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An explanation of urban sprawl phenomenon in Shiraz Metropolitan Area (SMA)

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ABSTRACT

Urban Sprawl, as a low-density, unplanned, unlimited and sporadic physical expansion towards suburban area is one of the worldwide challenges facing spatial development planning in recent years. In a great part of literature on urban sprawl, dealing with this phenomenon depends on controlling two main factors of "population growth" and "per capita land consumption". This study is to propose a comprehensive framework for dealing with this phenomenon emphasizing the case study of Shiraz Metropolitan Area (SMA) in Iran through identifying the drivers stimulating these two factors. Analyses were carried out by using spatial analytics, mathematical and statistical methods such as Holdern analysis, path analysis and other statistical analyses. Investigating the drivers and factors, the article suggests that unlike many reviewed experiences, "per capita land consumption" is not the main factor in SMA's Sprawl. Instead, "population growth" due to employment opportunities, higher relative household income and affordable housing policies are the main drivers. Furthermore, attracting creative class through development of knowledge economy and ICT infrastructures has adversely influenced urban sprawl. In addition, automobile-oriented developments have exacerbated this phenomenon by stimulating city expansion towards invaluable natural and rural areas. Thus, in order to control the phenomenon under study, it is necessary to take into account these factors in planning priorities and allocation of resources considering the causal relations between them.

1. Introduction

Urban sprawl refers to low-density, poorly planned, auto-dependent and sporadic physical expansion of urban and rural area which spreads out over large amounts of rural land. In other words, it's the rapid expansion of residential and non-residential development to the relatively intact environment (Burchell & Galley, 2003; Ewing, 1997; Nelson & Duncan, 1995; USHUD, 1999). A review of the literature shows that this phenomenon is gobbling up of forests, farmland, wetlands and woodlands (Ermer, Mohrmann, & Sukopp, 1994; Leser & Huber-Frohli, 1997) and leads to the destruction of farmlands (Berry & Plaut, 1978; Fischel, 1982; Hasse & Lathrop, 2003b; Nelson, 1990; Zhang, Chen, Tan, & Sun, 2007), natural landscape, decreased desirability and viability (Akademie fur Raumforschung und Landesplanung (ARL) and Schweizerische Vereinigung fur Landesplanung (VLP), 1999; Landscape Gesellschaft fur Geo-Kommunikation, 2000–2002; Grimm, Grove, Pickett, & Redman, 2000), increased travel duration (Sierra Club, 1999), leads to soil, water and air pollutions (Jacquin, Misakova, & Gay, 2008; Stone, 2008; Wang, Zhu, Wang, & Shi, 2003; Weng, Liu, & Lu, 2007), increases energy and natural resources consumption (Newman & Kenworthy, 1988) It's also increases costs of facility due to the spatial development of the city (Harvey & Clark, 1965), followed by increased current and civil costs and economic instability of the city and finally, decreased social ties and interactions leading to social instability (Benfield, Raimi, & Chen, 1999; Frumkin, 2002; Kunstler, 1993; Mitchell, 2001; Savitch, 2003; Sturm & Cohen, 2004; Yanos, 2007).

Iran's cities have been faced with the urban sprawl phenomenon, especially since the 1970s. More recently, scientific studies have been proved negative impacts of urban sprawl in Iran's cities including the destruction of landscapes and natural resources around the city (Soltani, Hosseinpour, & Hajizadeh, 2017) and coastal areas and resulted in declining the declining tourism performance of the city (Dadras, ZulhaidiMohd Shafri, Ahmad, Pradhan, & Safarpour, 2014), degradation and destruction of agricultural land around the city, decline in productivity, and threat to food and economic security (Mohammadian Mosammam, Tavakoli Nia, Khani, Teymouri, & Kazemi, 2016), destruction and losing of groundwater resources (demolition of 88 flumes in Mashhad and 376 in Tehran (Hosseini et al., 2014) and the water crisis, pollution of water and soil,

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increasing the cost of providing urban services, increasing the time and length of intra-city trips (Mohammady & Delavar, 2014) and as a result, increasing the consumption of fuel and energy as well as changing the local climate (Zanganeh Shahraki et al., 2011), Social segregation (Eslami Mahmoudabadi, Soroushnia, & Zekri, 2013; Zali, Hashemzadeh Ghal'ejough, & Esmailzadeh, 2016) and the reduction of social capital and increasing the crime rate of the city;

There are two major theoretical approaches to urban sprawl which are both opposite and supportive: anti-sprawl and pro-sprawl. Anti-sprawl movement is classified in two categories of "protection" and "smart growth" including three branches: *advocates of more efficient urban planning* in terms of energy, *high-density supporters* and *supporters of earth, valuable rural areas and environmental assets*. The aims of these branches have led to define and measure the sprawl from different point of view. For example, high-density supporters define and measure urban sprawl phenomenon in terms of density rate in metropolitan areas. "*USA today's sprawl index*" is an example in this regard. However, environmentalists, measure urban sprawl via agricultural and horticultural land-use change outside the metropolitan area (Beck, Kolankiewicz, & Camarota, 2003; Nelson, 1990). On the contrary, there is a group of liberal politicians, researchers, and journalists that have promoted urban sprawl phenomenon and American customs and values. They believe that urban sprawl has many benefits such as affordable housing, free parking lot, free movement, enough space, yard and neighborhood with green areas around the city as well as high quality of life for citizens who are tired of city life (Beck et al., 2003; Kahn, 2001).

Similar to other studies in Iran, this study also uses "Anti-sprawlers" approaches and aims to introduce comprehensive framework deals with this phenomenon by conducting case study of Shiraz Metropolitan Area (SMA) in Iran. Accordingly, with the aim of presenting a general framework for Iranian metropolises, an attempt has been made to make an analogy between the patterns and the reasons of sprawl in other cities of Iran, including large, medium and small cities based on existing studies and researches.

Shiraz as the sixth largest metropolis areas in Iran, has been chosen to explain urban sprawl because of its dramatic changes during past five decades. In this regard, after conducting the spatial analytics of urban sprawl in SMA, the causal relation explaining this phenomenon would be explored using path analysis method. This method is used to describe the direct and indirect dependencies among a set of variables or drivers stimulating the sprawl.

2. Theoretical framework

2.1. Conceptualization of urban sprawl

In contrast to "compacts cities", "urban sprawl" is an ambiguous concept and researches and organizations have not yet developed a commonly accepted definition of what constitutes urban sprawl. Urban sprawl could be defined as a situation (by measuring the degree of sprawl) or a process. In general, some experts claim urban sprawl is an urban/rural spatial expansion that constitutes three major features: (Acioly & Davidson, 1996) sporadic or dispersing development (Gouda, Hosseini, & Masoumi, 2016) commercial strips development (Akademie fur Raumforschung und Landesplanung (ARL) & Schweizerische Vereinigung fur Landesplanung (VLP), 1999) wide spread of low-density or single functional development (Ewing, 1997; Hasse & Lathrop, 2003a; Jaeger, Bertiller, Schwick, Cavens, & Kienast, 2010; Sierra Club, 1999). Also, according to Ewing, Pendall, and Chen (2002), this expression is recognizable by indicators such as limited-access to facilities and services and lack of functional outdoor spaces. Yet from another perspective, urban sprawl is the process by which the dispersion of development across the region happens faster than population growth (Beck et al., 2003; Ewing et al., 2002; Fulton, Pendall, Nguyen, & Harrison, 2001). Therefore, it has four dimensions: (Acioly & Davidson, 1996) low-density distribution of population, (Gouda et al., 2016) highly fragmented and disconnected households, shopping centers and workplaces (separate zoning of applications), (Akademie fur Raumforschung und Landesplanung (ARL) & Schweizerische Vereinigung fur Landesplanung (VLP), 1999) streets divided by large blocks with low-access of sidewalks (Al Gore, 1998) lack of a clear definition for thriving activity centers such as commercial centers and other urban centers. Burchell and Galley (2003), define urban sprawl as a sporadic low-density development determined by its indefinite spread out. In other words, urban sprawl is a significant residential and non-residential development in a relatively pristine environment. Jaeger et al. (2010), define this phenomenon as a visible status which is an urban landscape including sporadic urban development and building blocks placed in distance from one another.

In addition to these quantitative definitions, there are some other qualitative definitions of urban sprawl. For instance, Al Gore (1998), presented one definition, by in his speech at the annual conference of the Democratic Leadership Council: "chaotic and poorly planned development that may make it impossible to greet neighbors on the sidewalk, it would require gasoline, a quarter of a gallon, to buy a bottle of milk, and it would be impossible for children to walk to their school".

Through an overview of these definitions, the study describes the typology of sprawl phenomenon in the following four possible systems: (Acioly & Davidson, 1996) spatial expansion system: chaotic and disordered growth, sporadic diffused growth (detached construction), distancing from the city center; (Gouda et al., 2016) urban planning system (level of commitment to the plan's principles): unplanned and uncontrolled growth, dispersion of development beyond urban and functional edges, (Akademie fur Raumforschung und Landesplanung (ARL) & Schweizerische Vereinigung fur Landesplanung (VLP), 1999) the system of land-use and density: use change of open spaces, farmlands and rural fields, single functional development and promoting zoning approach, low density development; (Al Gore, 1998) system of communication and accessibility: limited and invariant access to transportation (automobile-oriented development), distancing residences from workplaces and activity centers. Aforementioned definitions are classified in Table 1 based on these four selected systems.

2.2. Urban sprawl measurement

Different methods have been introduced in the literature such as single-measure or multi-measure methods for measuring urban sprawl. However, the simplest and the most frequent variable is density (Peiser, 1989). In addition to density, other variables are also employed in urban sprawl measurement, such as location of residential and activity clusters in relation to each other or to other centers, continuity rate of urban developments, centralization and mixed-use (Bertaud & Malpezzi, 1999; Ewing et al., 2002; Galster et al., 2001; Gordon & Richardson, 1997). Kahn (2001), using "distribution of job centers in relation to city center" as his basic measure, has investigated the concentration of all job centers within 10 miles around City Business District (CBD) as zero sprawl and all job centers outside this radius as full sprawl. However, his definition is practically indifferent to the status of residential centers and porosity patterns of development for activity centers. Also, Glaeser, Kahn, and Chu (2001), have used the same measure to examine the sprawl of activity centers in USA in three miles and ten miles from businesses center.

Many researchers (Batty, Xie, & Sun, 1999; Siedentop & Fina, 2012; Sudhira, Ramachandra, & Jagadish, 2004; Terzi & Bolen, 2011; Torrens & Alberti, 2000; Tsai, 2005) used these three factors in urban sprawl measurement (Acioly & Davidson, 1996) density (gross population and construction density and occupancy level), (Gouda et al., 2016) mixed-use ratio (residential use ratio, commercial use ratio, urban facilities ratio such as hospitals, schools and parks) and (Akademie fur Raumforschung und Landesplanung (ARL) & Schweizerische Vereinigung fur Landesplanung (VLP), 1999)