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ACCEPTANCE AND POTENTIAL OF RENEWABLE ENERGY SOURCES BASED ON BIOMASS IN RURAL AREAS OF HUNGARY

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Content

1. Research background and objectives

The current research raises the issue of investigation of the potential usage of RES and EE improvement in rural territories of Hungary.

The research area is the Koppány Valley located in Somogy county in Hungary. This area was selected taking into consideration the reason of already existing initiatives related to the green local society development run by Vox Vallis Development Association (Filep-Kovács et al., 2016) and supportive "Renewable energy sources in a function of a rural development" (RuRes) project. The plans to establish locally photovoltaic elements and biogas power plant station are among them. Relevance of the current research is to assess social potential of the proposed RES's usage and to investigate awareness of the rural stakeholders towards them. Koppány Valley Nature Park is the development unit consisting of 10 settlements: Fiad, Kisbárapáti, Bonnya, Somogyacsa, Somogydöröcske, Szorosad, Kára, Miklósi, Törökkoppány, Koppányszántó. The lead organisation is Vox Vallis Association in cooperation with members of the self-governments of these settlements. Koppány Valley is in one of the most underdeveloped Hungarian territories considering serious economic, social and infrastructural issues based on 290/2014. (XI. 26.). Despite this fact, there is significant potential regarding the green energy sector if considering essential amount of local raw bio-material production (Mezei et al., 2018). The estimated theoretical potential of biomass in the area is substantial, however, I assumed that it is complicated to utilize it due to the social barriers such as lack of knowledge and low level of awareness regarding renewables among the local stakeholders.

Community acceptance is the subject of the current research aiming to investigate the attitudes of the local stakeholders and the community members of the Koppány Valley micro region regarding introduction of RES based on biomass in their neighbourhood.
Therefore, objectives of the dissertation are the following:

• To define the level of knowledge and awareness of bio-based RES among the local stakeholders in rural area;
• To investigate the social potential of the Koppány Valley regarding acceptance of RES based on biomass;
• To explore personal and specific factors influencing social acceptance of biogas power plant installation.

2. Materials and methods

Local population questionnaire survey was carried out in May 2018 in 10 settlements of the Koppány Valley micro region (n=310). Sampling was carried out with the help of a quota-based combined with snowball method – weighted by the settlements' population size. The questionnaire was divided into 3 general blocks: (1) *personal information* about respondents (background information); (2) *awareness about RES* in general; (3) *acceptance and potential of biomass-based RES*. Likert scale, multiple choice and open answer questions were applied to the questionnaires in the course of the survey. Descriptive statistics and cross table analysis were applied to describe the results.

The **multinomial logistic regression** methodology was selected for the data analysis, because it provides an appropriate technique to

predict the probability of category membership on a dependent variable based on multiple independent variables (Starkweather and Moske, 2011; Garson, 2013). In the research the probability of the categories of **acceptance** was predicted by 13 independent categorical variables.

A multinomial logit model was built under R software with the usage of R commander and "stargazer" packages, which were used to modifying the logit probability coefficients to *relative risk ratios* (RRR), that are the exponentiated values of the logit coefficients.

The dependent variable **acceptance** contains three basic categories: *YES*, *NO* and *MAYBE*. One of these categories should be selected necessarily as the basement or reference level category to run the multinomial logit model (Starkweather and Moske, 2011; Garson, 2011). In our case, category *MAYBE* was selected as a reference one. The probabilities of switching respondent's decision from *MAYBE* to *YES* or *NO* were examined. The probability of changing decision was expected to be influenced by the independent variables included in the model. It was expected to reveal the most important influencing factors of **acceptance**.

3. Results

Based on the survey results 45% of the respondents answered *MAYBE* for the question "Would you support biogas power plant installation in your local community?", 35% said *YES*, the other 20% stated *NO*. The hidden social potential should be realized from the population group with the uncertain opinion (majority of the respondents). In this

respect, exploration of factors having significant effect on the acceptance level, gains even more importance. It would be useful for the local decision-makers and local development strategy officials to know how to convince people to change their attitude in aspect of further investment to the bioenergy development infrastructure. In this respect, research has a focus on defining the common characteristics of the *MAYBE* (convincible) **acceptance** group. I suppose that uncertain population group should realise the social potential of the Koppány Valley regarding biomass-based RES acceptance.

3.1 Research questions and hypotheses

Research questions of the dissertation:

RQ1: Which personal factors are significant to the **acceptance** of a biogas power plant installation?
RQ2: Which specific factors are significant to the **acceptance** of a biogas power plant installation?
RQ3: What are the main personal characteristics of the respondents committed to *YES; NO; MAYBE* (convincible) **acceptance** groups?
RQ4: What are the main specific characteristics of the respondents committed to *YES; NO; MAYBE* (convincible) **acceptance** groups?

Hypothesis 1: Personal factors **trust.to.mayor** and **education** are associated with the **acceptance** of a biogas power plant installation.

Hypothesis 2: Specific factors **biomass.knowledge**, **energy.crops.knowledge** and **climate.change.knowledge** are associated with the **acceptance** of a biogas power plant installation.

Hypothesis 3: The convincible group of the respondents is characterized by the lack of **knowledge**, which can be improved.

3.2 Methodological analysis results

The data of 13 independent personal and specific variables and one result variable were chosen to define the multinomial logistic regression model of local population acceptance of biogas power plant installation. Multicollinearity was testing through the variance-inflation factors analysis.

Based on multinomial logistic regression model for the Independent variables' subset 1- "Personal factors", considering the significance level (p-value), parameters with high effect on the dependent variable **acceptance** were determined.

Acceptance is significantly influenced by the following personal variables (*age, education, residence, trust.to.mayor*):

1. **age**. The likelihood to choose **acceptance** category *YES* decreases by 0.28 times (the risk or odds is 72% lower) in comparison to category *MAYBE*, if respondent's **age** group is *[<30]* ($p<0.05$).
2. **education**. The likelihood to choose **acceptance** category *YES* decreases by 0.37 times (the risk or odds is 63% lower) in comparison to category *MAYBE*, if respondent's **education** group is *PRIMARY* ($p<0.05$).
3. **residence**. The likelihood to choose **acceptance** category *NO* decreases by 0.33 times (the risk or odds is 67% lower) in comparison

to category *MAYBE*, if respondent's **residence** group is *MIDDLE* ($p<0.05$).

4. **trust.to.mayor**. The likelihood to choose **acceptance** category *YES* increases by 18.24 times (the risk or odds is 1724% higher) in comparison to category *MAYBE*, if respondent's **trust.to.mayor** takes group *YES* ($p<0.01$).

The likelihood to choose **acceptance** category *NO* increases by 16.51 times (the risk or odds is 1551% higher) in comparison to category *MAYBE*, if respondent's **trust.to.mayor** takes group *NO* ($p<0.01$).

Based on multinomial logistic regression model for the Independent variables subset 2- "Specific factors", taking into account the significance level (p-value), parameters with high effect on the dependent variable **acceptance** were determined.

Acceptance is significantly influenced by the following specific variables (*biomass.knowledge, climate.change.knowledge, energy.crops.knowledge, own.plant, willingness.to.collect*):

1. **biomass.knowledge**. The likelihood to choose **acceptance** category *YES* increases by 1.74 times (the risk or odds is 74% higher) in comparison to category *MAYBE*, if respondent's **biomass.knowledge** is *YES* ($p<0.1$).

2. **climate.change.knowledge**. The likelihood to choose **acceptance** category *NO* decreases by 0.39 times (the risk or odds is 61% lower) in comparison to category *MAYBE*, if respondent's **climate.change.knowledge** is *YES* ($p<0.1$).

3. **energy.crops.knowledge**. The likelihood to choose **acceptance** category *YES* increases by 3.39 times (the risk or odds is 239% higher) in comparison to category *MAYBE*, if respondent's **energy.crops.knowledge** is *YES* ($p<0.01$).

4. **own.plant**. The likelihood to choose **acceptance** category *YES* increases by 2.39 times (the risk or odds is 139% higher) in comparison to category *MAYBE*, if respondent's **own.plant** is *YES* ($p<0.05$).

5. **willingness.to.collect**. The likelihood to choose **acceptance** category *YES* increases by 2.94 times (the risk or odds is 194% higher) in comparison to category *MAYBE*, if respondent's **willingness.to.collect** is *YES* ($p<0.01$).

4. Conclusions

Summarizing the results of the personal factors influencing **acceptance** analysis, the Hypothesis 1 was proved by the following findings:

1. **Trust.to.mayor** demonstrated high level of association with the **acceptance** ($p<0.01$).
2. **Education** associated with the acceptance in the way to having high school diploma provides higher **acceptance**.

The personal profile of the *MAYBE* (convincible) **acceptance** group is the following:

FEMALE, [<30] years old, living in the *MIDDLE* part of the Koppány Valley (including Somogyacsa, Somogydöröcske, Kára, and Miklósi), for *[<10]* years, possesses *PRIMARY* **education**, having *NON-*

ACTIVE, *HOMESTAY* occupational status and not sure in **trust.to.mayor** (*MAYBE)*.

Based on the specific factors model's results, the Hypotheses 2 and 3 proved due to the following findings:

1. **acceptance** is significantly influenced by the specific variables **biomass.knowledge**, **energy.crops.knowledge**, **climate.change.knowledge**.

2. Convincible group of the respondents is characterized by the lack of **knowledge** about the terms **biomass** and **energy crops**.

The specific profile of the *MAYBE* (convincible) **acceptance** group is the following:

people, which are not involved in farming activities such as plant cultivation or animal keeping (**own.plant** and **own.animal** both *NO*), do not know the terms **biomass** and **energy crops** (both *NO*), but aware of climate change (**climate.change.knowledge** *YES*). They are not willing to collect biomass (**willing.to.collect** *NO*).

5. New scientific results

I would like to highlight the ***new scientific results*** as the main outcomes of my dissertation:

1. I proved that educational level of a respondent (high school diploma obtained) associated to higher acceptance of the biogas power plant installation focusing on the research area.
2. I created the personal and the specific profiles of the convincible population group with the uncertain opinion regarding to **acceptance** biomass-based power plant in the Koppány Valley rural area of Hungary.
3. I proved that social acceptance of the biogas power plant installation is associated with the respondent's knowledge regarding biomass, energy crops and climate change focusing on the research area.
4. I found that the convincible group of the respondents is characterized by insufficient **knowledge** about the terms **biomass** and **energy crops**.

6.The publications related to the topic

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Titov, A., 2017. Renewable energy sources for sustainable rural development in Hungary. *Proceedings of the 6th International Conference of Economic* Sciences. Kaposvár, Hungary: Kaposvár University, pp. 405-411., 7 p.

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