ORIGINAL RESEARCH PAPER

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

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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.
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 21st 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 et al., 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
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 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
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>
<thead>
<tr>
<th>Name of the variable</th>
<th>Symbol</th>
<th>Background research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Size</td>
<td>HHS</td>
<td>(Armaş, 2012; de Oliveira Mendes, 2009; Finch et al., 2010; Guimarães, 2013; Wood et al., 2010)</td>
</tr>
<tr>
<td>Population density</td>
<td>POPDEN</td>
<td>(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)</td>
</tr>
<tr>
<td>Percentage of housing units with a room</td>
<td>PHWOR</td>
<td>(Cutter et al., 2003; Myck et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of the population under 5 years of age</td>
<td>POS</td>
<td>(Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of persons with disabilities</td>
<td>PDIS</td>
<td>(Cutter et al., 2003; Lee, 2014; Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of rented residential units</td>
<td>PRH</td>
<td>(Cutter et al., 2003; Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of housing units in form of sheds, huts and slums ...</td>
<td>PQH</td>
<td>(Labonté et al., 2011)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>UER</td>
<td>(Armaş, 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)</td>
</tr>
<tr>
<td>Percentage of illiterate population</td>
<td>ILR</td>
<td>(Armaş, 2012; Azpitarte, 2012; Guimarães, 2013; Labonté et al., 2011; Myck et al., 2015)</td>
</tr>
<tr>
<td>Percentage of the population over 65 years old</td>
<td>PO65</td>
<td>(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)</td>
</tr>
<tr>
<td>Actual dependency ratio</td>
<td>DER</td>
<td>-</td>
</tr>
<tr>
<td>Percentage of old housing units</td>
<td>POH</td>
<td>(Azpitarte, 2012; de Oliveira Mendes, 2009; Labonté et al., 2011; Nelson et al., 2015)</td>
</tr>
<tr>
<td>Percentage of housing units with unstable structure</td>
<td>PHWS</td>
<td>-</td>
</tr>
<tr>
<td>Kind of households settled in housing unit(female-headed)</td>
<td>KSHSNFH</td>
<td>(Labonté et al., 2011; Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of simple workers</td>
<td>PSW</td>
<td>(Borden et al., 2007; Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of housing units with an area of 50 m2 or less</td>
<td>PHWAU</td>
<td>(Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of housing units with access to piped water, electricity, telephone and gas plumbing</td>
<td>PHWF</td>
<td>(Alkire et al., 2014; Alkire and Santos, 2010; Cutter et al., 2003; De Oliveira Mendes, 2009; Martínez, 2009; Menoni et al., 2012; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of housing units with access to kitchen, bathroom and toilet</td>
<td>PHWB</td>
<td>(Cutter et al., 2003; de Oliveira Mendes, 2009; Menoni et al., 2012; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of housing units with public or private sewer network</td>
<td>PHWSW</td>
<td>(Alkire et al., 2014; Alkire and Santos, 2010; Martínez, 2009)</td>
</tr>
<tr>
<td>Percentage of households with access to computer</td>
<td>PHWCOM</td>
<td>(Labonté et al., 2011; Martínez, 2009; Myck et al., 2015)</td>
</tr>
<tr>
<td>Child mortality rate</td>
<td>CHDER</td>
<td>(De Oliveira Mendes, 2009)</td>
</tr>
<tr>
<td>Migration rate</td>
<td>PIMH</td>
<td>(Popay et al., 2010; Wood et al., 2010)</td>
</tr>
<tr>
<td>Persons per housing unit</td>
<td>PHU</td>
<td>(Flanagan et al., 2011; Myck et al., 2015)</td>
</tr>
<tr>
<td>Unemployment rate of men</td>
<td>UEMR</td>
<td>(Zebardast, 2013)</td>
</tr>
<tr>
<td>Unemployment rate of women</td>
<td>UEWF</td>
<td>(Cutter et al., 2003; de Oliveira Mendes, 2009; Nelson et al., 2015; Zebardast, 2013)</td>
</tr>
<tr>
<td>Percentage of households without motorcycles</td>
<td>PHWMO</td>
<td>(Kis and Gábos, 2016; Labonté et al., 2011)</td>
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</table>
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
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 FANP 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 FANP 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](image-url)
- 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 matrices: $W_{31}$, $W_{32}$ 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:

$$\text{NVI}_{ij} = 0.8 \left( \frac{x_{ij} - x_{j-min}}{x_{j-max} - x_{j-min}} \right) + 0.1$$

(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 FANP model ($w_{FANP,j}$) by its normalized value (NVI$_{ij}$).

$$\text{UPI}_i = \sum_{j=1}^{J} w_{FANP,j} \cdot \text{NVI}_{ij}$$

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

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

\[
W = \begin{bmatrix}
    0 & 0 & 0 \\
    W_{21} & 0 & 0 \\
    0 & W_{32} & W_{33}
\end{bmatrix}
\]

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

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

Table 5: Lesser poverty and more poverty group statistics

<table>
<thead>
<tr>
<th>Urban poverty group</th>
<th>Number of urban blocks</th>
<th>Number of urban blocks (percentage)</th>
<th>Population in urban blocks</th>
<th>Population in urban blocks (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesser poverty (Group A)</td>
<td>1814</td>
<td>14.899</td>
<td>302796</td>
<td>16.631</td>
</tr>
<tr>
<td>Average</td>
<td>8510</td>
<td>69.93</td>
<td>1339356</td>
<td>73.57</td>
</tr>
<tr>
<td>More poverty(Group B)</td>
<td>1845</td>
<td>15.170</td>
<td>178480</td>
<td>9.803</td>
</tr>
<tr>
<td>Total</td>
<td>12169</td>
<td>100</td>
<td>1820632</td>
<td>100</td>
</tr>
</tbody>
</table>
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
pressure of the economic gravity has pushed 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 must 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 Sepahanshahr 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...
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 FANP 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.

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


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