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# Social and Natural Opportunities for the Renewable Energy Utilization in the Koppany Valley Development Area

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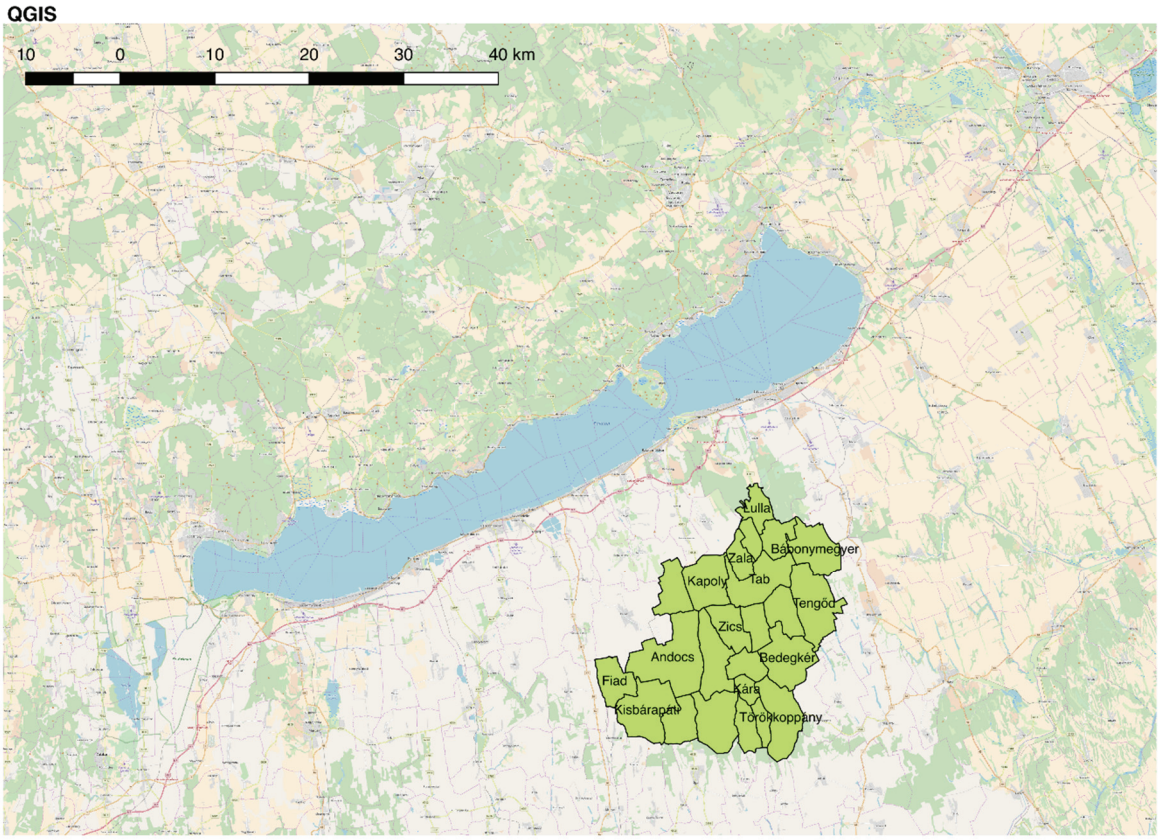
*Abstract.* Koppany Valley is located in one of the most underdeveloped Hungarian territories considering serious economic, social and infrastructural issues. Despite this fact, there is significant potential regarding the green energy sector if taking into account essential amount of local raw bio-material production. The estimated theoretical potential of biomass in the area is substantial, although however it is complicated to realise due to the social barriers such as lack of knowledge and low level of awareness regarding renewables among the local stakeholders. During 16 months of our research the most important social, economic and biomass production data of the examined settlements were collected primarily as well as secondary statistical data. Three hundred questionnaires were distributed in 10 rural settlements of the tested micro region. It was concentrated to three main parts of questions: general information about respondents (background information), awareness regarding renewable energy and different types of sources and a separate block considered biomass data specifically. In the questionnaire mostly Likert scale and multiple choice questions were applied. The study of social and natural opportunities for the renewable energy utilization helps to determine local economic circumstances by describing the social environment of the Koppany Valley. The main factors affecting public behavior towards local sustainable energy improvement were investigated. Based on the conducted survey and results obtained we provide the acceptance and awareness regarding biomass use for energy purposes, what could be considerable for the decision makers in order to invest capital to the local economy. Relying on statistical evidence, we believe that our results contribute to the implementation of regional development projects aimed to improve energy efficiency of households and to maximize the added value of the Koppany Valley. In this way, these measures may serve as possible solution to get out from the current difficult economic situation and to give impetus for the further rural and regional development.

*Keywords:* renewables, energy, rural development, local resources, social acceptance, biomass

## 1 Introduction

The location of our research was 10 settlements in the Koppány Valley, in the Northern part of Somogy County. 9 of them are administrative units in the Tab District and Koppanyszanto, which belongs to the other structural division (Tolna County, Tamasi District). This area has primarily small villages and considered as economically underdeveloped (based on 290/2014. (XI. 26.) government regulation on the classification of the beneficiary districts).
The area is typically characterized by small villages and located far away from towns. Bigger centrums do not affect them considerably.

**Pic.1** Geographical location of the research area




Source: own results

According to the national delimitation 6 of the 10 examined settlements are described as cumulatively underdeveloped and 3 of them suffer from severe unemployment. The small villages and the lack of towns in the area cause several serious social and economic disadvantages.
In this respect, it would be reasonable to consider and investigate alternative, more innovative sources for the local development. There are several possible local development strategies: FDI, Circular economy, Endogenous development, etc. Taking into account the fact, that the region is quite rich in the natural bio resources (forests, agricultural lands, etc.) and favourable natural conditions (climate, soil, etc.), the local resource based Endogenous development strategy seen as the most preferable and feasible. Realization of the natural resources potential could provide raw materials for the further renewable energy applications based on biomass in order to generate “green” energy supply for the local stakeholders. Therefore, every opportunity including the utilization of renewable energy must be grasped in order to improve the population retaining capacity and the employment rate. That change

would contribute to the energy savings, decrease natural gas dependency, employment promotion. In this way, the added-value growth of the region in general might be expected.

There are a few initiatives towards sustainable bio-resources utilization which were already implemented by the local authorities:

-Biomass storage places (mostly firewood for heating purposes);
-Green waste containers for more sustainable waste management and waste utilization;
-Agro-tourism promotions including walking tourist routs and places for leisure in nature to increase attractiveness of the area for visitors and newcomers.

In regard with environmental protection improvement and taking into account incentives from the local development association, we decided to explore the significance of the local raw bio-material production potential using two different approaches: by analysing local agriculture statistics and through the local population survey.

Local population survey was conducted in frames of the RuRES project- "Renewable energy sources and energy efficiency in the function of rural development" dedicated to Hungary-Croatia Cross-border Co-operation Programme.

## 2 Literature review

The examined area is among the traditionally ***underdeveloped areas*** of Hungary. The problems of the examined area are not totally new and had being analysed in previous studies. The complexity and interconnectedness of different social, economic and environmental issues were intensively researched. Such negative aspects as intensive agricultural production, poor employment power, degradation of natural resources and depopulation – should be addressed by complex solutions (Gelencsér, 2017). In order to recognise and define the problems, moreover to search for their solutions implementation of completely new strategic development programs on the local level is required. It the past few decades the approach of regional development strategies shifted from exogenous character (with intense contribution of external resources) to endogenous (Stimson et al., 2001), which supposes local development based on region's reliance and the most efficient utilisation of the local resources and facilities (Bodnár, 2013). In this respect, the proposed local development strategy would have a goal to create favourable conditions for a region aiming to maximize its local resources utilization. The main focus of it goes to endogenous processes such as an encouragement of collaborative and communicative advantages between the private, public and community local actors (Stimson et al., 2001). However, the changing policies and inadequate access to investment capital along with lack of cooperation of the actors of the area inhibit the implementation of these strategies and actions successfully (Mezei et al., 2018). Despite that fact, the target area has such local capital elements (Camagni, 2009) that can be utilised and fed into the development of the region (Bodnár, 2013). Use of landscape, partnership cooperation between the local actors, innovations, public activities and local governance may serve as local development engines in the same degree with the natural resources and acceptance, trust or esteem (Camagni, 2009). Apart of the natural resources potential, social capital and its potential including people knowledge is an important infrastructural part of the Endogenous local development strategy (Johansson et al., 2001).

## 3 Materials and methods

We used secondary data of Hungarian Central Statistical Office (HCSO) to indicate *economic and social features of the region*. The variables were considered: unemployment rate (ratio of unemployed persons to the economically active population), net income per capita (the average income earned per

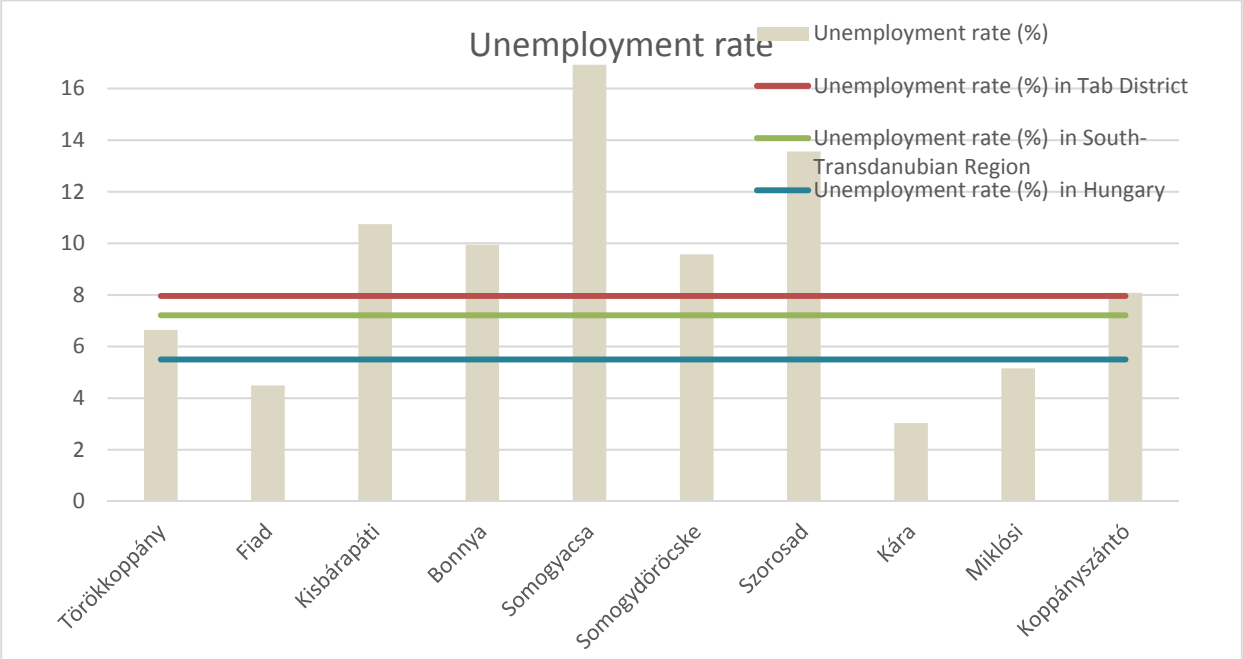
person in the area) in Hungarian forint and migration balance (the difference between the number of persons having entered the territory and the number of persons having left the territory). We applied the most recent available data from 2015, N=10 (panel data of 10 settlements of the Koppany Valley). Descriptive statistics were used to illustrate the results.
The theoretical potential of biomass was analysed with the use of several data sources such as agricultural data from TeIR-EI (*National Food Chain Safety Office*, *Forestry Directorate*) and Corine database on forestry management areas and agricultural land (N=25 settlements of the Tab district, year 2015). QGIS mapping method was applied for visualisation of the results on settlement level.
Local population questionnaire survey was carried out in May, 2018 in 10 settlements of the Koppany Valley micro region (n=310). Likert scale, multiple choice and open answer questions were applied to questionnaires in the process of the survey. Descriptive statistics and cross table analysis were applied, besides. The questionnaire consisted of several blocks – apart of background information. In this article we focus on only the results of the biomass awareness and potential.

## 4 Results

### *4.1. Economic and social features of the region*

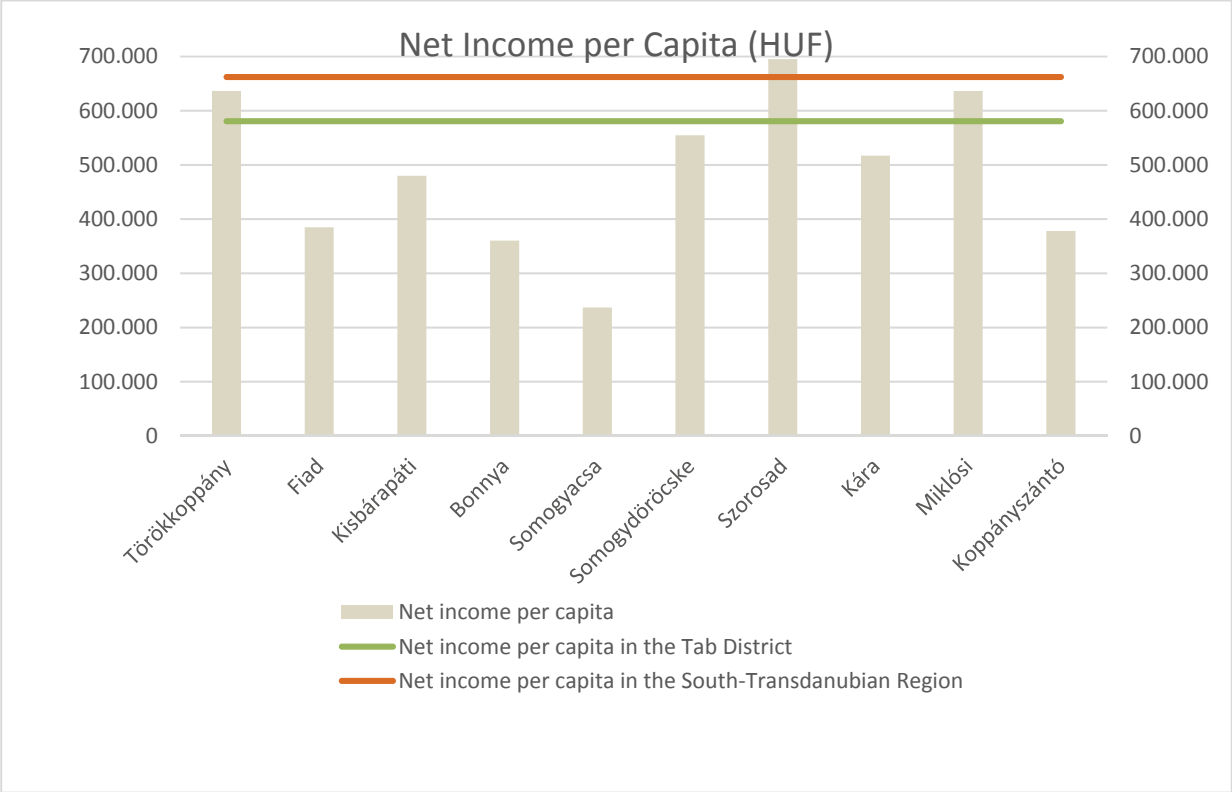
35% of Hungary's population which is a little more than 3.5 million people lives in villages. The average population of the villages is 1230 people.
2 095 people live in the examined area in 10 small villages. All the examined settlements have a population under 500 people, 5 of them have a population under 200 people.
Figure 1 demonstrates the level of unemployment in the settlements of the research area in comparison to the country, regional and district averages. The highest unemployment rate was indicated in Somogyacsa, Szorosad, Kisbarapati, Bonya and Koppanyszanto. It exceeds all the benchmark averages. The situation in Kara, Fiad and Miklosi does not cause concern.
The settlements on the south part of the Tab District including Somogyacsa, Bonnya, Fiad, and Kisbarapati are backward villages on the boarder of disappearing (Fig. 2). From the view of the regional development they form a so-called internal periphery which is very hard to develop. This is the poorest part of the district. In fact, only in Szorosad net income per capita is higher than regional average.
The largest problem of the area which also the most difficult to handle is the rapid decline of the social capital (Fig. 3). The basis of the community renewal disappears because of the multifactorial contra-selection caused by the migration of young people, the moving of successful businesses into towns, the moving of elder people to relatives in towns. The situation of the remaining population is dramatic and shows a continuous decline.
Based on the figures observed we may conclude that implications of the traditional rural development policy applied to the region have no positive effect on the local economic state.

**Fig. 1** Unemployment rate in the settlements of the Koppany Valley



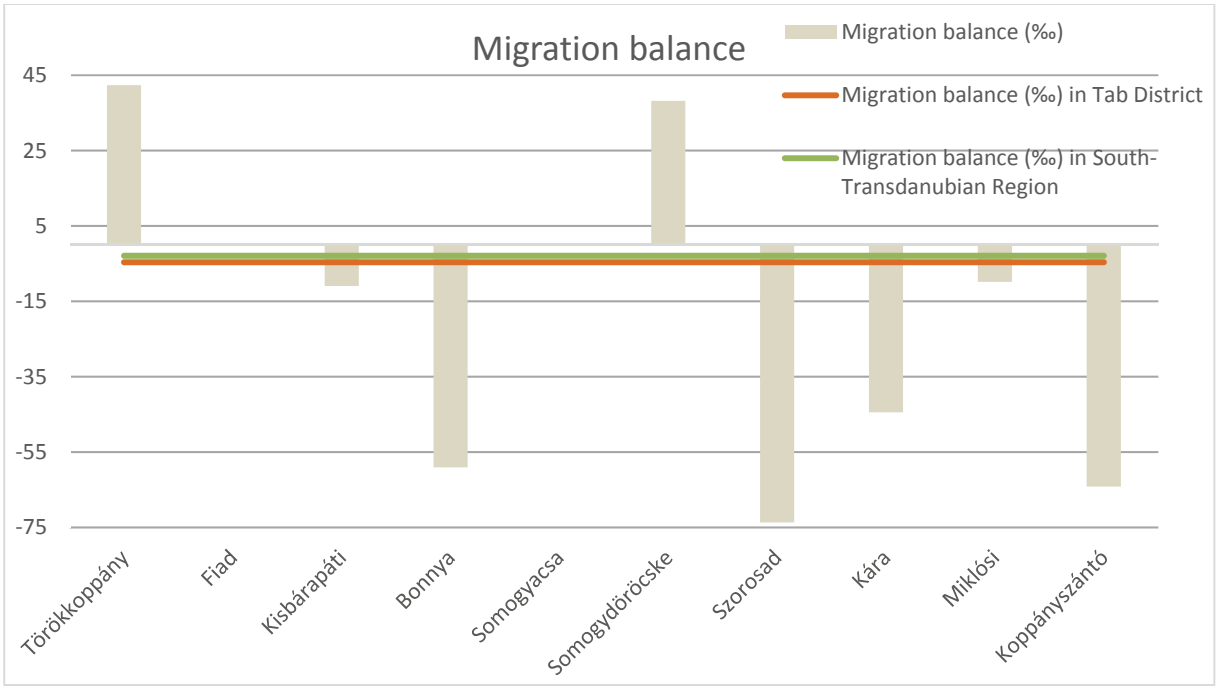

***Source:*** Own calculations based on Hungarian Central Statistical Office (HCSO), 2015

**Fig. 2** Net income per capita in the settlements of the Koppany Valley




***Source:*** Own calculations based on Hungarian Central Statistical Office (HCSO), 2015

**Fig. 3** Migration balance in the settlements of the Koppany Valley

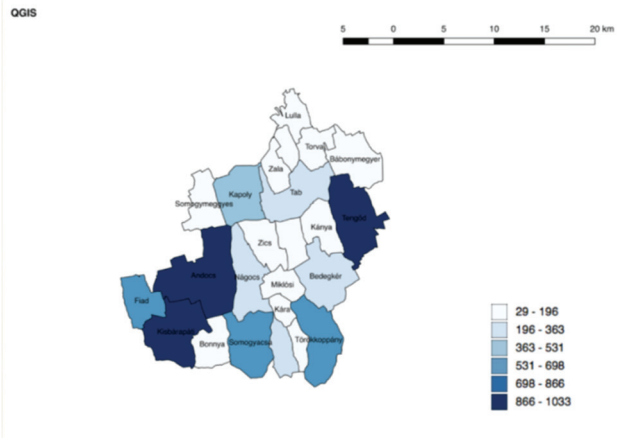



***Source:*** Own calculations based on Hungarian Central Statistical Office (HCSO), 2015

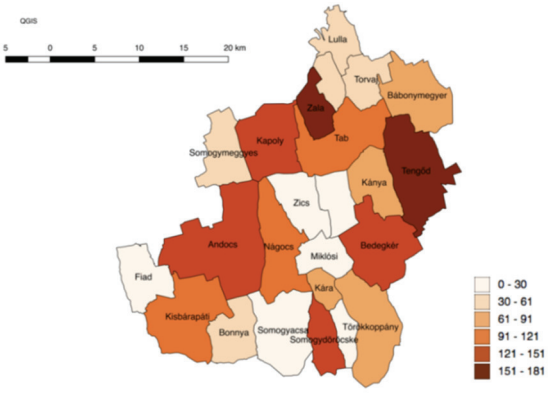
### *4.2. Natural resources potential*

For the QGIS mapping three basic indicators were applied: production forest, regenerated forest and agriculture management land in ha to the total area of the settlement. The equal intervals classification was used. The maps indicate the imbalances of biomass resources of the region.

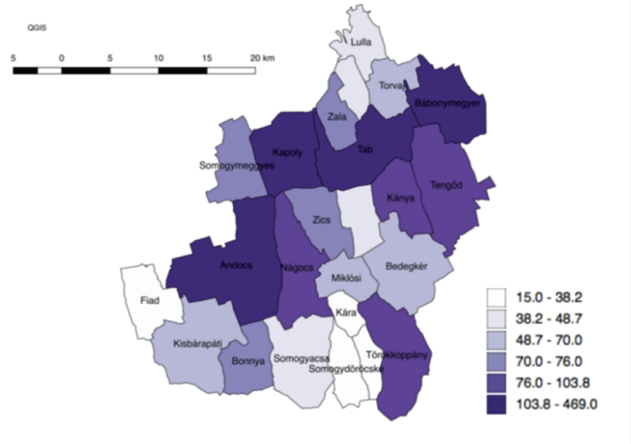
**Map 1.** Production forest in the area, ha




**Map 2.** Regenerated forest in the area, ha



**Map 3.** Agricultural management land in the area, ha




Source: own calculations based on Corine data, 2015

Under production forest (Map 1) we meant wood, by far the dominant product of forests, is used for many purposes, such as wood fuel (e.g. in form of firewood or charcoal) or the finished structural materials used for the construction of buildings, or as a raw material, in the form of wood pulp, that is used in the production of paper. (FAO, 2012). In our particular case, we approach the production forest resources as a consistent part of the biomass energy potential of the region. The concentration of the production forest is the highest in Tengod, Andocs and Kisbarapati settlements and amounts from 866 to 1033 ha.

Map 2 reflects to the areas of the forest regeneration. Forest regeneration is the act of renewing tree cover by establishing young trees naturally or artificially-generally, promptly after the previous stand or forest has been removed (IPCC, 2000). The amount of regenerated forest in the region is not so significant, that is why the estimation scale of this indicator in is much lower than it was used for the production forest assessment. We could find that regenerated forest in Tengod and Zala occupies from 151 to 181 ha of the total area, what is the highest number among the eligible settlements. Perhaps, expansion of the forest regeneration areas would contribute to improvement of the forest management system in general and lead to more sustainable way of forest resources utilization.

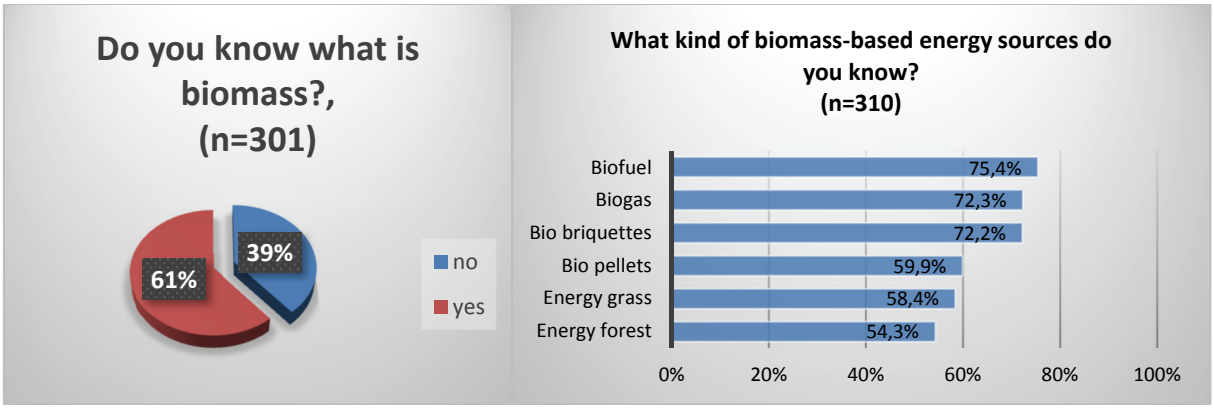
The third indicator we considered was agriculture management land. In comparison to the forestry resources it covers less area in the region. Nevertheless, agriculture is essential source of biomass considering organic waste, plant residues and potential switch to the energy crop lands production. Andocs, Kapoly, Tab and Babonymegyer villages performed as the most covered by the territory of agricultural activity. This should be taken into account in the process of planning, defining location and organising logistics for the proposed biomass-based local energy plant. Additionally, it was found that lands in the region are owned by several different local actors from the state and private sectors. This fact may create supplementary constraints in finding legal consensus for the power plant establishment.

### *4.3. Results of the local population survey*

Before the survey conduction we hypothesised that the social potential of the Koppany Valley regarding biomass based energy sources is limited. We assumed it is difficult to realise due to the social barriers such as lack of knowledge and low level of awareness regarding RES among the local stakeholders. Generally poor socio-economic characteristics only supported our expectations. However, the first results of the questionnaire analysis provided an interesting picture.

**Fig.4** Basic biomass knowledge

**Fig. 5** Bio-based energy sources knowledge



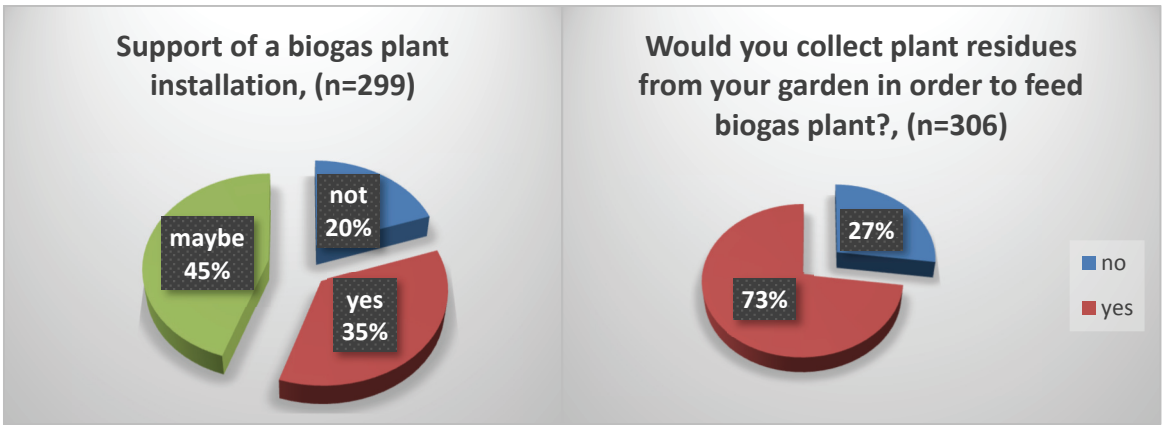

Source: own calculations based on population survey preliminary results (data) from RuRES, 2018

61% of respondents stated their knowledge about what biomass is (Fig. 1). Among the biomass energy sources biofuel, biogas and bio briquettes were mentioned as the most known with more than 72% of awareness rate. At least 54% of the population have knowledge about energy forest, energy grass and bio pellets (Fig. 2). Thus, general knowledge about biomass definition and bio-based energy sources among inhabitants of the Koppany Valley has basically moderate level, but it exceeded our initial expectations.

Then we switched to the public acceptance questions part. We asked stakeholders would they support installation of a biogas power plant in their local community. 35% of respondents answered "yes", 20% said "no" and the rest 45% declared "may be" (Fig. 6). It means most of the people are not quite sure about their decision regarding biogas plant installation. In spite of this, 73% of people are ready to collect plant residues from their garden in order to get raw materials for the proposed biogas plant (Fig. 7). For the Likert scale method we offered respondents to express their opinion about the statements using estimation scale from 1 to 5, where 1 meant "completely disagree" and 5 meant "completely agree". The analysis of the different acceptance aspects as willingness to collect organic waste (this question was applied to the Likert scale as well), willingness to make financial contributions for the green energy utilisation and readiness to participate community activities related to biogas production is represented by the Figure 8. We can see that people are much more likely to collect organic waste (so it confirmed our results in Fig. 7) than to work together and especially to provide financial aids.

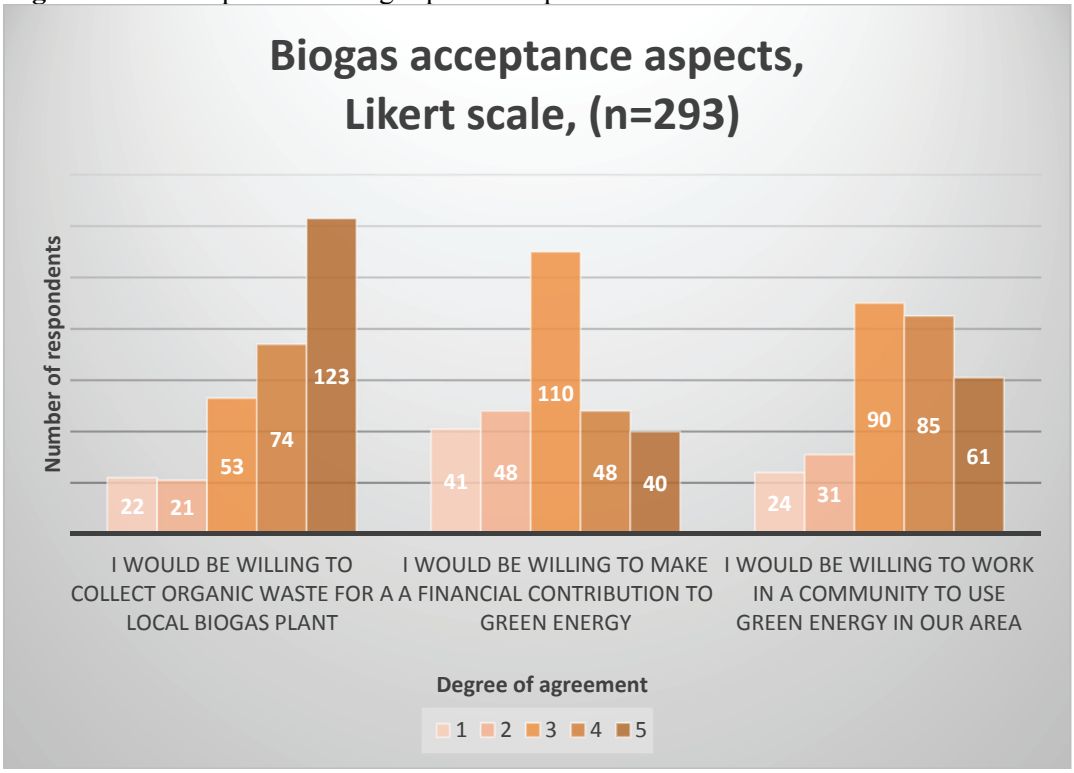
**Fig. 6** Support of a biogas plant

**Fig. 7** Collective activities




Source: own calculations based on population survey preliminary results (data) from RuRES, 2018

**Fig. 8** Different aspects of a biogas plant acceptance




Source: own calculations based on population survey preliminary results (data) from RuRES, 2018

Accumulation of raw materials is crucial issue for the operational maintenance of a biogas plant. Therefore, the fact that local population is willing to collect plant residues, organic waste and other bio sources for feeding biogas plant purpose indicates significant progress in the social potential of the area.

## 5 Conclusions

Although for less potential of the micro region in both social and economic power, the imbalances seen across the Koppany Valley cause attention to that settlements have different base of local development. This is also proved by the findings of (Mezei et al, 2018), which article comes to conclusion that diverse development strategy is reasonable in the micro region.
The natural resources of the area are outstanding in regard with forest covering and agricultural lands. The spatial distribution of these resources is also uneven- a local resource based development strategy shall consider the multifaceted interest points of view of the local stakeholders.
Besides the natural resources, local households' potential for biomass production can be significant. The analysis of attitude of inhabitants reflected that albeit there is a fair amount of biomass and several ways of its utilisation, there is still a big potential hidden. The hidden potentials lay both in the way of thinking of inhabitants which influence several aspects of waste management and considering their agricultural related activities (gardens, vineyards, animal keeping, etc.).

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