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LOCAL RESOURCE CLUSTERS OF SOUTHERN TRANSDANUBIAN SETTLEMENTS

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ABSTRACT

Development goals, priorities and strategies need to be based on available (local) resources, which are identified as either comparative advantages or uniform development goals at certain planning level. Core development policies of the region take centrum-periphery theory as the primary approach in planning allocating development funds. In this paper authors developed four settlement clusters based on their local resources (HCSO, AC, T-STAR database, 44 variables, cross section 2018). Few Strong and capable cities (n=31) are accompanied by mainly Agricultural villages (n=155) and there are settlements (n=170) with Concentrated capacities. But majority of the region's area (n=299) has Limited resources. The classification of the settlements can be used in gravity models that test the pull effect of central cities on the complex development of the surrounding settlements.
Keywords: planning, settlements, classification, spatial heterogeneity, local resources, clusters

INTRODUCTION

There are substantial differences across EU member states in terms of knowledge and institutional settings as well as the objectives of regional policies (*Varjú*, 2021). Hence, the approach, the applied methods and materials to support regional planning vary from country to country.

The Hungarian Government decided on the establishment of the South Transdanubian Economic Development Zone with its Government Decree of 1569/2020 (IX. 4.) in order to form economically and culturally unified areas, to develop internationally competitive economic units that will play a key role in strengthening the economy.

The current article analyses the local resources and classifies the region's settlements to provide most update information on and understand a) the variation of the local resources availability of settlements and b) support development strategies and policies targeting. The classification allows to describe the relative development status of each settlement groups in details. With the help of the results obtained, it is possible to suggest an allocation of diverse development funds which may better fit to the EU Horizon 2050 planning period. Further research may also build on the above classification of the settlements; e.g. we suggest to use it in gravity

modelling of the region in order for defining more suitable territorial scale and boundaries for planning and implementation of developments.

LITERATURE REVIEW

According to the followers of local resources based development (earlier: *Capello*, 2007; *Camagni*, 2009 and neo-endogenous: *Cejudo & Bavarro,* 2020; *Pollermann et al*, 2020; *Biczkowski*, 2020), development goals, priorities and strategies, concepts are supposed to be based on the resources that can be allocated, and are identified as either comparative advantages or uniform development goals. Resources are considered as factors that constitute the set of opportunities and provide value to developers (*G. Fekete*, 2013; *Mezei*, 2018; *Varjú et al*., 2020). The project absorption capacity of settlements also depends on the availability of local capital (e.g. resources) (*Horváthné et al*, 2021a). For most local developments, a territorial scale that goes beyond the boundaries of a particular municipality would be ideal for implementation (*Mezei & Varjú*, 2018).

The current planning period is specific and unique from certain point of view. Beside the bottom-up approach (where regional planning considers the county plans), planners have to deal with the central expectation of South-Transdanubian Economic Development Zone (*Hungarian Government*, 2020) in the new planning period. The development planning strategy suggests that core or central territories shall be targeted and it is expected that such developments are planned that best fit to the territories. The regional plan had to consider the county concepts, too. An earlier study (*Horváthné et al*, 2021b) on the county development plans (*Tolna County Local Government*, 2021; *Baranya County Local Government*, 2021; *Somogy County Local Government*, 2021) identified seven specific zones that are characterised by single or multiple development aims, but majority of the region's settlement are not targeted by development in the county concepts. Further feature of the planning is that it relies on the central focus and peripheral effect (i.e. pulling) of gravity. However, the (small) cities' capabilities for playing central role in the development of micro regions had not been found clear (*Horváthné et al*, 2017) in the Southern Transdanubian region, neither may be maintained if considering the perforated spatial structure of the region (*Máté et al*, 2017).

The authors' intention is to illustrate the dispersion of resource availability of settlements and to show that the settlements on the administrative micro regions are very diverse in terms of development and local resources. Several types of patterns can be applied (*Jia et al*, 2020) according to different relations of centrum – periphery (rural – city, etc.) and understanding the spatial structure of the region may help identify the most applicable ones for individual micro regions for better planning and allocation of developments.

The paper is structured as follows: after this introduction, in the second part the used materials, data, and the analytical, methodological framework are presented. In the results and discussion part the short description of the planning area is followed by the detailed presentation of the analyses. In the last part the authors conclude by arguing that the development strategy of the region needs to consider the diverse endowments and understand the possible roles of micro region centres.

THE STUDY AREA

The region includes 3 counties: Somogy, Tolna and Baranya. It is very heterogeneous from the point of view of development; it is made up of several development areas at administrative level. 656 settlements (41 towns and 615 villages) can be found in the region on a 14 198 km² large territory with 894 223 inhabitants, more than half of which (333 settlements) are social, economic and infrastructural beneficiaries, while 265 (40.4%) belong to the group of settlements with significant unemployment (105/2015. (IV. 23.) Government Decree). The Southern Transdanubian Region is bordered by lake Balaton in the North, river Danube in the East, the Croatian border line following River Drava on the South (*Figure 1*), which limits the peripheries' expansion.

Figure 1: Location and natural borders of the South Transdanubian Region (NUTS2)

Source: *Szabó* (n.d.)

Government Decree of 290/2014 (26.11.2014) on the classification of beneficiary districts defines the beneficiary areas as those districts where the complex indicator is lower than the average of the complex indicator of all districts. It also defines those districts among the beneficiary districts which have the lowest complex indicator and are home to 10% of the cumulated population of the country as districts to be developed with a complex programme.

MATERIALS AND METHODS

A cross section database of 656 settlements was created by using 44 socio-demographic, business-economic and agricultural indicators of the T-STAR settlement HCSO statistics of 2018 and Agricultural Census of 2010.

As a first step the data was divided with the number of permanent population or the size of the settlement in order to avoid size effect.

Then, three methods of index generation were employed to rescale data.

Relative index numbers of intensity

Relative index number xy_{ij}_rate (1) is calculated in a way that given variable for i^{th} settlement (x_i) is divided by another variable (mostly population or size) of the i^{th} settlement (y_i); it takes on value in range of [0-1].

$$xy_i\_rate = \frac{x_i}{y_i} \quad (1)$$

The same procedure was applied for the calculation of the ratio number of land use, where y_i was the total of agricultural land of i^{th} settlement.

Normalisation

We applied *min-max normalization* (2) to rescale values of variables ranging between 0 and 1. The normalised value for each observation x_i_st is calculated by the following formula, taking the range of each variable as denominator of the ratio.

$$x_i\_st = \frac{x_i}{max_{xi} - min_{xi}} \quad (2)$$

Scale transformation

We used the process of dividing the data by 100 or 1000 in order to rescale into [0;1].

Dummy variables

The value of a variable may take only 0 or 1. There was no need for scaling.

The set of indicators and variables used in the analysis is summarised in *Table 1*.

Table 1: Indicators and variables of settlements with main statistics

Indicator Name	Variable Name	Mean	St. Dev.	Min	Max
PERMANENT POPULATION (NORM) (HEAD) 2018	population (norm)	0.01	0.05	0.00	1.00
PERMANENT POPULATION AGED ABOVE 60 (HEAD) 2018	old (rate)	0.26	0.06	0.08	0.56
AREA OF SETTELEMNT (NORM) (KM²) 2018	acreage off settlement (norm)	0.13	0.12	0.01	1.01
AVERAGE NUMBER OF REGULAR CHILDREN AID PER MONTH (RT) (HEAD) 2018	children aid (rate)	0.07	0.06	0.00	0.31
INVERSTMENT SOF MUNICIPALITIES (HUF PER HEAD) (NORM) 2018	municipal investment (norm)	0.01	0.04	0.00	1.00
FULL TIME PRIMARY SCHOOL CLASS (Y/N) 2018	primary school (Boolean)	0.38	0.49	0.00	1.00
MIGRATION (PERMANENT AND TEMPORARY) RATE (RATIO) 2018	migration rate	0.08	0.03	0.01	0.32
UNEMPLOYMENT ABOVE ONE YEAR (RT) 2018	unemployment rate	0.01	0.01	0.00	0.09
NUMBER OF CULTURAL EVENTS (PCS PER YEAR) (RT) 2018	cultural events (rate)	0.04	0.08	0.00	1.67
MUNICIPAL SELECTIVE WASTE (TON S PER HEAD) (RT) 2018	recycled waste (rate)	0.07	0.09	0.00	0.55
GOVERNMENT AGENCY (Y/N) 2018	government agency (Boolean)	0.05	0.21	0.00	1.00

Indicator Name	Variable Name	Mean	St. Dev.	Min	Max
NUMBER OF COMPANIES WITH (PCS PER HEAD) 2018					
500+ EMPLOYEES (INCL. NONPROFIT) 2018 + 250-499 EMPLOYEES (INCL. NONPROFIT)	large companies (Boolean)	0.03	0.18	0.00	1.00
50-249 EMPLOYEES (INCL. NONPROFIT) + 20-49 EMPLOYEES (INCL. NONPROFIT)	medium sized enterprises (rate)	0.07	0.16	0.00	2.02
10-19 EMPLOYEES (INCL. NONPROFIT)	small sized enterprises (rate)	0.10	0.19	0.00	1.91
REGISTRATED COMPANIES IN PROCESSING INDUSTRY (Y/N) 2018	processing industry (Boolean)	0.54	0.50	0.00	1.00
NUMBER OF REGISTRATED COMPANIES IN PROCESSING INDUSTRY (PCS PER HEAD) (NORM) 2018	processing industry (norm)	0.01	0.05	0.00	1.00
AGRICULTURAL CENSUS 2010					
TOTAL UTILISED AGRICULTURAL LAND (NORM)	Agric acreaga (norm)	0.01	0.07	0.00	1.72
UTILISED LAND RATE OF FOREST PER AGRICULTURAL LAND (RATIO)	forest rate	0.13	0.19	0.00	0.95
UTILISED LAND RATE OF ORCHARD PER AGRICULTURAL LAND (RATIO)	orchard rate	0.02	0.05	0.00	0.89
UTILISED LAND RATE OF FISH LAKE PER AGRICULTURAL LAND (RATIO)	lake (fish) rate	0.01	0.04	0.00	0.50
NUMBER OF AGRICULTURAL PRODUCRES (HEAD PER POPULATION HEAD)	number of agricultural producers (rate)	0.86	0.20	0.05	1.00
UTILISED LAND RATE OF CROPLAND PER AGRICULTURAL LAND (RATIO)	cropland rate	0.69	0.26	0.00	1.00
AGRICULTURAL LAND PER SETTLEMENT AREA (PER 10000)	agri_land (rate)	0.01	0.05	0.00	1.21
NUMBER OF PIG (PCS) (NORM)	pig (norm)	0.02	0.09	0.00	1.00
NUMBER OF CATTLE (PCS) (NORM)	cattle (norm)	0.03	0.09	0.00	1.00
NUMBER OF POULTRY (PCS) (NORM)	poultry (norm)	0.02	0.06	0.00	1.00
NUMBER OF GOAT (PCS) (NORM)	goat (norm)	0.07	0.13	0.00	1.00
NUMBER OF HORSE (PCS) (NORM)	horse (norm)	0.06	0.09	0.00	1.00
NUMBER OF FARMS WITH ANIMALS (PCS) (NORM)	number of farms with animals (norm)	0.15	0.15	0.00	1.00
PRODUCTIVE FORESTS (HA PER SETTLEMENT HA)	Product_forest	0.1	0.12	0.00	1.00
SOIL_PROT_FOREST (HA PER SETTLEMENT HA)	Soil_prot_Forest	0.05	0.10	0.00	1.00
NAT_PROT_FOREST (HA PER SETTLEMENT HA)	Nat_prot_forest	0.03	0.12	0.00	1.00

Remarks: NORM refers to min-max normalisation; RT refers to relative index numbers; RATIO refers to ratio variable; Y/N refers to the Boolean (dummy) variable; / 100 or /10000 means a transformation of dividing the data by 100 or 1000 in order to rescale into [0;1].

The dataset of altogether 44 transformed variables of 656 settlements was imported to STATA 15 software.

Methods used

The counties and settlement shape files were downloaded from OpenStreetMap. We merged the panel data with the shape file. The visualisation of the results was based on maps created with QGIS 3.16.0 software.

In the cluster analysis K-means model (type: partition, method: k-means, dissimilarity measure: continuous, distance: Euclidean) was applied with STATA 15 software. The optimal number of clusters was selected on the basis of the Calinski–Harabasz-pszeudo–F statistics of stopping rule and the size of generated clusters (See Annex).

RESULTS

In the following, the results of the cluster analysis are shown. *Table 2* summarises the main statistics of the cluster model variables by clusters.

Table 2: Scores of variables in the resource clusters of South Transdanubian settlements

ID OF CLUSTER AND NUMBER OF SETTLEMENTS	Cl 1 n = 31		CL 2 n = 155		CL 3 n = 299		CL 4 n = 170	
VARIABLES	mean	s.dev	mean	s.dev	mean	s.dev	mean	s.dev
population (min-max norm)	**0.110**	0.184	0.003	0.002	0.002	0.002	0.010	0.006
old (rate)	0.293	0.031	0.261	0.062	0.248	0.071	0.264	0.048
acreage off settlement (min-max norm)	**0.443**	0.261	0.092	0.049	0.088	0.058	0.199	0.108
children aid (rate)	0.024	0.016	0.066	0.056	**0.089**	0.068	0.053	0.044
municipal investment (min-max norm)	**0.083**	0.185	0.001	0.003	0.001	0.001	0.004	0.008
primary school (Boolean)	1.000	0.000	**0.000**	0.000	0.164	0.371	1.000	0.000
migration rate	**0.061**	0.011	0.082	0.031	0.084	0.043	0.070	0.015
unemployment rate	**0.008**	0.005	0.014	0.014	0.016	0.016	0.011	0.008
cultural events (rate)	0.023	0.017	**0.054**	0.139	**0.050**	0.061	0.026	0.029
recycled waste (rate)	**0.173**	0.145	0.071	0.083	***0.041***	0.045	0.096	0.103
government agency (Boolean)	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
large companies (Boolean)	**0.484**	0.508	0.013	0.113	***0.000***	0.000	**0.029**	0.169
medium sized enterprises (rate)	**0.149**	0.066	0.089	0.164	***0.043***	0.191	**0.091**	0.108
small sized enterprises (rate)	**0.173**	0.080	**0.148**	0.236	***0.070***	0.205	0.104	0.111
processing industry (Boolean)	1.000	0.000	1.000	0.000	***0.000***	0.000	1.000	0.000
processing industry (min-max norm)	**0.109**	0.185	0.003	0.003	0.000	0.000	0.007	0.010
agricultural acreage (standardized)	**0.011**	0.024	***0.005***	0.011	0.011	0.100	***0.006***	0.011
forest rate	**0.167**	0.243	0.136	0.178	0.132	0.193	0.124	0.174
orchard rate	**0.028**	0.054	0.017	0.038	***0.010***	0.021	0.023	0.084
lake (fish) rate	0.001	0.002	0.006	0.035	**0.009**	0.044	0.005	0.022
number of agricultural producers (rate)	0.831	0.243	0.856	0.183	0.857	0.201	0.864	0.187
cropland rate	***0.626***	0.281	**0.681**	0.243	**0.699**	0.266	**0.690**	0.260
agri_land (rate)	***0.006***	0.021	**0.019**	0.099	0.012	0.035	***0.004***	0.006
pig (min-max norm)	**0.153**	0.283	0.007	0.029	0.007	0.029	**0.032**	0.101
cattle (min-max norm)	**0.189**	0.232	0.010	0.028	0.010	0.051	0.043	0.091
poultry (min-max norm)	**0.060**	0.103	0.016	0.093	0.006	0.019	**0.028**	0.065
goat (min-max norm)	0.235	0.228	0.045	0.088	0.053	0.112	**0.111**	0.126
horse (min-max norm)	**0.223**	0.217	0.037	0.041	0.030	0.050	**0.095**	0.093
number of farms with animals (min-max norm)	**0.44**	0.262	0.093	0.067	0.083	0.067	**0.254**	0.159
Product_forest	**0.213**	0.218	0.075	0.084	0.077	0.093	0.131	0.157
Soil_prot_Forest	**0.137**	0.187	0.050	0.091	0.036	0.083	0.069	0.120
Nat_prot_forest	**0.140**	0.267	0.028	0.086	0.016	0.059	0.057	0.152

Source: Based on HCSO settlement data (2018) and Agricultural Census data (2010)

Looking at the scores related to each variable across the four clusters defined in more details (*Table 2*), the main characteristics of the clusters are discussed in the following. The bold letters indicate highest, while the italics the lowest values for given variable, which information is used when describing the clusters of settlements.

Settlements belonging to *Cluster 1* are typically greater sized (acreage=0.443) and most populated (population=0.11) cities (n=31). Cluster 1 is characterised by the highest municipal investments (0.083), ratio of selective waste (0.173), relative number of large and medium sized companies (0.484; 0.149) and size of agricultural land (0.011). Due to the size of these settlements, the size (0.167) and relative size of forests to agricultural land are the highest, while the relative size of croplands (0.626) and agricultural lands (0.006) is the second smallest. This is the only cluster where all settlements have some government agencies (Boolean government agencies = 1.00). Furthermore, the regional capacity for processing industry is concentrated (Boolean processing industry = 1.00) in this cluster. The lowest migration rate (0.061), unemployment (0.008) and number of cultural events per capita (0.023) are seen here. This Cluster is named: *Strong and capable cities*.

The settlements of *Cluster 2* (n=155) lack primary schools (0.000), government agencies (0.00) and face high migration (0.082) and unemployment (0.014). Although the relative size of agricultural land is highest (0.019) and cropland (0.681) is significant, the number of farmers is moderate (0.856), suggesting a concentrated agricultural farm structure. Further strength of the settlements of this cluster is the presence of processing industry (1.00). The size and population of the settlements are the second smallest (0.003) among the four clusters. This Cluster is named: *Agricultural villages* (Small villages with agricultural and processing industrial capacities).

Cluster 3 settlements are the smallest ones, and the second highest migration (0.084) and unemployment (0.016) is seen here (n=299). It lacks processing industry (0.00). Children aid is the highest (0.089). Large parts of fishponds (0.009) and croplands (0.699) are here compared to the other clusters. Like cluster 2, the number of livestock is low. This Cluster is named: *Limited resources* (Small villages with very limited resources). The number of cultural events is the highest in Cluster 2 and 3.

The second highest part of livestock (pig: 0.032; cattle: 0.043; poultry: 0.028), high rate of orchards (0.023) and size of forests (0.124) are found in *Cluster 4* settlements (n=170). It is strong in the number of mid (0.091) and large sized (0.029) companies compared to cluster 2 and 3. This Cluster is named *Concentrated capacities* (Areas with significant livestock and processing industry, relatively high number of large and medium sized enterprises).

The boxplots of the variables compare visually the four clusters in *Figure 2 a* to *d*.

The groups of variables in the boxplot charts give a visibly comparable information on the difference between clusters of settlements (described above).

The membership of settlements in clusters 1 to 4 was illustrated in a settlement border map of the Southern Transdanubian region (*Figure 3*)

The settlements of Cluster 1 are major cities by lake Balaton and county capitals. Majority of these cities are micro region centres, too. Namely Balatonboglár, Balatonföldvár, Balatonlelle, Barcs, Bátaszék, Bóly, Bonyhád, Csurgó, Dombóvár, Dunaföldvár, Fonyód, Kaposvár, Komló, Marcali, Mohács, Nagyatád, Nagybajom, Paks, Pécs, Pécsvárad, Sásd, Sellye, Siklós, Simontornya, Siófok, Szekszárd, Szentlőrinc, Szigetvár, Tab, Tamási and Tolna belong here.

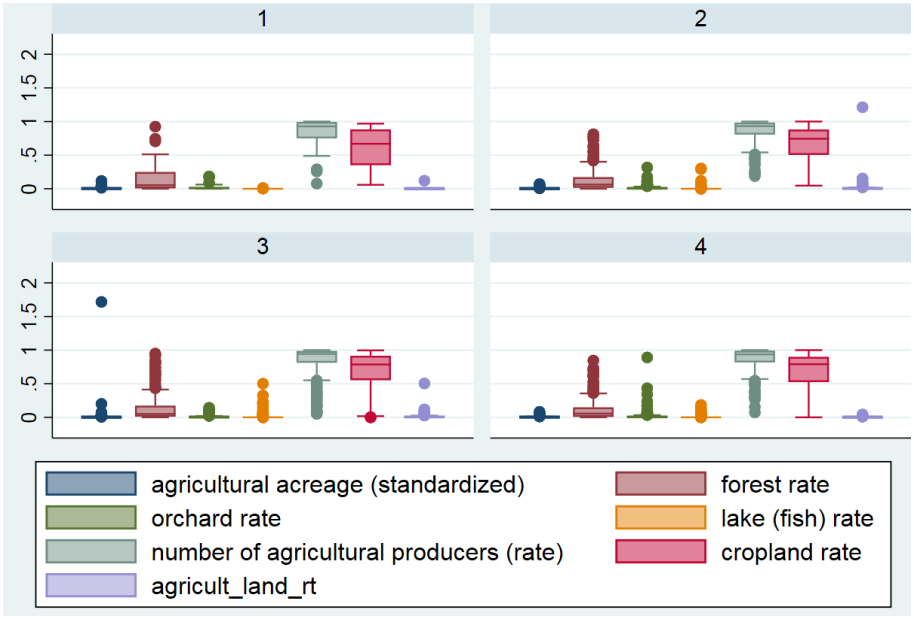
Figure 2 a: Boxplot of variables of four resource clusters of South Transdanubian settlements

Source: Based on the HCSO settlement data of 2018 and the Agricultural Census data of 2010

Figure 2 b: Boxplot of variables of four resource clusters of South Transdanubian settlements

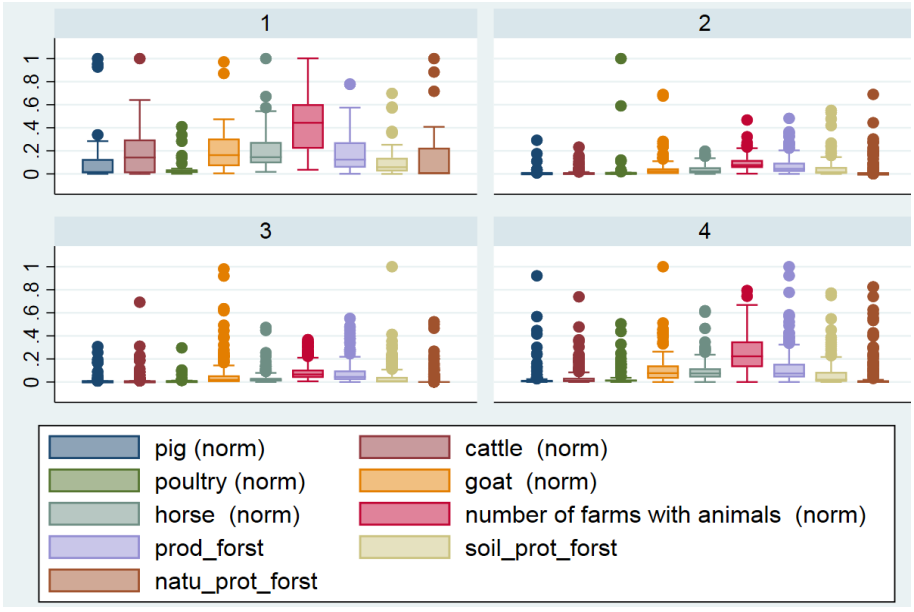
Source: Based on the HCSO settlement data of 2018 and the Agricultural Census data of 2010

Figure 2 c: Boxplot of variables of four resource clusters of South Transdanubian settlements



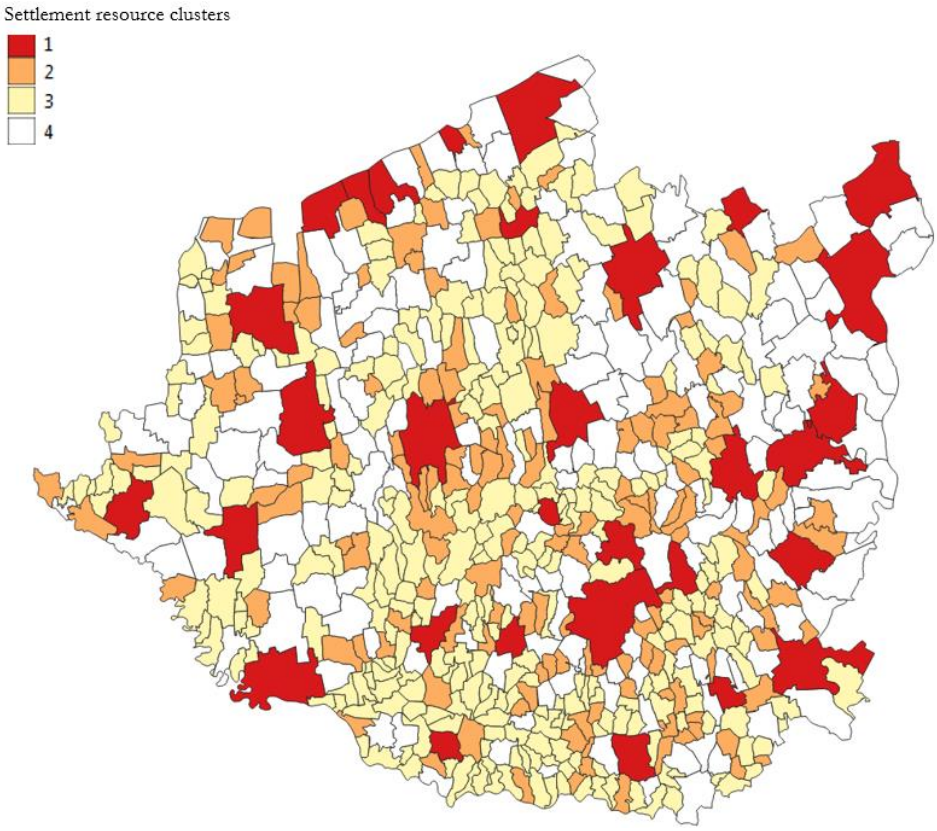
Source: Based on the HCSO settlement data of 2018 and the Agricultural Census data of 2010

Figure 2 d: Boxplot of variables of four resource clusters of South Transdanubian settlements



Source: Based on the HCSO settlement data of 2018 and the Agricultural Census data of 2010

Figure 3: Settlements' resource clusters in the Southern Transdanubian region (based on 43 variables, n=656)



Source: Based on the HCSO settlement data of 2018 and the Agricultural Census data of 2010

Most of Cluster 3 settlements (Limited resources) are situated along the north-to-south oriented zone in the middle of the region (internal periphery) and in the peripheral parts near Croatian border. Some further conglomerations are dispersed in the region's territory, which is worth a further analysis.

Settlements in the cluster of agriculture related strength are all over the region, they are spatially determined by the availability of agricultural resources.
The concentrated capacities settlements counterbalance the spatial structure where cluster 3 settlements are rarely present.

DISCUSSION

The clusters of resource availability of settlements in the Southern Transdanubian region can be described as the following.

Few *Strong and capable cities* (n=31) are accompanied by mainly *Agricultural villages* (Small villages with agricultural and processing industrial capacities) (n=155) and

there are settlements (n=170) with *Concentrated capacities* (Areas with significant livestock and processing industry, relatively high number of large and medium sized enterprises). Majority of the region's territory (n=299) has *Limited resources* (Small villages with very limited resources).

Our results are partly in line with the categories of beneficiary districts defined by the government regulation taking four groups of 24 indicators (including living conditions, as well). The findings of the current study suggest that the beneficiary approach based on district level may need a more differentiated viewpoint in the assessment and planning of heterogeneous districts development.

The development concepts of the counties making up the Southern Transdanubian region identifies core zones for various kinds of development targets (*Horváthné et al.* 2021). Although it was not discussed in detail above, the geographic pattern of the settlements belonging to the four resource clusters might point out for the need of a different approach.

CONCLUSIONS

The applied cluster analysis method was successful in classifying all the Southern Transdanubian settlements. The classification was performed on the theory basis of available local capital and resources of the settlements.

Various planning concepts and strategies targeting Southern Transdanubia (county concepts, regional economic development zones, tourism related developments, etc.) consider the centrum – periphery model and relies on the pull effect of central areas, cities. However, the expected (pulling) role of central areas is not confirmed clearly. Development concept of territories, zones assume similarity of these areas, but our findings show that the resource availability is heterogeneous considering the settlement level.

Scope of further research can be to reveal the spatial patterns of similar or heterogeneous (administrative) territories. The adsorption capacity for development funds could be also worth studying from the point of view of available local capital, which can be supported by the above introduced resource based classification of the settlements.

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ANNEX

Calinski - Harabasz pseudo F values of clusters 2 to 6

Number of clusters	Calinski/ Harabasz pseudo-F
6	246.35
5	235.83
4	269.69
3	309.23
2	314.44