Int. J. Hum. Capital Urban Manage., 6(3): 305-322, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Where are the urban poor? The spatial distribution pattern of urban poverty

M.J. Nouri*, E. Zebardast

School of Urban Planning, University of Tehran, Tehran, Iran

ARTICLE INFO

Article History:
Received 08 September 2020
Revised 08 January 2021
Accepted 24 January 2021

Keywords:
Concentration of urban poverty
F'ANP model
Isfahan metropolis
Spatial distribution pattern of poverty
Urban poverty index

ABSTRACT

BACKGROUND AND OBJECTIVES: One of the issues that have been evident in previous researches on urban poverty is the existence of a methodological gap in identifying spatial representation of urban poverty. This paper suggests a methodology for identifying the spatial representation of urban poverty and applies it to Isfahan Metropolis in Iran.

METHODS: A hybrid model of exploratory factor analysis and analytical network process was used with urban poverty indicators. Using the model, the compiled database consisted of 27 indicators with 12196 specific data per indicator was analyzed to determine the domains of urban poverty and relational importance coefficient of each indicator. A composite index of urban poverty was then constructed to evaluate urban poverty in each urban block. Also, the autocorrelation test and cluster and outlier analysis were used to find the spatial distribution pattern and concentrations of urban poverty in the metropolis.

FINDINGS: Seven domains of urban poverty in Isfahan metropolis were extracted which cumulatively explain about 57.3 percent of the data variance including "general poverty (13.25%), crowdedness in the housing unit (10.09%), economic poverty (9.462%), intrinsic poverty (8.23%), infrastructure poverty (6.243%), migrant's poverty (5.276%) and unhealthy living condition (4.173%). Classifying urban blocks based on the composite index has shown that 9.8% of the population and 15.7% of urban blocks had the highest poverty rate. The autocorrelation test (Moran's index=0.459; p-value=0.000) has indicated that urban poverty was clustered. Using Cluster and outlier analysis, it was determined that 70% of urban poverty concentrations were located in suburbs and peripheral districts.

CONCLUSION: Urban policymakers can adopt relevant policies in relation to various types of urban poverty identified in metropolises and determine policy priorities based on the weight calculated for each indicator. They can also suggest policies at the macro-micro levels using the urban poverty distribution pattern and concentration map.

DOI: 10.22034/IJHCUM.2021.03.08

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
47	13	5

*Corresponding Author:
Email: *mj.noori1992@ut.ac.i*
Phone: +989136416983

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

For the first time in the world history, the world urban population outpaced its rural population in 2007 and now about 55 percent of world population is urbanized (United Nation, 2015). This milestone shows the increasing growth of urbanization in the 21th century (Watson, 2009). The world population now is more than seven billion and this population is expected be about nine billion by the year 2040 (Teitz and Chapple, 2013). Against this background, in 2004, about one in five people in the developing world, or about 1 billion people, were deemed to be poor by the 1 dollar a day standard (Ravallion *et al.,* 2007). Urban poverty has become one of the most important issues in current planning efforts. Scholars in variety of fields have concentrated their efforts to the study of urban poverty as an important issue in human development processes. Studies show that poverty increasingly exists in urban contexts and urban poor are in the core of the urbanization process (Lemanski, 2016). Scholars employ several concepts such as "social exclusion", "inequality", "vulnerability" and "underdevelopment" as alternative concepts of urban poverty (Lok-Dessallien, 1999). Lok-Dessallien (1999) tried to clarify the distinctions among these concepts by emphasizing that these are interrelated concepts. Changes in poverty concept and definition has led to changes in the definition of the urban poor. The evolutions in the poverty/urban poverty definitions and their indicators include a spectrum from absolute poverty as the first point of evolutions to the adoption of multidimensional approaches towards urban poverty phenomenon (Niemietz, 2011). Urban poverty indicators can be divided into two procedural and substantive indicators (Lemanski, 2016; Wratten, 1995). While procedural indicators implicate on those indicators related to different procedures such as political, economic, social and legal procedures that cause urban poverty, substantive indicators relate to people's attributes and their life circumstances especially in the household scale. Absolute poverty (substantive indicators) implicates on physical indicators such as food, shelter, clothing resources and monetary indicators such as income resources. Relative poverty considers poverty and urban poor based on comparing individuals in any aspect of their life. Emergence of capability poverty (procedural indicators), indicates a shift from high focus on substantive indicators to procedural indicators. By this definition, policy makers have attempted to address those procedures that are aggravating the urban poverty. Ultimately, by consensus on the multidimensional trait of poverty, both substantive and procedural indicators have drawn the scholars' attentions simultaneously (Niemietz, 2011). Although the magnitude of urban poverty may be known, the question of the whereabouts of the urban poor in the cities of the third world countries has become a planning challenge to be addressed. Therefore, the main challenge here is about the methodology of identifying the urban poor and their spatial distribution in the cities of the developing countries. Each concept of urban poverty are equipped with a methodology. That is to say, that complicated urban contexts need methodologies that are more complicated in order to investigate urban poverty contextually. In absolute poverty, the methodology was clear because there was a standard indicator (such as poverty line) to calculate urban poverty. In comparison with absolute poverty, those concepts of urban poverty formulated based on relative poverty definition, have more complicated methodologies in which individuals are compared with each other. Furthermore, relative concept of poverty is contextual which means that in different urban scales and areas the result of any methodology could be different from one other. What makes this challenge more highlighted is the multidimensional nature of urban poverty, which includes a wide spectrum of criteria and indicators in order to identify the urban poor and calculate a composite urban poverty index. Therefore, there is a need to frame a methodology to calculate urban poverty and to identify the urban poor in the urban complexity era. In this paper based on the Wilson's "concentration effect" in the theory of "truly disadvantaged", it is assumed that urban context is not just a container of the urban poverty but that they underpin each other. Wilson (1987) affirms that the concentration effect of urban poverty leads to reproduce urban poverty. According to this theory, first, a methodology has been suggested based on substantive indicators of urban poverty, in order to calculate a multidimensional urban poverty index, identify urban poor contextually and define those urban districts that reproduce urban poverty (based on the concentration effect). The objective here is to add a spatial dimension to Wilson's theory. Second, substantive indicators mentioned in the

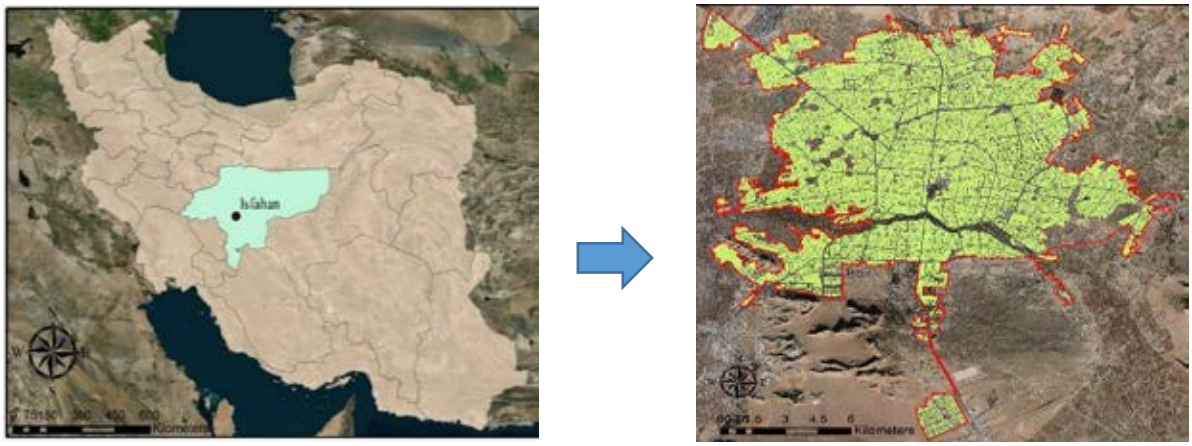

Fig. 1: the location of Isfahan metropolis in Isfahan province, Iran (a); Boundary and urban blocks of Isfahan Metropolis located in Isfahan province, Iran (b)

literature for urban poverty indicators and its similar concepts including "multi-dimensional poverty" ,"social vulnerability", "social exclusion", "inequality" and "under development" were determined. These indicators were used to compute a composite Urban Poverty Index (UPI). The UPI for each urban blocks was computed and used in the identification of the Urban Poverty Reproduced Districts (UPRDs). Third, a methodological gap in poverty research has been identified. In order to measure substantive indicators, scholars consider equal Relational Importance Coefficient (RIC) for indicators while there are various RIC for each indicator based on the different urban contexts. F'ANP model has been employed to calculate RICs contextually in order to fill this methodological gap. The current study has been carried out in Isfahan metropolis as the third largest city located in Iran in 2017. There are different spatial representations of urban poverty such as marginal informal settlements, a large number of declined urban fabrics, increasing rate of immigrants and unemployment rate of simple workers, and a huge number of female-headed households in Isfahan metropolitan area. These different kinds of urban poverty have made it difficult to accurately identify where the urban poor in Isfahan metropolis are.

MATERIALS AND METHODS

Description of the study area

The metropolis of Isfahan, the capital of Isfahan province in Iran, has been selected as a case study in this paper (Fig. 1a). Isfahan Metropolis (Fig. 1b) is the third largest city in Iran and had a population of 1,961,260 people in the 2016 census (SCI, 2016).

In this paper 12,196 urban blocks of Isfahan Metropolis were analyzed, however, in order to examine the main question of the paper implicated on "where the poor are", urban blocks have been classified based on their location in different areas developed through the evolution of Isfahan Metropolis (Fig. 2). These areas include: the historical district (developed before 1920) located at the center of Isfahan Metropolis; inner city area (between developed 1920 to 1964) that includes the old urban fabric; middle district (developed between 1964 to 1975) located between the historical and inner city area of Isfahan and peripheral districts; two peripheral districts developed in two different period (first one developed between 1975 to 1982 and the second developed between 1982 to 1996); annexed villages, towns and cities (annexed in 2003).

Development of the model

In order to identify and address the urban poverty, the applied methodology is composed of the following three phases (Fig. 3):

Phase 1. The urban poverty indicators were identified and extracted from the literature review (27 indicators). Excel and ArcMap software were used to join the data extracted from the population and housing census data (SCI, 2016) at the urban blocks level (12,169 blocks).

Phase 2. The F'ANP model (Zebardast, 2013) is a hybrid model consisting of an Exploratory Factor

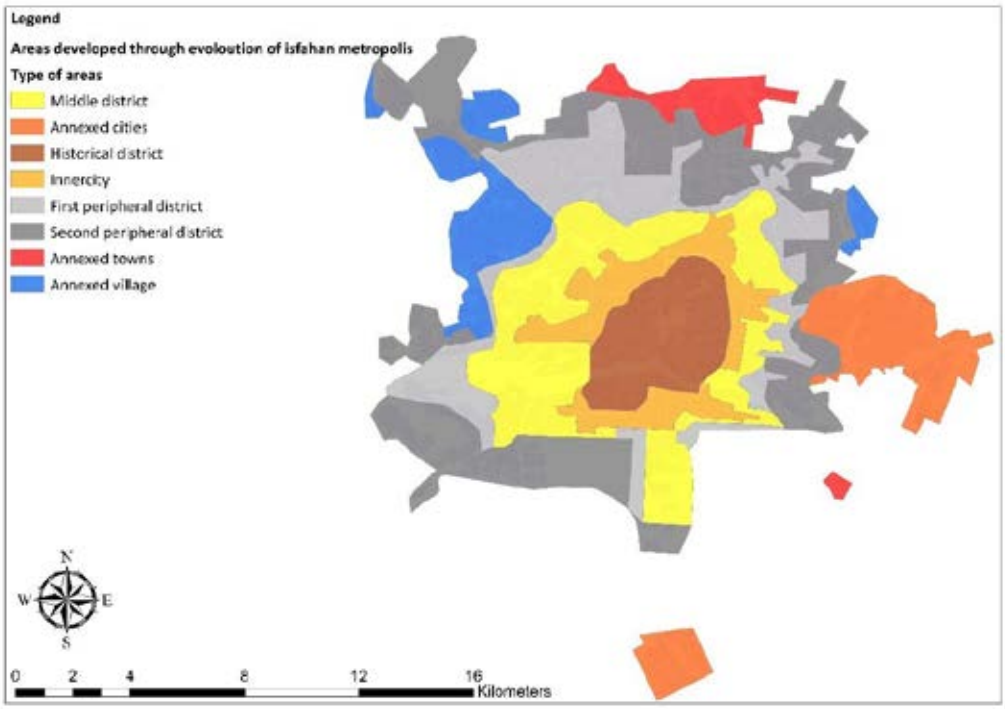

Fig.2: Areas developed through the evolution of Isfahan Metropolis; adapted from Atlas of Isfahan Metropolis (Atlas of Isfahan Metropolis, 2017)

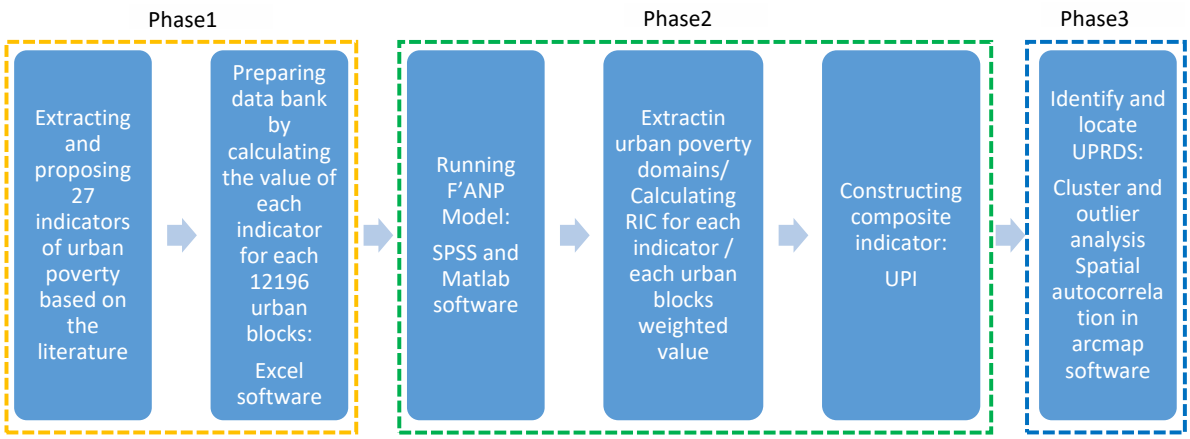

Fig.3: The research methodology and its process

Analysis (EFA) model and an Analytical Network Process (ANP). At first, the EFA model in SPSS 22 software has been run which forms the first stage of the F'ANP model process. Then, the outputs of the exploratory factor analysis model enter the analytical network process, using MATLAB 2016a software. The F'ANP model were used to compute the RIC of each indicator. Each indicator's status in Isfahan Metropolis were determined, the UPI for each urban block was calculated, and the urban poverty status in the Isfahan Metropolis was then evaluated.

Phase 3. Cluster and outlier analysis and spatial

autocorrelation (Moran's I) were used in order to identify and locate UPRDs.

Data collection

This study was made at metropolitan area scale and therefore the study area includes 12196 urban blocks. The value of each urban poverty indicator extracted from literature review was obtained from the population and housing census 2016. The compiled information allowed the elaboration of a database of 27 indicators, with 12196 specific data per indicator, coming from all the urban blocks of the Isfahan metropolis (Table 1). This is the phase 1 of proposed methodology. The database was analyzed with the SPSS V22, MATLAB V2016a and ArcMap software version 10.4.1 in further phases.

Table 1: Urban poverty substantive indicators

Name of the variable	Symbol	Background research
Household Size	HHS	(Armaş, 2012; de Oliveira Mendes, 2009; Finch *et al.,* 2010; Guimarães, 2013; Wood *et al.,* 2010)
Population density	POPDEN	(Armaş, 2012; Borden *et al.,* 2007; Chakraborty *et al.,* 2005; de Oliveira Mendes, 2009; Labonté *et al.,* 2011; Lee, 2014; Martínez, 2009; Myers *et al.,* 2008; Tate, 2013)
Percentage of housing units with a room	PHWOR	(Cutter *et al.,* 2003; Myck *et al.,* 2015; Zebardast, 2013)
Percentage of the population under 5 years of age	PO5	(Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of persons with disabilities	PDIS	(Cutter *et al.,* 2003; Lee, 2014; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of rented residential units	PRH	(Cutter *et al.,* 2003; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of housing units in form of sheds, huts and slums ...	PQH	(Labonté *et al.,* 2011)
Unemployment rate	UER	(Azpitarte, 2012; Bjarnadottir *et al.,* 2011; Flanagan *et al.,* 2011; Guimarães, 2013; Khan, 2012; Labonté *et al.,* 2011; Martínez, 2009; Myck *et al.,* 2015; Nelson *et al.,* 2015; Popay *et al.,* 2010; Schmidtlein *et al.,* 2008; Zebardast, 2013)
Percentage of illiterate population	ILR	(Armaş, 2012; Azpitarte, 2012; Guimarães, 2013; Labonté *et al.,* 2011; Myck *et al.,* 2015)
Percentage of the population over 65 years old	PO65	(Armaş, 2012; Esnard *et al.,*2011; Finch *et al.,* 2010; Flanagan *et al.,* 2011; Lee, 2014; Nelson *et al.,* 2015; Schmidtlein *et al.,* 2008; Tate, 2013; Van Zandt *et al.,* 2012)
Actual dependency ratio	DER	-
Percentage of old housing units	POH	(Azpitarte, 2012; de Oliveira Mendes, 2009; Labonté *et al.,* 2011; Nelson *et al.,* 2015)
Percentage of housing units with unstable structure	PHWWS	-
Percentage of households without a own car	PHWCAR	(Kis and Gábos, 2016; Labonté *et al.,* 2011)
Kind of households settled in housing unit(female-headed)	KHSHNFH	(Labonté *et al.,* 2011; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of simple workers	PSW	(Borden *et al.,* 2007; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of housing units with an area of 50 m2 or less	PHWAU	(Zebardast, 2013)
Percentage of housing units with access to piped water, electricity, telephone and gas plumbing	PHWF	(Alkire *et al.,* 2014; Alkire and Santos, 2010; Cutter *et al.,* 2003; De Oliveira Mendes, 2009; Martínez, 2009; Menoni *et al.,* 2012; Zebardast, 2013)
Percentage of housing units with access to kitchen, bathroom and toilet	PHWB	(Cutter *et al.,* 2003; de Oliveira Mendes, 2009; Menoni *et al.,* 2012; Zebardast, 2013)
Percentage of housing units with public or private sewer network	PHWSW	(Alkire *et al.,* 2014; Alkire and Santos, 2010; Martínez, 2009)
Percentage of households with access to computer	PHWCOM	(Labonté *et al.,* 2011; Martínez, 2009; Myck *et al.,* 2015)
Child mortality rate	CHDER	(De Oliveira Mendes, 2009)
Migration rate	PIMH	(Popay *et al.,* 2010; Wood *et al.,* 2010)
Persons per housing unit	PHU	(Flanagan *et al.,* 2011; Myck *et al.,* 2015)
Unemployment rate of men	UEMR	(Zebardast, 2013)
Unemployment rate of women	UEWF	(Cutter *et al.,* 2003; de Oliveira Mendes, 2009; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of households without motorcycles	PHWMO	(Kis and Gábos, 2016; Labonté *et al.,* 2011)

Table 2: Factors explaining poverty in Isfahan Metropolis

Name of Extracted factor	Explained variance	Factor loading	symbol
General poverty	13.25	0.794	PHWOR
		0.785	PHWCAR
		0.777	PHWCOM
		0.625	PSW
		0.603	ILR
		0.586	PHWAU
Crowdedness in housing unit	10.09	0.958	HHS
		0.955	PHU
		-0.602	KHSHNFH
Economic poverty	9.462	0.961	UER
		0.881	UEMR
		0.662	DER
		0.540	UEWF
Intrinsic poverty	8.23	0.684	POH
		0.581	PO65
		0.477	PHWWS
		0.416	PDIS
Infrastructure poverty	6.243	0.725	PHWB
		0.705	PHWF
		0.446	PHWSW
Migrant's poverty	5.276	0.582	PRH
		0.543	PHWMO
		0.500	POPDEN
		0.458	PIMH
Unhealthy living	4.713	0.735	CHDER
		-0.518	PO5
		0.462	PQH

RESULTS AND DISCUSSION

Running the F'ANP model (Phase 2 of the methodology) and Determining UPRDs (phase 3 of the methodology) have been addressed and discussed in this section.

Phase 2: running the F'ANP model

In order to run the F'ANP model, this phase was divided to two main interrelated sections including "Running EFA model" and the "The ANP part of the model".

Running EFA

EFA requires that the data used needs to be normally distributed. Skewness and kurtosis coefficients were calculated to check for normality of the data set. The results indicated the input data of the model, which was composed of 27 indicators in 12,169 urban blocks, follows a normal distribution. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and "Bartlett's Test of Sphericity" were calculated to check the adequacy of using an exploratory factor analysis. The KMO of 0.714 and the Bartlett's Test of Sphericity being significant (Sig. =0.0001), meant that the data set was suitable for factor analysis. The Kaiser criterion (Kaiser, 1960) was used to determine the number of factors to extract. Under this criterion factors with eigenvalues greater than or equal to 1.0 were extracted. Using this criterion, seven factors were extracted which cumulatively explain about 57.3 percent of the data variance. Varimax rotation was used in order to achieve a simple structure to explain the urban poverty in Isfahan Metropolis (Table 2).

The seven extracted factors were named as

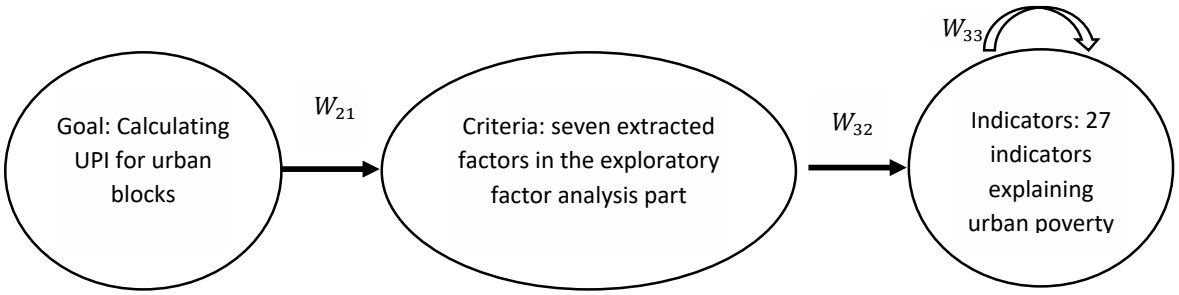

Fig. 4: External and internal relations among the indicators and the criteria

follows

Factor 1: General poverty in Isfahan. This factor includes the following indicators: "percentage of housing units with just one room", "percentage of households without a own car", "the number of households with access to computer" and "the percentage of housing units with an area of 50 m2 or less", "the percentage of simple workers" and "the percentage of illiterate population". It depicts the general poverty aspects in the city.

Factor 2: Crowdedness in housing units in Isfahan. "Household size", "persons per housing units" and "Kind of households settled in housing unit (female-headed)" are suitable indicators for showing the crowdedness in housing units in the city and the kind of households experiencing crowdedness in their housing unit.

Factor 3: Economic poverty in Isfahan. This factor includes the following indicators: "unemployment rate", "unemployment rate of men", "unemployment rate of women" and "actual dependency ratio". They show that the economic poverty in Isfahan has interrelation with population and household's structure.

Factor 4: Intrinsic poverty in Isfahan. This factor implicates on social and physical vulnerability. The former was about the weak structure of those households that include old individuals (percentage of the population over 65 years old) or/and disabled persons (percentage of Persons with disabilities). These two mentioned indicators make the household vulnerable against the external threat and shocks. Furthermore, physical aspect of intrinsic poverty implicates on the fragile physical structure of housing units ("percentage of old housing units" and "percentage of housing units with unstable structure"). This characteristic of housing units make them vulnerable for external threats especially natural disasters. That is to say, both the vulnerability aspect of urban poverty were embedded in intrinsic poverty, which means urban poor in Isfahan, can be both socially and physically vulnerable. In fact, they are intrinsically poor.

Factor 5: Infrastructure poverty in Isfahan. This factor includes "the percentage of housing units with access to kitchen, bathroom and toilet", "the percentage of housing units with access to piped water, electricity, telephone and gas plumbing" and "the percentage of housing units with public or private sewer network". It is related to the facilities of housing units and their accessibility to urban infrastructures networks.

Factor 6: Migrant poverty in Isfahan. This factor comprises "the percentage of rented residential units", "The percentage of households without motorcycles", "the migrant rate" and "Population density".

Factor 7: Unhealthy living in Isfahan. "Child mortality rate", "percent of the population under 5 years of age" and "the percentage of housing units in form of sheds, huts and slums" are indicators of this factor. It shows the child vulnerability, informal settlements and that they are interrelated.

The ANP part of the model

Constructing the model Network and identification of the internal and external relationships

In this step, the seven factors extracted from the exploratory factor analysis part of the model and their selected indicators were considered as the three distinct clusters in the ANP part of the model (Fig. 4). In this figure, the external and internal

relations among the indicators and the criteria were identified. The task of the F'ANP model in this step was to determine the RIC of each indicator. Making a three-level network (Fig. 5), the connections among the goal (UPI), the criteria (7 factors) and the sub-criteria (27-selected indicators) were defined.

Constructing single-entry matrices of initial super-matrix

The initial super-matrix that consists of three single-entry matrices was shown in figure 6. This matrix displays the connections through the three-level network. Using the F'ANP model, instead of using pair-wise comparison judgements (unlike the ANP), the matrices were computed in the following manner (Zebardast, 2013):

- Matrix W_{21} indicating the connection between the goal and the criteria, was obtained by normalizing the value of variance explained by each extracted factor;

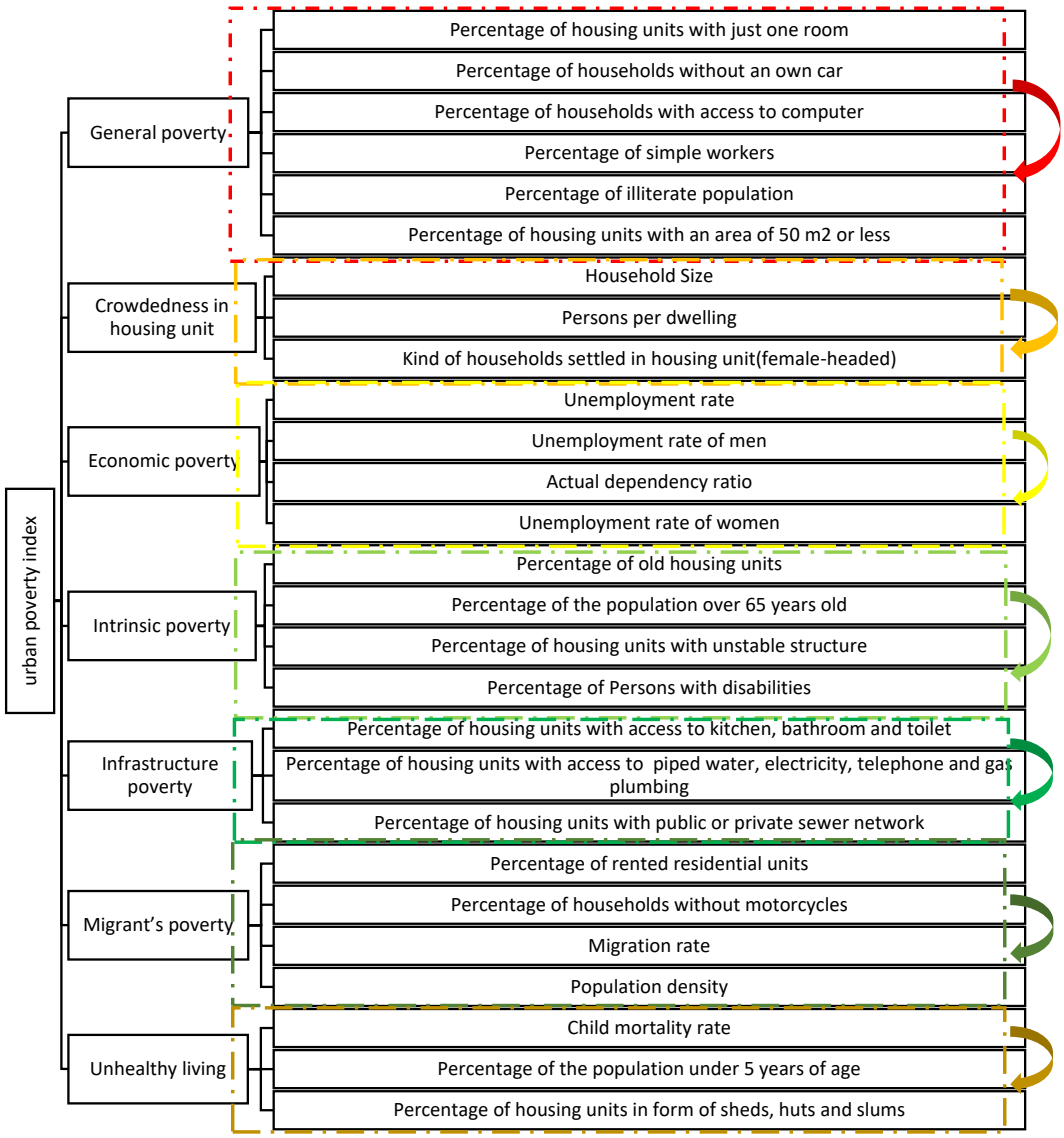

Fig. 5: The three-level network showing relationships among the indicators, criteria and goal

Table 3: Relational importance of indicators

Indicator symbol	RIC	Indicator symbol	RIC	Indicator symbol	RIC	Indicator symbol	RIC
HHS	0.064	POH	0.040	PSW	0.036	PDIS	0.029
PHU	0.063	PHWF	0.040	PHWWS	0.034	PRH	0.024
UER	0.051	PO65	0.040	PHWSW	0.032	POPDEN	0.024
KHSHNFH	0.049	PHWOR	0.039	UEWF	0.032	PHWMO	0.023
UEMR	0.045	ILR	0.039	PHWAU	0.031	PQH	0.023
PHWCOM	0.044	DER	0.037	PO5	0.030	PIMH	0.021
PHWCAR	0.043	PHWB	0.036	CHDER	0.029		

- Matrix W_{32} which shows the connection between the criteria and the sub-criteria (indicators), is equal to the normalized "factor loadings" of each indicator; and

- Matrix W_{33} which refers to interconnection among indicators themselves, was computed from the absolute normalized values of the correlation coefficient among the indicators of each factor.

Calculating RIC

After constructing the single-entry matrixes: W_{21}, W_{32} and W_{33}, they were entered into in the initial super- matrix to obtain the weighted super-matrix. The weighted super-matrix was then raised to a power of an arbitrarily large number (40 in this case) to obtain a convergence on the importance weights. The new matrix was called the limit matrix. The goal column of the obtained limit matrix shows the importance or weights of the 27 indicators selected for the purposes of this study. These weights were normalized to obtain the relative RIC of the indicators (Table 3).

Constructing urban poverty index (UPI)

There was a need for a composite index in order to show the urban poverty of each block cumulatively. The RIC related to each indicator was obtained through normalizing the indicators values and multiplying them by their corresponding weights. The normalization of indicators was done by application of the following normalization Eq. 1:

$$NVI_{ij} = 0.8\left[\frac{x_{ij} - x_{j-min}}{x_{j-max} - x_{j-min}}\right] + 0.1 \quad (1)$$

Where, x_{ij} is the value of block i for indicator j; x_{j-max} and x_{j-min} are the maximum and minimum values for indicator j, respectively. This formula sets the values of each indicator in the range of 0.1 to 0.9. Then, by applying Eq. 2, the urban poverty index is obtained by multiplying the weights of each indicator obtained from the F'ANP model ($W_{F'ANP\,j}$) by its normalized value (NVI_{ij}).

$$UPI_i = \sum_{j=1}^{J} W_{F'ANP\,j}\, NVI_{ij} \quad (2)$$

Analyzing urban poverty spatial pattern

The UPIs for the city's 12,169 urban blocks is calculated. Fig. 7 shows that UPI amounts of Isfahan Metropolis area are approximately normal (Skewness=0.681 and Kurtosis=0.861). Using Arc Map software, the UPI has been attached to the urban blocks. In the other words, the UPI has been georeferenced (Fig. 7).

Standard deviation method is used to classify the urban blocks based on their UPI (Table 4). Five classes of urban blocks have been identified based on their UPI. Class 1 refers to those urban blocks that have the lowest amount of UPI (about 42% of urban blocks with about 18 % of the city's population); The second class which covers about 14.48% of city's urban blocks and about 16.45% of the population) shows those urban blocks with low amount of UPI. The average class (class 3) comprises most of the city's urban blocks (about 69.73%) with 73.75 % of the population. About 11.57% of urban blocks with a population of 8.19% fall into class 4: urban blocks with high amount of UPI. The highest amount of urban poverty is in class five. It contains about 3.6% of urban blocks, and 1.61% of the city's population. Combining classes 1 and 2 (lesser amount of UPI: Group A) and classes 4 and 5 (more

$$W = \begin{matrix} \\ Goal \\ Criteria \\ Sub-criteria \end{matrix} \begin{matrix} \begin{matrix} Goal & Criteria & Sub-criteria \end{matrix} \\ \begin{bmatrix} 0 & 0 & 0 \\ W_{21} & 0 & 0 \\ 0 & W_{32} & W_{33} \end{bmatrix} \end{matrix}$$

Fig. 6: The primary super-matrix structure; the situation of single-entry matrices

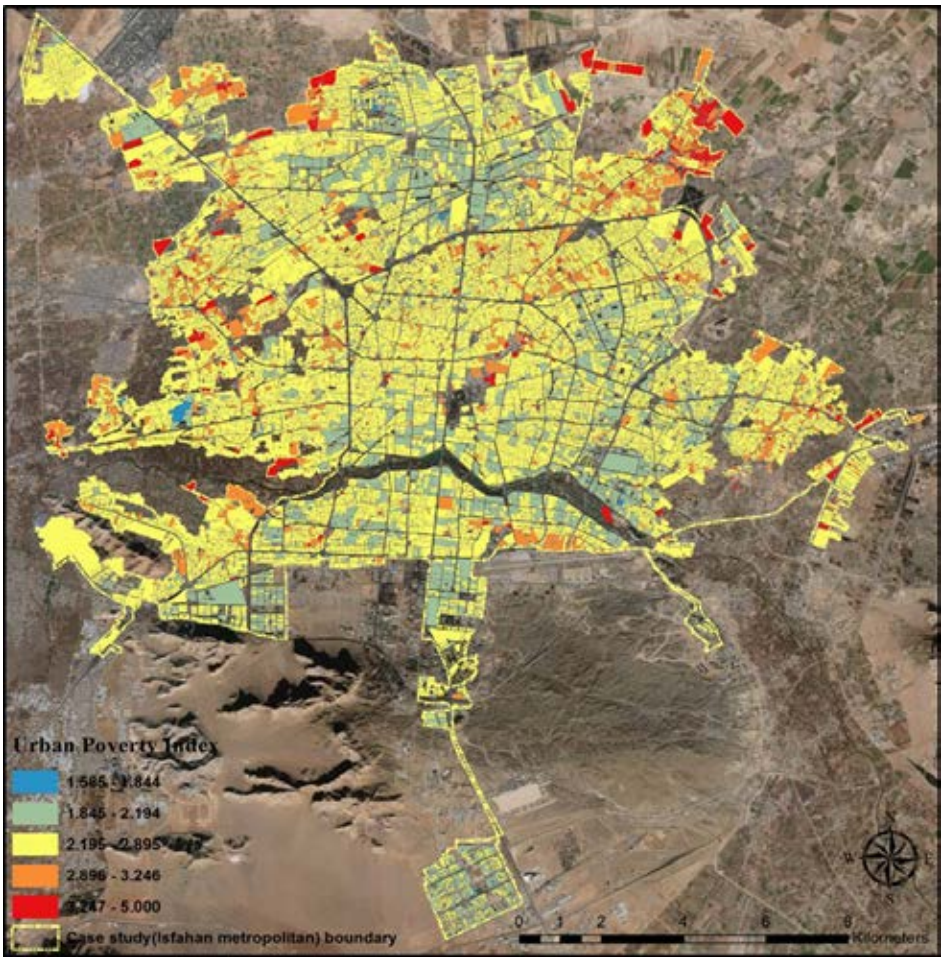

Fig. 7: UPI spatial distribution pattern in Isfahan Metropolitan area

Table 4: The condition of urban blocks and population in face of urban poverty

Urban blocks condition in face of urban poverty	Number of urban blocks	Number of urban blocks (percentage)	Population in urban blocks	Population in urban blocks (percentage)
Lowest (1.585-1.844)	52	0.42	3243	0.18
Low (1.845-2.194)	1762	14.48	299553	16.45
Average (12.195-2.895)	8510	69.93	1339356	73.57
High (2.896-3.246)	1408	11.57	149112	8.19
Highest (3.247-5.00)	437	3.60	29368	1.61
Total	12169	100	1820632	100

Table 5: Lesser poverty and more poverty group statistics

urban poverty group	Number of urban blocks	Number of urban blocks (percentage)	Population in urban blocks	Population in urban blocks (percentage)
Lesser poverty (Group A)	1814	14.899	302796	16.631
Average	8510	69.93	1339356	73.57
More poverty(Group B)	1845	15.170	178480	9.803
Total	12169	100	1820632	100

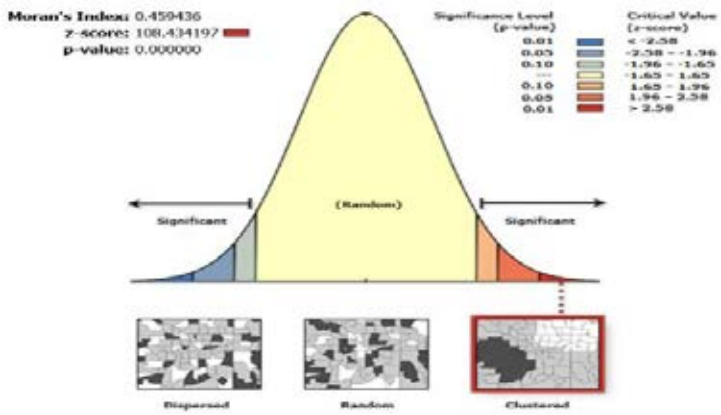

Fig. 8: The result of autocorrelation test indicating the spatially clustered pattern of UPI in Isfahan metropolis

amount of UPI: Group B) shows the regular conceptual pattern of the relationships among the amount of UPI, the number of urban blocks and their population. The number of urban blocks in these two groups are approximately equal. However, the urban blocks area of group A is 1.3 times more than the group B and the population of group A is 1.7 times more than that of group B (Table 5).

Phase 3: Determining UPRDs

In order to determine whether urban poverty in Isfahan Metropolis is concentrated in sporadic in nature (based on Wilson theory of poverty concentration), the Moran's "Spatial Autocorrelation index" has been employed. The outputs of the Moran's I indicate that the UPI is clustered and there are UPRDs in Isfahan (Fig. 8). In order to determine UPRDs, the spatial distribution pattern of UPIs shown in the Figure 7 is so general, because in some districts probably there are a mix of the three mentioned group (Group A; average group; group B). Using cluster and outlier analysis (Anselin local Moran I), UPRDs have been determined. "High-High" clusters show high values (UPRDs) explicitly referring to concentration of urban poverty. Poverty has been reproduced in these clusters. That is why it is important to give priority in policy making to them. "Low-Low" clusters show the concentration of those urban blocks with low UPI value. "High-Low" refers to those blocks wrestling with urban poverty while surrounded by those urban blocks, which have low value of UPI. "Low-High" implicates to those urban blocks with low value of UPI however surrounded by poor urban blocks (Fig. 9).

Where are the urban poor in Isfahan Metropolis?

By calculating UPI and determining UPRDs, it is possible to explain the spatial distribution of urban poor in different areas developed through the evolution of Isfahan Metropolis. It is likely to determine concentration of urban poverty in different kind of metropolis districts (Crowder, 2014). There are eight areas in Isfahan Metropolis where urban poor are concentrated. Historical district of Isfahan contains 74 HH urban blocks (3.9%). Most of these urban blocks surround the historical square of the

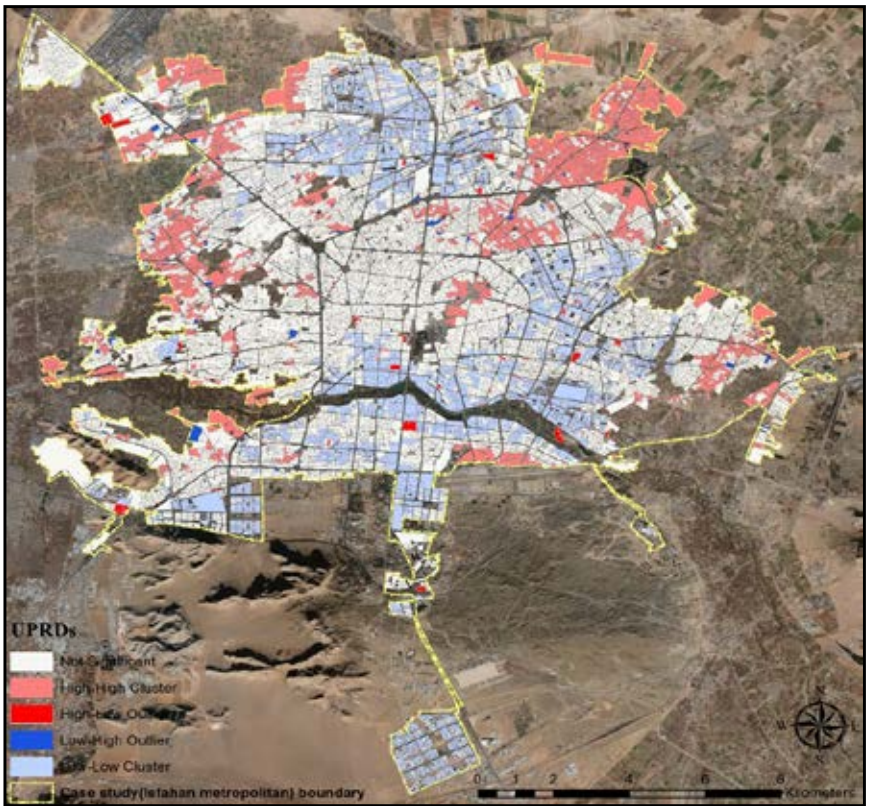

Fig. 9: Determining UPRDs through cluster and outlier analysis

city called “Imam Ali square”. Additionally, they are located at northeast of the “Naqshe Jahan Square”. It shows that urban poor surround the link path between two historical squares of Isfahan city (Fig. 10a). As Crowder (2014) affirms, urban old and historical districts may face with increasing of urban poverty by passing time. What can be concluded is that there is no need to be more concerned about urban poverty in historical district of Isfahan metropolitan. Inner city district includes 202 HH urban blocks (10.7%). There are three main concentrations of urban poor in this district. The first is located at northeast of inner city district called “Touqchi” neighborhood. The second is located at west of the inner city named “Afaran” neighborhood. The third is located at the southeast of inner city called “Hemet Abad” (Fig. 10b). These kind of districts as Anderson(2007) explained are faced with urban poverty specially in field of housing conditions and tenure security, inequalities in wages and employment opportunity, economic segregation and urban gentrification caused by urban redevelopment. The concentration of urban poverty in inner city district is truly importance to public policy because they face a unique set of circumstances (Crowder, 2014).

Middle district comprise 275 HH urban blocks (14.5%). There are six main areas where urban poor are located in. These areas are as follows (Fig. 11):

1) Northeast of middle district, the area attached to the east section of “Touqchi” neighborhood named “Zarab-Khane” neighborhood;

2) “Qaleh Shams Abad” neighborhood located in the north of the middle area;

3) North-west of middle district and the west section of “Fordavan” neighborhood;

4) West part of middle area called “Valladan” neighborhood;

5) South-west of the middle district;

6) Southern part of “Hemet Abad” neighborhood and southeast of middle district.

Urban poor who have located in this kind of district are those low-income households that the

Fig. 10: The spatial concentrations of urban poor (UPRDS) poor in historical district (a) and inner city area (b)

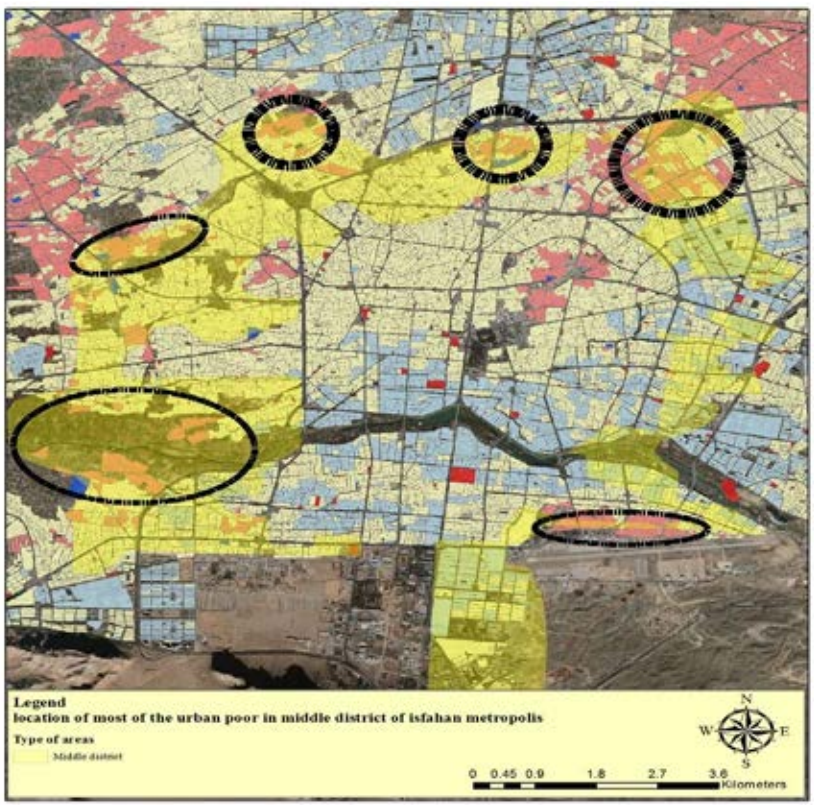

Fig. 11: The spatial concentrations of urban poor (UPRDS) in the middle district

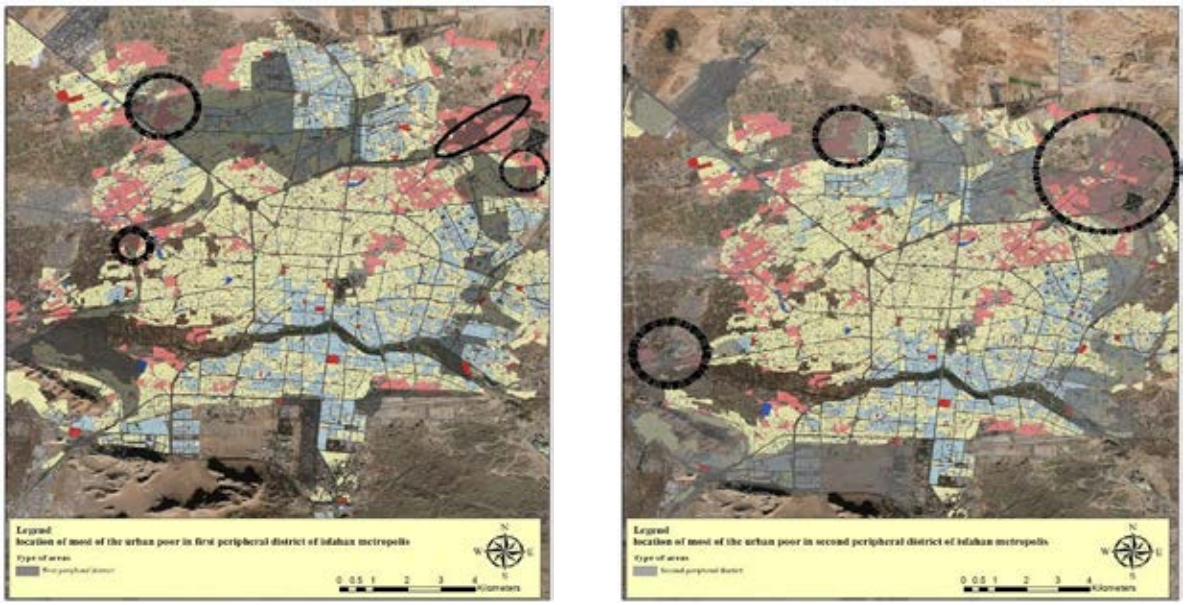

Fig. 12: The spatial concentrations of urban poor (UPRDS) in first peripheral district (a) and second peripheral district (b)

pressure of the economic gravity has push them to the nearest buffer of inner-city (Anderson, 2007)

There are two peripheral districts, which include 42.65% of HH urban blocks. These two main concentrations of urban poor are located at the northeast of first and second peripheral districts called “Zeinabieyeh” and “Haftoun” neighborhoods which include a high number of urban poor. In the northwest of first peripheral district, there is a neighborhood called “Marchin” where urban poor are concentrated in (Fig. 12a). “Nasser Khosro” neighborhood located in the northwest of the second peripheral district is another neighborhood faced with concentration of urban poverty. In the west part of the first peripheral district there is a neighborhood called “Sudan” where urban poor are located in. In the southwest part of second peripheral district there is a neighborhood called “Jerukan” where the poor located in (Fig. 12b). What can be concluded is that the concerns about urban poverty in Isfahan metropolitan area most be focused on the poverty concentration in peripheral districts. As Kinfu *et al.* (2018) affirms, poverty concentration in these kinds of districts mostly are the result of inefficient urban governance to provide land and shelter, and also the limitation to deliver services and infrastructure especially for migrants in city evolutions. Emergence of peripheral district mostly are accompanied with concentration of urban poverty and the deterioration of central city and, results social and economic inequalities and challenge the environmental sustainability (Joassart-Marcelli *et al.,* 2005). While urban management and planning system can see the urban poverty concentration in historical, inner city, and middle districts, contemporary urban policies fail to address the concentration of urban poverty in peripheral districts which confront with less quality of life in comparison with others (Anderson, 2007).

In 2003, some adjacent cities, towns and villages were annexed to Isfahan Metropolis. The result of this annexation is that Isfahan has surrounded by 512 HH urban blocks (28.25%). The two cities of Khorasgan and Sepahanshar are among those that were annexed to Isfahan Metropolis. “Khorasgan”, located in the southeast, is faced with a huge number of urban poor in its east part; while there is not any concentration of urban poor in “Sepahanshahr” which is located in the southern part of the Isfahan Metropolis (Fig. 13a). Among the towns attached to Isfahan Metropolis, there is just one old town called “Hasan Abad Gari” located at the north part of Isfahan Metropolis which is faced with concentration of urban poverty (Fig. 13b). There are three main urban poor concentrations located in the annexed

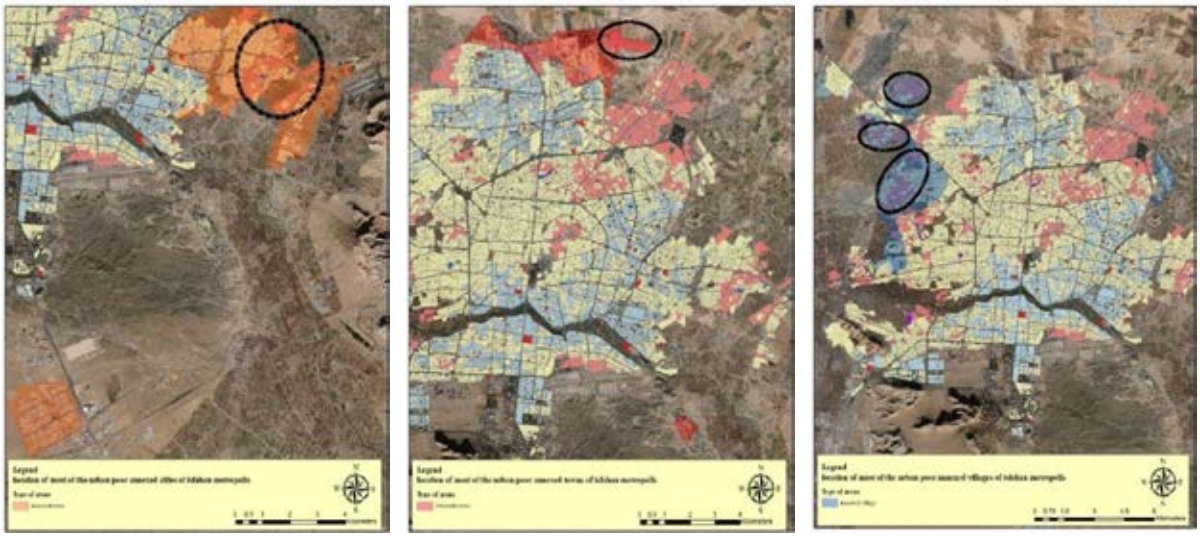

Fig. 13: The spatial concentrations of urban poor (UPRDS) in annexed cities (a), towns (b) and villages (c)

villages in northwest part of the Isfahan Metropolis: "Asheq Abad", "Babukan" and "Rahnan" (Fig. 13c).

In line with Berube and Kneebone (2006) and Cooke (2010), it is found that of the urban poverty concentration (near 70% in Isfahan metropolis) are located in suburb (annexed villages and cities) and peripheral district. Thus, public policy, urban management and planning system must focus on peripheral and annexed districts in Isfahan metropolitan area according to the high-concentration of urban poverty in them.

CONCLUSION

The growing trend of urban population, especially in the large cities and metropolises of the developing countries, has made the need for more complex and comprehensive policymaking undeniable. Urban policies must be able to address the problem of urban poverty, which is inherent in the present tense urbanization process. This requires equipping urban policymakers with a multifaceted and inclusive methodology that can explain the complexities surrounding urban poverty in metropolises. The aim of this paper was to suggest a methodology for identifying the spatial representation of urban poverty in Isfahan Metropolis. In this regard, first the indicators related to the substantive dimension of urban poverty were extracted from the related literature (27 indicators). Then, using the F'ANP model, 7 domains of urban poverty in Isfahan Metropolis were identified including "general poverty", "crowdedness in housing unit", "economic poverty", "intrinsic poverty", "infrastructure poverty", "migrant's poverty" and "unhealthy living condition". In the next step, the weight of each of the indicators affecting urban poverty in this metropolis was calculated. The findings show that "Household Size", "Unemployment rate", "Kind of households settled in housing unit (female-headed)", "Persons per housing unit" and "Unemployment rate of men" are the first five most important indicators in defining urban poor in Isfahan metropolis. The composite index of spatial distribution of urban poverty in Isfahan Metropolis (UPI) was calculated. Classifying urban blocks based on the UPI has shown that 9.8% of population and 15.7% of urban blocks had the highest urban poverty rate. Additionally, the traps of urban poverty that face the extreme concentration of urban poverty and can reproduce urban poverty were identified. Autocorrelation test has indicated that urban poverty is clustered in Isfahan metropolis. Finally, layers of development and evolution of Isfahan Metropolis were used to investigate the spatial distribution of urban poverty traps. Using Cluster and outlier analysis, it was determined that 70% of urban poverty concentrations were located in suburbs and peripheral districts.

In this paper, a methodology has been suggested

to:

- Investigate different aspects of the substantive dimension (spatial representation) of urban poverty in metropolitan areas and provide the conditions needed to identify the procedural dimension (the set of non-spatial processes that cause urban poverty). Determine variety types of urban poverty based on the metropolitan areas contexts (Exploratory Factor Analysis of F'ANP model): Unlike previous research, which mainly focused on the study of urban poverty with a predetermined theoretical framework, the methodology suggested in this paper extracts the urban poverty analysis framework based on the context of the case study.
- Prioritize the impact of indicators on urban poverty; (using Analytical Network Process of F'ANP model): Unlike previous studies that rely on expert opinions to determine the weight of urban poverty indicators or consider equal weights for all indicators, in the methodology suggested by this paper, the weights of indicators are calculated based on the relationships among the indicators through the F'ANP model. That is to say, the key determinant of the weight of the indicators in this methodology is the context (the data is driven from the context).
- Show the spatial distribution of urban poverty in metropolitan areas (Based on UPI made by F'ANP model),
- Identify urban poverty traps (UPRDS) that are actually reproducers of urban poverty (with Using the clustering and Outlier model)
- Determine that each UPRDS was formed in which part of the metropolis (in comparison with areas developed through the evolution of Isfahan Metropolis)

Urban policymakers can adopt relevant policies in relation with variety types of urban poverty identified in metropolises and determine policy priorities based on the weights calculated for each indicator. They can also suggest policies at the macro and micro levels using the urban poverty distribution map in metropolises. Those districts that face the trap of urban poverty or the overwhelming concentration of urban poverty require special policymaking. Investigating the areas facing urban poverty concentration in comparison with the areas developed in the metropolis evolution will help to elucidate the procedural dimensions of urban poverty that have shaped this spatial representation.

AUTHOR CONTRIBUTIONS

M.J. Nouri performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. E. Zebardast supervised the experiments, literature review, data compiling and manuscript preparation.

ACKNOWLEDGEMENT

The authors would like to extend their appreciation for the support of the Deputy of the Planning and Research Department of the Municipality of Isfahan.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATION

ANP	Analytical Network Process
CHDER	Child mortality rate
DER	Actual dependency ratio
EFA	Exploratory Factor Analysis
F'ANP	A hybrid model of exploratory factor analysis and analytical network process
HHS	Household Size
ILR	Percentage of illiterate population
KHSHNFH	Kind of households settled in housing unit(female-headed)
KMO	Kaiser-Meyer-Olkin
PDIS	Percentage of persons with disabilities
PHU	Persons per housing unit
PHWAU	Percentage of housing units with an area of 50 m2 or less
PHWB	Percentage of housing units with access to kitchen, bathroom and toilet
PHWCAR	Percentage of households without a own car
PHWCOM	Percentage of households with access to computer

PHWF	Percentage of housing units with access to piped water, electricity, telephone and gas plumbing
PHWMO	Percentage of households without motorcycles
PHWOR	Percentage of housing units with a room
PHWSW	Percentage of housing units with public or private sewer network
PHWWS	Percentage of housing units with unstable structure
PIMH	Migration rate
PO5	Percentage of the population under 5 years of age
PO65	Percentage of the population over 65 years old
POH	Percentage of old housing units
POPDEN	Population density
PQH	Percentage of housing units in form of sheds, huts and slums ...
PRH	Percentage of rented residential units
PSW	Percentage of simple workers
RIC	Relational Importance Coefficient
UEMR	Unemployment rate of men
UER	Unemployment rate
UEWF	Unemployment rate of women
UPI	Urban poverty index
UPRDS	Urban Poverty Reproduced Districts

REFERENCES

Alkire, S.; Conconi, A.; Seth, S., (2014). Multidimensional poverty index 2014: brief methodological note and results. University of oxford, department of international development, oxford poverty and human development initiative, oxford, UK.

Alkire, S.; Santos, M.E., (2010). Acute multidimensional poverty: a new index for developing countries. United Nations development program human development report office background paper (2010/11).

Armaş, I., (2012). Multi-criteria vulnerability analysis to earthquake hazard of Bucharest, Romania. Nat. Hazard, 63(2): 1129-1156 **(28 pages)**.

Anderson, M.W., (2007). Cities inside out: Race, poverty, and exclusion at the urban fringe. UCLAL. Rev., 55: 1095.

Atlas of Isfahan Metropolis (2017). Municipality of Isfahan Metropolis.

Azpitarte, F., (2012). Social exclusion monitor bulletin April 2012.

Berube, A.; Kneebone, E., (2006). Two steps back: city and suburban poverty trends 1999I2005. Washington, DC: The Brookings Institution.

Bjarnadottir, S.; Li, Y.; Stewart, M.G., (2011). Social vulnerability index for coastal communities at risk to hurricane hazard and a changing climate. Nat. hazards. 59(2): 1055-1075 **(21 pages)**.

Borden, K.A.; Schmidtlein, M.C.; Emrich, C.T.; Piegorsch, W.W.; Cutter, S.L., (2007). Vulnerability of US cities to environmental hazards. J. Homeland Secur. Emerg., 4(2): 1-21 **(21 pages)**.

Chakraborty, J.; Tobin, G.A.; Montz, B.E., (2005). Population evacuation: assessing spatial variability in geophysical risk and social vulnerability to natural hazards. Nat. Hazards. Rev., 6(1): 23-33 **(11 pages)**.

Cooke, T. J., (2010). Residential mobility of the poor and the growth of poverty in inner-ring suburbs. Urban. Geogr., 31(2): 179-193 **(15 pages)**.

Crowder, P.A., (2014). (Sub) Urban poverty and regional interest convergence. Marq. L. Rev., 98(2): 763-830 **(68 pages)**.

Cutter, S.L.; Boruff, B.J.; Shirley, W.L., (2003). Social vulnerability to environmental hazards. Soc. Sci. Q., 84(2): 242-261 **(20 pages)**.

De Oliveira Mendes, J.M., (2009). Social vulnerability indexes as planning tools: beyond the preparedness paradigm. J. Risk. RES., 12(1): 43-58 **(16 pages)**.

Esnard, A.M.; Sapat, A.; Mitsova, D., (2011). An index of relative displacement risk to hurricanes. Nat. Hazards., 59(2): 833-859 **(27 pages)**.

Finch, C.; Emrich, C.T.; Cutter, S.L., (2010). Disaster disparities and differential recovery in New Orleans. Popul. Environ., 31(4): 179-202 **(24 pages)**.

Flanagan, B.E.; Gregory, E.W.; Hallisey, E.J.; Heitgerd, J.L.; Lewis, B., (2011). A social vulnerability index for disaster management. J. Homland Secur. Emerg., 8(1): 1-22 **(22 pages).**

Guimarães, T., (2013). An integrated analytical tool for exploring the links between job accessibility and social exclusion. Paper presented at the XIII World Conference on Transport Research, XIII World Conference on Transport Research (Río de Janeiro).

Joassart-Marcelli, P.M.; Musso, J.A.; Wolch, J.R., (2005). Fiscal consequences of concentrated poverty in a metropolitan region. Ann. Assoc. Am. Geogr., 95(2): 336-356 **(21 pages)**.

Kaiser, HF., (1960). The application of electronic computers to factor analysis. Educ. Psychol. Measur., 20(1):141–151 **(11 pages)**.

Khan, S., (2012). Vulnerability assessments and their planning implications: a case study of the Hutt Valley, New Zealand. Nat. Hazards, 64(2): 1587-1607 **(21 pages)**.

Kinfu, E.; Bombeck, H.; Nigussie, A., (2018). Africa's Urbanization and Emerging Settlement Forms: Implications to Urban Planning.

Kis, A.; Gábos, A., (2016). Consistent poverty across the EU. Corvinus J. Sociol. Soc. Policy , 7 (2): 3-27 **(25 pages)**.

Labonté, R.N.; Hadi, A.; Kauffmann, X.E., (2011). Indicators of social exclusion and Inclusion: A critical and comparative analysis of the literature. Population health improvement research network.

Lee, Y.J., (2014). Social vulnerability indicators as a sustainable planning tool. Environ. Impact Assess. Rev., 44: 31-42 **(12 pages)**.

Lemanski, C., (2016). Poverty: multiple perspectives and strategies. Geography, 101(1): 4-10 **(7 pages)**.

Lok-Dessallien, R., (1999). Review of poverty concepts and indicators. UNDP.

Martínez, J., (2009). The use of GIS and indicators to monitor intra-urban inequalities. A case study in Rosario, Argentina. Habitat Int., 33(4): 387-396 **(10 pages)**.

Menoni, S.; Molinari, D.; Parker, D.; Ballio, F.; Tapsell, S., (2012).

Assessing multifaceted vulnerability and resilience in order to design risk-mitigation strategies. Nat. Hazards., 64(3): 2057-2082 **(26 pages)**.

Myck, M.; Oczkowska, M.; Duda, D., (2015). Innovations for better understanding deprivation and social exclusion. In: F. Malter, and A. Börsch-Supan (Eds.), SHARE Wave 5: Innovations and Methodology. Munich: Munich Center for the Economics of Aging (MEA): 29-36 **(8 pages)**.

Myers, C.A.; Slack, T.; Singelmann, J., (2008). Social vulnerability and migration in the wake of disaster: the case of Hurricanes Katrina and Rita. Popul. Environ., 29(6): 271-291 **(21 pages)**.

Nelson, J.; Grubesic, T.; Sim, L.; Rose, K.; Graham, J., (2015). Approach for assessing coastal vulnerability to oil spills for prevention and readiness using GIS and the Blowout and Spill Occurrence Model. Ocean. Coast. Manage., 112: 1-11 **(11 pages)**.

Niemietz, K.P., (2011). A new understanding of poverty. Institute of Economic Affairs Monographs (65).

Popay, J.; Escorel, S.; Hernandez, M.; Johnston, H.; Mathieson J, Rispel L., (2010). On behalf of the WHO social exclusion knowledge network .2008. Understanding and tackling social exclusion: Final report of the social exclusion knowledge network of the commission on social determinants of health. Geneva: World Health Organization.

Ravallion, M.; Chen, S.; Sangraula, P., (2007). New evidence on the urbanization of global poverty. Popul. Dev. Rev., 33(4): 667-701 **(35 pages)**.

Schmidtlein, M.C.; Deutsch, R.C.; Piegorsch, W.W.; Cutter, S.L., (2008). A sensitivity analysis of the social vulnerability index. Risk. Anal., 28(4): 1099-1114 **(16 pages)**.

SCI: Statistic Center of Iran, (2016). Population and Housing census.

Tate, E., (2013). Uncertainty analysis for a social vulnerability index. Ann. Assoc. Am. GEOGR., 103(3): 526-543 **(18 pages)**.

Teitz, M.B.; Chapple, K., (2013). Planning and poverty: An uneasy relationship. Policy, Planning, and People: Promoting justice in urban development, 205-223 (**19 pages**).

United Nations Department of Economic and Social Affairs, (2007). Indicators of sustainable development: guidelines and methodologies: United Nations Publications.

United Nations, Department of Economic and Social Affairs, Population Division, (2015). World urbanization prospects: The 2014 revision (ST/ESA/SER.A/420). New York: United Nations.

Van Zandt, S.; Peacock, W.G.; Henry, D. W.; Grover, H.; Highfield, W. E.; Brody, S. D., (2012). Mapping social vulnerability to enhance housing and neighborhood resilience. Hous. Policy Debate, 22(1): 29-55 **(27 pages)**.

Watson, V., (2009). 'The planned city sweeps the poor away…': Urban planning and 21st century urbanization. Prog. Plann., 72(3): 151-193 **(43 pages)**.

Wilson, W.J., (1987). The truly disadvantaged. Chicago: University of Chicago Press.

Wood, N. J.; Burton, C. G.; Cutter, S. L., (2010). Community variations in social vulnerability to Cascadia-related tsunamis in the US Pacific Northwest. Nat. Hazards., 52(2): 369-389 **(21 pages)**.

Wratten, E., (1995). Conceptualizing urban poverty. Environ. Urban., 7(1): 11-38 **(28 pages)**.

Zebardast, E., (2013). Constructing a social vulnerability index to earthquake hazards using a hybrid factor analysis and analytic network process (F'ANP) model. Nat. Hazards., 65(3): 1331-1359 **(29 pages)**.

HOW TO CITE THIS ARTICLE

Nouri, M.J.; Zebardast, E., (2021). Where are the urban poor? The spatial distribution pattern of urban poverty. Int. J. Hum. Capital Urban Manage., 6(3): 305-322.

DOI: 10.22034/IJHCUM.2021.03.08

url: http://