

## POSSIBILITIES FOR THE APPLICATION OF RENEWABLE ENERGY SOURCES IN RURAL AREAS

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### **Abstract:**

*This paper explores the **possibilities of applying renewable energy sources (RES)** in rural areas of the Republic of Serbia, aiming to increase energy efficiency, reduce environmental pollution, and promote sustainable development. By analyzing the characteristics of rural areas, demographic indicators, and the current state of agricultural holding, the paper identifies key potentials and challenges in the use of RES. Special attention is given to solar energy, wind energy, biomass, biogas, and geothermal energy, as well as their technical possibilities and practical applications in agriculture and households. Based on a survey on the awareness of rural populations regarding renewable energy sources, the study analyses attitudes, knowledge levels, and readiness for investment in RES. The results show significant potential for the development of renewable energy in rural areas of Serbia, emphasizing the need for greater education, institutional support, and financial incentives. This paper concludes that integrating renewable energy sources can contribute to the development of sustainable and energy-independent rural communities.*

**Keywords:** renewable energy sources, rural development, solar energy, biomass, sustainable development

### **1. INTRODUCTION**

The balanced development of countries worldwide is closely linked to the development of rural areas, which plays a crucial role in ensuring economic stability, social cohesion, and environmental sustainability [1]. Effective rural development policies require a robust analytical framework based on two key components: a clear and consistent methodology for the identification and classification of rural areas, and the definition of relevant rural development indicators along with their systematic application in policy design and evaluation.[2]

Numerous international organizations, including the **Organization for Economic Co-operation and Development (OECD)**, the **European Union (EU)**, the **Food and Agriculture Organization of the United Nations (FAO)**, and the **World Bank**, have undertaken significant efforts to develop methodological approaches aimed at standardizing the identification of rural areas and minimizing the number of indicators while preserving their analytical relevance.[3] Despite these efforts, the lack of a universally accepted international standard has resulted in methodological heterogeneity, with existing approaches providing primarily general guidance rather than a fully harmonized framework.

### **2. EXPERIMENTAL**

The study employed survey-based research design. The survey methodology is widely used in empirical research to collect data from individuals or groups through structured questionnaires consisting of standardized questions. Depending on the research design, surveys may be administered through various modes, including telephone interviews, online questionnaires, paper-based instruments, or face-to-face interviews.[4]

In this study, data was collected through a survey conducted among residents in rural areas. This method represents a systematic and non-experimental approach to data collection, enabling the gathering of

information on respondents' attitudes, opinions, beliefs, and self-reported behaviors related to the subject of the study. Due to its capacity to capture perceptions across a broader population, this approach is particularly suitable for social science and policy-oriented research.[5]

The survey constitutes a form of non-experimental research in which self-reported responses serve as the primary data source. Data was obtained using a standardized questionnaire and subsequently analyzed using appropriate analytical and statistical methods. The academic literature reflects differing views regarding whether surveys should be classified as a research method or a research technique.[6] The study sample included residents of villages or rural areas across the Republic of Serbia. A total of 107 respondents participated in the survey. Data collection was conducted using the Google Forms platform, after which the data was systematically processed and analyzed.

### 3. RESULTS

The survey examining the level of awareness of the rural population regarding the application of renewable energy sources was conducted in May 2025. The sample included 107 respondents of different age groups and educational levels, with varying degrees of familiarity with renewable energy sources. Respondents were informed about the survey through social media platforms, email communication, and closed online groups.

The questionnaire consisted of 22 questions, organized into thematic groups.

#### **Questionnaire Structure**

##### ***Demographic characteristics***

- Gender
- Age
- Level of education
- Type of settlement of residence
- Region of residence

##### ***Awareness of renewable energy sources***

- The need to increase awareness of RES
- Ways of acquiring information on RES
- Primary source of information on the application of RES

##### ***Personal attitudes***

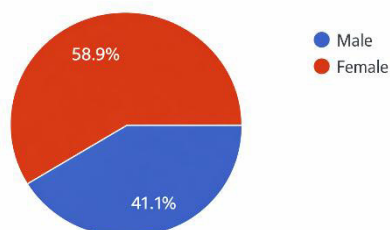
- Familiarity with renewable energy sources
- Perceived advantages of using RES
- Perceived local potential for RES application
- Familiarity with the application of RES in agriculture
- Possible uses of RES in agriculture
- The contribution of RES to improving the quality of agricultural products
- The contribution of RES to increasing the competitiveness of agricultural products
- The potential of RES to enhance agricultural development
- The contribution of RES to the revitalization of rural areas
- Current use of RES

##### ***Financial investment***

- The role of government financial support in the application of RES in agriculture
- Willingness to invest in RES **with** state support
- Willingness to invest in RES even **without** state support
- Familiarity with government support models for the use of RES

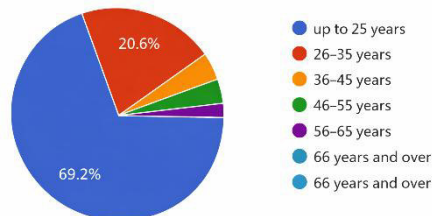
## 4. DISCUSSION

### 4.1 Demographic characteristics



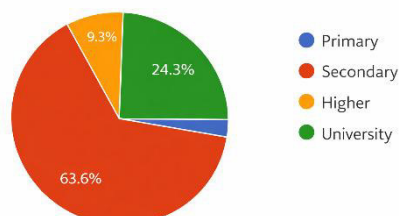
*Figure 1: Gender*

In response to the question regarding gender, 58.9% of respondents identified as female, while 41.1% identified as male. Accordingly, out of the total sample of 107 respondents, 63 were female and 44 were male.



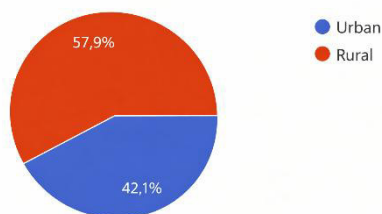
*Figure 2: Age*

The second question concerned the age of the respondents. The results indicate that the largest proportion of participants were aged up to 25 years, while no respondents were aged 66 years or older.



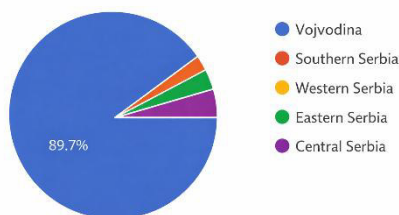
*Figure 3: Level of education*

With regard to educational attainment, the majority of respondents reported having completed secondary education, while the smallest proportion reported having completed only primary education.



*Figure 4: Type of settlement of residence*

The fourth question pertains to the type of settlement in which the respondents reside. A total of 57.9% of participants reported living in rural areas, while 42.1% indicated that they live in urban areas.



*Figure 5: Region*

The question addressed the region of origin of the respondents. The results indicate that the majority of participants were from the Vojvodina region, while no respondents were from Western Serbia.

#### 4.2 Awareness of renewable energy sources

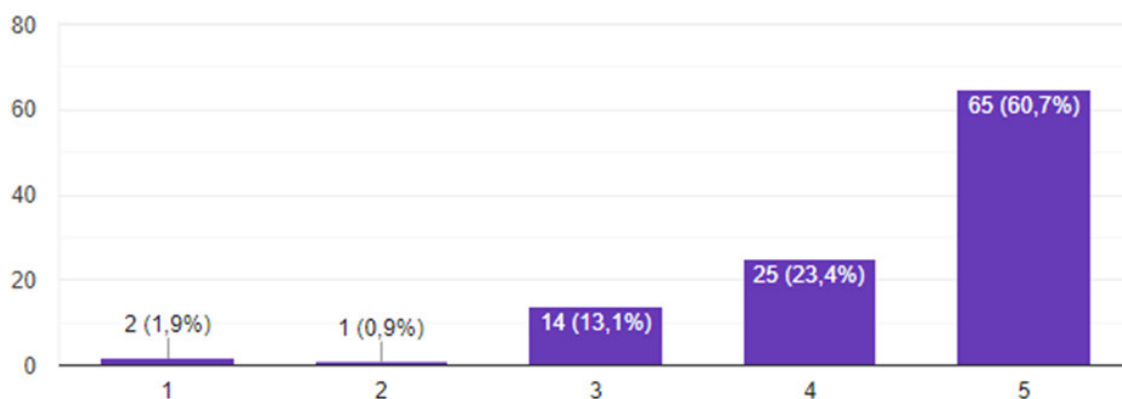


Figure 6: The need to increase awareness of RES

The question concerning the increase in awareness was presented using a scale from 0 to 5. A total of 65 respondents (60.7%) fully agreed that awareness of renewable energy sources should be increased, while 2 respondents (1.9%) disagreed with the need to enhance awareness. These results indicate a clear need for increased awareness of renewable energy sources.

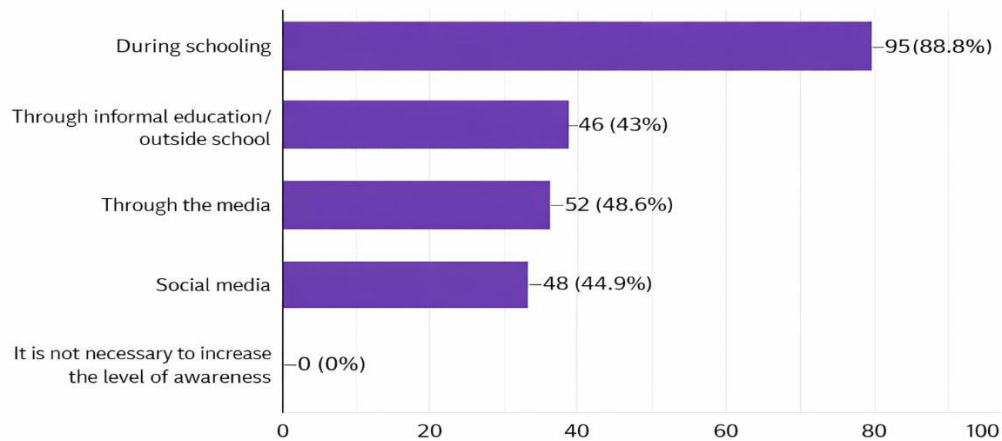


Figure 7: Ways of acquiring information on RES

The seventh question examined the sources through which respondents believe information should be acquired. Of the 107 respondents, 88.8% indicated that awareness of renewable energy sources should be developed through formal education. Notably, none of the respondents selected the option indicating that increasing the level of awareness is unnecessary.

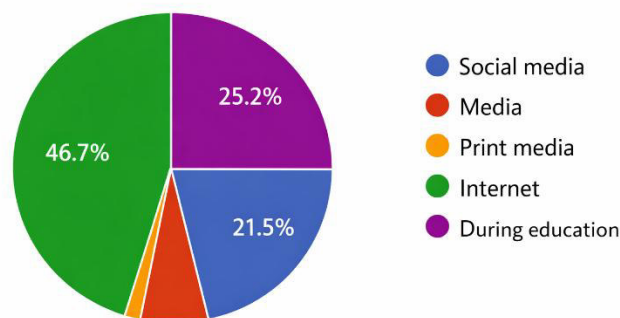


Figure 8: Primary source of information on the application of RES

The eighth question addressed the sources of information regarding the application of renewable energy sources. The results indicate that the Internet was the primary source of information (46.7%), while print media were the least frequently reported source (0.9%).

### 4.3 Personal attitudes

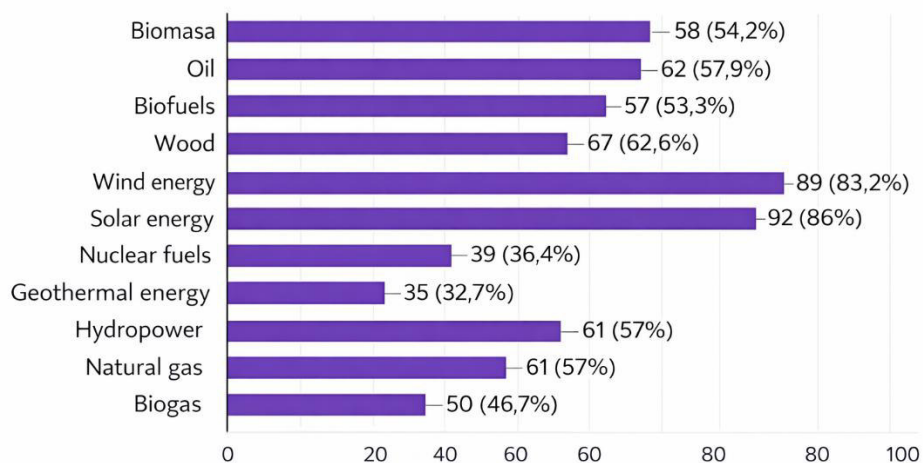


Figure 9: Familiarity with renewable energy sources

The observed pattern of responses suggests gaps in respondents' understanding, indicating limited differentiation between renewable and non-renewable energy sources.

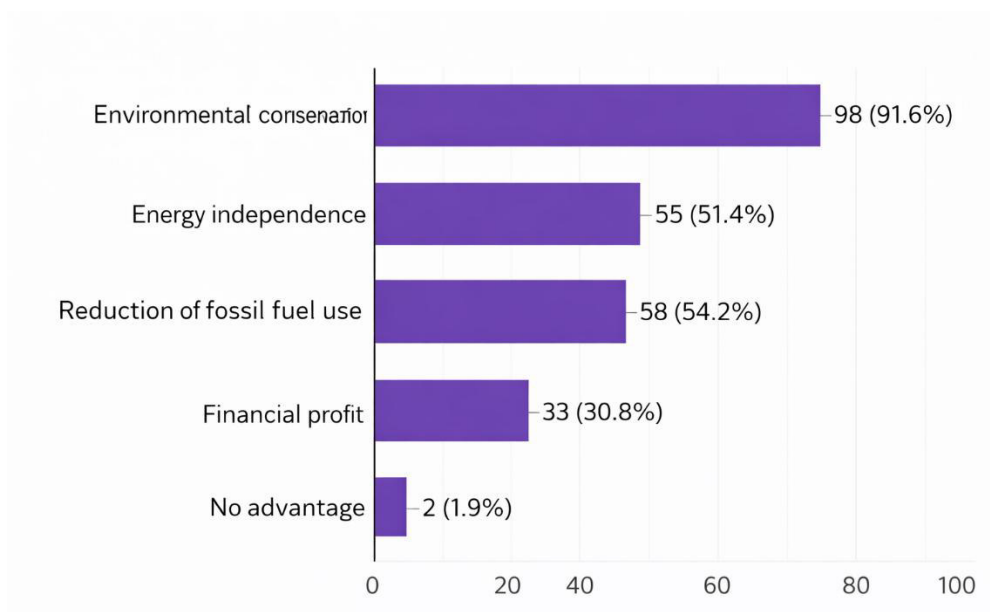


Figure 10: Perceived advantages of using RES

Environmental protection emerged as the most commonly perceived advantage of renewable energy sources (91.6%), whereas only a negligible proportion of respondents (1.9%) reported no perceived advantages.

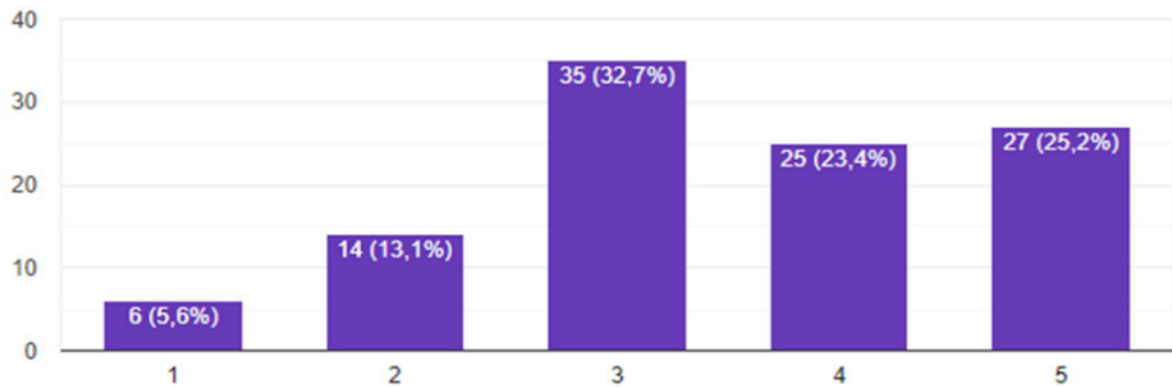


Figure 11: Perceived local potential for RES application

Respondents expressed moderate agreement with the statement concerning local renewable energy potential, indicating a degree of uncertainty regarding the feasibility of renewable energy implementation in their local environments.

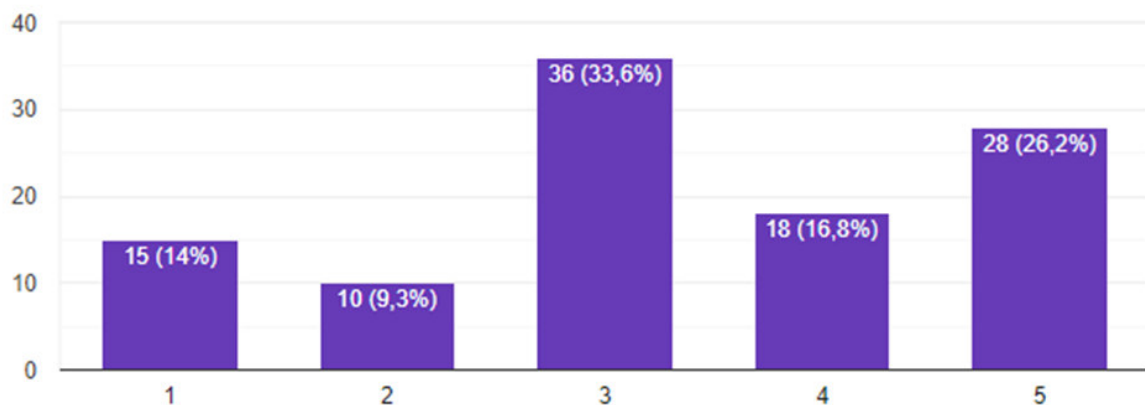


Figure 12: Familiarity with the application of RES agriculture

The question referred to the statement concerning respondents' familiarity with the possibilities for the application of renewable energy sources in agriculture. The results indicate that respondents are only partially familiar with the potential applications of renewable energy sources in the agricultural sector. These findings suggest that the majority of respondents lack sufficient knowledge regarding the application of renewable energy sources, highlighting the need for improved information and education.

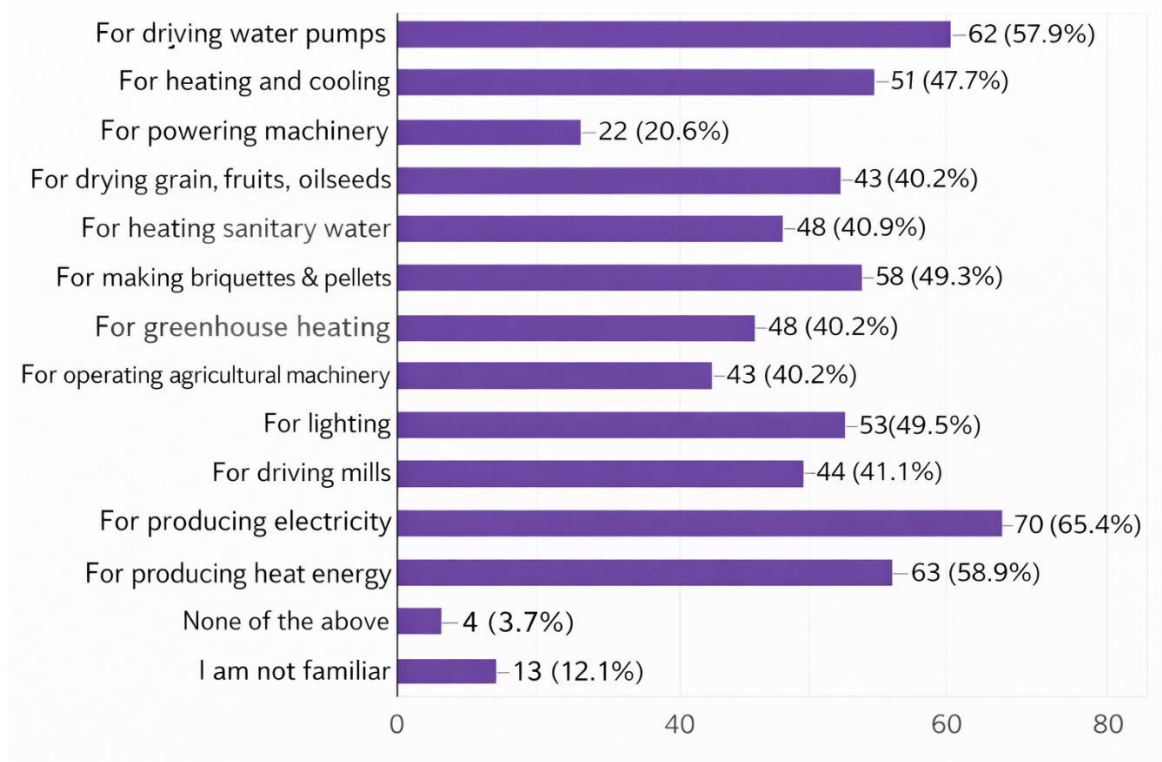


Figure 13: Possible uses of RES in agriculture

Approximately 55% of respondents reported familiarity with the application of renewable energy sources in agriculture.

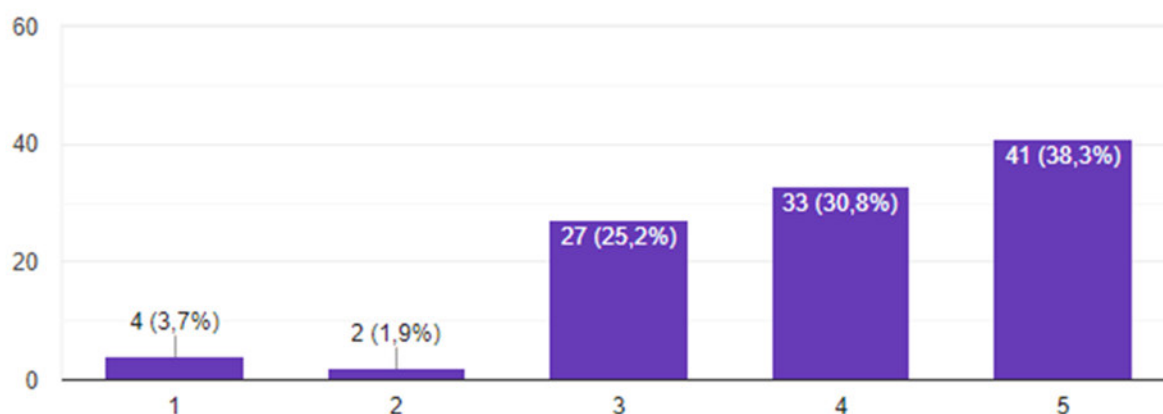


Figure 14: The contribution of RES to improving the quality of agricultural products

A majority of respondents expressed agreement with the statement regarding the positive impact of renewable energy sources on the quality of agricultural products.

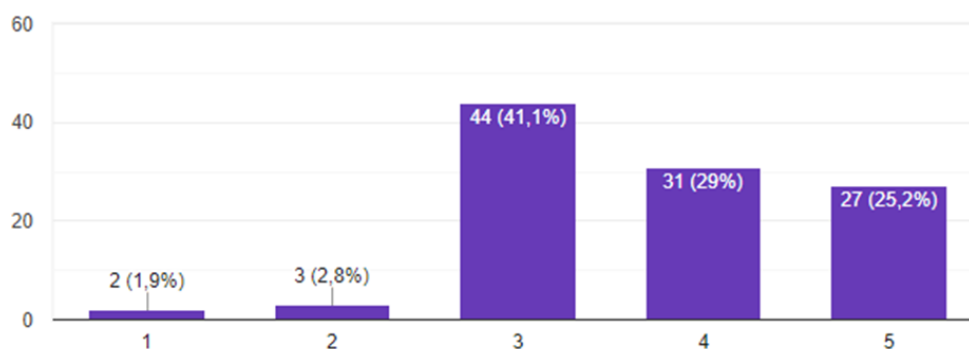


Figure 15: The contribution of RES to increasing the competitiveness of agricultural products

Partial agreement among respondents indicates a moderate perception of the role of renewable energy sources in improving the competitiveness of agricultural products.

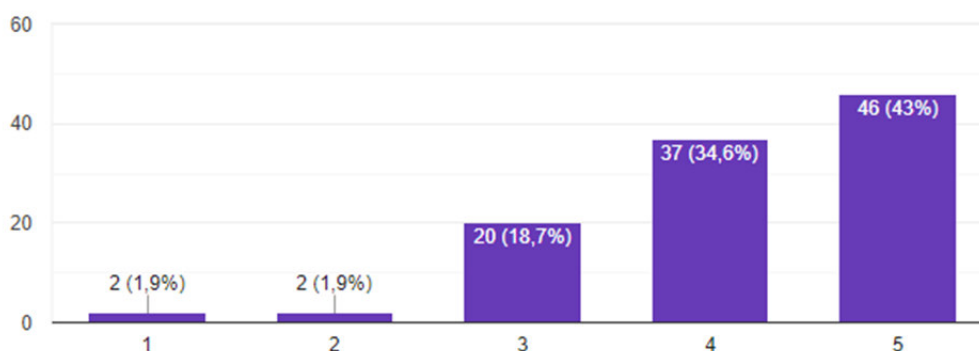


Figure 16: The potential of RES to enhance agricultural development

A plurality of respondents (43%) perceived renewable energy sources as having the potential to improve agricultural production.

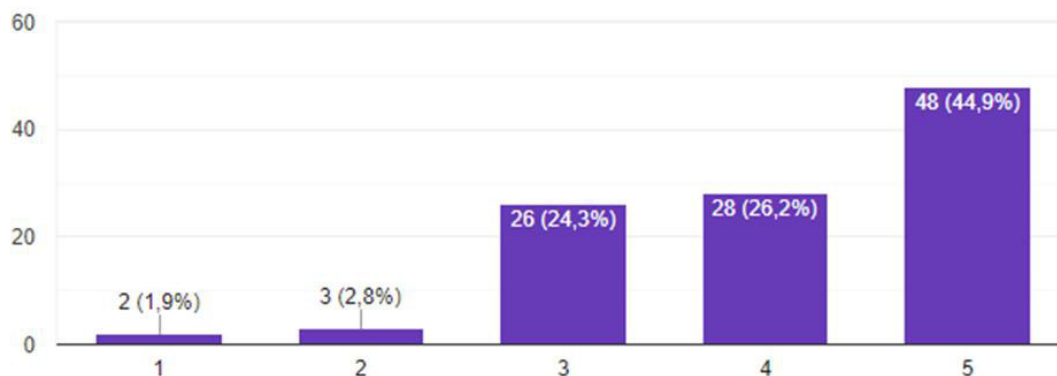


Figure 17: The contribution of RES to the revitalization of rural areas

A plurality of respondents (44.9%) perceived renewable energy sources as having the potential to revitalize rural areas.

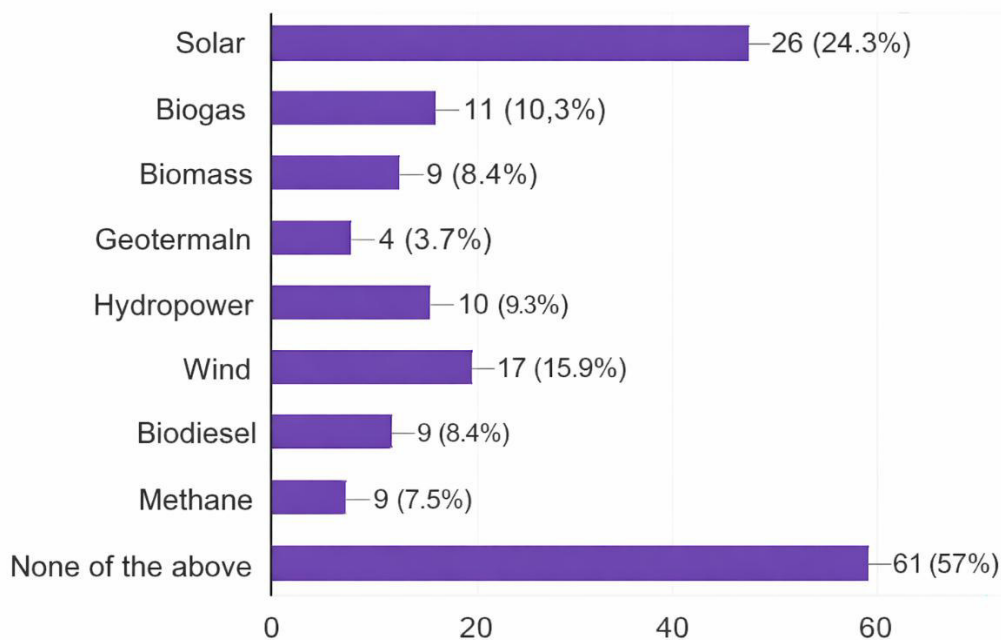


Figure 18: Current use of RES

The question examined the ways in which respondents use renewable energy sources. The largest proportion of respondents reported not using renewable energy sources, while 26 respondents indicated the use of solar energy. These results indicate that only a small proportion of respondents currently use renewable energy sources and that familiarity with the available possibilities for their utilization remains limited.

#### 4.4 Financial investment

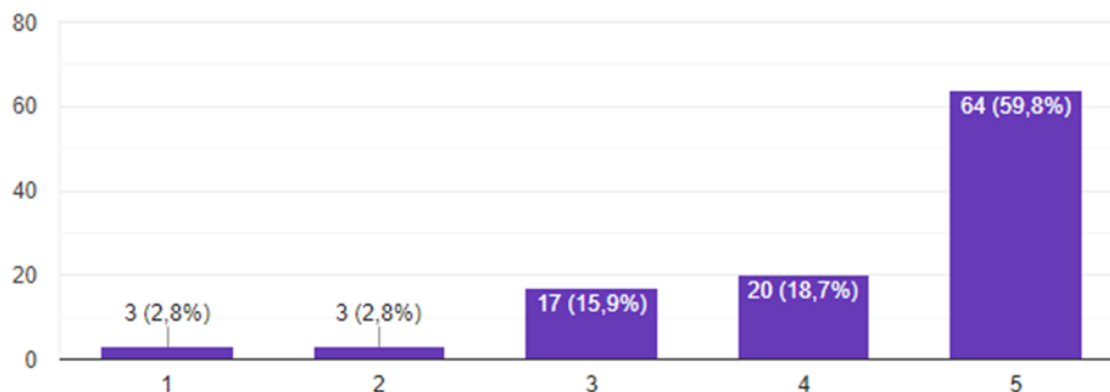


Figure 19: The role of government financial support in the application of RES in agriculture

The question examined respondents' opinions regarding government financial support for the implementation of renewable energy sources in agriculture. The majority of respondents expressed the view that state support is necessary for the adoption of renewable energy sources, while only a small proportion considered such support unnecessary. These results indicate broad agreement among respondents on the importance of financial assistance in facilitating the implementation of renewable energy sources.

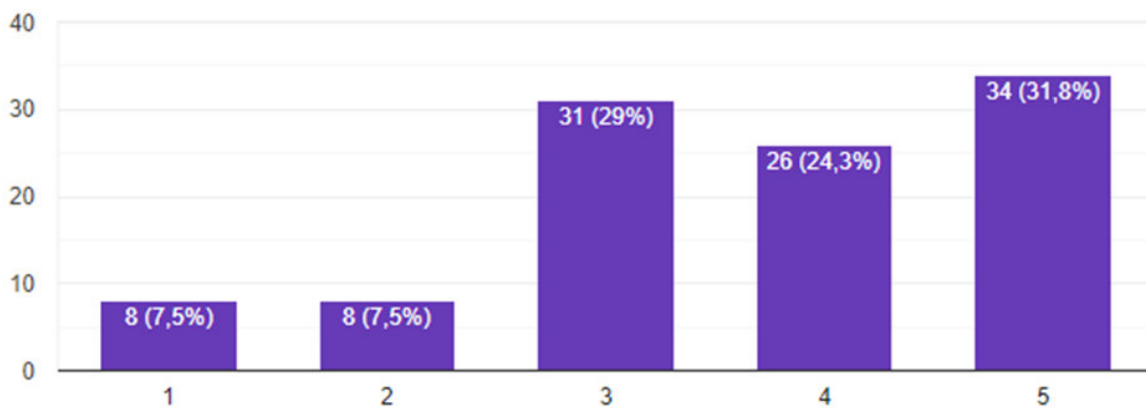


Figure 20: Willingness to invest in RES **with** state support

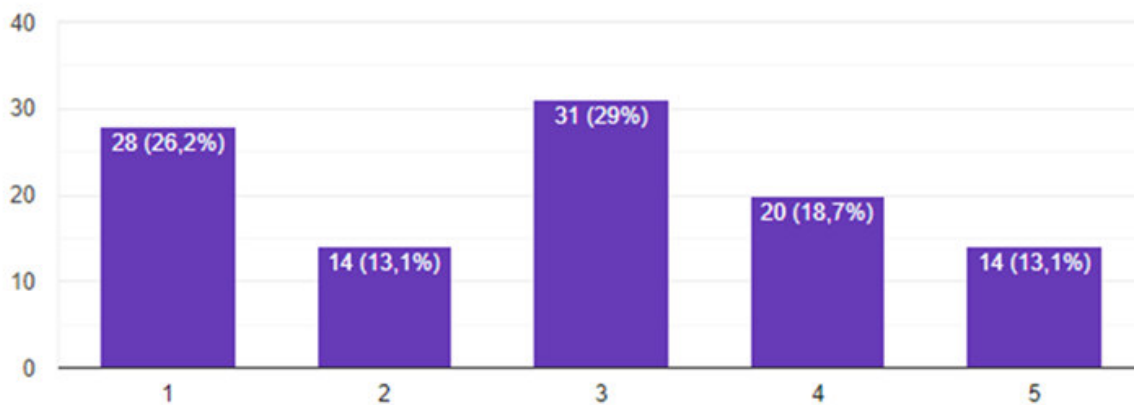


Figure 21: Willingness to invest in RES even **without** state support

Questions 20 and 21 examined respondents' willingness to invest in renewable energy sources with and without government support. The majority of respondents expressed willingness to invest when government support is available, while the same group reported only partial willingness to invest in the absence of such support. These results indicate a stronger inclination toward investment in renewable energy sources when financial support from the state is provided.

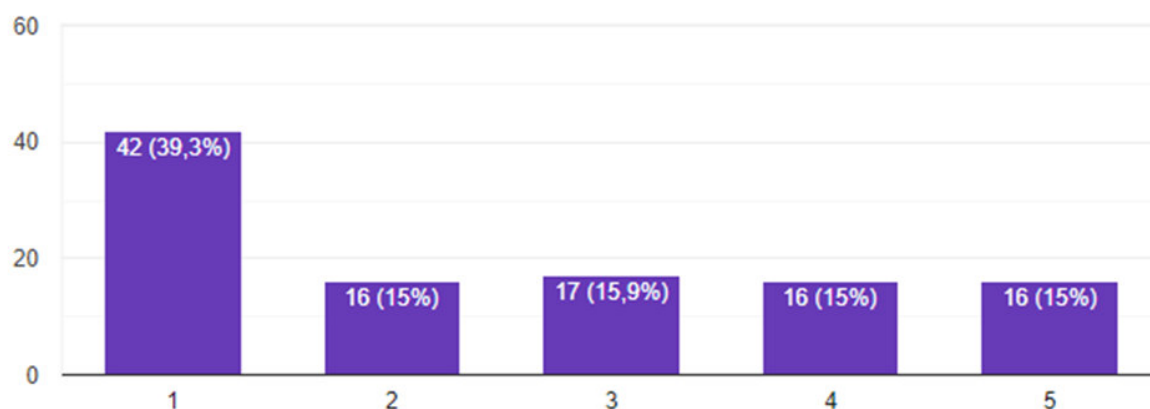


Figure 22: Familiarity with government support models for the use of RES

The question examined respondents' familiarity with government support models for the use of renewable energy sources. The largest proportion of respondents indicated a lack of familiarity with existing government support schemes for renewable energy use.

## 5. CONCLUSIONS

Based on the survey results, it can be concluded that the application of renewable energy sources could contribute to the development of rural areas in the Republic of Serbia. Through the use of renewable energy sources, the population could benefit both in agriculture and in everyday life. The findings indicate that if the state were to provide subsidies, the population would be more inclined to use renewable energy sources for electricity generation, household heating, and the heating of greenhouses. The survey of residents in rural areas further suggests that respondents of different educational levels and age groups do not clearly distinguish between renewable and non-renewable energy sources. Nevertheless, the majority of respondents expressed positive attitudes toward statements highlighting the benefits of using renewable energy sources. These results point to a clear need for increased public education and awareness. A large proportion of respondents also believe that government support is essential in order to enable wider adoption of renewable energy sources.

## 6. REFERENCES

- [1] BREZZI, M., L. DIJKSTRA and V. RUIZ: OECD Extended Regional Typology: THE ECONOMIC PERFORMANCE OF REMOTE RURAL REGIONS, VOL (2011) OECD Regional Development Working Papers, No. 2011/06, OECD Publishing, Paris, <https://doi.org/10.1787/5kg6z83tw7f4-en>.
- [2] OECD (2006), THE NEW RURAL PARADIGM: POLICIES AND GOVERNANCE, OECD Rural Policy Reviews, OECD Publishing, Paris, <https://doi.org/10.1787/9789264023918-en>.
- [3] DASGUEPA, P., MORTON, J. et al. :*RURAL AREAS*, Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, ISBN: 978-1-107-64165-5, Cambridge and New York, pp. 613-657

- [4] FERBER, R et al.:*WHAT IS SURVEY*, Executive Director American Statistical Association, 1429 Duke St., VA 22314-3402, USA.
- [5] MILIGAN, P. , NIJE, A. , BENNET, S.:*COMPARISON OF TWO CLUSTER SAMPLING METHNODS FOR HEALTH SURVEYS IN DEVELOPING COUNTRIES*, Int J Epidemiol . 2004 ; 33 (3): 469 - 76 . <https://do.org/10.1093/ije/dyh09>» <https://do.org/10.1093/ije/dyh096>
- [6] GROVES, R. et al.:*SURVEY METHODOLOGY*. 2nd edn. Wiley (2011) Available at: <https://www.perlego.com/book/1007676/survey-methodology-pdf>, Accessed: 26 January 2026
- [7] FOWLER, F.J. :*SURVEY RESEARCH METHODS*. 5th edn. Los Angeles (2014), California, SAGE.

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