

In the name of God

Urban Land Use Analysis with a Sustainable-Development Approach Using GIS and RS: Case Study Saadiyeh town in Shiraz

Dr.Nafiseh Marsousi-professor assistant, Ali Peyravi

Payame Noor University, Iran

Abstract: Nowadays, the cities of developing countries are facing numerous problems. Rise in the population growth rate, migration into cities and urbanization rate have caused a tremendous increase in population density in cities. Of the natural outcome of such a process is the shortage of appropriate land to inhabit the population and the imposing pressure on environmental limited resources. In this direction, the unprincipled and irregular use of land and change of land use with due attention to the environmental capacities have created an imbalance in environment. It has also made urban sustainable development face challenges such that today, one of the most important preoccupations of urban managers and planners is the sustainability of urban environment.

Analyzing the maps of urban land use of Saadiyeh town in Shiraz city by GIS and RS (Satellite Images), this article intends to evaluate the existing land use. Moreover, given the environmental indexes, it aims at proposing an efficient model of land use. Using the results, it plans to show the rate of lack of proportion of existing land use as compared with the primary principles of land use planning and the lack of environmental ability and urban infrastructures in meeting the population demands. So, it is necessary to study the rate of impact of such a process on social interactions and environment.

Keywords: Urban Development Plan, Urban Land Use, Urban Environment, GIS, RS, Saadiyeh town, Shiraz

Introduction:

A just access to land and using it efficiently is one of the basic components of sustainable development and social justice. Today, the concept of land and urban space has undergone qualitative changes from the natural and structural point of view and socio-economically. Thus, the dimensions and objectives of urban land use have become so vast and rather richer. It is clear that using land and space as a vital resource and a public wealth should be done under a standard planning. Decision making on the method of land use is not easily revisable due to its long standing and costly impacts. With the advancement of science and emergence of new methods, new instruments and technologies are at service of urban planners. Using these instruments and technologies, promoting awareness of the nature of implementation and increasing data in different domains; (which in turn affecting urban planning components), they can increase the potential of maneuver in planning and make an

easier and faster analysis of the influencing elements . Consequently, the risk of decision-making will be reduced. The satellite images are important and valuable instruments and sources of data on locating and help the urban planners remarkably. With regard to the alternating status, these images have a potential to display the changes of land surface with no high cost, in a shortest period and in every place. In developing countries including Iran with a high rate of urbanization, deep changes in short time and lack of easy access to data and shortage of statistical data have put urban planners into troubles. The satellite images have a potential to cover this weakness and compensate data needed by urban planners and decision makers. Of other new and efficient instruments in analyzing, the data on locations is the Geographical Information System (GIS). It provides the most complete system consist of storing, processing, analyzing and finally producing appropriate outputs.

Introducing the satellite images in planning of urban land use, this research intends to respond to the following questions:

How is the situation of land uses in relation with a sustainable development approach?

Has land use of Saadiyeh town been preformed based on a plan and by observing planning principles?

Has per capita of land use been distributed in proportion with population?

Definition of Sustainability

Sustainability is a concept for which each person has a different interpretation, but in general, sustainability is a process whose foundations are changed in accordance with change of conditions, ideas and capabilities of technology.¹

Another definition of sustainability is an adjective, which describes something, which makes peace, feed and supply livelihood and consequently is led to continuation of life and its prolongation.²

In general, three factors play roles in the sustainability of human communities, which include:

1. New technology,
2. Economy.
3. Population.

With the control of population and correction of economic views and efficient use of new technologies, the human and environment sustainability can be created and continued.

Definition of a Sustainable City

In defining the sustainable city, Saterth Waite, in his awareness-making discussion on a sustainable city, he speaks on the necessity of searching in cities and rural areas where the demands of the inhabitants on development are met without imposing non-sustainable demands on natural, local and global resources and systems.³

A sustainable city is an ideal city, which could provide a resort for human such that it can meet all inhabitants' needs. In the course of history, thinkers and authorities have dealt with the issue of sustainable city in accordance with the age in one way or another and each has considered a criteria.

But in the past, due to changes and limited interference of human in environment – the sustainability of the human community has not been exposed to a constant danger⁴. Whereas, with the reinforcement of interference of human in environment, the sustainability of environment has reduced daily. It is such that environment shows various reactions to maintain its balance (which is sometimes horrible and fast) and make the sustainability of the human communities face serious dangers. Katrina, Illinois storms and Tsunamis are some examples of these dangers. It can be said that since cities encompass a great part of the human communities' population, so that they are very sensitive and fragile vis-à-vis environmental reactions. For this very reason and in order to maintain the health and safety of their present and future inhabitants, they should think about their sustainability at present and in the future seriously.

Historical Background

The concept of sustainable development was created at the early 1980's, whereas tens of years of uncontrolled growth under the name of development had diminished the quality of environment at the global scale. When the report of Brundtland Commission entitled, "Our Common Future" was released in 1987, it revealed the discussions related to sustainability and deep differences in ideas related to development, economic growth, social changes and preservation of environment.⁵

In general, the 1970's can be considered as the decade of awareness of human societies of environmental crises, which created different reactions in the world. One of these reactions was sustainable development.

In line with this, the concepts of development underwent serious challenges and new concepts were put forth to prevent from environmental dangers, being expressed within the format of concepts of sustainable development, including the followings:

Sustainable development is a development which could supply the demands of the present generation without endangering the power of the future generations to meet its needs.⁶

In 1991, UN termed that kind of policy a sustainable policy which as a result of its practice, positive interests resulting from the consumption of natural resources could continue for a predictable time in the future.

Realms of Sustainable Development

It can be said that sustainable development has deep concepts in three environmental, economic and social realms. Thus, land use planning is one of the most important and influential pivots of sustainable development, because it has a close link and connection in three environmental, economic and social realms of sustainable development. It is such that with a change in attitudes and pivots of development plans, it receives many changes in contents.

Using various sciences and new technologies including remote sensing and geographical information system can have an important role in planning for urban land use to reach a sustainable development.

Process of Planning for Urban Land Use

The process of planning for the urban land use like other grounds of planning begins with understanding a planning phenomenon (statement of the problem). After developing objectives and determining priorities, it leads to the production of strategies, assessment and implementation.⁷

Studies and Measures Adopted in Planning for Urban Land Use

In order to have a successful planning for the urban land use, precise understanding of the existing situation should be based on realistic future perspective to guarantee achieving the objectives and moving in the path of sustainable development.

Developing a map is one of the most important measures in planning for the land use, which has a great role both in identifying the existing situation of land use and in selecting appropriate mechanism for development and finding appropriate location for land uses.

The maps of land uses include various maps. One of these maps is the map of natural damages (topography) which investigates the shape of the earth from the viewpoint of slope and not-leveled surfaces fully. These types of maps are prepared in two forms of handy and remote sensing. In the manual form, using field knowledge, maps are prepared. With the advancement of remote sensing technology, and the increasing expansion of cities and skeleton development of cities resulting from the rise on urban population, humans make enormous and deep environmental changes, so that developing a map with the help of hand has become inefficient. The science of remote sensing and using the geographical information system in developing map of land use and analyzing it has found an extraordinary importance in particular in relation with the sustainable development.

The Role of Remote Sensing in Planning for Urban Land Use

Presenting an extensive spectrum of comprehensive data in a low price on urban land use, and that of the quality of future expansion of the urban spaces, using satellite images, remote sensing provides the planners with a potential to lay down a balanced

and sustainable development for the region under investigation as an strategic attitude to maintain urban environment. The mentioned duty is performed by having a complete scientific awareness of the region, developing precise land use maps and allocating appropriate locations.

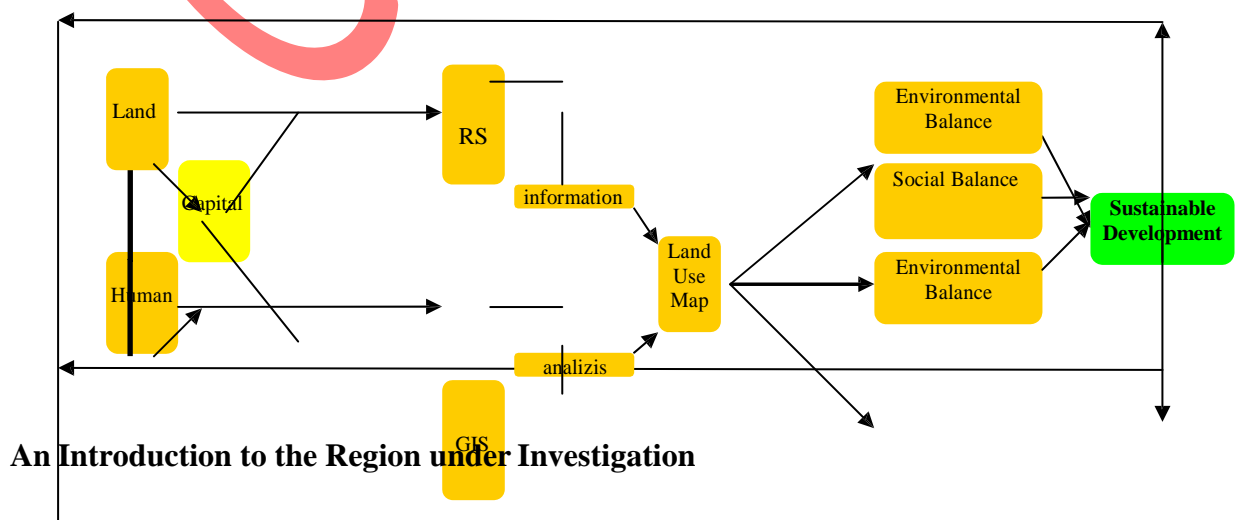
It can be said that with the increase of preciseness and power, the location detachment of images of remote sensing has increased so much, such that today using it is inevitable.

Today, satellite images are used to classify the land use and outcomes, to reveal the changes of urban land use, to prepare 3 dimensional models of urban land use, to prepare slope, to produce urban land use maps and to update the map of urban land use.

It is worth mentioning that in preparing topographical maps, the radar images are of high capability. Because, by using this technique, it is possible to extract the height curves in a high preciseness. In addition, it is possible to prepare profile of the region under investigation to display the slope. Of other capabilities of satellite images in urban development plan is the possibility of three-dimensional display of the region under investigation. It places the planners easily before the incidents, shape and form of unevenness and make possible to forecast the future natural risks.

The Role of Geographical Information System in Planning for Urban Land Use

The Geographical Information System is another new system, which has high applications in planning and management of urban land use. Having different capabilities to analyze and a quick and precise processing, this system can specify the location of appropriate land use. In this research, GIS was used to study the adaptability or inadaptability of existing uses.



Saddiyeh town in Shiraz [Saddiyeh Satellite Town] is located in the south of Iran and in the north east of Shiraz city in the geographical longitude of 52 degrees, 35 minutes , 19 seconds of eastern , 29 degree , 37 minutes and 24 seconds of the geographical northern width, in the 1565 meters height from the sea level and in a height more than 10 meters from Shiraz city. This Shahrak has a connected model which has been created at the neighborhood of Shiraz. Shahrak-e Saddiyeh has a high population density over 318 people per hectare due to its location at the limits of Shiraz city. It has developed very quickly. The area of Shahrak-e Saddiyeh in 2003 was over 224 hectares, the number of its population was 66486 and its density was 296 people per hectares. The population of Shahrak has amounted to 73786 people in 2008 , its areas to 232 hectares and density to 318 people per hectares (of which over 145 hectares were those with residential use encompassing 62.5 percent of the Shahrak area). The population of Saddiyeh Shahrak in the time horizon of 2012 will be 83582 and in the time horizon of 2016 will be over 92731 peoples. Thus, in the horizon of the year 2012 , 7799 people and in the time horizon of 2016, 18942 people will be added to the population of this Shahrak.

Table No. 1

| Census year | Area of the region /hectare | Population | Additional population |
|-------------|-----------------------------|------------|-----------------------|
| 2003 | 224 | 66486 | |
| 2008 | 232 | 73786 | |
| 2013 | | 83582 | 7792 |
| 2016 | | 92731 | 18942 |

Source: Iranian Statistical Center

Images and Sources Used

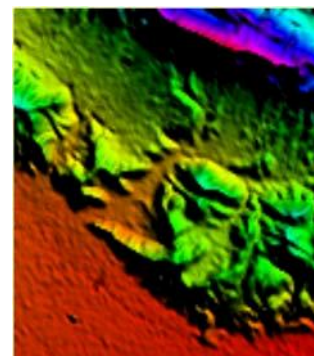
In this research, the satellite images of two types were used. Two images related to the years 2003 and 2008, taken from Orts Google Internet Site and the third image was taken from radar images.



Satellite image (2003)



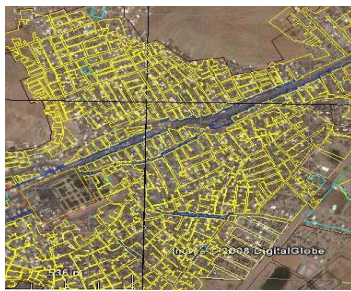
Satellite image (2008)



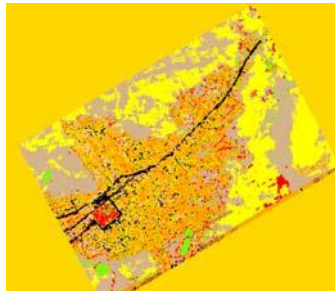
dem image

Method of Implementation

First, the images taken from the data received from GPS were geo-referenced. Then the image system was defined. The radar image was used to extract the height curve. Using the monitored classification method to extract the existing use was useful and the land use map was prepared by interpreting the satellite images and classification.



Adaptation of land use map with satellite image



Classified Map



Map of land use of the lands inahrak Saddiyeh in Shiraz -

With the help of the map of land uses prepared by satellite images of the year 2003, the area of the land use of the region under investigation was extracted. Then it was evaluated quantitatively. The per capita obtained indicates the lack of proportion between the land use and the population of the region under investigation. (Table No. 1). At the following stage, the map of land slope was created by using the radar images and using the HSV method. (Image 2). Through integration of the map of land use with the map of slope, the situation of land uses from the viewpoint of sustainable and authorized slope for land uses was analyzed. (Image 3) and interesting results were obtained. It was such that (1) of the total residential land uses, 30% were on unauthorized slope, that means that more than 15% were located. Also 70% of the residential land uses were on authorized slope. (Image 4) .

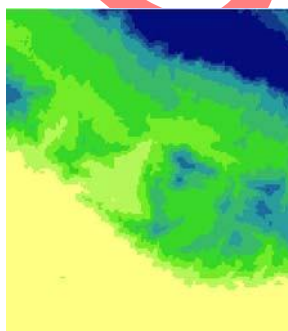


Image No. 4

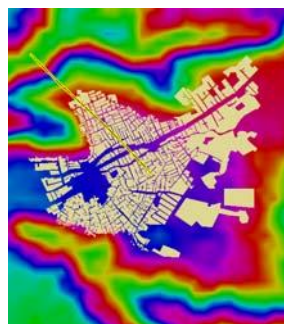


Image No. 3

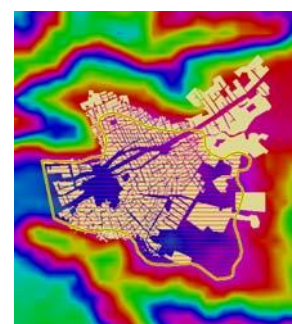
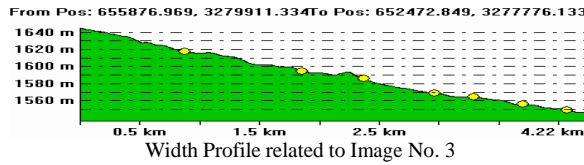
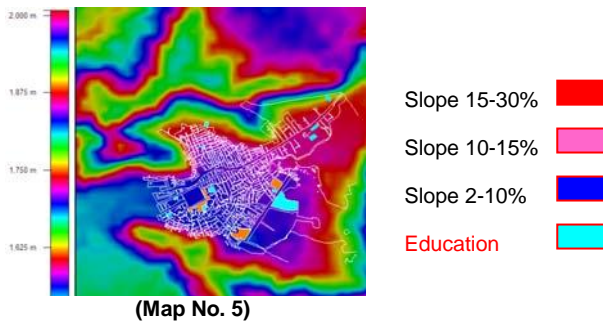


Image No, 2



2) Of the total educational land use, also 50% are located on slope more than 15% and 10% of the total educational application are also on slope more than 30%. (Map No. 5)



It is worth mentioning that by putting together the radar image and the image of the year 2003; first the three dimensional model of the region was studied. (Model No. 6). This model gives a comprehensive and complete view to the urban planners to be able to plan with a full awareness of the region under investigation.



(Model No. 6)

Also by revealing the changes, the process of development, direction of the development and type of added uses in the time distance of taking two images was specified. With regard to the high rate of gross density of population (318 people per hectare) and high rate of per capita of residential land use and too much low rate of educational, sport and green spaces per capita and also lack of some uses, it was expected that the share of residential per capita to be reduced and vice versa, the per capita of other uses to be increased. (In Table No. 2, the situations of four types of uses are presented).

| Table No. 2 | |
|-------------|------|
| 2003 | 2008 |
| | |

| Per capita | Area in hectares | National standard | Prevailing per capita | Shortage of existing situation | Per capita | Area in hectares | Use |
|------------|------------------|-------------------|-----------------------|--------------------------------|------------|------------------|--------------|
| 20.9 | 137 | 50 | 50 | 0.26% | 19 | 145 | Residential |
| 0.68 | 4.10 | 1.5 | 2-2.5 | 0.95 | -.55 | 4.10 | Sport |
| 0.22 | 1.33 | 2-2.5 | 7-12 | -1.82 2.32 | 0.18 | 1.33 | Green Spaces |
| 1.6 | 3.650 | | 3-5 | | 1.2 | 3.650 | Educational |

Though 8 hectares have been added to the area of Shahrak in the time distance 2003-2004, the results indicate the increase of population density and increase of the absolute share of residential land use as compared with the year 2003. It means that if attention was given to the planning of lands and sustainable development, the increase of residential use could be prevented from. Also in locating the land use, unauthorized slopes should have been avoided, but in practice, the changes show a rise in a population density and the expansion of residential land use still in unauthorized slopes. This kind of development is not only in conflict with a move towards sustainable development and environment preservation, but also by increasing pressure on environment, it causes environmental and social imbalances.

At the same time, the share of service-educational, sport per capita and green spaces is reducing with the increase of population. The situation occurred in Shahrake Saddiyeh reveals the reality that the development has been unplanned and in practice, there is no balance between existing land use and population.

ConclusionS:

Due to the high growth of population and shortage of per capita and also lands, and with regard to this point that most of the residential land uses are for one-floor units and the floor area of these land uses are low, so it is necessary to utilize land-use intensity, construct tall buildings and contribute in accumulative participatory projects to stabilize the residential share and make use of the existing intact spaces for other per capita uses in a planned way. Using the lands with a slope more than 15% for green space use (planting trees) to prevent from the possible landslide and using these lands for mountain climbing activities and increase of the green space per capita all seem to be appropriate mechanisms.

Endnotes

¹ American Association of Urban Planning, Developing Plans and Types of Plans , Translated by Iranian Association of Consulting Engineers, 2007, Maali Publication, 1st Edition, p. 371

² Mahmoodi , Mahnaz, Foundations of Sustainable Designing in Line with Urban Developmnt

³ Robert Paler, Celluloid, City in the Developing World, Translated by Irandoost , Kiumars, Dehghan Mashadi , Mehdi Ahadi, Celluloid 2005, Organization of Municipalities and Rural Districts .1st Edition, p.286

⁴ Robert Paler, Celluloid, City in the Developing World, Translated by Irandoost , Kiumars, Dehghan Mashadi , Mehdi Ahadi, Mitra, 2005, Organization of Municipalities and Rural Districts .1st Edition, p.287

⁵ Robert Paler, Celluloid, City in the Developing World, Translated by Irandoost , Kiumars, Dehghan Mashadi , Mehdi Ahadi, Mitra, 2005, Organization of Municipalities and Rural Districts .1st Edition, p.288

⁶ Baghayee, Hasanali , Mohammad Zadeh, Hamid, An Introduction on the Concept of Sustainable Urban Development and the Role of Urban Planning

⁷ Pourmohammad , Mohammad Reza , Planning for Urban Land Use, SAMT Publication, 2007 , p. 6

References

Remote Sensing for Urban Growth in Northern Part of Iran

Sedighe Lotfi, National University of Signapour, 2001

Inventorying Urban Areas With Very High Resolution Satellite Images – Tim Van Covoorde-Marc Binard- Conference on Geographical Information Science-Palma-2002

Monitoring Urban Sprawl Around Barcelona Metropolitan Area with The Aid of Satellite Imagery- J Roca-m-Bums-J. M. Carreras-Universidad Polytechnic de Catalonia-Barcelona- Spain , 2003

Satellite Remote Sensing and GIS Analysis For Urban Applications –Josef Littman-World Bank , October, 1992

GEO TURNIS