Codification of Sustainable Development Indicators in New Town of Iran: A Practical Municipal Level Approach

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ABSTRACT: One of the main reasons of unsustainability of city development in Iran is that planners and mayors have not almost been able to create connections between different dimensions of a city. Sustainability indicators are evaluation tools of cities operation applicable in living environmental, economical, and social aspects. The purpose of this paper is to offer a framework including the description of wide specter of indicators, with regard to the operation of environmental sustainability indicators. In order to have a common framework for sustainable indicators of Iranian new town, we create a charter in America and Australia. Therefore, we will study some samples of sustainable cities according to the documents and library related studies and comparative method of study. The result of this paper is as follows: The introduction of sustainability indicators for codification of sustainability indicators of Iranian new town.

Keywords: Sustainability indicators, Urban development, Sustainable development, New towns of Iran, Environmental sustainability

INTRODUCTION

In dynamic systems like, human societies, sustainability is considered as a subject of balance in history (Dahl,1995). Sustainability is an item that can not be easily standardized. In relation to the sustainable development, Wheeler expresses that:" Sustainable development is the one that improves the long-lasting ecological and social health of the cities and towns" (Weeler,1998).

Because of several problems such as: lack of assigning, the exact legal positions of the new town- , defining the sources for providing the expenses, cooperation of different organizations, built_ over facilities and the decision makers and mayors' lack of planning regarding sustainability, new towns of Iran tend towards unsustainability (Noori nejad, 2006). Through comparing these cities with considered purposes, it can be expressed that: "most of the new towns of Iran have not yet achieved their goals and disordering condition that dominates over the neo-cities of Iran is a good evident for this claim (Sheyeh, 2006). Sustainability indicators of cities are important tools for evaluating the operation of cities and also they are

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applicable in the environmental life, economical and social fields. Espangerberg believes that "using the indicators for creating a tool is considered a guide in policies of sustainable development (includes controlling the criteria and relations and their results in general scale)" (Spangenberg et.al, 2002).

Most of developed countries apply a series of indicators to achieve their goals and measuring their own success and for communicating; they adopt the result of adopted plans on their citizens. If we assume that the public institution can- not design the necessary strategy for sustainable development without having knowledge (Ronchi et.al, 2002), we can apply the indicators of environment and sustainable development to improve decision making about the environmental subjects under a condition through unclear variances.(Levy et.al 2000) and also for having a shared frame of city sustainable development indicators, we can create a charter of sustainble indicators in cities. Indicators are considered important factors in total evaluation of sustainable development. General principles of this evaluation were introduced in Bellagio conference in Italy in 1996 (Hardi et al., 1997). The first series of indicators were published in the 90's, before the summit of

Rio de Janeiro.

In fact, working on the indicators had started in late 80's, in Organization for Economic Co-operation and Development (OECD) and was continuing in some countries. One of these countries was Canada that started the plan on indicators in 1989 with a focus on the environmental indicators(Moldan et al., 1997). The United States and Australia were the countries that had a lot of activities regarding sustainability and evaluation of most institutions. Limitation of activity of these organizations was very extended and different projects were adopted in smaller and bigger scales. The most active institutions in The United States and Australia in the field of sustainable development indicators were: Sustainable Arizona Resource and Education Council, Energy and Sustainability Office, City of Berkeley, Boulder City/Boulder Valley Sustainability Indicators Project , City of Seattle, Office of Sustainability & Environment, Brisbane City Council - Clean and Green city, City of Gosnells Sustainable Development Initiative (Hardi et al., 1997)

According to the offered environmental indicators by mentioned organizations, steps can be taken to offer procedures for codification of sustainability indicators of new town of Iran and to improve the environmental and physical conditions. The purpose of this paper is to offer a framework that includes describing a wide range of adopted function in development of sustainable cities in the United States and Australia and offering procedures for codification of environmental indicators of new towns in Iran, with regard to the function of environmental sustainability indicators in developed cities.

Research Methodology
Reviewing Sustainable Indicators

In order to access a total evaluation of sustainability, we have analyzed the sustainable developed cities of The United States and Australia. In this research method, we have careful reviewed source materials and have taken notes. The cities under study are comparable to Iranian cities of similar climatic variety.

Comparison of cities is based on the area-based framework.

The present research is a case-control study in which 14 cities of The United States and Australia have been studied in terms of climatic similarities. It is crucial to mention that these countries are considered as pioneers in discussion of sustainability in the world. According to the theory of Wharton and Morgan sustainability indicators are "some experiments of sustainability and reflector of vital order for economical, social and environmental life health of a society within different generations" (Wharton et al,.1975). Accordingly it can be said that studying the sustainability indicators in sustainably developed cities is an efficient step in making a plan for a sustainably developed society.

Every case out of 14-selected city or region is in harmony with nature . In spite of the apparent differences, these cases are moving towards a common growing direction which is

protecting the environmental life. Although, the way in which each plan deals with So in spite of the kind of the encounter of every plan with climatic, economical, social, physical conditions and existing energy sources in that region and most important of all, the living criteria way of life criteria according to native qualities and conditions dominant ineach region of the world differently,they can be used primary plans in designing residences and residential areas in new towns of Iran. In selecting the cases of the study it has been attempted to consider different climatic condition in order to get various indicators.

Concordance analysis

In order to study the cities, we have analyzed them in the environmental framework and regulated the results in the intentioned framework. It is worth mentioning that every sample with regard to its special conditions and existing problems have the sustainability indicators in that pivot and fewer samples have related indicators regarding sustainability.

Samples under sustainability are as follows:

Mawson Lakes, Teviot Downs, Nathanvale, Beddington, Subi Centro, Christie Walk, New RoseHill, Austin, Boulder, Chattanooga, Metrodade, Chittenden, phoenix, and Portland.

The samples are chosen according to city scale, but some of them are chosen on the basis of regional scale Accordingly, these cities have been studied in environmental fields and based on key concepts in this field. These concepts are introduced as dimensions of environmental sustainability in this paper: land use, City transportation network, Ecology, Energy and Recycling and Green architecture. Its results are regulated in related tables.

With regard to the tables 1 through 5 it can be said that:

Environments Indicators of sustainable cities

Through studying the mentioned samples, cities sustainability indicators can be analyzed from different dimensions and introduced. As it can be seen in the table, the sustainable developed cities according to environmental and native conditions of the region have their own special indicators and it can be said that special dimensions of every city have been studied in city development. However, sustainability has multidimensional concepts and a city is called sustainably developed that is developed sustainably from all its dimensions; but it is not so, and thus, special aspects of every city is sustainabley developed and its indicators have been introduced in that field.

In Mawson Lakes, sustainability was studied from environmental dimension and the energy aspect and recycling materials and green architecture, was taken into attention in that dimension; Therefore, most of the indicators are in the fields of energy and recycling materials (Rob Ball, 2008). In the region of Teviot Downs was under attention in terms of land efficiency, energy,

material and green architecture.

In the region of Nathanvale the environmental indicators are studied according to ecological field; this is because of the special conditions of the region and its special nature. In the region of Beddington environmental sustainability has been studied from all dimensions all of which show sustainability indicators. Subi Centro region has been under attention in terms of land use, transportation, ecology and green architecture and redundancy. Indicators have been used in environmental dimension. Also in terms of being multi-dimentional, it is at a higher level. In Christie Walk, Sustainability in environmental dimension has been studied from energy and recycling and green architecture aspects. The reason for not studying other aspects of the project, is its scale that is more in the level of residential area; so the aspects of transportation and land efficiency are not seen in this project. New RoseHill has been dealt with in terms of recycling and green architecture, in a way that green house gases have been reduced 80 ton a year. It seems that studying the sustainability in terms of these aspects is rather inexpensive and can be attained through easy functions. In Austin, Texas, the environmental sustainability in the fields of transportation and energy and recycling and green architecture had been under attention. In this city energy indicators and recycling have been analyzed more. In Boulder, Colorado, environmental planning has been adopted in relation to the land use, energy and recycling, ecology and green

architecture. Codification of indicators is more seen in relation to reducing the air pollution and recycling. In Chattanooga and Hamilton counties that most of the sustainability plans had been in environmental fields and in relation to the ecology, redundancy indicators are seen. In Chittenden, Vermont the ecology and energy and recycling indicators are seen. In this region fewer environmental sustainability indicators have been used and just protection of the region was under attention. In Metro- dade county, Florida, the main purpose of sustainability plans is in the fields of land use, ecology, green architecture and it seems that in the field of energy adopting, planning of sustainability is necessary. In Phoenix, Arizona, the main purpose of sustainability plans are in the fields of, energy and recycling and green architecture and in relation to energy and recycling materials, there are more indicators. In Portland, Oregon, the main purposes of sustainability plans are in the fields of land use, energy and recycling and green architecture. There are more indicators in relation to green architecture and in the fields of energy there are no sustainability indicators. If cities are analyzed according to sustainability aspects of our environment, sustainability indicators in relation to land use, transportation, ecology, energy, and recycling and green architecture, according to tables 1, 2, 3, 4, 5 as they please consider below:

Table 1: Land use sustainability indicators Source: Authors

Row	City	Sustainability indicators of land efficiency
1	Mawson Lakes	
2	Teviot Downs	• Offering documents based on the way of structure in stages of selling the land. • Suitable road-makings for the region in direction of protection of the region.
3	Nathanvale	
4	Beddington	• Mass expansion model for reducing the pedestrian courses, roads and built over. • Place finding of the road in a way that cars move without interfering the pedestrians. • Using the natural form of the site
5	Subi Centro	• Expanding the central square of the sub co that have been the main principles of expansion. has reduced the commuting of cars. • Using designing system through considering the water and creating open spaces. • In city planning of Sub co the residual, trading regions and open spaces with and in relation with together are supposed to offer us a society with mixed used efficiency. • Designing the local through the plant covering. • Designing the special efficiencies.
6	Christie Walk	
7	New RoseHill	
8	Austin	
9	Boulder	• Some politics related to supporting the transportation.
10	Chattanooga	
11	Chittenden	
12	Metro-dade	• Controlling the growth and city transportation.
13	phoenix	
14	Portland	• Expansion of the growing boundary through keeping the present growing line and increasing the crowd of population in these boundaries.

Table 2: Transportation Sustainability indicators Source: Authors

Row	City	Sustainability indicators of transportation
1	Mawson Lakes	
2	Teviot Downs	
3	Nathanvale	
4	Beddington	• Good public transportation network in the region. • Designing and basing the politic of public transportation for reducing personal transportation. •Considering the trading and official spaces in city expansion parts for reducing the distance of transportation. • Considering the coffee shops and other welfare facilities in expansion regions for reducing the transportation. • Setting an expansion with average mass for reducing the built overs and road-makings. • Place-finding of the roads around the site convenient moving for cars and creating a friendly central core.
5	Subi Centro	• Using the bicycle and pedestrian transportation network noticeably is another kind of commuting. • Caring the parking space of the cars in street. • Encouraging the pedestrians and bicycle riders through creating a convenient bicycle and pedestrian network. •Designing the streets in a way that encourages for low speed, safety and available for all the people. •Improving situation of the roads their width through created spaces for parking. • Rail road line metro station in a way that an underground station rail road tunnel are placed in the center of this project .metro relates the northern and southern areas through expanded areas.
6	Christie Walk	
7	New RoseHill	• T-direction for close connection of all houses with city center.
8	Austin	• Using the electrical transport means. • Reducing the use of gas-burner transportation means.
9	Boulder	
10	Chattanooga	
11	Chittenden	• Protection of natural situation of the region and environment through a total process. • Protection of the life sources of the region.
12	Metro-dade	
13	phoenix	
14	Portland	

Table 3: Ecological Sustainability Indicators   Source: Authors

Row	City	Ecological Sustainability Indicators
1	Mawson Lakes	
2	Teviot Downs	• Recognition of the animal fossils and protection of native plants of the region for creating half-rural and cultivating spaces. • Assigning the dimensions of moving corridors for moving the animals.
3	Nathanvale	• Recognition of necessary managements of the region, like: management of the thicket burning. • Recognition of the efficiencies before the history of farming region and patterns of land erosion. • Creation of moving corridors in the region for moving the animals. • Reviving the plant covering in water following direction through creating piped channels.
4	Beddington	• Increasing the life variety of the region through creating green roof, public, farming and cultivation spaces.
5	Subi Centro	• Reviving and restructuring 80 hectors of industrial lands. • Picking up the products through rain water for categorizing plants. • Urban Green Space
6	Christie Walk	
7	New RoseHill	
8	Austin	
9	Boulder	• Supporting the natural areas and wild life residuals around city.
10	Chattanooga	• Using lands(studies three dimensional computerized modeling of the ponds, little pools, existing lands and entertaining use of them ,existence of extentioning species, dangers, cultural cases and historical sources in these water areas. • System of green direction (connecting the parks, directions, highness and lowness of a rounding lands.
11	Chittenden	• Protection of natural conditions and regional environments through the general processes. • Protection of life sources of the region.
12	Metro-dade	• Wild life management.
13	phoenix	• Saving the deserts.

Table 4: Energy and Recycling Sustainability Indicators Source: Authors

Row	City	Energy and Recycling Sustainability Indicators
1	Mawson Lakes	• Management of water losing through DLL commission. • Management of water flood (DLL commission). • Educational plans related to saving water. • Recycling the sewage for uses except drinking (irrigating the park, washing the cars, toilet tanks). of aware green spaces. • Solar water heating in all houses for providing hot consuming water. • Automatic lights of the yard.
2	Teviot Downs	• Management of water and prevention of losing water. • Management of sewage for not absorbing the mineral materials of soil through sewage (that hurts the plant covering).
3	Nathanvale	
4	Beddington	• Use of material with less potential energy that destroys the nature. • Providing a recycling store for all the residual spaces. • Attention to construction waste sewage. • Using the tanks with small capacity in the toilet and facilities with efficiencies of reducing water consumption and fixers in buildings. • Using the water consumption measuring set. • Using porous tiles in the parking floor for taking in water. • Storing the water of rain and using it in toilet tanks. • Using the green roof for taking in water of rain and reducing the flood. • Insulating the building for preventing the heat transmitting. • Using materials with high heat capacity, in a way that gains the solar heat and transmits it inside the space. • Using glasses with high efficiency. • Using high-quality materials and suitable fixers. • Using cast iron windows to prevent the transmission of cold weather. • Using the energy renewing technology for ventilating the region .include: • Mass life system CHP (combination of energy and heat) • Solar cells for providing fuel energy (fossil) • Using material with high energy capacity for regulating the inner heat of the building when the heat increases.
5	Subi Centro	
6	Christie Walk	• Using the photovoltaic sheets in the building. • Providing water of buildings through solar energy. • Using water recycling system and low-quality water in toilet tank and irrigating the yard. • Using underground tank for storing the low-quality water
7	New RoseHill	• Insulating the ceiling holes through insulation batt. • Using glasses with aluminum frames and low E plan for reducing the heat transmission. • Water recycling system. • Using the new energy production technology in residual regions.
8	Austin	• Establishing the powerhouse of Metan gas. • Plan of taking the expense for more rubbishes. • Cleaning the sea water and seaside. • Technical helps to local companies for reducing and protection of commercial water. • Plan of reducing the consumption of irrigating water. • Inspecting the water consumption degree of houses and informing for reducing the consumption.
9	Boulder	• Providing necessary things for recycling paper.
10	Chattanooga	• Using lands(studies three dimensional computerized modeling of the ponds ,little pools, existing lands and entertaining use of them ,existence of extentioning species ,dangers, cultural cases and historical sources in these water areas. • Green direction system (relates parks, directions, lowness and highness of rounding lands).
11	Chittenden	• Offering new projects related to energy.
12	Metro-dade	
13	phoenix	• Storing the thermal energy. • Efficient plans in energy output. • Installing photovoltaic cells. • Plan of promoting the cold making system. • Encouraging plans in transportation and using bicycle. • Saving water through planning of water division in irrigating.
14	Portland	• Stopping the use of containers having polyester foam • Reducing the 50 percent of urban solid loses till 2000.

Table 5: Green architecture, sustainability indicators Source: Authors

Row	City	Sustainability indicators of green architectural
1	Mawson Lakes	• Directing the buildings toward the light of north. • Spreading the glass in appearance of the building. • Using the trees that offer shad in summer and prevents light passing in winter.
2	Teviot Downs	• Keeping the environmental life condition.
3	Nathanvale	
4	Beddington	• Using the natural form of the site. • Choosing the material that their sources are not further than 60 kilometers. • Using natural, recyclable and reviving materials. • Using materials that are less allergic. • Weather harmony. • Directing the buildings in a way that gets sunlight in the winter and keeps it out in summer. • Natural efficient ventilation.
5	Subi Centro	
6	Christie Walk	• Designing through natural factors.
7	New RoseHill	• Designing the building in a way that directions of the windows are convenient for using the natural ventilation. • Edged roofs for creating shade. • Using the materials of the region, like: lumbers of the region's jungles. • Using the ceiling fans for natural ventilation. • Using green concrete (60% recyclable) for concreting the directions of bicycles and pedestrians. • Used materials in construction should be recyclable.
8	Austin	• Constructing green space.
9	Boulder	• Management of loses and prevention of pollution. • Controlling the water quality through educational plans of pollution test.
10	Chattanooga	
11	Chittenden	
12	Metro-dade	• Reducing the dioxide carbon.
13	phoenix	• Reducing loses and recycling the trashes. • Reducing loses and green road plans. • Prevention of pollution through burning the trashes.
14	Portland	• prevention of air pollution through planning in transportation field. • Attempts for reducing the pollution through helping the local societies for changing into fuel. • Increasing knowledge of the people about urban polluters and storm waters.

RESULT AND DISCUSSION

In this paper, it has been attempted to describe and evaluate the sustainability indicators of The United States, Australia in order to adapt them with new towns of Iran. The pattern of the sustainably developed city can be manifested in forms of history, culture; economic of the region .Codification of sustainability indicators is considered one of the main strategy of sustainable development. According to the figure 1, we conclude that less than 50% of the residential areas have studied the land use .It seems that sustainability indicators of land use have been less under attention against their importance. Also this figure shows that Beddington with the most privilege is the most sustainably developed city according to the sustainability indicators of land use. Subi Centro is in the second place and Teviot Downs is in the third position and Portland, Metro-dade, Boulder cities are of the same rank.
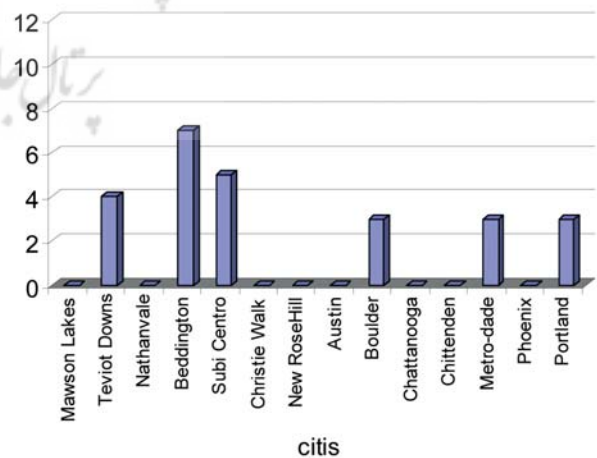

Fig.1: Indicators of sustainable land use in the American and Australian cities   Source: Authors

According to the figure2, we conclude that just about 35 percent of cities studied the sustainable development transportation that is a low percentage .This figure, shows that Bedding ton city is in the first position in terms of transportation and Subi Centro, New RoseHill and Austin are respectively in second, third and fourth position.
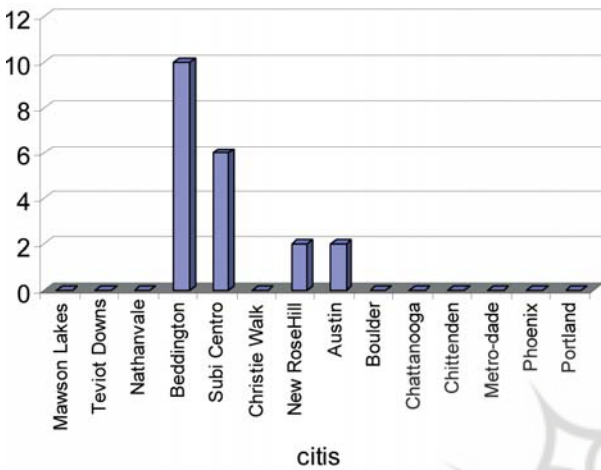
According to the figure4 we conclude that just 20% of the cities do not have the energy and recycling indicators. In this study, Beddington with the most privilege is in the first position and respectively Mawsonlakes with 28 privileges is in the second position and phoenix with privilege of 26 is in the third position and Austin with 24 privilege is in the fourth position, then respectively Christwalk, Chattanooga, New RoseHill, Teviot Downs, Portland, Boulder, Chittenden are in the next positions.

Fig. 2: Indicators of sustainable transport in the America and Australian cities   Source: Authors
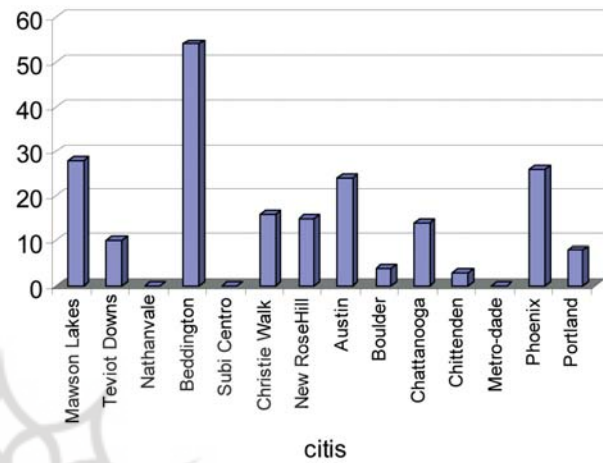

Fig. 4: Indicators of energy sustainability and recycling in the America and Australian cities   Source: Authors

The figure3 shows that according to the ecological sustainability indicators, Chattanooga with grade of 18 is in the first position and Chittenden and Nathanvale with grade of 14 are in the second position and Subi Centro with grade of 13 is in the thired and Teviot Downs is in the forth position and phoenix, Boulder and finally Metro-dade and Beddington are in the next positions. It seems that most of the cities have been studied in terms of the ecological sustainability Indicators are more applicable through them.
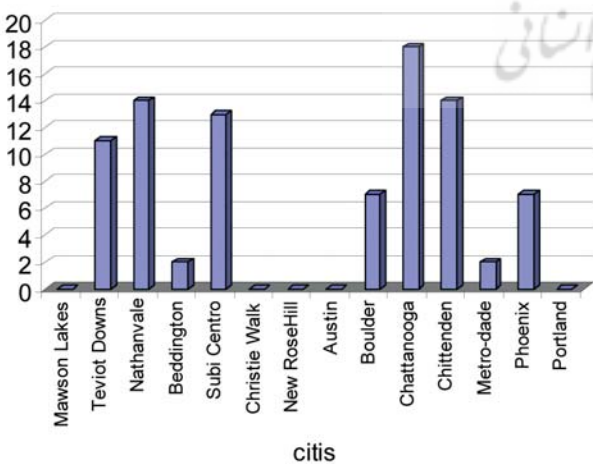
Trough studying the figure5 it can be said that Beddington with 25 privilege is in the first position .New RoseHill with 22 privilege is in the second position ,Portland with 18 privilege is in the third position and then Mawsonlake, Metro-dade, phoenix and Subi Centro are respectively in the next positions. Trough this explanation, it can be concluded that just less percentage of cities that have no green architecture sustainability indicators have not been studied.

Fig. 3: Indicators of ecological sustainability in the America and Australian cities Source: Authors
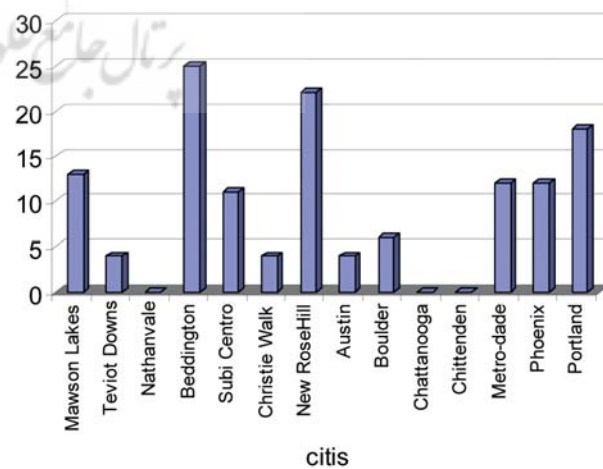

Fig. 5: Indicators of green architecture sustainable in the America and Australian cities   Source: Authors

CONCLUSION

An analysis of the environmental sustainability indicators is an effective way in offering methods to make a framework environmental indicators of Iranian new-towns. It might be concluded that environmental sustainability in sustainably developed cities totally depend upon their local and environmental conditions. Depending upon its environmental condition each city has different sustainability indicators. In order to find a complete framework for environmental sustainability indicators of Iranian new-towns, a study of samples from different environmental dimensions is necessary. Based on the present study it can also be concluded that energy and recycling and green architecture are the most principle fields in making the environmental sustainability indicators the most important issues among the cities under study. The energy and recycling and green architecture with a frequency of 78.6% are the two studied principle issues related to the sustainability among cities. The third factor is the ecology with a frequency of 64.5%. The fourth effective factor in urban sustainability is the land use which has a frequency of 43% among the cities under study. Finally. Transportation, with a frequency of 30% is the last effective factor in urban sustainability. Thus, through codification of sustainability indicators in fields such as: 1. Energy and recycling 2. Green architecture 3. Localoly and finally, transportation an effective step can be taken towards environmental sustainability in Iranian new-towns.

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