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STRUCTURAL CHANGES IN JAPAN'S URBAN SYSTEM FROM 1990 TO 2010

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Abstract: An urban system is a group of cities acting in close cooperation with one other. An examination of the factors of change in an urban system at the national scale remains to be done, given data limitations and research issues (e.g., scale, boundary). This study aims to clarify the spatiotemporal pattern of Japan's urban system (JUS) and then to elucidate the characteristics of change and the related factors, based on an inter-regional travel survey conducted in Japan from 1990 to 2010, as well as numerous official censuses. The results demonstrate the entire system's compactness, the dominance of the metropolises and the local system's bipolarization under the hierarchical structure of JUS, with the establishment of hub cities and the development of infrastructure during the two decades from 1990 to 2010. Finally, this study explains the factors of change with consideration of socio-economic characteristics and inter-regional interaction.

Key Words: *inter-cities' linkage, geo-spatial multivariate analysis, Japan's urban system*.

Introduction

An urban system can be regarded as a group of cities acting in close cooperation with each other. There are particular channels for persons, logistics, information, energy, capital, etc., flowing between the cities, whereby each city is supplied with the necessary "nutrients" for growth and each regional area is supplemented with mutual functions (Murayama 2000). The interaction between the cities brings about the expression of various regional attributes as the characteristics of the city group. Measuring this interaction is vital to understanding the formation and evolution of the urban system. Moreover, modeling the space of flow among cities and measuring its relationship with regional indexes in the context of an urban system bring insight on interpreting the cities' positions in a changing urban system.

Considering the achievements in research on national urban systems, numerous studies have elucidated the urban system pattern in terms of inter-cities' flow, such as the formation of national urban system and its changing process (Murayama 1982), the patterns of spatial interaction and the hierarchical structures (Song et al. 2008), and the connectivity of Chinese cities in the world city network (Derudder et al. 2013, Yao et al. 2018). Considering the background of China's high-development of infrastructure, Wang (2010) identified the inter-cities' container transport hubs and their distribution-aggregation pattern in a Chinese urban system, and Sun (2016) revealed the relationship between the China's hierarchical urban system and high-speed railway (HSR) network planning. Besides, the change of population scale (Wang et al. 2005), telecommunication flows (Dong et al. 2014), and innovation connection (Zhou et al. 2017) are also used to model the urban system.

Spatial scales adopted in empirical studies of urban systems (networks) are hierarchical and multilayer, consisting of three levels: international (Smith and Timberlake 2001, Guimerà et al. 2005, Choi et al. 2006, Wang et al. 2015), national (Murayama 1982, Song et al. 2008, Yu et al. 2008, Wang 2010, Leng et al. 2011, Zhen et al. 2012, Derudder et al. 2013, Sun 2016) and regional urban systems (Wang et al. 2005, Dong et al. 2014, Zhou et al. 2017). For example, at the international scale, some studies have focused on the world city network (WCN) and its

hierarchy (Smith and Timberlake 2001), some have compared the WCN in terms of different flow elements (Choi et al. 2006) and some have investigated the international linkage and role of the WCN by specifically targeting one country (Wang et al. 2015).

Investigating the hierarchical structure of an urban system can help us better understand its formation, change and reshaping processes. Measuring the scale of the urbanization index (e.g., GDP, population, commuting flow) provides justification for identifying the centrality of a city within an urban system. At the municipal (intra-city) scale, urban compactness can be reflected in terms of the balance of the availability of work with the number of residents, the advantages of the degree of accessibility and the dominance of urban resources. Between urban areas and suburban areas, the imbalances in population migration, the gap in job-housing choices and people's need and willingness for commuting activities have led to the bipolarization of urban development levels within metropolitan areas.

Differently, at the inter-city scale (e.g., province, country, international), the inter-regional traffic infrastructure can not only affect the compactness of the whole urban system, but also the segmentation-aggregation, uniformity-diversity, coordination-independence of the secondary (sub)urban system, shaping and controlling smaller local parts of the individual cities' secondary systems. Cities with fewer urban resources and potential tend to be marginalized by cities that hold central positions within the urban systems; this is also regarded as a reason for the bipolarization (or multipolarization) of the urban system. How to mitigate such bipolarization and how to find balance in such development toward the synergetic interaction among central cities and lower-class cities within an urban system must be studied as meaningful issues.

Problem statement, literature review and research purpose

In this section, the authors will herein reveal the research gap reflected within the field of urban system studies in terms of spatial scale choice, the obtaining of data and the interpretation of change factors, accompanied by a series of literature review. The previous studies include investigations of the formation processes of urban systems and the hierarchical structure of urban systems at different scales. However, most of them used the given administrative divisions as their analysis unit, bringing the problem of territorial heterogeneity due to the boundary, size, etc.

Furthermore, multi-view studies focusing on aspects of controllable scale and carried out with a combined-verified approach have rarely been performed in the field of urban system studies, excluding a handful of references in the research of Sun (2016), for example. The national HSR system forms the basis of the urban network pattern at the national scale, while the inter-urban HSR system satisfies people's travel needs within urban agglomerations at the regional scale (Sun 2016). In the context of Japan's urban study, considering that Japanese aviation system has been dominated by governments, the emergence of other traffic networks (e.g., HSR, highway) can be understood as a reflection of neoliberal policies that stimulated the transportation-oriented development after the late 1990s. For better seeking and realizing the reasonable urban planning for mitigating the problem of overly centralization and local depopulation, Japanese urban planners had reported a series of polices, such as the planning of networked compact cities (cf. the white paper from MLIT 1989-2000), as well as Japanese-suitable division methods of functional urban area, such as daily living sphere (MLIT 1990, 2010), urban employment area (CSIS 2015). As mentioned by Murayama (2000), different factors determined urban systems in different scales and they affected different patterns of diffusion process. Undoubtedly, it is necessary to model the pattern of urban system in terms of different transportation modes, from a comprehensive perspective and at a uniform and reasonable scale in the context of Japan's urban system. More related explanations will be presented in Section 2.1.

The third example of areas within the field of study that have been ignored so far is the preconceived idea of administrative planning. The urban and the countryside should not be divided with a strict boundary. They are typically mixed within a complex cooperated system. Here, the authors should mention Japan's special administrative planning. Municipalities in Japan consist of thousands of cities, special wards, towns and villages. However, the meaning and scale are completely different from other countries' administrative divisions (e.g., China). Japanese urban planners have strongly promoted a long-term urban policy, such as networked compacted cities, local hub-city conservation, combined metropolises, daily living spheres, etc., in order to face the urban problems of an aging society, depopulation and local recession. The area division adopted by previous studies was mostly based on the traditional administrative boundary. Different from them, this study uses the policy-based division as the spatial unit, defined by MLIT (1990, 2010) and supported by Morikawa (1998)'s theory of the daily living sphere. By doing so, the scale bias and the above-mentioned problems can be weakened. About this point, Section 2.1 will introduce in detail the Japan's master plan and guideline policy on the administrative division.

On the other hand, owing to the data shortage and the data inconsistency at the national and international scales, many scholars have preferred to carry out their research on urban systems as constructed by a single kind of flow. Burghouwt et al. (2003) confirmed that the hub-and-spoke network of European airlines required a concentration of traffic in a spatiotemporal dimension, and its configuration was described along with the distribution of traffic change. Guimerà et al. (2005) put forth that a city's global role in the aviation network was based on the city's inter-community and intra-community connections; they also suggested that the multi-community structure of the network leaded to the anomalous value of centrality. Some scholars have analyzed information flows — for example, Sina mico-blog (China's twitter) (Zhen et al. 2012), knowledge flows (Lu and Li 2010, Matthiessen et al. 2010, Zhou et al. 2017) and information communication (Dong et al. 2014) — to model the national urban system.

However, inter-urban interaction retains multiplex channels for moving persons, logistics, information, energy, capital, etc., via mutual functional cooperation (Murayama 2000). Moreover, the passengers' ability to choose the transportation modes and the competition between the different transportation industries may cause distortion in the results of a study of the urban system model. In this paper, the authors analyze Japan's urban system (JUS), using person flow data for all kinds of transportation modes (cf. Section 2.2) and aiming to overtake the data limitations outlined above.

Certainly, there are also many studies that have discussed a regional or national urban system in Japan, like Murayama (1984), Nishihara (1994), and Yokura (2016). Murayama (1984) and Nojiri (1993) investigated patterns of freight flows in Japan, pointing the way to understanding industrial locations and confirming spatial structures of regional economic activities. The relationship between the socio-economic features and the urban system pattern has also been considered at the regional or national scale (e.g., Murayama 1984, Nishihara 1994). However, all of these studies used the traditional administrative boundary as their spatial unit and they used a single type of flow to construct the urban system. Considering this, it is crucial to fill the noted research gap in the context of JUS studies.

The social network analysis is a quantitative analysis method proposed in the field of sociology. Recently, it has been widely used to analyze the flows of international flights, trades or cities' spatial structures and to understand the hierarchy that is formed through the interactions between cities. Globalization and World Cities Research Network (GaWC) has mustered hundreds of publications that analyze the global urban network using this theory, such as Taylor (2004) and Derudder et al. (2003, 2007, 2013), who pioneered a powerful database and approach to understanding the world city network. However, only using producer services or other single variables as the indicators, as in Taylor (2004)'s work, but not taking into

consideration the functional difference affected by other economic sectors, transportation or industrial flows, the results would potentially be biased or distorted (Lee 2008). Therefore, following the GaWC research group's basic theory and Lee's standpoint, this study modifies the original social network model, carrying out a series of analyses in terms of the connectivity of inter-city linkage and the national centrality of cities, using a high-quality database (1990-2010) from Japan's Government (Government of Japan 1990, 2010).

Urban centrality is a city's essential characteristic in terms of general function, based on which, most cities usually have corresponding particular characteristics that accompany the specific socio-economic, political, and cultural tasks or other human activities taking place there (Wang et al. 2005). Previous studies have attached importance to the modeling of centrality indexes integrated by cities (nodes) and inter-city/-regional relations (links) within the urban system from a shallow viewpoint. However, the consideration of the urban function differentiation (e.g., industry composition, economic status, urban resource facility, etc.) within the urban system is lacking. Most of the research has not paid enough attention to the interpretation of the impact of socio-economic features on this system from the individual-local (e.g., inhabitant attribute, local character) viewpoint.

Changes in the transportation network are not only a requirement of urban socio-economic development, but also a reflection of the changing characteristics of the urban system structures. Although the analysis of the dynamic process of urban systems in respect to the urban function was put forward on a classic theory derived from Christaller's Central Place Theory (Johnston 1982), these above-mentioned papers did not look at the functional interpretation of urban cooperation as a major issue. Wang et al. (2005) mentioned that the dynamic evaluation of the urban system is actually equal to the differential growth process of the city and that the difference in urban function is one of the key factors leading to the change of urban system. Unfortunately, their target area was limited within China's one province. They mapped the spatiotemporal pattern of the hinterland within a regional urban system over the span of fifty years, using private business census data. However, these achievements did not receive further verification (e.g., connecting them to the consideration of socio-economic indexes) because of the lack of data precision; the same was the case with Guo and Bai (1999).

Reviewing previous studies, we found that aside from elucidating the spatial pattern of the urban system, how to clarify the regional development and its related factors has rarely been addressed. Urban systems and their spaces of flow should be studied as being of equal value and importance. Performing multi-view studies that considered the issue of the urban system on a uniform scale by the way of introducing reasonable factors to explain the pattern within the urban system's mutual feedback mechanism, not just those resting on constructing this pattern itself, may bring some unknown research interests. In brief, an examination of the changing processes of the national urban system and the related factors, with consideration for the socio - economic features, is urgently needed to fill this research gap.

Against the above-mentioned backdrop, the purpose of this paper is to clarify the spatiotemporal pattern of the urban system in Japan and then to highlight and elucidate the change mechanisms of JUS and the related factors from 1990 to 2010, based on the inter-regional travel survey (ITS) in Japan (MLIT 1990, 2010) and numerous other official censuses. The rest of this paper is structured as follows. First, Section 2 focuses on transport infrastructure development and planning in Japan. In addition, Section 2 explains the data production and methodological framework. Then, Section 3 highlights the results of the spatiotemporal pattern of the hierarchical urban system in Japan, and it then reveals the factors causing the changes in JUS using two kinds of multivariate analysis, combined with qualitative investigation. Last, Section 4 summarizes the key findings and conclusions and it reaffirms the originality and significance of the study.

Methodology

Introduction of the daily living sphere and transport infrastructure development in the context of Japan's urban planning

A regional urban system is generally understood as an urban system organized on the regional scale in which a regional hub city plays the pivotal center. On the other hand, a prefectural urban system is organized on a prefectural scale, in which a prefectural capital is generally occupied in the top tier of the urban hierarchy. Differently, because of Japan's situation (narrow territory, special administrative division, etc.), the characteristics of Japan's urban system are reflected on three levels: a national urban system with centralized state power, a regional urban system based on the domain of the prefecture and a daily urban system based on the commuting area gathering its surrounding population (Yokura 2016). Fig. 1 illustrates how to understand the system of the daily living sphere (DLS), its referents (MLIT 2010) and other academic propositions discussed by Morikawa (1998). Furthermore, the arrangement of the DLS as the analysis unit in this study will also be highlighted in this section.

Certainly, other kinds of area division can also be used to model the changing pattern of national urban system, like Martinus et al. (2019) that examined the spatial pattern of industry, commuting and agglomeration to innovation for giving an overview of the development of JUS. However, the DLS used in this context is a kind of policy-based functional area, and this study is using this way of area division to model the pattern of the national urban system of Japan. The change of population, commuting rate and industry structure can affect the spatial pattern of the commuting area or the urban employment area within one DLS. Differently, how these factors drive the change of JUS, what can be seen from the structural change of JUS and how the change can be explained by using this DLS as the analysis unit to model the JUS are the target of this study. Clarifying the spatiotemporal pattern of JUS and elucidating the characteristics of change and the related factors from 1990-2010 require a unified area division in this context, otherwise the dataset of regional indexes cannot be integrated in the same GIS-based environment.

The DLS has a size between the domain of the prefecture and the daily commuting area in the context of Japan's urban planning. DLS is generally set up by dividing a prefecture into several areas from the viewpoint of a functional area. A city-region means a regional daily living sphere, which includes a core city and its neighboring rural areas most closely connected with the city both economically and socially. A metropolitan area can be regarded as a kind of nodal region at the DLS level, and the influence of Japan's local core city is well reflected and leading the typical daily human mobility of the DLS in this structure (Morikawa 1998). This paper regards the DLS as another term of conurbation (i.e., a networked compact city) that can be adopted to fit its research purpose. The definition of DLS has taken into account the state of the urban functional cooperation, the preservation of local hub-cities and the promotion of human mobility. Using a DLS as an analytical unit to model JUS is suitable and acceptable for addressing the shortages due to scale problems (i.e., territorial heterogeneity, boundary inconsistency) and cities' functional incompleteness.

Before constructing the pattern of the JUS, it is necessary to highlight the background of transport infrastructure development and planning in Japan during the period from 1990 to 2010, which helps to understand the particularity and practicality in terms of actual situations and policy implementation within JUS. The planning of Japan's transport infrastructure system can be traced back to 1969 with the proposal of a national spatial structure plan presented by the Japanese statesman Kakuei Tanaka[1] to build the nationwide high-speed railway network, spreading all over the country. Although this policy was difficult to fully realize and it was postponed owing to financial shortage due to the end of a high economic growth period by the

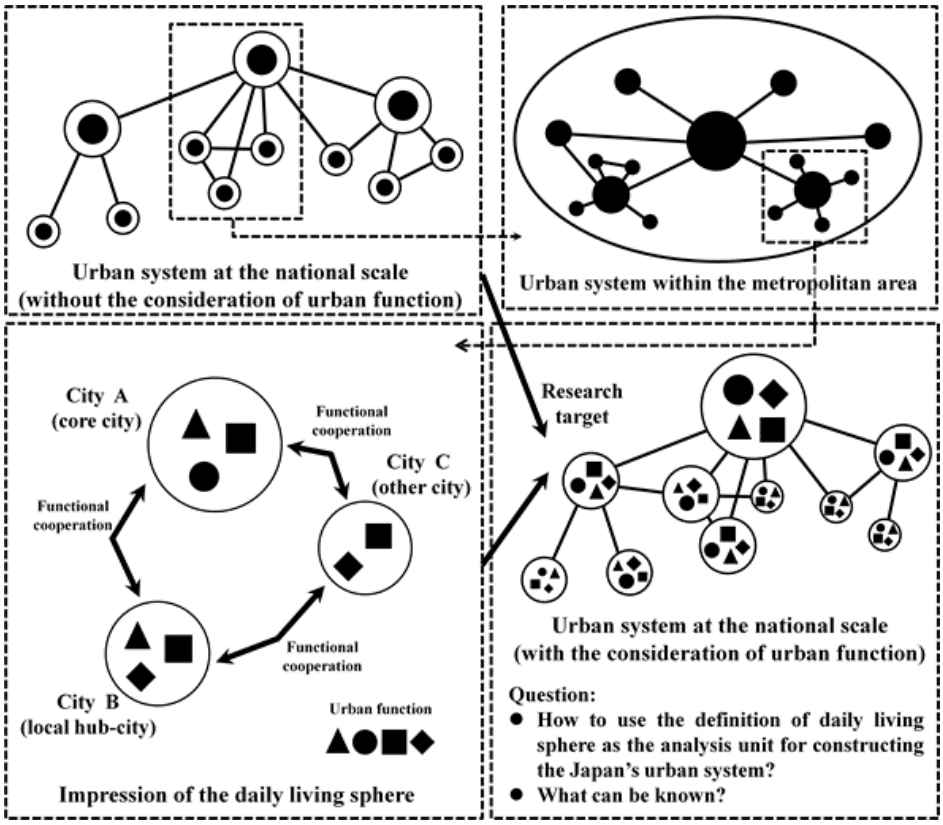

Fig. 1 ─ **The impression of the daily living sphere and how to use it as the analysis unit for constructing the pattern of the JUS**

oil crises, deficits and depopulation, it certainly promoted Japan's development of transport infrastructure and it brought with its regional economic booms. The Ministry of Land, Infrastructure and Transport (MLIT) has tried to amend this policy to satisfy passengers' demands and to maintain economic prosperity since the 1980s, after which HSR, airport, railway, highway, subway in (metropolises), Internet and other transport infrastructures began to hold great importance, considering the task of restraining the centralization of the three metropolitan areas (i.e., Tokyo, Nagoya and Osaka) and preserving the domination of regional core cities and other collection centers or transit points. Fig. 2 shows the major transport infrastructure development and planning in Japan from 1990 to 2010, from which some findings will be found to support our results in Section 3.

Data production in a GIS-based environment

This section highlights data production in a GIS-based environment. First, it is necessary to introduce comprehensive regional indicators for clarifying their impact on the urban system. This paper strives to fill the research gaps noted in the previous section. However, utilizing the data scattered across various resources presents a challenge, as it does coping with the big data storm in the modern IoT (Internet of Things) society. Unlike most previous studies that

shallowly limited the consideration on the pattern identification of the urban system but paid no attention to explore the underlying mechanisms of the impact of the regional feature on the urban system, in this study, many regional attribute variables covering diverse fields, including population, economy, transportation, industrial composition, human facility, etc., are introduced to improve reliability and to provide the project with a multivariate analysis.

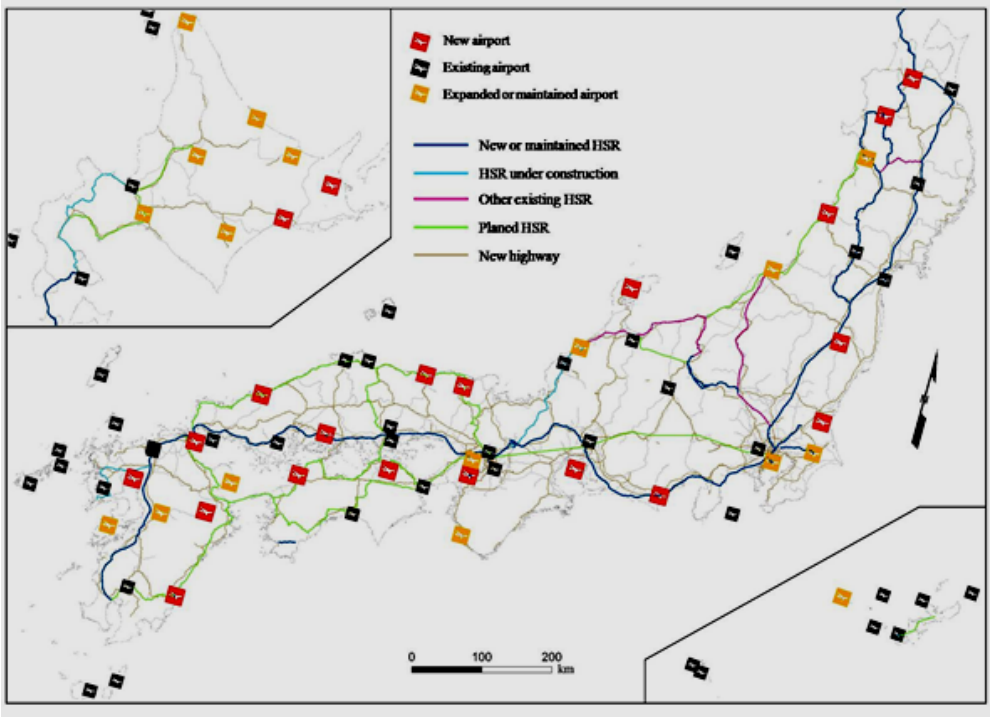

***Fig. 2* – Major transport infrastructure development and planning in Japan from 1990 to 2010**

Note: *Reorganized by the authors based on MLIT (1990, 2010), Land, Infrastructure and Transport White Paper (MLIT 1989-2000), and website information (source: http://www.mlit.go.jp/en/index.html).*
For a better understanding of Japan's long-term master plan on infrastructure development, the map focuses on the new HSR, HSR under construction (to 2010), planned HSR (only mentioned in governmental plans) and newly built HSR (during 1990-2010).

As outlined in the previous sections, the approach in this study for measuring JUS formation and change was based on the scale of DLS. That is, all original data has been recalculated by the authors in order to match this scale. The next stage in this paper is an explanation of the Inter-regional Travel Survey (ITS) conducted in Japan from 1990 to 2010, which was carried out as a national project for capturing human mobility in terms of all transportation modes among 207 consistent zones (i.e., DLS). According to MLIT (2010), Japan is divided into 207 zones, mainly based on the urban functional complementation and the mutual intra-regional commuting rate. Moreover, the authors' efforts in data collection and summarization of transportation flows and socio-economic variables over these twenty years are hard but satisfactory. Fig. 3 shows a map of the study area and the regional division, on which the location, ID and place name of each zone can be found.

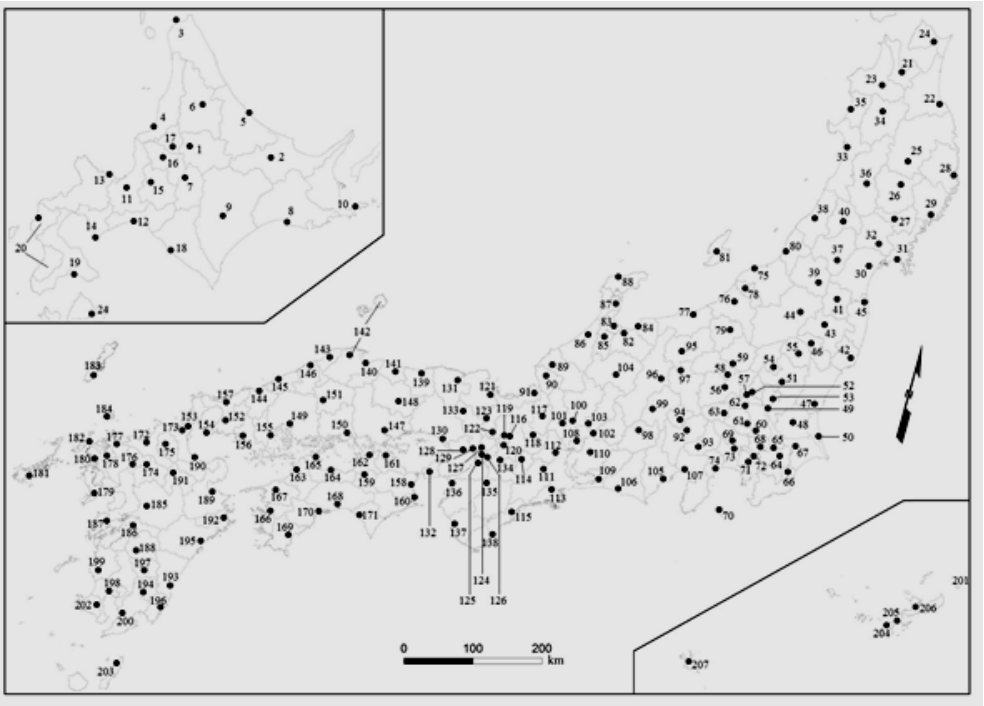

Fig. 3 **– Study area and regional division**

Note*: Dots show the central city of each daily living sphere and the ID corresponds to the place name (omitted here). Datasets of 1990 and 2010 have already been integrated based on the area division of this map*

Datasets used in this study are summarized in Table 1. Particularly, the authors integrate all raw data at different scales from multiple sources into one unitary scale — that is, the DLS — and then produces the original dataset in a GIS-based environment. By using these data, this study designs a statistical model to demonstrate the relationship between the pattern of JUS and the socio-economic features, following and learning from the achievements of previous studies, such as Murayama (1984) and Nishihara (1994). Note that all census data shown in Table 1 is aggregated on a municipal basis, i.e., *Shikuchōson* scale[2], given that the biggest difficulty is the data's inconsistency, this needed to be surmounted. In short, the authors collected the municipality-based raw data (1990 and 2010) from a variety of sources and they integrated them within the same GIS-based table according to its zone code as unique identifier, and then they merged the zones within the same DLS, and it lastly used the summary calculation for obtaining the dataset shown in Table 1. In addition, considering it was necessary to lessen the data bias due to the coexistence of an absolute value and a relative value, all variables (x) have been transformed into standard form, using the formula: .

$$x = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Table 1

Dataset and corresponding sources

ID	Variable	Source	ID	Variable	Source
1	Annual passenger flow (outflow) for different purposes	Inter-regional Travel Survey in Japan (MLIT 1990, 2010)	14	Rate of in-migrants	Basic Resident Register (MIC 1990, 2010a)
2	Annual passenger flow (inflow) for different purposes		15	Annual sales of merchandise	Census of Commerce (METI 1994, 2007)
3	Proportion of day-time population to night-time popula-tion	Population Census (MIC 1990, 2010b)	16	Number of employees per store	
4	Commuting rate outward to prefec-ture		17	Employment population	Population Census (MIC 1990, 2010b)
5	Population		18	Employment rate for primary sector of the economy	
6	Percentage of aged people (>65)		19	Employment rate for secondary sector of the economy	
7	Population density		20	Employment rate for tertiary sector of the economy	
8	Population growth rate (+ or -)		21	Number of privately-owned vehicles	Statistics of Privately-Owned Vehicles (AIRIA 1990, 2010)
9	Gross national income	Report on Pre-fectural Acco-unts (Government of Japan 1990, 2010)	22	Number of railway stations	National Land Numerical Information Download Service (NLNIDS 2010)
10	Agriculture population	Statistics of Agricultural In-come Produced (MAFF 1990, 2010)	23	Number of cultural facilities	
11	Agricultural income produced		24	Dummy variable of the isolated island	
12	Value of shipments of manufactured goods	Census of Man-ufacturers (METI 1990, 2010)	25	Number of high-way interchanges	
13	Number of emplo-yees per factory		26	Superiority of airport access	

The GIS dataset provided by MLIT is updated yearly and is not invariable; thus, the authors have downloaded the 2010 dataset. That is, the dataset for successive years (before 2010) is not available. However, some GIS data, such as the shape-file of railway stations, includes information about the architectural age or usage age. Hence, the authors revised these shape-files from 2010 and recreated those of 1990 using the GIS technology.

Annual inter-regional passenger flow among the 207 zones quantifies the centrality scale that expresses urban dominance within the entire JUS; this is a kind of long-term inter-regional flow for four different purposes: business, tourism, private affairs and other. Three kinds of transportation indexes — i.e., the ratio of human mobility for each purpose (not including the category of other or unknown) — were calculated for measuring the regional difference of passenger behaviors. It should be noted that ITS data does not include the daily commuting flow, which tends to be more of a short-term intra-regional flow (MLIT 1990, 2010). Thus, another two transportation indexes — i.e., the proportion of daytime population to night-time population and the commuting rate outward to the prefecture — were obtained from the Population Census (MIC 1990, 2010b) and they are introduced to measure an urban center's conglomerated power exerted on its surrounding commuting areas. Variables 1 to 4 correspond to the indexes of the transportation flows.

To explain why each variable is introduced into the analysis process, the research purpose and questions should be reiterated. The variables are not only introduced to model human mobility within JUS (e.g., variables 1 to 4), but also to measure socio-economic attributes within each zone (e.g., variables 5 to 26). Variables 5 to 8 and 14, focusing on the population, percentage of aged people, population density, population growth rate and number of in-migrants, capture the regional population features. Variables 9, 11, 12 and 15 are collected to consider the economic strength of three major industries. Variables 12, 13, 16 and 17 to 20 measure the employment population indexes in three sectors. Variable 21 reflects the vehicle transport capacity. Variables 22, 23, 25 and 26 consider the infrastructure service levels. Variable 24 is the dummy variable for the isolated island, which is an important geographical element. Particularly, the superiority of airport access (S_i) of zone *i* is calculated by using the form of the gravity model,

$$S_i = \sum_n \frac{Ln(a_n \times v_n)}{d_{in}^2}$$

where *a* is floor area of the airport, *v* is the annual number of passengers, *n* is the number of airports, and d_{in} is the Euclidean distance between the city center of the urban *i* and airport *n*.

In addition, neglecting the scale bias (partly from the regional differences of size, population, etc.), but giving importance to the avoidance of a collinearity problem, the authors use both absolute variables and rate variables (such as values 3, 4 and 5, and 15, 16 and 17). This is also useful for dividing similar values, or values with collinearity, into different factors. In other words, it might make us to get less monotonous factor results but more changeable results. For example, if using employment rate instead of employment population, value 14 with value 15-17 will terribly cause the problem of collinearity. This influence might be more problematic than the scale problem and thus not acceptable. Sometimes, the factor analysis also provides incorrect results. To avoid this collinearity problem and to consider the scale problem as fully as possible, the authors fully brought into play the potential of different and complex available datasets and they attempted to build a better model by undertaking the variable transformation (both standard transformation and logarithmic transformation), as mentioned above.

Constructing the pattern of the hierarchical urban system

In the national urban system, a city's influence indicates its national centrality (NC). This study devised a model for measuring the centrality indexes in JUS by using the ITS dataset, rather than the equation of prestige centrality, following Lee's (2008) approach. Through the values of NC, which city is connected to how many other cities in JUS, what passenger volumes are in a certain city and which connected city has the most volume can be examined. To calculate NC, a city's local centrality and the connectivity of inter-city linkage should first be examined. The equation of local centrality (L_i) is defined as follows:

$$L_i = \frac{t}{g-1} \times \sqrt{\frac{F_i}{M_g}}$$

where g is the total number of cities (207), t is the number of cities whose passenger flow is directly connected to the city i is higher than zero, M_g is the average total flows of all cities calculated as the equation: $\sum(O+D)/g$, wherein O and D express the row and column elements within the 207×207 OD matrix. F_i is total summation of inflow and outflow via city i.

Here the word "local" isn't a geographical concept but means one part of the whole system, i.e., the limited area formed by the direct-connection relationship between cities. This L_i also reflects the city's dominance within the sub-urban system. Next, the connectivity of inter-city linkage (C_{ij}) is measured according to the following equations:

$$C_{ij} = \frac{f_{ij}}{m} \times L_i \times L_j \ (i \neq j)$$

$$m = \frac{\sum(O+D)}{r}$$

where m is the average flow of all inter-city linkages, r is how many inter-city linkages have zero-higher number of passenger flows; f_{ij} is the number of the round-trip flow between city i and j. C_{ij} can be regarded as the product of the weight value of the local centrality of the origin and destination cities. Herein, the NC (N_i), which implies the city dominance referred to the whole urban system, can be defined as follows:

$$N_i = \sum_{j=1}^{g} \left\{ \frac{f_{ij}}{m} \times L_i \times L_j \right\} = \sum C_{ij}$$

This Ni can be regarded as the total summation of C_{ij}, which reflects the dominance of city i referred to the whole urban system. After the calculation of NC, the authors performed hierarchical classification to reveal the spatiotemporal pattern of JUS.

Performing a series of geo-spatial multivariate analyses and the study framework

This section explains how to apply the socio-economic variables, covering diverse fields in both 1990 and 2010, to conduct a factor analysis to capture the dynamic regional attributes. Then, the relationships between the hierarchical urban system and the regional functional differences, as well as further mechanisms of change in Japan's urban system and the related factors, are discussed via the canonical analysis. Fig. 4 indicates the study framework.

First, data cleaning and production are performed to obtain a clean OD matrix and table listing. All indexes are loaded into a GIS-based database at the scale of DLS level. Second, through the calculation of the centrality index and the hierarchical classification of NC and inter-regional

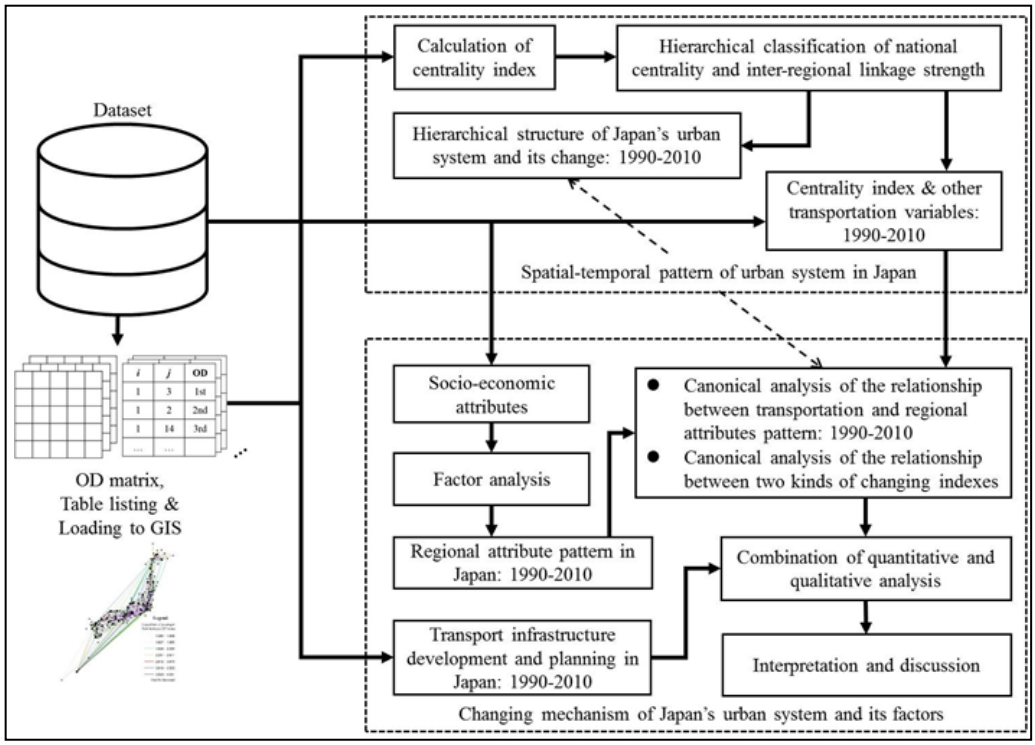

Fig. 4 – **Study framework**

linkage strength, the hierarchical structure of JUS and its changing patterns from 1990 to 2010 are investigated (cf. Section 3.1). At the same time, the centrality index and two other transportation variables are introduced into the next statistical model as one of the variable sets for the following canonical analysis. Next, the socio-economic attributes are entered into the factor analysis process to clarify the regional attribute pattern in Japan (Section 3.2). Fifth, canonical analysis is used to understand the relationship between transportation factors and regional attribute patterns from 1990 to 2010 and to observe the interdependency between these two kinds of changing indexes (cf. Sections 3.3 and 3.4). Finally, considering transportation infrastructure development and planning, as well as the rethinking of the actual national situation in Japan, this study makes a combination of quantitative and qualitative analyses and it provides an interpretation, discussion and conclusion to answer the final research question, i.e., revealing the changing mechanism of JUS and its factors (cf. Section 4).

Fig. 5 highlights the analysis process of the factor analysis and the canonical analysis. As Murayama (1984) noted, the regional socio-economic characteristics and inter-regional interactions are mutually associated and they are basically in a heterogeneous but analogous relationship. Therefore, the introduction of regional socio-economic factors can bring insight on the understanding of inter-cities' linkage and characterizing the pattern of urban system. Following Murayama's (1984) approaches, one of the tasks was to integrate the complicated patterns of socio-economic attributes into a small number of simple ones to deeply examine the potential spatiotemporal pattern among the socio-economic variables. In this study, through the

factor analysis according to two matrices filled with regional attribute variables from 1990 and 2010, a 414×5 matrix of factor scores is given. Five columns of factor scores can be seen as a set of concentrated regional attributes coming from the raw data. The 414 rows correspond to the 207 zones at two periods. Based on the results of factor analysis, the regional attribute patterns in Japan (factor scores of 1990 and 2010) and their change (subtraction of 1990's factor scores from 2010's) can be drawn in the map of Fig. 3.

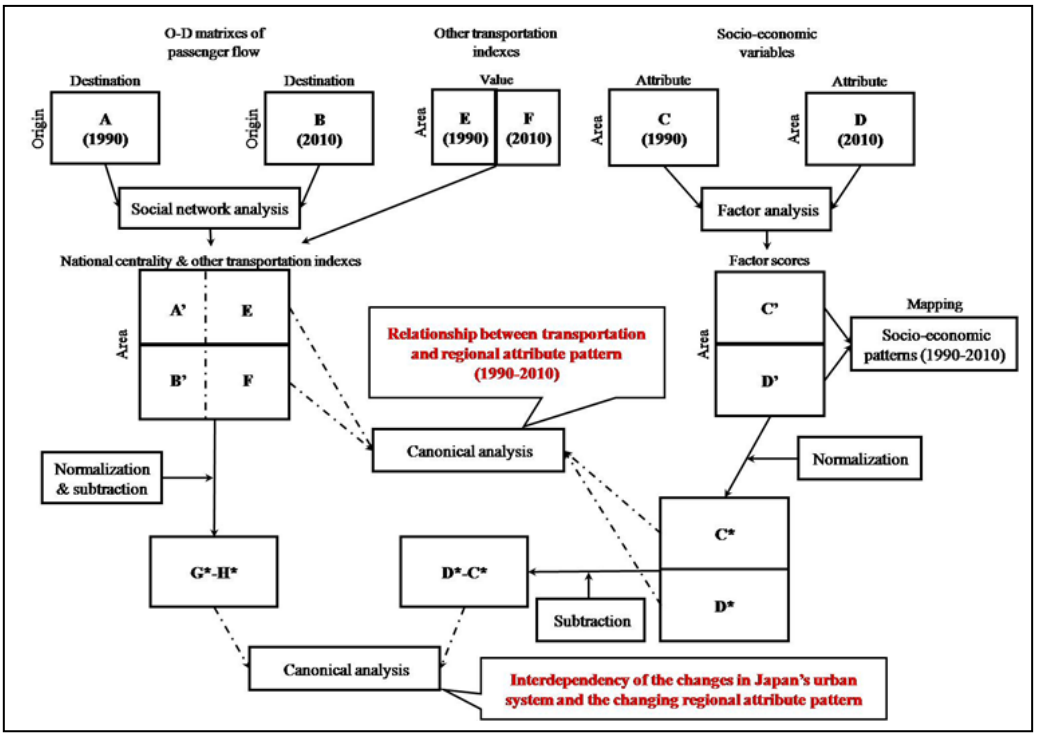

***Fig. 5* – Process of factor analysis and canonical analysis**
Note: *A, B, C, D and E correspond to each matrix. A' and B' fill in the values of NC. C' and D' fill in the factor scores. C*, D*, G* and H* are matrices after the transformation.*

Meanwhile, the social network analysis is used to consider the transportation factors within JUS. After combining the results of NC and the matrix of five other transportation indexes — i.e., the ratio of business behavior, the ratio of tourism behavior, the ratio of private affairs, the proportion of daytime population to night-time population and the commuting rate outward to the prefectures (cf. Section 2.2) — the next stage is to perform the canonical analysis on two sets of normalized matrices for two times, corresponding to the relationship between the transportation factor and the regional attribute pattern at two periods (Fig. 5). In addition, using the result of subtracting 1990's matrices from 2010's matrices, the interdependency of the changes in JUS and the changing regional attribute pattern are also investigated using the canonical analysis. Herein, this study has provided an accomplishment in urban system studies under the consideration of regional attribute variables covering diverse fields by performing a variety of statistical analyses to reveal the changing mechanism of JUS and the related factors from 1990 to 2010.

Results and Discussion

Four parts of the results will be presented in order to better understand the results and giving the key findings. Following the study framework shown in Fig. 4, this study successfully clarified the spatiotemporal pattern of JUS and it elucidated the characteristics of change and the related factors from 1990 to 2010, by performing a series of geo-spatial multivariate analyses (cf. Section 2.4). In addition, the change mechanisms of JUS from 1990 to 2010 can be qualitatively summarized and explained based on these findings.

Hierarchical structure of Japan's urban system and its change

Table 2 shows the results of calculating the centrality index and the number of cities within each hierarchy. Comparing the results of 1990 with those of 2010, we can see that the total transportation (M_g) increases about 36.3%, the entire transport capacity (m) strengthens nearly 18.2% and the number of inter-city linkages (over zero) becomes more than 15.5% higher. This proves that the development of Japan's transportation was quite remarkable from 1990 to 2010. Moreover, the Jenks natural breaks classification, regarded as a useful data clustering method designed to determine the best arrangement of values into different classes for statistical mapping (Surhone et al. 2010), is performed to identify the hierarchical structure of JUS. This classification method seeks to reduce the variance within clusters and to maximize the variance between clusters.

Hereupon, the authors divide six groups of cities within the hierarchical structure of JUS and then they show that, while the bipolarization between the higher and lower classes becomes more outstanding, the lower classes try to pursue the higher ones and to shrink the gap between them (cf. the 4th and 6th classes of Table 2). At the same time, focusing on this bipolarization phenomenon within JUS and digging up the significant evidences of it, the increase of cities in the 1st and 3rd hierarchy implies the segmentation-aggregation and uniformity-diversity of the top-class (sub)urban system (e.g., areas next to Tokyo, Nagoya, Fukuoka), as well as the coordination-independence of the secondary (2nd and 3rd class cities mainly) (sub)urban system (e.g., areas surrounding Japan's mega-cities, some regional hub-cities and some emerging new-towns). In other words, the hierarchical structure of JUS tended to be more compact from 1990 to 2010, because of the strengthening of inter-cities' linkage and the development of these sub-urban systems. This detail can be reconfirmed hereinbelow. Through the hierarchical classification of NC, this section further identifies the spatial structure

Table 2

Centrality index and the number of cities within each hierarchy

1990		**2010**	
M_g	19288	M_g	26290
m	319	m	377
r	12478	r	14416
1st	19	**1st**	26
2nd	35	**2nd**	32
3rd	35	**3rd**	45
4th	52	**4th**	41
5th	33	**5th**	35
6th	33	**6th**	28

of JUS and its changing patterns.

Focusing on the nodal flow, which has a 10% higher ratio of linkage amount to total amount, and the linkage among five major metropolitan areas (Tokyo, Nagoya, Osaka, Hiroshima and Fukuoka), Fig. 6 vividly illustrates the hierarchical structure of JUS in 1990 (a) and in 2010 (c), as well as it highlights its changing patterns (see sub-graphs b and d) within the mathematical axis space. Colors and sizes of the dots indicate 207 cities within six hierarchical clusters. The line expresses the spatial pattern of the nodal flow and the linkage among several major metropolitan areas. For a better understanding of the changing patterns of JUS, Fig. 6b and Fig. 6d abstractly simulate this change. The horizontal axis means the average distance to Tokyo[3], while Tokyo is placed at the zero point. The left and right directions of the horizontal axis, respectively, correspond to the west and east of Tokyo. The vertical axis expresses the normalized value of NC[4]. Japan's territory can be geographically divided into seven parts. Each

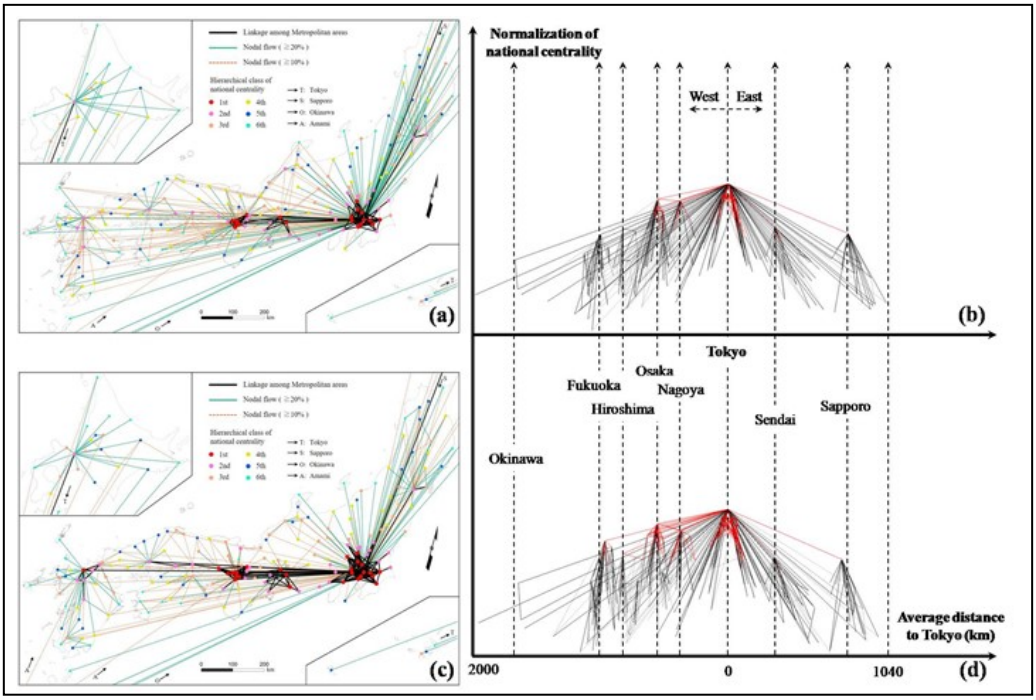

Fig. 6 – **The hierarchical structure of Japan's urban system and its change (1990-2010)**

part includes one or more mega-cities. Therefore, Tokyo, Nagoya, Osaka, Sendai, Hiroshima, Fukuoka, Sapporo and Okinawa are particularly shown for better understanding the change of JUS in Fig. 6.

Seven dotted lines show the datum line of seven mega-cities' relative distances toward Tokyo in 1990. Comparing Fig. 6a and Fig. 6c, meanwhile comparing Fig. 6b and Fig. 6d, this section proves several key findings as follows: 1) Nodal flows toward the metropolises are notable. In particular, Tokyo can be appointed as the leader of JUS in Japan, as nodal flows are more-or-less aggregated from even the cities that are far from Tokyo, proving that JUS in 1990 was

mononuclear. However, JUS in 2010 tends to become polycentric. The inter-city HSR system, especially that connecting to regional core cities or metropolises, has grown vigorously during 1990-2010. However, the regionally unbalanced development of transportation has brought about a serious gap between the Pacific Ocean coastal area and the Sea of Japan coastal area, as well as between the urban areas and the countryside. This detail can be supported by Fig. 3. 2) The dominance of these 8 metropolises (shown in sub-graph d) strengthens during 1990 to 2010. The linkage among the metropolitan areas becomes more obvious, especially those at Tokyo, Nagoya, Osaka, Hiroshima and Fukuoka. If combining this result with Fig. 3, we found that the inter-city HSR system, especially that connecting to regional core cities or metropolises, has grown vigorously during 1990-2010. However, the regionally unbalanced development of transportation has brought about a serious gap between the Pacific Ocean coastal area and the Sea of Japan coastal area, as well as between the urban areas and the countryside. 3) The spatial pattern of JUS becomes compact (Fig. 6b, Fig. 6d), and the accessibility of the whole system also has an obvious increment, because the long-distance transport cost[5] is substantially reduced. Fig. 3 and MLIT's white paper (MLIT 1989-2000) also implied that the development of the aviation industry has been remarkable, causing other industries, like tourism, to prosper. Moreover, the development of highways can split the transport burden with other transportation modes, can mitigate the unbalanced urbanization and can make metropolises more compact.

Regional attribute patterns in Japan and their change

This section attempts to integrate the complicated socio-economic attribute patterns into a small number of latent factors by applying the factor analysis onto the geographical matrix of 414 (207×2) rows of zone IDs and 22 columns of regional attributes (Table 1). Referring to the results of the factor analysis shown in Table 3, it can be seen that most socio-economic variables provide evidence of a high communality of over 0.70. Five factors with high eigenvalues were obtained from the factor analysis (Table 3). These five factors account for 80.26% of the total variance. According to the high factor loadings and their corresponding implications shown in Table 3, the authors hence refer to these five factors (I to V) as follows: scale of urbanization; population growth rate; industry and commerce; agriculture and cultural facilities and tertiary industry; isolated island and airport access.

In detail, factor I reflects high loadings in many categories, like population, GDP, employment and number of railway stations, which means that this factor is strongly associated with the urban development level and scale of urbanization. While factor II displays a high negative percentage of aged people and a positive population growth rate, it is unquestionable to give the above-mentioned name. In the case of factor III, indexes about industry and commerce (e.g., Nos. 11 and 13) have a higher loading, but negative loadings in the variable: employment rate for the primary sector. Therefore, the authors identify this factor as industry and commerce. On the contrary, agricultural population and agricultural income produced present a higher loading in factor IV. Furthermore, this factor also appears to have a higher positive correlation to the number of cultural facilities. Finally, factor V can be explained as the characteristics from the dominance of the tertiary industry, the isolated island situation and the advantageous airport access.

After interpreting each factor's pattern, the distribution patterns of the socio-economic attributes are mapped using the normalized factor score. Fig. 7 depicts their distributions from 1990 to 2010, as well as their changing patterns. Referring to the thematic maps illustrated by Fig. 7, we can clearly identify the extent of every factor displayed in every DLS zone and how its pattern changes. Dots show the central city of each DLS (this is the same as in Fig. 3). The colors of the dots express the numerical classification of the factor score. From the color's gradient and tone, the socio-economic pattern at two time periods and their changes can be

Table 3

Factor analysis of socio-economic attributes (1990-2010)

No.	Variables	Communality	Factor loadings				
			I	II	III	IV	V
1	Population	0.96	0.92				
2	Percentage of aged people	0.84		-0.87			
3	Population density	0.79	0.80				
4	Rate of in-migrants	0.78		0.77			
5	Population growth rate	0.84		0.80			
6	Gross national income	0.94	0.95				
7	Number of privately-owned vehicles	0.87	0.80				
8	Agricultural population	0.90				0.93	
9	Agricultural income produced	0.86				0.91	
10	Value of shipments of manufactured goods	0.63	0.61				
11	Number of employees per factory	0.63			0.78		
12	Annual sales of merchandise	0.83	0.89				
13	Number of employees per store	0.83	0.51		0.55		
14	Employment population	0.96	0.93				
15	Employment rate for primary sector of the economy	0.83			-0.73		
16	Employment rate for secondary sector of the economy	0.92					-0.81
17	Employment rate for tertiary sector of the economy	0.88					0.88
18	Number of railway stations	0.85	0.92				
19	Number of cultural facilities	0.80	0.68			0.48	
20	Dummy variable of the isolated island	0.49			-0.64		0.65
21	Number of highway interchanges	0.82	0.88				
22	Superiority of airport access	0.41					0.48
Eigenvalue			7.75	2.73	2.61	2.37	2.20
Percentage of total variance			35.22	12.41	11.85	10.76	10.01
Accumulative percentage			35.22	47.64	59.48	70.25	80.26

exhaustively read, zone by zone. To keep the data precise and consistent, the numerical classification of each category's factor score is performed using the same calibration (Fig. 7). Then, the regional attribute pattern of the whole JUS and its changes are revealed as follows.

The scale of urbanization strengthens widely but slightly, especially in the Pacific Ocean coastal area, Seto Inland Sea area and metropolises (Fig. 7a, Fig. 7b, Fig. 7c). However, urbanization declines slightly in depopulated areas like Chugoku, Shikoku and Kyushu District, and the in most isolated islands. This phenomenon can be interpreted and understood as Japan's regional imbalance of urban development levels and potential. Although a few areas near the seven major mega-cities present a slight improvement of this factor's score, the development levels of most DLS urbanizations are stagnating or even retrogressing (Fig. 7c) under the consideration and precondition of urbanization year-on-year growth in JUS.

Because of the economic crisis brought by the collapse of Japan's bubble economy in 1991, the population growth rate related to the whole of Japan slows compared to the 1980s.

Oppositely, it increases in the suburban areas of the metropolises because of the development of suburbanization. The population growth rate in the depopulated areas may be negative (Fig. 7d, Fig. 7e, Fig. 7f). After the bubble economy, Japan witnessed a steady and slow recovery from 1990 to 2010. The results suggest that the population grew in the suburban areas in 1990 (Fig. 7d), but in 2010, it become somewhat weaker (Fig. 7e). This can also be regarded as a reflection of the development of suburbanization. The re-growth of population with high growth rates in the inner area of megacities in 1990 can also be verified (Fig. 7d), while in 2010 this trend is limited in several few metropolitan areas (Fig. 7e). If comparing with Fig. 2, we can see an astonishing proposition: the transport infrastructure development in Japan promoted more population growth and immigration, while some depopulated areas were not able to enjoy the urban resources and they reluctantly allowed their population to gradually shrink. This phenomenon is known as the "straw effect" in the context of Japan[6].

Except in a few areas, industry and commerce develop remarkably and become prosperous, especially in the border areas of the metropolises (Fig. 7g, Fig. 7h, Fig. 7i). To some extent, this can be considered a slight recovery from the burst of Japan's bubble economy since the 2000s. The agriculture in Japan is quickly and widely falling into decay, except in the surrounding areas of the metropolises. Additionally, the number of cultural facilities (primary schools, mainly, based on the authors' calculation) decreases, clearly because of Japan's wide depopulation (Fig. 7j, Fig. 7k, Fig. 7l). This detail further corroborates that the negative impact on agricultural productivity and primary school maintenance have been intensely influenced by these factors (e.g., depopulation, straw effect and regional imbalance).

The tertiary industry and airport access develop dramatically, especially near the areas where new airports are constructed (Fig. 7m, Fig. 7n, Fig. 7o). Considering the previous findings and the information from Fig. 2, this study confirms that Japan's recovery is remarkably associated with the development of tertiary industries, including aviation. In addition, isolated island areas are usually tied to few areas by a weak linkage (Fig. 6), and airport access seems to be their only channel to the Japanese mainland (e.g., Okinawa). This is why factor V indicates higher scores in isolated island areas but it does not show an obvious increase in the patterns of change there.

Relationship between transportation factors and regional attribute patterns

After revealing the regional attribute patterns in Japan and their change by using the factor analysis, the canonical analysis is used to understand the relationship between transportation factors and regional attribute patterns from 1990 to 2010 and to observe the interdependency between these two kinds of changing indexes (Fig. 4, Fig. 5). This section attempts to reveal the relationship between transportation factors and regional attribute patterns using the canonical analysis. Moreover, the results of the canonical analysis provide rich hints that can be linked with the verification of exploratory hypotheses. Following the process mentioned in Section 2.4, the authors present the results in Fig. 8.

The descriptions of Y_1 to Y_6 (transportation factors) and X_1 to X_5 (factor scores of regional attributes) are defined as follows: Y_1 is national centrality; Y_2 is the ratio of business behavior; Y_3 is the ratio of tourism behavior; Y_4 is the ratio of private affairs or homecoming behavior; Y_5 is the proportion of daytime population to night-time population; Y_6 is the commuting rate outward to the prefectures; X_1 is the scale of urbanization; X_2 is the population growth rate; X_3 is industry and commerce; X_4 is agriculture and cultural facilities; X_5 is tertiary industry, isolated island and airport access. Though viewing two sets of canonical variables on three or two levels — i.e., U* and V*, autocorrelation within groups of Y_1 to Y_6 and X_1 to X_5 — the canonical correlation between them can be determined. From the structural equation highlighted at the bottom of each sub-graph and the arrows from the original variable factor (Y* and X*) toward each canonical variable (U* and V*), the factor loadings against the canonical variable pairs

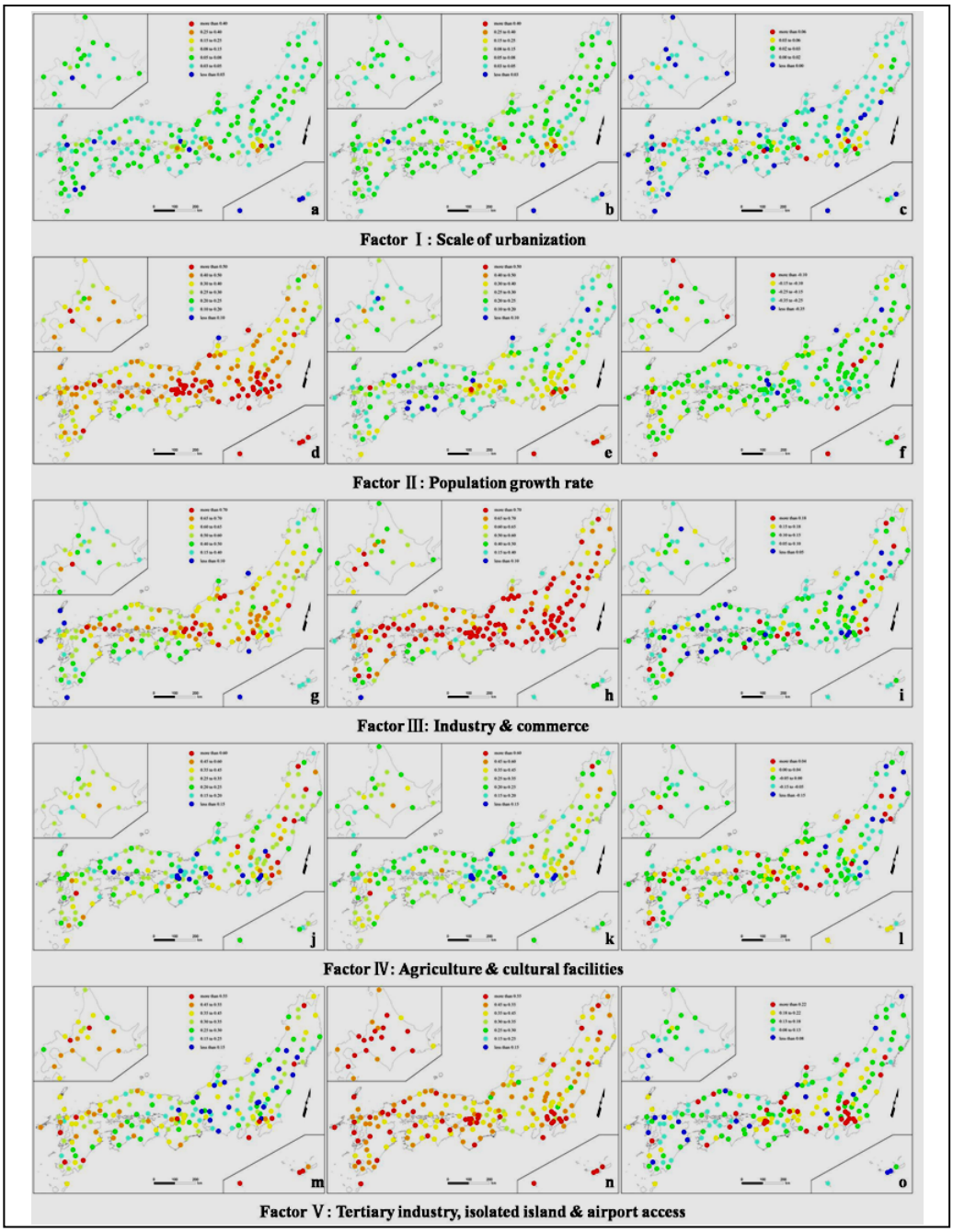

Fig. 7 **– Factor score distributions of socio-economic attributes from 1990 (left) to 2010 (middle) and their changing patterns (right)**

can also be checked in detail; this implies cross influence among them. Four canonical vectors are obtained for 1990, and three for 2010, at the 0.01 level of confidence. In-group correlation coefficients (dotted lines) can also be read, which indicate the scale of collinearity between the variables.

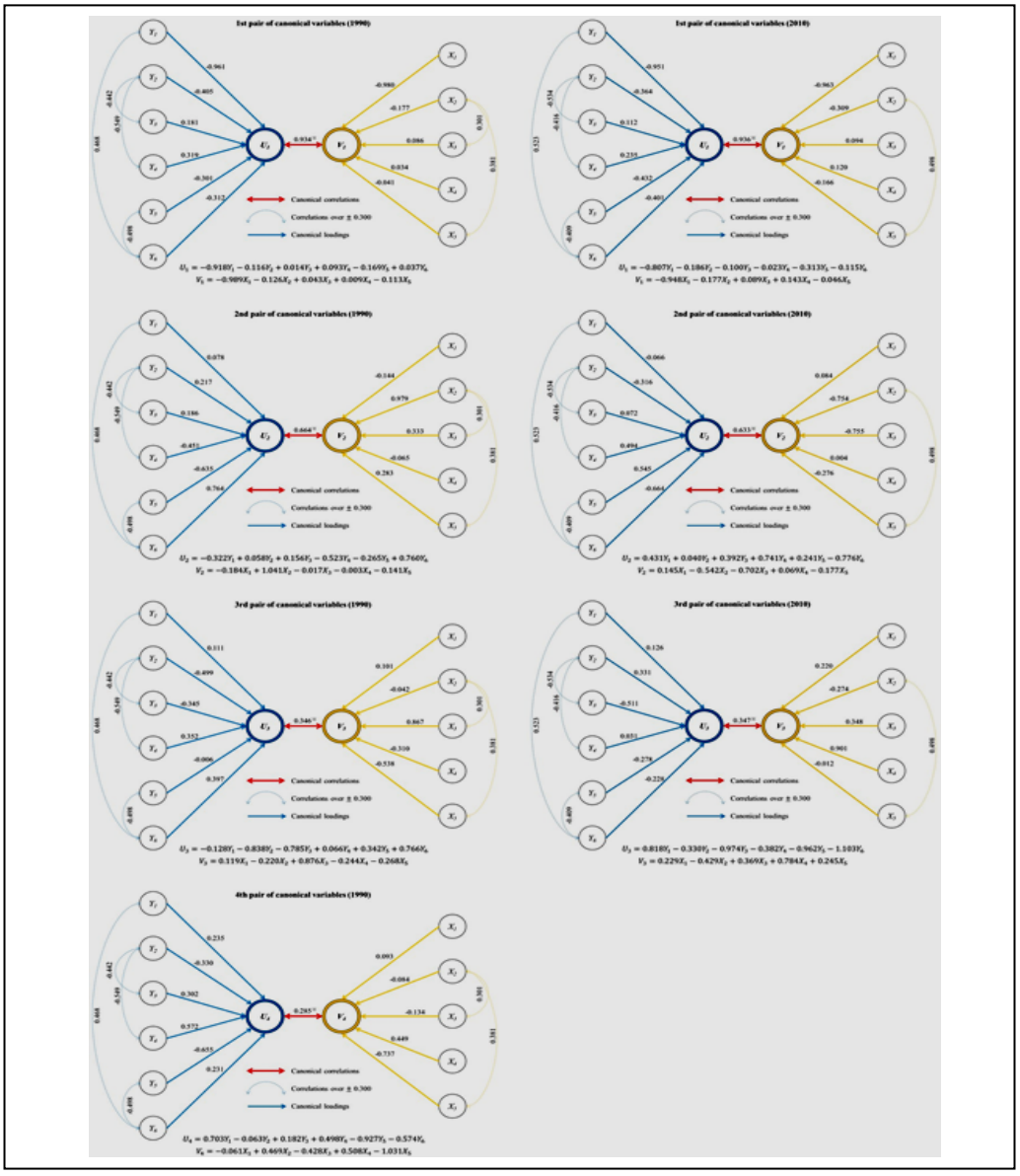

Fig. 8 **– Canonical analyses of the relationship between the transportation factor and DLS's attribute pattern in 1990 (left) and 2010 (right)**
Note: **Significant at the 0.01 level of confidence (same as Fig. 9)*

Overall, the results prove the following: 1) The 1st pair of canonical variables in both 1990 and 2010, as the highest canonical correlation between Y-set and X-set, implies that Y_1 has a strong positive correlation against X_1 because its canonical loadings are high and have the same sign. This reveals that the dominance of urbanization has a strong and mutual effect with the national centrality. This sequitur can also be proven from Y_2 and Y_5 and Y_6 toward X_2. Moreover, from Y_3 and Y_4 and X_3 and X_4, we find some weak positive correlations. This proves that tourism, private affairs or homecoming behavior, as well as the prosperity of industry, commerce, agriculture and culture may affect each other significantly. On the contrary, it is clear that Y_3 and Y_4 have a negative correlation against X_1, which means that urbanization may restrain tourism, private affairs or homecoming behaviors; 2) Similarly, the remaining canonical variable pairs can also be used to find the hidden relationships among the variables, as well as to discover the key arguments. Considering the second pair of canonical variables in 1990, Y_2, Y_5 and Y_6 have strong positive correlations against X_2, X_3 and X_5, which reveals that the development of secondary industry, commerce, tertiary industry, airport access and population growth have effects from (or on) the remarkableness of business behavior, day-night population diversity and long-distance commuting rates. Moreover, Y_4 and Y_5 have negative correlations against X_2 and X_3. Indeed, this is a kind of antithetical effect among the variables in the second canonical variable pair. This shows their opposite relationship to each other. 3) Considering the case of 2010, we found that the results vary in the changing indexes and it is not easy to compare the results between 1990 and 2010. At a minimum, the results from 2010 are generally consistent with the ones from 1990, except regarding Y_5. Unlike the case of 1990, the relationships between the day-night population diversity and the development of secondary industry, commerce and tertiary industry and population growth become negative correlations. It can be regarded as a phenomenon of the changing JUS, which will be considered in the next section. 4) Simply stated, the urban functions and the characteristics of transportation experienced a remarkable change during the period from 1990 to 2010. Considering the low correlation values of the third and fourth canonical variable pairs (<0.4), discussions of these categories are omitted here.

Interdependency of the changes in Japan's urban system and the changing regional attribute patterns

The same analyses performed in Section 3.3 are performed between the changing values of Y-set and of X-set to highlight the interdependency of the changes in JUS and the changing regional attribute patterns. Accompanying the findings from Sections 3.1 and 3.2, the kinds of places where the centrality index and the socio-economic features changed can be discussed together. Considering that the study's purpose is highlighting and elucidating the change mechanisms of JUS and the related factors, however, sometimes the results of the canonical analysis could not explain all changes or match the findings grasped in a simple way of visualization. This is because a country's mechanisms of change are quite complex, uncontrolled and highly random, with collinearity and regional bias. Moreover, it is difficult to unilaterally explain using the quantitative model. Therefore, in this section, this study confirms and it verifies some passable hypotheses based on the analyses and it further provides a qualitative interpretation supporting the whole study (Fig. 10).

In brief, the changes in national centrality (Y_1) and in day-night population diversity (Y_5) have positive correlations against the changes in urbanization (X_1) and in tertiary industry and airport access (X_5), following the general situation. Additionally, the change in the long-distance commuting rate (Y_6) has a negative correlation against the changes in industry and commerce (X_3). This can be understood as, for example, a place that has a remarkable industry and commerce may not have a high commuting rate outward to the prefectures, and vice versa. The same results can also be seen between Y_1 and X_3. Conversely, the changes in day-night population diversity (Y_5) have a positive correlation against the changes in industry and

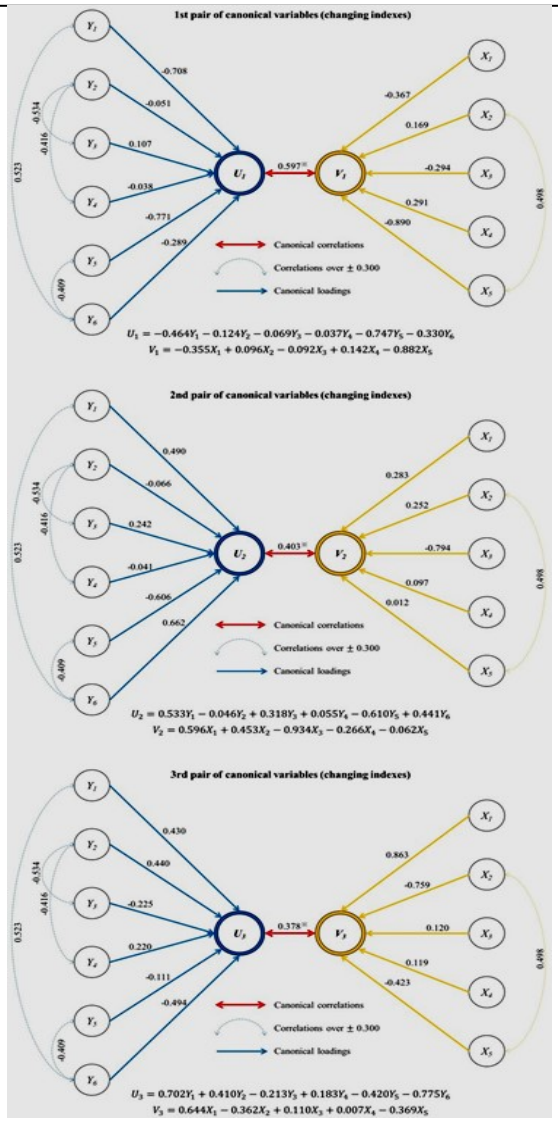

Fig. 9 **– The canonical analysis of the relationship between two kinds of changing indexes**

commerce (X_3), as the place with highly developed industry and commerce may tend to attract a larger commuting population. Finally, the changing ratio of tourism behavior (Y_3) and the changing long-distance commuting rate (Y_6) have positive correlations against the changing population growth rate (X_2) and the changes in tertiary industry and airport access (X_5), but they have negative correlations against the changing scale of urbanization (X_1). This is because more tourism and external commuting activities tend to promote population growth, as well as the development of tertiary industry and airport access. However, it can also

simultaneously cause counter-urbanization and depopulation to some extent, as mentioned in Section 3.2.

Conclusions

This study aims to clarify the spatiotemporal pattern of the urban system in Japan and then to highlight and to elucidate the changing mechanisms of JUS and the related factors. Based on the inter-regional travel survey conducted in Japan from 1990 to 2010 (MLIT 1990, 2010) and on the numerous other official censuses, the hierarchical structure of JUS is constructed. After that, a series of analyses were performed to reveal the regional attribute patterns, understanding the relationship between the transportation factors and the regional attribute patterns from 1990 to 2010 and lastly discussing the interdependency of the changes in JUS and the changing regional attribute patterns. The results prove that the changes have taken place in terms of the entire system's compactness, the metropolises' dominance and the local systems' bipolarization under the hierarchical structure of JUS, with the establishment of hub cities during the post-war high economic growth period and the development of infrastructure during the two decades in question.

The change mechanisms of JUS, with consideration of socio-economic characteristics and inter-regional interactions, are qualitatively summarized and explained in Fig. 10. In summary, owing to the progress of urbanization, the development of transport infrastructure and the development of aviation and tertiary industry, the dominance of metropolises has been remarkably enhanced, causing JUS to become more compact and the inter-regional interactions among cities to strengthen. At the same time, three major industries tend to be developed and promoted toward the outer edges of the metropolises. Although this can bring about some favorable circumstances in some areas, the industry recession and the decreasing population become profound in the depopulated areas, which can be regarded as the so-called

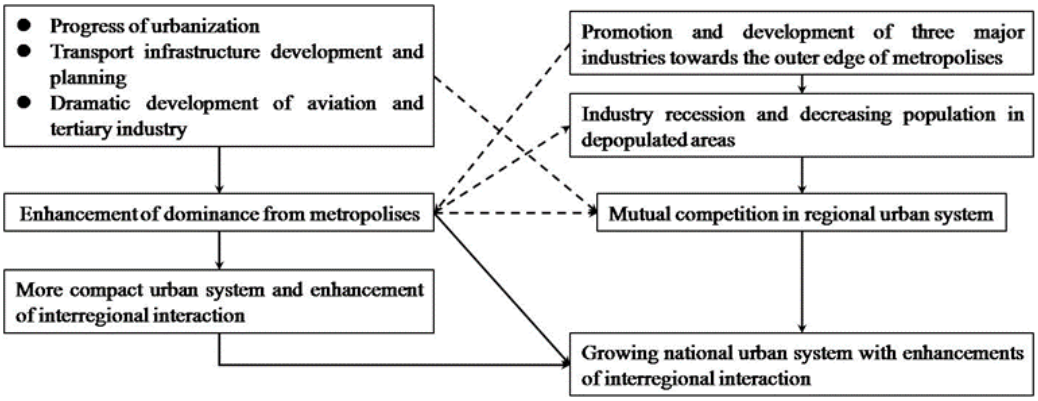

Fig. 10 **– Change mechanisms of Japan's urban system from 1990 to 2010**

"straw effect" in Japanese. Additionally, mutual competition in regional urban systems can be considered while the compact national system takes shape. Accordingly, JUS is generally a growing national urban system, with the enhancements of inter-regional interaction.

Overall, this study would have been valuable even if it only measured the hierarchical structure of JUS and its changing patterns. The exploratory analysis of what might be associated with the changes in JUS's hierarchical structure may also be useful for building hypotheses; to a

certain extent, the achievement of this study can serve as the case of a kind of explored-hypothesis verification. Considering about the originality that can be confirmed in this study, performing multi-view studies that considered the issue of the urban system on a uniform scale by the way of introducing reasonable factors to explain the pattern within the urban system's mutual feedback mechanism, not just those resting on constructing this pattern itself like most previous studies, have brought some unknown research interests. This study also provided an examination of the changing processes of JUS and the related factors, with consideration for the socio-economic features, aiming to fill the research gaps mentioned in Section 1.

Considering about the research limitation, explaining the causes of the changes seems quite ambitious and valuable, which means that a more rigorous approach should be taken to deeply explore the explanations for these changing mechanisms. Moreover, the description of Japanese policies and the transport infrastructure development and its association with the pattern of JUS are not fully explained in this context, which means that more future studies should be done for linking the findings of this study towards the previous studies and for providing academic verification to the MLIT's document.

As a consequence, this study is an accomplishment in urban system studies. Furthermore, in this research, the authors introduce regional attribute variables covering diverse fields — population, economy, transportation, industrial composition, human facility, etc. — as a research innovation compared to previous studies. Through a series of geo-spatial multivariate analyses, the changes in JUS and their factors are successfully addressed. Not only researchers and scholars, but also urban planners and the general public can find material to suit their interests, arguments and reference needs. This study possesses the value of providing guidance for urban planning optimization and urban development sustainability in the context of Japan.

Acknowledgements

The authors sincerely take this opportunity to express special thanks to the academic supervisor, Prof. Yuji Murayama. Other people also guided us in important ways, including Prof. Toshiaki Ichinose, and Assistant Professor Takehiro Morimoto. The Ministry of Land, Infrastructure and Transport (Japan) provided the raw GIS and statistical data needed in this research.

Notes

1. *Kakuei Tanaka*, Japanese Prime Minister (1972-1974), proposed the "Plan for Remodeling the Japanese Archipelago" in 1972, to promote the development of land in Japan.
2. The Prefectures of Japan (*Todōfuken*) consist of 47 prefectures, forming the first level of administrative division in Japan. Each prefecture consists of numerous municipalities. There are four types of municipalities in Japan: cities, special wards, towns and villages. In Japanese, this system is known as *Shikuchōson*.
3. This study calculates the average distance ($\overline{d}$) from city *i* to Tokyo based on the utilization ratio of three different major transportation modes as its weighted values, across multiple times at different distances. Its equation is defined as follows:

$$\overline{d} = \alpha_c d_1 + \beta_c d_2 + \gamma_c d_3$$

$$\text{case}\ \{d < 100;\ 100 \le d < 200;200 \le d < 300;\ 300 \le d < 500;\ 500 \le d < 750;\ 750 \le d < 1000\ and\ d \ge 1000\},$$

where d_1, d_2 and d_3 are the distance (km) by train, automobile and airplane, respectively. α, β and γ express their corresponding utilization ratios. Moreover, *c* indicates eight

distance cases of the line distance (*d*) from city *i* toward Tokyo: *d*<100; 100≤*d*<200; 200≤*d*<300; 300≤*d*<500; 500≤*d*<750; 750≤*d*<1000 and *d*≥1000. α, β and γ in these cases are defined and published by the MLIT (2010).

4. In this study, the equation of normalization of national centrality (N_i^*) is calculated as follows:

$$N_i^* = \frac{N_i' - min\{N_i'\}}{max\{N_i'\} - min\{N_i'\}} + \varepsilon$$

$$N_i' \in \{Ln(N_i)\}, i \in [1, 207], N_i^* \in (0,1], \varepsilon \to 0 \; and \; \varepsilon > 0$$

5 . According to MLIT (2010), the long-distance transport cost is defined as the one over 750 km. The meaning of “straw effect” in Japanese can be found in the website of Wikipedia, https://ja.m.wikipedia.org/wiki/ストロー効果

References

AUTOMOBILE INSPECTION AND REGISTRATION INFORMATION ASSOCIATION OF JAPAN (1990 and 2010), *Statistics of Privately Owned Vehicles*, AIRIA, Retrieved from: www.airia.or.jp.

BURGHOUWT G., HAKFOORT J., VAN ECK J. R. (2003), *The spatial configuration of airline networks in Europe*, Journal of Air Transport Management 9 (5), 309-323.

CHOI J. H., BARNETT G. A., CHON B.-S. (2006), *Comparing world city networks: a network analysis of Internet backbone and air transport intercity linkages*, Global Networks 6 (1), 81-99.

CENTER FOR SPATIAL INFORMATION SCIENCE (2015), *Need for Urban Area Definition*, CSIS. University of Tokyo, Retrieved from: www.csis.u-tokyo.ac.jp.

DERUDDER B., TAYLOR P. J., HOYLER M., NI P., LIU X., ZHAO M., SHEN W., WITLOX F. (2013), *Measurement and interpretation of connectivity of Chinese cities in world city network, 2010*, Chinese Geographical Science 23 (3), 261-273.

DERUDDER B., TAYLOR P. J., WITLOX F., CATALANO G. (2003), *Hierarchical tendencies and regional patterns in the world city network: a global urban analysis of 234 cities*, Regional Studies 37 (9), 875-886.

DERUDDER B., WITLOX F., TAYLOR P. J. (2007), *U.S. cities in the world city network: Comparing their positions using global origins and destinations of airline passengers*, Urban Geography 28 (1), 74-91.

DONG C., XIU C., WEI Y. (2014), *Network structure of ‘space of flows’ in Jilin Province based on telecommunication flows*, Acta Geographica Sinica 69 (4), 510-519.

GOVERNMENT OF JAPAN (1990, 2010), *Report on Prefectural Accounts*, Retrieved from: www.cao.go.jp.

GUIMERÀ R., MOSSA S., TURTSCHI A., AMARAL L. A. N. (2005), *The worldwide air transportation network: Anomalous centrality, community structure, and cities’ global roles*, PNAS 102 (22), 7794-7799.

GUO W. J., BAI M. Y. (1999), *A positive research on the functional hierarchy of urban air transportation and the features of air transportation relationship in China*, Human Geography 14 (1), 27-31.

JOHNSTON R. J. (1982), *The American Urban System*, Longman, London.

LEE H.-S. (2008), *The structure of the international air network through the social network analysis*, Journal of Geography 117 (6), 985-996.

LENG B., YANG Y. C., LI Y., ZHAO S. (2011), *Spatial characteristics and complex analysis: a perspective from basic activities of urban networks in China*, Acta Geographica Sinica 66 (2), 199-211.

LU L., LI Y. (2010), *A research on Chinese renovation urban system based on urban renovation function*, Acta Geographica Sinica 65 (2), 177-190.

MARTINUS K., SUZUKI J., BOSSAGHZADEH S. (2019), *Agglomeration economies, interregional commuting and innovation in the peripheries*, Regional Studies 54 (6), 776-788.

MATTHIESSEN C. W., SCHWARZ A. W., FIND S. (2010), *World cities of scientific knowledge: Systems, networks and potential dynamics. An analysis based on bibliometric indicators*, Urban Studies 47 (9), 1879-1897.

MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES OF JAPAN (1990, 2010), *Statistics of Agricultural Income Produced*, MAFF, Retrieved from: www.maff.go.jp.

MINISTRY OF ECONOMY, TRADE AND INDUSTRY OF JAPAN (1990, 2010), *Census of Manufactures*, METI, Retrieved from: www.meti.go.jp.

MINISTRY OF ECONOMY, TRADE AND INDUSTRY OF JAPAN (1994, 2007), *Census of Commerce*, METI, Retrieved from: www.meti.go.jp.

MINISTRY OF INTERNAL AFFAIRS AND COMMUNICATIONS OF JAPAN (1990, 2010a), *Basic Resident Register*, MIC, Retrieved from: www.soumu.go.jp.

MINISTRY OF INTERNAL AFFAIRS AND COMMUNICATIONS (1990, 2010b), *Statistics of Japan*, MIC, Retrieved from: www.stat.go.jp.

MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT OF JAPAN (1989-2000), *Land, Infrastructure and Transport White Paper*, MLIT, Retrieved from: www.mlit.go.jp.

MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT OF JAPAN (1990), *1990 inter-regional travel survey in Japan*, MLIT, Retrieved from: www.mlit.go.jp.

MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT OF JAPAN (2010), *2010 inter-regional travel survey in Japan*, MLIT, Retrieved from: www.mlit.go.jp.

MORIKAWA H. (1998), *Urbanization and Urban System in Japan*, Taimeido, Tokyo.

MURAYAMA Y. (1982), *Canadian urban system and its evolution process in terms of air -passenger flows*, Geographical Review of Japan 55 (6), 380-402.

MURAYAMA Y. (1984), *Regional structure of Japanese commodity flows: an approach of geographical field theory*, Annals of the Association of Economic Geographers 30 (2), 95-111.

MURAYAMA Y. (2000), *Japanese Urban System*, Springer, London.

NISHIHARA J. (1994), *Inter-urban linkages and systems of cities: the case of wholesaling activity in Kyushu province, Japan*, Geographical Review of Japan Ser. A 67 (6), 357-382.

NOJIRI W. (1993), *The patterns of freight flows carried by railway containers and regular road hauliers in Japan*, Annals of the Association of Economic Geographers 39 (2), 136 -154.

SMITH D. A., TIMBERLAKE M. F. (2001), *World city networks and hierarchies, 1977-1997: an empirical analysis of global air travel links*, American Behavioral Scientist 44 (10), 1656-1678.

SONG W., LI X.-W., XIU C.-L. (2008), *Patterns of spatial interaction and hierarchical structure of Chinese cities based on intercity air passenger flows*, Geographical Research 27 (4), 917-926.

SUN H. (2016), *Study on the correlation between the hierarchical urban system and high-speed railway network planning in China*, Frontiers of Architectural Research 5 (3), 301-318.

SURHONE M. L., TENNOE T. M., HENSSONOW F. S. (2010), *Jenks Natural Breaks Optimization*, Betascript Publishing, Riga.

TAYLOR P. J. (2004), *World City Network: A Global Urban Analysis*, Routledge, New York.

WANG C. (2010), *Identification of inter-urban container transport hubs and their spatial characteristics: a case study of railway transportation in China*, Acta Geographica Sinica 65 (10), 1275-1286.

WANG J., WANG H., JIAO J. (2015), *China's international aviation transport to the Belt and Road Initiative area*, Progress in Geography 34 (5), 554-562.

WANG M.-J., ZHANG X.-X., QI Y.-J. (2005), *On the evolving process of urban system in Shandong Province in the last 50 years: a study based on urban centrality*, Geographical Research 24 (3), 432-442.

YAO Y., LIU Y., WANG G., DONG Y., WANG H. (2018), *Relations between global city connectivity of the primary city and the size national economy*, Journal of Urban and Regional Analysis 10 (1), 5-23.

YOKURA Y. (2016), *Shifting centrality and connectivity of major cities in Japanese urban system through assigned functions of corporate offices*, Geographical Sciences 71 (1), 19-32.

YU T.-F., GU C.-L., LI Z.-G. (2008), *China's urban systems in terms of air passenger and cargo flows since 1995*, Geographical Research 27 (6), 1407-1418.

ZHEN F., WANG B., CHEN Y. (2012), *China's city network characteristics based on social network space: an empirical analysis of Sina micro-blog*, Acta Geographica Sinica 67 (8), 1031-1043.

ZHOU C., ZENG G., MI Z., XIAN G. (2017), *The study of regional innovation network patterns: evidence from the Yangtze River Delta urban agglomeration*, Progress in Geography 36 (7), 795-805.

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MANAGEMENT DEVELOPMENT OF DISTRICT IN THE ADMINISTRATION OF LOCAL GOVERNMENT IN EAST FLORES REGENCY, EAST NUSA TENGGARA PROVINCE

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Abstract: This study focused on exploring and analyzing management planning in the administration of local government, management of public services, and governmental leadership, while determining and analyzing the problems faced in the district management, as well as the possible development model for district management. This study used the constructivist approach (discovery and assimilation), and it involved 10 respondents. The results showed that in the district management in East Flores regency, the management of planning had not been implemented optimally; the management of public services had not been implemented optimally, effectively and efficiently; and the governmental leadership had been properly implemented in terms of service, but it had not been optimally implemented in terms of administrative management duties. The management development in the aspect of management of planning was expected to be carried out through these stages: setting goals, developing commitment to goals, developing effective action plan, following the steps of achieving the goals, and maintaining flexibility of planning.

Key Words: *development of planning management, public service management, governmental leadership, administration of local government*.

Introduction

The shift of the administrative paradigm from centralization to decentralization in essential had promoted change in the administration of government, development and public service in the course of good governance. In the globalization era, the public demand to government was for the government to implement the functions of the state properly (Curristine et al. 2007). This demand was normal and should be responded by the government by implementing significant and directed changes. In addition, the changes that were implemented by the government through planning, designing and realignment of organization and its management were positive in order to follow the progress of service paradigm into something that was currently highly expected by the public. Good governance could be achieved by administrating effective and efficient local government, implementing an evenly distributed regional development, and delivering quick, inexpensive, simple and high quality public services (Huther and Shah 2005, Adisasmita 2011, Nasution 2016).

Nowadays, the main problem faced by the government was the poor management, but not on what the government does, but on how the government did. The government failure in achieving public welfare was in its management (Winston 2006, Hepburn 2010, Keech and Munger 2015). It meant that the management factor plays a significant role in achieving the purpose of the state pursued by government in the aspect of social life. The fact was that people often complain about governance, one of which was the poor behaviors of the public apparatus for giving unsatisfactory services, such as the unfriendly attitude and throwing responsibility on each other. This condition had brought on the sarcasms about the poor behaviors of the public apparatus, such as: "*if you could slow it down, why would you speed it up?*", "*if you could make it difficult, why would you make it easy?*", and "*if you could make it*

expensive, why would you make it cheap?" (Siswadi 2012).

Through the spirit of reform that came along with decentralization, it was necessary to execute the management alignment of the government in comprehensive, basic and conceptual manners, and to rebuild governmental management to be more responsive towards public demands and aspirations as well as external changes. This was in line with the government's spirit in the current President Joko Widodo administration, which was expressed in Nawa Cita. One of the agendas in Nawa Cita was to build clean, effective, democratic and reliable governance (Hafidz 2017, Hernayanto and Dewi 2017). Besides, the shift of paradigm in the administration of the government to be more system-oriented had made the role of management significant for a cooperation system. Thus, in the administration of the local government, management played a role to deal with local issues through collaboration between the classical approach (which focuses on productivity, technology, work design and methods, and the blue print of local governmental management), and the social approach (which emphasizes the attainment of efficiency and harmony in the workplace environment).

Management, in practice, was inseparable from policy. The management of local government, as demanded by the change in laws, should also transform along with the demand of globalization (Passaris 2006, Raharjo 2011). Management of local government, in the perspective of decentralization, aimed to accelerate the decision-making process to be more efficient, it increased the responsiveness to public needs, it accelerated the quality improvement of public services, it reduced the political intervention, it encouraged innovations, and it increased the personnel diligence and motivation (Pitono 2014). Many local governmental organizations in Indonesia had been mixing up the main duties and functions implemented by the organizational elements. There were staff functions and auxiliary functions that carry out operational activities of citizen administrative services or licensing services, or other activities directly related to the public. On the other hand, the line function that was supposed to play an important role in the operational activities was often paid less attention, both in terms of given authority and facilities.

The district (*Kecamatan*), as an organizational unit in the local government, had a strategic position as being in the front line to directly deliver services to the public with different backgrounds, needs and ever-changing demands (Zuhriyati and Rahmawati 2014). The district was the eye of the government to see, face and deal with the problems in the community. It meant that the district serves the service mission entrusted for the line function, such as to directly perform operational activities (to do, to act) of public services (Wasistiono et al. 2002). District organization was viewed as representative of the state and of the agency of local government that was always needed by the members of the community in the region. The roles of the district and the district head (*Camat*) as guardian, public protector and public servant should always be present in the function of the district.

This condition encouraged us as researchers to carry out a study focused on three main points: 1) the management of district in East Flores Regency in terms of management of planning, management of public services and governmental leadership; 2) the problems that were faced in dealing with the management of district in terms of management of planning, management of public services and governmental leadership in East Flores Regency, East Nusa Tenggara Province; and 3) the management development of district in terms of management of planning, management of public services and governmental leadership in East Flores Regency, East Nusa Tenggara Province. This study was expected to discover a new development concept and model to be applied in the local government that could cover not only Indonesia, but also foreign countries.

Methodology

This study investigated the management development of local governmental administration at East Flores Regency East Nusa Tenggara province Indonesia. This study was proposed and designed to review and evaluate the local governmental administration to suggest several strategies of development for the succession and stability of the local government world-wide, especially in East Flores Regency, East Nusa Tenggara province, Indonesia. As a review, this study was based on the constructivist approach. The constructivist approach was a form of evaluation strategy based on basic assumptions that undergirded the constructivist paradigm. It had at least two phases on its application. The first phase was the discovery (represented the evaluator/researcher's efforts to describe what was going on the researched object). The second phase was the assimilation (represented by the evaluator/researcher's efforts to incorporate and to suggest new discoveries into the existing concept) (Iofciu et al. 2012, Sutton and Austin 2015).

To this evaluative research, the researcher of this study firstly highlighted and reviewed the condition of the management at the local governmental administration in East Flores Regency, East Nusa Tenggara province (the *discovery* phase), and he suggested a new model as development on management at the local governmental administration in East Flores Regency, East Nusa Tenggara province (the *assimilation* phase). Thereby, to execute these processes, this study had employed several respondents whom were categorized into several titles:

1. Regent of East Flores.
2. Chairman of Regional House of Representatives of East Flores Regency.
3. Assistant Regional Secretary for Government and Public Welfare of East Flores Regency.
4. Head of Regional Development Planning and Research and Development Agency of East Flores Regency.
5. Head of General Governmental Affairs Division of Regional Secretariat of East Flores Regency.
6. 5 representatives of district heads:
    a. Head of Larantuka district – an urban district which had 18 sub-districts and 2 villages.
    b. Head of Tanjung Bunga district – a district located at the eastern end of Flores island which had the largest area (257.57 km^2 or 14.21% of total area size of East Flores Regency), with 16 villages, and a general topography of waving landscape and hills with a slope of 0-80^o from the sea level, thus having a relatively far and difficult access to several villages.
    c. Head of East Adonara district – a district with the highest number of villages/ sub-districts (19 villages and 2 sub-districts), for which the access to the capital of the regency must be done by sea transportation.
    d. Head of West Adonara district – a district with 18 villages, for which the access to services in several villages was relatively far and difficult in the west monsoon season and the access to the capital of the regency must be done by sea transportation.
    e. Head of West Solor district – a district located in Solor island, with a topography of hills, thus having difficult access to several villages in the west monsoon season, and the access to the capital of the regency must be by sea transportation.

The conceptual operationalization as conceptual framework with the theme of local governmental strategies in improving the information technology-based integrated services and the subtheme of the five strategies concept for reinventing the government, as well as their definition, can be seen in the table of conceptual operationalization below (Table 1).

Table 1

Conceptual Operationalization

Concept	Aspect	Indicators
Management of District	1.Management of Planning	Management of Planning in the District
	2. Management of Public Services	Management of Public Services in the District
	3. Governmental Leadership	District Governmental Leadership
Problems faced in management	1. Management of Planning	Internal Factors
		External Factors
	2. Management of Public Services	Internal Factors
		External Factors
	3. Governmental Leadership	Internal Factors
		External Factors
Management Development of District in the Administration of Local Government (Selected Topics on the Management of Local Government, Wasistiono 2003)	1. Management of Planning (Williams 2001)	1.1. Setting goals
		1.2. Developing commitment to goals
		1.3. Developing an effective action plan
		1.4. Following the stages of goal achievement
		1.5. Maintaining flexibility of planning
	2. Management of Public Services (Ratminto and Winarsih 2008)	2.1. Service system emphasizing on public interests
		2.2. Service culture in the organization of the service provider
		2.3. Human Resources oriented on public interests
	3. Governmental Leadership (Wasistiono 2013)	3.1. Leader
		3.2. Situation and Condition
		3.3. Subordinate
		3.4. Organizational vision and missions

Source: Williams (2001), Wasistiono (2003), Ratminto et al. (2008), Simangunsong (2016)

Results

Since the enactment of Law No. 22 of 1999 on the Local Government (followed by the Law No. 32 of 2004 and the Law No. 23 of 2014), all sectorial technical duties were entrusted by the central government to the local government of the regency/city. This condition caused the district organization to lose its authority to manage public services as it was taken over by the sectorial administration of the regency/city government. The district only became an institution which gave a recommendation to people who wanted to process licensing and citizen administrative services. This eventually made the bureaucratic chain longer (Jabes 2005).

In addition, the amendment of the Law on Local Government had brought the effect that all

budgets for sectorial development were now under the authority of the regency government and implemented by the regional technical agencies and offices. The district's authority to plan and to implement the development in the district region was revoked. This condition described that the district organization was currently like "*a toothless tiger*", whose presence was felt, but unable to do anything for the community (Kolopaking 2010). The dysfunction of the district was caused by the absence of the authority to independently plan and manage the implementation of governmental activities and services in their own region.

In relation with the change of the main function of the local government from promoter of development to public service provider, the district should be and it was reasonably functioning as center for public services (*Pusat Pelayanan Masyarakat* – PUSYANMAS, Wasistiono et al. 2009). Moreover, the district was actually a medium for the formulation of alternative programs/ activities of development and empowerment as its position was close to the community and the villages/sub-districts.

The Law No. 23 of 2014 had confirmed that the purpose for the formation of the district in the regency/city was to increase the coordination of the administration of the government, the implementation of public services and community development in villages/sub-districts. This regulation implied that the district had a strategic position and it played a functional role in the governmental, development and social administration and services. The district was expected to be a local agency that could deliver public services with clear and transparent procedures, costs and delivery time. Therefore, the development of a district institutional model should be directed to follow the development trend of organizational and public administration theories (Motta and Schmitt 2013). District institutional development included aspects as follow: *first*, organizational structure; *second*, personnel; *third,* work mechanism; and *fourth,* performance measurement (Wasistiono et al. 2010). To ensure the implementation of district head's duties, the regent/mayor needed to delegate some of the administrative authorities to the district head as mandated by the Law on Local Government. The delegation of the authority was not only to provide legalization to the district head, but also to increase the effectiveness and efficiency in providing public services and using public funds and facilities. The effectiveness and efficiency of public services required good governance and management (Kefela 2011), which began with public service-oriented planning and it was supported by visionary leadership.

The consequence of the delegation of authority was that there would be different workloads between the districts which in turn resulted in a typology of districts: type A – a district with heavy workload, and type B – a district with a light workload. The difference of type from the workload had affected the allocation of resources, such as personnel, finance and facilities and infrastructures. The implementation of position, duties and authorities of the district head in Indonesia was varied between regions (Blomkamp et al. 2017). Some local authorities still position the district head in an unclear situation. Most local authorities did not show a positive political will in the delegation of some of the authorities from regent to district head, and that district institution became susceptible to dysfunction as there was no clear duty to be entrusted by the regent/mayor. The district head was demanded to play a role like in the past, as the person in charge of a particular jurisdiction, but without a clear authority and source of finance. In other words, there was an imbalance between the district head's responsibility and the district head's authority and financing. As the implementation of Law No. 23 of 2014 on Local Government and Government Regulation No. 18 of 2016 on Local Bureaucracies, the East Flores Regency Government had issued the Regional Regulation of East Flores Regency No. 11 of 2016 on the Formation and Structure of Local Bureaucracies of East Flores Regency and the Regulation of East Flores Regent No. 98 of 2016 on the Position, Organizational Structure, Duties and Functions, and the Work Procedures of the District. Despite the fact that there was a difference in characteristics between districts (area size, number of villages/sub-districts, distance to the capital of the regency and geographical difficulty), both legal products were, in

fact, uniform in typology (type A), organizational structure, duties and functions, and work procedures of the district.

East Flores Regency was one of the regencies in the administrative region of East Nusa Tenggara Province. It was an island regency with an area of 5,983.37 km^2, consisting of 1,812.85 km^2 of land area and of 4,170.53 km^2 of sea area. Administratively, East Flores Regency consists of 19 districts, 229 villages and 21 sub-districts, and it consists of 251,611 inhabitants. The civil servant of East Flores Regency consists of 361 people. The distribution of the districts, the villages/sub-districts, was presented in the table below (Table 2).

Table 2

Data of Area Size and the Distribution of Villages and Sub-districts in the Districts of the Administrative Region of East Flores Regency

Island	District	Distance to the Capital of the Regency (in km)	Village	Sub-district	Area size (km^2)	Area size (in %)
	1. Wulanggitang	60.15	11	-	225.85	12.46
	2. Titehena	50.18	14	-	154.84	8.54
	3. Tanjung Bunga	28.24	16	-	257.57	14.21
	4. Ile Mandiri	11.40	8	-	72.76	4.01
	5. Larantuka	3.37	2	18	48.91	2.70
	6. Demon Pagong	26.12	7	-	85.40	4.71
	7. Ile Bura	66.45	7	-	118.32	6.53
	8. Lewolema	12.74	7	-	92.84	5.12
East Flores Land				**18**	**1,056.49**	**58.28**
	9. West Solor	61.41	14	1	128.20	7.08
	10. East Solor	72.24	17	-	66.56	3.68
	11. South Solor	35.43	7	-	31.58	1.74
Solor				**1**	**226.34**	**12.50**
	12. West Adonara	18.15	18	-	79.71	4.40
	13. Wotan Ulumado	18.14	12	-	86.31	4.76
	14. East Adonara	40.86	19	2	91.06	5.02
	15. Ile Boleng	55.14	21	-	49.30	2.72
	16 Witihama	64.82	16	-	79.43	4.38
	17. Kelubagolit	45.11	12	-	44.41	2.45
	18. Central Adonara	38.33	13	-	42.73	2.36
	19. Adonara	35.21	8	-	56.80	3.13
Adonara			**119**	**2**	**529.75**	**29.22**
East Flores Regency			**229**	**21**	**1,812.85**	**100**

Source: IDR JMD of East Flores Regency, 2017-2022 (processed by the Researchers)

The table above showed the geographical condition of East Flores Regency with the distribution of districts and villages/sub-districts in 3 (three) large islands (eastern Flores land,

Adonara and Solor). Tanjung Bunga was the district with the largest area, such as 257.57 km^2, while the districts with the highest number of villages were East Adonara (19 villages and 2 sub -districts) and Ile Boleng (21 villages). It was also known from the table that most of the districts were located relatively far (low reachability) from the capital of the regency, resulting in difficult and costly transportation for the access to and from the capital of the regency.

With the topography described above, the presence of the district was highly required by the community. The district with good governance was considered as the agency of local government of East Flores Regency for the role of guardian, public protector and public servant. However, the reality was far from expectation. Districts in East Flores Regency could not do much for the community. The districts had not been delegated with authority to plan and to manage the administrative activities, the public empowerment and service appropriately. One of the management aspects that was frequently complained by the community was the public service management in the district. Public services delivered by the district were far from satisfying the public expectations for quick, inexpensive, simple and good services.

There had been many members of the community complaining of the management of the public services, such as in processing citizenship documents (identity card or *KTP*) with a long procedure from the bottom level (*RT/RW*), village/sub-district and district, to the Population Affairs and Civil Registration Agency of East Flores Regency. This kind of process was time, cost and effort consuming for the community. The far location caused many members of the community to use the service of illegal intermediaries (*Calo*) to process any document, resulting in the increase of costs and, in many cases, time delivery. In addition, there were also other problems, such as the unfriendly attitude of the apparatus in delivering services, and the identity card printing that could take one to two weeks. To respond to the aforementioned problems in public services, the East Flores Regency Government actually had issued the Regulation of East Flores Regent No. 3 of 2008 on the Delegation of Some of the Authorities in Governmental Affairs from Regent to District Head. One of the delegated authorities was the implementation of citizen administrative service activities. Moreover, in 2016, the East Flores Regency Government had also issued the Regulation of East Flores Regent No. 64.1 of 2016 on the Implementation of District Integrated Administrative Service (*Pelayanan Administrasi TeIDR adu Kecamatan – PATEN*) in East Flores Regency. However, both legal products were still unable to be implemented at the practice level. This was because there were no regulation/ technical guidelines for the delegation of authority and the implementation of PATEN in East Flores Regency, and due to the lack of support, personnel and logistics for the district.

In 2017, the total expenditure in the Regional Budget of East Flores Regency was of 74,935,809.22 USD, and the amount allocated for the 19 districts was of 3,584,971.16 USD (or 5% of the total allocated expenditure in the Regional Budget of 2017). Besides, the budget allocation for the district in the budget year of 2018 can be seen in the table below (Table 3).

From the table above, the total allocated expenditure in the Regional Budget of East Flores Regency in 2018 was 79,107,331.89 USD, with an Indirect Expenditure of 45,743,271.18 USD (57.8%) and an Indirect Expenditure of 33,365,485.95 USD (42.2%). Of the total expenditure, the total budget allocated for the 19 districts in East Flores Regency in 2018 decreased from the previous year, such as 2,737,890.36 USD (3.46% of the total expenditure in the Regional Budget) with an Indirect Expenditure of 2,056,750.51 USD (4.50% of the total Indirect Expenditure) and a Direct Expenditure of 681,256.81 USD (2.04% of the total Direct Expenditure). This budget allocation was relatively small and uniform without considering the workload according to area size, topography, and number of villages/sub-districts with a difficult topography. This had impact on the less optimal implementation of the duties and functions of the district.

Table 3

Budget Allocation for the Districts in East Flores Regency (Budget Year 2018)

No	District	Indirect Expenditure		Direct Expenditure		Amount	
		IDR in USD	%	IDR in USD	%	IDR in USD	%
1	Wulanggitang	107,444.00 USD	0.23	24,644.78 USD	0.07	131,951.64 USD	0.17
2	Titehena	89,667.58 USD	0.20	20,323.73 USD	0.06	109,877.10 USD	0.14
3	Ile Bura	52,641.21 USD	0.11	25,634.92 USD	0.08	78,227.68 USD	0.10
4	Tanjung Bunga	68,765.62 USD	0.15	24,066.49 USD	0.07	92,772.71 USD	0.12
5	Lewolema	68,629.70 USD	0.15	23,269.02 USD	0.07	91,793.30 USD	0.12
6	Larantuka	583,132.02 USD	1.27	210,370.75 USD	0.63	792,502.19 USD	1.00
7	Ile Mandiri	68,841.00 USD	0.15	21,291.19 USD	0.06	90,015.83 USD	0.11
8	Demon Pagong	58,378.40 USD	0.13	21,027.67 USD	0.06	79,305.91 USD	0.10
9	West Solor	73,746.06 USD	0.16	31,389.89 USD	0.09	105,135.95 USD	0.13
10	South Solor	60,910.52 USD	0.13	25,517.27 USD	0.08	86,437.23 USD	0.11
11	East Solor	81,733.38 USD	0.18	21,438.08 USD	0.06	103,183.31 USD	0.13
12	West Adonara	99,506.05 USD	0.22	20,794.38 USD	0.06	120,282.12 USD	0.15
13	Wotan Ulumado	70,888.75 USD	0.15	20,225.87 USD	0.06	91,103.08 USD	0.12
14	Central Adonara	87,907.34 USD	0.19	24,507.51 USD	0.07	112,400.38 USD	0.14
15	East Adonara	150,321.94 USD	0.33	63,546.95 USD	0.19	213,850.15 USD	0.27
16	Ile Boleng	102,703.90 USD	0.22	21,009.77 USD	0.06	123,693.31 USD	0.16
17	Witihama	69,516.58 USD	0.15	31,381.93 USD	0.09	100,888.39 USD	0.13
18	Kelubagolit	94,441.10 USD	0.21	26,475.65 USD	0.08	120,899.55 USD	0.15
19	Adonara	68,787.70 USD	0.15	24,266.34 USD	0.07	93,042.57 USD	0.14
Amount		2,055,974.45 USD	4.50	681,043.40 USD	2.04	2,737,344.56 USD	3.46
Total Regional Budget		**45,727,964.48** USD	**57.8**	**33,355,034.22** USD	**42.2**	**79,091,561.91** USD	**100**

Source: Regional Budget of East Flores Regency, Budget Year 2018 (processed by the Researchers)

The Indirect Expenditure for the district was used for salary and allowances for all the district personnel in several district regions. The amount of the allocated budget in Direct Expenditure as in the table above had influence on the implementation of the main duties and functions of

the district. The districts in East Flores Regency received the number of funds that was sufficient only for the routine activities. This was not in line with the mandate of the Law No. 23 of 2014, that as a local bureaucracy, the district must make a strategic plan to support the accomplishment of the goals of the regency/city as stated in the *IDR JMD*. Therefore, the district should be and it was reasonably granted with sufficient funds to enable it to make the planning for the administrative, service and spatial development activities in its region (Kolopaking 2010).

In terms of human resources, the placement of civil servants in the district seemed disordered and poorly implemented, as seen in the table below (Table 4).
From the table above, the number of Civil Servants (*PNS*) placed in each district was not distributed proportionally according to the area size and the workload of each district. For example, in Ile Mandiri, with an area of 72.76 km^2 and 8 villages in its territory, the number of the district personnel was greater (21 civil servants) than in West Solor, with an area of 128 km^2 and 14 villages and 1 sub-district in its territory, which only had 16 civil servants. In terms of educational level, the placement of civil servants had not been fully supportive for the district organization, which would bring an impact on the performance of the district organization. These problems could still be found in every annual report of the district.

Table 4

Number of Civil Servants of Districts in East Flores Regency, by Education Level

No	District	Educational Level						Number
		SD	Junior High School	Senior High School	Diploma	Bachelor	Master	
1	Wulanggitang	2	2	15	2	4	-	25
2	Titehena	2	2	10	2	3	-	19
3	Ile Bura	-	1	9	1	4	-	15
4	Tanjung Bunga	-	1	11	-	4	-	16
5	Lewolema	1	1	7	-	4	1	14
6	Larantuka	-	-	14	-	4	-	18
7	Ile Mandiri	-	-	15	1	5	-	21
8	Demon Pagong	1	1	8	1	5	1	17
9	West Solor	-	-	11	2	3	-	16
10	South Solor	-	-	7	1	3	-	11
11	East Solor	-	1	15	3	4	1	24
12	West Adonara	4	9	8	4	1	1	27
13	Wotan Ulumado	-	3	11	-	5	-	19
14	Central Adonara	-	3	12	4	3	-	22
15	East Adonara	1	2	19	1	5	-	28
16	Ile Boleng	-	3	18	-	6	-	27
17	Witihama	-	2	12	-	6	-	20
18	Kelubagolit	-	-	18	3	5	-	26
19	Adonara	-	-	8	1	6	1	16
TOTAL		**11**	**31**	**228**	**26**	**80**	**5**	**381**

Source: Report of the Administration of East Flores Regency Government, 2017 (processed by the Researchers)

The internal problems of the district government were: limited or lacking number of personnel, poor personnel discipline, apparatus' lack of understanding on the job description as implemented in the program description that was supposed to facilitate the service duties in the

district office, and limited knowledge in making the Standard Operating Procedure (SOP) as guidelines for delivering service in the district office (Erawan 1999, Makaduro 2014, Syarifudin 2014, Anggraeni 2016). Moreover, the supporting facilities for the operational activities of the office and public service were still inadequate.

From the explanation above, there were incompatibilities between the main duties, functions and responsibilities of the district and the amount of funds allocated and the number of human resources placed in each district. In other words, the district was required for the implementation of its duties and it was accountable for its performance without sufficient support of inputs such as regulation, facilities and infrastructures, budget and other resources. This described the district's weak position in the administration of the local government in East Flores Regency, resulting in the poor implementation of its functions as provider of public services (Nursalam 2010, Mahsyar 2011). In this regard, the organizational and management development of the district was considered as an important agenda in the administration of the local government, especially in East Flores Regency.

Discussion

The law No. 23 of 2014 on the Local Government and the Regional Regulation No. 17 of 2018 on District suggested that the regency/city formed the district to increase the coordination of the administration of the government and the implementation of public services and public empowerment. In addition to the general administrative affairs, the district head was also delegated by the regent/mayor to implement some of the administrative affairs under the authority of the regency/city. The law and the regulation above have become the main bases on the importance of management development of district in East Flores Regency, East Nusa Tenggara Province, to achieve optimal public services. Singh (2011) states in-line that a mutual linkage is needed to establish a mutual relationship between the community and the government to achieve the governmental projects.

The management development above could be implemented on management of planning, management of public services and governmental leadership. All three aspects were considered as significant in district governance, because the management of planning was an important aspect in order to achieve the purpose of district organization, and to achieve optimal public services, visionary governmental leadership was needed (Chumaidi 2012, Rusniati and Haq 2014).

The implementation and development of organizational management in public sectors for achieving optimal public services, in general, faces many problems, both internal and external. Therefore, the concept of effective and efficient management development was necessary. To explain the relationship between these aspects, see the figure of the theoretical framework below (Fig. 1).

Based on the results of the study on the management development of districts in the administration of local government in East Flores regency, it could be explained that:

1. Management of district in East Flores Regency is evidenced in terms of management of planning, management of public services and governmental leadership.
    a. Management of planning in the district in East Flores Regency has not been optimal yet. The district, with its strategic position in delivering public services, was not properly employed by the local government by giving it clear functions and a role in planning the administration of the government, and the implementation of development and public services.
    b. Management of public services in the district in East Flores Regency has not been optimal, effective and efficient yet. Services were still centered on the regency, and

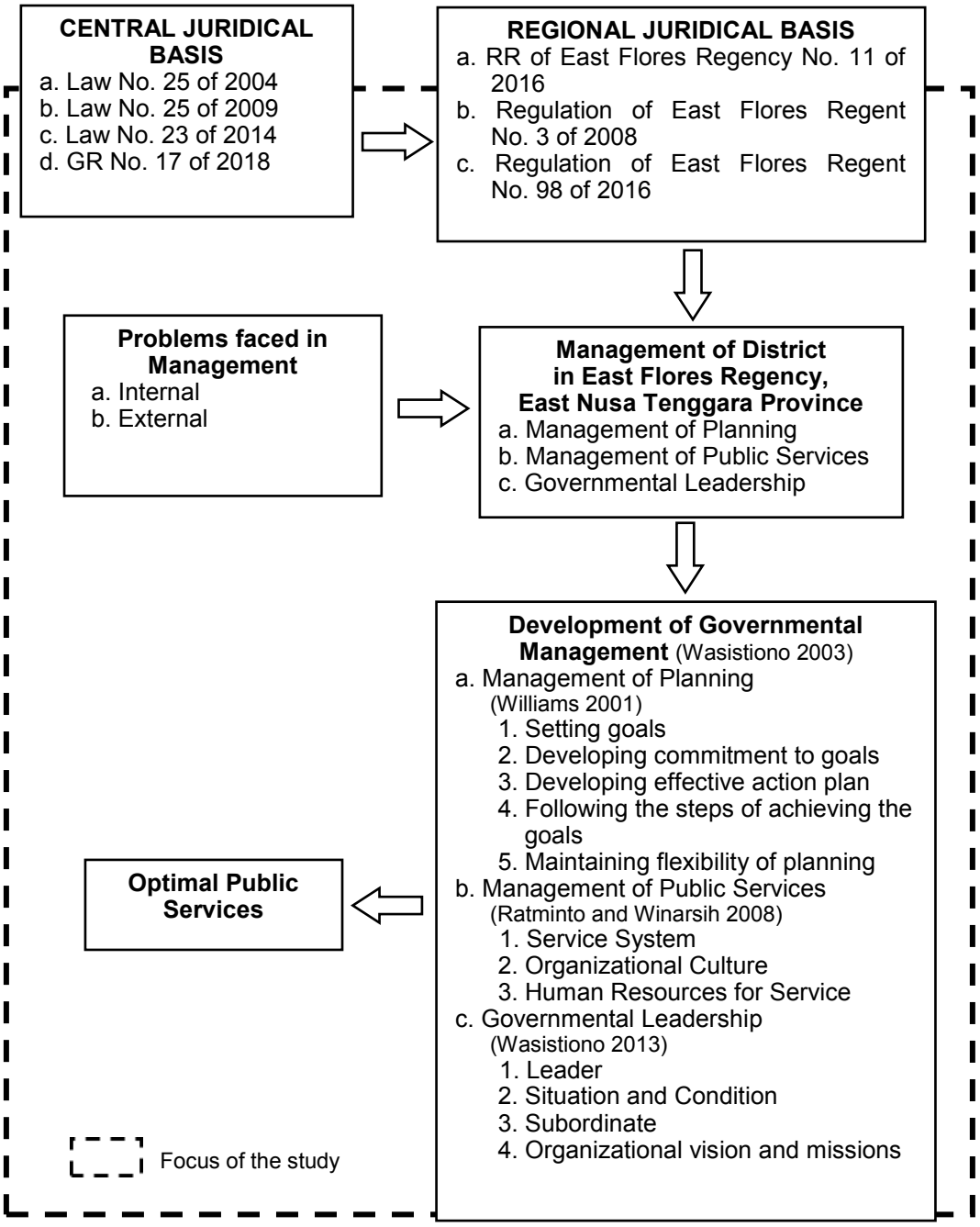

Fig. 1 **– Theoretical Framework: Management Development of District in the Administration of Local Government in East Flores Regency, East Nusa Tenggara Province**

there was no proper Standard Operating Procedure for most of the services (making reference and recommendation letters) in the district. The position, functions and roles of the district were very limited in delivering optimal public services. This condition resulted in high costs and difficulty for the community to access public services, especially for the community who settles and lives in rural areas at East Flores Regency. The centered public administration should also take concern on how the community can access public services located in the centered public administration. By giving any accommodation (like transportation) would be sufficiently a good thing to help them.

c. Governmental leadership in the district in East Flores Regency, in terms of services, had been properly implemented. Despite of the limitations, the district head tended to use an open and non-formal leadership style in meeting public needs. However, for the implementation of administrative duties, governmental leadership in the district has not been optimal due to a lack of understanding on the governmental management resulting in using an incompatible leadership style.

2. Problems faced in dealing with the management of district in terms of management of planning, management of public services and governmental leadership in East Flores Regency, East Nusa Tenggara Province.

a. Problems faced in the management of planning in the district in East Flores Regency.

1) Among the internal problems, there were:

(a) Limited human resources.
(b) Low level of human resources, resulting in a slow work method.
(c) Limited facilities and infrastructures.
(d) The budgets allocated to all districts were relatively the same and small in amount.

2) Among the external problems, there were:

(a) Lack of political will from the top leader to delegate some of the authorities from the regent to the district head, causing the district unable to make a development plan according to public needs and potentials.
(b) The presence of political interests (technocratic planning in clash with political planning).
(c) Lack of coordination between sectors/local bureaucracies, resulting in a lack of information on the development planning received by the districts.
(d) High sectorial egoism of local bureaucracies for not wanting to hand over their affairs/programs/activities to the districts.
(e) Low understanding of the public on the importance of planning, resulting in a low public participation in the district development planning forum (*MUSRENBANG*).

b. Problems faced in the management of public services in the district in East Flores Regency.

(1) Among the internal problems, there were:

(a) Limited number of personnel placed in the districts, with the level of human resources being incompatible with the requirement.
(b) Low mentality and work passion of the personnel.
(c) Limited budget allocated to the district.
(d) Limited supporting facilities and infrastructures for public service activities.
(e) Absence of clear SOP in regard to the service provided.

2) Among the external problems, there were:

(a) The delegation of some of authorities from the regent to the district has not been properly implemented.
(b) Difficult topography with damaged roads, resulting in difficult access from and to villages.

(c) Limited information and communication network in the districts.

c. Problems faced in governmental leadership in the district in East Flores Regency.

(1) Among the internal problems, there were:

(a) Lack of administrative technical knowledge, resulting in the less optimal implementation of governmental management in the district.

(b) Absence of guardianship character in the leadership style.

(c) Incompatible health and mental condition of the district head with the given workload.

(d) Inadequate supporting personnel for the district head, both in quantity and quality.

(e) Limited budget and supporting facilities and infrastructures.

(2) Among the external problems, there were:

(a) Low public participation/support in all administrative activities.

(b) Difficult territorial characteristics and inadequate supporting infrastructures.

(c) Lack of commitment of the local government to support the districts; for example, authorities that had not been delegated, placement of district head that was not according to the regulation and requirement due to political interests, and perception of district as a dump for civil servants.

3. Management development of the district in terms of management of planning, management of public services and governmental leadership in East Flores Regency, East Nusa Tenggara Province.

a. The development of management of planning in the district in East Flores Regency was carried out by considering things as follows:

1) Setting goals.

Delegating authorities to the district in order to set its own specific, realistic, reasonable, measurable, and timely goals, according to its own potentials.

2) Developing commitment to goals.

Requiring support from the regency government to develop commitment to district goals organizationally by placing personnel with capabilities as required and to distribute the resources (budget and facilities) as required. The support for the district personnel could take the form of encouragement/motivation, the implementation of reward and punishment, and the improvement of human resources.

3) Developing an effective action plan.

Carried out by making activity plans, including stages of goal achievement, requirement of resources, and scheduling of activities.

4) Following the stages of goal achievement.

Carried out by making the annual work plan (RENJA) as the elaboration of the strategic plan (RENSTRA) of the district which includes programs/ activities, performance indicators, the funding requirements, and the performance target. In addition, carrying out a working visit to the districts and meetings (work meetings and coordination meetings) are considered.

5) Maintaining flexibility of planning.

Carried out by making an alternative plan based on social dynamics, strengthening of regulation, district head's improvisation and courage in facing risks.

b. Development of management of public services in the district in East Flores Regency was carried out by placing the community as a top priority supported with:

1) Service System.

Carried out by bringing services closer to the community through delegating

some of the authorities from the regent to the district head, integrating the development of information technology to the management of public services, implementing *PATEN*, making SOP for every service provided by the district and by implementing a voice mechanism, as well as strengthening the regulations.

2) Organizational/Service Culture.
Carried out by developing the culture of services oriented to public interests by applying principles such as: "*to serve instead of being served*", "*make it easy instead of difficult*", "*be simple instead of complicated*", "*be inclusive instead of exclusive*", "*community are customers, not applicants*", and by applying the *Lamaholot* culture.

3) Human Resources for the Service.
Carried by placing the appropriate human resources to the districts, and by developing human resources oriented to public services.

c. Development of governmental leadership in the district in East Flores Regency was carried out by considering variables as follows:

1) Leader.
The district head should be a leader of character with capability of managing, guiding, directing and motivating, who is open to input and who has a sense of service as well as initiative to make something new in achieving the purposes of the district.

2) Situation and Condition.
District head's leadership style that can understand the situation and condition of the district, and that can adapt to the dynamics of the environment.

3) Subordinate.
The district head should be able to understand the characteristics of the subordinates, to develop good communication and to apply a leadership style that could embrace and direct the subordinates to the goals set.

4) Organizational vision and missions.
The district head should have a personal vision in implementing a leadership style with orientation to the vision and missions of the district.

Conclusions

This study did not only give a theoretical development of district administration at local government level in East Flores Regency, but it also gave a considerable evaluation for the better improvement of public services and public administration centered in East Flores Regency. Therefore, from an overall explanation, the main findings related to the three topics arisen in this study were:

1) The problems that were faced in the management of planning were: a) internal problems that included the limited human resources, low quality of human resources, limited facilities and budget, and b) external problems that include the lack of political will, the influence of political interest, lack of coordination, high sectorial ego and low level of public understanding.
2) The problems faced in the management of public services were: a) internal problems that included the limited number of civil servants, absence of SOP, limited budget and facilities and infrastructures, and b) external problems that include the non-delegation of authority, difficult topography, and limited communication network.
3) The problems faced in governmental leadership were: a) internal problems that involved low administrative technical knowledge, incompatible leadership style, limited amount of budget, limited number of personnel, facilities and infrastructures,

and b) external problems that include a low public participation, difficult conditions due to territorial characteristics, and the lack of commitment from the government.

This study was expected to give overcoming solutions for the improvement of public administration and public services at East Flores Regency. The researchers in this study believe that all data and results within this study have been empirically approved by the evidence in the field. Therefore, based on the research of this study, there are several recommendations as idea contribution for the East Flores Regency Government to formulate and to make policies related with the management development of the district in the administration of the Local Government in East Flores Regency.

1. Management of district in East Flores Regency in terms of management of planning, management of public services and governmental leadership.
   a. Management of planning in the district.
      In this case, the local government should realign the management of planning in the district by delegating authorities to the district to bridge between regency plans and public needs.
   b. Management of public services in the district.
      For this matter, the local government should optimize the strategic position, functions and roles of the district as agency of the regency by delegating some of the authorities from the regent to the district head on the public services along with a good SOP.
   c. Governmental leadership in the district.
      In this section, the local government should consider the requirement for hiring a civil servant on the district head position, and developing a leadership style of service.
2. Problems faced in the management of district in East Flores Regency.
   a. Problems faced in the management of planning in the district:
      1) Internal Problems:
         (a) By increasing the number of district personnel.
         (b) By improving the human resources of the district personnel.
         (c) By improving the supporting facilities and infrastructures.
         (d) By increasing the budget allocation for the districts.
      2) External Problems:
         (a) By building the political will of the top leader of East Flores Regency Government.
         (b) By avoiding political interests.
         (c) By improving coordination between sectors/local bureaucracies.
         (d) By synchronizing the perception on the delegation of authorities from the regent to the district head.
         (e) By increasing the public understanding on the importance of management of planning in the district.
   b. Problems faced in the management of public services in the district:
      1) Internal Problems:
         (a) By increasing the number of civil servants in the district and by improving the human resources.
         (b) By improving the work passion of the district personnel.
         (c) By increasing the amount of the budget (direct expenditure) allocated to districts.
         (d) By improving the supporting facilities and infrastructures for public service activities.
         (e) By making and promoting SOP for every service provided.
      2) External Problems:
         (a) By building the political will of the regent to implement the delegation of authorities from the regent to the district head on public services.

(b) By improving infrastructures (road) for access to and from villages.
(c) By improving the information and communication network in the districts.

c. Problems faced in the governmental leadership of the district:
1) Internal Problems:
(a) By increasing the capacity of the district head in governmental management through regulation.
(b) By developing the district head's leadership style of guidance.
(c) By considering the health aspect of the civil servant whom was positioned as district head according to the conditions and workload of the district.
(d) By supporting the leadership of the district head by placing the adequate and competent human resources as district personnel.
(e) By supporting the leadership of the district head by strengthening the supporting facilities and budget.
2) External Problems:
(a) By making efforts to influence and motivate the community to support the leadership of the district head.
(b) By making efforts to improve infrastructures (road) to facilitate the district head in implementing the leadership function in the district.
(c) By building the commitment of the regency government to support the district organization by making the authorities of the district clear, by placing the district head according to regulation and requirement, by placing civil servants with good competences according to the requirements in the districts.

3) Management development of districts in terms of management of planning, management of public services and governmental leadership in East Flores Regency, East Nusa Tenggara Province.
a. Developing the management of planning in the district deals with five key points:
1) Setting goals.
The local government delegates the authorities to the district in order to set its own specific, realistic, reasonable, measurable, and timely goals according to its own potentials.
2) Developing commitment to goals.
The local government, through a support from the regency government, requires developing the commitment of the district to achieve the goals through strengthening the required resources and by motivating the district personnel to develop their competences.
3) Developing an effective action plan.
The local government establishes the program plans following the goal setting, along with the steps of achieving the goals, the requirements of resources and the time schedule.
4) Following the stages of achieving the goals.
The local government increases the quality of planning in the district (work plan and strategic plan), and the intensity of the working visits and the intensity of work and coordination meetings.
5) Maintaining flexibility of planning.
The local government strengthens and properly understands the regulation and the district head's capability in making alternative plans based on the social dynamics.

b. Developing the management of public services in the district deals with three key points:
1) Service System.
The local government makes the district as a center for public services with

the principle of being close to the customer by delegating some of authorities from the regent to the district head, by implementing *PATEN*, making proper SOP, and applying a voice mechanism supported with adequate regulation.

2) Organizational/Service Culture.
   The local government builds the organization culture of services oriented to public interests and local wisdom, and it applies the *Lamaholot* culture in the management of public services in the district.
3) Human Resources for the Service.
   The local government develops the good management of the personnel by regulation.

c. Developing governmental leadership in the district deals with four key points:
   1) Leader.
      Increasing the district head's capacity of leadership.
   2) Situation and Condition.
      Requiring the district head to understand the situation and condition of the district with a compatible leadership style.
   3) Subordinate.
      Increasing the district head's capability in understanding the characteristics of the personnel and the public, and developing the district head's communication ability to direct all elements of the district to achieve the goals set.
   4) Organizational vision and missions.
      Developing the district head's visionary leadership in implementing the function of the leadership with orientation to the organizational vision and missions of the district.

References

ANGGRAENI M. R. R. S. (2016), *The role of Regional Agency of Business Management (BUMDES) on rural society's welfare: A study on Regional Agency of Business Management (BUMDES) at Gunung Kidul Yogyakarta*, MODUS 28 (2), 155-167.

BLOMKAMP E., SHOLIKIN M. N., NURSYAMSI F., LEWIS J. M., TOUMBOUROU T. (2017), *Understanding Policymaking in Indonesia: In Search of a Policy Cycle*, The Policy Lab (University of Melbourne), The Indonesian Centre for Law and Policy Studies (PSHK), Retrieved from: www.pshk.or.id.

CHUMAIDI M. (2012), *Optimizing the role of organization management in the management of high school*, Jurnal Sains dan Teknologi 5 (1), 55-63.

CURRISTINE T., LONTI Z., JOUMARD I. (2007), *Improving public sector efficiency: challenges and opportunities*, OECD Journal on Budgeting 7 (1), 1-41.

ERAWAN I. K. P. (1999), *Political reform and regional politics in Indonesia*, Asian Survey 39 (4), 588-612.

HAFIDZ J. (2017), *Nawacita and the law enforcement of civil state apparatus in constitutional law perspectives in Indonesia*, Jurnal Pembaharuan Hukum 4 (2), 201-213.

HEPBURN C. (2010), *Environmental policy, government, and the market*, Oxford Review of Economic Policy 26 (2), 117-136.

HERNAYANTO Y., DEWI S. H. (2017), *Good corporate governance for private multi-national company to comply with global anti-bribery regulation (UK Bribery Act & FCPA) and Indonesia company law*, Advances in Social Science, Education and Humanities Research 131, 300-305.

HUTHER J., SHAH A. (2005), *Applying a Simple Measure of Good Governance to the Debate on Fiscal Decentralization*, The World Bank, Retrieved from: documents.worldbank.org.

IOFCIU F., MIRON C., ANTOHE S. (2012), *Constructivist approach of evaluation strategies in science education*, Procedia - Social and Behavioral Sciences 31, 292-296.

JABES J. (2005), *The Role of Public Administration in Alleviating Poverty and Improving Governance*, Asian Development Bank, Kuala Lumpur.

KEFELA G. T. (2011), *Good governance enhance the efficiency and effectiveness public sending –Sub Saharan countries*, African Journal of Business Management 5 (11), 3995-3999.

KEECH W. R., MUNGER M. C. (2015), *The anatomy of government failure*, Public Choice 164, 1-42.

KOLOPAKING L. M. (2010), *District for public welfare*, PSP3-IPB, Bogor.

MAHSYAR A. (2011), *The problem of public service in Indonesia in the perspective of public administration*, Otoritas 1 (2), 81-90.

MAKADURO M. (2014), *The application of discipline in improving district governmental apparatus working profession: A study on district governmental office at Mapangel Manado*, Jurnal Politico 1 (4), 1-13.

MOTTA P. R., SCHMITT V. G. H. (2013), *Administration for development: the idea and the renewal*, Cadernos Ebape.Br 11 (2), 197-206.

NURSALAM (2010), *The implementation of policy on the improvement of local basic food production and local food tenacity at Nusa Tenggara Timur province*, Jurnal Administrasi Publik 1 (1), 66-77.

PASSARIS C. E. (2006), *The business of globalization and the globalization of business*, Journal of Comparative International Management 9 (1), 3-18.

NASUTION A. (2016), *Government Decentralization in Indonesia*, Asian Development Bank Institute, Retrieved from: www.adb.org.

PITONO A. (2014), *Management of local government*, IPDN Press, Jatinangor.

RAHARJO A. (2011), *Management of local government*, Graha Ilmu, Yogyakarta.

RATMINTO, SEPTI W. A. (2008), *Service management: development of conceptual model, application of citizen's charter and minimum service*, Pustaka Pelajar, Yogyakarta.

RUSNIATI, HAQ A. (2014), *The strategic plannings in the perspective of organization*, Jurnal Intekna 14 (2), 1-8.

SIMANGUNSONG F. (2016), *Public administration research methodology*, Alfabeta, Bandung.

SINGH P. (2011), *Capacity development of local governance institutions in South Asia*, Capacity Development of Local Governance Institutions in South Asia, PRIA Global Partnership, New Delhi.

SISWADI E. (2012), *Future bureaucracy: towards effective and excellent governance*, Mutiara Press, Bandung.

SUTTON J., AUSTIN Z. (2015), *Qualitative research: data collection, analysis, and management*, CJHP 68 (3), 226-231.

SYARIFUDIN A. (2014), *The influence of human resource competence and process of internal audit towards the quality of local government finance report by intervening as system of internal government control*, Jurnal Fokus Bisnis 14 (2), 26-44.

WASISTIONO S. (2003), *Selected topics on management of local government (revised ed.),* Fokus Media, Bandung.

WASISTIONO S. (2010), *Model of district institutional development for optimization of public services*, Seminar Proceeding at PKP2A I LAN RI.

WASISTIONO S. (2013), *Kapita Selekta Manajemen Pemerintahan*, Alqaprint Jatinangor, Sumedang.

WASISTIONO S., NURDIN I., FAHRUROZI M. (2009), *Development of district organization from then to now*, Fokusmedia, Bandung.

WASISTIONO S., RIYANI O., YOUSA A., PITONO A. (2002), *Institutional Realignment of District Government*, Pusat Kajian Pemerintahan STPDN, Jatinangor.

WILLIAMS C. (2001), *Management: Book I*, CRC Press, Boca Raton.

WINSTON C. (2006), *Government Failure versus Market Failure: Microeconomics Policy Research and Government Performace*, AEI-Brookings Joint Center for Regulatory Studies, Washington D.C.

ZUHRIYATI E., RAHMAWATI D. E. (2014), *Transformational leadership in the city of Yogyakarta during Herry Zudianto's era*, Journal of Government and Politics 5 (2), 139-151.

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QUALITY OF LIVING ASSESSMENT IN RURAL ROMANIA. AN ANALYSIS OF SETTLEMENTS WITH LOW ACCESSIBILITY TO MEDICAL SERVICES

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Abstract: Several factors contribute to the lower quality of living of post-communist countries like Romania, such as housing quality, access to basic infrastructure or services including healthcare, and low income and education levels. To evaluate to what extent the quality of living is related to social and economic factors, including access to medical services, a field questionnaire was applied to 703 respondents from 8 settlements located in the South-East of Romania. Using the Principal Component Analysis, four determinants were selected to compute a Quality of Living Index (QoLI): sewage, room surface per dweller, dwelling accessibility and fuel use for cooking. The QoLI computed for each respondent varied between 29.7 and 94.8 with a mean value of 58.5. It was directly related to the level of education and income and with several healthcare parameters. The mean value for each Local Administrative Unit was used to establish a ranking, with the commune of Mihail Kogălniceanu (Constanța county) having the highest average QoLI, and the commune of Brăești (Buzău county) having the lowest average QoLI. The QoLI of investigated settlements was in line with the results reported by other studies that assessed the socio-economic development of towns and it can be used as a tool to establish the level of living conditions and to prioritize the need of intervention.

Key Words: *quality of living, rural settlements, composite indicator, public healthcare, education and income*.

Introduction

Quality of life is considered to be one of the most difficult to define concepts of the post-modern society (Mărginean and Bălaşa 2005). It is a very fluid concept, and it involves many different parameters, depending in large part on the society upon which the study is conducted. Consequently, there is no unanimity in defining the quality of life concept, as it encompasses notions such as well-being, access to better environment and better facilities, its assessment being different in each nation or local jurisdiction (Bukenya et al. 2003).

Many researchers all over the world became interested in defining and working with data on quality of life and its reflection in different areas of life (Precupeţu 2019). At the European level, where countries are quite different in terms of development and perceived standards of living, especially in terms of urban-rural comparisons (Shucksmith et al. 2009), an overall agreed definition of the concept is even more difficult to achieve. Over the second half of the 20th century, different methods of measuring welfare, quality of life and quality of living conditions have been developed (Johansson 2002, Weber et al. 2002, Mărginean 2019). The concept of quality of life, as part of the more general concept of *welfare* arose for the first time at the end of the 1960s. It was the consequence of a largely dominant goal at that time, of increasing the material level of living (Noll 2002). Thus, the *quality of living* concept is a more elaborate version of the concept of welfare, encompassing both material and immaterial dimensions, both objective and subjective data (Argyle 1996). This is how the EUROMODULE was developed, in 1998, as a set of *basic questions which could be implemented in different types of ongoing*

surveys, designed to measure three kinds of welfare components: objective living conditions, subjective well-being and perceived quality of life (Delhey et al. 2002). Issues such as education, health status or employment possibilities thus become central in determining life satisfaction in different communities (Bukenya et al. 2003). With the concept of quality of life strongly linked to health (Testa and Simonson 1996), a closer analysis of the relation between health care access and quality of living issues (mainly objective living conditions) is crucial to support adequate policies in fragile territories.

In the case of rural living, economic indicators, dwelling characteristics, social and environmental factors are all considered to be important when defining well-being, both from an objective and a subjective viewpoint (Deller et al. 2001, Brereton et al. 2011). Socioeconomic status and health are considered to be strongly linked, while individuals with scarce economic resources are less likely to have access to health services (Williams 1990, Sells and Blum 1996, Adler and Ostrove 1999, Kawachi et al. 1999, Singh and Hiatt 2006, Sano and Richards 2011). Geographical location also plays an important role, especially when it comes to physical accessibility and access to different resources (Duncan et al. 2002, Bauer et al. 2011).

Geographic access to medical services is one of the main factors for reduced healthcare utilization in rural areas, especially because of spatial isolation from metropolitan areas or urban centers (Arcury et al. 2005). Research studies have shown that *rural residents have fewer overall visits and see fewer medical specialists and more generalists for their care than their urban counterparts* (Chan et al. 2006), an aspect which is explainable by the fact that many of the rural residents go to the doctor only when it is *absolutely necessary*, for acute care visits, often neglecting regular and chronic care visits (Arcury et al. 2005).

The chances of employment in rural settlements or rural towns (Sîrodoev et al. 2015) are lower than those in the urban areas (Neagu 2012). As a result, most of the inhabitants in these specific areas struggle to support their family and to cover basic survival needs (Dolan et al. 2011). The poor access of services and facilities in rural areas is also influenced by limited transport options (Tay et al. 2004, Shucksmith et al. 2006, Brereton et al. 2011). Consequently, people living in rural areas tend to have less access and to receive less formal support services in terms of healthcare and other social services (Dolan et al. 2011), which leads not only to a lower quality of life, but to increased mortality rates (Knudson et al. 2015). Poor access to healthcare services is closely linked to the low supply of professionals (Wilson et al. 2009) and hospitals in rural areas – a fact which becomes even more problematic considering the threats (e.g. pesticides used in agriculture) posed by the rural environments to human health (Ricketts 2000). Hence, access to medical care is often the most important problem of rural and remote populations (McGrail and Humphreys 2009). The inequitable access to medical services derives both from spatial factors (uneven distribution of healthcare providers) and non-spatial factors (Wang and Luo 2005), occurring when social structure or income determine who gets medical care (Andersen 1995). Although the shortage of doctors in rural areas has tried to be resolved by the implementation of incentive schemes or programs designed to encourage doctors to relocate, it remains the most important barrier in accessing health services at times of need (Li et al. 2014).

Rural Romania covers 87.1% of the country's surface and it includes approximately 45% of its total population (Ignat et al. 2014). Most of the population in these areas is confronted with severe poverty and poor living conditions (Mărginean 2006, Precupeţu et al. 2018). Besides the rural areas, some of Romania's towns are also considered to be "rural" (Sîrodoev et al. 2015), struggling with the same quality of living problems as the rural villages (Naldi et al. 2015). Furthermore, between 2002 and 2012, following the 2008 economic crisis, 35 public hospitals have been closed in small towns in Romania because of the under-financing from the central government (Mitrea and Cocheci 2015).

Official statistical data (National Institute of Statistics 2011) highlight that the most affected regions in Romania regarding the lack of medical personnel are the Eastern and Southern regions. Most of the eight rural villages and rural towns analysed in this paper belong to these three regions of Romania.

According to EUROSTAT data, in 2016, 38.8% of the Romanian population was exposed to poverty risk and social exclusion: *"In fact, in 2016 Romania is in the unenviable position of being the EU member state with the highest level of income inequality, ranked last in relative poverty and second to last, after Bulgaria, in the poverty or social exclusion indicator"* (Stănescu 2018). Romanians were considered, in 2012, the poorest people in Europe (Bădescu 2012), with Romania holding the first place in the European Union regarding the relative poverty rate. Rural development thus becomes strongly dependent on infrastructure provision and the possibility to diversify the rural economy (Turnock 2005). This is especially difficult in isolated rural areas in Romania that are considered to be disadvantaged areas, where the population does not have the same opportunities as the population of other rural areas, not to mention the population of some urban centers (Ianoş et al. 2010). Recent studies on marginalization in rural Romania showcase a strong association of these marginalized areas with the low levels of human development (Tesliuc et al. 2016).

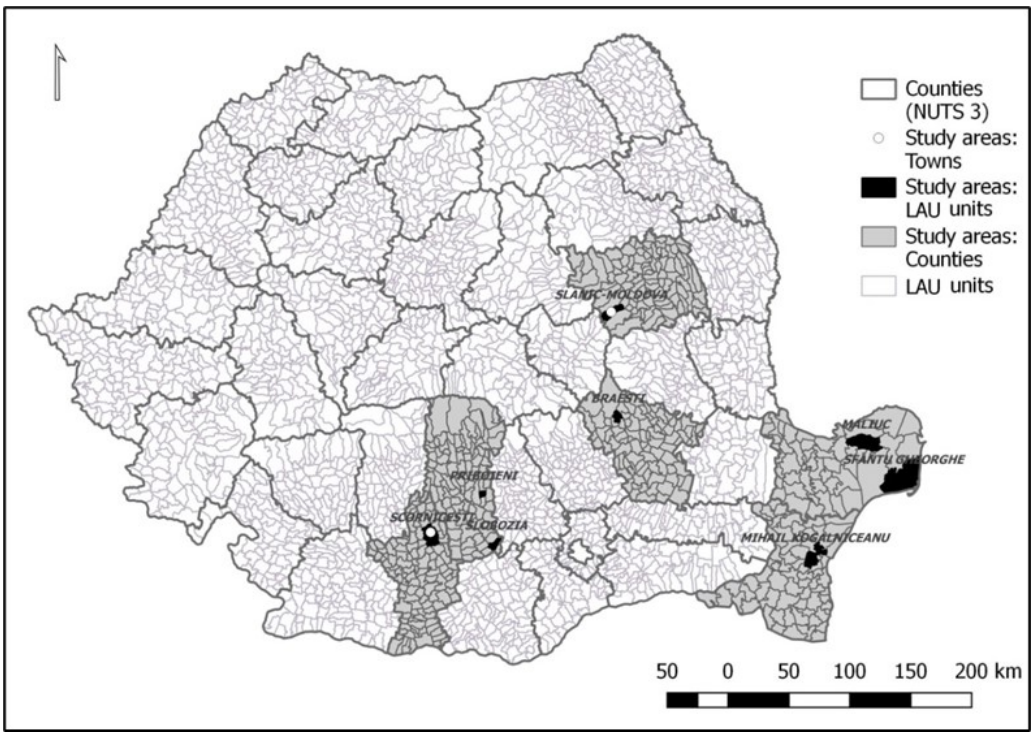

Fig. 1 – **Location of study areas in Romania**

Accordingly, this study focuses on the specific case of quality of living assessment in rural Romania and how it relates to healthcare. The objective of our study was to gather information from eight Local Administrative Units (LAUs) and to create a composite quality of living index (QoLI) that reflects the socio-economic status and the living conditions in the studied areas.

Afterwards, we evaluated the links between the quality of living and the education level, income and access to medical services.

Methodology

The study was conducted in eight LAUs located in the South and East of Romania (Fig. 1).

Between October 2015 and September 2016, a social questionnaire was applied during the "Medical Doctor's Caravan" campaigns to people waiting for medical consult. The questionnaire was applied to 703 people. Twenty subjects were removed from the analysis because of inadequate responses regarding the surface and number of rooms in their dwellings, leaving 678 final entries for the statistical analysis. The questionnaire had five main sections:

a) General questions aiming to profile the respondents (age, gender, marital status);
b) Quality of living indicators designed to obtain information about the respondents' home and surroundings, their access to facilities and the general living conditions. Two other housing indicators were computed from the responses: average room surface per dweller and average number of dwellers per room. The questions in this section were based on the form used by the National Institute of Statistics in the 2011 census (National Institute of Statistics 2011).
c) The education level was assessed by asking the respondents which was the highest school level they had graduated, e.g. primary school, middle school, high school, college/University.
d) The economic indicators were: (1) the current employment of the respondents (employed, pensioner, unemployed looking for work, unemployed looking for first employment, stay-at-home, social pension, pupil/student); (2) the monthly income divided into four categories: under 400 RON (~90 EUR); between 400-750 RON (90-170 EUR); between 750-1200 RON (170-270 EUR); over 1200 RON (270 EUR) – between 2015-2016, the average value of one EURO was of 4.47 RON (the European Central Bank); in the same period, the minimum wage in Romania was of 750 RON (170 €) and the minimum pension was of 400 RON (90 €).
e) The used healthcare indicators were: (1) the distance (in km) to the nearest medical facility/dispensary and the number of months passed since their (2) last medical examination, and (3) last blood test. Depending on the amount of time passed since the respondents' last visit to the doctor and the last blood test, the answers were divided into three categories: less than one year, over one year and never.

Statistical analysis

A principal component analysis (PCA) was used to identify the main components defining the *Quality of Living Index*. Ten variables related to quality of living aspects were included in the PCA: (1) average room surface per dweller, (2) average number of dwellers per room, (3) bathroom, (4) kitchen, (5) water supply, (6) hot water supply, (7) sewage system, (8) fuel used for cooking, (9) heating system and (10) accessibility of the housing unit. To ensure that all statistical analyses could be run on all variables, the nominal variables were transformed into ordinal variables.

Descriptive statistics, exploratory analyses and paired correlations were computed for the ten variables, to exclude the outliers, as well as the variables significantly correlated with each other (correlation coefficient >0.7).

After running the PCA, four components were identified with an Eigenvalue above 1, which explained a cumulative variance of 66.96% of the total variance in the dataset. The appropriateness of the data for the factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) test which returned a value of 0.607, revealing an acceptable mediocre sample

adequacy, and the Bartlett's Test of Sphericity (BTS), which was statistically significant: Chi^2=1054.118, p<0.001 (Chan and Idris 2017).

In the end, the variable with the highest correlation coefficient for each identified component was selected for the computation of a quality of living index for each questionnaire respondent. The selected variables were normalized (maximum value = 100), and the index was computed by weighing each normalized indicator. The assigned weights for each indicator were established based on the cumulative variance explained in the PCA, normalized to 100% (Table 1).

Table 1

The selected indicators for computing the Quality of Living Index

Component	Indicator (variable)	Variance explained	Assigned weight
1	Sewage system	24.29 %	36.28 %
2	Average room surface/dweller	17.54 %	26.20 %
3	Dwelling accessibility	15.05 %	22.48 %
4	Fuel used for cooking	10.07 %	15.04 %

For each of the LAUs, an average Quality of Living Index was computed. Frequency analyses were performed for the variables which were not included in the computation of the quality of living index, but which were considered indicative for the profile of the respondents (age, sex, marital status) and the general housing characteristics (property type, type of housing, building materials), as well as for the education, economic and healthcare indicators.

The numerical variables that had a normal distribution were reported as mean and standard deviation, while the variables with non-normal distribution where reported as median and first and third quartiles (Q1, Q3).

Correlations were computed to explore the eventual relations between the QoLI and the healthcare indicators, the monthly revenue, and the level of education. The analysis of variance was used to assess the differences between the group means. The Chi Square statistic was used for testing the relationships between the categorical variables. The Pearson bivariate correlation was used to describe the linear relationship between the continuous variables, while the Spearman correlation was used in the case of non-normally distributed continuous variables. A p<0.05 was considered significant.

Results

The average age of the respondents was 53 years, and over two thirds (67%) were females. Three quarters declared to be married (75%) and 9% were widowed.

Almost 98% people declared to live on a private property – only 3% stated that they lived in social houses, the majority living in single-family houses (86%). 25% of the respondents claimed to live in adobe houses. The average surface of the housing units was 58.5±27.0 square meters with a mean number of dwellers/housing unit of 3.5±1.5 (Table 2).

Two thirds had attended only primary (17%) and middle school (47%), 30% had finished high school. A staggering 94% of the respondents did not have a higher level of education.

Regarding the medical questionnaire, about 10% of the respondents (n=618) had never been examined by a physician. The median time between the visits to the doctor was 6 months (Q_1 1, Q_3 17; max 360). Also, 17% had never done a blood test and the median time from their last blood test was 12 months (Q_1 3, Q_3 36, max 360).

Table 2

The observed indicators of the Quality of Living

Indicators	N	Percent
Type of housing unit		
- House	588	87.0
- Block of flats	88	13.0
Property type		
- Private	580	85.5
- Social housing	17	2.5
- Group property	81	11.9
*Accessibility of the housing unit by road		
- Access by dirt road	108	16.2
- Access by paved road	275	41.3
- Access by asphalt road	283	42.5
Building materials of the residence		
- Adobe	168	24.9
- Concrete, brick, stone	508	75.1
*Bathroom		
- Does not have	72	10.6
- Outside of the residence	219	32.3
- Inside the residence – just toilet	74	10.9
- Inside the residence – with shower or hot tub	313	46.2
*Kitchen		
- No cooking facilities	3	0.4
- Kitchen outside of the residence	157	23.2
- Kitchen inside the residence	518	76.4
*Water supply		
- Doesn't have	29	4.4
- From own system (well)	305	45.9
- From the public network	330	49.7
*Hot water supply		
- Doesn't have	145	21.5
- From own system (central heating, boiler)	428	63.6
- From the public network	100	14.9
*Sewage		
- Doesn't have	158	23.3
- Own system (septic tank)	347	51.3
- From the public network	172	25.4
Electricity		
- Not available	669	98.7
- Available	8	1.2
*Type of fuel used for cooking		
- Electric energy	2	0.3
- Solid fuel (wood, coal)	66	9.7
- Liquefied gases (gas tank)	600	88.5
- From the public gas system	10	1.5
*Heating		
- Other	1	0.1
- Electric Energy	15	2.2
- Stove	598	88.2
- Gas cooker	6	0.9
- Personal central heating	45	6.6
- Public heating system	13	1.9
*Variables retained in the Quality of Living Index		

The QoLI computed for each respondent varied between 29.7 and 94.8 (as compared to a maximum value of 100). The mean value was 58.5, with 26% of the respondents having a staggering score bellow 50.

An average QoLI was calculated for the studied LAUs. The mean QoLI of the investigated LAUs was 60, Brăești village having the lowest value (47.5) (Table 3).

Table 3

The observed Quality of Life Index in the investigated LAUs

LAUs	Mean Quality of Living Index
Brăești (Buzău county)	47.55
Slănic Moldova (Bacău county)	52.69
Slobozia (Argeș county)	56.23
Scornicești (Olt county)	58.90
Maliuc (Tulcea county)	61.99
Sfântu Gheorghe (Tulcea county)	64.48
Priboieni (Argeș county)	66.43
Mihail Kogălniceanu (Constanța county)	75.37

The Quality of Living significantly varied according to the level of education. The mean QoLI increased by 6 points in those with middle school level, high school and college, as compared to those with primary school level ($F_{3,487}$=32.67; p<0.001). However, the increase was not significant in the case of high school versus college/University, probably because of the low number of higher education graduates (Table 4, Fig. 2).

Table 4

QoLI according to the level of education

Level of education	N	Mean	95% Confidence Interval	
			Lower bound	Upper bound
Primary school	88	51.34	49.14	53.54
Middle school	243	57.04	55.68	58.40
High school	140	63.78	61.84	65.72
College/University	20	69.69	66.64	72.74

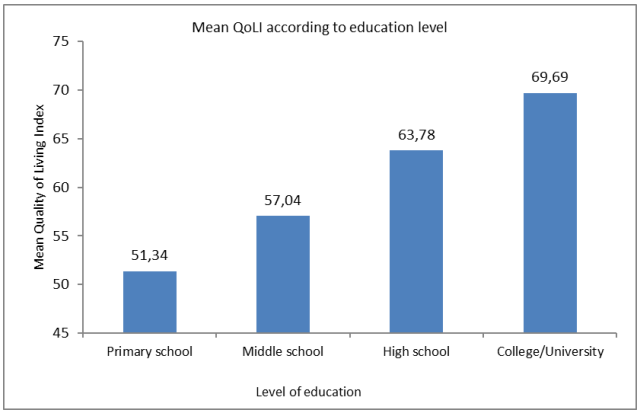

Fig. 2 **– Mean QoLI according to the level of education**

The same statement can be made when examining the relationship between QoLI and the income: the QoL increased in line with the income ($F_{3,456}$=21.38, p<0.001) (Table 5, Fig. 3).

Table 5

QoLI according to income

Monthly Income	N	Mean	95% Confidence Interval	
			Lower bound	Upper bound
Under 400 RON (90 EUR) – *minimum pension*	103	51.35	49.076	53.6242
Between 400-750 RON (90-170 EUR) – *minimum pension/minimum wage*	175	57.82	56.2265	59.4264
Between 750-1200 RON (170-270 EUR)	131	59.95	58.1286	61.7879
Over 1200 RON (270 EUR)	51	65.07	62.1014	68.0481

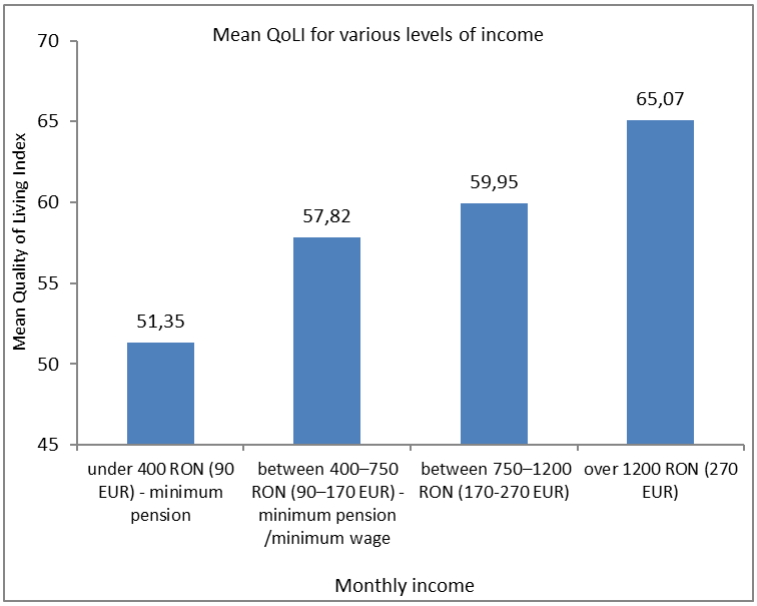

Fig. 3 **– Mean QoLI for various levels of income**

The respondents' level of education was strongly directly related with their income (X2(9) = 135.038, p<0.001) (Fig. 4).

When examining the relationship between the Quality of Living and the health care indicators, the mean QoLI was higher in those who had visited the doctor in the past year than in those who hadn't been to the doctor for more than a year. Surprisingly, those who never visited the doctor had higher QoLI than those who went to the doctor at least once ($F_{2,435}$=9.15, p<0.001) (Table 6, Fig. 5). There was a negative correlation between the time passed since the respondents' last visit to the doctor and their QoLI (r_s=-0.13, p<0.01).

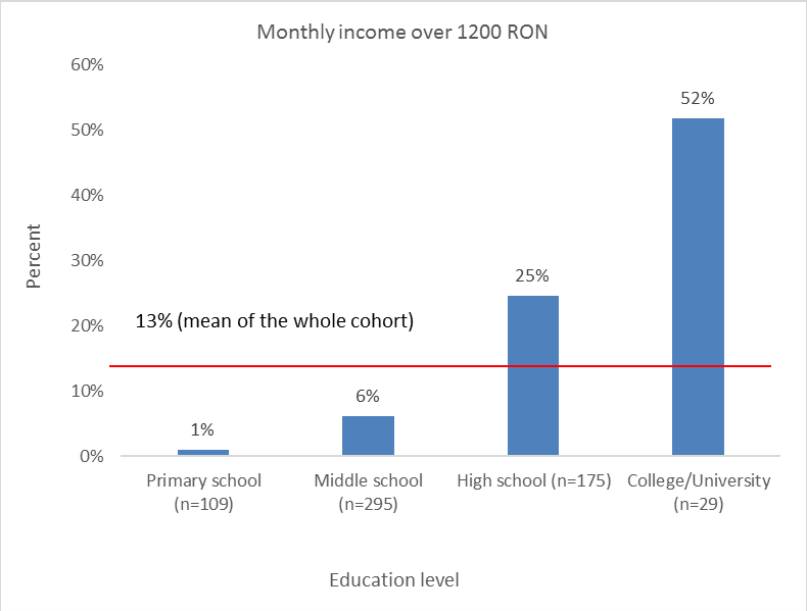

Fig. 4 – **Percent of the inhabitants with income over 1200 RON according to the level of education**

Table 6

QoLI according to the time passed since the last visit to the doctor

Time since the last visit to the doctor	N	Mean	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
< one year	302	59.12	57.74	60.48
> one year	104	54.71	52.43	56.97
Never	32	64.16	59.95	68.36
$F_{2,435}$=9.15, p<0.001				

A similar trend was observed in the relationship between the QoLI and the time since the respondents' last blood test ($F_{2,434}$=2.21, p=0.11), but the difference was not significant.

A key factor in public health is the addressability of the healthcare facility. The respondents' mean distance to the nearest medical unit/hospital was 2.6 km, with a median of 1 km (Q_1 1, Q_3 2, max 45), the distribution being non-normal. The distance to the nearest medical unit/ hospital was weakly directly correlated with the time of the last visit to the doctor (r_s=0.156, p<0.01), and the time since the last blood test (r_s=0.087, p=0.035).

The level of income was also significantly correlated with the time since the last visit to the doctor (X2(6) = 17.439, p=0.008). There was no relationship with the time passed since the last blood tests or when comparing the level of education with the frequency of doctor visits and blood tests performed.

Discussion

This is the first study that creates a composite indicator for the quality of living in rural Romania by using on-site information collected from a directly applied questionnaire to the inhabitants of the studied areas. The proposed Quality of Living Indicator was correlated with education, economic and healthcare indicators, and it seemed to properly depict the situation of Romanian rural areas.

The respondents' profile highlights the specific characteristics of Romanian rural areas and small towns: old age, higher proportion of females, high ratio of married people, single-family and privately-owned houses, poor access to facilities and medical services.

The proposed QoLI is based on the four indicators extracted after running the Principal Component Analysis; each of them could significantly influence the quality of living in rural areas. Firstly, areas with a high ratio of houses connected to public sewage networks are less likely to suffer from soil and water pollution caused by poorly built septic tanks or, worse, by the total lack of sewage systems (Corcoran et al. 2010). Secondly, a high average room surface per dweller implies a higher level of in-door comfort but it could indicate a slight depopulation of the analysed study areas, with houses now sheltering less people than initially planned. Thirdly, the accessibility by road (whether the road is paved, cobbled or just a dirt road) can be related, indirectly, with the people's accessibility to other basic services (shops, schools, medical services). Most often, these services are located along the main roads of the settlements – national or county roads, and less along the secondary roads. Finally, the fuel used for cooking indicates if a house is connected to a public gas network, while houses in rural areas are often dependent on gas tanks to ensure this fuel.

There are only a handful of other studies that have created instruments to measure the level of development of towns and villages in Romania, all using information derived from the data of the National Institute of Statistics and the National 2011 census (National Institute of Statistics 2011). Sandu (2011) used seven indicators, e.g. life expectancy at birth, average age of the population, education level, income (estimated through the number of cars/person), housing surface, gas consumption and size of town/village, to create a Settlement Social Development Index (Sandu 2011). Another study was conducted by the Academy of Economic Studies and it used 25 indicators, e.g. number of inhabitants, population density, agricultural and forestry surface, sewage and heating availability, economic indicators (number of companies/1000 inhabitants and number of reported tourists), to create a complex Socio-economic Development Potential of villages in Romania (Boboc and Ileanu 2015). Teșliuc et al. (2016) created a map with the most "marginalized" rural settlements in Romania (LAUs that have disproportionately low inhabitants, workplaces, and living conditions as compared to the average level of the same type of rural settlement) (Table 7). Vâlceanu and Zulaica (2012) proposed to create a housing quality index by using over 20 indicators (such as the surface and building materials of the dwelling, access to public water, gas sewage, number of people per dwelling, percent of green spaces per inhabitant, employment rate etc.) and by attributing an assigned weight to each indicator, the final index being the sum of all the indicators according to their weights.

The hierarchization of the eight LAUs according to the average QoLI illustrates some interesting results, especially when compared with the other studies. The highest average QoLI is registered in the village of Mihail Kogălniceanu (Constanța county), located in the metropolitan area of Constanța, the fifth largest city in Romania and the biggest port-city in the country. This is consistent with the results of previous studies: the village of Mihail Kogălniceanu ranked high (10th place) in the socio-economic development potential of villages in Romania, while the village is considered to be a developed one according to the Settlement Social Development Index.

Table 7

The observed Quality of Living Index in investigated LAUs and other reported indicators of social development

LAU (towns/villages)	**Mean QoLI**	**Socio-economic potential of villages** – *normalized* (Boboc and Ileanu 2015)	**Settlement Social Development Index** (Sandu 2011)	**Marginalization rate** (Teșliuc et al. 2016)
Brăești (Buzău county)	47.55	38	32	Severe
Slănic Moldova (Bacău county)	52.69	N/A	68	N/A
Slobozia (Argeș county)	56.23	46.26	47	Moderate
Scornicești (Olt county)	58.90	N/A	71	N/A
Maliuc (Tulcea county)	61.99	52.73	41	None
Sfântu Gheorghe (Tulcea county)	64.48	51.71	38	None
Priboieni (Argeș county)	66.43	44.64	55	None
Mihail Kogălniceanu (Constanța county)	75.37	60.9	66	None
N/A=not available				

The two small towns in the study (Scornicești, Olt county, and Slănic-Moldova, Bacău county) have registered rather low values of the QoLI, below villages like Priboieni (Argeș county), Maliuc or Sfântu Gheorghe (Tulcea county). In the case of Scornicești, the low values could be explained by the fact that the questionnaire was applied in the village of Negreni, located in the administrative territory of Scornicești, but having rural characteristics. This discussion could be detailed in future studies, as the situation of urban villages (villages located within the administrative territory of cities, but which often have rural characteristics) is special in Romania. Both small towns are also considered to be poor according to the other social development indexes.

The village of Priboieni, in Argeș county, registers the second highest mean value of the QoLI. Priboieni is also ranked second according to the Settlement Social Development Index, however it ranks less in the Socio-economic Development Potential ranking. It is interesting to note, comparing the two villages of Argeș county (Priboieni and Slobozia) with the villages of Tulcea county (Maliuc and Sfântu Gheorghe), that the latter have a better score in the socio-economic development potential index, but a worse one in both the Quality of Living Index and the Settlement Social Development Index. This could be explained by the fact that the two villages in Tulcea county are located in the Danube Delta, where technical the infrastructure provision and road accessibility are low, but the development potential of tourism is high.

The village of Brăești (Buzău county) registered the lowest mean value of the Quality of Living Index, in line with the results of both Sandu (2011) and Boboc and Ileanu (2015) data. Furthermore, the World Bank's study (Teșliuc et al. 2016) regarding the rural marginalized areas in Romania also classified Brăești as a village with a severe rate of marginalization (over

24% of the population living in marginalized areas), representing the highest rate of marginalization within the analyzed LAUs.

Thus, the proposed QoLI seems to be useful in classifying rural areas in Romania using "field" questionnaires, but it needs to be further refined by its application in more LAUs, with more varied characteristics and in more geographical regions. Alternatively, the questionnaire can be validated using data collected with the occasion of the National Census (2011).

The relationship between the computed QoLI and the other investigated parameters was evaluated. There was a direct correlation between QoLI and the level of education and the monthly income, which suggests that a higher level of education is linked with higher standards demanded by the people in relation to the quality of living. Also, the economic component should not be ignored, as the development of public infrastructure (including quality of roads) is often difficult in LAUs where the population registers lower levels of income (and tax returns are lower). Even when the technical infrastructure is provided, poorer families often do not have the financial possibilities to connect to the existing water or sewage networks and to support the monthly utility costs.

Regarding the healthcare parameters, the study shows a direct relationship between an individual's quality of living and the care for personal health. An increased QoLI was observed for those who went more frequently to the doctor as opposed to those who had not seen any physician in over a 1-year period. Interestingly, those who had never been to a doctor had the highest QoLI. Although this category was represented by a small number of respondents, an assumption can be made that people with high quality of life, being healthier, are not motivated to visit a doctor. Although other factors need to be accounted for, such as the availability of the general practitioner or the distance from the resident's house to the nearest medical facility, the elements included in the QoLI influence the people's decision when it comes to their personal health. Thus, as expected, the proposed QoLI seems also to be related to some healthcare indicators. Accordingly, presumably, as the quality of living improves, so it does the interest time allocated for healthcare by the residents.

The limitations of the study are represented by the profile of the respondents: the questionnaire was applied during a campaign that offered free medical services and an argument can be made that the people who wanted to benefit from such services may not accurately depict the status of all the inhabitants in the LAUs where the study was conducted. Moreover, the campaign aimed to provide medical care in locations with a low level of development. However, the study depicts a situation which could be rather frequent in rural areas of Romania, as sustained by EUROSTAT data, where the risk of poverty or social exclusion is the second highest in Romania (38.8% of population), and it points to an urgent need of intervention.

The applied questionnaires belong to an opportunity sample, where the main criteria were the access to the services offered by the "Medical Doctor's Caravan". However, given the large number of respondents, the statistical data obtained illustrate a hierarchy of the localities which is very similar to the one presented in a strictly statistical analysis (Sandu 2013). The opportunity sample on which the results of this paper are based represents one of the limits of our research. It is however balanced by the high number of the respondents which allows us to invoke, in this particular case, the "law of big numbers" (Vulpe and Chirilov 2005).

Conclusions

The results of this study are based on the statistical analysis of data collected directly from the respondents, through a questionnaire which was applied in 8 LAUs located in 6 different Romanian counties. While a more thorough analysis, comprising more LAUs, would be

necessary, we consider that the results of this study highlight the existing quality of living problems in Romanian rural areas and small towns and their links with educational and economic issues. The healthcare parameters that we analysed also offered us an insight into the more profound socio-economic issues in some of the LAUs.
The proposed Quality of Living Index based on field questionnaires is in line with other socio-economic indices of the Romanian rural areas computed from census data, and it allows the ranking of the settlements. Moreover, the QoLI correlated with educational and economic factors and it showed a direct relationship with some healthcare parameters. Although more research is needed to validate the proposed QoLI, it can be used as a tool to establish the level of living conditions and to prioritize the need for intervention.

An advantage of the proposed method is the fact that it is based on the questionnaire structure from Romania's national census. The method could be extended for computing a Quality of Living Index for the entire country, and the micro-data from the next National Census in 2021 should be available for such analyses. Such an index should be the first step in identifying the areas with significant living issues, both in urban and in rural areas in Romania. The index could also be adapted for analyses at county or municipal level and it could become a method used in baseline studies for County Territorial Plans, General Urban Plans or development strategies at regional, county or local levels.

Consequently, our research highlights the potential role of such composite indices in identifying areas with major quality of living issues, as a pre-requisite step in the development of targeted policies and programmes for rural areas and rural towns in Romania. These policies could target areas such as the provision of technical infrastructure (water, sewage, gas), the development of social infrastructure (education, health, social services) and transport infrastructure (improving road quality, public transport provision) or the improvement of living conditions (housing refurbishment). Furthermore, the QoLI could be compared to demographic forecasts in order to define the priority areas for intervention and to adapt other policies and development programmes to the specific situation of shrinking towns and rural areas.

The limits of this study, already discussed in previous chapters, relate to the application of questionnaires and the statistical validation of the index. While this research was based on an opportunity sample, it would be interesting to compare the results obtained through a representative sampling of the population in each Local Administrative Unit. Furthermore, while we elected to compare the rankings for the 8 LAUs with other similar studies realized at national level, the methodology could be further developed through other statistical validations of the proposed index.

All in all, the computation of the QoLI produced a similar ranking to the previous research regarding the socio-economical characteristics of rural areas in Romania, however we intend to further develop our research in order to better explain the relationship between quality of living and different health care issues observed in the analysed LAUs (the health status of the population, as well as the accessibility to medical services). Moreover, at a broader level, the research can be a stepping stone in the development of specific health policies in rural areas, in conjunction with other integrated policies.

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References

ADLER N. E., OSTROVE J. M. (1999), *Socioeconomic status and health: what we know and what we don't*, Annals of the New York Academy of Sciences 896 (1), 3-15.

ANDERSEN R. M. (1995), *Revisiting the behavioral model and access to medical care: does it matter?*, Journal of Health and Social Behavior 36 (1), 1-10.

ARCURY T. A., GESLER W. M., PREISSER J. S., SHERMAN J., SPENCER J., PERIN J. (2005), *The effects of geography and spatial behavior on health care utilization among the residents of a rural region*, Health Services Research 40 (1), 135-156.

ARGYLE M. (1996), *Subjective well-being*, in: Offer A. (ed.), In pursuit of the quality of life, Oxford University Press, Oxford, pp. 18-45.

BAUER J. W., DYK P. H., SON S., DOLAN E. M. (2011), *Rural does matter: Understanding the rural context*, in: Bauer J. W., Dolan E. M. (eds.), Rural Families and Work: Context and Problems, Springer, New York, pp. 37-54.

BĂDESCU C. I. (2012), *Distribuția riscurilor în societatea românească şi efectele sale asupra politicilor de protecție socială* (Distribution of risks in the Romanian society and its effects on social protection policies), Calitatea Vieții 23 (2), 161-180.

BOBOC D., ILEANU B. (coord.) (2015), *Studiu privind stabilirea potențialului socio-economic de dezvoltare al zonelor rurale* (Study on establishing the socioeconomic development potential of rural areas), Bucharest University of Economic Studies, Retrieved from: www.madr.ro.

BRERETON F., BULLOCK C., CLINCH J. P., SCOTT M. (2011), *Rural change and individual well-being: the case of Ireland and rural quality of life*, European Urban and Regional Studies 18 (2), 203-227.

BUKENYA J. O., GEBREMEDHIN T. G., SCHAEFFER P. V. (2003), *Analysis of rural quality of life and health: A spatial approach*, Economic Development Quarterly 17 (3), 280-293.

CHAN L., HART L. G., GOODMAN D. C. (2006), *Geographic access to health care for rural Medicare beneficiaries*, The Journal of Rural Health 22 (2), 140-146.

CHAN L. L., IDRIS N. (2017), *Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha*, International Journal of Academic Research in Business and Social Sciences 7 (10), 400-410.

CORCORAN E., NELLEMANN C., BAKER E., BOS R., OSBORN D., SAVELLI H. (eds.) (2010), *Sick water? The central role of wastewater management in sustainable development: a rapid response assessment*, UNEP, UN-HABITAT, GRID-Arendal, Arendal.

DELHEY J., BÖHNKE P., HABICH R., ZAPF W. (2002), *Quality of life in a European perspective: The EUROMODULE as a new instrument for comparative welfare research*, in: Hagerty M. R., Vogel J., Møller V. (eds.), Assessing Quality of Life and Living Conditions to Guide National Policy: The State of the Art, Springer, Dordrecht, pp. 163-176.

DELLER S. C., TSAI T.-H., MARCOUILLER D. W., ENGLISH D. B. K. (2001), *The role of amenities and quality of life in rural economic growth*, American Journal of Agricultural Economics 83 (2), 352-365.

DOLAN E. M., BAUER J. W., BRAUN B. (2011), *Policy Issues and Applications: Rural Concerns*, in: Bauer J. W., Dolan E. M. (eds.), Rural Families and Work: Context and Problems, Springer, New York, pp. 217-230.

IANOŞ I., HUMEAU J. B., TĂLÂNGĂ C., BRAGHINĂ C., ANCUŢA C., BOGDAN L. (2010), *Ethics of space and the treatment of most disadvantaged areas*, Carpathian Journal of Earth and Environmental Sciences 5 (2), 211-217.

IGNAT R., STOIAN M., ROŞCA V. (2014), *Socio-economic Aspects of Rural Romania*, Procedia Economics and Finance 15, 1331-1338.

JOHANSSON S. (2002), *Conceptualizing and measuring quality of life for national policy,* in: Hagerty M. R., Vogel J., Møller V. (eds.), Assessing Quality of Life and Living Conditions to Guide National Policy: The State of the Art, Springer, Dordrecht, pp. 13-32.

KNUDSON A., MEIT M., TANENBAUM E., BRADY J., GILBERT T., KLUG M. G., ARSEN E. L., POPAT S., SCHROEDER S. (2015), *Exploring rural and urban mortality differences*, Rural Health Reform Policy Research Center, Retrieved from: www.ruralhealth.und.edu.

LI J., SCOTT A., MCGRAIL M., HUMPHREYS J., WITT J. (2014), *Retaining rural doctors: Doctors' preferences for rural medical workforce incentives*, Social Science & Medicine 121, 56-64.

MĂRGINEAN I. (2006), *Condiţiile de viaţă ale populaţiei din mediul rural* (Living conditions of rural population), Calitatea Vieţii 17 (1-2), 153-170.

MĂRGINEAN I. (2019), *Evoluţii recente privind valorile indicelui dezvoltării umane. România în context european şi mondial* (Recent evolutions of the Human Development Index values. Romanian in the European and global context), Calitatea Vieţii 30 (1), 76-83.

MĂRGINEAN I., BĂLAŞA A. (2005), *Calitatea vieţii în România* (Quality of life in Romania), Expert, Bucharest.

MCGRAIL M. R., HUMPHREYS J. S. (2009), *The index of rural access: an innovative integrated approach for measuring primary care access*, BMC Health Services Research 9, 124.

MITREA A., COCHECI R. M. (2015), *When normative planning fails small towns*, AESOP Prague Annual Congess 2015 Book of Proceedings, pp. 1169-1178.

NALDI L., NILSSON P., WESTLUND H., WIXE S. (2015), *What is smart rural development?*, Journal of Rural Studies 40, 90-101.

NATIONAL INSTITUTE OF STATISTICS (2011), *Rezultate definitive ale Recensământului Populaţiei şi al Locuinţelor 2011* (Final results of the population and housing census), National Institute of Statistics, Retrieved from: www.recensamantromania.ro.

NEAGU G. (2012), *Şanse de acces la educaţie în societatea românească actuală* (Opportunities for access to education in the current Romanian society), Lumen, Iaşi.

NOLL H.-H. (2002), *Towards a European system of social indicators: Theoretical framework and system architecture*, Social Indicators Research 58, 47-87.

PRECUPEŢU I. (2019), *Introducere: repere ale cercetării recente de calitatea vieţii* (Introduction: landmarks of recent quality of life research), Calitatea Vieţii 30 (3), 203-206.

PRECUPEŢU I. (coord.), MIHALACHE F., PETRESCU C., POP C. E., TUFĂ L., VASILE M. (2018), *Calitatea vieţii în România în context european. Raport de cercetare* (Quality of life in Romania in a European context. Research report), Research Institute for Quality of Life, Retrieved from: www.iccv.ro.

RICKETTS T. C. (2000), *The changing nature of rural health care*, Annual Review of Public Health 21, 639-657.

SANDU D. (2011), *Social disparities in the regional development and policies of Romania*, International Review of Social Research 1 (1), 1-30.

SANDU D. (coord.) (2013), *Disparităţi şi fluxuri în fundamentarea social-economică a regionalizării administrative a României* (Disparities and fluxes in the social-economic assessment of administrative regionalization of Romania), CONREG, Retrieved from: www.regionalizare.mdrap.ro.

SANO Y., RICHARDS L. N. (2011), *Physical health, food security, and economic well-being: The rural perspective*, in: Bauer J. W., Dolan E. M. (eds.), Rural Families and Work: Context and Problems, Springer, New York, pp. 77-98.

SHUCKSMITH M., SHUCKSMITH J., WATT J. (2006), *Rurality and social inclusion: a case of preschool education*, Social Policy & Administration 40 (6), 678-691.

SHUCKSMITH M., CAMERON S., MERRIDEW T., PICHLER F. (2009), *Urban–rural differences in quality of life across the European Union*, Regional Studies 43 (10), 1275-1289.

SELLS C. W., BLUM R. W. (1996), *Morbidity and mortality among US adolescents: An overview of data and trends*, American Journal of Public Health 86 (4), 513-519.

SINGH G. K., HIATT R. A. (2006), *Trends and disparities in socioeconomic and behavioural characteristics, life expectancy, and cause-specific mortality of native-born and foreign-born populations in the United States, 1979–2003*, International Journal of

Epidemiology 35 (4), 903-919.

SÎRODOEV I., SCHVAB A. C., IANOȘ I.-L., ION F. (2015), *Rural towns in Romania: a reality asking for specific sustainable development policies*, Carpathian Journal of Earth and Environmental Sciences 10 (3), 147-156.

STĂNESCU I. (2018), *Quality of life in Romania 1918-2018: an* overview, Calitatea Vieţii 29 (2), 107-144.

TAY J. B., KELLEHER C. C., HOPE A., BARRY M., GABHAINN S. N., SIXSMITH J. (2004), *Influence of sociodemographic and neighbourhood factors on self rated health and quality of life in rural communities: findings from the Agriproject in the Republic of Ireland*, Journal of Epidemiology & Community Health 58 (11), 904-911.

TESTA M. A., SIMONSON D. C. (1996), *Assessment of quality-of-life outcomes*, New England Journal of Medicine 334 (13), 835-840.

TEȘLIUC E., GRIGORAȘ V., STĂNCULESCU M. S. (coord.) (2016), *Atlasul zonelor rurale marginalizate şi al dezvoltării umane locale din România* (Atlas of marginalized rural areas and of local human development in Romania), The World Bank, Retrieved from: www.documents.worldbank.org.

TURNOCK D. (2005), *The poverty problem in rural Romania*, Geographia Polonica 78 (2), 53-76.

VÂLCEANU D.-G., ZULAICA L. (2012), *Indicele calităţii locuirii – instrument de evaluare a calităţii locuirii urbane*, Urbanism. Arhitectură. Construcții 3 (4), 45-56.

VULPE I., CHIRILOV P. (2005), *Legea numerelor mari în spaţii abstracte* (Law of large numbers in abstract spaces), Integral Equations and Modeling of Applied Problems 1, 112-113.

WANG F., LUO W. (2005), *Assessing spatial and nonspatial factors for healthcare access: towards an integrated approach to defining health professional shortage areas*, Health & Place 11 (2), 131-146.

WEBER B. A., DUNCAN G. J., WHITENER L. A. (eds.) (2002), *Rural dimensions of welfare reform*, Upjohn Press, Kalamazoo.

WILLIAMS D. R. (1990), *Socioeconomic differentials in health: A review and redirection*, Social Psychology Quarterly 53 (2), 81-99.

WILSON N. W., COUPER I. D., DE VRIES E., REID S., FISH T., MARAIS B. J. (2009), *A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas*, Rural and Remote Health 9 (2), 1060.

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HOW TO CLASSIFY THE URBAN AREA? A PERSPECTIVE OF MULTI-CRITERIA APPROACH IN THE CONTEXT OF HYPER-DIVERSITY IN SETTLEMENTS IN GHANA

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Abstract: Ghana is experiencing high population growth, rapid urbanization and a constantly accelerating growth of urban areas. Yet, the accurate delineation of urban settlements remains a major challenge faced by urban planners. While the emergent urban settlements are being characterized by highly-diverse, heterogeneous, and multiplicity of features, the need to rethink how best to classify new urban growth areas, beyond the commonly used population threshold of ≥ 5000 inhabitants, is becoming increasingly inadequate. Thus, this paper proposes a multi-criteria approach, drawing on the concept of 'hyper-diversity'. Eight key dimensions – urban form, built-up extent, socio-economic functions, land-use dynamics, occupational structure, and governance structure and population size – were identified as a guide to the delineation of new urban settlements. Inferring these dimensions requires accurate spatial and statistical data on the prevailing land-use dynamics. Thus, the paper argues that analysing satellite-based remote sensing and ground truth-gathered data may provide standardized and timely information on the aforementioned dimensions. Applying this multi-dimensional approach may be useful for Ghana and similar countries where there is a lack of regular mapping of urban areas.

Key Words: *urban classification, population size, hyper-diversity, satellite-based remote sensing, Ghana.*

Introduction

Ghana, similar to many other countries in Sub-Saharan Africa (SSA), is experiencing a high population growth, rapid urbanization and a constantly accelerating growth of urban areas – broadly defined as demographically large, relatively densely populated, built-up areas (Bloch et al. 2015). Following its independence in 1957, Ghana's rapid urban population growth in both absolute and relative terms has been accompanied by the expansion of the existing built-up areas and the emergence of new 'urban' areas (Ghana Statistical Service 2014). In 1960, when the first population and housing census (PHC) was carried out by the Ghana Statistical Service – the institution responsible for delineating urban areas in Ghana, there were 98 estimated urban localities with an urban population of about 1.5 million people; by 2010, when the last PHC was conducted, the number of urban localities (including towns, cities, municipalities and metropolis) had risen to more than 636 (Naab et al. 2013). A recent World Bank report showed that, at a growth rate of 4.4 per annum, the urban population growth has fast outpaced the rural population growth between 1984 and 2013, which is a clear indication that urban areas are expected to keep growing and increasing in numbers owing to the high natural population growth and to the in-migration, particularly from the rural hinterland (World Bank Group 2015).

Whilst the increase in urban areas play a key role in the spatial transformation processes of the country, their classification or delineations remain a major challenge faced by the urban planners and developers. Given that there is no universally-accepted approach, many countries, including Ghana, classify the urban areas, usually for PHC enumeration purposes, using a population threshold criterion. However, this approach has been questioned for various reasons. In the specific case of Ghana, the nature of urban growth makes the approach inadequate to describe what is classified as urban. The speed and degree of the urban growth,

often preceding urban planning, has caused the spatial delineation of urban areas much more difficult to determine. It is worth noting that urban development in many parts of Ghana is mainly characterized by unregulated, fragmented, sprawling low-density growth and thereby it defies the geographical and administrative boundaries (Cobbinah and Erdiaw-Kwasie 2016). This makes it difficult to accurately delineate urban area boundaries for purposes of urban planning and management.

More so, a key characteristic of urban growth patterns as identified within the urban studies literature is the growing heterogeneity that exists in newly urbanizing areas. The changing spatial organisation alongside the rapid spatial transformation processes occurring within most cities in Ghana have caused a diversification in their urban form, reflecting the appearance of a multiplicity of functions, activities, social-economic realities and changing political and governance structures that were previously non-existent (Mahendra and Seto 2019). Today, urban areas have long emerged as engines of economic growth and nodes of development. With the ongoing massive urban transformation, new urban growth areas, especially growing peri-urban areas, are emerging as centers for education, employment, innovation, technological transfer, and as a ready market for manufactured goods and agricultural products (Dodier 2013, Rickards et al. 2016, Iossifova et al. 2018). In view of this, the single population-based classification criterion does not adequately capture the areas that are currently urban or urbanizing.

Whereas PHC data collected on a decadal basis consistently provide key information about urban areas in Ghana, the reliance on such data has become insufficient due to the growing heterogeneity and multiple features characterizing urban areas (Elmqvist et al. 2018, Keil 2018, Mahendra and Seto 2019). The main challenge associated with such data is the long period of time over which they are collected which implies that they not only get quickly out-dated but they also fail to keep pace with the rapid urban development, in particularly, of areas outside the official urban boundaries such as growing urban areas which are rapidly absorbed into towns without any statutory status. These concerns have been buttressed by Songsore (2009) who described the population-based approach as very narrow and a contributory factor to unsustainable spatial development patterns being experienced by cities in Ghana. Considering the apparent challenges and difficulties associated with the use of the population threshold of five thousand or more people to classify urban areas, the mandated institutions and urban scholars across the country have been increasingly preoccupied with determining how best to accurately classify urban areas in a timely and efficient manner (Owusu 2008, Ghana Statistical Service 2014). It is understandable that a multi-criteria approach can guide not only the accurate classification of urban areas but also it can help in identifying the multiple factors driving the development of new urban areas, it can better monitor the change processes from rural to urban, and it can assess the links between the scale and type of urban growth, and the spatial development patterns while urban growth is more accurately characterized.

Various scholars have attempted to standardize the delineation of urban areas in remote sensing data. However, the lack of universally accepted spatial-statistical dimensions (Moehl et al. 2016) coupled with the use of different types of satellite imagery, different classification schemes and different scales of analysis, has made a commonly accepted classification of urban areas difficult to achieve. As noted by Møller-Jensen et al. (2020), most remote sensing studies, through satellite-based classifications, have provided up-to-date and accurate information about the extent of urban growth, but yet there is neither a universally agreed definition nor a classification approach of urban areas. Consequently, information on what defines an urban area and/or how to classify areas that have attained the urban status is conceptually and practically lacking. Therefore, the aim of this paper is to focus primarily on exploring and identifying a multi-dimensional approach as a feasible alternative to guide both the classification and the mapping of urban areas in Ghana. We do this by addressing the question: *How best can we classify urban areas beyond the conventional population-based or*

administrative criterion in Ghana? We addressed this question by drawing on the concept of hyper-diversity as propounded by Tasan-Kok et al. (2013). By widening the focus to encompass the diverse, multi-dimensional attributes and spatially differentiated conditions which characterize and reflect the status quo qualities of newly developing urban areas (Vertovec 2007, Schmid et al. 2018), the hyper-diversity perspective provides an understanding that goes beyond the population-based classification of new urban areas.

Classifying urban areas using the minimum population threshold

The minimum population threshold (MPT) is the most widely used criterion to distinguish urban localities from rural localities across different countries. Reports compiled by the United Nations Population Division (United Nations 2018) indicate that 101 countries use the MPT to classify urban settlements (Deuskar 2015). The thresholds used vary from country to country. In Denmark and Sweden, the minimum population size is 200; in Canada and Australia, it is 1000; in United States and Mexico, it is 2,500; in Ghana and Nigeria, it is 5000; and in Japan, it is as high as 30,000 (United Nations 2018).

Despite its wide and continuous usage, the MPT is not a satisfactory criterion for classifying urban areas, especially in highly industrialised countries (Dijkstra and Poelman 2014, Deuskar 2015). For this reason, some countries have taken other dimensions such as prevailing land-use patterns and other socio-economic conditions into consideration (Uchida and Nelson 2009).

More so, there are widely reported weaknesses associated with the MPT criterion for determining urban areas (Baker and Pedersen 1992, Songsore 2009, Ghana Statistical Service 2014, Deuskar 2015). A major limitation of the MPT criterion originates from the numerous errors associated with censuses through which population data is captured. According to Hansen et al. (1953), population censuses almost always have inherent errors such as sampling errors, response errors, compilation errors, errors due to the chosen methodology and inappropriate definitions. These errors produce spurious population figures that are not a true reflection of the actual population size of a given locality. This leads to misclassifications of settlements and so we argue that population size as a sole criterion is not adequate for the accurate classification of urban settlements.

The spatial organization of emergent urban settlements exhibit diverse dimensions (Schmid et al. 2018) that are worth considering. In particular, the spatial aspects provide useful insights into the dynamic nature of new urban areas. This may explain the emergence and rapid growth of the urban land-use science community (Gamba and Herold 2009, Bhatta 2010, Rashed and Jürgens 2010, Seto et al. 2012, Kleemann et al. 2017). These experts have variously applied geospatial data, tools and techniques to detect and map urban areas. A criterion in this direction would be a very useful complement for the population-based criterion.

More so, to identify the key and salient features of a new urban phenomenon, urban scholars and planners would have to consider the frontiers of emergent urban structures - peri-urban[1)] areas (Adam 2014). It is important to note that the ongoing urban expansion in most cities in Ghana concentrates at the periphery. Yet, these areas, although characterized by low population densities, exhibit several conditions which are urban in character (Kleemann et al. 2017). Given the growing materializations of the diverse urban conditions at the periphery, Gough and Yankson (2006) have suggested that peri-urban areas should be considered as an extension of the urban rather than an entirely distinct area. In Møller-Jensen et al. (2020), the

1) Peri-urban is used in this paper to refer to the land around the edges of an urban area, either just within or beyond urban boundaries, where land use patterns are often in the process of changing from more rural (agriculture) to more urban (buildings).

analysis of the urban land-use dynamics showed that the rapidly developing settlements at the periphery are dominated by urban housing (and related infrastructure and services) and they are occupied by urban residents engaged in urban livelihood activities.

Current definition and classification of urban settlements in Ghana

In Ghana, urban areas are defined as settlements with a threshold population of 5000 or more (Ghana Statistical Service 2014). According to the data and statistics (Fig. 1) provided by the United Nations (2018), Ghana's population growth and urbanization experienced a trend of steady increases. With a current urbanization level of 56%, it is reasonable to assume that as the pace of urbanization accelerates, so that the number of urban settlements keeps increasing. In fact, smaller towns and cities are observed to have experienced the fastest rate of urban growth over the last couple of years (World Bank Group 2015). Forecasts also show that the number of urban settlements in the country may increase massively in the coming decades. As new and existing localities such as large villages, hamlets and rural enclaves grow to exceed 5000 inhabitants, they are classified as urban areas.

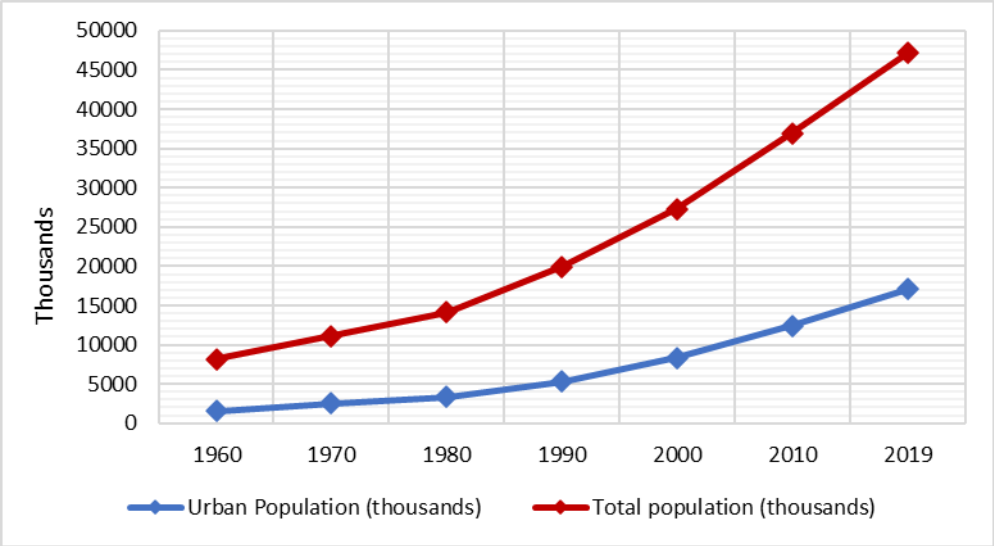

Fig. 1 **– Trends in population growth and urbanization in Ghana (1960-2019)**
Source: United Nations (2018)

As indicated by a recent World Bank report, "the number of medium (20,000–50,000 people) and large medium (50,000–100,000) sized towns have over the years quadrupled and tripled, respectively" (World Bank Group 2015: 2). The main factors driving urban growth and increases in urban settlements are: governmental policies (such as decentralization), natural population increase in urban areas, rural-urban migration, and the immigration from other countries (Ghana Statistical Service 2014). Whilst these factors contribute to the distribution of the population, they are also responsible for the growing diversity characterizing the emergence of new urban settlements.

At the core of Ghana's ongoing urbanization dynamics, the emergence of new urban growth can be observed at several levels. These include mainly conurbations, urban agglomerations,

secondary cities, and the merging of towns and villages. Currently, there are neither published data nor a full list with the precise number of urban settlements in Ghana. However, according to Potts (2018), as of 2020, there were 257 small 'Class 8' settlements which had populations between 5000 and 10,000 people. It was also noted that 70 of these settlements were classified as rural in the previous PHC in 2000. A recent up-to-date database produced by SWAC (2020) revealed the total number of urban agglomerations in Ghana to be 209 (Fig. 2) as of 2015. This is an increase from 87 urban agglomerations established in 1990 (SWAC 2020). It is believed that much of this urban agglomeration growth occurred from the emergence of smaller agglomerations with populations between 10,000 and 50,000 inhabitants. Besides, a 2019 map data obtained from the Ghana Statistical Service (2014) shows 219 major urban localities in Ghana. Taking this together, it seems clear that the identified number of urban localities does not commensurate the Ghana's level of urbanization. As noted by Potts (2018), the precise number of urban areas is not easily ascertained.

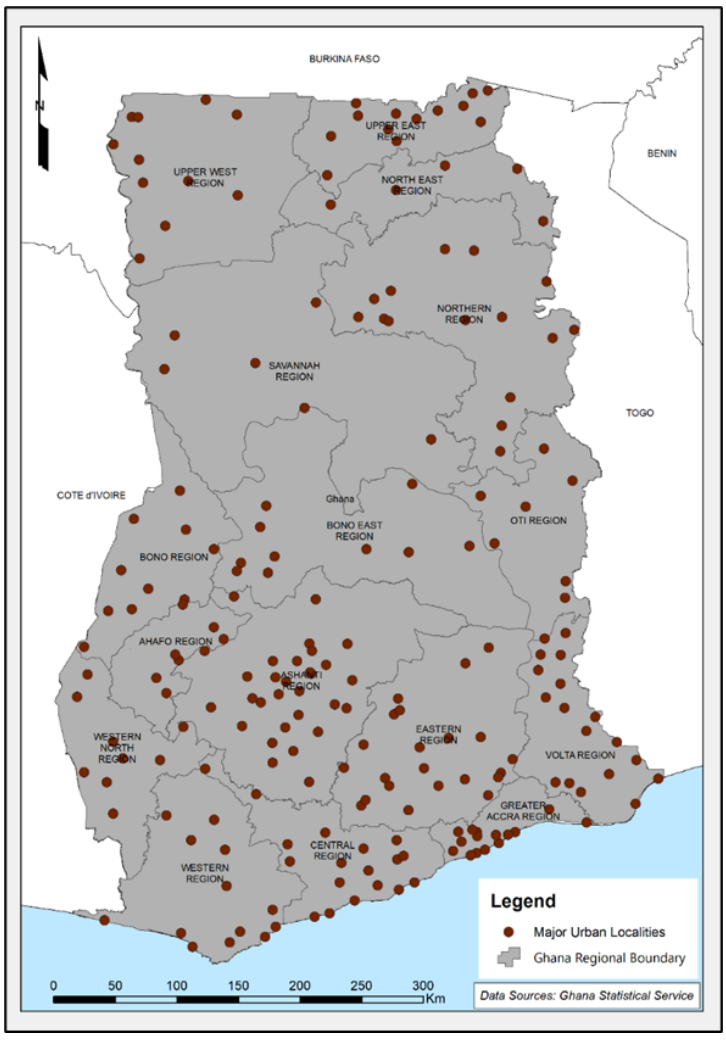

Fig. 2 **– Map of Ghana showing the major urban localities in a regional context**

Quite a number of urban remote sensing studies (Oduro et al. 2014, Angel et al. 2016, Benza et al. 2016, Appiah et al. 2017, Møller-Jensen et al. 2020) have revealed a significant urban growth and steady increases in the urban settlements' patterns in Ghana. However, doubts have been casted on the data on the country's level of urbanization as well as on the quantum of urban areas being produced by various studies (Potts 2018, Møller-Jensen et al. 2020). The fact that settlements in Ghana are classified or delineated as "urban" purely on the population size (a threshold of 5000 people) has been the subject of concern among some Ghanaian urbanists. At the 'First International Conference on Urbanization and Rural–Urban Migration in sub-Saharan Africa' held in Nairobi (2012), there has been the argument that the 5000 threshold is misleading due to a number of limitations. It asserted that the approach has led to the spurious classification of settlements which were still largely villages in their socio-economic characteristics. Potts (2018) concurs, arguing that a threshold of 5000 has become less reliable to distinguish between 'rural' and 'urban' settlements in an economic function sense. This is because it is observed that although localities may easily attain the 5,000 threshold to be qualified as urban, they may maintain their rural outlook based on the predominant economic activities (Ghana Statistical Service 2014). This is an indication of the tendency to overestimate both urban population figures and the number of settlements that are re-classified as being urban. As argued by Potts (2018), without the inclusion of erroneously classified 'urban' villages, Ghana should probably not, as yet, be regarded as half urban.

Although PHC data tend to be regularly available, i.e. every ten years, the long gaps between the census years often result in the misrepresentation and over-generalization of urban growth. This undoubtedly can lead to the spurious delineation of urban settlements. A major challenge in this regard can be due to the expansion of urban areas beyond the administrative boundaries into rural settlements. This is evident in some census reports where some relatively large urban localities, which form a part of municipal and metropolitan areas, were found to have engulfed 'rural' areas.

Taking into consideration Ghana's rapid urban growth in terms of both population and area, the use of the population size criterion alone to classify an urban locality has become both problematic and inadequate (Ghana Statistical Service 2014). The approach was adopted and used for the first post-independence census in Ghana in 1960. During this period, the total population found in the settlements was usually low (Potts 2018). At this point in time, the threshold of 5,000 was not only more reliable and sufficient, but also convenient to delineate the urban settlements. So far, Ghana has conducted five PHC (1960, 1970, 1984, 2000 and 2010). Yet, the population size criterion alone is still being used today (Szabo 2016). With the high population growth taking place today, coupled with the rapid merging of hitherto scattered rural localities and forming agglomerated urban settlements, a threshold of 5,000 has become very unreliable and inadequate to delineate urban localities from rural areas (Potts 2018).

Although population data provide information on the size of the urban population, information on the spatial (geo) location of urban areas remains difficult to obtain (Moriconi-Ebrard et al. 2016). It is important to state that urban settlements differ in size, form, configuration, as well as different socio-economic structures, thus applying one sole criterion in their classification impedes cross-regional comparisons. For instance, the current classification approach of the 'urban' neither denotes the spatial extent nor the geolocation of areas classified as urban. This makes the comparative regional analysis of trends and patterns of urban growth difficult. More so, the data on population size do not provide key information on the spatial variation in the size of different urban settlements.

In addition, the criterion does not offer any means to delineate urban hierarchies in different regions of Ghana (Owusu 2005). For instance, categories such as 'small', 'medium' and 'large' are undefined by the MPT criterion. Although urban localities in Ghana have been graded

according to the following categories: 5,000–9,999 people, 10,000–19,999 people, 20,000–49,999 people, 50,000–99,999 people, and 100,000 people and over (Yeboah et al. 2013), there is no accompanying description. Thus, such categorizations are deemed vague. Lastly, the 'urban' classification approach being used counts the floating population, creating a spatial mismatch that introduces a bias (Weeks 2010). During the census, people are enumerated at wherever they were on the census night and not at where they usually resided (Ghana Statistical Service 2014). In the context of current urban development patterns, the majority of people stay overnight in the peri-urban settlements (Doan and Oduro 2012, Gough et al. 2015), but they commute to the central business district to work. Yet, given their very low population densities, peri-urban areas are not considered as urban as far the population-based criterion is concerned. Therefore, the probability of miscounting or under-counting due to the unpredictable movement of people is high. Against this backdrop, the Ghana Statistical Service (2014) has admitted that the population-size criterion alone is unsatisfactory for classifying the urban settlements and, therefore, it argues for other considerations based on the settlements' functions and primary socio-economic activities (Ghana Statistical Service 2014).

Given the limitations and challenges associated with the MPT criterion, the authors argue that a multi-criteria approach may be more appropriate in the classification of 'urban' settlements in Ghana. The evolution of urban settlements has generated important salient functions based on spatio-economic processes, structures and features that can be considered in addition to population data to classify urban localities. As noted by Schmid et al. (2018), as urban settlements grow and expand, spatial structures and processes, in terms of economic, social, political and demographic changes, materialize. These dynamics can be regarded as both new urban conditions and desirable outcomes of urban development – referred to by Vormann (2015) as urban diversity. Vormann (2015) describes diversity as one of the main features of modern cities, denoting a situation of multiplicity and heterogeneity. As spaces of agglomerations, conurbations and intersections, urban areas are often at the centre of debates and discourses on diversity. Within this context, we reckon that the novel and classical idea of hyper-diversity (Tasan-Kok et al. 2013) grants us insights into the normative dimensions engrained by urban development processes.

Manifestations of hyper-diversity in urban settlements

Hyper-diversity of urban spaces is reflected in the evolving heterogeneity of cities (Korcelli-Olejniczak 2017). With heterogeneous features and distinguishing characteristics manifesting, the reliance on one criterion (population size) for distinguishing urban areas may thus become less reliable. As Schmid et al. (2018: 21) state, "the urban world has fundamentally changed in the last decades whereby varied urbanization processes and conditions have characterized urban landscapes". In particular, urban areas have become very dynamic and heterogeneous in terms of demographics, functions, spatial structures, socio-economic and employment and lifestyles among others (Schmid et al. 2018). This is consistent with the hyper-diversity concept of Tasan-Kok et al. (2013). Hyper-diversity broadly includes the "intense diversification of the population in socio-economic, social and ethnic terms, but also with respect to lifestyles, attitudes and activities" (Tasan-Kok et al. 2013: 6). This perspective has given us insights into the heterogeneous and multi-dimensional characteristics of urban settlements (Schmid et al. 2018).

The main argument we make for 'urban' hyper-diversity is that towns and cities in Ghana and elsewhere are not homogeneous spaces. They originate differently, perform different functions and exhibit a wide range of features. Thus, the attempts of statistical authorities to classify the urban localities by using a single criterion simply fail to consider relevant heterogeneous dimensions (Pitter and Lorinc 2016). Elaborating on the context-specific concept of 'urban' hyper-diversity, Korcelli-Olejniczak (2017) explained that the spatial organization of towns and

cities is characterized by numerous inter-related features.

Three salient features underscored by hyper-diversity in Tasan-Kok et al. (2013) and Korcelli-Olejniczak (2017) are particularly relevant in guiding us to identify and to take into account the meaningful dimensions in measuring what is 'urban'. The choice of this concept as an entry point towards identifying urban dimensions is premised on three key issues. Firstly, the notion evades the simple classification of urban areas based on the MPT. Secondly, the concept provides insights into very different aspects of socio-economic, socio-demographic, ethnic and cultural diversity as the emerging 'urban' conditions and they are generally viewed as desirable dimensions to consider in classifying urban settlements. Thirdly, the perspective places an emphasis on the multi-dimensional features that strongly characterize the development of urban areas.

More to the point, the concept of hyper-diversity triggers a thinking that does not oversimplify the urban. Rather, it emphasizes the realities of the structures and processes that unfold to shape the spatial organization of urban areas. From this perspective, we argue that the hyper-diversity notion can capaciously be used to rethink how urban areas grow and expand with regard to the dynamic structures and processes within which individuals, households, communities and institutions continually and increasingly distribute themselves (Colomb and Raco 2015). We, therefore, draw on the notion of hyper-diversity as a conceptual and theoretical perspective to gain an understanding of the multi-dimensions that can aid in classifying urban settlements.

As already noted, Ghana's urban population is highly diversified and as such urban settlements are evolving in ways that require a multi-criteria approach to accurately delineate and classify the 'urban' localities from the surrounding rural areas. The idea of hyper-diversity provides a logical understanding of the many ways of conceptualizing and defining the 'urban' beyond the number of the inhabitants in a given area. Importantly, the key structural economic and spatial changes, social and political factors, as well as the forms and patterns of urban development (Gough et al. 2015) provide an excellent lens through which a multi-dimensional criterion can be ascertained to guide the classification of urban areas.

Methodology

In order to identify the concrete dimensions typifying the emergent urban settlements in Ghana, we carried out a comprehensive review and synthesis of the literature. The findings from the existing studies including scientific publications, peer-reviewed articles, theses and dissertations, working papers, conference materials and other grey literature, were accessed mainly from Web of Science, Annual Reviews and Google Scholar. These online databases were searched using combinations of keywords: *urban*, *what-is-urban?*, *how-do-we-define-or-measure 'the urban'?*, *urban-classification-systems*, *urban-hyper-diversity*, *urban-dimensions*, and *determining-urban-settlement*. By focusing on these content-related search terms, we sought to explore the key data and information for our topic. The selected texts, documents and scientific materials were stored in the Citavi for Windows version 5.7. This was used to organize the texts and knowledge as well as to manage the reference citations. At least 124 papers were reviewed out of which eight overarching, causally related urban dimensions were derived. Overall, these dimensions provide the key baseline information which can aid in determining the urban in Ghana.

Results and Discussion

The dimensions noted in Table 1 reflect a vivid illustration of urban hyper-diversity. The notion requires us to acknowledge that 'urban' spaces contain multiple and heterogeneous conditions.

Thus, by using a hyper-diversity lens, we are able to identify other criteria to measure what is urban. In addition to the highlighted dimensions, various other possible dynamic attributes of human settlements can be considered a categorization and delineation of the urban. These include: lifestyles, attitudes, household income levels, access to core urban services and activities. Whilst, the highlighted dimensions prove to be key factors to enhance how urban areas are identified and classified, and analyzing such functional, structural and morphological changes requires data on the urban settlements and populations. Yet, compiling urban data in Ghana remains a major challenge. In fact, the lack of accurate and timely local data brings severely constraints for the estimations of urban settlements.

Table 1

Dimensions portraying hyper-diversity in urban settlements in Ghana

Dimension	Key findings derived from the supporting literature	Source
Urban form	Urban form refers to the broad spatial characteristics of an entire urban region including the shape, distribution, patterns and arrangement of urban complexes that represent the urban land use within the region. • Ghana is experiencing a rapid outward expansion of urban development (urban sprawl). • With the growing dispersion of people, activities, institutions and resources, urban spatial transformation has been traditionally characterised by a shift from monocentric to polycentric patterns. • New trends, patterns and processes regarding peri-urbanization are manifesting and, similarly, new urban settlements are materializing. Therefore, the urban form may be a useful criterion for classifying the urban status.	Asiedu and Arku (2009), Gough and Yankson (2011), Doan and Oduro (2012), Owusu (2013), Benza et al. (2016), Kleemann et al. (2017)
Extent of built-up area	'Built-up areas' refer to the areas covered with and used for residential, industrial and commercial buildings and infrastructure, and other urban structures. • The rapid increase in built-up areas is driven by the increasing demand for housing and the related infrastructure and services by urbanites. • Current urban development patterns are characterized by the spontaneous proliferation of large-scale built-up areas with an expansive spatial distribution of massive residential developments. • The extent and pattern of built-up areas is thus a key dimension of urban landscapes. The settlements with contiguous patches of built-up land greater than 1 km^2 each could be a relevant criterion for classifying the urban areas.	Schneider and Woodcock (2008), Doan and Oduro (2012), Gough et al. (2015), Appiah et al. (2017)

Land-use dynamics	In the context of classification, this means a human use of the land for different purposes that are characteristically urban. It encompasses diverse and mixed uses of land within an urban scene. • The rapid sprawl of urban core cities into peripheral zones is transforming land use. There are diverse, multi-functional uses of land on the periphery of Ghana's major cities. • Land-use diversity signifies urban development. Thus, heterogeneous, rapidly changing land-use may be a suitable criteria for classifying the urban status. • Advances in satellite-based remote data and technology, as well as in algorithm development, have allowed scientists to classify urban settlements based on land use features.	Gough and Yankson (2000), Owusu (2013), Seto and Reenberg (2014), Appiah et al. (2015), Oduro et al. (2015), Angel (2016), Stow et al. (2016), Appiah et al. (2017)
Socio-economic functions	The services, activities, systems and institutions contributing to the dynamics of settlements. • In Ghana, urban expansion (including population increase) in peri-urban spaces involves a de-concentration of core urban functions (e.g. services, residential, administrative etc.). • Small peripheral towns and villages are rapidly assuming the urban status due to the coalescence and strong presence of social and economic activities, systems and institutions. • Thus, an urban status classification scheme could consider the presence and availability of local government offices, markets and shopping centres, health facilities, hotels, transport, factories, energy consumption, schools.	Yeboah et al. (2013), Ghana Statistical Service (2014), Gough et al. (2015)
Occupa-tional structure	It covers the predominant employment status, and the occupation type, including technical and vocational professions, in a given locality. • In Ghana, the outward expansion of cities changes the occupational structure of peri-urban areas. • There has been a massive shift from rural, agricultural, activities to service activities in urban areas. Manufacturing is increasing the fastest in peri-urban areas. • Therefore, the urban status can be categorized by considering the main economic activities of the population and of each locality.	Bawakyillenuo et al. (2013), Ghana Statisti-cal Service (2014), Gough et al. (2015), World Bank Group (2015)

Population size	The conventional criterion for classifying urban settlements. • A large population size corresponds with a high urbanization, resulting in the rapid conversion of rural to urban areas (re-classification). • Villages and small towns are rapidly attaining the MPT of 5000 people due to the natural population increase. • Population size is the most convenient criterion for determining urban settlements. It can be enhanced by integrating other dimensions too.	Doan and Oduro (2012), Ghana Statistical Service (2014), Oduro et al. (2014)
Governance structure	The institutional political structures, mechanisms and processes through which decision-making, the use of resources and service provision are achieved in a political area. • Following the decentralization in 1988, the local government in Ghana has proliferated in line with the rapid urbanization and urban growth. New settlement areas have rapidly been converted into economic, political and administrative units. • In expanding peri-urban areas, state-led governance systems exist alongside informal actors (including community actors and traditional leaders, the private sector and civil society organizations). • The presence of local government structures, institutions and offices may serve as a useful justification for delineating a given area as urban.	Owusu (2008, 2013, 2015), Ghana Statistical Service (2014), Cities Alliance (2017)
Housing structure	Housing structure is an indicator of the general income and living standards of the residents. It also includes the level of infrastructure in a given settlement. • Massive growth in peri-urban areas is characterized by new middle-class housing settlements. • Almost all houses built in peri-urban areas are constructed using materials permitted for urban housing by the Ghana Building Code 1988. • Importantly, housing structure could serve as a criterion for classifying an area as urban if there are high-quality housing units built with materials stipulated by the Ghana building code for urban houses.	Møller-Jensen and Knudsen (2008), Gough and Yankson (2011), Doan and Oduro (2012), Yeboah et al. (2013)

At this point, we reckon that only a geospatial approach can directly and indirectly help to detect spatial and statistical data on urban settlements. In principle, a geospatial approach that combines satellite-based remote sensing data with urban demographic, socio-economic and actual land use characteristics can help discover both the location of existing and of newly urbanized areas and their sizes. This approach allows for a verification of the existence, or lack thereof, of an urban settlement based on the dimensions and associated indications. It is further argued that satellite-based classification of 'urban' land-use dynamics reinforced by ground truthing proves to be an objective method to classify urban areas. This is because land-use dynamics expresses the most visible form of a settlement's transition from rural to urban. In other words, the urban scene is composed of easily detectable spatial structures (patterns, forms, layout and distribution of geographic phenomena), and spatial processes (mechanisms producing spatial structures). Thus, the spatial and temporal dynamics of land-use effectively portrays the manifold dimensions underpinning the spatial development of any urban settlement (Adam 2014). Within this context, this study defines urban settlements as a heterogeneous and multi-dynamic geographical area, with increased human-made structures over time and a land-use system that encompasses all basic services and facilities underpinned by social, economic, political, demographic processes and functions. From this definition, we draw attention to the fact that the 8 highlighted dimensions can be detected based on the prevailing uses of land within a particular settlement. This is equally based on the premise that the spatial development of the settlements in inextricably linked to the use of land.

As noted earlier, the use of geo-information techniques has already become a widely adopted approach to land related data analysis. Therefore, the relation between the highlighted dimensions and the land use dynamics can be established based on satellite data, ground-truth assessments and the selection of training sites. For instance, an urban status classification could be done based on the functions performed (and services provided) in a given settlement. Such functions and services can be ascertained based on the prevailing land use dynamics in the area. Thus, data on basic spatial structures related to each of the identified dimensions can be gathered, mapped and combined with the MPT of 5,000 people in order to classify a locality as urban. Given that satellite-based remote sensing data offer a unique assistance to measure what is urban based on physical land features, we expect that urban remote sensing scientists can develop algorithms that can infer the basic structures and processes of the proposed dimensions to classify urban areas. We believe this is consistent with the quest to standardize the definition of the urban using remote sensing data (Mahendra and Seto 2019).

Classification of urban areas by satellite-based remote sensing data and techniques

Given the near accurate change detection of land-use features, the classification of urban and non-urban areas is emerging from work using GIS and remote sensing (Kleemann et al. 2017, Mahendra and Seto 2019, Møller-Jensen et al. 2020, for recent examples). The analysis of high-resolution satellite imagery and of other spatially explicit data provides detailed information on the urban land uses and it reveals urban forms, built infrastructure, socio-economic functions and activities, the presence of truck infrastructure, the seemingly urban residential buildings, and the availability of core urban services (Mahendra and Seto 2019).

There have been many studies that looked at classifying urban areas using different satellite-based remote sensing data and at different scales. Some examples are Donnay et al. (2001), Bhatta (2010), Griffiths et al. (2010), Mahendra and Seto (2019). In Ghana, for instance, Kleemann et al. (2017) used cloud-free high-spatial-resolution satellite data provided by Digital Globe via Google Earth to identify the patterns of urban development in Takoradi and Bolgatanga. In another study, Benza et al. (2016) also used Landsat Enhanced Thematic Mapper Plus (ETM+) and European Remote Sensing Satellite-2 (ERS-2) synthetic aperture radar (SAR) imagery to define the urban-based on land use and land cover. This enabled the

delineation of nine urban patches which were triangulated with census derived population size (Benza et al. 2016). Putting together a database, SWAC (2020) applies spatio-statistical criteria to the delineation of urban agglomerations. Its geospatial standardized database combines demographic data, satellite and aerial imagery and other cartographic sources to carry out a comprehensive assessment of ongoing processes of urbanization and spatial development dynamics in Africa.

Although remote sensing is useful for mapping and classifying urban areas, some limitations exist. Firstly, the heterogeneity of urban settlements coupled with characteristics of the consistently available low-medium resolution Landsat-Tm makes the delineation of urban areas quite difficult but not impossible (Mahendra and Seto 2019, Møller-Jensen et al. 2020). It is noted that despite its capability of providing consistent information on land features, built-up form and configuration, some human settlements are really difficult to discern from space. Whilst satellite-based data is limited by the remote sensing scientist's knowledge of ground conditions. A major challenge in this regard is represented by the variations in object reflectance and the inability of some single remote sensing sensors to differentiate across land surface features. Thus, processing, analysing and classifying SRS images of urban areas may be limited due to the difficulties associated with their multi-sensor, multi-temporal and multi-modal nature and the sources of data. Integrating or fusing multi-source satellite data is a complex and time-consuming task (Donnay et al. 2001). To surmount these challenges, geospatial analysts and urban land-use scientists advocate for the application of segmentation and mosaicking techniques (see for example Rashed and Jürgens 2010). According to Estes et al. (2018) and Møller-Jensen et al. (2020), object-oriented segmentation and/or classification of very-high spatial resolution imagery produces accurate and favourable results rather than a per -pixel classification. Technically, object-oriented classification allows the integration of multiple non-spectral information on the structure and characteristics of urban areas (Estes et al. 2018). Yet, also, a fundamental problem associated with this approach is that while there is often a relatively simple, direct relationship between the land-cover type and the detected spectral reflectance, the same cannot be applied to land-use dynamics. Land-use is considered an abstract amalgamation of cultural and economic factors (Seto et al. 2012, Mahendra and Seto 2019), most of which cannot be determined directly by remote sensing. However, different types of urban land-uses reflect a characteristic spatial pattern of a spectrally distinct land cover, which then enables their recognition in high spatial resolution SRS images (Estes et al. 2018).
To improve the detection and delineation of urban areas based on land features, it may be necessary to integrate SRS data from modern imaging spectrometers, such as the Environmental Mapping and Analysis Program (EnMAP, Kaufmann et al. 2016). The development and intensified use of imaging spectrometers or hyper-spectral imaging to record multi-temporal SRS data at short intervals and at high spatial and spectral resolution open up new possibilities to effectively detect land-use patterns within urban settlements (Guanter et al. 2016). EnMAP combines excellently with multi-spectral satellite systems, such as IKONOS and Quickbird, to assess the spatial and temporal diversity of changing in urban land use dynamics (Kaufmann et al. 2016), which is the focus of a successive study being carried out by the authors.

Conclusions

The aim of this paper has been to explore how best the classification of urban areas in Ghana could be performed. This has been based on the premise that population size alone is no longer reliable to classify an urban area due to increased populations, changes in spatial development patterns and, of course, the accelerating growth of urban areas over time and space. Drawing inspiration from the concept of hyper-diversity in settlements, our review and synthesis of the literature revealed eight key dimensions. Quite apart from the conventional

population threshold of 5,000 people, the paper finds that data on the urban form, the extent of the built-up area, the land-use dynamics, socio-economic functions, and occupational, governance and housing structures, could also be used to classify a settlement as urban.

Whilst admitting that some of these dimensions cannot be directly measured, the paper suggests that detecting and analyzing land use dynamics from satellite-based remote sensing data and techniques, various spatial and statistical data on the aforementioned dimensions can be derived. Combining advanced satellite imagery with ground truth-gathered data, as well as in algorithm development, could allow analysts and urban planners to classify urban areas in a timely manner with frequent updates.

Overall, the findings of this paper contribute to a better understanding of how urban settlements can be classified by using a multi-dimensional approach as a feasible alternative. It also offers an insight to the Ghana statistical service to "think out of the minimum population threshold box" and to begin to consider the heterogeneity and multiple attributes characterizing the areas of new growth, especially the urban "villages" on the periphery of cities. Future studies should thus focus on developing remote sensing algorithms that can infer the proposed dimensions from physical land features. It is also important to develop indices for each dimension to aid in the classification of urban areas.

References

ADAM A. G. (2014), *Land Tenure in the Changing Peri-Urban Areas of Ethiopia: The Case of Bahir Dar City*, International Journal of Urban and Regional Research 38 (6), 1970-1984.

ANGEL S., BLEI A. M., PARENT J., LAMSON-HALL P., SÁNCHES N. G., CIVCO D. L., QIAN LEI R., THOM K. (2016), *Atlas of Urban Expansion 1: The 2016 Edition. Areas and Densities*, New York University, New York, UN-Habitat, Nairobi, Lincoln Institute of Land Policy, Cambridge, MA.

APPIAH D. O., FORKUO E. K., BUGRI J. T., APREKU T. O. (2017), *Geospatial Analysis of Land Use and Land Cover Transitions from 1986-2014 in a Peri-Urban Ghana*, Geosciences 7 (4), 125.

APPIAH D. O., SCHRÖDER D., FORKUO E. K., BUGRI J. T. (2015), *Application of Geo -Information Techniques in Land Use and Land Cover Change Analysis in a Peri-Urban District of Ghana*, ISPRS International Journal of Geo-Information 4 (3), 1265-1289.

ASIEDU A. B., ARKU G. (2009), *The rise of gated housing estates in Ghana: Empirical insights from three communities in metropolitan Accra*, Journal of Housing and the Built Environment 24, 227-247.

BAKER J., PEDERSEN P. O. (eds.) (1992), *The rural-urban interface in Africa: Expansion and Adaption*, Nordiska Afrikainstitutet, Uppsala, Centre for Development Research, Copenhagen.

BAWAKYILLENUO S., OSEI AKOTO I., AHIADEKE C., ARYEETEY E. B.-D., AGBE E. K. (2013), *Tertiary Education and Industrial Development in Ghana*, International Growth Centre, Retrieved from: www.theigc.org.

BENZA M., WEEKS J. R., STOW D. A., LÓPEZ-CARR D., CLARKE K. C. (2016), *A pattern-based definition of urban context using remote sensing and GIS*, Remote Sensing of Environment 183, 250-264.

BHATTA B. (2010), *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, Springer, Berlin, Heidelberg.

BLOCH R., FOX S., MONROY J., OJO A. (2015), *Urbanisation and Urban Expansion in Nigeria*, Urbanisation Research Nigeria (URN), London.

CITIES ALLIANCE (2017), *Urban Governance and Services in Ghana: Institutional, financial and functional constraints to effective service delivery*, Cities Alliance, Retrieved from: www.citiesalliance.org.

COBBINAH P. B., ERDIAW-KWASIE M. O. (2016), *Urbanization in Ghana: Insights and Implications for Urban Governance*, in: Benna U. G., Garba S. B. (eds.), Population Growth and Rapid Urbanization in the Developing World, IGI Global, Hershey, pp. 82-104.

COLOMB C., RACO M. (2015), *Planning for / in the super-diverse city: between celebratory policy narratives and the reality of planning policies in London*, RC21 International Conference on "The Ideal City: between myth and reality. Representations, policies, contradictions and challenges for tomorrow's urban life", Retrieved from: www.rc21.org.

DEUSKAR C. (2015), *What does "urban" mean?*, World Bank, Retrieved from: www.blogs.worldbank.org.

DIJKSTRA L., POELMAN H. (2014), *A harmonised definition of cities and rural areas: the new degree of urbanisation*, European Commission, Retrieved from: www.ec.europa.eu.

DOAN P., ODURO C. Y. (2012), *Patterns of Population Growth in Peri-Urban Accra, Ghana*, International Journal of Urban and Regional Research 36 (6), 1306-1325.

DODIER R. (2013), *Modes d'habiter périurbains et intégration sociale et urbaine*, EspacesTemps.net.

DONNAY J.-P., BARNSLEY M. J., LONGLEY P. A. (eds.), (2001), *Remote Sensing and Urban Analysis*, CRC Press, London.

ELMQVIST T., BAI X., FRANTZESKAKI N., GRIFFITH C., MADDOX D., MCPHEARSON T., PARNELL S., ROMERO-LANKAO P., SIMON D., WATKINS M. (eds.) (2018), *Urban Planet: Knowledge towards Sustainable Cities*, Cambridge University Press, London.

ESTES L., CHEN P., DEBATS S., EVANS T., FERREIRA S., KUEMMERLE T., RAGAZZO G., SHEFFIELD J., WOLF A., WOOD E., CAYLOR K. (2018), *A large-area, spatially continuous assessment of land cover map error and its impact on downstream analyses*, Global Change Biology 24 (1), 322-337.

GAMBA P., HEROLD M. (eds.) (2009), *Global Mapping of Human Settlement: Experiences, Datasets, and Prospects*, CRC Press, London.

GHANA STATISTICAL SERVICE (2014), *Urbanization in Ghana: 2010 Population and Housing Census Report*, Retrieved from: www.statsghana.gov.gh.

GOUGH K. V., ANDREASEN M. H., ESSON J., MAINET H., NAMANGAYA A. H., YANKSON P. W. K., AGERGAARD J., AMANKWAH E., KIUNSI R., MØLLER□JENSEN L., YEMMAFOUO A. (2015), *City Dynamics: Mobility and Livelihoods of Urban Residents*, RurbanAfrica, Retrieved from: www.rurbanafrica.ku.dk.

GOUGH K., YANKSON P. (2006), *Conflict and cooperation in environmental management in peri-urban Accra, Ghana*, in: McGregor D., Simon D., Thompson D. (eds.), The Peri-Urban Interface: Approaches to Sustainable Natural and Human Resource Use, Earthscan, Abingdon, pp. 196-210.

GOUGH K. V., YANKSON P. (2011), *A Neglected Aspect of the Housing Market: The Caretakers of Peri-urban Accra, Ghana*, Urban Studies 48 (4), 793-810.

GOUGH K. V., YANKSON P. W. K. (2000), *Land Markets in African Cities: The Case of Peri-urban Accra, Ghana*, Urban Studies 37 (13), 2485-2500.

GRIFFITHS P., HOSTERT P., GRUEBNER O., VAN DER LINDEN S. (2010), *Mapping Megacity Growth with Multi-Sensor Data*, Remote Sensing of Environment 114 (2), 426-439.

KAUFMANN H., FÖRSTER S., WULF H., SEGL K., GUANTER L., BOCHOW M., HEIDEN U., MÜLLER A., HELDENS W., SCHNEIDERHAN T., LEITÃO P. J., VAN DER LINDEN S., HOSTERT P., HILL J., BUDDENBAUM H., MAUSER W., HANK T., KRASEMANN H., RÖTTGERS R., OPPELT N., HEIM B. (2016), *Science Plan of the Environmental Mapping and Analysis Program (EnMAP)*, EnMAP, Retrieved from: www.gfzpublic.gfz-potsdam.de.

HANSEN M. H, HURWITZ W. N, PRITZKER L. (1953), *The Accuracy of Census Results*, American Sociological Review 18 (4), 416-423.

IOSSIFOVA D., DOLL C. N. H., GASPARATOS A. (eds.) (2018), *Defining the Urban: Interdisciplinary and Professional Perspectives*, Routledge, London.

KEIL R. (2018), *Suburban planet: Making the world urban from the outside in*, Polity Press, Cambridge.

KLEEMANN J., INKOOM J. N., THIEL M., SHANKAR S., LAUTENBACH S., FÜRST C. (2017), *Peri-urban land use pattern and its relation to land use planning in Ghana, West Africa*, Landscape and Urban Planning 165, 280-294.

KORCELLI-OLEJNICZAK E. (2017), *EU 7 FP project. Governing urban divercity: creating social cohesion, social mobility and economic performance in today's hyper-diversified cities (DIVERCITIES) – the case of Warsaw*, Geographia Polonica 90 (2), 123-129.

MAHENDRA A., SETO K. C. (2019), *Upward and Outward Growth: Managing Urban Expansion for More Equitable Cities in the Global South*, World Resources Institute, Retrieved from: www.wri.org.

MOEHL J. J., ROSE A. N., BRIGHT E. A. (2016), *Spatializing Global Urban Extent: A Source Driven Approach*, International Conference on GIScience Short Paper Proceedings, 203-207.

MØLLER-JENSEN L., ALLOTEY A. N., KOFIE R. Y., YANKSON P. W. K. (2020), *A Comparison of Satellite-Based Estimates of Urban Agglomeration Size for the Accra Area*, ISPRS International Journal of Geo-Information 9 (2), 79.

MOLLER-JENSEN L., KNUDSEN M. H. (2008), *Patterns of population change in Ghana (1984-2000): urbanization and frontier development*, GeoJournal 73, 307-320.

MORICONI-EBRARD F., HARRE D., HEINRIGS P. (2016), *Urbanization Dynamics in West Africa 1950-2010: Africapolis I. 2015 Update*, OECD Publishing, Paris.

NAAB F. Z., DINYE R. D., KASANGA R. K. (2013), *Urbanisation and its impact on agricultural lands in growing cities in developing countries: A cast study of Tamale in Ghana*, Modern Social Science Journal 2 (2), 256-287.

ODURO C. Y., ADAMTEY R., OCLOO K. (2015), *Urban Growth and Livelihood Transformations on the Fringes of African Cities: A Case Study of Changing Livelihoods in Peri -Urban Accra*, Environment and Natural Resources Research 5 (2), 81-98.

ODURO C. Y., OCLOO K., PEPRAH C. (2014), *Analyzing Growth Patterns of Greater Kumasi Metropolitan Area Using GIS and Multiple Regression Techniques*, Journal of Sustainable Development 7 (5), 13-31.

OWUSU G. (2005), *Small Towns in Ghana: Justifications for their Promotion under Ghana's Decentralisation Programme*, African Studies Quarterly 8 (2), 48.

OWUSU G. (2008), *The Role of Small Towns in Regional Development and Poverty Reduction in Ghana*, International Journal of Urban and Regional Research 32 (2), 453-472.

OWUSU G. (2013), *Coping with urban sprawl: a critical discussion of the urban containment strategy in a developing city, Accra*, Planum: The Journal of Urbanism 26 (1), 1-17.

OWUSU G. (2015), *Decentralized Development Planning and Fragmentation of Metropolitan Regions: The Case of the Greater Accra Metropolitan Area, Ghana*, Ghana Journal of Geography 7 (1), 1-24.

PITTER J., LORINC J. (eds.) (2016), *Subdivided: City-building in an age of hyper-diversity*, Coach House Books, Toronto.

POTTS D. (2018), *Urban data and definitions in sub-Saharan Africa: Mismatches between the pace of urbanisation and employment and livelihood change*, Urban Studies 55 (5), 965-986.

RASHED T., JÜRGENS C. (eds.) (2010), *Remote Sensing of Urban and Suburban Areas*, Springer, London.

RICKARDS L., GLEESON B., O'CALLAGHAN C., BOYLE M. (2016), *'The urban': a concept under stress in an interconnected world*, The Conversation, Retrieved from: www.theconversation.com.

SAHEL AND WEST AFRICA CLUB (2020), *Africapolis*, SWAC, Retrieved from: www.africapolis.org.

SCHMID C., KARAMAN O., HANAKATA N. C., KALLENBERGER P., KOCKELKORN A., SAWYER L., STREULE M., WONG K. P. (2018), *Towards a new vocabulary of urbanisation processes: A comparative approach*, Urban Studies 55 (1), 19-52.

SCHNEIDER A., WOODCOCK C. E. (2008), *Compact, Dispersed, Fragmented, Extensive? A Comparison of Urban Growth in Twenty-five Global Cities using Remotely Sensed Data, Pattern Metrics and Census Information*, Urban Studies 45 (3), 659-692.

SETO K. C, REENBERG A. (eds.) (2014), *Rethinking Global Land Use in an Urban Era*, The MIT Press, London.

SETO K. C., REENBERG A., BOONE C. G., FRAGKIAS M., HAASE D., LANGANKE T., MARCOTULLIO P., MUNROE D. K., OLAH B., SIMON D. (2012), *Urban land teleconnections and sustainability*, PNAS 109 (20), 7687-7692.

SONGSORE J. (2009), *The Urban Transition in Ghana: Urbanization, National Development and Poverty Reduction*, University of Ghana, Retrieved from: www.pubs.iied.org.

STOW D. A., WEEKS J. R., SHIH H.-C., COULTER L. L., JOHNSON H., TSAI Y.-H., KERR A., BENZA M., MENSAH F. (2016), *Inter-Regional Pattern of Urbanization in Southern Ghana in the First Decade of the New Millennium*, Applied Geography 71, 32-43.

SZABO S. (2016), *Urbanisation and Inequalities in a Post-Malthusian Context: Challenges for the Sustainable Development Agenda*, Springer, New York.

TASAN-KOK T., VAN KEMPEN R., RACO M., BOLT G. (2013), *Towards Hyper-Diversified European Cities: A Critical Literature Review*, Utrecht University, Utrecht.

UCHIDA H., NELSON A. (2009), *Agglomeration index: Towards a new measure of urban concentration*, World Bank, Washington, DC.

UNITED NATIONS (2018), *The 2018 Revision of World Urbanization Prospects*, Department of Economic and Social Affairs, Retrieved from: www.population.un.org.

VERTOVEC S. (2007), *Super-diversity and its implications*, Ethnic and Racial Studies 30 (6), 1024-1054.

VORMANN B. (2015), *Urban Diversity: Disentangling the Cultural from the Economic Case*, New Diversities 17 (2), 119-129.

WEEKS J. R. (2010), *Defining Urban Areas*, in: Rashed T., Jürgens C. (eds.), Remote Sensing of Urban and Suburban Areas, Springer, London, pp. 33-45.

WORLD BANK GROUP (2015), *Rising through Cities in Ghana: Ghana Urbanization Review Overview Report*, World Bank, Washington, DC.

YEBOAH I. E. A., CODJOE S. N. A., MAINGI J. K. (2013), *Emerging urban system demographic trends: informing Ghana's national urban policy and lessons for Sub-Saharan Africa*, Africa Today 60 (1), 98-124.

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MEASURING THE CAPACITY OF LOCAL MUNICIPALITIES TO ADOPT AN URBAN E-GOVERNANCE POLICY USING A SMART SYNTHETIC MODEL

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Abstract: One of the main problems of urban governance in Algeria is bureaucracy. Based on the experience of other countries, the concept of smart cities is becoming increasingly important, including urban e-governance which is considered as an important corner stone of smart cities. Hence, e-governance is proposed as a new tool to solve urban governance problems. Its main objectives are focused on strengthening credibility and accountability. This paper tried to assess the ability of Algiers bay municipalities to adopt urban e-governance policies and to see strategies to be deployed to solve urban related problems. To achieve this goal, the work presented in this paper describes the development of a Smart Synthetic (SS) model that could serve as a tool for policy makers to assess their policies and to identify ways to solve urban problems. This 'SS model' is based on the findings of relevant, locally based case studies from the bay area, to which the model is later applied. In order to achieve this, the authors opted for a Multi-Attribute Value Theory method. The application of the model revealed that of a total of nine municipalities, four are in a position to adopt an urban e-governance policy. However, the remaining ones have not yet been able to adopt such a policy due to several barriers which are mainly related to the governance policy. The advantage of this model is therefore its flexibility. It could even be adapted to evaluate urban e-governance in other cities.

Key Words: *urban policy, intelligent governance, smart city, mixed approach, ICT.*

Introduction

E-governance is one of the most important pillars of smart cities. It plays an important role in the coordination between different disciplines and stakeholders. Praharaj et al. (2018) state that the success of a smart city depends on smart governance capable of integrating the embedded political, social and economic aspects of a city.

Urban e-governance is based on the integration of ICT to improve government services. It plays a great role in bringing citizens closer to the administration. It is also a major player in curbing corruption, reducing costs and delays and in enabling transparency and efficiency of urban management, by opening up information to the public. Moreover, it plays a great role in "improving public services such as transportation, power, health, water, security, and municipal services" (Kundu 2017). E-governance plays a great role in involving citizens in new processes of co-creation, co-production and citizens supply (Meijer 2015). However, the role of government in creating a real e-governance is still limited, as it is mainly informative (Norris 2010, Meijer 2015).

Shiang (2009) argues that e-governance is based on multi-stakeholders' coordination and responsibility. He adds that the formation of the informational society requires new forms of solidarity, partnership and cooperation between different stakeholders. According to the same author, territorial actors must propose projects and evaluate their importance, effectiveness and impact. Then, they must implement the principles of global approach, partnership and participation.

Much of the published work relating to this kind of research uses surveys to analyze the e-governance process. Even those who use the multi-criteria analysis end up with a theoretical model based on a qualitative approach. This kind of approach has some limits, such as time-consuming and subjectivity, and even the difficulty in explaining the obtained results. In this work, the authors opted for a mixed-method approach that combine the qualitative and quantitative analysis with a view to improve what the previous methods offered. They, therefore, conceptualized a theoretical model that was evaluated and verified using the statistical analysis. The choice of the approach is justified by the need to develop a model that uses previously known qualitative data and yet capable of evaluating the decision-making process according to numerical data, in order to rank the municipalities' capability and readiness to adopt urban e-governance policies.

The most recent findings are those of De and Bandyopadhyay (2020), who develop a pro-citizen model for the optimum functioning of urban e-governance and of Jiang et al. (2020), who establish a framework that examines the impact of urban contexts on the sociotechnical interaction between urban technological innovation and urban governance in the realm of smart cities. Lopes and Farooq (2020) propose a smart city governance model for Pakistan cities while Mukherjee (2018) explores the use of GIS and other information and communication technologies in governance. Praharaj et al. (2018) attempt through their work to assess the ability of Indian cities to adopt more collaborative governance. Sharma and Kalra (2019) study the level of acceptance of the e-governance policy in the capital city of Uttar Pradesh, and Santos (2017) argues that the key to success is the collaboration of different stakeholders (administrations, agencies, citizens). Palomo-Navarro and Navío-Marco (2018) are conducting a study on the smart city network which takes into account the interaction between smart governance and public network studies. They attempt to assess the impact of the smart city network at local, national and international levels (Palomo-Navarro and Navío-Marco 2018). They discovered that the Spanish network of smart cities is able to configure "future policies in local administration, necessarily related to efficiency, digitalization and citizen centricity and with key topics to build the future" (Palomo-Navarro and Navío-Marco 2018: 872). Meijer and Bolívar (2016) explain that e-governance is not only a technological issue, and they add that it also requires institutional and political changes. Castelnovo et al. (2016) propose a holistic approach for assessing smart city governance.

It is important to mention that many studies of urban e-governance are carried out as part of multi-disciplinary approaches to other topics such as trust, transparency, stakeholders, e-participation, etc. However, the assessment of urban e-governance using a 'Smart Synthetic Model' that evaluates its performance and identifies problems that could hinder its better performing systems using a mixed approach is scarce, especially when considering cities in African developing countries.

Moreover, these studies ideally explore the concept of e-governance and its relationship with the stakeholders and the coordination between them. The study of different cases of cities that have adopted the e-governance policy revealed that it is difficult to control the balance in decision-making between different stakeholders (Bovaird 2005). Such a process will be in the hand of some stakeholders; be it government departments or businessmen. In most cases, there are businessmen who take it over from other stakeholders. It is important to mention that it is impossible for ICT to be accessible to all citizens because, on one hand, some citizens are not smart enough to live in a smart city and to deal with its intelligent governance. On the other hand, the cost of ICT may exclude some poor people who could not buy new technological tools. This leads to the marginalization of a certain social strata, which is considered a kind of discrimination.

To fill this gap, the authors chose to conceive a model that expects the problems that could hinder the implementation of urban e-governance. In addition, it rates the municipalities that are

in a position to adopt an urban e-governance policy. This model was evaluated and verified through its application to the case of the municipalities of the bay of Algiers.

This model takes into account important factors such as the balance in decision-making, citizens' participation, the barriers that could hinder the implementation of urban e-governance and other factors extracted from the literature.

The literature reveals that many problems and barriers could hinder the adoption of the e-governance policy. The introduction of ICT into governance policies can be hampered by the inability of many stakeholders to adopt this type of technology (Dougherty 1992, Meijer 2015). A number of barriers can be identified under the following two headings:

- Government barriers that can be divided into: personal capacity, technical capacity, financial capacity, legal issues (lack of political support and management), lack of leadership (Eynon and Margetts 2007, Meijer 2015), lack of coordination (Eynon and Dutton 2007, Eynon and Margetts 2007, Meijer 2015), and, finally, inter-organizational (Sørensen and Torfing 2011, Meijer 2015).
- Technical barriers related to hardware and software, interoperability (Eynon and Margetts, 2007, Meijer 2015), and the ability to maintain confidentiality and security (Gilbert et al. 2004, West 2005, Meijer 2015).

Citizen-related barriers, such as motivation and skills to cooperate with the government, represent the so-called "digital divide" that is mentioned as a key barrier (Van Deursen and Van Dijk 2011, Meijer 2015). It is also suggested that staff may resist to e-governance for the fear that technology may replace the people. Another obstacle is that ICT cannot be integrated into the daily routine (they are not domesticated). It is important to mention that even the mental image that citizens have of the government could be an obstacle, especially if they do not trust the government, so they will never interact with the government using ICT (Margetts and Dunleavy 2002, Meijer 2015) and, finally, structural and cultural barriers are mentioned by Schwester (2009) and Meijer (2015).

Shiang (2009) explains that ICT is not a neutral tool. He explains that the use of ICT to maintain democracy is important, but it can also have a negative effect in the case of cities where democracy is fragile. He argues that ICT can make power more concentrated through information control. This situation can give powerful stakeholders the opportunity to be even more powerful by controlling the information and by excluding the citizens from the decision-making process. He adds that ICT can contribute to producing a democratic society, but they can also produce autarky.

Finally, Chadwick and May (2003), Torres et al. (2006) and Shiang (2009) argue that ICT in developing countries strengthens management without creating opportunities for citizen participation in policy making.

Shiang (2009) argues that ICT can lead to the emergence of new forms of segregation between the information rich and the information poor; the latter will therefore be excluded from the political life, while coordination between different stakeholders is strongly recommended in the e-governance policy as it plays an important role in improving the delivery services (Kunstelj and Vintar 2004, Špaček 2014). Špaček (2014) argues that coordination through e-governance is considered a key factor for effective governance at the national level. Shiang (2009) explains that an information society needs new forms of solidarity and cooperation between different actors.

In addition, the development of ICT within the government can play an important role in improving the efficiency of the government's administrative body (Heeks 2001, Ismail 2010). This work has the particularity of providing a model based on the study of problems and

barriers that could hinder the better performance of the e-governance policy. The study is based on tried and tested methods by different scholars.

Moreover, the authors tried to use this model to solve problems that already existed in previous experiences in order to establish an intelligent system capable of predicting problems and trying to solve them automatically, taking into account the specificity of Algiers (a city located in a developing African country with an unclear governance system). In addition, this model attempted to integrate citizens into the political process using ICT, and, also, it could predict the proportion of citizens who could be marginalized due to the ignorance of ICT tools or the inability to buy them to facilitate integration in the political process.

The aim of this work is to demonstrate the application of the e-governance policy in the bay of Algiers using a "Smart Synthetic Model", composed of several attributes and variables. This work will help decision makers to identify any potential problems that could hinder the performance of such a policy and to enable it to be inclusive towards the citizens. Given that the model is based on data from the local municipalities, it helps decision-makers to decide on the kind of operations to adopt, in order to reduce the gap between the aspirations, needs and practicalities of the governance system in Algiers.

The paper presents a model for assessing and ranking the ability of Algiers' bay municipalities to adopt the urban e-governance policy and to identify the problems and barriers that could hinder adopting such a policy. Through this work, the authors were able to assess and rank the municipalities of the bay of Algiers in terms of their potential to adopt an urban e-governance policy.

Methodology

Many researchers chose for qualitative research when studying a decision-making process (Table 1). In order to realize the objective of this work, the authors opted for a mixed-use approach. The Multi-Attribute Value Theory, or MAVT for short, is a mixed method, based on numerical representations in order to help decision-makers to choose between alternative decisions. It is largely used by many researchers such as Ferretti et al. (2014), Da Cruz and Marques (2017), and Cheniki et al. (2019). It relies on using a multitude of attributes which are different in the type and scale of measurement. It is generally used to measure and rank the performance of a service or an activity. MAVT can use qualitative and/or quantitative descriptions in order to measure the performance of an objective. Moreover, the experts' judgment can substitute quantitative data if it is not available. According to Ferretti et al. (2014), the objective of MVAT is to find a way to associate a real number to each alternative to establish an order of preference for the alternatives consistent with the value judgment of the decision-maker.

Using such a method, all alternative values could be transformed into one simple value by aggregating the values for all attributes. The alternatives with the highest values are ranked the highest. The use of the methodology is through two distinct stages. The first one consists of a conceptualization that involves fixing the appropriate objectives to be evaluated. Those objectives are defined using a set of attributes. This step was undertaken using a literature review that helped to fix the suitable alternative attributes. The second one, that of application, was realized by moving from abstract concepts into measured attributes. According to Ferretti et al. (2014), such attributes can be directly derived from the definition of objectives, constructed to measure the degree to which any objective is met or indirectly related to the defined objectives. The performance of any of the attributes may be described either qualitatively or quantitatively.

Table 1

Advantages and disadvantages of a qualitative approach

Qualitative approach	
Advantages	**Disadvantages**
• It describes in detail the feelings, opinions, and experiences of the interviewees and it explains their significance (Denzin 2001). • It explains the participant's experience in specific settings. • Ideographic research. • It permits to study and understand the interviewees' feelings and experiences, and to figure out how meanings are shaped through culture (Strauss and Corbin 1990). • Collected data are subjective and detailed. • Flexible framework so it can be built and be readapted in order to obtain a greater extent (Maxwell 2012).	• Focus on meanings and experiences (Cumming 2001, Silverman 2016). • Decision-makers may refute results obtained by using the qualitative approach. • In order to analyze a phenomenon, stakeholders usually use the quantitative approach (Sallee and Flood 2012). • The problem of generalizing the findings to the whole population of the research using a few number of samples (Thomson 2011, Harry and Lipsky 2014). • Analyzing data and discussing results is more complicated comparing to quantitative approaches (Richards and Richards 1994). • It consumes a lot of time.

Source: the authors, based on Rahman (2017)

Case study applications

The bay of Algiers (Fig. 1) is considered as the most important urban area in Algeria, due to several variables such as: strategic location, history, heritage, social and cultural situation, economy and port activity (1st commercial port in Algeria).

From an administrative point of view, the study area is made up of nine municipalities with 54.43 km², covering 6.7% of the surface area of Algiers with approximately 574 880 inhabitants, and representing 18.2% of the population of the capital. These municipalities are different in terms of area, population density (which varies between 35 949 inhabitants/km^2 for Casbah and 3294 inhabitants/km^2 for El Marsa), density of blocks, land use categories, proportion of different activities in urban areas and socio-economic importance.

Urban governance in Algiers

Algiers' governance system is characterized by precarious institutions. Icheboudène (2009) explains that the problem of governance in Algiers is linked to incoherence between the conception and the use of this policy and the adoption of inadequate objectives and tools of governance. In addition, he argues that there is a lack of coordination between the government institutions. Hence, the relationship between the government and the urban society is already conducted through a failed policy. The author adds that in the case of Algiers, the regional authority (Wilaya) controls the municipalities by misusing the law to the point of forbidding municipalities from carrying out their main functions. He argues that there is a contradiction between the legislative instruments and what is actually happening in the municipalities. He goes on further to state that the city represents a contradiction between government policy and

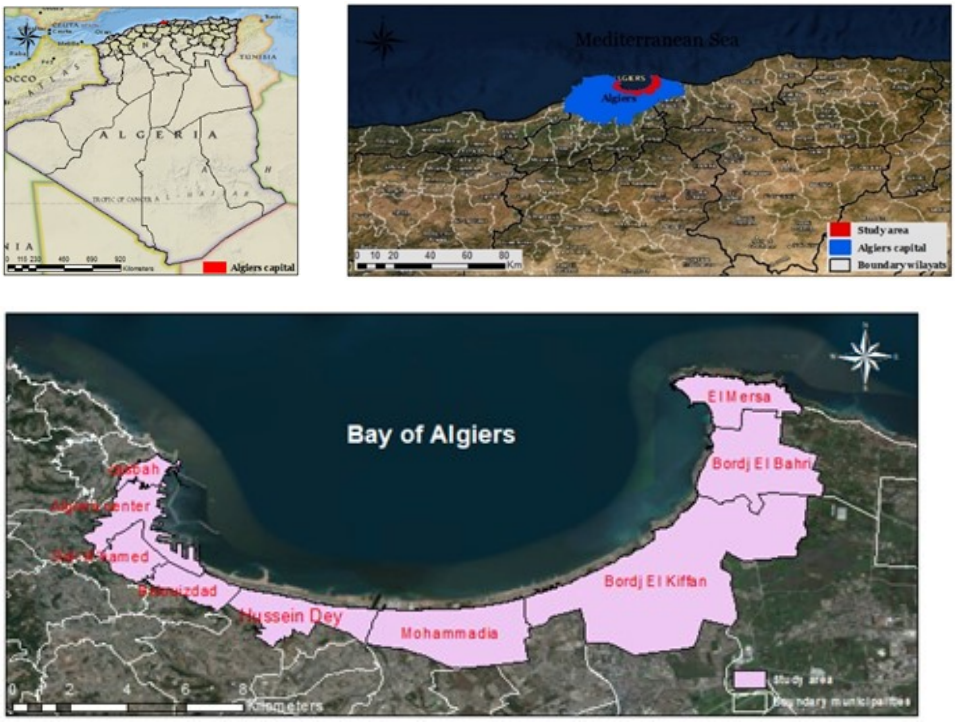

Fig. 1 **– Presentation of the bay of Algiers**

citizen's action. He adds that Algiers represents a special case of cities that try to retain political power and to be the sole center of decision-making.

The decision support process. Structuring the model framework

In order to realize the Smart Synthetic Model's tree, the authors used a top-down approach. This model was realized from the definition of the concept of urban e-governance and the objective of this work (Fig. 2).

The analysis of the development of the concept of urban e-governance and the problems that could hinder its better application led the authors to build a model for a successful urban e-governance. In order to achieve this, the authors adopted an MAVT approach to put forward a "Smart Synthetic Model" conceptualized on the basis of the definition, characteristics and objectives of an urban e-governance policy. The model is able to predict problems and it tries to mitigate against their negative impact before they happen. In other words, it was based on a critical analysis of the urban e-governance policy.

This model outlined two main priorities: preserving the obligation to integrate the citizens into the political system, and to maintain a balance between the stakeholders in the decision-making process in order to keep the equity between the priorities and obligations of different stakeholders. The model is capable of measuring the degree to which the objectives of the urban e-governance policy, such as accountability, transparency, efficiency and economic benefits, were realized.

The attributes of the SS Model can be described as follows:
(A) ICT: it measures the ability of stakeholders in each of the municipalities of Algiers' bay to be connected to internet, taking into account the ability of the citizens to own ICT tools and the citizens' ability to be integrated into an intelligent atmosphere. It takes into account the presence of ICT tools and ICT infrastructures, even of technology literate citizens who could use ICT without any problem.
(B) Participatory and digital democracy: it measured the degree of participation of different stakeholders in an urban e-governance process.
(C) Infrastructure: this attribute has not been taken into consideration in developed countries; however, it seems that it is important to consider in the case of cities located in developing countries because there were many municipalities that didn't have enough infrastructures (decision-making infrastructure or public services).
(D) Transparency and public accountability: measuring this attribute was more complicated than that of other attributes, because its evaluation is more qualitative than quantitative. Hence, to measure this attribute, the authors used a binary variable by answering the following questions:
- Is the municipal budget's information posted on the Internet?
- Is the budget's information for the operation posted on the Internet?
- Does the municipality provide open information and public assessment works to strengthen the citizens' voice and exit?
- Is there a mandatory referendum on major projects?
(E) Efficiency: the authors considered two main attributes (e-administration and e-voting); both were qualitative attributes.
(F) Local economy: the assessment of this attribute was based on the measurement of three main variables (structural projects, land for sale on local markets and land prices in each municipality).
(G) Rule of law: this attribute measured the degree of respect for the law in each municipality of the bay of Algiers. In order to achieve this objective, two main attributes were proposed (number of uncorrupted mayors, information on corruption published on the Internet), this information was based on the collection of information published on the Internet, including information published in the different daily newspapers.
(H) Political stability: This attribute was based on measuring citizens' satisfaction with their executive mayors. For this paper, the measurement of this attribute is based on:
- The number of executive mayors serving more than one mandate, so that full stability will be represented by the same mayor for all these years (Swianiewicz 2001). In the case of Algiers' bay municipalities, the mayoral mandates taken into account were those of 2002, 2007, 2012, 2017 (twenty years).
- Pluralism in decision-making, by counting the number of political parties involved in the decision-making process.
- Percentage of votes obtained by the winning political parties.

Measuring the raw values

There were two kinds of attributes, quantitative and qualitative ones. Measuring the former was easier than the latter. Quantitative attributes were measured using different sources such as surveys, counting and using different android applications for mobile phone, such as "Speedtest", for calculating signal force for mobile internet (2G, 3G, and 4G), and software such as ArcGIS for measuring infrastructures and services (Table 2). However, qualitative attributes were measured using different methods. In the case of our model, attributes such as transparency, public accountability and efficiency, were measured by the means of questionnaires using a series of Yes/No questions.

Table 2

Source of the database used in measuring the "SS model" of Algiers' bay municipalities

Attributes		Variables	Source of information
ICT	ICT tools	Internet users	DPTIC (2017)
		Home phone	DPTIC (2017)
		Computer users	DPTIC (2017)
		Smart phone users	–
		Signal force 2G, 3G, 4G	Measured by the authors using the "Speedtest android" application on mobile phones (2018)
		ICT infrastructures	DPTIC (2017)
	Human ability to use ICT	Citizen's literacy	ONS (2011)
Participatory & digital democracy	Social participation	Civic societies	GIS of Algiers (2018) realized by the authors
		Voters	DALE (2017)
	Companies	Public companies	GIS of Algiers (2018) realized by the authors
		Private companies	GIS of Algiers (2018) realized by the authors
Infrastructure		Decisional infrastructure	GIS of Algiers (2018) realized by the authors
		Public infrastructure	GIS of Algiers (2018) realized by the authors
Transparency & public accountability		Municipalities' budget information posted on the internet	Information published on the internet (2018)
		Operation's budget information posted on the internet	Computed by the authors from information published on the internet (2018)
		Open information and public assessment works to strengthen the citizen voice and exit	Calculated by the authors from information published on the internet (2018)
		Mandatory referendum on large projects	Calculated by the authors from information published on the internet (2018)
Efficiency		E-administration	Calculated by the authors from information published on the internet (2018)
		E-voting	–
Local economy		Structural projects	DAUC (2016)
		Land for sale	Computed by the authors from OuedKniss (2018) consulted in 2018
		Land's price	Computed by the authors from OuedKniss (2018) consulted in 2018

Rule of law	Uncorrupted mayors	Calculated by the authors from information published on the internet (2018)
	Corruption information published on the internet	Computed by the authors from information published in internet (2018)
Political stability	Pluralism in decision making	D.G.L.P.A.J. (2017)
	Number of executive mayors occupying a position in different years	Calculated by the authors from information published on the internet (2018)
	Successful political party	D.G.L.P.A.J. (2017)

Normalization (standardizing scores)

Raw scores of different attributes can't be used as they are and they needed to be standardized in order to be compared. This operation was done by transforming the raw scores into normalized scores, by using the Z-score, which are represented as standard deviations from their means. So, the Z-scores have zero as mean value and the standard deviation is equal to one (Abdi 2007). In order to realize that operation, it is necessary to use a multitude of samples that have different raw scores to be compared and transformed into Z-score values (Abdi 2007), using Equation 1:

$$Z = \frac{Y - M_Y}{S_Y}$$

Equation 1. The Z-score formula

It is important to mention that raw scores are represented in positive and negative values; when 0 is considered as medium level, positive scores mean that the objective is highly realized in those municipalities and negative values mean that the performance objective is low.

Weighting values

There are many ways to calculate the weights of different attributes. In this work, the Analytic Hierarchy Process (AHP) method seems to be an adequate method to be used. It is a theory based on the pairwise comparison of different judgments of experts in urban governance in order to obtain the priority scale (Saaty 2008). This is undertaken in two steps.

First, a scale is set, which indicates the importance of each element to another with respect to the type of element (attribute or variable). The authors used a 1 to 9 scales for all attributes: 1 – equal importance, 2 – weak or slight importance, 3 – moderate importance, 4 – moderate plus importance, 5 – strong importance, 6 – strong plus importance, 7 – very strong or demonstrated importance, 8 – very, very strong importance, and 9 – extreme importance (Saaty 2008).

The second step involves building a pairwise comparison matrix based on the experts' opinions (35 experts were asked) to form a qualitative judgment with different alternatives. Each attribute was compared with another one in the same level in order to obtain its weight using the AHP scale explained above. Table 3 presents the pairwise comparison of the weighted attributes of urban e-governance of Algiers bay municipalities. The same process was carried out in order to compute the weights for the variables (i.e. the attributes were compared with each other and the variables were compared with other variables which are related to the same attribute).

It is important to mention that judgement matrices information could be obtained from different methods; it may be interviews, decision conferencing, web-based questionnaires and surveys. In this work, we have used web-based questionnaires to obtain the information quickly.

Table 3

Standardized matrix

Attributes	A	B	C	D	E	F	G	H	Weight
A	0.37	0.57	0.23	0.44	0.26	0.21	0.36	0.30	0.34
B	0.12	0.19	0.20	0.33	0.23	0.19	0.29	0.25	0.22
C	0.09	0.03	0.03	0.02	0.01	0.07	0.01	0.01	0.03
D	0.09	0.06	0.17	0.11	0.19	0.16	0.22	0.20	0.15
E	0.07	0.03	0.09	0.02	0.04	0.09	0.02	0.02	0.05
F	0.12	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.03
G	0.07	0.05	0.15	0.04	0.15	0.14	0.07	0.15	0.10
H	0.06	0.04	0.12	0.03	0.11	0.12	0.02	0.05	0.07

CI=0.009; CR=0.01

Source: the authors, based on the experts' evaluation

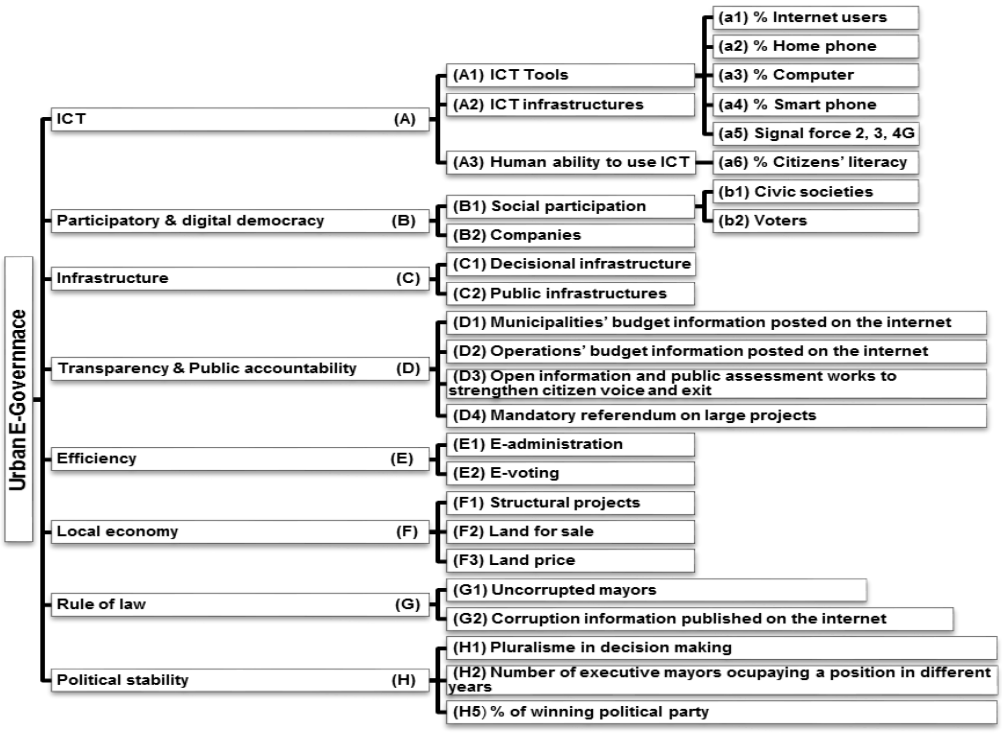

Fig. 2 **– Synthetic Smart model tree (Attributes and variables)**

Results

The Algiers' bay municipalities database was conceived using different sources of information. The collection of such data was time-consuming. Once this was achieved, the variables and attributes defining the "SS model" were measured. The verification of the model yielded a Cronbach Alpha coefficient of 0.7, which is considered as "good". The key findings of this study are presented under the following two main headings.

Urban e-governance ability (ranking of municipalities)

In order to measure and rank the ability of Algiers' bay municipalities to adopt an urban e-governance policy, the authors attempted to build and use the "SS model". Hence, measuring the attributes defining that model yielded the following results (Fig. 3).

Algiers Center was ranked as the best municipality that is able to adopt the urban e-governance policy followed respectively by Hussein Dey, El Marsa, Sidi M'hamed, Mohammadia, Bordj El Kiffan, Casbah, Belouizdad and Bordj El Bahri.

Algiers Center and Hussein Dey were ranked as the best by obtaining the highest scores (+1.1582, +0.1711), followed by El Marsa and Sidi M'hamed with average scores (+0.0511, +0.0123). However, five other municipalities were ranked as being the worst (with negative scores).

It is important to mention that Algiers Center is the only municipality that obtained positive scores for all the attributes of the "SS model".

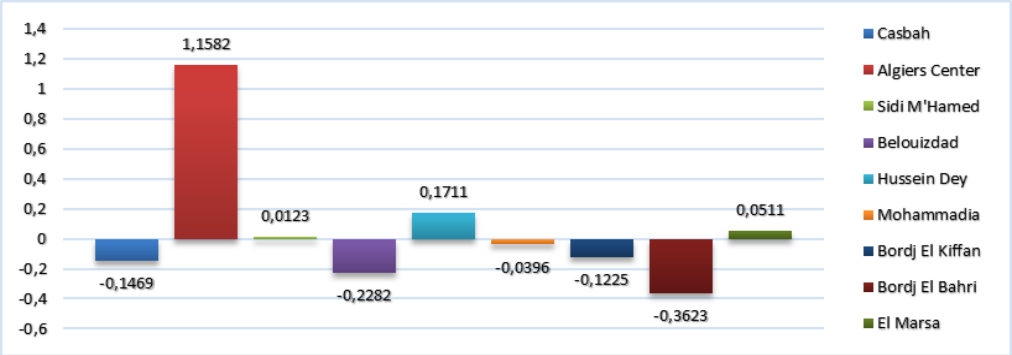

Fig. 3 – **Urban e-governance ability (Ranking of Algiers' bay municipalities)**

Barriers into adopting the e-governance policy

After measuring all attributes related to the urban e-governance policy in nine different municipalities, Fig. 4 demonstrates the different scores obtained by measuring each attribute of the "SS model". This showed that Algiers center was the only municipality that obtained positive scores by measuring all attributes. For the rest of the other municipalities, there are two kinds of problems. First, problems related to the urban governance. Secondly, problems related to information and communication technologies.

Referring to the barriers related to urban governance, the "SS model" revealed the following Information:

- 4 out of 9 municipalities under study failed to involve the citizens and the civic society into the urban governance policy (Belouizdad, Mohammadia, Bordj El Bahri, El Marsa).
- 4 out of 9 municipalities have not provided their citizens with the necessary infrastructure for their well-being (Casbah, Mohammadia, Bordj El Bahri, El Marsa).
- 6 out of 9 municipalities failed to be more transparent and more accountable (Sidi M'hamed, Belouizdad, Hussein Dey, Mohammadia, Bordj El Bahri, El Marsa).
- 8 out of 9 municipalities failed to be more efficient in responding to the citizens' requests (Casbah, Sidi M'hamed, Belouizdad, Hussein Dey, Bordj El Kiffan, Bordj El Bahri, El Marsa, Mohammadia).
- 5 out of 9 municipalities failed to develop their local economy (Hussein Dey, El Marsa, Bordj El Bahri, Belouizdad, Casbah).
- 3 out of 9 municipalities failed to apply the rule of law in their municipalities (Casbah, Bordj El Kiffan, El Marsa).
- 4 out of 9 municipalities were politically unstable (Hussein Dey, Mohammadia, Bordj El Kiffan, Bordj El Bahri).

The results revealed that the most important barriers are related to urban governance and not only to the integration of ICT in that policy. So that, the barriers related to the information and communication technology were that 5 out of 9 municipalities failed to integrate ICT into their decision-making process (Casbah, Sidi M'hamed, Belouizdad, Bordj El Kiffan, Bordj El Bahri).

Discussion

This paper discussed the ability to adopt the urban e-governance policy using the "SS model" and the Algiers' bay municipalities' database which played a great role in realizing the purpose of this study by building a "Smart Synthetic model" and by using it to evaluate and rank the ability of these municipalities to adopt the urban e-governance policy. Also, we tried to extract the factors that can hinder the adoption of this policy in the case of Algiers' bay municipalities.

There are only a few works that attempt to assess the urban e-governance policy; most of them evaluate only the urban governance in the case of developing or developed countries. The most relevant work belongs to Da Cruz and Marques (2017), as the authors attempt to assess local governance indicators in the case of Lisbon (city located in a developing country). Besides, through this work, the authors tried to build a Smart Synthetic model (SS model) which was based on the context of an African developing country in order to assess the ability of their cities to adopt the urban e-governance policy by helping the decision-makers to take the appropriate decisions to solve the problems related to the urban e-governance policy. The results got from assessing the ability of Algiers' bay municipalities to adopt the e-governance policy were surprising.

Algiers Center is perfectly able to adopt the urban e-governance policy; the assessment using the "SS model" revealed that the scores obtained from measuring all attributes were positive. Hence, it was ranked as the first municipality to be able to adopt the urban e-governance policy compared to the other municipalities of this case study.

The scores obtained from measuring three other municipalities were also positive. It means that Sidi M'hamed, Hussein Dey and El Marsa have been able to adopt the urban e-governance policy. However, the rest of the other municipalities had negative scores. It means that they were not yet in a position to adopt the e-governance policy.

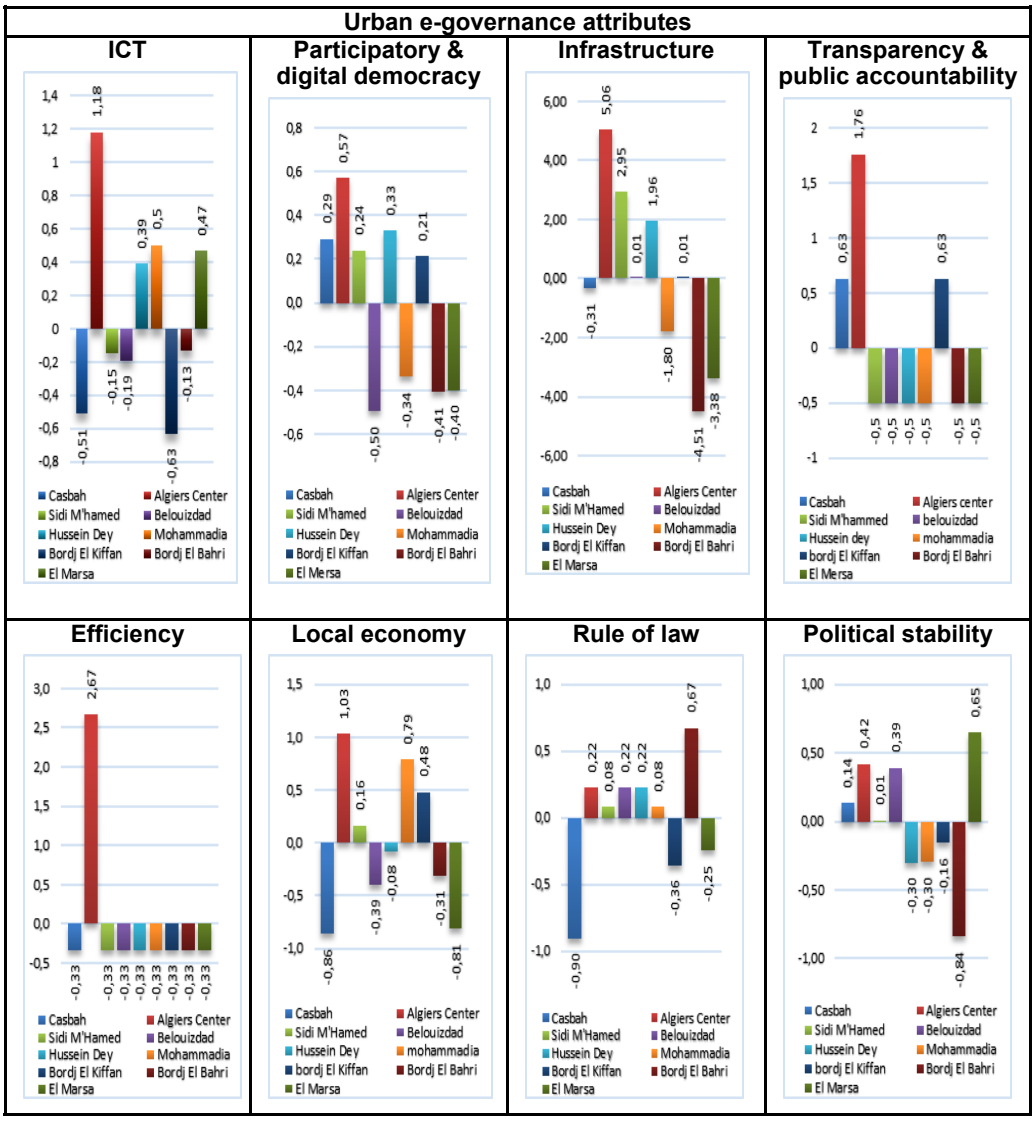

Fig. 4 **– Evaluation of urban e-governance policy in Algiers' bay municipalities, by Attributes**

The most remarkable barriers were not only related to the ICT knowledge, but also to the urban governance policy which was not respected in most of the municipalities.

It is important to mention that the authors attempted to evaluate the ability of Algiers' bay municipalities to adopt the urban e-governance policy by using the "SS model". Fortunately, Algiers' bay municipalities' database played a great role in realizing this objective. However, some attributes were not used due to the lack of information (i.e. number smartphone users), or

the non-existence of a certain service (i.e. e-voting).

This work is different from the previous ones on the urban governance policy, because it included the possibility to integrate ICT into the urban governance policy in cities located in an African developing country. Two kinds of barriers were considered: urban governance barriers and ICT barriers.

The application of the "SS model" in the case of Algiers' bay municipalities led the authors to discover the following realities.

Despite the centralized urban governance system in Algiers, the results obtained by using the "SS model" attributes in the case of Algiers' bay municipalities revealed that each municipality presented itself a distinct case (the results are different from those of the other municipalities). The only similarity between most of them was that they all had urban governance barriers. Surprisingly, only Algiers center was highly able to adopt the urban e-governance policy because it fulfilled all attributes of good governance and ICT knowledge. Three other municipalities were considered the best (Hussein Dey, Sidi M'hamed, El Marsa), but they suffered from numerous barriers (i.e. in the case of Hussein Dey, lack of transparency and public accountability, efficiency, weak local economy, and weak political stability). This study demonstrated that urban e-governance in Hussein Dey municipality could be caused by many problems, mainly: low human capacity to use ICT, weak participation of civic society and citizens, lack of numerous infrastructures and transparency & accountability, poor efficiency, scarcity of constructible lands and structural projects, and finally, problems related to corruption and political stability. Decision-makers must therefore focus on solving these problems in order to then promote the urban e-governance policy; they only have to solve the problems that need to be solved first.

Therefore, the role of Hussein Dey's decision-makers was to fill these gaps in order to achieve an effective political system to be able to adopt a fully-fledged urban e-governance policy. However, the rest of the other municipalities were not able to adopt this policy, as they had to intervene in many parts to obtain a more efficient political system.

Broadly, this study led the authors to believe that the municipalities of the bay of Algiers suffer the most from governance problems. Thus, before trying to integrate ICT into a failing governance system, it is more beneficial to fill the gaps of the urban governance system in these municipalities before trying to integrate ICT into it.

It is important to mention that the used approach has many advantages, such as building and testing the theory at the same time (Malina et al. 2011). Although, it is able to produce a model that could save time, especially when developed into a software. This methodology makes use of two kinds of approaches (qualitative and quantitative) that were combined to better explain the obtained results. However, this kind of approach is time-consuming to implement because it requires building a theoretical model based on literature review and the collation of numerical information for its application. It also requires the knowledge of tools such as GIS tools and statistical tools. The reader is reminded that qualitative data is difficult to transform into numerical scores.

Concerning the SS model, it is important to mention that it has some limitations. It believed in the availability of information in many fields in order to achieve the objective under study. The lack of information was a barrier that hindered the realization of the underlined objective, especially in cities in developing countries where it was difficult to obtain information that is available, yet at times it did not even exist.

Moreover, the normalization of the same value in all municipalities led to ignoring some variables (variables that had the same value in all municipalities were automatically rejected during the normalization). In addition, the compensatory nature of the model revealed broadly the scores without taking into account the detailed information of each attribute (i.e. low scores were compensated by high scores).

Finally, this work will contribute significantly to the understanding of urban e-governance in cities located in developing countries. It will play an important role in helping decision-makers to make the best decisions. This model was built using different attributes that define urban e-governance in cities in developing countries. It is important to mention that there have been few works on the evaluation of urban e-governance in cities of African developing countries.

The "SS model" will serve as a reference for the assessment of the urban e-governance policy; it could be applied to many other cities, particularly in developing countries. It had the advantage of being useful for evaluating and ranking urban e-governance in municipalities. It is flexible, because it had the possibility to be adopted in other cities as it can be customized by adding or deleting certain attributes and variables that could be related to the study objective.

Conclusions

Research work on urban e-governance policy for cities in developed and developing countries is widely available. Studies on cities located in African developing countries are scarce. This paper puts forward a model to study urban e-governance in cities located in African developing countries. This study yielded two kinds of results. First, it revealed a model that measures urban e-governance in cities of developing countries. Secondly, it measured and ranked the capacity of the municipalities of the bay of Algiers. The results obtained while measuring urban e-governance by using the "SS model" revealed that there were two kinds of problems that could hinder the adoption of that policy (problems related to the governance policy and other problems related to their inability to adopt or use ICT technologies).

The "SS model" had the advantage of being more flexible, because it handles the addition or deletion of other attributes and variables for a better efficiency. Yet it could be adapted to evaluate urban e-governance in other cities too, particularly in the case of municipalities located in a developing country.

It also had the advantage of being more intelligent by transforming it into an android application that could be used by any stakeholder. This operating system could help the decision-makers to intervene quickly and surely. It saves more time and money. It also had the capacity to rank urban e-governance in cities and to predict the problems that could hinder the development of the urban e-governance policy in these cities.

It is important to note that the "SS model" will be a reference for the researchers when studying the applicability of the urban e-governance policy in cities of developing countries. The performance of the model relies heavily on the availability of information on the used attributes and variables.

References

ABDI H. (2007), *Z-scores*, in: Salkind N. J. (ed.), Encyclopedia of Measurement and Statistics. Vol. 1, SAGE, Thousand Oaks, CA, pp. 1055-1058.

BOVAIRD T. (2005), *Public governance: balancing stakeholder power in a network society*, International Review of Administrative Sciences 71 (2), 217-228.

CASTELNOVO W., MISURACA G., SAVOLDELLI A. (2016), *Smart Cities Governance: The Need for a Holistic Approach to Assessing Urban Participatory Policy Making*, Social Science Computer Review 34 (6), 724-739.

CHADWICK A., MAY C. (2003), *Interaction between States and Citizens in the Age of the Internet: "e-Government" in the United States, Britain, and the European Union*, Governance 16 (2), 271-300.

CHENIKI K., BAZIZ A., BOUDIAF B. (2019), *Evaluating Relationship between Mixed-land Use and Land-use Compatibility in Algiers Bay*, International Journal of Environmental & Science Education 14 (7), 389-404.

CUMMING A. (2001), *ESL/EFL instructors' practices for writing assessment: specific purposes or general purposes?*, Language Testing 18 (2), 207-224.

D.G.L.P.A.J. (2017), *Elections of 23 November 2017 (APC), Distribution of Seats by Lists - Preliminary Results*, in: Assembly C. P. S. (ed.), Ministry of the Interior, Local Government and Spatial Planning, Algiers.

DA CRUZ N. F., MARQUES R. C. (2017), *Structuring composite local governance indicators*, Policy Studies 38 (2), 109-129.

DALE (2017), *Election of the directors of APC and APW of the wilaya of Algiers*, Directorate of Local Administration of Elections and Voters, Algiers.

DAUC (2016), *Master plan for development and urban planning*, PDAU Architecture, Urban Planning and Construction Department, Algiers.

DE J., BANDYOPADHYAY S. (2020), *Urban E-Governance: A Quest for Pro-citizen Conceptual Model*, in: Bandyopadhyay S., Pathak C., Dentinho T. (eds.), Urbanization and Regional Sustainability in South Asia. Contemporary South Asian Studies, Springer, Cham, pp. 297-309.

DENZIN N. K. (2001), *Interpretive interactionism*, SAGE, Thousand Oaks, CA.

DOUGHERTY D. (1992), *Interpretive barriers to successful product innovation in large firms*, Organization Science 3 (2), 179-202.

DPTIC (2017), *Telecommunication*, in: D.O.P.A.I.A.C. (ed.), Technologies, The Ministry of Post, Telecommunications, Technologies and Digital Technology, Algiers.

EYNON R., DUTTON W. H. (2007), *Barriers to networked governments: Evidence from Europe*, Prometheus 25 (3), 225-242.

EYNON R., MARGETTS H. (2007), *Organisational solutions for overcoming barriers to eGovernment*, European Journal of ePractice 1, 1-13.

FERRETTI V., BOTTERO M., MONDINI G. (2014), *Decision making and cultural heritage: An application of the Multi-Attribute Value Theory for the reuse of historical buildings*, Journal of Cultural Heritage 15 (6), 644-655.

GILBERT D., BALESTRINI P., LITTLEBOY D. (2004), *Barriers and benefits in the adoption of e-government*, International Journal of Public Sector Management 17 (4), 286-301.

HARRY B., LIPSKY M. (2014), *Qualitative research on special education teacher preparation*, in: Sindelar P. T., McCray E. D., Brownell M. T., Lignugaris/Kraft B. (eds.), Handbook of research on special education teacher preparation, Routledge, New York, pp. 445 -460.

HEEKS R. (2001), *Understanding e-governance for development*, Institute for Development Policy and Management, Manchester.

ICHEBOUDÈNE L. (2009), *Réflexion sur la gouvernance urbaine à Alger. Prérogatives institutionnelles et monopoles politiques*, Insaniyat 44-45, 97-113.

ISMAIL H. (2010), *Citizens' Readiness for E-government in Developing Countries (CREG)*, in: Kamel S. (ed.), E-Strategies for Technological Diffusion and Adoption: National ICT Approaches for Socioeconomic Development, IGI Global, Hershey, PA, pp. 215-233.

JIANG H., GEERTMAN S., WITTE P. (2020), *A Sociotechnical Framework for Smart Urban Governance: Urban Technological Innovation and Urban Governance in the Realm of Smart Cities*, International Journal of E-Planning Research 9 (1), 1-19.

KUNDU D. (2017), *Urban E-Governance*, IGNOU, Retrieved from: www.egyankosh.ac.in.

KUNSTELJ M., VINTAR M. (2004), *Evaluating the progress of e-government development: A critical analysis*, Information Polity 9 (3-4)**,** 131-148.

LOPES N. V. M., FAROOQ S. (2020), *Smart City Governance Model for Pakistan*, in: Lopes N. (ed.), Smart Governance for Cities: Perspectives and Experiences, Springer, Cham, pp. 17-28.

MALINA M. A., NØRREKLIT H. S. O., SELTO F. H. (2011), *Lessons learned: advantages and disadvantages of mixed methods research*, Qualitative Research in Accounting & Management 8 (1)**,** 59-71.

MARGETTS H., DUNLEAVY P. (2002), *Better Public Services through e-government: Academic Article in support of Better Public Services through e*-government, LSE Research Online, Retrieved from: www.eprints.lse.ac.uk.

MAXWELL J. A. (2012), *Qualitative research design: An interactive approach*, SAGE, London.

MEIJER A. (2015), *E-governance innovation: Barriers and strategies*, Government Information Quarterly 32 (2)**,** 198-206.

MEIJER A., BOLÍVAR M. P. R. (2016), *Governing the smart city: a review of the literature on smart urban governance*, International Review of Administrative Sciences 82 (2)**,** 392-408.

MUKHERJEE F. (2018), *GIS use by an urban local body as part of e-governance in India*, Cartography and Geographic Information Science 45 (6)**,** 556-569.

NORRIS D. F. (2010), *E-Government 2020: Plus ça change, plus c'est la meme chose*, Public Administration Review 70 (s1)**,** s180-s181.

ONS (2011), *The urban frame RGPH 2008: The main results of the exhaustive exploitation*, National Office of Statistics, Algiers.

OUEDKNISS (2018), *OuedKniss*, Retrieved from: www.ouedkniss.com.

PALOMO-NAVARRO Á., NAVÍO-MARCO J. (2018), *Smart city networks' governance: The Spanish smart city network case study*, Telecommunications Policy 42 (10)**,** 872-880.

PRAHARAJ S., HAN J. H., HAWKEN S. (2018), *Towards the right model of smart city governance in India*, International Journal of Sustainable Development and Planning 13 (2)**,** 171-186.

RAHMAN M. S. (2017), *The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language "Testing and Assessment" Research: A Literature Review*, Journal of Education and Learning 6 (1)**,** 102-112.

RICHARDS T. J., RICHARDS L. (1994), *Using computers in qualitative research*, in: Denzin N. K., Lincoln Y. S. (eds.), Handbook of qualitative research**,** SAGE, London, pp. 445-462.

SAATY T. L. (2008), *Decision making with the analytic hierarchy process*, International Journal of Services Sciences 1 (1)**,** 83-98.

SALLEE M. W., FLOOD J. T. (2012), *Using qualitative research to bridge research, policy, and practice*, Theory Into Practice 51 (2)**,** 137-144.

SANTOS B. (2017), *E-Government, e-Governance and Urban Planning: Towards a Complete Digital Planning Process*, in: Kő A., Francesconi E. (eds.), EGOVIS 2017: Electronic Government and the Information Systems Perspective, Springer, Cham, pp. 32-45.

SCHWESTER R. (2009), *Examining the barriers to e-government adoption*, Electronic Journal of e-Government 7 (1)**,** 113-122.

SHARMA G., KALRA S. (2019), *Advanced multi-factor user authentication scheme for E -governance applications in smart cities*, International Journal of Computers and Applications 41 (4)**,** 312-327.

SHIANG J. (2009), *Stakeholder Analysis in Territorial Intelligence in Digital Governance*, Retrieved from: www.halshs.archives-ouvertes.fr.

SILVERMAN D. (2016), *Qualitative research*, SAGE, London.

SØRENSEN E., TORFING J. (2011), *Enhancing collaborative innovation in the public sector*, Administration & Society 43 (8)**,** 842-868.

ŠPAČEK D. (2014), *Coordination of and through E-Government: The Case of the Czech Republic*, The NISPAcee Journal of Public Administration and Policy 7 (1)**,** 83-106.

STRAUSS A., CORBIN J. M. (1990), *Basics of qualitative research: Grounded theory procedures and techniques*, SAGE, London.

SWIANIEWICZ P. (2001), *Institutional Performance of Local Government Administration in Poland*, in: Jabes J. (ed.), Ten Years of Transition: Prospects and Challenges for the Future of Public Administration, NISPAcee Press, Bratislava, pp. 162-186.

THOMSON S. B. (2011), *Qualitative research: validity*, JOAAG 6 (1)**,** 77-82.

TORRES L., PINA V., ACERETE B. (2006), *E-Governance developments in European Union cities: reshaping government's relationship with citizens*, Governance 19 (2)**,** 277-302.

VAN DEURSEN A., VAN DIJK J. (2011), *Internet skills and the digital divide*, New Media & Society 13 (6)**,** 893-911.

WEST D. M. (2005), *Equity and accessibility in e-Government: A policy perspective*, Journal of E-Government 1 (2)**,** 31-43.

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THE EFFECT OF INFRASTRUCTURAL INTEGRATION OF REGIONAL TRANSPORT ON TOURISM PROMOTION: THE CASE OF GUILAN PROVINCE, IRAN

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Abstract: This article examines the impacts of infrastructural integration of regional transport (IIRT) on tourism and the idea of using IIRT to promote tourism. The process of striving for IIRT requires a number of factors to be operationalized, among which the most common are: multimodal terminals (MMT), shared stops (SST), highway construction and improvement (HCI), and railway construction and improvement (RCI). The aim of this article is to evaluate the impacts of IIRT factors on the factors which lead towards the promotion of tourism. The results showed that Guilan province, despite of profiting with all four major transportation modes, has a lack of infrastructural integration among all transportation modes. Furthermore, it was concluded that IIRT can have a significant effect on the promotion of tourism and it can be used as an approach to promote the tourism industry of Guilan province with using several strategies in this regard.

Key Words: *infrastructural integration, regional transport, tourism promotion, Guilan province.*

Introduction

Tourism is considered as one of the most important industries and its promotion plays a central role in development (Najdawi 2009, Wang and Chen 2015, Zhang et al. 2015). According to some estimates, tourism accounts for between six and seven percent of the global gross domestic product and for 1 in 11 jobs, making it the world's largest industry. According to UNWTO (2019), international tourist arrivals increased by 5% worldwide in 2019, reaching a record of 1.4 billion arrivals, while international tourism receipts increased by 4%, achieving a record of US$ 1.7 trillion in revenue. Among all activities that lead to tourism promotion, transportation can be considered as a facilitator of the tourism activity and tourism expansion (Israeli and Mansfeld 2003).

Understanding the tourist flow and the factors influencing the relationships that tourists have with the destinations has profound implications for infrastructure and transport development (Zeng and He 2019). Transportation is a key element supporting tourism and one of the most effective factors in the success of the tourism industry. The inextricable relationship between them makes the expansion of tourism as one of the main reasons for the expansion and improvement of transportation (Lumsdon 2000, Sorupia 2005, Yao et al. 2011, Lohmann and Pearce 2012, Mammadov 2012, Turnbull and Griffin 2012, Krejić and Plečić 2016, Van Truong and Shimizu 2017).

It seems that one of the best regional transportation systems to promote tourism is the integrated regional transport system. There is no fully accepted definition of the meaning of integrated transport, however, numerous descriptions and explanations have been provided to better understand the concept of integrated transport, including a series of steps, and many aspects and activities (Potter and Skinner 2000, Nosal and Solecka 2014, Lu et al. 2018). Several definitions and criteria of integrated transportation can be found in different literature (Underdal 1980, May and Roberts 1995, Hine 2000, Potter and Skinner 2000, Janic 2001,

Ibrahim 2003, Stead 2003, Hull 2005, May et al. 2006, Givoni and Banister 2010, Preston 2010, Nosal and Solecka 2014, Solecka and Żak 2014).
Janic (2001) has attempted to present some of the recent developments and issues related to integrated transport system policies in the European Union (EU). The study defines and uses the term of integrated transport systems for systems providing door-to door passenger transport services and it is believed that integration can occur at different levels and it may involve many aspects and activities (Janic 2001).

In another case, transport integration is defined as a helpful method for people to move around more easily, with less costs and inconveniences of travel (Ibrahim 2003). According to the author (Ibrahim 2003), integration is about traveling via rider-friendly intermodal facilities and interconnections. The author studied the current status of Singapore's public transit system and then, by examining the various aspects of the integrated transport, he presented several solutions towards the improvement of the public transportation of the city (Ibrahim 2003).

Stead (2003) examined the extent to which transport and land-use planning policies are integrated by the local authorities in England.

Transport integration may occur at different levels and it contains different types and forms. There are a number of different types of transport integration presented by different authors (Table 1).

Infrastructural integration is one of the most commonly introduced principles. The concept of infrastructural integration consists of a combination of elements that make up the integrity of a transport network (Nosal and Solecka 2014). The most important of these elements include multi-modal terminals and shared stops for different means of public transportation at regional level, highway construction and the improvement of existing road and rail routes[1)] (May and Roberts 1995, Potter and Skinner 2000, Hull 2005, Nosal and Solecka 2014, Solecka and Żak 2014). The aim of this article is to evaluate and to discuss the impacts of the infrastructure integration factors on the factors which lead towards the promotion of tourism. In order to show the practical application of the proposed approach, the example of Guilan was used.

Methodology

The data used in this study are characterized into two sections approaching transportation and tourism individually. The first part on transportation contains the information on the air transport of Guilan, including the location of the airport and the accessibility of other transportation modes to the airport. The second part refers to water transport, which includes information on the harbors of the province and their status of accessibility to each other and the different transportation modes. The last part on transportation, includes the condition of land transport, which is divided into two parts, namely road transport and rail transport. This part opens up with information on land and rail transport networks and it continues with the description of roads and railroads conditions, as well as the location of stations and terminals. The second section dedicated to tourism issues describes the location of tourism attractions and the accessibility of them according to transportation routes and stations.

Transportation

Research findings are based on data from the Spatial Development Plan (SDP) of Guilan province, published by the Management and Planning Organization of Guilan. The study data

1) The introduced measures are sometimes presented in the modal and spatial integration subcategories.

Table 1

Transport integration types

Author(s)	Title	Different types of transport integration
Ibrahim (2003)	Improvements and integration of a public transport system: the case of Singapore	Fare integration/Information integration/Physical integration/ Network integration/Integrated planning
May et al. (2006)	The principles of integration in urban transport strategies	Integration between policy instruments involving different modes/Integration between policy instruments involving infrastructure provision, management, information and pricing/ Integration between transport measures and land use planning measures/Integration with other policy areas such as health and education
Hine (2000)	Integration, integration, integration… Planning for sustainable and integrated transport systems in the new millennium	Integration within and between different types of transport/ Integration with the environment/Integration with land use planning/Integration with other policies for education, health and wealth creation
Hull (2005)	Integrated transport planning in the UK: From concept to reality	Integration between authorities/Integration between measures involving different modes/Integration between measures involving infrastructure provision, management and pricing/ Integration between transport measures and land use planning policies/Integration between transport measures and policies for the environment/Integration between transport measures and policies for education, health and wealth creation
Potter and Skinner (2000)	On transport integration: a contribution to better understand-ing	Functional or modal integration/Transport and planning integration/Social integration/Environmental, economic and transport policy integration
Preston (2010)	What's so funny about peace, love and transport integration?	Integration of fares, service patterns, terminals/stops and information within the public transport/Integration of infrastructure provision, management and pricing for public and private transport/Integration of passenger and freight transport/ Integration of (transport) authorities/Integration between transport measures and land use planning polices/Integration between general transport policies and the transport policies of the education, healthcare and social services sectors/Integration between transport policies and the policies for the environment and for economic development
Solecka and Žak (2014)	Integration of the urban public transportation system with the application of traffic simulation	Integration of different modes of public transportation/Integration of public and individual transportation/Integration of the transportation policy with other policies concerning spatial planning and city management/Spatial integration based on the application of efficient land use strategies/Infrastructural integration based on the development of different technical solutions in the transportation infrastructure/Organizational integration/Economic integration focused on the introduction of different measures supporting the sustainability and efficiency of the public transportation systems

of transportation, including its qualitative status and the length of different transport routes, were obtained from the second chapter of the SDP, entitled 'Transportation'. Also, the layers of transportation in the ArcGIS software, including the transportation routes, the location of

transport stations, the harbors and the airport, are provided by the database of the SDP of Guilan.

In order to determine the accessibility of the different zones of the province to transportation modes, the Euclidean distance tool with Fuzzy logic in the ArcGIS software was used for each transport infrastructure individually. Ultimately, in order to obtain the final vision on the transport accessibility of the province, an AHP-based survey using interviews with 20 experts was used for weighting the importance ratio of each infrastructure of transportation.

Tourism

The tourism based findings are mostly based on the data provided by the Management and Planning Organization of Guilan in the third chapter of the SDP, entitled 'Tourism', in which data such as the number and type of tourist attractions are collected individually by the municipality of each city and they are integrated into maps and tables in the SDP. Also, the location map of tourist attractions is provided by the organization of Handicrafts and Cultural Heritage and the SDP as well.

Results and Discussion

Guilan province, situated in the North of Iran and the South of the Caspian Sea, has been of interest in this study due to its specific potential of visiting, with a total number of 1043 tourist attractions (cultural, human-made and natural). The regional transport in Guilan is facilitated by four modes of water, air, rail and road transport, which grants different options for travelers in choosing a transportation mode to enter the province. This study steps forward to figure out the presence or the absence of infrastructural integration of transportation in Guilan, and the effect of infrastructural integration on the tourism promotion, which have not been discussed before, then to use a number of strategies based on infrastructure integration in order to promote the tourism industry of Guilan.

Air transport

Guilan province contains only one airport named Sardar-e jangal international airport, which mostly contains domestic travels, while the only international travels of this airport are limited to Islamic religious countries such as Saudi Arabia, Iraq and Syria. The airport is located in Rasht and in the vicinity of Rasht-Anzali highway which provides a proper road access to the air transport, but it is found that there is the issue of the accessibility of the airport to the terminals of other transportation modes.

The nearest bus stations to the airport are Rasht and Kouchesfahan bus terminals which are respectively in the distance of 11.2 km and of 19.2 km from it. This is while there is no bus terminal or bus station in the airport area. Also, the nearest train station from the airport is Pirbazar station, which is located at the distance of 11.4 km and it is connected to the airport through primary roads. This means that the tourists or travelers who enter the province through air transport have two options to reach the tourist attractions of the province through public transportation: 1. to use a taxi to reach the nearest bus terminal, which is located 19.2 km from the airport, and then to use the bus to reach the rest of the province; or 2. to take a taxi to reach the nearest train station, which is located 11.2 km from the airport, and then to reach the rest of the province by using the rail transport. Also, there is the opposite of this case for those who want to reach the airport from the other parts of the province. It is clear that these conditions bring numerous issues for the tourists and all passengers in terms of time, costs, convenience etc.

Water transport

There are two seaports in the province, namely Anzali and Astara, which are located on the

northern coast of the province. Today, the ports serve as the main terminals for the importation of oil etc. Although water travels are currently limited to freight transport, there is also the potential for passenger transportations.

It was found that Anzali and Astara both have proper access to the highway network of the province. Two major highways of the province, namely Rasht-Anzali and Rasht-Astara, connect these ports to the center of the province and the Sardar-e Jangal airport. Also, the Rasht-Anzali and Rasht-Astara railways that reach both Astara and Anzali ports are under construction, but currently, the nearest train stations to Anzali and Astara are, respectively, in the distance of 36.7 and 180 kilometers from them.

Land transport

According to the Management and Planning organization of Guilan, the province has a network of roads of varied quality and capacity, totaling about 8347 km. The majority of the land routes of the province are rural roads which cover 77.62% of the total, while the freeways have the smallest share of the total land routes. The Qazvin-Rasht-Astara railway, of which the most part is located in Guilan, has a length of 205 km.

Studies on the transportation network of Guilan follow that the development of transportation is concentrated in the central parts of the province and the peripheral parts of the Caspian Sea. The rail network is initially connected to the center (Rasht) from the south and then in the future, in the form of a parallel to the Caspian Sea border, it continues to the north to Bandar-e Anzali, to the west to Astara and to the east to Chaboksar and Mazandaran province. The highway network also has an almost similar pattern to the rail network in the province and the only existing freeways with lengths of 10 and 20 km are located in the south of the province. The southwest and southeast parts of the province, which include a number of important tourism counties, such as Fuman, Masal, Siahkal, and Rasht, lack a proper access to the transportation network. It is while the statistical surveys show that Fuman and Rudsar have the highest total number of tourist attractions in the province, and despite the fact that the highway network is entering the northern parts of these counties, all of their major tourist attractions have no direct access to the highways. For example, the Rasht-Fuman highway enters Fuman from the eastern part of the city, but the major tourist attractions of the city are located in the western parts. Also, in Rudsar, where the highway network enters the city from the northern parts, there are important tourist attractions in the south of the city which have no access to the highway network.

Also, according to the studies, there are currently 27 bus terminals in Guilan and also 7 train stations, namely Manjil Station, Lowshan Station, Rostamabad Station, Emamzadeh Hashem Station, Rasht Station and Pirbazar Station, while only Manjil, Lowshan and Rasht have both a bus terminal and a train station (Fig. 1). On the other hand, Rudbar, despite being on the railroad track, has no train station.

Tourism

Guilan province is profited by all three types of tourism attractions (natural, human made and cultural-historical). The results indicate that Fuman, with 267 tourism attractions (25.6% of the total), ranked the first among all counties, while Rudsar and Amlash ranked the second and third after Fuman, based on the total number of tourist attractions. The information was

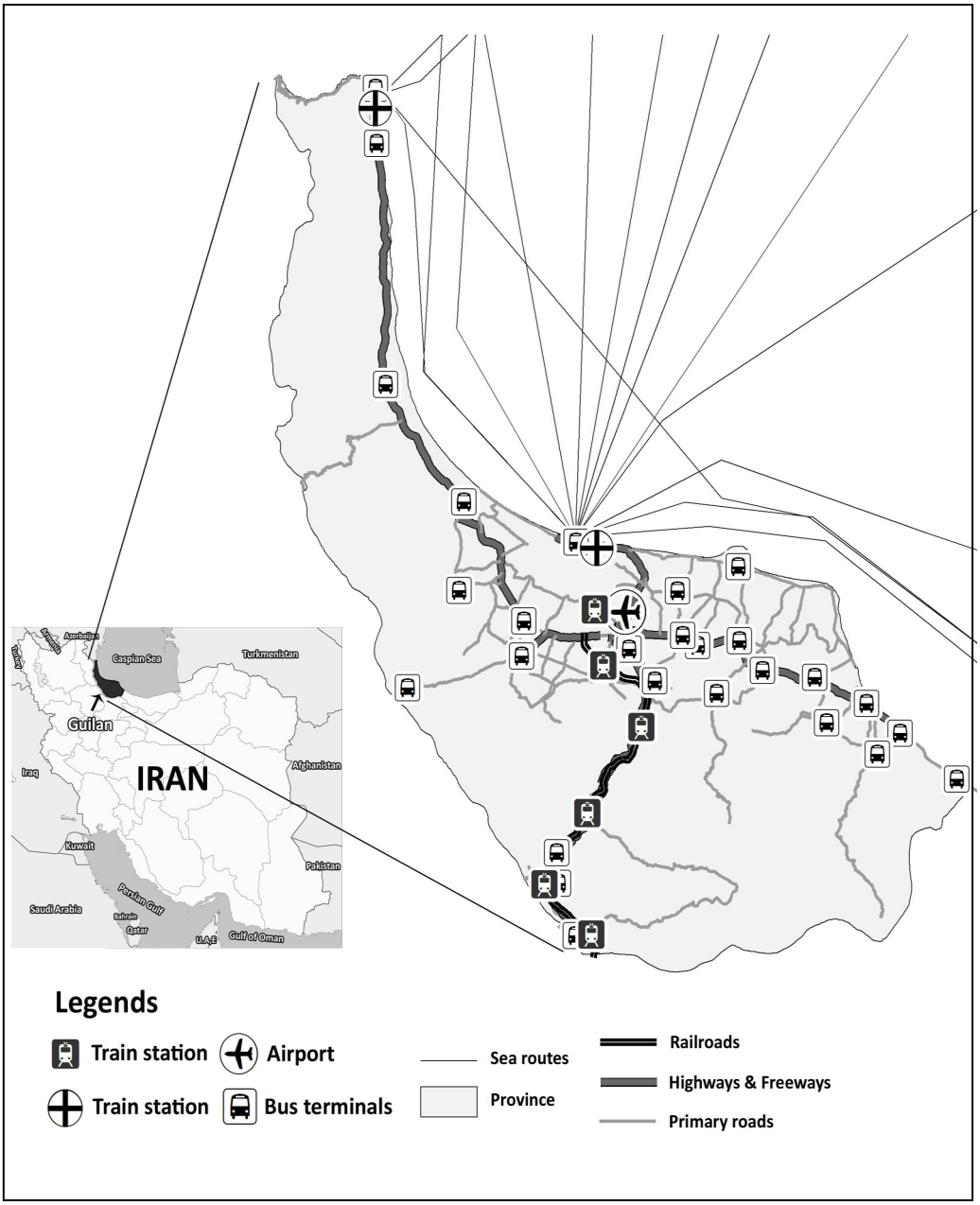

Fig. 1 **– Transport network and stations of Guilan province**
Source: Spatial development plan of Guilan province (2018)

obtained from the Organization of Management and Planning of Guilan and the results are shown in the following table (Table 2).

Table 2

Guilan tourist attractions by city

Attractions / County	Natural		Human made		Cultural-historical		Total		Ranking (based on total attractions)
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	
Astara	10	6.90	3	5.36	4	0.48	17	13.63	1) Fuman 2) Rudsar 3) Amlash 4) Rudbar 5) Rasht 6) Rezvanshahr 7) Tavalesh 8) Lahijan 9) Bandar-e Anzali 10) Masal 11) Siahkal 12) Langarud 13) Sowme'eh Sara 14) Astara 15) Astaneh-ye Ashrafiyeh 16) Shaft
Astaneh-ye Ashrafiyeh	5	3.45	2	3.57	3	0.36	10	0.96	
Amlash	7	4.83	1	1.79	143	16.98	151	14.48	
Bandar-e Anzali	8	5.52	9	16.07	11	1.31	28	2.68	
Rasht	8	5.52	17	30.36	41	4.87	66	6.33	
Rezvanshahr	3	2.07	3	5.36	52	6.18	58	5.56	
Rudbar	11	7.59	4	7.14	79	9.38	94	9.01	
Rudsar	20	13.79	4	7.14	135	16.03	159	15.24	
Siahkal	11	7.59	0	0	14	1.66	25	2.40	
Shaft	3	2.07	1	1.79	-	0.36	7	0.67	
Sowme'eh Sara	5	3.45	2	3.57	14	1.66	21	2.01	
Tavalesh	8	5.52	0	0	48	5.70	56	5.37	
Fuman	13	8.97	5	8.93	249	29.57	267	25.60	
Lahijan	4	2.76	1	1.79	27	3.21	32	3.07	
Langarud	8	5.52	4	7.14	12	1.43	24	2.30	
Masal	21	14.48	0	0	7	0.83	28	2.68	
Province	145	100	56	100	842	100	1043	100	

Source: Spatial development plan of Guilan province (2018)

Transportation routes and accesses

As mentioned in the previous sections, some parts of the province have no proper access to the transportation system and this section shows the quality of the accessibility of the different zones of the province to all transportation modes. In order to collect data, the Euclidean distance tool in the ArcGIS software and the Fuzzy Logic have been used. According to this

method, the accessibility of provincial zones to the transportation networks is divided into 4 categories. From 0 to 0-0.2 as 'Zones with high accessibility', 0.2-0.4 as 'Accessible zones', 0.4 -0.6 as 'Zones with poor accessibility', and 0.6 and above as 'Zones with very poor accessibility'.
There are 10 elements considered to determine the accessibility of the province to road transportation, namely freeways, highways, primary roads gr. 1, primary roads gr. 2, primary roads gr. 3, non-primary roads gr. 1, non-primary roads gr. 2, non-primary roads gr. 3, inner-city ways and bus terminals, and all of the mentioned elements are overlapped by different importance ratios using the AHP method.

In order to indicate the accessibility of air and water transport, the distances from the airport

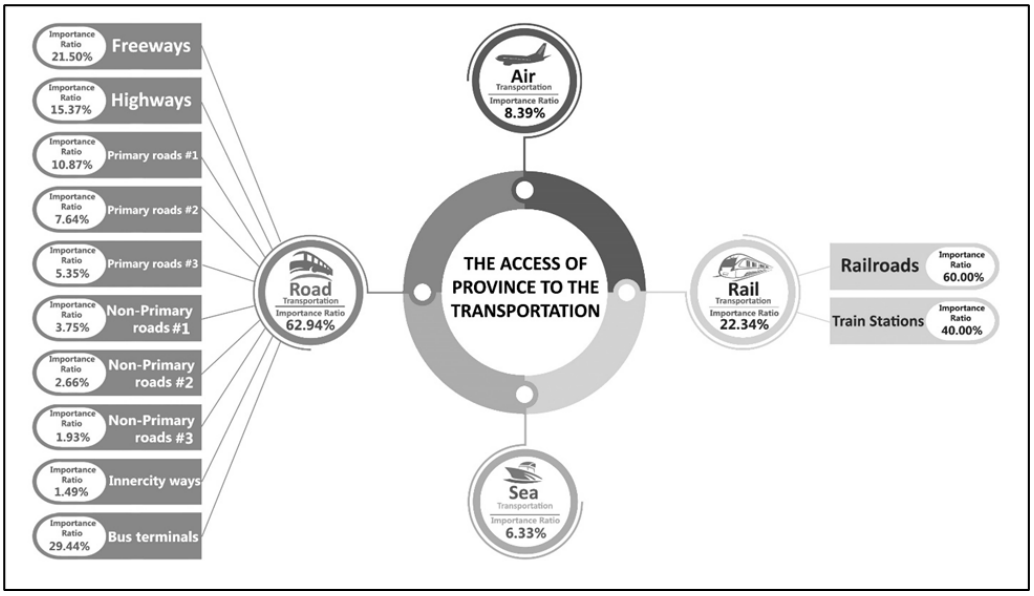

Fig. 2 **– The importance ratio of the amount of accessibility of the Province's zones to all transportation modes**

and ports are considered, as well as the distances from railways and train stations for the accessibility of rail transport.

Finally, in order to achieve the accessibility of the province to transportation, all transportation modes have been overlapped with different importance ratios determined by using the AHP method. Fig. 2 illustrates the importance ratios of different transportation modes in the Guilan province.

The results indicate that almost 70% of the zones of the province have proper access to transportation (Fig. 3). The other 30%, which represent the northwest and southeast parts of the province and include Tavalesh, Rudsar, Rezvanshahr, Siahkal, Amlash, Masal and Rudbar, have the highest percentage of inefficiencies in the accessibility to transportation due to the size of each county.

In summary, it was found that there is no multimodal terminal or shared stop in the province.

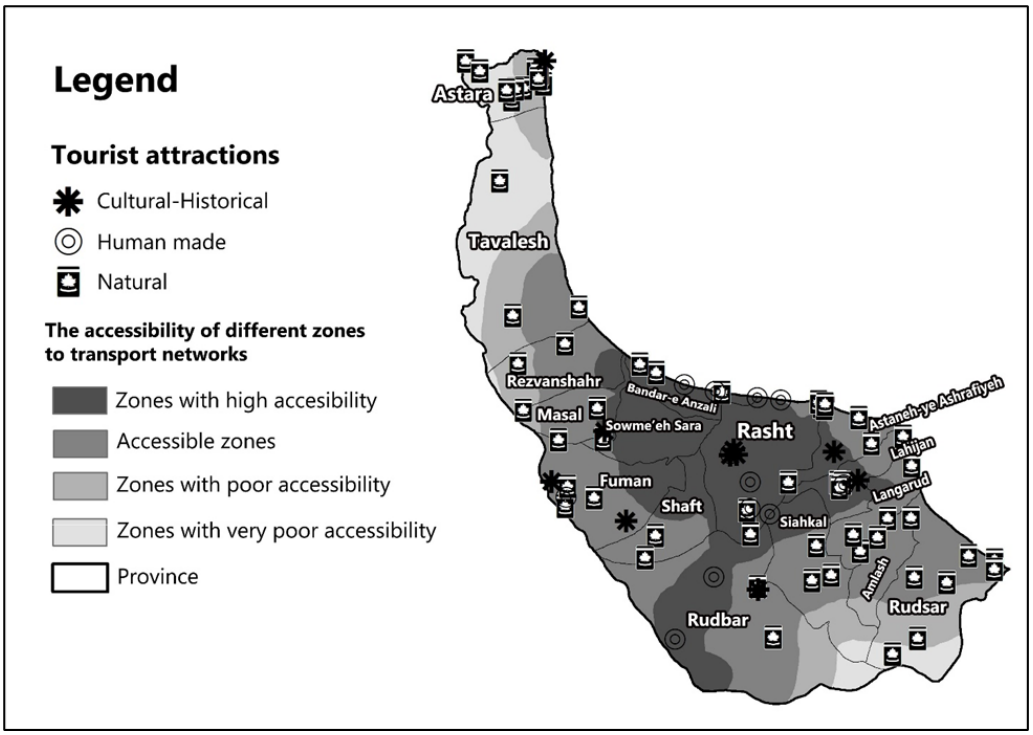

Fig. 3 **– Spatial analysis of the accessibility of provincial zones and tourist attractions to all transportation infrastructure**
Source: analyzed by the authors based on the data of the Spatial development plan of Guilan province (2018)

Sardar-e Jangal airport, Astara and Anzali ports have no direct access to the rail network and there are many tourist areas that have no proper access to the highway network. This indicates a clear need to construct new highways and to improve the existing ones, as well as constructing railways, multimodal terminals and shared stops with the purpose of connecting different modes of transport and of providing accessibility to tourism attractions.

Therefore, the research has step by step found that there is a lack of integration for the transport infrastructure of Guilan province whilst transportation in the province is facilitated with four modes of regional transport and there is the complete possibility of infrastructure integration of transportation in this province.

According to different literatures, there are a number of effective factors in tourism promotion, including accessibility, mobility, transport and network connectivity, affordability and cost, time, comfort and safety (Crouch and Ritchie 1999, Shin 2005, Tóth and Dávid 2010, Kővári and Zimányi 2011, Mammadov 2012, Santos et al. 2014, La Rocca 2015, Madhuwanthi et al. 2015, Chan and Yuan 2017, Yang et al. 2019). Also, as mentioned in the previous sections, there are various factors in terms of infrastructural integration, namely, multimodal terminals (MMT), shared stops (SST), highway construction and improvement (HCI) and railway construction and improvement (RCI) (May and Roberts 1995, Potter and Skinner 2000, Hull 2005, Nosal and Solecka 2014, Solecka and Żak 2014, Van Truong and Shimizu 2017). The aim of this

section is to recognize the effectiveness of infrastructural integration factors on the factors affecting tourism promotion.

MMTs and SSTs have analogous functions, practically, and there is the task of connecting several transportation modes to each other, except that MMTs operate at a larger scale than SSTs, but in terms of cost, it is more affordable to construct SSTs. These two factors have direct impacts on tourism promotion.

One of the most considerable transport-based principles in tourism is the accessibility of travelers to different modes of transport, so that travelers have the possibility to access their desired modes of transport, and this possibility can be acquired through MMTs or SSTs. Suppose that a tourist enters Guilan province through air, rail or water transport and he needs to access the public road transport to get to his desired destination, and, due to air, rail and water transport restrictions, the access to that particular location is only possible through road transport. It is effortless for the tourist to have instant accessibility to road transport once they reach the province, and one of the best solutions is to integrate the stations of different modes of transport by the means of MMTs and SSTs. On the other hand, these terminals and stops can create connectivity between different transport networks, which requires the crossing of different transport paths on each other, in order to construct an MMT or SST in a particular location with direct accessibility to several transportation networks. Furthermore, efficient transport connectivity can significantly reduce travel time and costs for the tourists (Peng et al. 2015). If travelers have no direct access to different transport modes, they are compelled to use a taxi to reach their desired transport stop. This not only increases costs and it reduces the affordability of tourists to use transportation, but it also causes them to waste a lot of time in switching the transport modes. On the other hand, the accessibility of the stations has a direct influence on the comfort. MMTs and SSTs provide an instant access to different transport modes stations and it is much safer and more convenient for the travelers to change the transport modes without using a taxi or other private vehicles (Gutiérrez et al. 2019).

HCI and RCI are the first steps of infrastructural integration. Regardless of the importance of MMTs and SSTs, transport integration cannot be implemented if there is a lack of efficient roads and railways. Highways and railways make a crucial contribution to tourism promotion. Functional highways and railways facilitate the proper access of tourists to tourist attractions, as well as the different transport stations. In a region with numerous tourist attractions like Guilan, while each one is located in different parts of the province, it requires efficient transport networks to provide accessibility to all attractions through different modes of transport.

Also, HCI and RCI should be based on the connectivity of transport networks. Connectivity refers to the directness of travel between destinations (Sreelekha et al. 2016). It means that the highway and railroad construction is not only able to connect transport routes to tourist attractions, but it also contributes to the connectivity of different transport stations. For instance, HCI should be directed to railway stations in order to establish the connectivity between road and rail transport, which can provide the opportunity to construct an MMT or SST. Also, the connectivity of transport networks can lead to a better mobility of transport, which has a strict connection with tourism (La Rocca 2015).

There is another important concept in traveling and it is the concept of travel time. Accordingly, travelers would like to diminish the number of trips, to travel to closer destinations and to reduce the travel time for a given trip (Metz 2008). HCI and RCI can relatively reduce travel times and travel costs. One of the main tasks of the highways and railways is to provide the shortest routes with the best quality, and thus from this benefit the tourists to spend less time and expenses on traveling.

One of the most considerable topics in promoting tourism are the safety and comfort of tourists, which can be achieved through the construction and improvement of highways and railways. Safety has always been an indispensable condition for travel and tourism (Kővári and Zimányi 2011) and the quality of transportation routes has a major impact on transport safety. The quality of highways and rail networks should be sufficiently high to minimize the risks of transport. On the other hand, if the transport routes are as short as possible, travelers spend less time on the routes and, obviously, with a reduced transport time, the risks of transport are reduced and this helps to improve the convenience and the comfort of travelers, which can lead to their satisfaction (Chan and Yuan 2017).

Fig. 4 visually shows the effect of each infrastructure integration factor on the effective transport-based factors in tourism promotion.

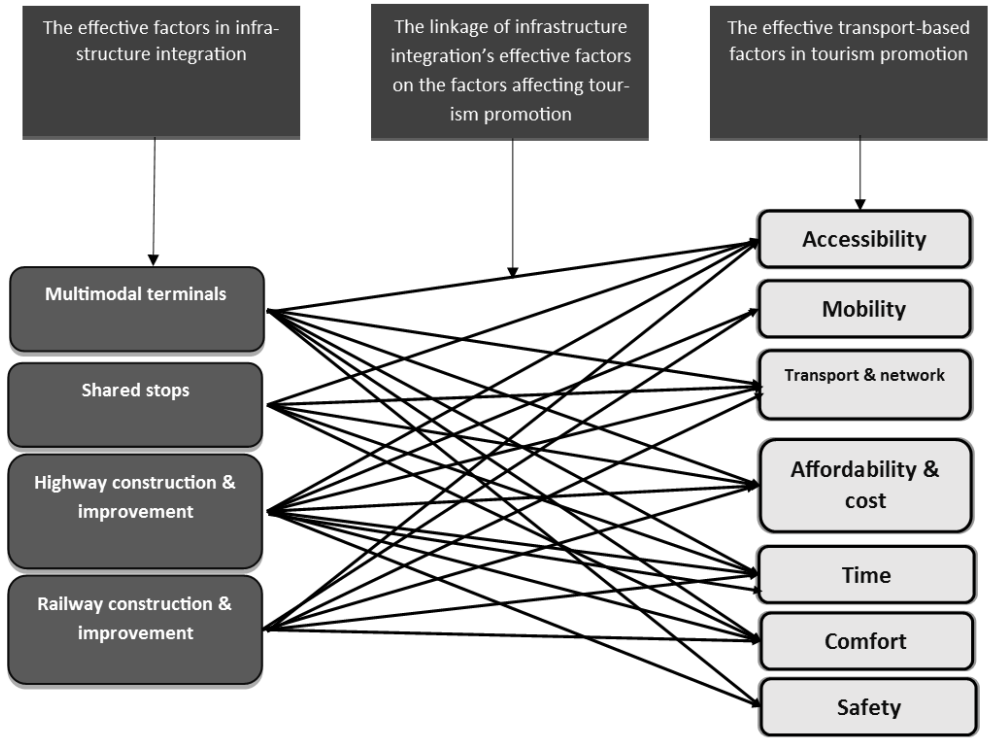

Fig. 4 **– The effectiveness of the infrastructure integration factor on the effective factors in tourism promotion**

The results of this study made it clear that IIRT is one of the effective transport-based strategies to promote the tourism industry. Such results are more important for tourism regions like Guilan, in which the infrastructures of different transport modes operate separately from each other with no integration.

Many studies have provided transport-based solutions to promote tourism and the relationship between transportation and tourism. So that, a gravity framework was employed by Khadaroo

and Seetanah (2008) to evaluate the importance of transport infrastructure in determining the attractiveness of tourism destinations. The study was based on a panel data set of bilateral tourism flows among 28 countries over the decade 1990-2000. It was found that transport infrastructure is an important driver of the tourism entry to a destination and the evidence of repeated tourism around the world. Also, the disaggregated continent-wise analysis revealed that the sensitivity of tourism flows to transport infrastructure varies depending on the origin and destination (Khadaroo and Seetanah 2008).

Musa and Ndawayo (2011) examined the relationship between transportation (as measured by road connectivity, road condition) and the development of tourism (as measured by the location of national parks) in Nigeria, using an analysis that is performed on two levels, the disaggregate and the aggregate. A major finding of the study is that transportation is a significant determinant of tourism development in Nigeria. However, other factors that include access to recreational and social facilities and security also play a positive role, because they encourage patronage (Musa and Ndawayo 2011).

Chen and Haynes (2015) developed a method called the Spatial Econometric Computable General Equilibrium (SECGE) model which integrates both spatial econometrics with equilibrium modeling techniques to improve the effectiveness of impact analyses on transportation infrastructure. The results confirmed that the US highway and streets play an essential role among all transportation infrastructure systems in economic development, while public transit and passenger transport play only the least role among the systems. The results of the general equilibrium analysis also show the difference between the use of spatial econometric estimates and traditional OLS estimates. Although the differences in their aggregate case study are relatively minor, the implications for more sensitive disaggregated regional models are clear (Chen and Haynes 2015).

In the study of Gołembski and Majewska (2018), the purpose was to determine the importance of transport infrastructure among other classical factors of a gravity model that influence the foreign inbound tourism to Poland. Their study was based on panel data on bilateral tourism turnovers in the period 2008-2016 from 33 countries trading with Poland, and the results indicated that transport infrastructure development has a significant impact on foreign inbound tourism in Poland (Gołembski and Majewska 2018).

The study of Lumsdon (2000) evaluated the concept of a planned sustainable transport network, and the National Cycle Network in the UK, as a potential model for the integration of transport, tourism and leisure, and it concluded with a number of implications, which may be considered when developing similar tourism transport networks, while a model of sustainable transport development was presented (Lumsdon 2000).

Previous studies have pointed to important topics including various factors which influence the tourism industry such as: road conditions, attractiveness of tourism routes and transport infrastructure, in which the common result between the reviewed studies and this article is that transportation has a significant impact on tourism promotion. Our work provides IIRT as a transport-based strategy which can help regions to promote their tourism industry with a series of steps. In this sense, it would be helpful if governments could collaborate to enhance IIRT factors in the regions aiming to promote the tourism industry.

Conclusions

Surveys indicate the decisive role of transport in the tourism industry and the mutual relationship between tourism and transport and it was also found that IIRT, as a transport improvement system, can play a significant role in promoting tourism in a region. MMTs, SSTs,

HCIs and RCIs, as infrastructural integration factors, can have direct impacts on the factors which can lead to tourism promotion.

Guilan province, region with more than 1000 tourist attractions, is considered as one of the most important tourist areas in Iran and the Middle East. However, there are still many problems with the transportation of tourists in this province. On the other hand, given that Guilan province is profited with all four main modes of transport (road, rail, air and water), there is a good potential for the implementation of an integrated transport system in the province. Surveys showed that there were no MMTs or SSTs in the province, and the highway and rail network of the province were not as well-developed as they should have been, therefore, IIRT can help towards the promotion of the tourism industry in the province.

Furthermore, it is expected for the highway network to be expanded to the southeast and northwest parts of the province which lack a proper accessibility to transportation, and for the existing networks to be improved. Also, Rasht-Anzali, Rasht-Astara and Rasht-Sari rail lines need to be put into operation as soon as possible and a passenger water transport infrastructure in Anzali and Astara ports will also be required.

On the other hand, in order to integrate the transportation of the province, MMTs and SSTs need to be established at the necessary points to create connectivity between the different modes of transport, including the creation of a multimodal air-road-rail terminal at the current range of Sardar-e jangal airport, shared stops at Anzali and Astara ports, and shared rail-road stops at the train stations in the province. It is expected that, with the realization of these strategies, the transportation of the province will be greatly improved and, consequently, the tourism industry of the province will also be promoted.

References

CHAN C.-S., YUAN J. (2017), *Changing travel behaviour of high-speed rail passengers in China*, Asia Pacific Journal of Tourism Research 22 (12), 1221-1237.

CHEN Z., HAYNES K. E. (2015), *Spatial impact of transportation infrastructure: a spatial econometric CGE approach*, in: Nijkamp P., Rose A., Kourtit K. (eds.), Regional Science Matters: Studies Dedicated to Walter Isard, Springer, Cham, pp. 163-186.

CROUCH G. I., RITCHIE J. R. B. (1999), *Tourism, competitiveness, and societal prosperity*, Journal of Business Research 44 (3), 137-152.

GIVONI M., BANISTER D. (2010), *Integrated Transport: from policy to practice*, Routledge, London.

GOŁEMBSKI G., MAJEWSKA J. (2018), *The impact of transport infrastructure on international Inbound tourism – A gravity model for Poland*, International Journal of Contemporary Management 17 (4), 133-152.

GUTIÉRREZ A., MIRAVET D., SALADIÉ Ò., CLAVÉ S. A. (2019), *Transport Mode Choice by Tourists Transferring from a Peripheral High-Speed Rail Station to Their Destinations: Empirical Evidence from Costa Daurada*, Sustainability 11 (11), 3200.

HINE J. (2000), *Integration, integration, integration... Planning for sustainable and integrated transport systems in the new millennium*, Transport Policy 7 (3), 175-177.

HULL A. (2005), *Integrated transport planning in the UK: From concept to reality*, Journal of Transport Geography 13 (4), 318-328.

IBRAHIM M. F. (2003), *Improvements and integration of a public transport system: the case of Singapore*, Cities 20 (3), 205-216.

ISRAELI Y., MANSFELD Y. (2003), *Transportation accessibility to and within tourist attractions in the Old City of Jerusalem*, Tourism Geographies 5 (4), 461-481.

JANIC M. (2001), *Integrated transport systems in the European Union: An overview of some recent developments*, Transport Reviews 21 (4), 469-497.

KHADAROO J., SEETANAH B. (2008), *The role of transport infrastructure in international tourism development: A gravity model approach*, Tourism Management 29 (5), 831-840.

KŐVÁRI I., ZIMÁNYI K. (2011), *Safety and Security in the Age of Global Tourism (The changing role and conception of Safety and Security in Tourism)*, Applied Studies in Agribusiness and Commerce 5 (3-4), 59-61.

KREJIĆ Ž., PLEČIĆ K. (2016), *Competitiveness of Vojvodina as a tourism destination: the analysis of selected travel & tourism competitiveness index indicators*, SITCON 2016: Quality as a basis for tourism destination competitiveness, 49-58.

LA ROCCA R. A. (2015), *Tourism and Mobility. Best Practices and Conditions to Improve Urban Livability*, TeMA - Journal of Land Use, Mobility and Environment 8 (3), 311-330.

LOHMANN G., PEARCE D. G. (2012), *Tourism and transport relationships: The suppliers' perspective in gateway destinations in New Zealand*, Asia Pacific Journal of Tourism Research 17, 14-29.

LU M., HSU S.-C., CHEN P.-C., LEE W.-Y. (2018), *Improving the sustainability of integrated transportation system with bike-sharing: A spatial agent-based approach*, Sustainable Cities and Society 41, 44-51.

LUMSDON L. (2000), *Transport and tourism: cycle tourism – a model for sustainable development?*, Journal of Sustainable Tourism 8 (5), 361-377.

MADHUWANTHI R. A. M., MARASINGHE A., RAJAPAKSE R. P. C. J., DHARMAWANSA A. D., NOMURA S. (2015), *Factors influencing to travel behavior on transport mode choice: A Case of Colombo Metropolitan Area in Sri Lanka*, International Journal of Affective Engineering 15 (2), 63-72.

MAMMADOV R. (2012), *The importance of transportation in tourism sector*, 7th Silk Road International Conference "Challenges and opportunities of sustainable economic development in Eurasian countries", 381-386.

MAY A. D., KELLY C., SHEPHERD S. (2006), *The principles of integration in urban transport strategies*, Transport Policy 13 (4), 319-327.

MAY A. D., ROBERTS M. (1995), *The design of integrated transport strategies*, Transport Policy 2 (2), 97-105.

METZ D. (2008), *The myth of travel time saving*, Transport Reviews 28 (3), 321-336.

MUSA I. J., NDAWAYO B. A. (2011), *The role of transportation in the development of tourism in Nigeria*, Tourismos: an international multidisciplinary journal of tourism 6 (1), 297-305.

NAJDAWI A. (2009), *SOA and web services for leveraging inter-organizational integration in travel and tourism*, 2009 Congress on Services-I, 151-154.

NOSAL K., SOLECKA K. (2014), *Application of AHP method for multi-criteria evaluation of variants of the integration of urban public transport*, Transportation Research Procedia 3, 269-278.

PENG B., SONG H., CROUCH G. I., WITT S. F. (2015), *A meta-analysis of international tourism demand elasticities*, Journal of Travel Research 54 (5), 611-633.

POTTER S., SKINNER M. J. (2000), *On transport integration: a contribution to better understanding*, Futures 32 (3-4), 275-287.

PRESTON J. (2010), *What's so funny about peace, love and transport integration?*, Research in Transportation Economics 29 (1), 329-338.

SANTOS M. C., FERREIRA A. M., COSTA C. (2014), *Influential factors in the competitiveness of mature tourism destinations*, Tourism & Management Studies 10 (1), 73-81.

SHIN Y.-S. (2005), *Safety, security and peace tourism: The case of the DMZ area*, Asia Pacific Journal of Tourism Research 10 (4), 411-426.

SOLECKA K., ŻAK J. (2014), *Integration of the urban public transportation system with the application of traffic simulation*, Transportation Research Procedia 3, 259-268.

SORUPIA E. (2005), *Rethinking the role of transportation in tourism*, Proceedings of the Eastern Asia Society for Transportation Studies 5, 1767-1777.

SREELEKHA M. G., KRISHNAMURTHY K., ANJANEYULU M. V. L. R. (2016), *Interaction between road network connectivity and spatial pattern*, Procedia Technology 24**,** 131-139.

STEAD D. (2003), *Transport and land-use planning policy: really joined up?*, International Social Science Journal 55 (176)**,** 333-347.

TÓTH G., DÁVID L. (2010), *Tourism and accessibility: An integrated approach*, Applied Geography 30 (4)**,** 666-677.

TURNBULL K. F., GRIFFIN G. P. (2012), *Transportation and Tourism*, University Transportation Center for Mobility, Retrieved from: www.utcm.tti.tamu.edu.

UNDERDAL A. (1980), *Integrated marine policy: What? Why? How?*, Marine Policy 4 (3)**,** 159-169.

VAN TRUONG N., SHIMIZU T. (2017), *The effect of transportation on tourism promotion: Literature review on application of the Computable General Equilibrium (CGE) Model*, Transportation Research Procedia 25**,** 3096-3115.

WANG S., CHEN J. S. (2015), *The influence of place identity on perceived tourism impacts*, Annals of Tourism Research 52**,** 16-28.

WORLD TOURISM ORGANIZATION (2019), *International Tourism Highlights, 2019 Edition*, UNWTO, Madrid.

YANG Y., LI D., LI X. R. (2019), *Public transport connectivity and intercity tourist flows*, Journal of Travel Research 58 (1)**,** 25-41.

YAO L.-F., LONG R.-Y., LIU A.-Y., QINGCHEN L. (2011), *Cointegration relationship analysis of tourism and transportation in China*, 2011 International Conference on Business Management and Electronic Information, 141-144.

ZENG B., HE Y. (2019), *Factors influencing Chinese tourist flow in Japan – a grounded theory approach*, Asia Pacific Journal of Tourism Research 24 (1)**,** 56-69.

ZHANG C. X., DECOSTA P. L. E., MCKERCHER B. (2015), *Politics and tourism promotion: Hong Kong's myth making*, Annals of Tourism Research 54**,** 156-171.

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MITIGATING FLASH FLOODS WITH THE USE OF NEW TECHNOLOGIES: A MULTI-CRITERIA DECISION ANALYSIS TO MAP FLOOD SUSCEPTIBILITY FOR ZAKYNTHOS ISLAND, GREECE

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Abstract: Floods can be extremely harmful for the welfare of societies regardless if they are natural or caused by humans. The Mediterranean region has experienced an increase in flash floods frequency and severity. The suddenness and episodic nature of these type of floods makes it more difficult to predict them compared to river floods. In this study, a map was developed in regard to the flood susceptibility of Zakynthos Island with the use a multi-criteria decision analysis. This analysis utilized six factors: a) flow accumulation, b) land use, c) slope, d) rainfall intensity, e) geology and f) elevation. Each factor had a different weight based on their importance in regard to flash floods. The analysis was run in GIS. To validate the developed susceptibility map, the locations of the recorded past floods on the island were utilized. The end product was a validated flood susceptibility map. This map can help the Civil Protection Authority of Zakynthos Island to mitigate communities' susceptibility to flash floods.

Key Words: *flood susceptibility map, MCDA, GIS, Mediterranean islands*.

Introduction

When large amounts of water exceed the natural boundaries of water bodies and occupy areas that are typically dry, floods occur. Floods are natural hydro-meteorological disasters (Cavallo and Noy 2011). They typically result from extreme meteorological events, such as heavy rainfalls or sudden snowmelts, but they can also be caused by earthquakes, landslides, tsunami or dam failures. Anthropogenic activities have accelerated flash floods frequency and magnitude. Such activities include: a) changes in land-uses (primarily urbanization and agriculture), b) exponential increase in population, c) river regulation of most rivers (dams, channelization) and d) climate changes (Jonkman 2005, Trenberth 2008, Zaimes and Emmanouloudis 2012). When floods are compared to other disasters, they are the costliest, deadliest and most frequent (Gaume et al. 2016). Human life, economic, ecosystem, historical and cultural losses, and associated diseases are some of the direct consequences. The loss of economic and agricultural production and a decrease in the socio-economic welfare are some of the indirect consequences (Jonkman 2005). Flooding consequences are also categorized based on the temporal scale (Cavallo and Noy 2011). Those occurring during the flood event are immediate consequences and include damages to infrastructure, buildings, equipment, roads, bridges, reservoirs and agricultural land. When transportation and services stop being produced or provided, for up to five years after the flood event, they are considered as intermediate consequences. Finally, the changes in the macroeconomic variables, the migration of the population and the devaluation of properties are the long-term consequences. These numerous and wide-ranging consequences have led to global efforts to mitigate flood impacts before, during and after they occur.

The types of a flood event depend on the location they occur in, the flood water speed and amount, and/or their causes (Heathcote 2009, Zevenbergen et al. 2010, Simonović 2012, Chilikova-Lubomirova and Zaimes 2018, Şen 2018). The main flood categories are: a) river (or fluvial), b) coastal, c) urban, d) flash, e) pluvial, and f) dam and dyke failure. Flash floods are the focal point of this study that are typically caused by very high intensity rainfalls or sudden massive snowmelts (Gaume et al. 2009, Marchi et al. 2010). Their main characteristic is that the water flowing in its channel and/or outside has a very high velocity. This is caused by the steep slopes of their watersheds that lead to high concentration times of the rainfall water that rapidly reaches their channels. Small areas are typically covered with water from flash floods. Still they are very dangerous because the depth and the travelling velocity of the water can be very high and the waters have a large transport capacity that can carry rocks, trees and cars. Finally, most flash floods stop as fast as they start, making them very difficult to predict. Overall, they have not been studied or recorded as extensively as needed in order to completely comprehend them, especially when compared to other types of floods (Lumbroso and Gaume 2012). This is surprising because flash floods in Europe are a major natural disaster (Marchi et al. 2010). The reasons for the limited comprehension of flash floods are: a) they occur in watersheds that do have formal and regular measurements of the discharge or the magnitude of the event; b) flash floods data are recorded in the technical reports of the local authorities, companies and research units, and they typically remain unpublished, so it is difficult to access them, and they are written in the national languages (Gaume et al. 2009).

The complex climate, topography and geomorphology of the Mediterranean Basin leads to many diverse environments, typically prone to flash flooding (Camarasa Belmonte and Segura Beltrán 2001). The Euro-Mediterranean region has more extreme floods than the European continental regions, especially flash floods (Ferraris et al. 2002). The frequent appearance of flash floods is due to the rough mountainous landscape that in many cases is near the coastline (Llasat et al. 2010, Ducrocq et al. 2014). The slopes of the Mediterranean mountains are steep and the altitudinal difference from the mountain top to the coastline is quite large despite the small horizontal distance. Secondly, intense precipitation events are very common in the region (Tarolli et al. 2012, Gaume et al. 2016). Therefore, the watershed hydrologic timescale in the Mediterranean can be only of a few hours (rainfall concentration time). The climate, the topography and geology have also led to its fluvial systems being primarily composed of ephemeral and intermittent streams (Camarasa Belmonte and Segura Beltrán 2001, Emmanouloudis et al. 2011). These types of streams are called ‘wadis’ in the Eastern and Southern Mediterranean and ‘torrents’ in the Northern Mediterranean (Emmanouloudis et al. 2011). Flash floods in ‘torrents’ and ‘wadis’ are the most extreme in autumn (Ducrocq et al. 2014). In addition, urban settlements have and continue to rapidly expand along the Mediterranean coastlines leading to a greater number of people exposed to flash flooding (Llasat et al. 2016). Finally, flash floods in the region are also the consequence of the frequent wildfires that are a natural disturbance of many Mediterranean ecosystems (Ranis et al. 2015). Burned watersheds are bare of vegetation, thus the surface runoff is high and the hydrologic regime timescale is very quick (García-Comendador et al. 2017).

The climate change potential impact on the hydrology should also be considered. Temperatures and evapotranspiration increases, more intense rainfalls, and rainfall amount declines by 50% in the summer have been forecasted for the Mediterranean (Terrado et al. 2014). These changes will enhance drought frequency and length and they lead to a quicker hydrological cycle that should reduce even more the water availability in this water-scarce region (Rault et al. 2019). The natural flow regimes of the water bodies are expected to change (Pedro-Monzonís et al. 2016), with perennial streams becoming intermittent and intermittent streams becoming ephemeral. Overall, the flash flood frequency and magnitude are expected to increase. Drought increases will increase the frequency of wildfires and they lead to larger burnt areas thus indirectly increasing the flash floods’ potential (Mitsopoulos et al. 2017, Duane et al. 2019).

In Greece, numerous flash floods are recorded every year (Diakakis and Deligiannakis 2017). This is associated with the intense rainfall events that occur and the rugged, steep mountainous topography of Greece that ends in lowlands along the seacoast, where most people live (Emmanouloudis et al. 2011). The unorganized urban development in Greece, which for many times has led to settlements developed in former torrent channels or floodplains, has also increased the susceptibility to flash flooding impacts. Finally, the areas surrounding the urban centers have frequent wildfires that further exponentially enhance the potential of floods in the cities. In many cases, this fact leads to losses of human lives. A total of 151 deaths were recorded in Greece from 1970 till 2010, caused by 53 flood events (Diakakis and Deligiannakis 2017). Most fatalities, specifically 39, occurred in 1977 due to a major flood in Athens (Diakakis 2014). A similar flood event occurred in Mandra, a town that lies outside of Athens, on November 15th 2017, that caused the loss of 24 lives. The event was caused by an extreme rainfall storm, that had 300 mm of water fall within a 13 h period (Diakakis et al. 2019). This flash flood had the most deaths in Greece, in the last 40 years. Overall, the rapid population congregation in urban centers, the uncontrolled and unorganized urban development, will lead to more flash flood events, indicating clearly that standardized measures that are science-based need to be taken to mitigate this danger.

This study utilized new technologies and methodologies to develop flood susceptibility maps that identify the areas with the highest susceptibility for the island of Zakynthos in Greece. Few studies have focused on floods on the Greek islands despite a plethora of flood events recorded on Greek islands. These events are typically the result of their rugged topography and the frequent intense rainfalls. In addition, most infrastructure and settlements are along the coastlines, increasing the potential negative impacts of flash floods. Finally, the Flood Directive 2007/60/EC, that was established to assess and manage flood risks, requires all member states to: a) assess the water courses and coastlines that are at risk from flooding; b) map the flood extent and the assets and humans that are at risk in these areas; and c) implement coordinated measures to reduce these flood risks (European Council 2007). This study addresses the Flood Directive by focusing on a specific flood prone island.

Methodology

Study area

The topographic and climatic conditions of the Greek peninsula along with the population congregation in urban centers will enhance the susceptibility and impacts from the frequent flash flood events. Greece has approximately 6000 islands although most are not populated. Islands differ to the inland areas because of their unique hydrometeorological characteristics. This makes them special case studies in regard to flooding events, especially in the Mediterranean. The Greek populated islands have a high hypsometric variability within a relatively small area, with torrents primarily flowing on them (Emmanouloudis et al. 2011). The end points of the torrents are along the seacoast where most development is concentrated, thus enhancing flood vulnerability (Kourgialas and Karatzas 2016, Koutalakis et al. 2017a, Vozinaki et al. 2018, Fortesa et al. 2019).

Zakynthos Island was the focus of this study (Fig. 1). Zakynthos is located in western Greece, in the Ionian island cluster. It is one of the larger islands of the Ionian cluster. Its total area is 406 km^2, while the length of coastline is 123 km, and it is occupied by 41,000 people. It is approximately triangular in shape, with Skinari Cape in the north, and Marathia Cape (on the southwest) and Gerakas Cape (on the southeast) to the south. Between the two southern capes is Laganas Bay, a National Marine Park since 1999. The reason for this designation is because the endangered Caretta-Caretta sea turtle utilizes the island as a nesting ground. This is another reason for focusing on the specific island. The Brachion Peak is the highest point of

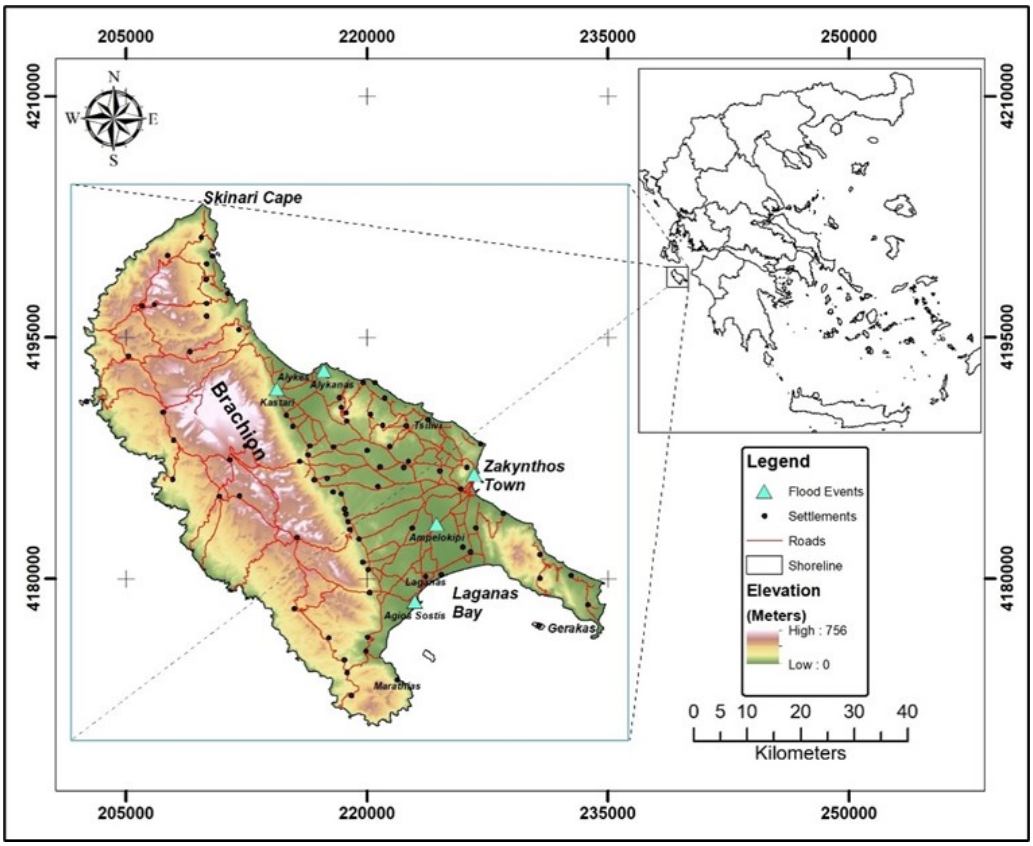

Fig. 1 **– Zakynthos Island that is located in the Ionian Sea in western Greece was the study area**

the island with an elevation of 756 meters. Overall, 55.15% of the island is semi-mountainous, primarily the western part of the island and the two southern capes (Marathia and Gerakas).

The eastern part has most of the lowlands. In regard to the geology, the western parts are mainly of limestone. The middle of the island has primarily clastic deposits and marly limestones. Finally, the western parts have evaporites that in many instances are overlaid by clastic deposits and marly limestones. Along the seacoast and the lowland areas, you can also find, in small areas, scree, coastal and recent marsh deposits and alluvial and eluvial formations. Zakynthos has a mild Mediterranean climate, and it rarely experiences extreme temperatures. Temperatures below 1-2^{o}C have scarcely been recorded, while humidity can reach high levels, as high as 80%, and the average annual precipitation is 940 mm. This results in the island having a rich and dense vegetation. From a hydrological approach, no major rivers flow through the island. Still, the many rainfall events and the high annual amount of rainfall lead to flows through the island torrents that frequently have flash floods. This is the second reason for selecting Zakynthos Island. The island has four main torrents that are Lagana, Zakynthos, Tsilivi and Alykes. All these have an ephemeral flow and they start in mountainous areas, continue in the lowlands and end in the sea. The torrents also run through the settlements of Zakynthos Island (typically in the lowlands) were the greatest susceptibility to floods exists. Housing can be found on both sites of the torrents and some rudimentary flood

prevention infrastructure has been developed (e.g. levees or cement walls or gabions on the banks).

Finally, climate change implication should also be considered. Specific studies for the island have not been conducted. The projections for the Mediterranean region forecast an intensification of the hydrological cycle. Specifically, the temperature is expected to increase, the rainfall will concentrate in shorter periods of time, the precipitation will decrease up to 50% in the summer, and the drought frequency and strength will increase (Rault et al. 2019). These conditions should lead to a more surface runoff and it is the reason why the frequency of large floods in the region has been forecasted (Calbó 2010).

A Multi-Criteria Decision Analysis within a Geographical Information System to assess flash floods

Flash floods have an episodic nature. They developed very fast but also they end very sudden. Innovative and modern technologies can help develop state of the art tools for the sustainable management of water resources. This is a major need in the Mediterranean region that is water -scarce and it experiences flash floods quite often (Kourgialas et al. 2015, Maugeri et al. 2015, Diaconu et al. 2019, Koutalakis et al. 2019). Using modern technologies can mitigate torrent damages during flash floods while enabling their utilization to benefit the neighboring communities (Koutalakis et al. 2017a, Koutalakis et al. 2017b, Tufekcioglu et al. 2017).

Combining a Geographic Information System (GIS) with an 'expert system' can be such an innovative tool, particularly for ecosystem and environmental assessments (Gounaridis and Zaimes 2012, Zaimes et al. 2012). GIS provides spatial data analysis and capabilities for analytical modeling (Malczewski 2006). An expert system tries to emulate a human expert in order to transfer knowledge and expertise and to produce recommendations by utilizing reasoning methodologies in a computer-based system (Malczewski 2006, Zaimes et al. 2016). Such a system, that is frequently used because of its flexibility and innovation, is the Multi-Criteria Decision Analysis (MCDA). A MCDA can structure decision problems by utilizing science-based approaches and schemes to form, assess and prioritize alternative decisions (Malczewski 2006). The combination of GIS and MCDA can support effectively and efficiently the spatial decision-making process. It can be an optimal tool for land managers to assess flash flood risk because it can provide support but it also helps to quantify the relationships between floods and their influencing factors.

In the recent decades, a major increase in the use of MCDA coupled with GIS has been observed. This is because: firstly, the scientific progress and the use of GIS have increased exponentially; secondly, their acceptance as decision analysis and support methods has been worldwide spread; and, thirdly, the MCDA software with its support modules, that are low-cost and easy to use, is easily coupled with the GIS software and readily available (Malczewski 2006, Goodchild 2010, Zaimes et al. 2016).

MCDA mines knowledge that is translated into a computer language, typically by assigning weights for the most important factors of the studied phenomenon (e.g. flash floods) (Malczewski 1999, Rahman and Saha 2008). The weight (value) for each factor depends on its importance based on the experts' opinions. The most difficult and critical step of this widely used method is the problem structuring. The reason is that different weights and rankings can be produced that depend on the experts' opinions (Malczewski 2006). In this study, the MCDA method was employed within a GIS environment. In addition, the Analytic Hierarchy Process (AHP) and the Weighted Linear Combination (WLC) were used.

The criteria selected for the MCDA were based on the reviewed literature, the availability of

data and the authors' expertise in regard to flash floods (Li et al. 2019, Toosi et al. 2019). Six criteria were selected that considered topographic, environmental, climatic and anthropogenic parameters (Fig. 2). Each criterion brief description follows: 1) Flow Accumulation – it shows how much water will be accumulated in different locations. Firstly, the Digital Elevation Model (DEM) was develop in order to delineate the Zakynthos watersheds. The fill-sinks and flow-direction algorithms with the ArcHydro's flow-accumulation tool were used to identify the water concentration in each location; 2) Slope. The surface runoff is highly dependent on the watershed topography. Slope's length, steepness and shape are the main parameters that were considered. The DEM was utilized to determine the slope parameters; 3) Land Use – it can increase or decrease the soil infiltration that impacts the surface runoff rate and the watershed precipitation concentration time. Smaller watershed concentration times have a higher flash flood susceptibility. The vector data from the CORINE Land Cover of 2018 were utilized. The land uses were: a) industrial and urban areas, b) shrublands and rangelands, c) cultivated areas, d) other agricultural areas, and e) small forested areas; 4) Rainfall intensity. The nearest meteorological stations provided the necessary data. The MFI index was used to estimate the intensity. It was estimated with the following equation (Morgan 2005):

$$MFI = \Sigma p^2 / P \text{ (equation 1)},$$

where MFI is the rainfall intensity index, p is the daily monthly rainfall and P is the mean annual rainfall; 5) Geology. Soil infiltration heavily depends on the geologic substrate. High infiltration rates reduce the surface runoff and consequently the flash flooding. The geologic formations of Zakynthos island were separated based on their infiltration capacities: a) impermeable, b) low infiltration, c) medium infiltration, d) high infiltration, and e) very high infiltration; 6) Elevation – it had six categories. Lower elevation areas were considered of a higher susceptibility because they have urban settlements which indicate that flash floods can have more significant impacts. In contrast, higher elevation areas are substantially less populated on the island, which indicates a lower susceptibility.

Four of the six selected factors were quantitative. Specifically, a) flow accumulation, b) slope, c) rainfall and d) elevation. The other two factors, geology and land use, were qualitative and

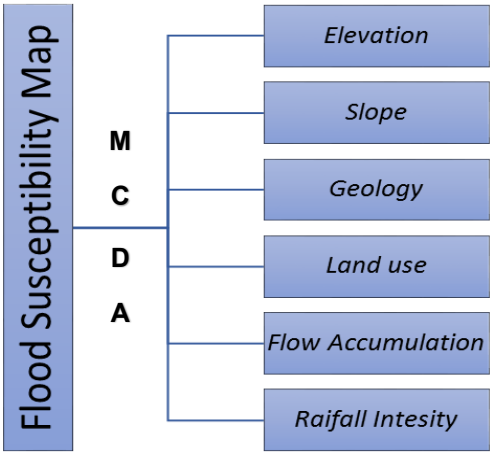

Fig. 2 **– Six criteria were used for the Multi-Criteria Decision Analysis (MCDA) to develop the Zakynthos Island Flood Susceptibility Map**

they were modified in order to be able to receive numerical values. All the data used in the MCDA were raster-based. The pixel size was 25x25 meters. The calibrated values ranged from 1 (very low susceptibility) to 5 (very high susceptibility) depending on the class/category of their original values. This was necessary so that all selected criteria had the same scale. Finally, each criterion received a percentage that was based on their importance according to the experts' opinion on the increasing surface runoff.

For the Final Flash Flood Susceptibility Map, all six selected factors were combined by utilizing the Weighted Linear Combination (WLC) method. This method was implemented in GIS. In this method, each calibrated factor (Xi) is multiplied by its respective weight percentage (Wi). The sum of these gives us the final flood susceptibility map of the study area. This model was developed by using the map algebra in GIS. The equation of the model was:

$$Ri = \sum_{i=0}^{n} Wi\ Xi$$

where R is defined as the value of risk for pixel i, n the number of criteria used, W is the weight of a criterion i and X is the rank of criterion i according to the range of the criterion values. Each pixel risk value is estimated by considering all criteria, and the criteria values are the input data needed to develop the study area final map.

Finally, validating the results is essential when using a GIS-based MCDA in order to assess its usefulness. Historical recorded data on flash floods locations that were provided by the civil protection authorities were used to validate the identified GIS MCDA high flash flood susceptibility areas of the island.

Results and Discussion

The classification and calibrating values for each selected factor can be seen in Table 1. Based on these values, six flood susceptibility maps were developed, one for each factor (Fig. 3).

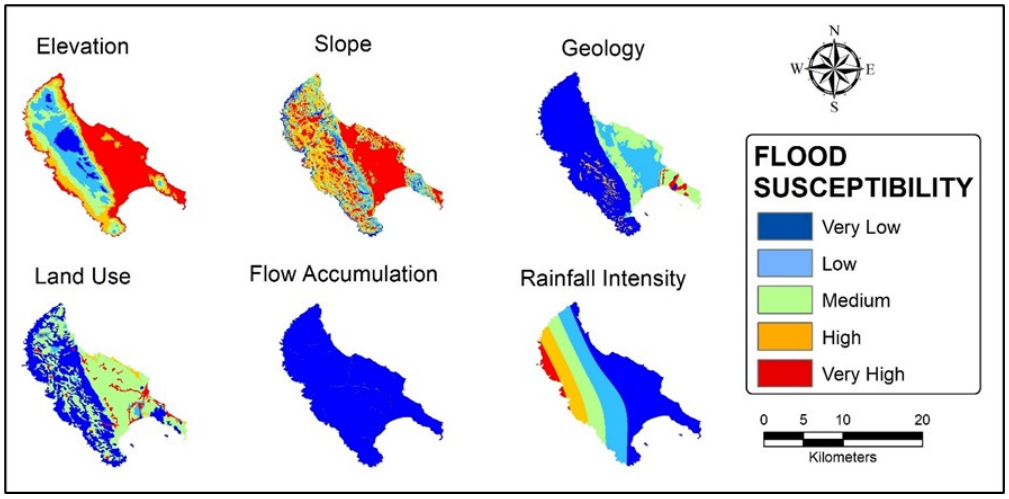

Fig. 3 **– A flood susceptibility map was developed for each selected factor**

Table 1

The six criteria weights and rates that were included in the Multi-Criteria Decision Analysis for the flash floods of Zakynthos Island

	Criteria	Classes	Flash Flood Risk	Weight of Factor	Rate	Corrected Weight	Total Weight	Final Rate %
1	**Flow accumulation** (pixels)	81778-110923	Very High (5)	10	1.5	15	39	9.67
		51737-81778	High (4)	8		12		
		26100-51737	Medium (3)	5		7.5		
		6525-26100	Low (2)	2		3.0		
		0-6525	Very Low (1)	1		1.5		
2	**Slope** (degrees)	0-5	Very High (5)	10	2.0	20	52	12.90
		5-13	High (4)	8		16		
		13-22	Medium (3)	5		11		
		22-35	Low (2)	2		4		
		35-72	Very Low (1)	1		2		
3	**Land-use**	Urban and industrial areas	Very High (5)	10	3.0	30	78	19.36
		Rangelands and shrublands	High (4)	8		24		
		Cultivated areas	Medium (3)	5		15		
		Other agricultural areas	Low (2)	2		6		
		Small forested areas	Very Low (1)	1		3		
4	**Rainfall Intensity** (Units MFI)	849-970	Very High (5)	10	1.5	15	39	9.67
		727-849	High (4)	8		12		
		689-727	Medium (3)	5		7.5		
		656-689	Low (2)	2		3		
		638-656	Very Low (1)	1		1.5		
5	**Geology**	Impermeable	Very High (5)	10	3.0	30	78	19.36
		Low infiltration	High (4)	8		24		
		Medium infiltration	Medium (3)	5		15		
		High infiltration	Low (2)	2		6		
		Calcareous	Very Low (1)	1		3		
6	**Elevation** (meters)	0-104	Very High (5)	10	4.5	45	117	29.04
		104-246	High (4)	8		36		
		246-379	Medium (3)	5		23		
		379-515	Low (2)	2		9		
		515-756	Very Low (1)	1		5		
Total							403	100

These maps show how different factors identified other areas with very high susceptibility. The elevation factor identified the coastal areas around the island and the southwestern region of the island as the most susceptible to severe flooding. The southwestern region of the island was again the most susceptible to flooding based on the slope factor, but the coastal areas were identified with very low susceptibility. The overall geology of the island has a high infiltration and only the southwestern cape has areas with a very high flood susceptibility. The land-uses identified very few areas of very high susceptibility that were primarily the urban areas. In these areas, flood mitigation measures should be implemented, since flash floods in these areas can have major negative impacts (e.g. loss of human lives). The areas most likely to have floods, based on the flow accumulation factor, are the channels of the island's torrents, since most surface waters are collected in them. Finally, the greatest amount of rainfall falls in the eastern region of Zakynthos, indicating the greatest runoff potential. By reviewing the six maps, the complexity of flash floods and the influence of each factor on the flood magnitudes and susceptibility are evident. Incorporating all six factors is necessary to accurately forecast the potential locations of high-susceptibility to flash floods.

The flood susceptibility model of this study utilized map algebra in GIS to incorporate all six factors selected that allowed the development of the final flood susceptibility map for Zakynthos Island (Fig. 4). The areas with the highest susceptibility of flooding are marked in red on the map, and they are primarily located in the eastern lowlands and the urban areas of Zakynthos. In these populated areas, flash floods have the potential to cause serious social and economic damages.

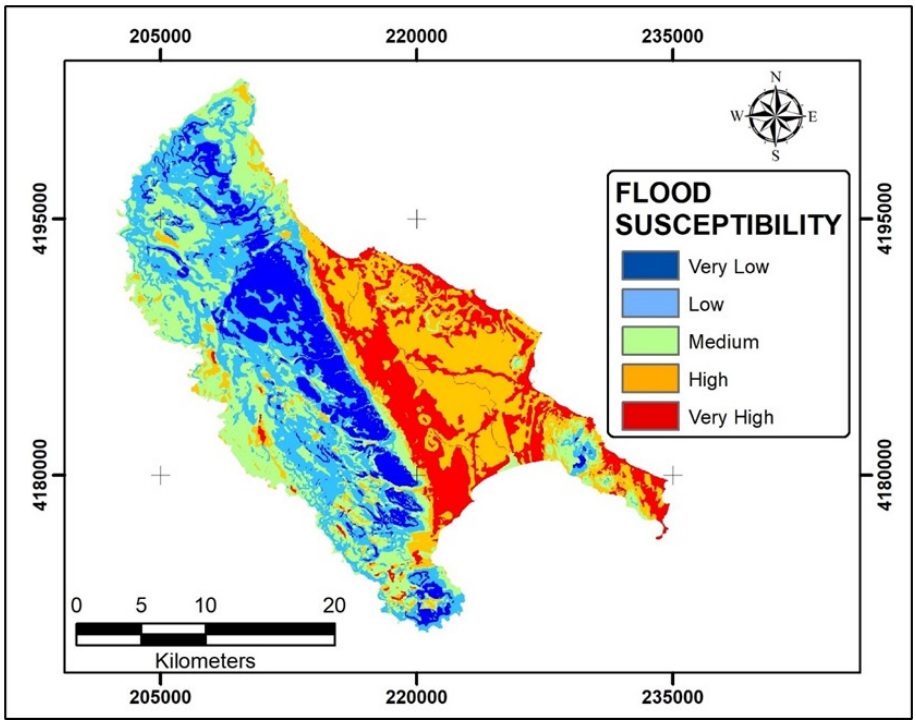

Fig. 4 **– The final flood susceptibility map for Zakynthos Island**

To validate the map, the areas in red (e.g. high susceptibility) were compared to the historically recorded floods, data that were provided by the local authorities. Major flood events had previously occurred in Zakynthos: in Katastari in 1992; in Laganas, Ag. Sostis and Alykanas in 2005, and in Zakynthos Town and Ampelokipoi in 2016. The comparison of the recorded flooded areas with the final map produced revealed that all of them produced within the high and very high flood susceptibility areas. This showcases the validity of the applied method and the usefulness of the final map to the local authorities for future flood mitigation and protection.

Floods in the Mediterranean region are a major natural disaster (Diakakis et al. 2018). Every year, the region has many economic losses and, in many cases, losses of lives, because of this disaster. The frequency and magnitude of floods are expected to increase due to climate change and they are forecasted to become more extreme in magnitude in Greece (Giannakopoulos et al. 2011, Roudier et al. 2016). This clearly indicates that there is a need to develop tools to mitigate the future impacts of floods at regional and local scale. This is also a requirement for all EU member states based on the Flood Directive of 2007. Specifically, the member states of the EU need to: a) map the river basin districts of each river; b) register the flood history of the districts and also include information on the flooded areas and the consequences on the society; and c) evaluate the future potentially negative flood consequences on the human society taking into consideration health, the environment, the cultural heritage and the economy (European Council 2007). Once these activities are completed, the most susceptible areas need to be recorded and presented in the form of maps of flood risk potential. The method that was presented here could help the responsible authorities to meet the Flood Directive mandatory requirements.

Emphasis should be given to the populated islands of Greece and in general of the Mediterranean since these can be very crowded due to tourism and in many cases urban planning is very poor and unorganized which could lead to severe problems if flash flood events occur. To better combat this problem, tools that are based on new and modern technologies should be utilized (Kourgialas and Karatzas 2011, Artinyan et al. 2016, Kourgialas and Karatzas 2017). Such an approach is presented in this study that focuses on a Greek island (specifically Zakynthos) and the end result is represented by the easy to read and utilize maps. Such maps should be developed for all the Greek islands that are inhabited. This will allow the Civil Protection, municipalities and urban planners to be more efficient and effective in minimizing the human and economic losses from flooding.

Based on the final map, several urban areas have very high and high susceptibility to flooding. These areas are typically at or close to the mouth of the four torrents of the island. These include the town of Zakynthos and the settlements of Tsivili, Alikananas and Laganas that are all located on the southern and eastern seacoast of the island. Immediate measures need to be taken in these urban areas. Specifically, some of the potential measures could include levees and gabions on the banks while, in the channel, check dams could be constructed or, if possible, the deepening and widening of the channels could be realized. Another solution could be the development of detention and retention ponds that should collect the runoff and increase the concentration time that the runoff requires to reach the channel, thus reducing the flood peaks. Of course, for the selection of the final measures, detailed studies need to be conducted at the local level, taking into consideration the type of infrastructure (e.g. houses, parks etc.), the torrents and the areas most likely to be flooded because of the topography. Finally, the future urban planning should try to avoid building new housing and hotel developments in potential flood zones.

While these measures might prove effective in the short-term, as the towns and villages continue to expand, more sustainable solutions need to be implemented. Specifically, for each of the four torrents of the island, integrated water resources management (IWRM) plans need

to be developed (Le Page et al. 2020). These have been very successful in providing a sustainable water management throughout the world (Hülsmann et al. 2019, Chang et al. 2020). One of the key components is working at the watershed scale and incorporating all hydrologic processes at this scale. In the case of flood management, the goal is to reduce the amount of the runoff water that reaches the stream channel or altering the concentration time of the surface runoff reaching the stream to reduce the flood peaks. The principle is to take mitigation measure before the water reaches the channel. The idea is to implement ecosystem-based (Dhyani et al. 2018, Hülsmann et al. 2019) and ecohydrological (Janauer 2016) approaches, and nature-based solutions (Bridgewater 2018, Zaimes et al. 2019a, Brillinger et al. 2020), which are more sustainable and environmentally friendly ways to reduce flooding in the long-term. For example, these could be the establishment and maintenance of the natural riparian vegetation along the torrents (Zaimes et al. 2019b) and the wetlands in the targeted locations of the watershed (Wu et al. 2020).

Overall, the major types of surface water bodies on these islands are the torrents. Torrents, by nature, have a very extreme hydrologic regime that can range from no flow to a flash flood in a matter of hours (Emmanouloudis et al. 2011). This makes them extremely unpredictable and very difficult to manage. It is a necessity to improve our understanding of the processes that govern these systems (Koutalakis et al. 2017a). It will be essential to develop and utilize tools that predict flows for semi-arid intermittent and ephemeral streams (Tzoraki et al. 2013) and especially peak flows from poorly or ungauged torrents (Koutroulis and Tsanis 2010) that run through the urban settings (Papaioannou et al. 2018). Finally, enhancing the awareness of the general public on the impacts of flash floods events, along with mitigation measures, before, during and after these events, should also be a major priority for the Civil Protection Authorities of Greece (Diakakis et al. 2018).

Conclusions

The areas of Zakynthos Island that have the greatest flood susceptibility were identified by implementing MCDA in a GIS environment. Six factors that influence flash floods were selected and different weights were assigned to them based on the experts' opinions on their importance to this phenomenon. The algebraic sum of the above six factors in GIS categorized the study area into five susceptibility zones, from very low to very high. The results were very satisfactory since the very high susceptibility areas corresponded to the areas that experience flood events in the past.

Improvements can be made to this method. The lack of detailed data on some of the factors was the main source of uncertainty for the results of this study. This uncertainty was related to the geological and land-uses data (too coarse resolution), the lack of high-resolution terrain data (topography), and the few meteorological stations located on the island. Improving the resolution and the spatial accuracy of data would substantially improve the results of this method. Improvements could also be accomplished by including additional factors such as watershed area, watershed stream density, soil type, vegetation cover, population density, road network and the existence of flood mitigation measures.

Overall, the results were very promising. Similar maps, based on this method, should be developed for other islands or regions of Greece that face flash floods. One of the main advantages is the relatively easy implementation of the method. The production of such maps will be very useful to the Civil Protection Authorities of Greece for many reasons. The use of these maps would showcase the areas were flash floods events could occur. This would allow the early evacuation of these areas during flash floods. In addition, the flood mitigation infrastructure and other measures, would be constructed by relying on science-based information in the most needed areas (targeted approach).

Climate change and the continued expansion of urbanization are expected to increase the flood events' frequency and magnitude. This is particularly true for Greece and the Mediterranean, where fatalities due to flash floods have been recorded in the recent past years. These facts necessitate the utilization of modern and innovative methodologies to mitigate flash floods, particularly into urban settings. Methods such or similar to this study can be an important tool for Greece and the Mediterranean. Civil protection authorities should adapt such methods since they provide a cost-effectively alternative to protect the citizens from this natural disaster. Municipalities should also avoid urban development in areas that have high susceptibility to floods. Finally, more prevention measures need to be implemented in the high susceptibility flash flood areas, at both the local urban scale and the watershed scale, along with enhancing the awareness through various activities with the citizens of these areas.

References

ARTINYAN E., VINCENDON B., KROUMOVA K., NEDKOV N., TSAREV P., BALABANOVA S., KOSHINCHANOV G. (2016), *Flood forecasting and alert system for Arda River basin*, Journal of Hydrology 541 (Part A), 457-470.

BRIDGEWATER P. (2018), *Whose nature? What solutions? Linking Ecohydrology to Nature-based solutions*, Ecohydrology & Hydrobiology 18 (4), 311-316.

BRILLINGER M., DEHNHARDT A., SCHWARZE R., ALBERT C. (2020), *Exploring the uptake of nature-based measures in flood risk management: Evidence from German federal states*, Environmental Science & Policy 110, 14-23.

CALBÓ J. (2010), *Possible Climate Change Scenarios with Specific Reference to Mediterranean Regions*, in: Sabater S., Barceló D. (eds.), Water Scarcity in the Mediterranean. The Handbook of Environmental Chemistry, vol. 8, Springer, Berlin, pp. 1-13.

CAMARASA BELMONTE A. M., SEGURA BELTRÁN F. (2001), *Flood events in Mediterranean ephemeral streams (ramblas) in Valencia region, Spain*, CATENA 45 (3), 229-249.

CAVALLO E., NOY I. (2011), *Natural Disasters and the Economy – A survey*, International Review of Environmental and Resource Economics 5 (1), 63-102.

CHANG I.-S., ZHAO M., CHEN Y., GUO X., ZHU Y., WU J., YUAN T. (2020), *Evaluation on the integrated water resources management in China's major cities - - Based on City Blueprint® Approach*, Journal of Cleaner Production 262, 121410.

CHILIKOVA-LUBOMIROVA M., ZAIMES G. (2018), *River Hydraulics during Flood Events: The Balkan Experiences*, MATEC Web of Conferences 145, 03002.

DIACONU D. C., BRETCAN P., PEPTENATU D., TANISLAV D., MAILAT E. (2019), *The importance of the number of points, transect location and interpolation techniques in the analysis of bathymetric* measurements, Journal of Hydrology 570, 774-785.

DIAKAKIS M. (2014), *An inventory of flood events in Athens, Greece, during the last 130 years. Seasonality and spatial distribution*, Journal of Flood Risk Management 7 (4), 332-343.

DIAKAKIS M., DELIGIANNAKIS G. (2017), *Flood fatalities in Greece: 1970-2010*, Journal of Flood Risk Management 10 (1), 115-123.

DIAKAKIS M., PRISKOS G., SKORDOULIS M. (2018), *Public perception of flood risk in flash flood prone areas of Eastern Mediterranean: The case of Attica Region in Greece*, International Journal of Disaster Risk Reduction 28, 404-413.

DIAKAKIS M., ANDREADAKIS E., NIKOLOPOULOS E. I., SPYROU N. I., GOGOU M. E., DELIGIANNAKIS G., KATSETSIADOU N. K., ANTONIADIS Z., MELAKI M., GEORGAKOPOULOS A., TSAPROUNI K., KALOGIROS J., LEKKAS E. (2019), *An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece*, International Journal of Disaster Risk Reduction 33, 290-309.

DUANE A., AQUILUÉ N., CANELLES Q., MORÁN-ORDOÑEZ A., DE CÁCERES M.,

BROTONS L. (2019), *Adapting prescribed burns to future climate change in Mediterranean landscapes*, Science of The Total Environment 677, 68-83.

DUCROCQ V., BRAUD I., DAVOLIO S., FERRETTI R., FLAMANT C., JANSA A., KALTHOFF N., RICHARD E., TAUPIER-LETAGE I., AYRAL P.-A., BELAMARI S., BERNE A., BORGA M., BOUDEVILLAIN B., BOCK O., BOICHARD J.-L., BOUIN M.-N., BOUSQUET O., BOUVIER C., CHIGGIATO J., CIMINI D., CORSMEIER U., COPPOLA L., COCQUEREZ P., DEFER E., DELANOË J., DI GIROLAMO P., DOERENBECHER A., DROBINSKI P., DUFOURNET Y., FOURRIÉ N., GOURLEY J. J., LABATUT L., LAMBERT D., LE COZ J., MARZANO F. S., MOLINIÉ G., MONTANI A., NORD G., NURET M., RAMAGE K., RISON W., ROUSSOT O., SAID F., SCHWARZENBOECK A., TESTOR P., VAN BAELEN J., VINCENDON B., ARAN M., TAMAYO J. (2014), *HyMeX-SOP1: The Field Campaign Dedicated to Heavy Precipitation and Flash Flooding in the Northwestern Mediterranean*, Bulletin of the American Meteorological Society 95 (7), 1083-1100.

DHYANI S., LAHOTI S., KHARE S., PUJARI P., VERMA P. (2018), *Ecosystem based Disaster Risk Reduction approaches (EbDRR) as a prerequisite for inclusive urban transformation of Nagpur City, India*, International Journal of Disaster Risk Reduction 32, 95-105.

EMMANOULOUDIS D., RODRÍGUEZ J. L. G., ZAIMES G. N., SUÁREZ M. C. G., FILIPPIDIS E. (2011), *Euro-Mediterranean torrents: Case studies on tools that can improve their management*, in: Richards K. E. (ed.), Mountain Ecosystems: Dynamics, Management and Conservation, Nova Science Publishers, New York, pp. 1-44.

EUROPEAN COUNCIL (2007), *EU Directive of the European Parliament and of the European Council on the estimation and management of flood risks (2007/60/EC)*, Publications Office of the European Union, Luxembourg.

FERRARIS L., RUDARI R., SICCARDI F. (2002), *The Uncertainty in the Prediction of Flash Floods in the Northern Mediterranean Environment*, Journal of Hydrometeorology 3 (6), 714-727.

FORTESA J., GARCÍA-COMENDADOR J., CALSAMIGLIA A., LÓPEZ-TARAZÓN J. A., LATRON J., ALORDA B., ESTRANY J. (2019), *Comparison of stage/discharge rating curves derived from different recording systems: Consequences for streamflow data and water management in a Mediterranean island*, The Science of the Total Environment 665, 968-981.

GARCÍA-COMENDADOR J., FORTESA J., CALSAMIGLIA A., CALVO-CASES A., ESTRANY J. (2017), *Post-fire hydrological response and suspended sediment transport of a terraced Mediterranean catchment*, Earth Surface Processes and Landforms 42 (14), 2254-2265.

GAUME E., BAIN V., BERNARDARA P., NEWINGER O., BARBUC M., BATEMAN A., BLAŠKOVIČOVÁ L., BLÖSCHL G., BORGA M., DUMITRESCU A., DALIAKOPOULOS I., GARCIA J., IRIMESCU A., KOHNOVA S., KOUTROULIS A., MARCHI L., MATREATA S., MEDINA V., PRECISO E., SEMPERE-TORRES D., STANCALIE G., SZOLGAY J., TSANIS I., VELASCO D., VIGLIONE A. (2009), *A compilation of data on European flash floods*, Journal of Hydrology 367 (1-2), 70-78.

GAUME E., BORGA M., LLASSAT M. C., MAOUCHE S., LANG M., DIAKAKIS M. (2016), *Sub-chapter 1.3.4. Mediterranean extreme floods and flash floods*, in: Thiébault S., Moatti J.-P. (eds.), The Mediterranean Region under Climate Change. A Scientific Update: abridged English/French version, IRD Editions, Marseille, pp. 133-144.

GIANNAKOPOULOS C., KOSTOPOULOU E., VAROTSOS K. V., TZIOTZIOU K., PLITHARAS A. (2011), *An integrated assessment of climate change impacts for Greece in the near future*, Regional Environmental Change 11, 829-843.

GOODCHILD M. F. (2010), *Twenty years of progress: GIScience in 2010*, Journal of Spatial Information Science 1, 3-20.

GOUNARIDIS D., ZAIMES G. N. (2012), *GIS-based multicriteria decision analysis applied for environmental issues; the Greek experience*, International Journal of Applied Environmental Sciences 7 (3), 307-321.

HEATHCOTE I. W. (2009), *Integrated watershed management: principles and practice, 2nd edition*, John Wiley & Sons, Hoboken.

HÜLSMANN S., SUŠNIK J., RINKE K., LANGAN S., VAN WIJK D., JANSSEN A. B. G., MOOIJ W. M. (2019), *Integrated modelling and management of water resources: the ecosystem perspective on the nexus approach*, Current Opinion in Environmental Sustainability 40, 14-20.

JANAUER G. A. (2016), *Ecohydrology, floodplain water bodies, European legal provisions and the future*, Ecohydrology & Hydrobiology 16 (1), 58-65.

JONKMAN S. N. (2005), *Global Perspectives on Loss of Human Life Caused by Floods*, Natural Hazards 34, 151-175.

KOURGIALAS N. N., KARATZAS G. P. (2011), *Flood management and a GIS modelling method to assess flood-hazard areas – a case study*, Hydrological Sciences Journal 56 (2), 212-225.

KOURGIALAS N. N., DOKOU Z., KARATZAS G. P. (2015), *Statistical analysis and ANN modeling for predicting hydrological extremes under climate change scenarios: The example of a small Mediterranean agro-watershed*, Journal of Environmental Management 154, 86-101.

KOURGIALAS N. N., KARATZAS G. P. (2016), *A flood risk decision making approach for Mediterranean tree crops using GIS; climate change effects and flood-tolerant species*, Environmental Science and Policy 63, 132-142.

KOURGIALAS N. N., KARATZAS G. P. (2017), *A national scale flood hazard mapping methodology: The case of Greece – Protection and adaptation policy approaches*, Science of the Total Environment 601-602, 441-452.

KOUTALAKIS P., VLACHOPOULOU A., EMMANOULOUDIS D., ZAIMES G. N. (2017a), *Simulation of torrent discharge using SWAT and evaluation by field survey in Thasos Island*, Journal of Engineering Science and Technology Review 10 (3), 7-10.

KOUTALAKIS P., ZAIMES G. N., IOANNOU K., IAKOVOGLOU V. (2017b), *Application of the SWAT model on torrents of the Menoikio, Greece*, Fresenius Environmental Bulletin 26 (2), 1210-1215.

KOUTALAKIS P., TZORAKI O., ZAIMES G. (2019), *UAVs for Hydrologic Scopes: Application of a Low-Cost UAV to Estimate Surface Water Velocity by Using Three Different Image-Based Methods*, Drones 3 (1), 14.

KOUTROULIS A. G., TSANIS I. K. (2010), *A method for estimating flash flood peak discharge in a poorly gauged basin: Case study for the 13-14 January 1994 flood, Giofiros basin, Crete, Greece*, Journal of Hydrology 385 (1-4), 150-164.

LE PAGE M., FAKIR Y., AOUISSI J. (2020), *Chapter 7 - Modeling for integrated water resources management in the Mediterranean region*, in: Zribi M., Brocca L., Tramblay Y., Molle F. (eds.), Water Resources in the Mediterranean Region, Elsevier, New York, pp. 157-190.

LI W., LIN K., ZHAO T., LAN T., CHEN X., DU H., CHEN H. (2019), *Risk assessment and sensitivity analysis of flash floods in ungauged basins using coupled hydrologic and hydrodynamic models*, Journal of Hydrology 572, 108-120.

LLASAT M. C., LLASAT-BOTIJA M., PRAT M. A., PORCÚ F., PRICE C., MUGNAI A., LAGOUVARDOS K., KOTRONI V., KATSANOS D., MICHAELIDES S., YAIR Y., SAVVIDOU K., NICOLAIDES K. (2010), *High-impact floods and flash floods in Mediterranean countries: The FLASH preliminary database*, Advances in Geosciences 23, 47-55.

LLASAT M. C., MARCOS R., TURCO M., GILABERT J., LLASAT-BOTIJA M. (2016), *Trends in flash flood events versus convective precipitation in a Mediterranean region: The case of Catalonia*, Journal of Hydrology 541 (Part A), 24-37.

LUMBROSO D., GAUME E. (2012), *Reducing the uncertainty in indirect estimates of extreme flash flood discharges*, Journal of Hydrology 414-415, 16-30.

MALCZEWSKI J. (1999), *GIS and Multicriteria Decision Analysis*, John Wiley & Sons, New York.

MALCZEWSKI J. (2006), *GIS-based multicriteria decision analysis: a survey of the literature*, International Journal of Geographical Information Science 20 (7), 703-726.

MARCHI L., BORGA M., PRECISO E., GAUME E. (2010), *Characterization of selected extreme flash floods in Europe and implications for flood risk management*, Journal of Hydrology 394 (1-2), 118-133.

MAUGERI M., BRUNETTI M., GARZOGLIO M., SIMOLO C. (2015), *High-resolution analysis of 1 day extreme precipitation in Sicily*, Natural Hazards and Earth System Sciences 15 (10), 2347-2358.

MITSOPOULOS I., MALLINIS G., ZIBTSEV S., YAVUZ M., SAGLAM B., KUCUK O., BOGOMOLOV V., BORSUK A., ZAIMES G. (2017), *An integrated approach for mapping fire suppression difficulty in three different ecosystems of Eastern Europe*, Journal of Spatial Science 62 (1), 139-155.

MORGAN R. P. C. (2005), *Soil Erosion and Conservation, 3rd edition*, Wiley-Blackwell, Oxford.

PAPAIOANNOU G., EFSTRATIADIS A., VASILIADES L., LOUKAS A., PAPALEXIOU S. M., KOUKOUVINOS A., TSOUKALAS I., KOSSIERIS P. (2018), *An operational method for Flood Directive implementation in ungauged urban areas*, Hydrology 5 (2), 24.

PEDRO-MONZONÍS M., DEL LONGO M., SOLERA A., PECORA S., ANDREU J. (2016), *Water Accounting in the Po River Basin Applied to Climate Change Scenarios*, Procedia Engineering 162, 246-253.

RAHMAN M., SAHA S. K. (2008), *Remote sensing, spatial multi criteria evaluation (SMCE) and analytical hierarchy process (AHP) in optimal cropping pattern planning for a flood prone area*, Journal of Spatial Science 53 (2), 161-177.

RANIS G. D., IAKOVOGLOU V., ZAIMES G. N. (2015), *Ecosystem Post-Wildfire Effects of Thasos Island*, International Journal of Environmental and Ecological Engineering 9 (10), 1282-1285.

RAULT P. A. K., KOUNDOURI P., AKINSETE E., LUDWIG R., HUBER-GARCIA V., TSANI S., ACUNA V., KALOGIANNI E., LUTTIK J., KOK K., SKOULIKIDIS N., FROEBRICH J. (2019), *Down scaling of climate change scenarii to river basin level: A transdisciplinary methodology applied to Evrotas river basin, Greece*, Science of The Total Environment 660, 1623-1632.

ROUDIER P., ANDERSSON J. C. M., DONNELLY C., FEYEN L., GREUELL W., LUDWIG F. (2016), *Projections of future floods and hydrological droughts in Europe under a +2°C global warming*, Climatic Change 135, 341-355.

ŞEN Z. (2018), *Flood Modeling, Prediction and Mitigation, 1st edition*, Springer, New York.

SIMONOVIĆ S. P. (2012), *Floods in a Changing Climate: Risk Management*, *1st edition*, Cambridge University Press, Cambridge.

TAROLLI P., BORGA M., MORIN E., DELRIEU G. (2012), *Analysis of flash flood regimes in the North-Western and South-Eastern Mediterranean regions*, Natural Hazards and Earth System Sciences 12, 1255-1265.

TERRADO M., ACUÑA V., ENNAANAY D., TALLIS H., SABATER S. (2014), *Impact of climate extremes on hydrological ecosystem services in a heavily humanized Mediterranean basin*, Ecological Indicators 37 (Part A), 199-209.

TOOSI A. S., CALBIMONTE G. H., NOURI H., ALAGHMAND S. (2019), *River basin-scale flood hazard assessment using a modified multi-criteria decision analysis approach: A case study*, Journal of Hydrology 574, 660-671.

TRENBERTH K. E. (2008), *The Impact of Climate Change and Variability on Heavy Precipitation, Floods, and Droughts*, in: Anderson M. H. (ed.), Encyclopedia of Hydrological Sciences, J. Wiley and Sons, Chichester.

TZORAKI O., COOPER D., KJELDSEN T., NIKOLAIDIS N. P., GAMVROUDIS C., FROEBRICH J., QUERNER E., GALLART F., KARALEMAS N. (2013), *Flood generation and classification of a semi-arid intermittent flow watershed: Evrotas river*, International Journal of River Basin Management 11 (1), 77-92.

TUFEKCIOGLU M., YAVUZ M., ZAIMES G. N., DINC M., KOUTALAKIS P., TUFEKCIOGLU A. (2017), *Application of Soil Water Assessment Tool (SWAT) to suppress wildfire at Bayam Forest, Turkey*, Journal of Environmental Biology 38 (5), 719-726.

WU Y., ZHANG G., ROUSSEAU A. N., XU Y. J., FOULON É. (2020), *On how wetlands can provide flood resilience in a large river basin: A case study in Nenjiang river Basin, China*, Journal of Hydrology 587, 125012.

VOZINAKI A.-E. K., TAPOGLOU E., TSANIS I. K. (2018), *Hydrometeorological impact of climate change in two Mediterranean basins*, International Journal of River Basin Management 16 (2), 245-257.

ZAIMES G. N., EMMANOULOUDIS D. (2012), *Sustainable Management of the Freshwater Resources of Greece*, Journal of Engineering Science and Technology Review 5 (1), 77-82.

ZAIMES G. N., GOUNARIDIS D., IAKOVOGLOU V., EMMANOULOUDIS D. (2012), *Assessing soil erosion risk for Rhodes island, Greece with a GIS-based multi-criteria decision analysis*, Proceedings of the IASTED International Conference on Water Resource Management, 317-324.

ZAIMES G. N., TUFEKCIOGLU M., TUFEKCIOGLU A., ZIBTSEV S., COROBOV R., EMMANOULOUDIS D., URATU R., GHULIJANYAN A., BORSUK A., TROMBITSKY I. (2016), *Transboundary Collaborations to Enhance Wildfire Suppression in Protected Areas of the Black Sea Region*, Journal of Engineering Science and Technology Review 9 (1), 108-114.

ZAIMES G. N., TARDIO G., IAKOVOGLOU V., GIMENEZ M., GARCIA-RODRIGUEZ J. L., SANGALLI P. (2019a), *New tools and approaches to promote soil and water bioengineering in the Mediterranean*, Science of The Total Environment 693, 133677.

ZAIMES G. N., TUFEKCIOGLU M., SCHULTZ R. C. (2019b), *Riparian Land-Use Impacts on Stream Bank and Gully Erosion in Agricultural Watersheds: What We Have Learned*, Water 11, 1343.

ZEVENBERGEN C., CASHMAN A., EVELPIDOU N., PASCHE E., GARVIN S., ASHLEY R. (2010), *Urban Flood Management*, CRC Press, Boca Raton.

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Analysis of the urban and regional condition needs to be interdisciplinary. In reality, urban researchers usually tend to belong to a discipline reflecting their training whether as sociologists, geographers, planners or any number of subjects concerned with the study of space and place. Our training very often endorses an appreciation of how other disciplines explore the city. For the journal the acknowledgement of the many disciplines that concerned with understanding cities and regions will be indicated by the different disciplinary back-grounds reflected in the papers published. Articles will be published by geographers, sociologists, planners, economists, political scientists, to mention just few of the disciplines involved in urban and regional study.

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