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RESIDENTS' PERCEPTION OF RENEWABLE ENERGY SOURCES – A CASE STUDY: TEMSKA VILLAGE, STARA PLANINA MOUNTAIN (EASTERN SERBIA)

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Abstract: Renewable energy sources (RES) have the possibility to regenerate in a shorter time interval than the non-renewable energy sources and that is why they have always been the subject of interest, especially in the last decades. The Republic of Serbia has RES in the form of solar, wind, the power of water flow, geothermal heat, and biomass. The scientific research conducted in July 2016 in Temska village (City of Pirot) aimed to assess inhabitants' attitudes and awareness of using RES. By interviewing 167 respondents, it is concluded that inhabitants do not have sufficient knowledge of quality and information on RES. Mostly, they are familiar with all terms: hydropower, solar, wind and geothermal energy (over 80%), and the term of biomass energy as well (70.7%). There is an extremely high level of misinformation about the RES subventions that are provided by the Government of the Republic of Serbia (up to 85.6% of respondents are not informed). These subventions are published in the Regulation on incentive measures for the production of electricity from RES and are based on the Feed-in Tariff system that is defined as non-refundable financial assistance from the state. A small number of respondents use RES, but a considerable number (21.6% 'yes' and 47.3% 'maybe') that does not use RES is interested, or already planning to use it in the future.

Keywords: renewable energy sources; Temska village; Stara Planina

Introduction

Renewable energy sources (RES) represent virtually inexhaustible sources of energy generated from natural sources that are renewed after a certain period, either completely or partially (Ellabban, Abu-Rub, & Blaabjerg, 2014). The use of RES has a wide variety of socio-economic benefits: welfare, income generation, mitigating the aging of the people, increase in social cohesion, etc. (Benedek, Sebestyén, & Bartók, 2018), and environmental benefits, such as reduced CO_2 emissions during energy production compared to coal, oil, natural gas, and nuclear energy (Energy Portal of Serbia,

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2017). The development of advanced renewable energy technologies can be one of the possible solutions that can contribute to sustainability, as well (Dincer, 2000).

Serbia could produce and consume electricity from large and small watercourses, solid biomass, biogas, solar energy and wind energy (Ministry of Mining and Energy, Development and Environmental Protection, 2016). *Security of Supply Statement – Republic of Serbia* (2018) reports that RES accounted for 18% of the domestic production of primary energy in 2017. The hydropower plants produced 26.32% of the total gross electricity generation and geothermal energy production was less than 1% of the total domestic production of primary energy. The biggest is the potential of biomass, which is estimated to 3,448 million tonnes of oil equivalent (Mtoe) or 60.3% of the total RES potential. (Republic of Serbia, Ministry of Mining and Energy, 2016).

In accordance with the Directive 2009/28/EC and the Decision of the Ministerial Council of the Energy Community that was implemented in October 2012 (D/2002/04/MS – EnC), an obligatory goal of 27% partake of RES in total energy consumption was determined for Serbia to reach by the year 2020. Of the total available technical potential of RES, calculated in 2013, estimated at ~5.6 Mtoe/year, 35% of potential (~1.9 Mtoe/year) is used through hydropower, biomass, and geothermal energy (Ministry of Energy, Development and Environmental Protection, 2013). According to the Ministry of Mining and Energy, Development and Environmental Protection (2016), it can be assumed that the undertaken incentive measures do not give the desired results since RES share in the gross final energy consumption in Serbia for 2013 was 10.0 Mtoe while for 2015 it was 9.3 Mtoe (Republic of Serbia, Ministry of Mining and Energy, 2016).

In order to assess the level of readiness of residents to accept renewable energy investments in their area, we used "social acceptance" concept (Caporale & Lucia, 2015) as a measure of their attitude toward using new technologies (Ntanos, Kyriakopoulos, Chalikias, Arabatzis, & Skordoulis, 2018) in the near future. The scope of this paper is to discuss people's knowledge of and attitudes toward renewable sources of energy and to address the main economic and social dimensions of RES for a rural area of Serbia. There are three main research aims: (1st) to examine people's perceptions and awareness of terms and benefits of RES, (2nd) to estimate if they would be willing to pay more for greener energy, and (3rd) to check what their plans for the future possible investments in RES are.

Research area

Temska village is situated in the south-western foothill of Stara Planina Mountain (Figure 1), at an altitude of about 500 m and has a temperate continental climate (Sadiković, Čapelja, & Dašić, 2012). The mountain is located in the bordering area of Serbia and Bulgaria and it belongs to the Carpathian-Balkan mountain range (Gavrilović & Gavrilović, 1998). Its part that spans from Vidlič ridge on the south to Kadibogaz Mountain pass on the north, has been declared a protected area of nature (Uredba o zaštiti parka prirode „Stara Planina", 2009).

The village belongs to the City of Pirot and it is 15 km far from the city center and according to the last census, it had 707 inhabitants and 291 households. Most of the households have two members (32%), and the least numerous are the households with five members (3.1%). Also, there is a high percentage of households with one member (31.6%) which is bigger than average in Serbia and the City of Pirot (Statistical Office of the Republic of Serbia, 2011).

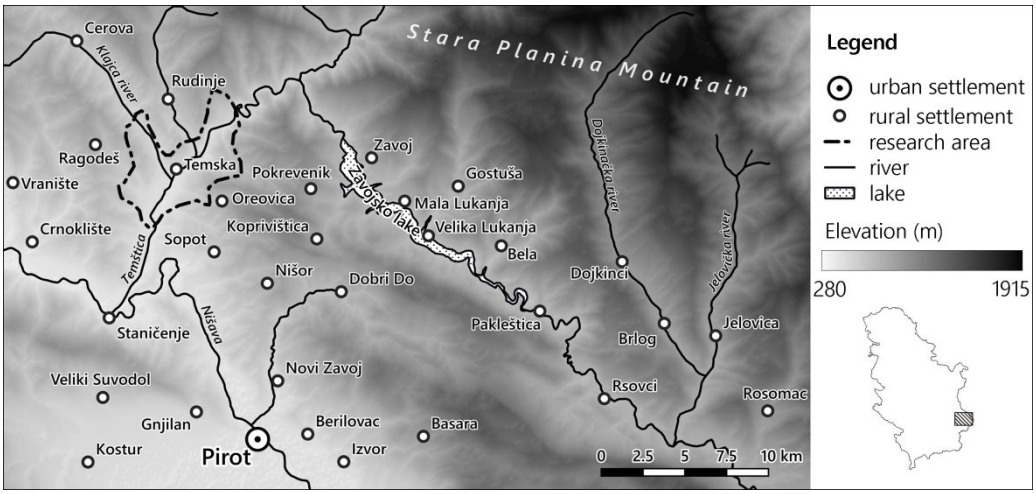

Figure 1. Research area.

The largest percentage of the population is in the age category 75–79 (10.4%), followed by 60–64 (9.5%). Most of the inhabitants are elderly people, 45% of the population is over 60 and young people under 20 participate with just 12% (Stojsavljević, Leščešen, Miljković, & Kalkan, 2015).

Methodology

The research was conducted following the example of the India Renewable Energy Awareness Survey (Mercom Capital Group, 2011). The survey was conducted face-to-face with 167 inhabitants from Temska village. It consists of 19 questions that are divided into four units: 1) type of inhabitants' household, 2) their knowledge about RES, 3) current usage of RES, and 4) future plans. All these questions were closed-ended which means that there was a limitation of the answers of the respondents to the response option provided in the questionnaire. The results of the survey were analyzed in Microsoft Excel using cross-tabulations and graphs.

Based on the statistics of the population in the village, as well as the respondents' lifestyle and satisfaction, the survey sought answers to the following four questions:

Q1: Is there a significant relationship between a respondent's age and their level of knowledge about RES?

Q2: Are people with higher incomes more willing to use electricity obtained from the RES?

Q3: If the household is an agricultural type, is it more possible for members to know the benefits of using RES?

Q4: Is there a possibility to consider the use of RES in the future if more information is provided?

Results and discussion

The demographic characteristics of the investigated area play a significant role in the interpretation of the research results. The surveyed sample shows that 50.3% of households are of agricultural type, 43.1% represents a non-agricultural type, while 6.6% of respondents stated that they belong to both types. The socio-economic characteristics of the surveyed sample are shown through the

number of household members (Figure 2a) and the amount of monthly incomes (Figure 2b). The extremely small monthly income per household indicates the economic underdevelopment of the village.

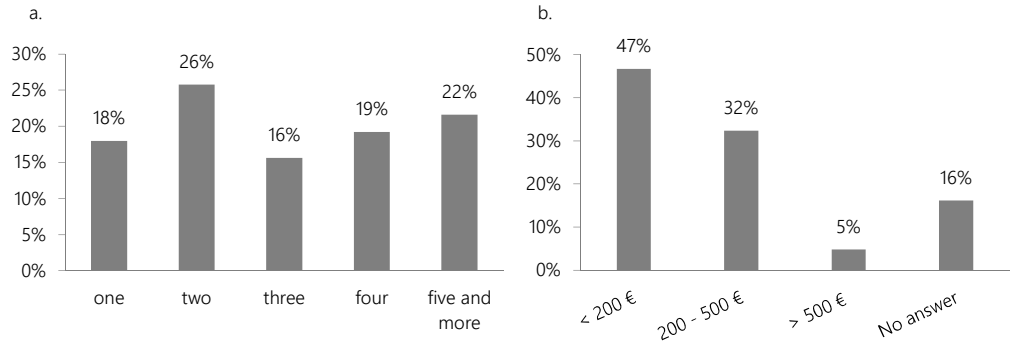

Figure 2. Participation of respondents according to the number of household members (a) and their monthly incomes (b).

The first part of the research concerned the examination of the residents' awareness of terms such as "renewable energy sources" ("clean energy") and "CO_2 emissions". As it can be seen (Table 1), most respondents are familiar with the RES (70.1%). However, only 65.9% are informed about CO_2 emissions. The part of the respondents who answered positively about the terms is the set of people who had the largest number of negative answers about using it in the future. But the positive attitude about investing in RES technology in this area is not negligible. Because of this connection of answers, they need more information about RES, regulatory policy, fiscal incentives, and public financing. They think that their local media do not cover news related to policies, initiatives, and programs on RES.

Table 1
Absolute and percentage numbers of participants regarding their knowledge of the RES term and their plan to utilize the RES in the future

Have you ever heard about the term "renewable energy sources"?	Are you planning to utilize RES in the future?							
	Yes		No		Maybe		Total	
	N	%	*N*	%	*N*	%	*N*	%
Yes	26	22.2	56	47.9	35	29.9	117	70.1
No	10	20.0	23	46.0	17	34.0	50	29.9
Total	36	21.6	79	47.3	52	31.1	167	100

The surveyed sample has shown that energy efficiency programs are not widely known. Even though 52.1% of the respondents were familiar with this term, many of them have also stated that they may not be certain what exactly this term refers to, but that they have heard about it in the media. On the other hand, the awareness of government subsidies for RES was recorded as very low: only 14.4% of respondents answered positively, while 85.6% have no knowledge of these initiatives at all. The Government provided subventions through Feed-in Tariffs that are defined as incentive purchase prices (in euro cents) per kWh produced from RES which is in line with the technology that is applied

and which the Government prescribes for a certain period of time to encourage investors and reduce the investment risk (Energy Portal of Serbia, 2017). This brings to light a very important fact that the level of information about these subventions among residents is not taking place as it should be. The government has not been doing enough to promote the wider use of RES.

The second part of the research relates to the current adoption of the use of RES in the surveyed sample of households. When asked if they use some kind of RES in their household, only 7.2% of the surveyed sample responded positively. Usually, these people are more educated and have good access to information on technologies, vendors, subsides, and other needed information. The other 92.8% of respondents are satisfied with the current situation and do not have a need for shifting to RES.

When asked what the surveyed population sample uses to warm their homes, it was shown that there is a dominant use of wood for heating in as much as 91% of the households (Figure 3). This way of heating would have many advantages if inhabitants considered using "modern biomass" (Goldemberg & Coelho, 2004). The data points to insufficient knowledge of the inhabitants regarding the meaning of different terms and types of RES, especially the way they can use biomass, and what is considered under this energy source.

Goldemberg and Coelho (2004) defined the so-called "modern biomass" and "traditional biomass". According to their research, "modern biomass" is the one that is produced in a sustainable way which means that it is used to generate electricity and produce heat and it includes transportation fuels, derived from agriculture and forest remains and solid waste. Otherwise, there is "traditional biomass" that refers to an unsustainable way of production and usually, it is used for lighting, direct heating or cooking in rural areas where access to affordable, modern energy services is limited. During combustion of fuel of wood-based biomass, emissions of harmful gases, in particular, CO_2, are reduced compared to fossil fuels (Saidur, Abdelaziz, Demirbas, Hossain, & Mekhilef, 2011), and using fuel derived from wood is one of theways to reduce the emission of greenhouse gases (Omer, 2008). Moreover, its advantages include the disposal and utilization of waste and residues produced by forestry, agriculture and timber industry (Stolić, Pešić, Milošević, Spasić, & Lazić, 2017). Also, it increases local entrepreneurship, supports

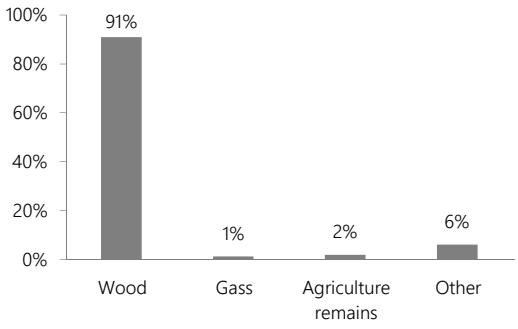

Figure 3. Partition of respondents according to home heating fuels.

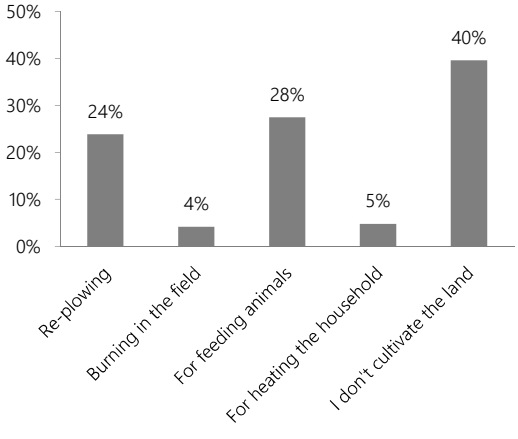

Figure 4. Partition of respondents according to their manner of treating agricultural remains after harvest.

price stability, increases the income of the local population, and generates employment as well as local technology improvement providing higher living standards, local cooperation and chances to save rural areas from depopulation (Benedek et al., 2018). There are great quantities of wood residues left in Serbian forests (10.4 million tons of residues per year), that can be used with better organization and without big investments (Vukašinović, Gordić, Babić, Jelić, & Končalović, 2016).

Since this waste can be used as a potential source of energy, the question about what inhabitants do with agricultural remains is examined. The survey results show that most households belong to the agricultural type, but 39.6% of them do not engage in land cultivation (Figure 4). If we observe only the positive responses, we can say that re-plowing and the usage for animal feed are the most highly quoted.

When cross-tabulations were made (Table 2), it was noticeable that a great number of people replied that they do not use RES (92.8%) even if unremarkable number of them answered that they use agricultural remains e.g. for feeding animals (27.5%). These results are unsuitable since it is known that these activities such as using remains for feeding animals or heating the household are ways of RES utilization, and the respondents are not aware of it. It is concluded that respondents do not have enough knowledge about what is considered under using RES.

Table 2
Absolute and percentage numbers of participants regarding their utilization of RES and the type of household

Do you use any type of RES in your household?	What is the type of your household?							
	Agriculture		Non-agriculture		both		Total	
	N	%	*N*	%	*N*	%	*N*	%
Yes	8	66.7	3	25.0	1	8.3	12	7.2
No	76	49.0	69	44.5	10	6.5	155	92.8
Total	84	50.3	72	43.1	11	6.6	167	100

The third part of the research was directed towards the planning to use RES in the future. As a base for examining these attitudes, the level of satisfaction with the prices of electricity bills was used (Figure 5a). The obtained results indicate that 70.1% of the surveyed sample finds that the electricity bills are high. Taking into account the previously shown monthly household income, such results are expected.

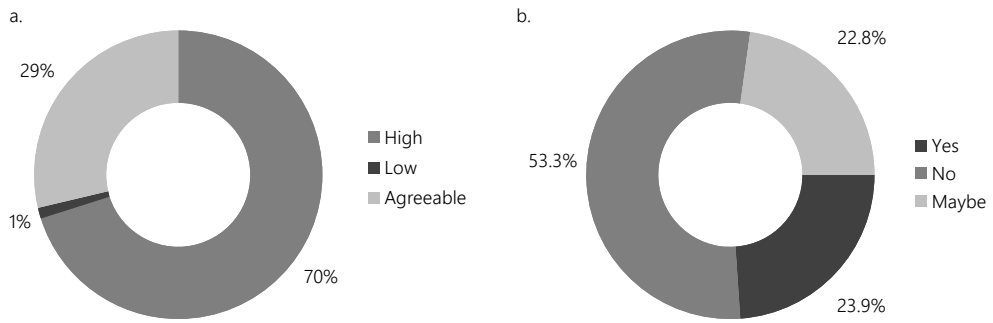

Figure 5. Partition of respondents by satisfaction degree to electricity rates (a) and their wiliness to pay slightly more for the electricity from RES (b).

In the fourth part, respondents were asked about their future plans. One of the questions was about their willingness to use electricity obtained from RES, even if the price was slightly more expensive (Figure 5b). The majority of the population is against the purchase of this type of energy under given conditions (53.3%). The reason for this is tightly connected to the previous issue, where most of the respondents stated that they were not satisfied with the pricing of electrical energy, and therefore their budget would not be able to withstand additional price increase. Respondents who gave a positive answer would agree to higher electricity prices if that would be invested in the transition from non-RES to RES and so reduce the pollution of the environment. People whose answer was 'maybe' are mainly those people who have never come across this concept. The last question was about the use of RES in the future. The largest share of the population responded negatively (47.3%), while the number of undecided respondents is 31.1%. The reasons for negative answers were that RES will not be able to meet the complete energy need, high maintenance cost, no easy availability of the technology at the market or they are simply not convinced enough to make the switch. The people who answered positively (21.6%) are aware of the necessary funds that need to be invested in transitioning to RES.

Conclusion

The investigated area of Temska village has great potential in terms of RES, which is only partially exploited through hydropower energy. The greatest potential in this area is in the energy produced from woody biomass, which is an environmentally friendly fuel produced from RES if it is treated regularly. However, the surveyed households are using wood/timber (91%) to heat their homes which belongs to "traditional biomass" that is still unsustainable way of using RES. This indicates to insufficiently informed population about RES. The inhabitants said that they do not see the potential of RES to meet their energy demand partially or completely. This means that a significant share of people does not have the relevant and required information to make the shift to RES. Since a substantial number of respondents was not aware of the government's programs, there is a lot more that needs to be done in terms of easy and accessible information transfer. Poverty, socio-economic circumstances, financial incentives are also reasons that can make them distracted from the idea of investing in these types of energy. Relatively large number of people answered positively on the question of potential future use of RES, which can be considered as a step forward in accepting new ways of producing energy. To achieve this, it is important to raise awareness of the Government that there is a need for more effective actions on promoting subsidies/policies/plans for the utilization of RES emphasizing individual/household-centric benefits.

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