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Methods for measuring the spatial mobility of tourists using a network theory approach

Gabriella NOD[1] and Antal AUBERT[1]

Abstract

The present study uses the methodological tools of network theory to investigate the spatial movements of tourists in the sample area, which is the South Transdanubian tourism region of Hungary. The basic idea of the study is that tourist movements across settlements in a larger tourist destination make a coherent network. As long as the approach is correct, this network can be measured by properties that are characteristic of networks, such as centrality or degree. A review of the methodology of similar studies previously published on the subject has been used to supplement the method of analysis used below. As a result, the study not only characterised the sample area municipalities in terms of network characteristics, but also classified them into clusters for strategic planning purposes on the basis of the mobility propensity of the tourists staying there.

Keywords: destination management, tourism mobility, cluster analysis, network theory

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Introduction

The tourism industry has a long-standing desire to predict the movement of tourists within and across destinations, their consumption and the popularity of tourist destinations. Researches focusing on this have used a variety of approaches. There are many studies on consumption theory, where the aim is to assess tourists' choices based on their consumption decisions (Bernecker, P. 1962; Kotler, P. 1967; Mas-Colell, A. *et al.* 1995; Csapó, J. and M. Császár, Zs. 2021; Telbisz, T. *et al.* 2022) and their spatial movements (D'Agata, R. *et al.* 2013; Pécsek, B. 2015; Asero, V. *et al.* 2016). Also, the role of consumer preferences in travel decisions has been studied for decades (e.g., Woodside and Lysonski's "General destination choice model") (Woodside, A. and Lysonski, S. 1989). The former use economic and sociological perspectives, but the researches also include geographical approaches, for example, the optimal road accessibility of a given tourist destination (Tóth, G. and Dávid, L. 2009). In recent years, network approach research has become popular (Scott, N. *et al.* 2008a; 2009; Madarász, E. and Papp, Zs. 2013; Casanueva, C. *et al.* 2014), and thanks to digital advances we can now work with big data and determine the location and movement of an individual based on GPS coordinates or cell phone cellular data (Spinney, J.E. 2003; Ahas, R. and Mark, U. 2005; Díez-Díaz, F. *et al.* 2007; Wind, S. 2015; Zheng, W. *et al.* 2017).

We have therefore seen several attempts to measure the number of visitors. At the moment, Hungary is in the process of introducing the registration and mandatory data reporting in the system of the National Tourism Data Supply Centre (NTAK), as a supplement to the "Government Decree 239/2009 (X. 20.) on the detailed conditions for the provision of accommodation services and the procedure for issuing accommodation operating licences". The obligation to provide data mainly concerned accommo-

[1]Department of Tourism, Institute of Geography and Earth Sciences, University of Pécs. Ifjúság u. 6. H-7624, Pécs, Hungary. E-mails: gabica13@gamma.ttk.pte.hu, aubert@gamma.ttk.pte.hu

dation establishments and is now gradually being introduced for catering establishments and operators of tourist attractions as well.

In the long term, the obligation to provide data now in the implementation phase will provide a database for tracking the consumer choices of guests, and will also form the basis of the process discussed below, which could also be a tool for promoting the development of a destination marketing strategy or a development plan at regional level. The literature on tourism destination management and tourist mobility; in Hungary (Piskóti, I. 2007; Sziva, I. 2014; Nod, G. *et al.* 2019; Aubert, A. *et al.* 2021) is well established, but the system is just in a phase of transformation, in Butler's life cycle model (Butler, R.W. 1980), it is in the process of repositioning itself in the National Tourism Development Strategy 2030 – Tourism 2.0 (2021), which designates 11 tourist regions (Government Decree 429/2020 [IX. 14.]) within the borders of the country (Hungarian Tourism Agency 2021). The method presented in the study supports the development of regional strategies and the optimisation of the management system.

The following study applies the network approach, one of the many theories outlined above, to investigate the mobility of tourists arriving in the South Transdanubian tourism region of Hungary during their stay in the region, with the aim of determining the visitation of certain destinations, the length of stay in the region and the degree of mobility of tourists during their stay and in which direction.

The theory is not alien to the literature. Asero, V. *et al.* (2016) conducted a similar study in Sicily (with a similar sample to the one used in the present study), with the aim of identifying tourism networks by analysing tourism mobility across destinations. The results show that tourists' choices define the role of a destination within a network as "central" or "peripheral". Similar clusters, but delineated on the basis of several variables, are formed by the findings discussed later in this paper. A fundamental difference between the results of the two studies is that while Asero, V. *et al.* (2016) use a functional approach, the present study uses a more geographic approach and also characterises the municipalities under study by other network characteristics based on tourism mobility.

Since network research not only allows the discovery of network patterns, but also the prediction of their future functioning by knowing the properties and behaviour of the network (Scott, N. *et al.* 2008b, 2009), it is an excellent tool for strategic planning.

The literature on network theory can be traced back to the Swiss mathematician Leonard Euler (1741), who interpreted graph theory in the urban spatial structure by using the logical pattern of the bridges of the former Prussian town Königsberg (today Kaliningrad, Russia) and road network. The tourist movements examined in this study also connect several settlements, i.e., they are measurable physical movements. However, they do not follow optimal public, rail or water routes, but 'artificial' routes formed by tourists' motivations.

The discovery of Euler, L. (1741) laid the foundations for the development of graph theory, for which the terminology and formal tools were created by the Hungarian mathematician Dénes Kőnig (1936). The randomness and complexity of the networks that surround us in reality were described by the Erdős-Rényi model (Erdős, P. and Rényi, A. 1960), followed by the Watts-Strogatz model, which detected the formation of groups within the network (Watts, D.J. and Strogatz, S.H. 1998). The most recent major success in the study of networks was achieved by the research team led by Albert-László Barabási (2002), who described scale-independence using the example of the World Wide Web (Albert, R. and Barabási, A.-L. 2002).

According to the hypothesis formulated during the research design, *the role of each destination in the supply market of the region can be measured by the tourist movements of tourists across destinations (H1)*. To measure this, the study uses the centrality and degree calculations of network theory developed by Albert, R. and Barabási, A.-L. (2002), Letenyei, L. (2006), and Barabási, A.-L. (2016) to determine the centrality of the settlements.

The research designed to support this hypothesis is based on the following three research questions:

Q1: Can tourism movements in the region be understood as a coherent network?

Q2: Can the characteristics of the network (centrality, number of degrees) be used to characterise the position of a destination within the region?

Q3: Does the mobility of the visitor staying in a given settlement characterise the market role of the settlement?

Two studies are presented in the paper to support the hypothesis and answer the questions. The first presents the extent of the network of connections of each destination (with other settlements in the region) using central and degree measures. The second part of the research characterises and classifies each settlement into separate clusters based on the mobility willingness of the guests staying there.

Readers interested in the study but less familiar with the subject are recommended to consider the list of basic terms used later:

Centrality – the most obvious measure of centrality is the number of connections (degrees) of each point relative to the total number of connections. This is called degree centrality or proximity. It expresses the distance of an individual in the network from other individuals (Freeman, L.C. 1979).

Degree centrality (CD) – the activity of an actor in a network is measured by the number of other actors directly connected to it, i.e., the degree of the actor (Bolland, J.M. 1988).

Hub (di) – a concept from graph theory, the apex of a network, a point that is connected to other actors in the network (Kőnig, D. 1936).

Edge (Li) – a segment connecting the vertices forming a graph, each edge running between two vertices (Kőnig, D. 1936).

Methodology

The methodology developed on the basis of the research questions was tested on an existing data set. The survey was carried out by the Department of Tourism of the Faculty of Sciences, University of Pécs, during the last active tourism peak seasons (in 2018 and 2019 from May to September) before the pandemic, and aimed to map the travel and consumption habits of tourists arriving at the South Transdanubian tourist region. The survey was carried out in collaboration with the authors of this study (Gabriella Nod project coordinator, and Antal Aubert project manager). The primary data collection was done on paper through a field quantitative survey (in the form of a questionnaire, using assistants to help filling out). The representativeness was based on the spatial distribution, taking into account the data on tourist arrivals previously published by the Hungarian Central Statistical Office (KSH) in 2018. Data processing was performed on a sample of N = 430 items.

Sampling was done by a field survey with a Pécs focus. The Baranya County seat accounts for 16 percent of the sample, Szekszárd, Kaposvár and the Harkány–Villány–Siklós triangle have a significant share, similar to the KSH (2018) data.

7.9 percent of respondents were foreigners, 10 percent came to the region from Budapest, and 27.9 percent were travelling within South Transdanubia during the survey. The male/female ratio among the respondents was 5.5 to 4.5. The top 3 travel motivations were relaxation/regeneration (65.35% of cases), city visits (44.19%) and hiking in nature (25.58%). Data on the *accommodation used* by respondents, *destinations visited*, *travel motivation* and general *demographic factors* influencing the decision were processed.

In the sample area, i.e., the South Transdanubian tourism region, 529,384 guests stayed in *commercial accommodations* (providing business accommodation and meeting the legal requirements: minimum 5 rooms or 10 beds (Government Decree 239/2009 [X. 20.]) in 2019 (KSH, 2020). Prior to the introduction of the data supply system in 2020, only the guest flows of commercial accommodation were included in the statistics, so we had only estimates of the actual guest night numbers, which is why "invisible or hidden tourism" is an important research topic (Gonda, T.

et al. 2018; Michalkó, G. and Ilyés, N. 2020). The big data database to be built from 2020 onwards will now allow tracking guest movements and drawing conclusions for the narrow section of the profession that has access to this data. In the absence of access to data, similar sampling could help track tourists' spatial movements and improve the available measurement tools and methodology.

Mobility map analysis

The first part of the research aims to model the tourist movements of tourists within a sample area (region) as a coherent network, and then to determine the position of each destination within the region in terms of the direction and frequency of movements. The network science literature most commonly uses *centrality* and *prestige* analysis for position analysis, the former being applied to undirected and the latter to directed networks (Albert, R. and Barabási, A.-L. 2002; Letenyei, L. 2006; Tiszberger, M. 2015; Gao, C. *et al.* 2022). In the present study, the touristic movements of tourists within the region represent the interconnections of the network, the settlements where tourists used accommodation services became the *hubs (di)* of the network, the links between them, i.e., the tourist movements, are the *edges (Li)*. The settlement providing accommodation is therefore the hub and the settlements visited from there form the other elements of the network, i.e., there were tourist movements from hub *di* to a settlement with *k* elements. At this stage of the analysis, the network should therefore be treated as a directed network.

The cartographic representation of tourist movements was done in QGis 3.10 software and the data analysis (determination of the touristic position of the destination, analysis of the frequency of contacts) was done in Microsoft Excel.

Focal point testing in the network

One possible way to characterize the positions of settlements based on the data is to use *degree centrality* (*CD*), where analysis assumes that the degree (i.e., the number of other actors directly connected to it) is a good measure of the activity of an actor, following Letenyei, L. (2006).

$$CD(n_i) = d(n_i) = \sum_j x_{ij}, \quad (1)$$

where $d(n_i)$ is the degree of operator *i*, i.e., the sum of the values in row *i* of the matrix (Letenyei, L. 2006).

The degree number of the settlements $d(n_i)$, indicates the number of destinations that send visitors to the municipality. Since the indicator depends on the size of the network, for comparability this number must be divided by the maximum value of the network, which is g–1 (if it is connected to all other actors), where g is the number of members in the network, i.e., the number of settlements in the network (in the case of the study: 120).

$$C'D(n_i) = d(n_i) / (g–1), \quad (2)$$

where $d(n_i)$ is the degree of the operator *i* and g is the number of members in the network (Tiszberger, M. 2015).

Let *k* denote the number of members of the subnetwork formed by d_i, i.e., all the settlements that are connected to d_i (either as sending or receiving parties). $Fd(n_i)$ denotes the frequency of connections made. L_i denotes the number of connections realized, i.e., all connections made to d_i, whether outward or inward from d_i. N_i denotes the number of tourists staying in and visitors to a given settlement within the sample (N = 430). $Fd(n_i)$, or *frequency of degree*, denotes the total number of movements to *di* from the sending settlements $d(n_i)$.

Total tourism movements between sending settlements and designated settlements as a proportion of potential movements

This requires the ratio of total number of tourism movements ($Fd(n_i)$) from the sending settlements ($d(n_i)$) to the total number of

possible movements to the designated settlement (d_i). In other words, the percentage of visitors staying in the sending settlement who visited the designated settlement:

Number of guests staying in the sending settlements / Total number of tourist movements to the selected settlement = ∑ (number of guests) $d(n_i)$ / $Fd(n_i)$.

Positioning of settlements according to the propensity of tourists to mobilise

The next part of the study focuses on the market positioning of each destination, using data on accommodation and destinations visited from the survey responses. The remainder of the study also uses the previously described degree number $d(n_i)$, i.e., the number of other settlements that send guests directly to the surveyed settlement.

Suppose that by n number of guests stay at settlement *di* who visit settlement t_1, t_2 ... t_n. We can determine the percentage of the n number of guests staying in settlement *di* who visit settlements t_1, t_2 ... t_n and vice versa. This allows us to measure both an inward and an outward networking. These indicators serve to define the positioning of destinations, which can also optimise the structure of co-operations and destination management.

Once the database has been sorted, the study determines the number of guests staying in each settlement ($N(g_i)$ *number of guests*) and the number of settlements visited by guests during their stay in the region (k_{out}), which also indicates the extent of mobility of the settlement. The average number of settlements visited by a guest gives the mobility propensity of a settlement (M_w, *willingness to be mobile*). The "popularity" of a settlement is further measured by the degree number of the settlement $d(n_i)$ and the degree frequency $Fd(n_i)$. The former represents the number of sending settlements and the latter the number of guests from the sending settlement. Since each settlement has a mobility propensity score and a popularity score, *a k-means calculation* can be used to determine the position of the settlements, i.e., which cluster is closest to the central value of the cluster based on the position of the two scores (Tan, P.-N. *et al.* 2006):

$$ROOT((\text{"Popularity"-INDEX(BLOCK(Cluster mean X,Y))}\text{^}2 + (M_w\text{-INDEX(BLOCK (Cluster mean X,Y))}\text{^}2, \quad (3)$$

where the coordinates of the mean of each cluster are given as criteria.

Analysis of findings

The performance of some tourist destinations is determined by the size of the sending area, so the results are presented first by plotting the movements of visitors to the region between their place of residence and their destination of choice in the region in vector form *(Figure 1).* (For readability of the map, only movements of domestic tourists are displayed.)

In the case of the present study area, the spatially representative survey describes a strong intra-regional movement, with 13.0 percent of the respondents living in Baranya county, 8.7 percent in Somogy county and 6.3 percent in Tolna county (counties of South Transdanubia). A significant proportion of foreign visitors to South Transdanubia come from the capital city Budapest (10.3%) and Pest county (2.6%), Fejér county (8.7%), and the proportion of foreign tourists not shown in the map (8.2%) is also significant. (Given the history of the region and the visiting habits of the expatriate German and Swabian population still living here, it is not surprising that a significant proportion of foreign visitors are Austrian and German.)

Characteristics of the network

The analysis of a mobility map helps to determine the position of a tourist destination within the region, i.e., whether it is a destination in its own right or whether it offers a complementary service to the region's tourism

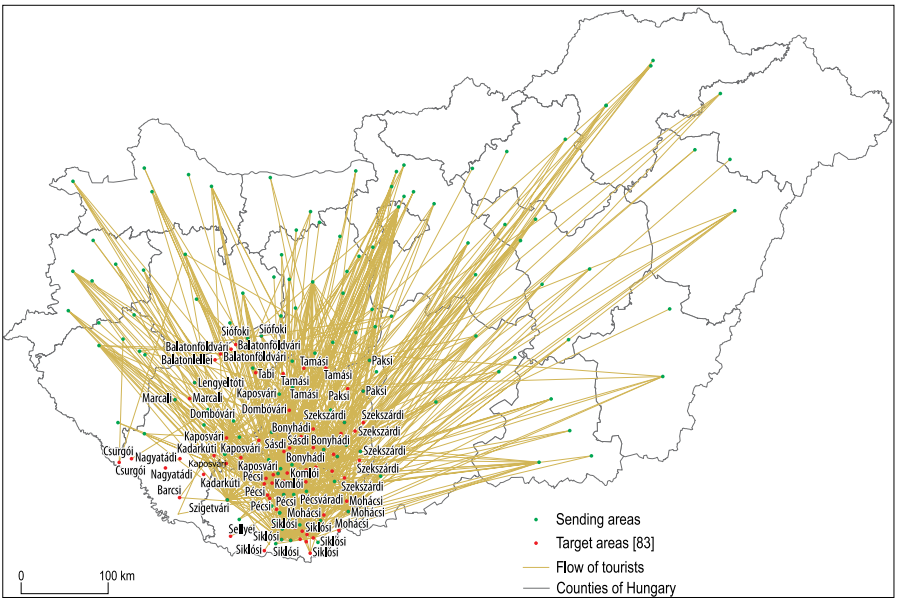

Fig. 1. Tourist arrivals in the South Transdanubian tourist region, 2018. *Source*: Survey and editing by the authors.

offer. In total, tourists surveyed used accommodation services in 60 municipalities and visited 98 settlements with touristic intentions.

As the total number of elements of the network (accommodation + visited destination) is 120 settlements, corrected by the number of settlements that are both accommodations and destinations, it is not possible to present the full sample, i.e., all the contacts of all the settlements, due to space limitations, but the study highlights some of them that demonstrate the applied research methodology. The population size of the municipalities was defined as a criterion, with the lower limit being the level of small urban municipality (> 10,000 inhabitants). In Baranya, Tolna and Somogy counties, there are 14 municipalities above this population, 10 of which are statistically assessable on the basis of the survey. This group is completed by Villány and Harkány *(Table 1)*, which do not meet the population criterion but are important in the region because of their small-town status and tourist offer.

Although Siófok corresponds to a medium-sized city in terms of population and was named by the respondents as a preferred destination in the open-ended questions, as a settlement on the shore of Lake Balaton it was part of the priority tourism development area (Government Decree 429/2016 [XII. 15.]), which means that its development opportunities and access to funding sources differ significantly from other typical settlements in South Transdanubia, which is why it was not included in the study.

Degree centrality in the network

After the data collected during the sampling were digitized and sorted into a database, the data of the 12 settlements to be analysed were selected: the number of respondents using accommodation services in the settlement (the number of guests staying in the settlement), and the number of sending settlements (the degree of settlement), i.e., from which settlements the guests staying there came to the settlement under study *(Table 2)*. It is important to note that the data in the table

Table 1. Municipalities in South Transdanubia included in the study

Town	Local population, persons	County	Type of settlement
Pécs	144,188	Baranya	Big city
Kaposvár	61,920	Somogy	Medium-sized cities
Szekszárd	32,156	Tolna	
Komló	22,832	Baranya	
Paks	18,788	Tolna	Towns
Dombóvár	17,995	Tolna	
Mohács	17,143	Baranya	
Bonyhád	12,982	Tolna	
Tolna	10,987	Tolna	
Szigetvár	10,545	Baranya	
Harkány	4,632	Baranya	
Villány	2,282	Baranya	

Source: Own editing based on 2019 KSH data.

only include data from the sample; the statistics shows that these municipalities have proportionally higher guest flows. However, since the sample was spatially representative, the approach is relevant for the methodology.

To interpret the data in *Table 2*, let us take Pécs as an example. In the case of Pécs, 27 other settlements were visited by guests staying here (111 persons) and 35 other accommodation establishments (settlements) sent tourists to the county seat. The corrected degree-centrality of the settlement in the total network is 0.29, that is 29 percent of all the settlements in the network are linked to Pécs. Our Pécs-centred network is connected to 45 peaks (each settlement with which Pécs is connected is represented as a peak in the network, whether it is a sending or receiving municipality or both). The adjusted *degree-centred value* is therefore a good measure of the centrality of a settlement in the network, and, where appropriate, its position in the tourism market. The high networking of Pécs as a regional centre is not surprising, while the higher values of Szekszárd, Mohács, Harkány and Villány are associated with a strong local tourism offer. Next, the share of total tourism movements from the sending settlements to Pécs is presented in relation to the potential movements. That is, the percentage of visitors staying in the sending settlement who actually visit Pécs. In the case of Pécs, the rate is 44.1 percent, i.e., almost half of all possible movements to Pécs are made in the Pécs-centred network. A significant value is also seen in the case of Harkány and Villány, where one in four of the guests staying in the sending settlements is sure to visit the settlement that is the centre of the network (Harkány or Villány, as the case may be). The value indicates a kind of likeliness of the proportion of the guest flows in the vicinity of a given settlement within the actual guest flows of that settlement. This value can therefore be used for forecasting and as a tool for strategic planning. The value *Li* represents the total tourist flows to Pécs, i.e., the number of tourists staying here and the number of visitors coming for one day in the sample.

Positioning of settlements according to the mobility propensity of tourists staying in them

Of the 430 guests surveyed in the sample, 395 had used accommodation services during their stay in the region. The average number of nights spent by a guest in the region was 4.1 (standard deviation being 3.09). In total, respondents used accommodations in 62 settlements and visited 101 settlements for tourism purposes. Guests staying in one settlement moved to an average of 5.34 additional

Table 2. Metrics of the networks in the surveyed municipalities

Town	Number of guests staying in the settlement	Number of destination visited, pcs	Degree centrality, $d(n_i)$	Degree of the settlement, $C'D(n_i)$	Number of network items, pcs	Frequency of degree, $Fd(n_i)$	$Fd(n_i)$ compared to all possible movements, %	Passing edges Li, pcs
Pécs	111	27	35	0.29	45	116	41.1	227
Kaposvár	11	10	7	0.06	13	18	9.7	29
Szekszárd	35	20	23	0.19	35	33	16.7	68
Komló	10	13	3	0.03	13	8	4.8	18
Paks	5	5	5	0.04	7	9	16.7	14
Mohács	11	9	18	0.15	22	33	12.2	44
Dombóvár	20	11	7	0.06	14	10	6.3	30
Bonyhád	6	4	8	0.07	10	12	7.0	18
Tolna	2	3	1	0.01	4	2	5.7	4
Szigetvár	3	5	11	0.09	15	38	14.4	41
Harkány	36	18	13	0.11	25	56	30.4	92
Villány	16	8	19	0.16	22	68	24.6	84

Source: Own survey.

settlements during their stay. A settlement was visited by staying guests from another 3.14 settlements, on the average.

Based on the number of guests staying in a settlement $N(g_i)$ and the number of settlements they visited during their stay in the region (k_{out}), we obtain the average number of settlements visited by a guest, which shows the mobility propensity of guests staying in a settlement (M_w,) *(Figure 2).* Together, the number of tourists staying in a municipality and the number of guests visiting it in the course of the query give the "popularity" indicator of the settlement, which is categorised by colours in *Figure 3.*

The mobility propensity score ranges from 0.3 to 8.0 for the present study, where three broad groups are typically distinguished. The value below 1.0 is typical of those settlements where one or two guests' opinions were collected and the number of other settlements visited by them is low; the group's use of accommodation is characterised by more cost-effective solutions (33.3% stayed with a relative/friend, 23.8% in a boarding house, 14.3% in a holiday home). Bikal is an exception in the group, with higher accommodation expenditure (87.5% of Bikal guests stayed in a hotel), but Bikal and its medieval-style experience facility offer a complete stay of several days, which explains the low mobility.

The next groups are typically medium-sized towns and large cities, with high numbers of guests and lower mobility willingness, explained by the complex and multi-functional tourism offer of the destinations. Smaller municipalities also scored high in terms of mobility, where, as in the first category, the number of guests staying and the expenditure on accommodation are typically low (46.7% staying with friends/relatives, 26.7% in campsites and 20–20% in rural accommodation or boarding houses) but where mobility is high. In the light of the data, this group is characterised by a longer length of stay (6.6 nights on average).

The *mobility propensity* values, complemented by the *number of guests* $N(g_i)$, the *number of degrees* $d(n_i)$ and the *frequency of*

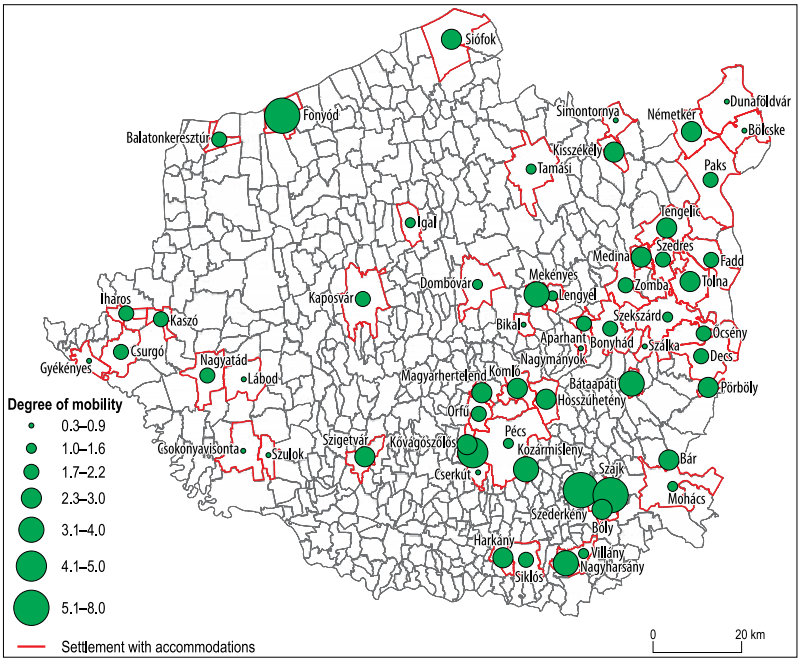

Fig. 2. The surveyed settlements of the South Transdanubian tourism region according to the mobility propensity of the visitors staying there. *Source*: Survey and editing by the authors.

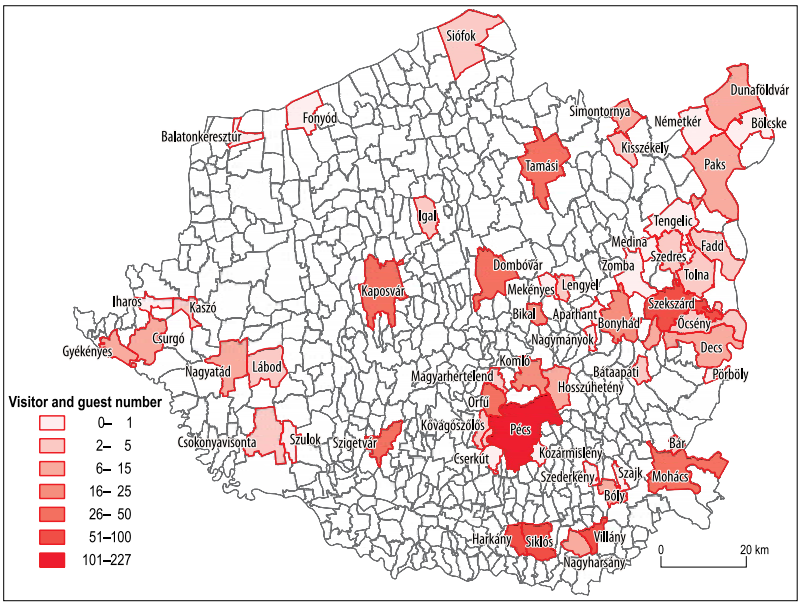

Fig. 3. The popularity of the surveyed settlements in the South Transdanubian tourism region in terms of the number of guests and visitors. *Source*: Survey and editing by the authors.

degrees Fd(n_i), which help to measure the "popularity" of the settlements, divide settlements into six categories: less preferred municipality with high propensity to move out; less preferred municipality with low propensity to move out; medium preferred municipality with higher propensity to move out; medium preferred municipality with lower propensity to move out; preferred municipality with high propensity to move out; and preferred municipality with low propensity to move out. The k-means calculation used in the cluster analysis, based on the position of each municipality according to two values (popularity value and mobility propensity), placed the municipalities in the group closest to the central value of each cluster *(Table 3).*

The municipalities receiving each cluster value and their spatial distribution within the sample area are illustrated in *Figure 4.*

Figure 4 distinguishes six clusters. As in Asero, V. *et al.* (2016), the categories can be generalised and applied to the development of regional or (depending on the available data) national strategies. The number of visitors staying in and visiting a municipality is an indicator of its popularity, while the mobility propensity measures the tourist retention capacity of the municipality, the lower the mobility, the stronger the tourist retention capacity of the municipality. At the same time, the multiplier effect of tourism may be stronger in the vicinity of settlements with high mobility, i.e., settlements in the vicinity are more likely to experience an increase in visitor numbers. Based on the mobility propensity scores of visitors to a settlement, another grouping can also be applied, similar to the categories known from the literature on settlement geography (Pirisi, G. and Trócsányi, A. 2019):

– *Independent settlement* from which the resident guest does not move or moves only slightly. These are low mobility settlements with a group-specific or broad touristic offer.
– *A "sleeping" settlement*, with *a* favourable accommodation offer for the visitor, but little or no other tourism offer; characterised by a high mobility propensity.
– *A cooperative settlement* with its own touristic offer, but its strength lies at the regional level, where it creates, together with other municipalities in the region, an attractive touristic offer.

Conclusions

The study applies two approaches based on the methodological tools of network theory. To support the hypothesis formulated in the introduction (*the role of individual destinations in the supply market of the region can be measured by the tourist flows across destinations*), it primarily models the tourist flows within the region as a coherent network. This is demonstrated in chapter 3.2 by presenting the characteristics of the network (degree number and centrality), i.e., by answering question *Q1* (Can tourism movements in the region be interpreted as a coherent network?) and *Q2* (Can the characteristics of the network (centrality, degree) be used to depict the position of each destination within the region?). The degree number and the centrality of the settlements provide a

Table 3. Clusters defined by k-means

Cluster number	Popularity, persons	Mobility, M_w settlement/person	Cluster characteristics
1st	1.00	7.33	Less preferred with high propensity to move out
2nd	1.45	2.24	Less preferred with low propensity to move out
3rd	5.22	3.05	Medium preferred with higher propensity to move out
4th	5.91	1.46	Medium preferred with lower propensity to move out
5th	28.50	1.77	Preferred with high propensity to move out
6th	109.80	1.82	Preferred with low propensity to move out

Source: Own survey.

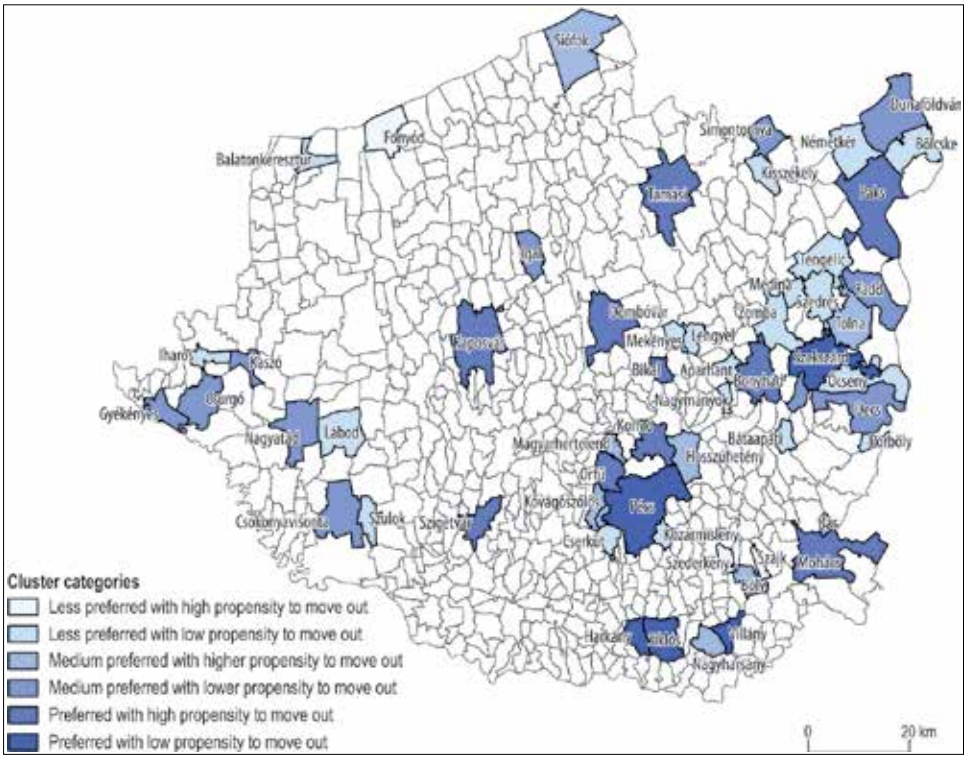

Fig. 4. Clusters based on the mobility propensity and popularity of the studied settlements in South Transdanubia. *Source*: Own survey, own editing.

good measure of their position in the region's tourism offer, and their links, which can be statistically demonstrated by analysing the data, can also serve as a guide for cooperation.

Finally, research question *Q3* would characterise a given settlement on the basis of the mobility propensity of the guests staying in a destination. To demonstrate this, the study calculates a mobility propensity score for each settlement where respondents used accommodation services at the time of the survey. It then calculates the popularity of the settlement based on the number of guests staying there, the degree number of the settlement and the frequency of the degree number. Finally, clusters are formed based on the indicators of popularity of the settlement and the mobility propensity scores. The resulting clusters are geographically independent and can be applied in practice anywhere. They are of strategic importance as they can be used as logical categories in development plans.

The weakness of the study is that it does not use a complete regional database, only a small sample. This flaw can be overcome by accessing the above-mentioned national statistical database under construction. This type of data collection is also an internationally known practice, and so it is not confined within the country's borders. It is innovative in the sense that few studies have so far dealt with network analysis of tourism movements at international level. It identified network characteristics based on the tourism movements studied and presented a possible clustering of tourist destinations based on the popularity of the locality and the mobility propensity of the visitors staying there.

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