respondents were willing to pay for clean energy source given that the prices were not too high.

Keywords: renewable energy, contingent valuation, perception, bid

INTRODUCTION

Energy and energy sources are necessary for the economic development and survival of humans on earth. Clean energy is defined as renewable energy (RE) sources characterized by natural energy flows useful for human purposes (Gristsevskyi, 2008). Clean energy affects the demand for and supply of conventional energy and may have positive effects on the energy system, the environment and the economy. Such energies are better than traditional fossil fuels because they are clean and pollution-free, and are produced through energy savings and renewable energy generation. Therefore, they represent a sustainable form of energy (CPP, 2011).

Clean energy can generate broad and diverse economic benefits that largely differ across economic sectors and over time. Investments in clean energy mean more energy cost savings for consumers. They also improve air quality, reduce the adverse public health effects, decrease the number of air pollution related hospitalizations, and increase productivity. Therefore, clean energy has the potential to increase the Gross Domestic Product of a nation. In agriculture, Renewable Energy Technologies (RETs) are more crucial to income-generation than lighting. They enable food preservation (for instance, drying, smoking, chilling and freezing) and can improve income by preventing post-harvest losses between gathering and commercialization. This is particularly critical for producers who are distant from, or have difficult access to, markets. RET-enabled preservation also creates the ability to take advantage of short-term arbitrage of goods (White, 2002). Therefore, choosing

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a cleaner development path based on low-carbon energy alternatives will reduce greenhouse gas (GHG) emissions; ensure sustainable consumption and production patterns of natural fuel; and combat climate change and its debilitating impacts, thereby meeting the twelfth and the thirteenth Sustainable Development Goals.

Despite the aforementioned roles of clean energy, roughly 1.6 billion people worldwide do not have access to electricity in their homes, representing slightly more than one quarter of the world population. Most of the electricity-deprived people live in South Asia and sub-Saharan Africa. They rely on wood biomass as a source of energy and must collect and burn straw, dung, and scraps of wood to cook their meals. They often live without refrigeration, radios and even light (REN21, 2007).

Nigeria has abundant but untapped renewable energy resources in varying combinations of solar, wind, geothermal, and biomass power. Renewable energy penetration in Nigeria is still in its nascent stage, and the country's only source of renewable energy is hydropower, biomass, wind and solar power, deployed only to an infinitesimal extent (Renewable 2007 Global Status Report). The country has significant biomass resources to address both traditional and modern energy uses, including electricity generation; however, its potential is yet to be harnessed significantly (Ighodaro, 2010; Murtala et al., 2012; Oyedepo, 2014). Currently, the hydro-energy technology is a prominent source of renewable commercial energy in the country's electricity supply mix. It represents a potential of about 8,824 MW with an annual electricity generation potential in excess of 36,000 GWh which, however, has not been fully exploited (Emodi, 2016; Oladeji, 2014). Nigeria is located within a high sunshine belt. Solar radiation is well distributed and the annual solar energy available is about 27 times that of the country's total fossil fuel resource, and is over 115,000 times the electrical power generated (Augustine and Nnabuchi, 2009). Therefore, renewable energy (RE) is the best option for a sustainable diversification of energy sources, and a major way to address the problem of clean energy provision (Ahuja and Tatsutani, 2009).

Because of its population, Nigeria offers a large market for renewable energy and has better opportunities than most of other African countries for investments in the renewable energy sector. Although there is a limited but growing appreciation of the potential market and benefits for solar energy in Nigeria, the level of renewable energy dissemination in Nigeria is very low (almost negligible). The rate of renewable energy uptake in the country is not at par with that of the global renewable industry (Sesan, 2008). Being the largest country in the African continent, Nigeria has a share of about 60 percent (over 95 million people) in the African population without access to electricity supply (Malo, 2017). Fuel wood is the most widely used, supplying over 80 percent of household energy, while less than 20 percent is supplied by other sources and supplemented by small quantities of coal and charcoal (Sesan, 2008).

Previous studies have focused on attitudes towards green energy and on acceptance of renewable energy (Ek, 2005; Jobert et al., 2007; Mallett, 2007; Roe et al., 2001; Zoellner et al., 2005). Others examined the amount that consumers are willing to pay, as a premium, for renewable energy investments, and the role of socio-demographic determinants in developed countries, for instance in Italy (Bollino and Polinori, 2007) and Korea (Ku and Yoo, 2010). Previous studies on renewable energy in Nigeria focused on the country's electricity consumption and economic growth (Akinlo, 2009; Akinwale et al., 2013) and on descriptive analyses of RET awareness (Akinwale et al., 2014). As the use of clean energy is still low in Nigeria compared to developed countries, there are not enough socioeconomic studies on the local population's Willingness-to-Pay (WTP) for clean energy. Therefore, this study contributes to the existing literature on clean energy in Nigeria by investigating the willingness of rural people to pay for clean energy in Kajola Local Government Area of Oyo State.

THEORETICAL FRAMEWORK

An accurate measure of the value attached by the population to improved energy sources is their willingness to pay (WTP) for clean energy (Spencer, 1996). This is defined as the highest amount an individual is willing to pay for renewable energy (Gil et al., 2000). WTP is an interesting aspect because it allows, by cumulating the buyers who accept to pay the price p (or a higher price), to determine the quantity q purchased at that sale price. The conventional welfare measures for price changes are compensating and equivalent variations which correspond to the maximum amount an individual would be willing to pay (WTP) to secure changes (Adepoju and Omonona, 2009). A Hicksian surplus measure, the willingness to pay can be expressed in a number of equivalent ways (Lusk and Hudson, 2004).

The willingness to pay can be explained with the consumer utility theory. In this instance, an individual has preferences for various energy sources whose consumption is denoted by vector *X*. Also, there is hydroelectricity whose consumption (q) is the most preferred one, and *S* is the index of a good's quality. The individual consumption (q) is exogenous, although consumers can easily vary their consumption of *X* (Hanemann, 1991). The consumer takes the level of q as given and chooses the level of a market good *Xm* that maximizes utility. The result is an ordinary (Marshallian) demand function $Xm(p, y, q)$ and an indirect utility function $v(p, y, q)$; p is the market price of the goods and y is the income (Lusk and Hudson, 2004). Assuming that the quality of energy improves when moving from traditional hydroelectricity to improved hydroelectricity (i.e. from q_1 to q_2) with prices and income remaining constant (p, y), the individual changes his/her utility from $U_1 = (p, y, q)$ to $U_2 = (p, y, q_2) \geq U_1$ (Hanemann, 1991). The compensating variation (C) measure of this change (intended to improve the individual's well-being) before changes (U_1) is defined as:

$$V(p, y\text{-}c, q_2) = v(p, y, q_1) \qquad (1)$$

This is a measurement of the value the consumer places on the improvement in energy quality. It can be derived by determining the magnitude of WTP such that the following equality holds (Lusk and Hudson, 2004):

$$V(p, y\text{-WTP}, q_2) = v(p, y, q_1) \qquad (2)$$

The consumer would be willing to pay compensating variation (CV) in order to secure this quality change.

MATERIALS AND METHODS

This study was carried out in Kajola Local Government area (Oyo State), with an estimated land area of 609 sq. km and a population of 2,009,997 (population census as at 2006). The territory is located in the Southern Guinea savannah region with average temperatures ranging from 21°C to 29°C, which means favorable conditions for the cultivation of crops such as yam, maize, cassava, millet, sorghum, palm tree and cashew. A multi-stage random sampling procedure was employed in the selection of 200 rural respondents. The first stage of the sampling was the random selection of Kajola Local Government Area (LGA) among the rural LGAs in Oyo state. Five wards were also selected randomly from a total of eleven wards in this LGA. The final stage was the random selection of 200 respondents pro rata to the population of the wards. Information on the households' socioeconomic characteristics and their willingness to pay for clean energy was obtained from the respondents. The clean energies investigated were uninterrupted hydroelectricity, solar photovoltaic (solar PV) energy, solar lamps and biomass

The data was collected in September 2015 using the Contingent Valuation Method (CVM) which enables the calculation of WTP and price elasticity. First, respondents were requested to express their WTP for a product (open-ended contingent valuation: "Kindly indicate if you would accept to pay an extra amount of money for improved electricity, wind energy, or biomass"). They were later asked to answer several successive questions on whether they would, or would not, buy the product at a given price (closed-ended contingent valuation: "Would you be willing to pay NGN[1] *X* for this offer?").

The logit regression was used to identify the correlates of the log likelihood of the willingness to pay for clean energy, because of its comparative mathematical simplicity and asymptotic characteristics, which constrained the predicted probabilities to a range of zero to one. A dichotomous logit model was used for this study, as specified by Ivanova (2012).

$$\text{Mean WTP} = (\alpha + \sum(\beta_1 \times X\text{a})/\beta_2) \times -1 \qquad (3)$$

With: α = constant; β_1 = coefficient of X variables; β_2 = coefficient of the bid price; Xa = mean value of X variables.

RESULTS AND DISCUSSION

Tables 1 to 4 present the profile of the respondents' willingness to pay for clean energy sources. Because electricity is a major driver of economic growth in any developing economy, poor access to electricity has been a major impediment to Nigeria's economic growth (Ogundipe and Apata, 2013). Recently, the National Electricity Regulatory commission has approved the abolition of the fixed maintenance fee while increasing the electricity tariff by an average of 49% with effect from February 2016. However, the

[1] Naira (NGN) is the unit of currency in Nigeria.

Table 1. Profile of respondents' willingness to pay 25% increase in tarrif for uninterrupted hydro-electricity
Tabela 1. Skłonność respondentów do płacenia o 25% więcej za nieprzerwaną dostawę energii elektrycznej uzyskiwanej z systemów hydroenergetycznych

Socio-economic characteristics Cechy społeczno-gospodarcze	Not willing to pay Brak skłonności do zapłaty (N = 58)	Willing to pay Skłonność do zapłaty (N = 142)	Pooled Łącznie (N = 200)
1	2	3	4
Age (years) – Wiek (lata)			
< 30	8.62	15.49	13.5
31–40	12.07	30.28	25.0
41–50	24.14	41.55	36.5
51–60	22.41	12.68	15.5
> 60	32.76	0	9.5
Total – Razem	100	100	100
Sex – Płeć			
Male – Mężczyzna	72.41	59.86	63.5
Female – Kobieta	27.59	40.14	36.5
Total – Razem	100	100	100
Marital status – Stan cywilny			
Single – Osoba samotna	15.52	17.61	17.0
Married – Żonaty/zamężna	43.10	77.46	67.5
Widowed – Wdowiec/wdowa	37.93	3.52	13.5
Divorced – Osoba rozwiedziona	3.45	1.41	2.0
Total – Razem	100	100	100
Religion – Wyznanie			
Islam	62.07	59.15	60.0
Christianity – Chrześcijaństwo	36.21	40.85	39.5
Traditionalist – Religie tradycyjne	1.72	0	0.5
Total – Razem	100	100	100
Educational level – Poizom wykształcenia			
No formal education – Brak formalnego wykształcenia	36.21	0	10.5
Primary school – Podstawowe	29.31	7.04	13.5
Junior sec school – Gimnazjalne	12.07	9.86	10.5
Senior sec school – Średnie	15.52	54.23	43.0
Tertiary institution – Policealne/wyższe	6.90	28.87	22.5
Total – Razem	100	100	100

Table 1 cont. – Tabela 1 cd.

1	2	3	4
Occupation – Aktywność zawodowa			
Farming – Rolnictwo	60.34	18.31	30.5
Artisan – Rzemiosło	13.79	30.28	25.5
Civil servant – Stanowisko urzędnicze	8.62	28.17	22.5
Trading – Handel	17.24	23.24	21.5
Total – Razem	100	100	100
Household size – Liczba osób w gospodarstwie			
1–3	27.59	25.35	26.0
4–6	51.72	69.01	64.0
> 6	20.69	5.63	10.0
Total – Razem	100	100	100
Income – Dochód			
First quintile – Pierwszy kwintyl	65.52	30.99	41.0
Second quintile – Drugi kwintyl	17.24	19.72	19.0
Third quintile – Trzeci kwintyl	10.34	21.13	18.0
Fourth quintile – Czwarty kwintyl	3.45	14.79	11.5
Fifth quintile – Piąty kwintyl	3.45	13.38	10.5
Total – Razem	100	100	100
Membership of cooperative – Członkostwo w spółdzielni			
Belong – Tak	84.48	80.99	82.0
Not belong – Nie	15.52	19.01	18.0

Source: own elaboration.
Źródło: opracowanie własne.

new tariff regime met a stiff opposition by the consumers because of the need for uninterrupted power supply. Results showed that the majority of the respondents were willing to pay for uninterrupted hydroelectricity (71%) as it is the major source of power supply in Nigeria, and its benefits are well-known to the entire population, whether connected or not to the national grid. With the incessant supply of this form of energy, most consumers and non-consumers alike were willing to pay for uninterrupted hydroelectricity supply. The proportion of respondents willing to pay for uninterrupted hydroelectricity supply initially increases with age but then declines as the consumers advance in age. This suggests that elderly rural dwellers might just be satisfied with the incessant hydroelectricity supply and not willing to pay any premium for improved service. This could be because these respondents were not in their economically active years, and therefore had reduced incomes. More than three quarters of female respondents and about two thirds of male respondents were willing to pay for uninterrupted hydroelectricity supply. This suggests that female rural residents were more willing to pay for improved and stable hydroelectricity. This might be because stable power supply will empower them in their domestic responsibilities, providing them with the ability to

Table 2. Profile of respondents' willingness to pay for Solar PV
Tabela 2. Skłonność respondentów do płacenia za słoneczną energię fotowoltaiczną

Socio-economic characteristics Cechy społeczno-gospodarcze	Not willing to pay Brak skłonności do zapłaty (N = 173)	Willing to pay Skłonność do zapłaty (N = 27)	Pooled Łącznie (N = 200)
1	2	3	4
Age (years) – Wiek (lata)			
< 30	14.45	7.41	13.5
31–40	23.70	33.33	25.0
41–50	35.26	44.44	36.5
51–60	15.61	14.81	15.5
> 60	10.98	0	9.5
Total – Razem	100	100	100
Sex – Płeć			
Male – Mężczyzna	64.74	55.56	63.5
Female – Kobieta	35.26	44.44	36.5
Total – Razem	100	100	100
Marital status – Stan cywilny			
Single – Osoba samotna	18.50	7.41	17.0
Married – Żonaty/zamężna	64.16	88.89	67.5
Widowed – Wdowiec/wdowa	15.03	3.70	13.5
Divorced – Osoba rozwiedziona	2.31	0	2.0
Total – Razem	100	100	100
Religion – Wyznanie			
Islam	59.54	62.96	60.0
Christianity – Chrześcijaństwo	39.88	37.04	39.5
Traditionalist – Religie tradycyjne	0.58	0	0.5
Total – Razem	100	100	100
Educational level – Poizom wykształcenia			
No formal education – Brak formalnego wykształcenia	12.14	0	10.5
Primary school – Podstawowe	15.03	3.70	13.5
Junior sec school – Gimnazjalne	10.98	7.41	10.5
Senior sec school – Średnie	45.07	29.63	43.0
Tertiary institution – Policealne/wyższe	16.76	59.26	22.5
Total – Razem	100	100	100

Table 2 cont. – Tabela 2 cd.

1	2	3	4
Occupation – Aktywność zawodowa			
Farming – Rolnictwo	33.53	11.11	30.5
Artisan – Rzemiosło	28.32	7.41	25.5
Civil servant – Stanowisko urzędnicze	17.34	55.56	22.5
Trading – Handel	20.81	25.93	21.5
Total – Razem	100	100	100
Household size – Liczba osób w gospodarstwie			
1–3	27.17	18.52	26.0
4–6	62.43	74.07	64.0
> 6	10.40	7.41	10.0
Total – Razem	100	100	100
Income – Dochód			
First quintile – Pierwszy kwintyl	45.66	11.11	41.1
Second quintile – Drugi kwintyl	20.23	11.11	19.0
Third quintile – Trzeci kwintyl	17.92	18.52	18.0
Fourth quintile – Czwarty kwintyl	9.83	22.22	11.5
Fifth quintile – Piąty kwintyl	6.36	37.04	10.5
Total – Razem	100	100	100
Membership of cooperative – Członkostwo w spółdzielni			
Belong – Tak	82.08	81.48	82.0
Not belong – Nie	17.92	18.56	18.0

Source: own elaboration.
Źródło: opracowanie własne.

use lighting, refrigerating and blending appliances, to mention just a few.

The mean household size was 4 ±2 members. Large households were the least willing to pay for uninterrupted hydroelectric supply while the highest willingness to pay was demonstrated by those with four to six members. The results further showed that farmers were the least responsive while artisans were the most willing to pay a premium for stable hydroelectricity. Note that rural farmers use primitive production and processing techniques that do not require the use of electric power. This supports the assertion that electricity is crucial for the productivity and a major driver of micro and small-scale entrepreneurship in Nigeria.

The installation of solar PVs is a nascent development in Nigeria. While most Nigerian households are connected to hydroelectricity, solar PVs are very rare in the urban centers, let alone in the rural areas, owing to the high installation costs. As shown in Table 2, a little above ten percent of the rural population were willing to pay for solar PVs, primarily because of its installation-related expenses. With an average monthly income of NGN 28,864.50, most of the rural milieu might not be able to afford a minimum cost of installation of about

Table 3. Profile of respondents' willingness to pay for solar lamp
Tabela 3. Skłonność respondentów do płacenia za lampy solarne

Socio-economic characteristics Cechy społeczno-gospodarcze	Not willing to pay Brak skłonności do zapłaty (N = 83)	Willing to pay Skłonność do zapłaty (N = 117)	Pooled Łącznie (N = 200)
1	2	3	4
Age (years) – Wiek (lata)			
< 30	14.46	12.82	13.5
31–40	21.69	27.35	25.0
41–50	22.89	46.15	36.5
51–60	18.07	13.68	15.5
> 60	22.89	0	9.5
Total – Razem	100	100	100
Sex – Płeć			
Male – Mężczyzna	60.24	65.81	63.5
Female – Kobieta	39.76	34.19	36.5
Total – Razem	100	100	100
Marital status – Stan cywilny			
Single – Osoba samotna	19.28	15.38	17.0
Married – Żonaty/zamężna	48.19	81.20	67.5
Widowed – Wdowiec/wdowa	27.71	3.42	13.5
Divorced – Osoba rozwiedziona	4.82	0	2.0
Total – Razem	100	100	100
Religion – Wyznanie			
Islam	62.65	58.12	60.0
Christianity – Chrześcijaństwo	36.14	41.88	39.5
Traditionalist – Religie tradycyjne	1.21	0	0.5
Total – Razem	100	100	100
Educational level – Poziom wykształcenia			
No formal education – Brak formalnego wykształcenia	25.30	0	10.5
Primary school – Podstawowe	21.69	7.69	13.5
Junior sec school – Gimnazjalne	8.43	11.79	10.5
Senior sec school – Średnie	34.94	48.72	43.0
Tertiary institution – Policealne/wyższe	9.64	31.62	22.5
Total – Razem	100	100	100

Table 3 cont. – Tabela 3 cd.

1	2	3	4
Occupation – Aktywność zawodowa			
Farming – Rolnictwo	45.78	19.66	30.5
Artisan – Rzemiosło	22.89	27.35	25.5
Civil servant – Stanowisko urzędnicze	10.84	30.77	22.5
Trading – Handel	20.48	22.22	21.5
Total – Razem	100	100	100
Household size – Liczba osób w gospodarstwie			
1–3	32.53	21.37	26.0
4–6	51.81	72.65	64.0
> 6	15.66	5.98	10.0
Total – Razem	100	100	100
Income – Dochód			
First quintile – Pierwszy kwintyl	62.65	25.64	41.1
Second quintile – Drugi kwintyl	16.87	20.51	19.0
Third quintile – Trzeci kwintyl	12.05	22.22	18.0
Fourth quintile – Czwarty kwintyl	6.02	15.38	11.5
Fifth quintile – Piąty kwintyl	2.41	16.24	10.5
Total – Razem	100	100	100
Membership of cooperative – Członkostwo w spółdzielni			
Belong – Tak	79.51	83.76	82.0
Not belong – Nie	20.48	16.24	18.0

Source: own elaboration.
Źródło: opracowanie własne.

NGN 100,000 (USD 330) for a 1 kVA solar PV, depending on its country of origin. This is buttressed by the fact that WTP for a solar PV increases with income and educational levels. Furthermore, the highest proportion (55%) of those willing to pay for solar PVs were civil servants, with a regular source of income. Similarly to the response to improved hydroelectric power supply, the share of respondents willing to pay for the installation of a solar PV initially increases with age but then declines as the consumers advance in age.

Because most rural areas in Nigeria are not connected to the national grid, combined with the fact that solar lamps are much cheaper than the installation of a solar PV (a solar lamp can be purchased at NGN 6,000 [USD 20]), a higher percentage (58.5%) of the respondents were willing to pay for a solar lamp. However, a higher proportion of male respondents were willing to pay for the solar lamp than their female counterparts (Table 3). Households with four to six members were the most willing to pay while those with more members were the least willing to pay for solar lamps. Notably, the WTP increased with educational levels. Also, a higher percentage of civil servants, artisans and traders were willing to pay for solar lamps. Conversely, a larger share

Table 4. Profile of respondents' willingness to pay for biomass energy
Tabela 4. Skłonność respondentów do płacenia za energię z biomasy

Socio-economic characteristics Cechy społeczno-gospodarcze	Not willing to pay Brak skłonności do zapłaty (N = 145)	Willing to pay Skłonność do zapłaty (N = 55)	Pooled Łącznie (N = 200)
1	2	3	4
Age (years) – Wiek (lata)			
< 30	16.55	5.46	13.5
31–40	24.83	25.46	25.0
41–50	30.35	52.73	36.5
51–60	15.17	16.36	15.5
> 60	13.10	0	9.5
Total – Razem	100	100	100
Sex – Płeć			
Male – Mężczyzna	64.14	61.82	63.5
Female – Kobieta	35.86	38.18	36.5
Total – Razem	100	100	100
Marital status – Stan cywilny			
Single – Osoba samotna	20.69	7.27	17.0
Married – Żonaty/zamężna	60.69	85.46	67.5
Widowed – Wdowiec/wdowa	15.86	7.27	13.5
Divorced – Osoba rozwiedziona	2.76	0	2.0
Total – Razem	100	100	100
Religion – Wyznanie			
Islam	61.38	56.36	60.0
Christianity – Chrześcijaństwo	37.93	43.64	39.5
Traditionalist – Religie tradycyjne	0.69	0	0.5
Total – Razem	100	100	100
Educational level – Poziom wykształcenia			
No formal education – Brak formalnego wykształcenia	14.48	0	10.5
Primary school – Podstawowe	17.93	1.82	13.5
Junior sec school – Gimnazjalne	11.72	7.27	10.5
Senior sec school – Średnie	40.69	49.09	43.0
Tertiary institution – Policealne/wyższe	15.17	41.82	22.5
Total – Razem	100	100	100

Table 4 cont. – Tabela 4 cd.

1	2	3	4
Occupation – Aktywność zawodowa			
Farming – Rolnictwo	36.55	14.55	30.5
Artisan – Rzemiosło	29.66	14.55	25.5
Civil servant – Stanowisko urzędnicze	15.86	40.0	22.5
Trading – Handel	17.93	30.91	21.5
Total – Razem	100	100	100
Household size – Liczba osób w gospodarstwie			
1–3	28.28	20.0	26.0
4–6	60.0	74.55	64.0
> 6	11.72	5.45	10.0
Total – Razem	100	100	100
Income – Dochód			
First quintile – Pierwszy kwintyl	52.41	10.91	41.0
Second quintile – Drugi kwintyl	21.38	12.73	19.0
Third quintile – Trzeci kwintyl	13.10	30.91	18.0
Fourth quintile – Czwarty kwintyl	6.90	23.64	11.5
Fifth quintile – Piąty kwintyl	6.21	21.82	10.5
Total – Razem	100	100	100
Membership of cooperative – Członkostwo w spółdzielni			
Belong – Tak	80.0	87.27	82.0
Not belong – Nie	20.0	12.73	18.0

Source: own elaboration.
Źródło: opracowanie własne.

of farmers were not willing to pay for solar lamps which can be attributed to low returns from traditional farming systems prevalent in the study area.

Less than a third of the respondents (27.5%) were willing to pay for biomass energy from animal dung[2]. This might be because of the foul source of this energy. A higher proportion of both male and female respondents were not willing to pay for biomass. However, the majority of those willing to pay for biomass were male. As previously observed, civil servants were the most willing to pay for biomass energy while farmers were the least willing to do so. Also, those with four to six members were the most willing to pay for biomass energy. On the other hand, households with more than six members were the least willing to do so. Additionally, married respondents would be more willing to pay for biomass energy than their single, widowed or divorced counterparts. The willingness to pay for biomass increased with educational levels. Note also that the majority of those willing to pay were members of

[2] As the rural households had no toilet facility, they disposed their faecal waste into the bush. Thus, they had no reservoir for human excrements.

a cooperative society. This suggests that education and membership of a cooperative society have a positive impact on the WTP for biomass energy.

DETERMINANTS OF THE WILLINGNESS TO PAY FOR CLEAN ENERGY

Tables 5 and 6 present the coefficients of the determinants of the willingness to pay (WTP) for renewable energy source(s) and the marginal effects after the logit transformation. The consumers' WTP for uninterrupted hydroelectricity supply decreased with their age, which is consistent with previous findings of Abdullah and Jeanty (2011) in Kenya; and Liu et al. (2013) in China. The marginal effect revealed that a one-year increase in the age of the rural respondents reduced the likelihood of WTP for improved hydroelectricity supply by 0.025 unit. Further, marital status had a significant effect on the willingness to pay a premium for improved hydroelectricity, solar lamp and biomass, suggesting that

Table 5. Determinants of willingness to pay for renewable energy sources
Tabela 5. Uwarunkowania skłonności do płacenia za energię ze źródeł odnawialnych

Variables Zmienne	Hydro power Energia wodna	Solar panel Panele słoneczne	Solar lamp Lampy solarne	Biomass Biomasa
Bid – Cena	–0.005** (0.003)	–0.002 (0.002)	–0.008*** (0.002)	–0.003** (0.002)
Age – Wiek	–0.1506** (0.065)	–0.0132 (0.058)	–0.0245 (0.048)	0.0280 (0.048)
Sex – Płeć	0.0300 (0.486)	–0.140 (0.489)	0.864** (0.393)	0.096 (0.399)
Marital status Stan cywilny	3.027*** (0.944)	1.266 (1.059)	1.271* (0.692)	1.686** (0.849)
Years of working experience Staż pracy	0.022 (0.065)	–0.061 (0.066)	–0.086* (0.051)	–0.044 (0.052)
Education Wykształcenie	2.735*** (0.560)	1.336* (0.763)	1.387*** (0.446)	1.960*** (0.591)
Diversification Zróżnicowanie źródeł energii	–0.720 (0.640)	–0.707 (1.249)	–0.672 (0.616)	–1.237 (1.136)
Household size Liczba osób w gospodarstwie	0.195 (0.174)	0.347* (0.213)	0.188 (0.145)	0.003 (0.174)
Membership of cooperative Członkostwo w spółdzielni	–0.278 (0.595)	0.106 (0.596)	0.392 (0.457)	0.579 (0.503)
Environmental benefits Korzyści dla środowiska	0.476 (2.184695)	0.234 (2.184695)	0.102 (1.617441)	–2.183 (1.885284)
PCE Wydatki konsumpcyjne	1.26e–05 (0.000)	5.66e–05* (0.000)	1.24e–05 (0.000)	–7.78e–07 (0.000)
Constant Stała	–8.681 (6.145)	–14.456 (10.794)	–21.875 (5.457)	–17.634 (8.093)

Figures in parenthesis (standard error); ***Significant at 1%; **Significant at 5%; *Significant at 10%.
Source: own elaboration.
W nawiasach podano błąd standardowy; ***Zmienna istotna na poziomie istotności 1%; **Zmienna istotna na poziomie istotności 5%; *Zmienna istotna na poziomie istotności 10%.
Źródło: opracowanie własne.

Table 6. Marginal effect of WTP for clean energy sources
Tabela 6. Efekt krańcowy skłonności do płacenia za energię z czystych źródeł

Variables Zmienne	Hydro Energia wodna	Solar panel Panele słoneczne	Solar lamp Lampy solarne	Biomass Biomasa
Bid – Cena	–0.001**	–0.000	–0.002***	–0.001**
	(0.000)	(.00016)	(0.001)	(0.000)
Age – Wiek	–0.023**	–0.001	–0.006	0.005
	(0.010)	(0.005)	(0.011)	(0.008)
Sex – Płeć	0.005	–0.012	0.208**	0.015
	(0.074)	(0.041)	(0.093)	(0.063)
Marital status Stan cywilny	0.618*** (0.161)	0.076 (0.047)	0.307** (0.157)	0.193** (0.068)
Years of working experience Staż pracy	0.003 (0.010)	–0.005 (0.005)	–0.020* (0.012)	–0.007 (0.008)
Education Wykształcenie	0.498*** (0.092)	0.096* (0.048)	0.330*** (0.100)	0.266*** (0.069)
Diversification Zróżnicowanie źródeł energii	–0.126 (0.128)	–0.048 (0.068)	–0.165 (0.152)	–0.153 (0.098)
Household size Liczba osób w gospodarstwie	0.030 (0.027)	0.028* (0.017)	0.045 (0.035)	0.001 (0.028)
Membership of cooperative Członkostwo w spółdzielni	–0.040 (0.081)	0.008 (0.046)	0.095 (0.113)	0.083 (0.064)
Environmental benefits Korzyści dla środowiska	0.083 (0.429)	0.083 (0.428)	0.025	–0.488 (0.402)
PCE Wydatki konsumpcyjne	1.92e–06 (0.000)	4.64e–06* (0.000)	–2.96e–06 (0.000)	–1.25e–07 (0.000)

Figures in parenthesis (standard error); ***Significant at 1%; **Significant at 5%; *Significant at 10%.
Source: own elaboration.
W nawiasach podano błąd standardowy; ***Zmienna istotna na poziomie istotności 1%; **Zmienna istotna na poziomie istotności 5%; *Zmienna istotna na poziomie istotności 10%.
Źródło: opracowanie własne.

being married increases the probability of the willingness to pay for these renewable energy sources. Similarly, educational attainment was significant and had a positive relationship with the WTP as regards the four sources of clean energy. The result of the marginal effect revealed that higher education levels of rural respondents increased the likelihood of WTP by 0.5 units, which is consistent with the findings from a study by Ertör-Akyazı et al. (2012) and Ivanova (2012) performed in Australia.

Both the household size and per capita monthly expenditure had a positive and significant relationship with the willingness to pay for the installation of a one-kVA solar PV. This implies that the willingness to pay for the above source of clean energy can be enhanced by improving the households' welfare, which is consistent with the findings from a study by Gerpott and Mahmudova (2010) performed in Germany. The log-likelihood of the WTP for solar lamp is higher for male consumers. However, the log-likelihood of the WTP for uninterrupted hydroelectricity supply, solar lamp and biomass energy reduces with the increment of their unit prices. A one-naira increase in the bid for these RETs will reduce the log-likelihood for the willingness to pay for the above sources of clean energy by 0.001, 0.002 and 0.001 respectively. This suggests that consumers were willing to pay for these clean energy sources at low premiums.

As calculated in the above table, the mean willingness to pay for hydro-energy, solar panels, solar lamps and biofuel is NGN 1,718.54, NGN 6,711.17, NGN 2,474.40 and NGN 25,655.00, respectively.

CONCLUSION

This study assessed the willingness to pay for renewable energy technologies in southwest Nigeria, and found that a positive relationship exists between higher education levels and the likelihood of the willingness to pay for RETs. Furthermore, the increase in the unit price and the large size of the household reduced the log-likelihood of the willingness to pay for clean energy sources. The lowest and the highest willingness to pay a premium for stable hydroelectricity was declared by farmers and artisans, respectively. This suggests that for suppliers, the knowledge acquired by rural households is the key to become more competitive in the retail market and to reduce the costs. This is because education is a way to enhance access to information, understand the benefits of technologies and consequently increase the willingness to pay for RETs. Thus, it is pertinent for Local Government Authorities to fully support and intensify their basic education campaigns among the rural dwellers (especially the farming, elderly and female population), so as to raise their awareness of the benefits of clean energy sources. Policies focused on reducing the market prices of these RETs and improving the welfare of the rural households will also improve their willingness to pay for such energies, especially among farmers and those with large household sizes, thereby creating a sustainable environment for all.

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CZY WIEJSKIE GOSPODARSTWA DOMOWE SĄ SKŁONNE PŁACIĆ ZA CZYSTĄ ENERGIĘ? PRZYKŁAD POŁUDNIOWO-ZACHODNIEJ NIGERII

Streszczenie. Nowoczesne usługi operatorów energetycznych, takie jak dostawa elektryczności, zapewniają korzyści w wymiarze społecznym, gospodarczym i zdrowotnym. Ma to szczególne znaczenie dla wiejskich gospodarstw domowych, których funkcjonowanie jest oparte wyłącznie i w całości na paliwach tradycyjnych. Wiedza o preferencjach tych gospodarstw oraz o ich skłonności do płacenia za czystą energię to kluczowy czynnik, dzięki któremu dostawcy będą mogli poprawiać swoją konkurencyjność na rynku detalicznym, a instytucje rządowe – opracowywać politykę energetyczną. Niniejsze badanie zostało przeprowadzone, aby ocenić skłonność do płacenia za energię ze źródeł odnawialnych w okręgu samorządowym Kajola w stanie Oyo. Procedurą wieloetapowego pobierania próbek objęto 200 gospodarstw domowych z badanego obszaru. Do analizy danych wykorzystano metody statystyki opisowej, skalę Likerta i model logitowy. Otrzymane wyniki wykazały, że respondenci są w większości skłonni zapłacić za energię pozyskiwaną z usprawnionych systemów hydroenergetycznych (71%) oraz za lampy solarne (58,5%). Ponadto około 13% respondentów wyraziło chęć płacenia za słoneczną energię fotowoltaiczną, a 27,5% – za energię uzyskiwaną z biomasy. Z modeli logitowych wynika również, że najważniejszymi czynnikami decydującymi o skłonności respondentów do płacenia za czystą energię są cena zakupu, wiek, płeć, stan cywilny, wielkość gospodarstwa domowego, wydatki w przeliczeniu na osobę oraz wykształcenie. Respondenci wyrażali skłonność do płacenia za energię z czystych źródeł pod warunkiem, że ceny nie będą zbyt wysokie.

Słowa kluczowe: odnawialne źródła energii, wycena dóbr pozbawionych cen rynkowych, postrzeganie, cena zakupu

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