Analysing the impact of unplanned metropolitan growth on the peripheral natural environment: special reference to the metropolitan region of Tehran*

Zohreh Abdi Daneshpour**
Masoud Tarantash***

Abstract

Statement of the problem: Metropolitan areas in the more and less developed countries of the world have formed essentially due to the utilization of economies of scale, and successively the metropolitan regions are formed through spatial-functional linkages of the metropolitan areas with their peripheral environments. This is while the increasing density and intensifying activities within metropolitan regions are not directly related and relevant to the principle of economies of scale; considering that the density and boundaries are determined and affected by population and ecological thresholds. Unplanned metropolitan growth and departure from the mentioned thresholds creates and accumulates spatial problems in metropolitan regions, especially in the peripheral natural environments. Many metropolitan regions have the experience of unplanned expansion and their damaged and problematic natural peripheral
environments. This have led to the production and reproduction of many urban and environmentally related problems, such as spatial confusion in economic, social, organisational and physical aspects that causes the exhaustion of resources and helps further the wasting of economic, social, and physical capital.
Purpose: Main purpose of this paper is to discuss the unplanned built environments formed by the unplanned growth of the metropolitan areas and metropolitan regions worldwide, and specifically the metropolitan area and the metropolitan region of Tehran. Moreover, the purpose is to confer the unplanned nature of these formed spaces and to consider the consequences of such urban growth. This is to empower and enable the metropolitan planning system and
mechanism in encountering the production and re-production of urban and natural environmental problems. Based upon the results of analysing the impact of unplanned metropolitan growth of Tehran upon its peripheral natural environment in this paper, proposals to establish an appropriate planning mechanism for this metropolitan region can be devised.
Methodology: This paper has a descriptive-analytical approach, which is devised to identify and analyse the emergence of problems in natural environments due to unplanned growth in the metropolitan region of Tehran. To achieve this, a three staged process has been
conceived and adopted: first; the theoretical foundations of the subject under study are reviewed, through following the experiences of some of the more and less developed countries. Second; the
paper further reviews the Environmental Impact Assessment (EIA) and Ecological Footprint (EF) methods in order to find an appropriate method and a set of appropriate indicators for analysing the impact of the growth of Tehran towards its peripheral natural environment. Third; application of the methods and indicators to analyse the ecological footprint of Tehran, to find the impact of unplanned growth of Tehran and its expansion towards the peripheral natural environment.
Achievement: The main outcome and achievement of this paper is to emphasis on establishing a planning and policy-making mechanism in the metropolitan region of Tehran, enabled to reduce, solve, and prevent the problems related to the natural environment.

Keywords

Metropolitan region of Tehran, Unplanned growth, Natural environment, Environmental Impact Assessment (EIA), Ecological Footprint (EF).

....

The Scientific Journal of NAZAR research center (Nrc) for Art, Architecture & Urbanism

Introduction and research background

Economies of scale and reduction of the expenses are significant reasons for formation of metropolises. However, there is no direct relationship between increasing density and intensifying activities (residential and non- residential activities) and increasing economies of scale within metropolitan regions (Tiebout, 1960: 442; Grove, 1967: 4-6). Metropolitan growth and further increasing of density – due to unplanned mechanism or incorrect policies and planning or adoption of policies that ignore the negative impacts of unplanned metropolitan growth - can lead to increasing of socio-economic-environmental costs in the face of socio-economic-environmental benefits by infringing the population threshold (i.e. the size of population beyond which species inevitably have to experience sudden, unintended and unexpected changes) and ecologic threshold (i.e. a level beyond which small changes in the environment leads to rapid change and widespread changes in the ecosystem). Metropolitan growth in such circumstances leaves adverse effects and turns into the source of diseconomies of scale in metropolitan regions that eventually result in spatial issues particularly in the natural environment (Groffman, 2006). Metropolitan growth toward natural peripheral environment (and formation of metropolitan regions) is categorized in two main items in different countries: the first considers abandonment and unplanned growth while the second considers the existence of a controlling mechanism and conduction of metropolitan growth (with various degrees of efficiency which is related to the capability and potentials of the planning system). In the first situation, there exists no thinking in advance about the negative and positive consequences of metropolitan region growth. Thereby, the decision-makers' and decision-takers' being shocked in city and beyond city scales, can be considered as the negative consequences and indications of such situation. In the second situation, thinking and planning are managed in advance in order to control the negative consequences and

maximize the positive implications of metropolitan region growth.

The metropolitan regions undergo fast and far-reaching changes caused by market forces and pressures of market regulations in the first situation since it tackles with the absence of tact, appropriate and capable mechanism, planning, management and conduction of metropolitan spatial structure (including population systems, human activities as well as residential and non-residential spaces which encompass these activities). Contrastingly, the city structure and changes in a situation of planned metropolitan regions are set to be controlled within a reconsidered framework by a planned system. Metropolitan growth in both situations – despite more intensity and diversity in the first situation-leads to spatial1 disorder (with respect to all economic, social, institutional and physical aspects), as well as establishment and reproduction of extensive new problems, and exacerbation of pre-existing problems in all dimensions. These problems cause waste of vital resources of communities and economic, social and environmental capital assets in metropolitan regions. In both situations, problems gradually appear in the city and population size, utilities, communications, housing and urban land market, and formation of undesired peri-urban[2] environments and as well as the formed relevant spaces and activities, especially in natural environments (Allen, da Silva & Corubolo, 1999: 12-16). The outcomes of unplanned metropolitan growth in all the mentioned areas can be categorized as below:

A. Formation and expansion of autonomous communities beyond the areas where urban utilities are located. This will lead to social and political pressures for providing infrastructures and required services (Staley, & Mildner, 1999: 6-7; Staley, Edgens, & Mildner, 2000; Woo, 2007: 26-27) and increasing of multiple problems related to natural environment.

B. Alterations in land use and activity structure in urban fringe where access to urban and suburban transportation network has to be increased

(Brody, 2013: 2). This can lead to the formation of a variety of problems, especially problems related to the natural environment despite providing access and services of commuting.

C. Formation of urban autonomous areas, i.e. areas with minimum need for utilizing urban facilities (such as water, sewage and power), that establish weak administrative-political link with the peripheral areas (Cowan, 2005: 415; Zasada, et al, 2011:60). D. Formation and expansion of informal settlements, also known as peri-urban settlements that are emerged due to unplanned growth. In other words, these spaces have features of both urban and rural spaces simultaneously and they are the center of concentration of urban poverty and provider of informal sector workforce employment (Fazal, 2013: 17). E. Deactivation of policies of urban growth management (Hutchison, 2010: 333 & 833). Decreased quality of life and urban degradation (Ibid) in the main metropolitan and peripheral environments.

Although the origins of formation and transformation in metropolitan and urban region spatial structure can be detected in both More Developed Countries (MDCs) and Less Developed Countries(LDCs)[3], the rate at which metropolises are formed and advanced is higher in LDCs than MDCs (Krugman, & Elizondo, 1996: 138). Unequal distribution of opportunities for production, employment and related opportunities to welfare services (such as education and health) in some LDCs make metropolises who benefit from these services and more appealing (in contrast with other cities). The resultant of these forces causes the labor and seekers of higher level of prosperity and opportunity to migrate. Metropolises and their peripheral environment (which are generally referred to as metropolitan regions in this paper) are centers of attracting migration flows. Metropolitan growth in these countries inevitably generates multiple negative consequences rapidly, especially in the peripheral natural environment (UN, 2008; Fazal, 2013: 15-17). The first signs of metropolitan formations in Iran

dates back to the late 1960s and to the city of Tehran. The spatial structural evolution of Tehran metropolis from late 1920 to late 2010 shows the variable entity of its advancement during different periods: **First)** until 1940 the Tehran growth was slow and shaped around a central nucleus in layers, **Second)** From late 1970 to 1980 the city undergoes a rapid jointed growth along main urban and suburban connection network, **Third)** From 1990 to 2010, the city experiences a rapid disjointed growth(i.e. urban discontinuity and lack of activity and function cohesion)[4]. Rapid and disjointed growth of this metropolis toward the peripheral natural environment continues the formation and growth of metropolitan region (including main metropolis and its spatial-functional links with other cities around Tehran, which is roughly intended as Tehran province in this article). Therefore, the unplanned growth of this metropolis after 1970s and its subsequent spatial and decision-taking problems in this area can be detected by intense concentration of political-administrative activities in Tehran as the capital of the country.

On one hand, this phenomenon has taken place due to major planning at national and regional scale(including the entity of planning, supporting mechanism of planning and implementation as well as the spatial and aspatial nature of planning at these scales). On the other hand, inefficiency of planning mechanism in the metropolitan region of Tehran, that are emerged by lack of regulatory policies[5] such as confining city growth and absence of distributive policies[6] like effective intervention in distribution of goods and facilities (with emphasis on welfare facilities) have aggravated the issue. The problems caused by this phenomenon are categorized and analysed by using "content analysis"[7] or textual analysis of selected researches[8] in the following table at three scales; **First)** the mutual problems of built environment and natural environment, **Second)** the environmental problems and **Third)** procedural and substantive problems related to urban and regional planning which are detected and classified in Table 1[9].

Introduction of purpose and methodology

The basic question forming the purpose of this article is defined on the basis of the introduced triple problem areas generated from unplanned metropolitan region growth (areas discussed in Fig.1.) and impact analysis of this phenomenon on the peripheral natural environment. By using a descriptive-analytical approach, this papers aims to discuss unplanned urban formations generated by metropolitan growth in Tehran, which is the study area of this paper. Furthermore, this paper seeks to investigate the implications of such development, planning and policy-making processes in a specialized field of action, so that the widespread problems of the production and reproduction of these issues could be tackled. Having analysed the impacts of Tehran unplanned metropolitan growth on the peripheral natural environment, multiple polices can be suggested.

The analytical level of this article as a whole or as a functional spatial set comprises the metropolitan region of Tehran. It includes urban and non-urban spaces in main metropolis and its peripheral environment, especially its natural environment with the variety of activities that shape their daily set of transaction (such as labor, goods and energy).

In order to give answers and achieve the purpose of this article, a three stage method including the following steps has been devised:

First stage- The nature and characteristics of the phenomenon of metropolitan growth and its expansion towards the peripheral environment in MDCs and LDCs: In this stage, the theoretical frameworks and global experiences related to the phenomenon of metropolitan growth and its expansion towards the peripheral environment and formation of metropolitan regions as well as its derived problems are described and categorized in MDCs and LDCs. This stage includes three main activities in the following three steps:

First step- Describing the nature of the phenomenon of metropolitan growth and its expansion towards the peripheral environment and formation of metropolitan regions as well as identifying the characteristics and factors affecting the formation of such phenomenon.

Second step- Detection of problems caused by unplanned metropolitan growth and their impact on the spatial-activity mechanism.

Third step- Concluding from the findings of the first stage in order to discover the overall principles for analysing and discussing the formation and transformation of metropolises and their expansion toward the peripheral natural environment and utilizing the achieved principals in reviewing the metropolitan region of Tehran.

Second stage- Finding criteria of analysing the impacts of metropolitan growth on the peripheral natural environment: In order to assess the environmental impacts in this stage, with emphasis on the effects of metropolitan growth and its expansion towards the peripheral environment and the formation of metropolitan regions, the existing and applied methods in different cases are investigated and categorized. This stage includes three main activities in the following three steps:

First step- Review and categorization of environmental impact assessment methods

Second step- Review and categorization of the appropriate methods to analyse the effects of unplanned metropolitan growth on the peripheral natural environment

Third step- Concluding from the findings to select appropriate methods and criteria to be applied for the analysis of environmental effects caused by growth of the metropolitan region of Tehran.

Third stage- Analysing the impacts of Tehran metropolitan growth and its expansion towards the peripheral natural environment and formation of the metropolitan region of Tehran: At this stage, the phenomenon of Tehran metropolitan growth and the formation of metropolitan regions in terms of planning intervention mechanism are analysed. Furthermore, the most significant factors

affecting this phenomenon are described through content analysis of related researches and studies. Eventually, the effects of Tehran metropolitan growth and its expansion towards the peripheral natural environment and formation of metropolitan region are analysed with the use of selected criteria in the second stage. This stage includes three main activities in the following three steps:

First step- Introducing the phenomenon of Tehran metropolitan growth and its expansion towards the peripheral natural environment and the formation of metropolitan regions (in terms of planning intervention mechanism) and the factors affecting its formation and

evolution from 1960s to 2010s.

Second step- Analysing the impacts of Tehran metropolitan growth on the natural peripheral environment, with an emphasis on its unplanned growth and expansion towards the peripheral natural environment and the formation of the metropolitan region of Tehran. This can be achieved by identifying and producing standards applied in the case of the metropolitan region of Tehran. Having assessed the ecological footprint of each criterion, the negative effects of unplanned growth of metropolitan region on the peripheral natural environment is detected and analysed.

Table.1. Detecting and classification of problems caused by unplanned growth of the metropolitan region of Tehran. Source: authors, 2015.

Problem area	"content analysis" sources8	Examples of detected problems
First-Problems concerning bilateral relationship between the built environment and the natural environment	A	• Demolition ofenvironmentally sensitive areas. • Formation of unplanned peri- urban settlements. • Establishment of some activities in sensitive areas (man-made and natural hazardous areas*). • Increasing of the built environments versus open spaces and natural environments.
Second- Environmental problems	B	• Destruction of agricultural lands and gardens; green belts and open spaces of natural peripheral environment**. • Reduction of natural environment ecological capacity and power of supplying agricultural production and natural environment required for metropolitan region of Tehran. • Environmental pollution caused by the increasing use of motorized transportation methods***. • Environmental pollution caused by severe industrial activities and use of fossil energy in metropolitan region of Tehran.
Third-Problems concerning procedural and substantive aspects of urban planning	C	• Procedural aspects: Formation of peri-urban residential environment and undesired rural-urban spaces with internal and external caused problems. Inequality in accessing housing, welfare services and infrastructure. Excessive use of preserved urban development lands and derogation of land protection policies****. Formation of informal activitis and autonomous urban and peri-urban areas. • substantive aspects: Reduced public sector efficiency and strengthened planning and management of housing market and urban land in state of under pressure development. Deficiency /Inefficiency of urban management supervision on space formation and illegal activities in peri-urban environments.

*. Such as faults, river beds and river margins, space power grids and road connections./**. Especially in the west and southern plains of Tehran.
. For a variety of activities such as human transportation, goods and etc./ *. With the exception of areas in the north of Tehran metropolis where there is no possibility of advancement due to natural containment (Alborz Mountains).

Third step- Concluding from the results of Analysing the phenomenon of expansion towards the peripheral natural environment and comparing the results from analysis of unplanned metropolitan growth in the metropolitan region of Tehran with the findings of similar researches.

Theoretical foundations and comparison of global experiences related to metropolitan regions and their growth and expansion in MDCs and LDCs

In this stage, theoretical and empirical foundations of this issue and the main reasons and consequences of their expansion towards the peripheral environment are discussed aiming at comparing of metropolitan regions in MDCs and LDCs (in terms of planning intervention mechanism and approaches). The expected outcome of this review detects and compares areas of similarity or distinction in formation and expansion of metropolitan regions in MDCs and LDCs.

• Metropolitan region definition

Metropolitan region refers to a set of interdependent realms which are either located in central metropolitan areas or its peripheral areas (Hutchison, 2010: 509-510). This definition is applied for understanding spatial metropolitan formation, dynamism and life. It also highlights the mutual effects of activities, complex communication networks and movement circulations in metropolitan regions. Metropolitan regions are advanced from more accumulated urban center to less dense peripheral spaces. They are advanced through merging with peripheral existing residential settlements, formed around metropolises due to economies of scale. Although urban accumulation is abated away from metropolis centers, metropolitan regions are under influence of the themain city (in contrast to other territories that may be indirectly influenced by metropolitan activities or refusing any influence). In other words, metropolitan regions combine urban clusters (jointed built environments) with areas that are close interaction with the

center, and do not necessarily seem urban which may expand beyond the political realm of the main metropolis (Hutchison, 2010: 504; Caves, 2005: 459).

• Comparing the causes of metropolitan growth and expansion towards the peripheral natural environment and formation of metropolitan region in MDCs and LDCs

The way and intensity at which a city growth is a resultant of eccentric and concentric forces. When the land price and built environment value in peri-urban environment is lower and affordable for a broader range of population groups and when the planning mechanism is not capable of growth control, the unplanned situation prevails and eccentric forces leads the metropolitan growth toward the peripheral natural environment, open spaces and rich agricultural lands with natural ecological value. A powerful planning mechanism can manipulate the resultant of these forces and lead them to the locations aimed for planning. Population size, economic status and composition of social classes, metropolitan growth planning and management, are the most significant factors which affect the intensity and direction of the resultant forces at different rates in MDCs and LDCs (Bhatta, 2010: 18-27; Brody, 2013: 2).

Although some factors affecting metropolitan growth and their expansion towards the peripheral natural environment and formation of metropolitan regions are similar in various communities, the way these factors function indicate differences that can lead to expansion of regions in any of planned or unplanned cases. Here, using causal comparative[10] research method, the expansion of world's metropolises are analysed by considering the metropolitan growth type (in any of both cases) as the dependent variable and the causes and consequences of this phenomenon in MDCs and LDCs as the independent variable. The results show that:

First- population structure: population growth in many metropolises and metropolitan areas leads to empowering of eccentric forces. However, the

intensity at which MDCs and LDCs are affected is different. On the one hand, some experiences of MDCs suggest unplanned expansion towards the peripheral natural environment despite low or even negative population rate. On the other hand, some experiences reveal that despite rapid population growth, metropolitan growth may not be associated with unplanned expansion and can be controlled by efficient planning systems. Nevertheless, population growth and increased migration to metropolitan regions are the most effective forces in empowering the phenomenon of unplanned growth - particularly in LDCs (Bhatta, 2010: 18-21).

Second- socio-economic classification of population: Economic growth and increasing per capita income of economic enterprises and households in some MDCs have boosted the demand for offices and housing with more facilities (such as more activity and residential spaces, open spaces and warehouses) whose reflection is vividly obvious in households and Institutionschoices. Attraction of living in peripheral metropolitan open spaces with lower taxes (in particular for private sector economic enterprises) have turned into opportunities to achieve the demands of rich socio-economic groups (such as experts and businessmen) and have raised demand the formation and expansion of metropolitan regions towards the peripheral natural environment. Furthermore, unprepared context of some LDCs for adapting to sudden changes of global market have overcome the empowering forces of unplanned metropolitan growth where some shaped environments do not offer appropriate residential and urban spaces (Brueckner, 2000; Brody, 2013: 2). Socio-economic classification of population is effective on the metropolitan region growth in both MDCs and LDCs. Racial and ethnic differences in some communities and metropolitan areas have led the low-income socio-economic groups to the worst peripheral urban areas (in terms of living conditions, quality of life, security and access to welfare services) (UN, 2008; Fazal, 2013: 15-17).
Some ethnic groups as well as groups affiliated

tospecial types of occupation and living[11] socially come together in order to take advantage of the living in the same neighborhood groups (and being protected from other rival groups) mostly in peri-urban settlements. In LDCs, immigrants in search of employment, who are usually from low-income socio-economic groups, compete to find an affordable housing in peri-urban environments which accelerates the unplanned metropolitan areas toward the peripheral natural environment (Bhatta, 2010: 26; Carruthers, & Ulfarsson, 2002: 312-317).

Third- Planning mechanism: A mechanism fitting to the circumstances of each country with efficient planning, in some MDCs (such as Great Britain) have balanced eccentric forces and empowered centric ones. Moreover, in some MDCs (such as U.S.A) no particular planning, monitoring and restriction system is set around metropolitan regions and it is relied on establishment of maintenance utilities, security and so on by the private sector. In most cases in LDCs inefficient planning mechanism has resulted into unplanned metropolitan growth toward natural open environments and formation of metropolitan regions (Bhatta, 2010: 26; Carruthers, & Ulfarsson, 2002: 312-317).

• Review and classification of all types of metropolitan growth and expansion towards peripheral natural environment and their consequences in MDCs and LDCs
The type and entity of metropolitan growth and expansion towards peripheral natural environment and the consequences differ according to their being planned or unplanned framework. These spaces indicate huge differences in MDCs and LDCs (in areas such as socio-economic composition of the population and activity, and physical structure including communication network characteristics and residential structure features). In order to detect these distinctions "content analysis" methods was selected for a number of preceding studiesand the results are shown in Table 3 (Glaster, et al, 2001: 682-685; Brody, 2013: 2).
 At this stage, the aim of this paper from investigationg

Table. 2. Methods and relationships between main activities selected in the article. Source: authors, 2015.
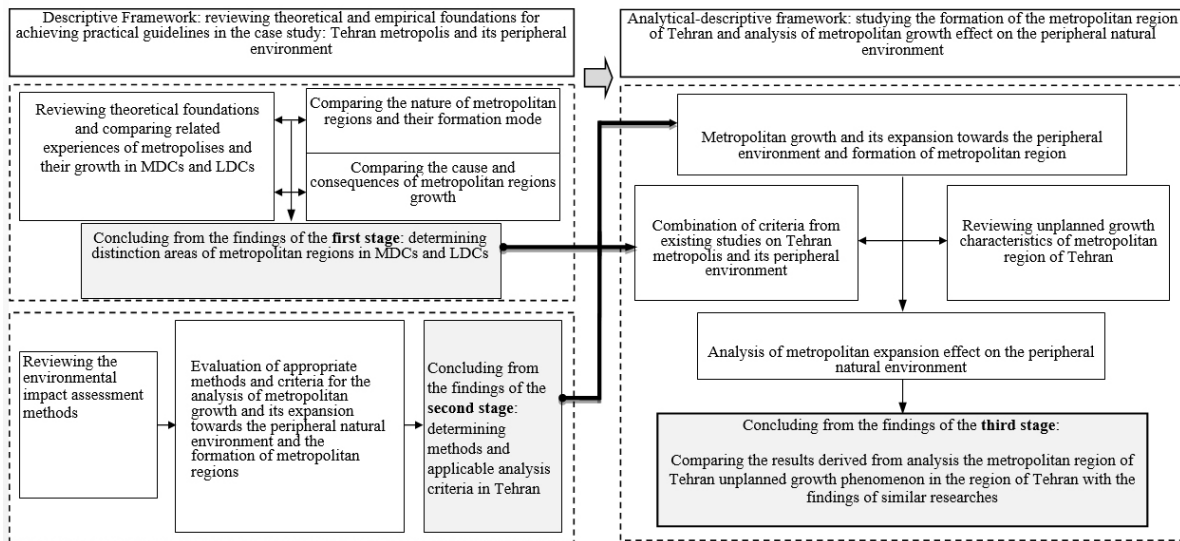

Table 3. Detection and comparison between consequences of various types of metropolitan growth in MDCs and LDCs. Source: authors, 2015. /*Rapid and uncontrolled growth from fringe lands of the main nucleus started with higher density and expanded to the peripheral areas gradually./ **in dispersal growth , detached parts are created in fringe lands. They leap from human-built or natural consternations in case of confrontation./ ***In strip growth, the residential and non-residential activities are formed along the transportation network routes of peri-urban environments. /**** They are shaped in detached single-family, low density and closed community neighborhoods, which are established and managed mostly by the private sector mechanism.

Classification of metropolitan growth types	"Content analysis" sources12	Examples of detected consequences associated with metropolitan growth types	spatial representation
Spiraling growth around nucleus of main metropolis*	A	• Undefined edge between urban and rural areasdue to the mixing of activities and spaces. • Changes in the natural environment, open spaces and peripheral agricultural lands of metropolitan regions.	In LDCs
Leapfrogging growth**	B	• Extensive growth and single-function of land (with prevailing residential function). • Intensification of land use and expenditure of the public sector to provide infrastructural facilities. • Inefficiency of public transport services, reduction of opportunities for pedestrians and cycling.	In MDCs and LDCs
Strip or ribbon growth***	C	• Inefficiency of suburban transformational road network; and decreased immunity, due to a concentration of various activities by the road network. • Growing need to increase new transportation network and subsequent invasion of activities to benefit from the advantages of new access. • Unlimited metropolitan growth along the access routes to the peripheral areas.	In MDCs and LDCs
Low-density, single family dwellings growth****	D	• Allocation of a greater share of residential land compared to the main metropolis, and thus intensification of land use with ecological and natural capital. • Undefined urban, rural and natural environment edges in metropolitan regions. • Clustering of residential spaces of various socio-economic groups in peripheral urban environments.	In MDCs

on this classification is to look for a match or a combination of conditions that best suit the growth of metropolitan region of Tehran.

• Concluding from the findings of the first stage: defining distinction areas and characteristics of metropolitan growth, expansiontowards peripheral natural environment, and formation of metropolitan regions in MDCs and LDCs

In concluding the findings of the first stage of this paper, distinction areas and characteristics of metropolitan growth and expansion towards peripheral natural environment, and formation of metropolitan regions in MDCs and LDCs were reviewed. Similar aspects can be detected in formation and transformation of metropolitan regions in many countries of the world. However, their dissimilar aspects in MDCs and LDCs reveal their differentiations. Ignoring these differences by spatial planners leads to establishment of problems rather than problem-solving[13]. Despite some apparent similarities (such as population and city size), comparison of importantfactors on metropolitan region growth and formation (include the replacement of natural environments with built environments, emergence and development of activities, the combination of employment, social justice and public health situation) indicate multiple differences between metropolitan regions in MDCs and LDCs (UN, 2008; Fazal, 2013: 15-17). Some of these differences are described in Table 4.

Review and classification of Environmental Impact Assessment (EIA) methods and determination of appropriate methods to be applied in the metropolitan region of Tehran

Aiming at finding an appropriate method of analysing the effects of unplanned metropolitan growth towards the peripheral natural environment and formation of metropolitan regions; all related methods of environmental impact assessment in original researches are reviewed in this paper. The expected output suggests appropriate criteria for analysing the impacts of unplanned metropolitan

growth towards the peripheral natural environment and formation of metropolitan regions.

• Review and classification of Environmental Impact Assessment (EIA) methods

Change of public and environmental planning activities, particularly the natural environment, during 1970s and the natural environment's being at the center of social concerns, was empowered with formation of official institutions and Non-Governmental Organizations (NGOs) at the international level, especially in MDCs. Following these changes and declaring of objectives such as sustainability and social equality in planning (Daneshpour, 2014: 423-419) different methods were applied associated with analysis of human activity effect on the natural environment. Moreover, the advantages of new technologies (such as Information Technology: IT and using computer) have improved the ability of tools related to these methods which have made the assessment of environmental consequences a key element in cost- benefit analysis of the options and decision-making process in planning (Canter, & Sadler, 1997; Finn, 1989: 167-192; Lohani, 1997: 59-60). Every study aimed to evaluate the effects of a program, policy, project and also a phenomenon whose impact on the natural and built environment is considered as an "Environmental Impact Assessment (EIA)". Various approaches, principles and theoretical foundations are applied to determine and analyse and the severity of environmental change which are almost identical in their field of application. according to the scope of the subject matter (micro, mezzo, and macro level) in these methods, expected goals, the type of available information, and different constraints; possibility of harm to the environment are analysed and different harm inhibitory processes of and their mitigation trends are recommended (Canter, 1999; UNEP, 2002: 113-115). The most important activities in the process of EIA are introduced in the following five steps[15.]
Step one - screening: screening initial information

gathered on environmental problems; and making decisions on the need for implementation of EIA.

Step two- scoping: restriction of spatial scale, gathering environmental knowledge and information, consultation with relevant experts and organizations, reviewing laws and guideline frameworks.

Step three- impact assessment: EIA according to spatial scale and the scope of the study, suggestion of various scenarios for achieving the expected targets, and impact of options for selecting the best scenario.

Step foure- mitigation measures: determination of measures to evaluate activities, in order to inhibit or minimising the possible negative impacts of proposed actions.

Step five- action: interconnection of select scenarios with policy-making and administrative operating frameworks, and monitoring.

A wide range of EIA methods are applied and devised in different communities (especially in MDCs). However, according to the internal logic of these methods and their expected outcomes, all types of global experience in application of EIA are categorized in a quadruplet classification. Table 5 shows the related cases to each category:

First category- predictive methods: In this category, a list of effective elements in determination of environmental quality and predicting techniques of the related consequences to preparation of elements are scrutinized, composed, valuated, and evaluated according to the characteristics of the study. In this category, the potential harmful elements such as air (using techniques such as urban area statistical models and monitoring from analogs), surface waters and groundwater (using techniques such as pollution source surveys and waste load allocations); noise and landscape are assessed (Canter & Sadler, 1997; Lohani,, et al, 1997: 122).

Second category- Environmental Risk Assessment (ERA) methods: Regarding uncertainty in this category, unlike predictive methods, data related to possible environmental hazards and mitigation of uncertain impacts in decision-making, are collected. Maximising of environmental hazards control and

minimising of uncertainty impacts are main purposes of this methos to enhance health and biodiversity in the ecosystems (Lohani et al, 1997: 171).

Third category- socio-economic analysis methods: Socio-economic and environmental attitudes are combined in this category. The socio-economic attitude in cost-benefit analysis of options acts as one of the main components of weighting and decision-making. The environmental consequences of policies and proposed measures are also taken into account by considering the mentioned attitudes (Lohani, et al, 1997: 216 & 230).

Forth category- expert systems analysis methods: Experts establish strong ties with all aspects and stages of assessment methods in this category and the mentioned ones. The used models of these methods are products of a long-term collective knowledge and experiences. Expert systems (using techniques such as explorative knowledge[16]) provide adequate clarification for judgment, according to the possibilities and constraints, similar experiences, legal and technical frameworks (Lohani, et al, 1997: 252; Finn, 1989: 167).

• Review of methods for analysing unplanned metropolitan growth impact on the peripheral natural environment

In order to analyse the effects of phenomena such as urban growth on the peripheral natural environment in a state of uncertainty and overcoming of constraints in accessing environmental data (due to lack of efficient monitoring mechanisms) the risk assessment methods are used to evaluate the intensity of undesired change and environmental risks, and as decision supporting systems (Lohani, et al, 1997: 171-73). One of the most used methods in the category of risk analysis is Ecological Footprint (EF)[24] calculation which introduces human demand for land ecosystem or natural human capital that may be greater than environmental or ecological capacity of the earth to supply (Ewing, et al, 2010: 1-2; Moore, et al, 2013: 7; Wackernagel, 1999: 381). In the EF calculation method for residents of metropolitan regions, the relationship

Table 4. Detection and comparison between areas of differentiation of metropolitan regions in MDCs and LDCs*. Source: authors, 2015. /*Differences are tracked and compared in the highest and lowest state of development of countries. In fact, countries of the world experience different degrees of development and none is completely developed or fully undeveloped.

Areas of differentiation in metropolitan regions	Areas of differentiation in MDCs	Areas of differentiation in LDCs
Formation, transformation and growth	• Skilled labor recruitment commensurate with the growth of industrial sector. • Metropolitan growth in a planned and controlled state (with various degrees of effectiveness). • low rates of immigration to metropolitan regions. • Existence of a planning mechanism and controlling the substitution of natural environments with built environments.	• Non-specialist recruitment in the service sector. • Metropolitan growth in an unplanned and abandoned state. • High rate of migration to metropolitan regions. • Lack of planning mechanism for substitution of natural environmentswith built environments.
Activities and combination of occupations	• Concentration of activities and recruitment in post-industrial sector. • Formal employment (sponsored by professional organisations) and linked to intellectual work.	• Concentration of activities and recruitment in agriculture and service sector, as well as industries related to the extraction of raw materials. • Informal employment, related to unskilled labor.
Social justice and public welfare	• Higher per capita income through comprehensive tax systems, and wealth redistribution policies. • Public access to residential spaces and welfare services. • Higher rate of literacy and convenient access to developed instructional methods and professional technical skills. • Further efforts to reduce sexual, ethnic and racial discriminations.	• Lower per capita income and the absence (or the failure) of redistributive policies. • Lack of appropriate residential spaces, bad housing and absence of welfare services. • Higher rate of illiteracy and confined access to instructional services, instructional methods, and professional technical skills. • Less efforts to reduce sexual, ethnic and racial discriminations.
Health and public hygiene	• Public access to healthy potable water and edible food products. • Public access to appropriate health and medical services. • Lower rate of birth and death; as well as lower rate of natural population growth. • Older combination of population.	• Lack of public access to healthy potable water and edible food products. • Lack of public access to appropriate health and medical services. • Higher rate of birth and death; as well as higher rate of natural population growth. • Younger combination of population.

Table 5. Types of EIA methods. Source: authors, 2015. /*Such as assessment of such as measuring air quality, water, soil and ecological / biological resources.

Types of EIA methods	Methods of relevant cases with each category	Relevant sources17
predictive methods	• predicting quantitative environmental changes • predicting quantitative environmental changes*	A
Environmental Risk Assessment (ERA) methods	• Environmental Risk Assessment(ERA)18 • Ecological footprint assessment method • Human health risk assessment19 • Comparative risk analysis20	B
socio-economic analysis methods	• Changes in productivity assessment method • Market prices & surrogate market prices assessment method • Replacement cost assessment method21 • Social Impact Assessment (SIA)22	C
expert systems analysis methods	• Knowledge base assessment method • knowledge acquisition procedure assessment method • Inference from documents and library database23	D

between the urban environment and peripheral natural environment and the sustainability of this relationship is discussable by detection and analysis of supply and demand flows. This analysis demonstrates the relationship between cities and the peripheral natural environment, in the continuum of an unstable to stable situation, where an image of their mutual effects is presented (An example of the correlation matrix using for calculating EF is shown in Table 6). Using this method requires collection and calculation of various criteria and sub-criteria which generally represent the amount of resources and waste production, and reveal the threshold of natural environment capacity for the survival and sustainability of this cycle (Wackernagel, et al, 1999; Moore, et al, 2013).

• Concluding from the findings of the second stage: determining applicable criteria for the metropolitan region of Tehran

In order to scrutinize the methodology of basic researches related to this paper and aiming at finding appropriate criteria for analysing the impacts of unplanned metropolitan growth on the peripheral natural environment, the findings of this stage are summed up according to the described method in section two. The calculation of various criteria and findings from a field study in EF calculation, and comparison of supply and demand flows (Fig. 6), especially in the state of information uncertainty, provides a more accurate image of the relation between cities and their peripheral natural environment. However, the two following main flows represent the most important aspects and effects of this relation. All relevant criteria can be situated as one of these two flows (Allen, da Silva, & Corubolo, 1999: 12-16; Tacoli, 1998) which are employable for analysis of communication quality between urban spaces and their peripheral natural environment in the metropolitan region of Tehran:

First flow- Provision of necessary resources to support residence, employment, and other activities of metropolitan regions in which the criteria for the

consumption of resources, such as land and built environment are included.

Second flow- Waste generation and pollution in the metropolitan region, in which the criteria for the production and distribution of contaminants in the peripheral natural environment are included.

• Review of Tehran metropolitan formation and growth: analysis of the impacts of Tehran metropolis growth on the natural peripheral environment

In this section, the entity and process of Tehran metropolis changes as well as the metropolitan region of Tehran growth are discussed, So that the consequences of unplanned growth in the metropolitan region of Tehran on the peripheral natural environment could be detected through the achieved above criteria.

• Review of the metropolitan region of Tehran formation and growth

Tehran metropolis as the capital of Iran, in terms of political-administrative structure and land management at the national level, alike other countries with similar political economy and capitals of LDCs has experienced high population and activity rate since 1960s. Compared to other cities and metropolises of the country, the highest population growth rate during all population and housing censuses (1956 to 2006) belongs to Tehran metropolis and its peripheral environment. Comparison of population changes during this period suggests higher share of population growth in the peripheral environment and consequently increasing of activities and demand for land and built environment (Diagram 1&2).

Data used in basic research of this paper on changes of population in Tehran metropolis is obtained from population and housing census data from 1956 to 2006. It was not possible to add census data of 2011 to this article for two reasons. **Firstly**, Tehran province (which is assumed the metropolitan region of Tehran in this paper) has been divided and compacted (with population decrease from 13.4

Table 6. Matrix of comparing of supply and demand flows between urban spaces the peripheral natural environment. Source: authors, 2015, on the basis of Wackernagel, et al, 1999: 381.

Supply				Demand			
Supply per capita: environmental capital or ecological capacity				Demand per capita: residents' needs			
Evaluation criteria	amount	equivalence coefficients	Amounts with applying the coefficients	Evaluation criteria	amount	equivalence coefficients	Amounts with applying the coefficients
Constructible land	-	-	-	Built environment	-	-	-
The recoverable resources	-	-	-	Resource expenditures	-	-	-
The adsorption and desorption ability of sustainable disposal of waste and pollution	-	-	-	Waste generation and pollution	-	-	-
Total supplied	-	-	-	Total used and demand	-	-	-

Table 7. Criteria for analysing the impacts of metropolitan growth on the peripheral natural environment in EF calculation method. Source: authors, 2015./* Related to EF calculation

Main flows		The criteria of analysing metropolitan growth on their peripheral natural environment	sources and global experiences[25]*
resource consumption	Land use changes in the natural urban and peripheral environments of metropolises	• Metropolitan growth and unplanned land-use changes in metropolises and peripheral environments. • Reduction of agricultural lands and ecological lands in metropolises and peripheral environments.	**A**
	Resources and energy consumption in metropolises and peripheral environments	• The use of renewable energy resources. • The use of non-renewable energy resources.	**B**
waste generation	The release and distribution of waste to the peripheral natural environment of metropolises	• The waste generation and pollution from residential activities, and distribution in the peripheral natural environments of metropolises. • The waste generation and pollution from industrial activities,and distribution in the peripheral natural environments of metropolises.	**C**

million to 12.1 million) due to detachment of its part known as Alborz during censuses of 2006 to 2011. If this study uses 2011 data, the administrative-political detachment of Alborz Province has to be ignored which will have no academic justification. **Secondly**, the EF is only calculated for Tehran in 2006 and there are information in some sources and interviews[26] from 2006 onwards who's queried (academically) and incomparable to data of previous years (statistically).

The problems arisen from formation of unplanned peri-urban environment and accordingly increasing of various activities all over the metropolitan region of Tehran (with the exception of the northern highlands and the south-eastern desert areas) and environmental consequences of this phenomenon are resulted from absence of a integrated mechanism of planning and urban management. Ignoring existing structures and sectoral policy practices (Daneshpour, Ebrahimnia and Mahmoudpour, 2015: 68-66) in the associated fields of unplanned growth and as well as ignoring Tehran metropolis thresholds and ecological capacities are considered as the reasons for formation of unplanned peri-urban environments. In the absence of an efficient and integrated mechanism to control Tehran metropolis with collaborative agenda to manage the metropolitan region, the peripheral natural environment of Tehran has become an incidence of environmental destruction. Land-use change and substitution of agricultural and natural lands with built environment, acceleration of speculative interventions, uncontrolled constructions, and excessive growth of the informal settlements with low income families are the resultants of the mentioned phenomenon[27].

• **Analysis of the impacts of Tehran metropolis growth on the natural peripheral environment**
In order to analyse of the impacts of Tehran metropolis growth on the natural peripheral environment, residents' EF can be calculated. In order to determine the criteria, two parallel but complementary cases have been followed. In the first case, existing studies about Tehran and this topic

in different related disciplines[28] were detected and scrutinized by "content analysis" so that evaluating criteria would be achieved from combination and interpretation of these researches. In the second case, the data on the metropolitan region of Tehran - which support secondary data of the first case – were detected and collected. Afterwardsaccording to the agenda and purpose of this paper the results of the two cases were compared and combined, so that appropriate criteria for EF calculation would be detected and identified.

- Detection and definition of appropriate criteria for analysis of the metropolitan region of Tehran: scrutiny of consumption flows that lead to waste generation
In order to calculate the EF of metropolitan region of Tehran, consumption flows which leads to waste generation were selected with the help of three criteria: first, the land-use changes in the natural urban and peripheral environments of metropolitan region of Tehran, second, resources and energy consumption in the metropolitan region of Tehran; and third, the amount of pollution and waste generation in the metropolitan region of Tehran. These three criteria are defined and described in the following:

First criterion- land-use changes in the natural urban and peripheral environments of metropolitan region of Tehran: The most influencing factors in empowering eccentric forces in the metropolitan region of Tehran are population growth and migrations. Tehran metropolis population has increased more than 5 times during the years from 1986 to 2006 while its area increased more rapidly and has become more than 15 times bigger. Average annual population growth rate of Tehran province (or the metropolitan region of Tehran) has always been higher than the other cities of the country (Diagram 1&2). Population growth of peripheral environment in comparison with Tehran metropolis has been constantly higher and the peripheral environment population growth rate has been constantly increasing (Diagram 2)
After 1970s the average periodical growth rate

of formed dispersed settlements in peripheral environments of Tehran metropolis (in 10-year census periods), has always been higher than the average growth rate of Tehran metropolis29. This phenomenon has been parallel with changes in land-use and natural environments of this metropolitan region. Forces of housing demand in metropolitan region of Tehran has resulted in formation of formal and informal settlements or even their integration with Tehran metropolis and a continuous decline in the quality of life. Moreover, residential and non-residential spaces in these areas are at risk of natural and man-made hazards.

Providing residential space in Tehran metropolitan region is inevitably faced increasing of density and building height, as well as excessive natural land and open space use. This has led to new problems and accentuation of the previous ones (such as reduction of open spacesdue to transformation into built environments and rapid change of city fringe to city realm, such as district 22 of Tehran municipality). Uncontrolled using of natural environments and open spaces in this metropolitan region has led the criteria of quality of life, which describes the relation of residence and green space, such as" built and open space ratio" and "per capita of access to green space", to be nationally and internationally at the bottom30. This is the result of sharp decline of open spaces in contrast with built environments in the metropolitan region of Tehran31.

Second criterion - resources and energy consumption in the metropolitan region of Tehran: The use of resources and renewable and non-renewable energy (such as use of water resources, the extraction rate and use of minerals) in Tehran metropolitan region compared to per capita consumption of other geographical areas shows a rapid growth in the use of resources and energy32. The main goal of population and migration flows in the country between the years 1956 to 2006 were Tehran peri-urban area in the first place, and inside areas of Tehran metropolis in the second (Diagram 1 & 2). This phenomenon shows the activity-physical

structure growth and a rise in use of resources and energy (mostly non-renewable) to meet the needs of residential and non-residential activities of Tehran metropolitan region residents33.

Third criterion - the amount of pollution and waste generation in Tehran metropolitan region: A study of the basic elements of life (including water, air and soil) in Tehran metropolitan region reveals severe pollution and an intense drop in the quality of these elements. For instance, this metropolis is one of the most polluted cities in the world in terms of air pollution34 and waste generation in comparison with many of the world's metropolises35. On the one hand, the absence of efficient mechanisms in management of waste generation and pollution emissions and the pressure caused by unplanned metropolitan growth on the other hand, have led to many changes (sometimes irreversible) in this metropolitan region36. The results of some studies37 show high levels of industrial pollutants, heavy metals, chemical fertilizers and pesticides in soil and water resources of Tehran metropolitan region, especially in its southern and southwestern lowlands. This has caused undesirable effects on drinking water and agricultural products.

- EF calculation of metropolitan region of Tehran though resource consumption and waste generation flows

In order to calculate EF through use of selected criteria described in past section of this paper, the land area and the amount of natural resources consumed by metropolitan regions residents of Tehran (on average) to meet their own needs (in hectare per person) was detected. The total area of land needed for meeting these requirements was considered and calculated as Tehran metropolitan region footprint in 2006.

Therefore, the areas of basic needs were divided into "residence" and "supportive activities for residents" (i.e. all activities for goods production and human services and spaces contributing to these activities) and an "intermediate area" that connects activities of

Diagrm1. Tehran metropolis and Tehran province population; and comparison between average annual population growth rate of the whole country and Tehran during 1956-2006*.Source: authors, 2015, on the basis of Statistical Center of Iran 1956-2006./*In 10-year-old period of population and housing census.
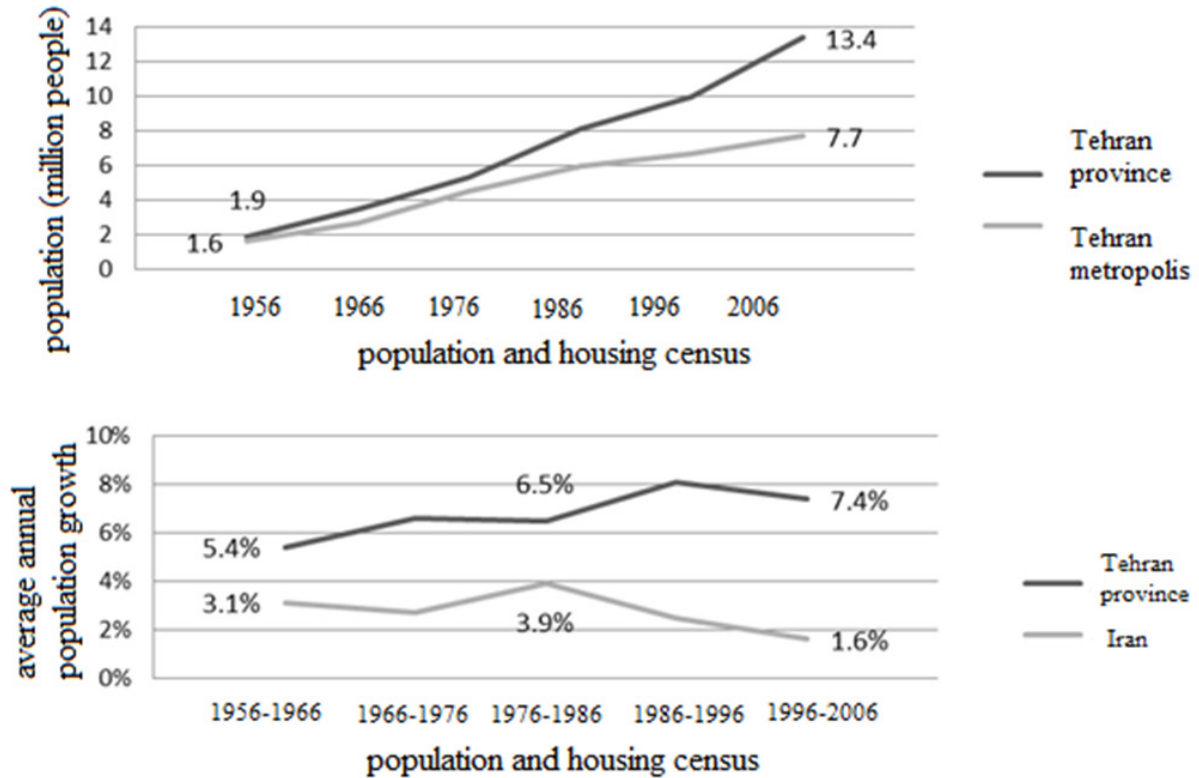

Diagram2. Comparison between periodic population growth rate of Tehran metropolis and peripheral settlements*.¬Source: authors, 2015, on the basis of Statistical Center of Iran 1956-2006. /*In 10-year-old period of population and housing census.
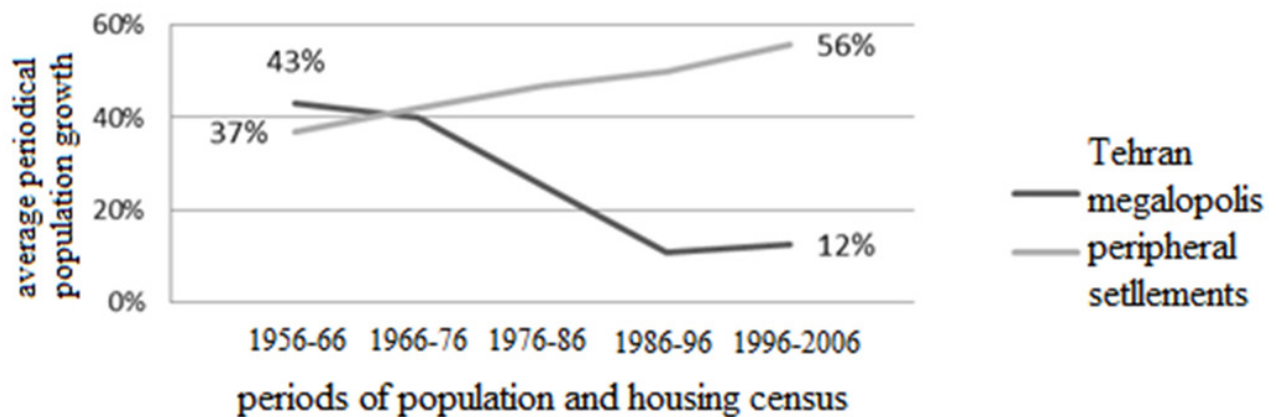
Table 8. EF calculation of Tehran metropolitan region (hectare per person), 2006. Source- authors 2015, on the basis of Sasanpour, 2010: 330-344 and Tavallai & Sasanpour; 2009:192-93./*Land required to absorb and convert various pollution caused by energy consumption, especially of fossil fuels./ **Land required for the production of agricultural and horticultural crops, livestock products , etc./ ***Natural land and open spaces that have turned into built environments to support various activities.

The main areas of needs in order to support the residents activities of metropolitan region of Tehran	EF resulted from energy lands*	EF resulted from the use of agricultural land, pasture and similar lands**	EF resulted from natural land used for built environment***
Living spaces and their related infrastructure (such as education and leisure time)	0.204	0.118	0.084
Movement and transportation (by road, rail and etc.)	1.08	0.095	0.042
Goods (such as food and clothing) and services (such as welfare and etc.)	0.42	1.672	0.076
Total	1.704	1.885	0.202
EF amount in Tehran metropolitan region	3.791		

the two domains (i.e. activities and spaces related to transportation, movement of people and goods), and demonstrated in Table 8.

• **Discussion on findings of the third stage: analysis and comparison of EF amount of metropolitan region of Tehran**
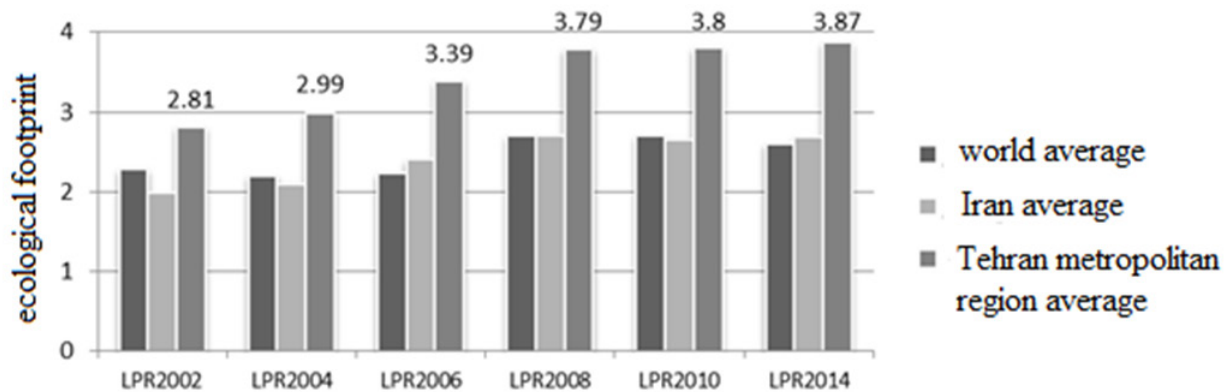
For summing up the findings of the third stage of the process described before, i.e. analysing the effects of Tehran metropolitan growth and its expansion toward the peripheral natural environment and formation of Tehran metropolitan region, an analysis for EF calculation of Tehran metropolis has been proceeded. This analysis will be compared to similar experiences carried out in the world and Iran. Therefore, the biennial reports of World Wide Fund for nature (WWF) which is published as Living Planet Report since 1998, which survey EF and natural environment capacity, were reviewed. These reports represent growth intensity of human activities on the natural environment as well as reduction of natural environment capacity for supporting of these activities. The average amount of Iran EF in these reports (i.e. 2.42 hectare per person) has always been close to the global average (i.e. 2.54 hectare per person). This amount is estimated lower than countries with high income per capita (i.e. 6.32 hectare per person) and higher than countries with low income per capita (i.e. 1.39 hectare per person). The findings of researches[38] on calculating EF of metropolitan region of Tehran and interpolation of amounts for the periods in which there are constraints on access to information (due to absence of periodical and planned survey of EF in Iran urban regions) indicates that the average amount of EF in Tehran metropolitan region (i.e. 3.44 hectares per person) is one and a half times higher than the average amount of Iran and the world average. Diagram3 draws a comparison between the amount of EF in Tehran metropolitan regions (achieved from internal

research and interpolation), Iran and the world average (achieved from periodical Living Planet Reports). Thus, if Tehran metropolitan region population in 2006 was equal to 13.4 million with an area of 18000 square kilometers; assuming that all areas of this metropolitan region had the sufficient ecological capacity to provide resources and disposal of the waste, the use of resources in Tehran metropolis and its peripheral environment had been about [28] times larger than the ecological capacity of this geographic area. However, it is not a correct assumption[39] in this geographical area due to wasting, unplanned changes and ecological characteristics' transformation of Tehran natural environment. This survey clearly reflects the negative effects of unplanned metropolitan region growth on the peripheral natural environment.

Diagram3. A comparison between EF averages in Tehran metropolitan region, Iran, and world (hectare per person). Source: authors 2015, on the basis of Sasanpour 2010: 330-334; WWF, 2002; 2004; 2006; 2008; 2010; 2014.

Source- authors 2015, on the basis of Sasanpour 2010: 330-334; WWF, 2002; 2004; 2006; 2008; 2010; 2014

Conclusion

Considering the main aim of this paper which seeks to find the impacts of unplanned growth of metropolitan region of Tehran on the peripheral natural environment; theoretical foundations and global experiences related to metropolitan regions, and their environmental impact assessment methods were reviewed. These studies were revised so that multiple criteria be detected and employed for Tehran metropolitan region. Therefore, the negative impacts of unplanned growth of Tehran metropolitan growth was analysed and detected through calculating EF of each criterion. The results and achievements of this study are summarized in the followings:

First- The phenomenon of metropolitan region growth in MDCs and LDCs is resultant of various factors. It has to be indicated that merely those factors that were related to the use of urban and regional planning mechanism are detected and classified in this paper. Scrutiny of other factors in other levels and academic disciplinesrequire further investigation.

Second- Despite some similarities in formation and growth reasons of metropolitan regions in MDCs and LDCs, any policy-making and utilization of practical experience requires accurate, expert reviews, and case scrutiny.

Third- LDCs have fewer applicable and research investigations on defining policies forintervention in metropolitan regin growth, comparison with MDCs. In addition, metropolitan region growths in many of LDCs are mostly unplanned and abandoned. This situation results in formation of undesirable spaces and activities and the emergence of complex problems in metropolises, especially in their peripheral natural environment.

Forth- There are multiple methods for analysing the effect of metropolis and metropolitan region growth in the peripheral natural environment. EF calculation is mostly applied in this case. The number and type of criteria which are selected in this method are function of object and level of analysis, constraint of information, and etc. However, most experiences investigating the aim of this paper in the world and Tehran have considered consumption resource and waste generations as the most effective factors for calculating the amount of EF.

Fifth- There are constraints and inhibitors in accessing information for selecting the best criteria for analysing the impacts of Tehran metropolis growth and expansion towards peripheral natural environment. Moreover, detection of land-use change, resource and energy consumption, pollution emission and waste generation in metropolitan region of Tehran and EF calculation of their equivalent flows indicates further exploitation of natural environment, and ecological overshoot in this metropolis. They can all be considered as main consequences of unplanned growth in this metropolitan region.

Endnote

1. Spatial refers to topological and multi-dimensional space.
2. Peri- urban environments refers areas formed by interaction of urban and rural environments. For more information see also: (Daneshpour, 2006).
3. More developed countries are the ones located in areas of North America, Western and Northern Europe, some countries in the area of Pacific Ocean and Japan. Less developed countries are the ones located in Latin America, East and South-East and South Asia, countries located in Sub-Saharan Africa.
4. For more information on spatial structure transformation of Tehran metropolis from 1920a to 2010s see also: (Mahdavivafa, Razavain, &Moneni, 2009:10); (Haeri, 1999: 70-72), (Institution of the studies and preparation of urban development plans of Tehran, 2007).
5. Regulatory policies mean defining authority limitations for different sections and setting them for the expected goals of public sector. For more information see also: (Schultz, 2004: 364-65); (Daneshpour, 2014: 90-94).
6. Distributive policies mean appropriate distribution of goods and services and their related costs within different sections. For more information see also: (Schultz, 2004: 364-65); (Daneshpour, 2014: 90-94).
7. "Content analysis" or "textual analysis" method that are applied in theoretical and empirical bases of research in this paper, is a method for studying recorded human communications such as written texts, documents and etc. in order to understand and interpret the underlying content. For more information on see also: (Delavar, 2005); (Naderi and Seifnaraghi, 2006); (Saroukhani, 2006); (Neuendorf, 2001); (Neuman, 1997); (Holsh, 1969).
8. Analysed and reviewed researches by authors through use of "content analysis" method are as follows:
(A) = Daneshpour, 2003, 2006, 2008; Amayesh Tosee Alborz, 2012; Pars Aria Ravad, 2012; Institution of the studies and preparation of urban development plans of Tehran, 2007.
(B) = Amirinejad, 2009; Institution of the studies and preparation of urban development plans of Tehran, 2007; Amayesh Tosee Alborz, 2012; Pars

Aria Ravad, 2012.

(C) = Amayesh Tosee Alborz, 2012; Pars Aria Ravad, 2012; Institution of the studies and preparation of urban development plans of Tehran, 2007; Daneshpour, 2008; Masoudi, 2010.

9. Tehran metropolitan unplanned growth is under influence of urban and regional planning mechanism in Tehran and socio-economic and political changes in the Iran. Reviewing of national issues is not within the scope of this paper.

10. "Causal comparative" research or "ex-post facto" researches, which is used in this paper in order to find the causes of metropolitan growth and function in MDCs and LDCs, is a method in which the possible cause (or causes) of a phenomenon is investigated through scrutiny of variable (or variables). Casual comparative research is a retrospective study and reviews the effect (s) to find potential cause (s). For more information on" causal comparative" research see also: (Biabangard, 2005); (Ragin, 1987).

11. Areas where religious minorities (like Muslims in Christian countries), ethnic (like Arabs in non-Arab countries) and racial (like colored people in white colored countries) and homogeneous classes of living and employment (such as public and private sector employees, workers, etc.) are congregated in order to live and do their activities together.

12. Analysed and reviewed researches by authors through use of "content analysis" method are as follows:

(A) =Brody, 2013; Torrens & Alberti, 2000; Glaster, et al, 2001; Heimlich & Anderson, 2001

(B) = Benfield, et al, 1999; Brody, 2013; Torrens & Alberti, 2000

(C) =Tsai, 2005; Brody, 2013; Heimlich & Anderson, 2001

(D) = Song &Knaap, 2004; ; Heimlich & Anderson, 2001

13. For more information see also: (Daneshpour, 2008)

14. The EIA is carried out in two stages of Initial Environmental Assessment and Environmental Impact Assessment. The products of the first stage guide researchers to use the right experience and tools, according to the objectives and evaluation facilities. At this stage, measures of damaging potential possibilities to the environment and mitigation measures are determined. The product of the initial stage is a clear statement of the most important environmental problems, based on accessible information sources and it provides a plan for carrying out the impact assessment. In addition, the scope and depth of studies are also determined at this stage (Canter & Sadler, 1997).

15. "Explorative knowledge" is the researcher's perception of studied problem and situation that is achieved through research and exploration. Explorative knowledge is applicable especially at a time when not enough information is accessible, and can be applied with various methods such as interviews, group discussions, field tests, and observations. For more information see also: (March, 1991); (Gavetti, et al 2000)

16. Analysed and reviewed researches by authors through use of "content analysis" method are as follows:

(A) = Canter & Sadler, 1997; Lohani, et al, 1997: 122- 170

(B) = Lohani, et al, 1997: 171-215

(C) = Lohani, et al, 1997: 216- 251

(D) = Finn, 1989; Lohani, et al, 1997: 252- 281

17. Environmental Risk Assessment (ERA) is attributed to process of estimating the probability of unintended environmental effects, which may be caused by human activities or affected by them. For more information see also: (Lohani, et al, 1997: 175-97) .

18. Human health risk assessment is attributed to the process of estimating the probability of human health affection by environmental pollution and resources such as food, water, and air. For more information see also: (Lohani, et al, 1997: 198-203) .

19.Comparative risk analysis is a rational and efficient tool for comparing risks of different environmental strategies. Moreover, this method determines the most important uncertainties of each strategy for further scientific scrutiny. For more information see also: (Lohani, et al, 1997: 198-203) .

20. Methods for evaluation of productivity changes, evaluation of market cost and replacement costs; assesses monetary benefits and losses arisen from environmental changes by cost-benefit analysis. These methods evaluate market cost (or replacement cost) for inputs and outputs and attribute their proportional changes to environmental changes. For more information see also: (Lohani, et al, 1997: 216-229) .

21. Social Impact Assessment (SIA) method helps the planners and decision-makers to maximise social benefits of their strategy and minimise the social negative effects. These methods are faced with wide range of procedures and qualitative social measures; and sometimes contradictory, benefits of social groups who gain or lose from environmental strategies. For more information see also: (Lohani, et al, 1997: 230-251) .

22. Library databases, evaluation through knowledge acquisition, deduction from documents and library data; enables expertise judgment of different and qualitative aspects of environmental strategies as backup methods.

Although difficulties of collecting, reviewing, analysing and reporting from quantitative information which are used in different methods of EIA has reduced due to new technologies and quantitative models, some aspects of environmental strategies cannot be simplified and quantified and their judgment complexity is solvable by the use of decision support systems and deduction of professional findings. For more information see also: (Lohani, et al, 1997: 252-281).

23. EF which is introduced as an environmental topic is applied as a tool for analysis and calculation of consumption rate and human life style and environmental capacity for providing human needs. EF per capita and its analysis can notify planners and decision-makers about consumption rate of environmental resources. Thus, when compared to the environmental capacity, the stabilization policies or lifestyle and general consumption would be adjusted according.

24. Analysed and reviewed researches by authors through use of "content analysis" method are as follows:

(A) = Allen & da Silva & Corubolo, 1999; Global Footprint Network, 2009; Tacoli, 1998

(B) =Moore, et al, 2013; Allen & da Silva & Corubolo, 1999; World resources institute, 1996; The footprint company, 2009

(C) = Moore, et al, 2013

25. Available sources and interviews such as (ILNA news, 03.07.2014); (Bahar news, 08.24.2014); (Donya-e-eghtesad newspaper, 02.17.2012).

26. For more information see also: (Davoudpour, 2005); (Daneshpour, 2006&2008); (Institution of the studies and preparation of urban development plans of Tehran, 2007); (Tehran municipality, 2015).

27. Such as urban and regional planning, urban sociology, urban management and policy, public health, the environment and natural resources.

28. For more information see also: (statistical center of Iran, 2014); (Tehran urban planning and research center, 2012); (Institution of the studies and preparation of urban development plans of Tehran, 2007).

29. For more information see also: (Tabibiyan,& Faryadi, 2001); (Behzadfar, 2009), (Sasanpour, 2010); (Tehran urban planning and research center, 1998 &2012).

30. For example built environments in district 22 of Tehran municipality have increased from a total of 8.12 square kilometers to 20.48 square kilometers from late 1980s to early 2000s. Open and green space of this district was decreased from 88.81 square kilometers to 74 square kilometers.

31. For more information see also: annual energy balance; ministry of energy, 1991 to 2014. Research projects of surveying energy consumption in Tehran, Statistical Center of Iran, 2011. Survey of energy consumption in the household sector, the Statistical Center of Iran, 2011. Survey of energy consumption in industrial sector, Statistical Center of Iran, 2011

32. For more information see also: (Tehran urban planning and research center, 2012); (Sasanpour, 2010); (Tabibiyan,& Asadi, 2008).

33. In most days of the year, air quality indices of Tehran metropolis are in an unhealthy state. In 2006, 20%of the population and 25% of industries of the Iran were located in an area equivalent to 1% of the whole area of the country. Pressure caused by the concentration of industry and their related activities, transportation traffic that infringe network capacity (which accounts for half of the air pollution source in Tehran metropolis), appearance of more than five thousand tons of suspended particles and air pollutants per year, thermal inversion phenomenon, and wasting of resources have caused tangible air quality reduction in the metropolitan region. Natural and man-made factors including more than 3 million active vehicles and 300thousand motorcycles, 5000 industrial units, consuming 20% of country's energy, and concentration of 70% of country's facilities in this metropolis have transformed it to one of the most polluted metropolises of the world. For more information see also: (Sasanpour, 2010) (Hosseinzadeh dalir,& Sasanpour, 2006); (Hamshahri newspaper, 07.24.2008); (Jam-e-Jam newspaper, 04.18.2009); (Mehr news, 02.01.2008, 02.17.2008,& 05.09.2009); (Etemad newspaper, 05.11.2009) and information accessed on Portal of Coordination Centre of air pollution in Tehran on http://www.air.tehran.ir

34. The growing trend of waste generation from residency and work activities on the one hand, unsustainable and insanitary disposal of more than 80% of the generated waste (by methods such as landfill, incineration, leading to rivers) in the absence of an efficient waste management mechanism on the other, has led a decrease in the quality of soil and water resources in the natural environment of Tehran metropolitan region. Daily waste generation per capita in the world is 250 to 300 grams per day per person, while this amount is estimated 600 grams per day per person during 1990s and 2000s in Iran and up to 1200 grams per day per person in some Tehran metropolitan areas and its peripheral environments. The frequency of waste collection is two to three times a day in Tehran metropolis while waste is collected two to three times a week in numerous MDCs. For more information on waste generation and pollution in Tehran metropolis and its peripheral settlements see also: (Torabian,& Baghouri, 1997); (Sasanpour, 2010); (Mehr news, 05.18.2009,& 05.23.2009); (Madani Shahroudi,& Nasiri, 2007); (Tehran municipality, 2013).

35. For more information see also: (Madani Shahroudi,& Nasiri, 2007) .

36. For more information see also: (Torabian,& Baghouri, 1997) .

37. For more information see also: (Hosseinzadeh dalir,& Sasanpour, 2006); (Samadpour, & Faryadi, 1998); (Sasanpour, 2010)

38. For more information see also: (Tehran urban planning and research center, 2011); (Ebtekar, 2014).

Reference list

• Allen, A., da Silva, N. & Corubolo, E. (1999). *Environmental problems and opportunities of the peri- urban interface and their impact upon the poor, peri- urban research team, development planning unit.* London: University collage London.

• Benfield, F. K., et al. (1999). *Once there were green fields: how urban sprawl is undermining America's environment, economy and social fabric.* New York: Natural resources defense council.

• Bhatta, B. (2010). *Analysis of urban growthand sprawl from remotesensing data.* Springer-Verlag: Heidelberg.

• Brody, S. (2013). The characteristics, causes, and consequences of sprawling development patterns in the United States. *Nature Education Knowledge,* 4(5): 2.

• Brueckner, J.K. (2000). Urban sprawl: Diagnosis and remedies. *International Regional Science Review*, (23): 160-171.

• Canter, L. (1999). Pragmatic suggestions for incorporating risk assessment principles in EIA studies. *Invited paper, The Environmental Professional,* 15 (1): 125–138.

• Canter, L. Sadler, B. (1997). *A tool kit for effective EIA practice review of methods and perspectives on their application.* International Association for Impact Assessment (IAIA): Oklahoma & Lincoln.

• Carruthers, J. I. and Ulfarsson, G. F. (2002). Fragmentation and Sprawl: Evidence from Interregional Analysis. *Growth and Change*, 33(3): 312–340.

• Caves, R.W. (2005). *Encyclopedia of the city.* Routledge: London & New York.

• Cowan, R. (2005). *The dictionary of urbanism.* Streetwise press: Wiltshire.

• Daneshpour, Z. A. (2014). *An introduction to planning theories with special reference to urban planning theories.* 3rd edition, Tehran: Shahid Beheshti University(SBU) publication.

• Daneshpour, Z. A. Ebrahimnia, V. & Mahmoudpour, A. (2014). Devising a knowledge management framework for integrated policy-making in Tehran. *Journal of Honar-Ha-Ye Ziba*, 19(1): 57-70.

• Ewing, B., et al. (2010). *Calculation Methodology forthe National Footprint Accounts.* 2010 Edition. Oakland: Global Footprint Network.

• Fazal, S. (2013). *Land use dynamics in a developing economy.* SpringerBriefs in Geography. Springer Netherlands: Dordrecht.

• Finn, G.A. (1989). Applications of expert systems in the process industry. In: *G.G. Patry and D. Chapman (eds.). Dynamic Modeling and Expert Systems in Waste-water Engineering.* London: Lewis Publishers.

• Galster, G., et al. (2001). Wrestling Sprawl to the Ground: Defining and measuring an elusive concept. *Housing Policy Debate*, 12(4): 681-717.

• Global Footprint Network. (2009). *Ecological Footprint Standards 2009. Oakland: Global Footprint Network.* Available from: http://www.footprintstandards.org/

• Groffman, P., et al. (2006). Ecological thresholds: the key to successful environmental management or an important concept with no practical application?. *Ecosystems,* 9 (1):1–13.

• Grove, W.R. (1967). *Economies of scale in the provision of urban public services.* Department of city planning, Massachusetts institute of technology: Massachusetts.

• Heimlich, R. E. & Anderson, W. D. (2001). *Developing the urban fringe and beyond: impacts on agriculture and rural land. report number 803.* Washington, DC: USDA economic research service.

• Hutchison, R. (2010). *Encyclopedia of urban studies.* California: Sage publications, Inc.

• Krugman, P. R. Elizondo, R. L. (1996). Trade policy and the third world metropolis. *Journal of development economics*, 49(1): 137- 150.

• Lohani, B., et al. (1997). *Environmental Impact Assessment for Developing Countries in Asia*. Vol. 1- Overview. Manila: Asian Development Bank (ADB).

• Moore, D., et al. (2013). *Methodology for calculating the ecological foorprint of California.* 2013 Global Footprint Network. Available from: http://www.footprintnetwork.org/

• European Communities. (2001). *Guidance on EIA Scoping.* Office for Official Publications of the European Communities: Luxembourg.

• Sasanpour, F. (2006). *Sustainable development of metropolises, with reference to Tehran metropolise.* Tehran: Tehran urban planning and research center.

• Song, Y., Knaap, G. K. (2004). Measuring the effects of mixed land uses on housing values. **Regional Science and Urban Economics,** (34): 663-680.

• Staley, S., Edgens, J., Mildner, G. (2000). A Line in the Land: Urban-growth Boundaries, Smart Growth, and Housing Affordability. *Journal of Policy Study*, (263).

• Staley, S. Mildner, G. (1999). *Urban-Growth Boundaries and Housing Affordability: Lessons from Portland.* Research Public Policy Institute, policy brief No. 11.

• Statistical center of Iran. (2009). *Population and housing census 2006- general results of Tehran province.* Tehran: Statistical center of Iran publication.

• Statistical center of Iran. (2014). *National portal for statistics.* Available from: http://www.amar.org.ir/

Tacoli, C. (1998). Rural- urban interactions: a guide to the literature. *Environment and urbanization,* 10 (1): 147-166.

• Tavallai, S., Sasanpour, F. (2009). Some aspects of Tehran`s ecological footprint. Journal of sustainable development, 2 (3): 187- 194.

• Tiebout, C. (1960). Economies of scale and metropolitan governments. *Journal of the review of economics and statistics*, 42(4): 442-444.

• Torrens, P. M. & Alberti, M. (2000). *Measuring sprawl*. Paper 27 ed. Center for advanced spatial analysis. London: University college London.

• Tsai, Y. (2005). Quantifying urban form: compactness versus sprawl. *Urban Studies,* (42): 141-161.

• UN. (2008). *Handbook on the least developed country category: inclusion, graduation and special support measures. Committee for Development Policy (CDP) and United Nations Department of Economic and Social Affairs (DESA*). New York: United Nations publications.

• UNEP. (2002). Environmental impact assessment training resource manual. 2nd Ed,United Nations Environment Programme. Geneva: (UNEP)/ Economics and Trade Branch.

• Wackernagel, M., et al (1999). National natural capital accounting with the ecological footprint concept. *Ecological Economics*, (29): 375-390.

• Woo, M. (2007). *Impacts of urban containment policies on urban growth and structure.* Columbus, Ohio: The Ohio State University.

• World resources institute. (1996). *World Resources 1996-97. World resources institute, united nations environment programme, united nations development programme and the world bank.* Available from: http://www.wri.org/publication/world-resources-1996-97

• WWF.(2002, 2004, 2008, 2010, 2012, 2014). Living Planet Report. World Wide Fund for nature: Gland, Switzerland.

• Zasada, I., et al. (2011). Peri-urbanisation and multifunctional adaptation of agriculture around Copenhagen. Danish *Journal of Geography,* 111 (1): 59- 72.