ANALYSIS OF LAND USE CHANGE USING THE SATELLITE IMAGES AND GIS

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Abstract

The movement of residential and commercial land use to rural areas at the periphery of metropolitan areas has long been considered as sing of regional economic vitality. But it is benefits are increasingly balanced against ecosystem impacts, including degradation of air and water quality loss of form land and forests, and socioeconomic effects of economic disparities, social fragmentation and infrastructure costs. In this paper, we used Multitemporal Land sat Thematic Maper (TM) and Spot data for analyzing land use changes in Bonab County for 1989 and 2005. The compared of data maps showed that between 1989 and 2005 the urban land and build areas increased. So, if this process is continued at this trends, we will faced with an environmental crisis in this area and will be destroyed its beautiful natural landscape. The result quantify the land use change patterns in this area and demonstrate the potential of satellite images to provided an accurate, economical means to map and analyze changes in land use cover time that can be used as inputs to land management and policy decisions.

Keywords: Land Use; Urban Growth; Remote Sensing; Bonab County.

1. INTRODUCTION

All over the world, we see cities expanding by converting land use at the fringes from rural to urban a process that is usually referred to as green field development (Yuan et al.2004). Wherever this process is very ancient but an important problem has emerged as 'sprawl' development of urban areas.

For landscape and environmental planning, the 'sprawl' of low-density settlements and urban development along transport corridors is causing particular concern in highly-industrialized countries. It is feared that these processes lead to settlement patterns which are environmentally inefficient and have negative impacts on the surrounding countryside (e.g. Antrop, 2000; Swenson and Franklin, 2000; Pauleit, 2003).

The term urban sprawl is so cloudy and confused that more precise language is needed to characterize what is bad urban growth. The term is used variously to mean the gluttonous use of land, uninterrupted monotonous development, leapfrog discontinuous development and inefficient use of land (Peiser, 2001).

Urban sprawls in overview of the Florida region management center are characterized by:

1- premature or poorly planned conversion of rural land to other uses;
2- the creation of areas of urban development or uses which are not functionally related to adjacent land uses; or
3- the creation of areas urban development or uses which fail to maximize the use of existing public facilities and the use of areas within which public services are provided (Peiser, 2001).

If this process perfectly does not recognized and analyzed, it can be caused the creation of economic, social and environmental destruction. So that, Satellite imagery is increasingly used elsewhere to assess urbanization by measuring land use and land cover change for whole cities and city regions (U.S. Geological Survey, 1999; Alberti et al., 2002; Jürgens, 2003; Pauleit, 2003). Satellite images provide greater amounts of information on the

ISBN: 978-605-64453-1-6

geographic distribution of land use and changes, along with advantages of cost and time savings for regional size areas. Importantly, remotely sensed imagery provides an efficient means of obtaining information on temporal trends and spatial distribution of urban areas needed for understanding, modeling, and projecting land change (Elvidge et al., 2004; Yuan et al.2004).
In this paper, changes of land use are analyzed in Bonab County using Satellite images in duration 1989-2005. Also in this paper, we proposed recommendation for reducing of settlement sprawls development and environmental problems in this area.

2. SURVEY OF CASE STUDY

Bonab County is located in the southeast of Ormieh Lake and it has 110 kilometers distance from Tabriz. Bonab county area is 80250 hectare approximately. This county contains four geographic districts:
1- mountain district 2- plain district 3- salt-marsh district 4- part of Ormieh Lake.
The Plain district area that is very important for settlement and agriculture aspects is 18537 hectare. This district contains 23.09 percent of county area. But 90 percent of population Bonab County lives in plain district. Population of Bonab County was 125209 in 2006 census. The number of Bonab city population and total rural settlements was 75332 and 49877 respectively.
This county has 29 village that the biggest and smallest village are Garachopog (5915 people) and Khane Baraghe Isakhani (34 people) respectively. So, Bonab city has to dominate over in economical and population aspect in county (table 1). Growth rate in this county was 1.51 from 1989 to 2005 and the number of population increased from 96986 To 125209 people.

3. METHODS AND ANALYSES

1.3. Population Growth and Its Distribution

In the base of latest census in 2006, total population of Bonab County was 125209 people. 75332 people lived in Bonab city and 49877 people lived in 29 rural settlements. Thus, urbanization rate in this county was 60.2 percent. The most populated village is Garachopog with 5915 people and the least populated village is Khane Baraghe Isakhani with 34 people. So, in this county is a perfectly dominate of primate city.
18 village and Bonab city are located in plain district with 112793 people that contained 90 percent of county people. 7 villages, with 4176 people and 3.3 percent of population have located in mountain district and 4 villages with 8240 people and 6.6 percent of population have located in salt-marsh district.While, those districts contain 23.09, 34 and 42.91 percent of county area, respectively.
Population Growth rate of total settlements in this county was 1.94 percent in during 1985-2005. While in this duration, the Growth ratio of Bonab city was 2.96 percent and rural settlements were 0.68 percent. So in duration of two decades number of population in rural area is reduced and number of population in Bonab city is very increased.

3-2- Land Use Analysis

We used 1989(tm) and 2005 (Spot) satellite image for survey of land use changes. Land uses area is calculated in Arcgis 9.1 software. For classification of land uses, we are used supervised classification method. After this process, results of classification are corrected using land data and Arial photos. The land cover of Bonab County divided to 6 classes that those contain: build area, gardens, agricultural area, grassland and mountainous land, salt-marsh area and water (lake and rivers).

Table 1. Population changes in Bonab County.

Row	Settlements	Population in 1986	Population in 1989	Population in 1996	Population in 2006	Growth Rate from 1986 to 1996	Growth Rate from 1996 to 2006	Growth Rate from 1989 to 2006
1	Chalfayi	3843	4051	4582	4573	1.77	-0.02	0.72
2	Dizaje parvaneh	924	977	1113	1028	1.88	-0.79	0.3
3	Khoshe	3484	3866	4930	3633	3.53	-3.01	-0.37

ISBN: 978-605-64453-1-6

	Mehr							
4	Tezekande khoshe Mehr	1663	1708	1818	1814	0.9	-0.02	0.35
5	Yengikande Khoshe Mehr	867	921	1060	1131	2.03	0.65	1.22
6	Shorgol	625	607	566	516	-0.99	-0.92	-0.95
7	Gimas Khan	360	222	72	47	-14.87	-4.18	-8.73
8	Gara Zaki	181	152	101	100	-5.67	-0.1	-2.43
9	Sour	403	387	353	350	-1.32	-0.09	-0.59
10	Tota Khaneh	917	830	659	529	-3.25	-2.17	-2.62
11	Algo	1870	1895	1954	1710	0.44	-1.32	-0.6
12	Doush	773	796	853	924	0.99	0.8	0.88
13	Roshte Bozorg	3102	3079	3026	2616	-0.25	-1.45	-0.95
14	Roshte Kochak	1002	1044	1150	1492	1.39	2.64	2.12
15	Zavasht	3034	3174	3526	3802	1.51	0.76	1.07
16	Chopoglu	2453	2619	3052	3189	2.21	0.44	1.16
17	Haji Mossayyeb	132	108	68	102	-6.42	4.14	-0.35
18	Gara Geshlag	543	537	522	540	-0.39	0.34	0.04
19	Khane Barage Gadim	891	988	1256	1309	3.49	0.41	1.67
20	Khalilvand	500	604	941	1187	6.53	2.35	4.05
21	Ali KHaje	838	988	1452	1418	5.65	-0.24	2.15
22	Akhond Geshlag	3380	3577	4081	4409	1.9	0.78	1.24
23	GAra Chopog	5225	5396	5818	5915	1.08	0.17	0.54
24	Khne Barage Jdid	1977	2076	2326	3230	1.64	3.34	2.63
25	Khane Barage Isakhani	44	40	32	34	-3.13	0.61	-0.95
26	Zavarag	2274	2400	2720	2247	1.81	-1.89	-0.39
27	Kota Mehr	592	546	452	338	-2.66	-2.86	-2.78
28	Yengi Knde Khane Barag	1382	1388	1402	853	0.14	-4.85	-2.82
29	Geshlage Khane Barag	1174	1221	1337	841	1.31	-4.53	-2.17
30	Total villages	**44453**	**46197.48**	**51222**	**49877**	**1.43**	**-0.27**	**0.45**
31	**Bonab city**	45885	50520	63240	75332	3.26	1.77	2.38
32	Total Settlements	**90338**	**96986**	**114462**	**125209**	**2.4**	**0.9**	**1.51**

ISBN: 978-605-64453-1-6

Table 2. Land use changes of Bonab County during the 1989 to 2005.

Class	Land Use	Land Area in 1989	Land Area in 2005	Amount of Changes	Rate of Changes
1	Built	1297.3735680	2487.3568720	1189.9833040	91.72248713
2	Salt-marsh	10444.4591160	28682.8756420	18238.4165260	174.6228917
3	gardens	4183.3577030	4086.8813320	-96.4763710	-2.306194637
4	agriculture	12106.6956200	11963.0519892	-143.6436308	-1.186480897
5	water	19554.8729620	1244.6245836	-18310.248378	-93.63522031
6	grasslands	32663.6131693	31785.5817195	-878.0314498	-2.688102646
-	total	80250.3721383	80250.3721383	0.0000000	0

Result of land use changes in the above table; show that the area of build and salt-march classes are increased, while the area of water, grasslands, gardens, and agricultural classes are decreased. Build class contains residential area, factories, animal husbandry and road network that its growth is 90 percent and the most changes occurred in around of Bonab city. The development in plain district was linear in vicinity of road network an industrial area inside agricultural district that its development was dispersing pattern (Sprawl development). Also, the measurement of land use changes survey show that salt-marsh and water area decreased. Major cause of area decreasing in above classes is reduction of entrance water to Ormieh Lake. This process caused that the level standing of lake water decreased and salt-marsh and wetland area are increased. This process is one of the most environmental risks in regional and national level. Figure 1 and 2 shows the change of land use in two periods (1989-2005).

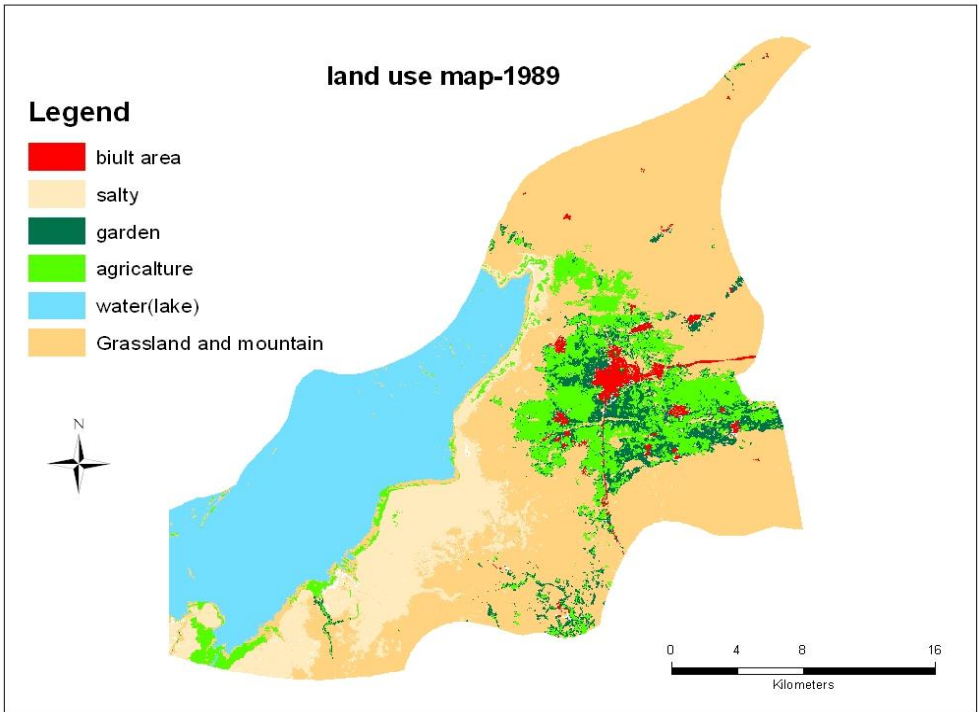

Figure1. Land use Map of Bonab County in 1989 Using TM Data

ISBN: 978-605-64453-1-6

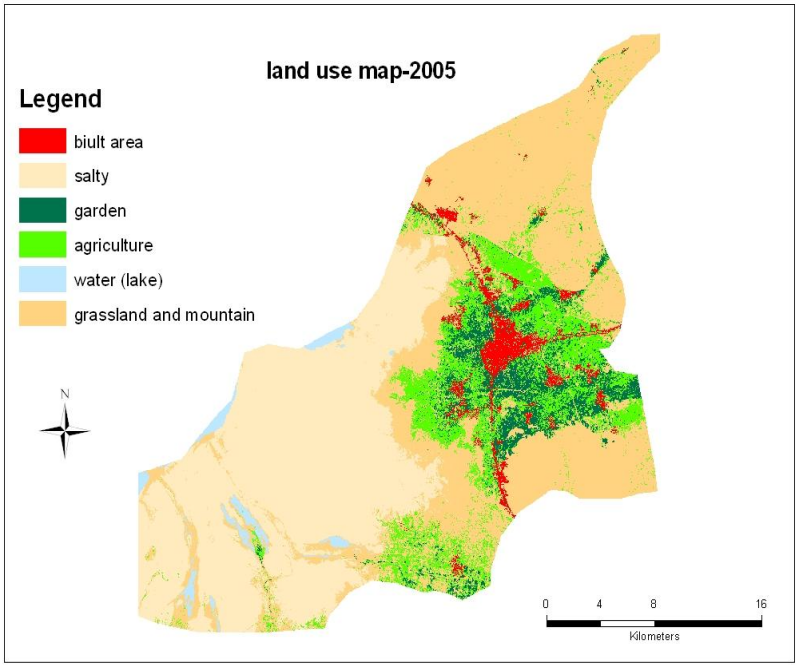

Figure2. Land use Map of Bonab County in 2005 Using Spot Data

4. RESULTS AND DISCUSSION

Different factors in during 17 years ago caused spread changes of land cover in Bonab County. Such as: Rapid growth of population, Spread out of urban area, unplanned location of production-industrial places, Development of road network, and Ormieh lake retrogression.

4.1. City and Villages Population Increased

In study duration, 28223 people were increased to population of Bonab County that the most number of increased populations settled in Bonab city. So that, growth rate of Bonab city and total villages was 1.51 and 0.45 in per years respectively.

The other factor is population distribution pattern and its effect on land use changes. The gross density in this county is 156 people in squire kilometer. While, the gross density in plain district is 564 people in squire kilometer. It shows that the most pressure development activities are on agricultural area.

4.2. Disperse Spread or Sprawl Development of Human Settlements

Build class area in study duration, increased from 1297.37 hectare to 2487.36 hectare that it has approximately become twice as much. The most population growth and the most spread of build area in this County have occurred in Bonab city and in vicinity of road network.

The analyzing of Sprawl index (rate of increased build area to rate population increased) is 0.42 percent. While mean population growth was 1.5 percent. Mean spread built area in study duration was 3.9 percent.

With consideration rural population stability, the sprawl development in Bonab County is affected by rapid growth in population and activates in Bonab city.

4.3. Demolition of Agricultural and Gardens Land Use

However, result of satellite image classification show that agricultural class decreased 240 hectare only. But more than 80 percent of built class is developed in agricultural lands. In this process, fertility lands converted to build area. In stead, grasslands and little fertility lands converted to agricultural and gardens uses. Another problem in this process, development of built areas within the agricultural and gardens areas. This changing destructed ecological condition.

ISBN: 978-605-64453-1-6

4- Retrogression of Ormieh water lake level and the destruction of natural ecosystem in Lake Periphery: one of the Bonab county attractive landscapes is Gaz shrubby in the Ormieh Lake peripheral that located between lake and Bonab city. This landscape formed in season river delta that used as wild life places and filtered the air pollution. With construction of damps on the rivers and lack protection of these natural resources, mostly part of this resource converted to agricultural uses or destructed.
Also, construction of damps on the rivers that located on water-shed Basin of Ormieh Lake the level of water Lake goes down and salt-marsh area replaced with lake water.

5. CONCLUSION

Access for accurate information in different time series using satellite images can be powerful instrument for analyses land use changing and minimizing the time and expanses. Application of satellite images in urban development survey and combination with Arial photos and census data appeared the land cover changes in Bonab County very accurately. The result of this study represented that the Bonab County has confronted with two dominated changes in land cover on duration study: 1) environmental changes such as converted of agricultural land to built areas and Ormieh lake retrogression, 2) urban and rural settlements Sprawl development and unsuitable use of lands. We proposed use of the smart growth recommendation for rearrangement of settlement sprawl development in Bonab County such as urban growth boundary, residential and industrial New towns.

6. REFERENCE LIST

Alberti, M., Weeks, R., Booth, D., Hill, K., Coe, S., Stromberg, E. (2002). Land Cover Change Analysis for the Central Puget Sound Region 1991–1999. *Final Report. Urban Ecology Research Laboratory, University of Washington*, Download from: http://www.urbaneco.washington.edu/, 2002.

Antrop, M., 2000. Changing patterns in the urbanized countryside of Western Europe. *Landscape Ecol*. 15, 257–270.

Dousset, B., Gourmelon, F., 2003. Satellite multi-sensor data Jürgens, C. (Ed.). (2003). Remote Sensing of Urban Areas. In: Proceedings of the ISPRS WG VII/4 Symposium, Regensburg, 27–29 June 2003, vol. XXXIV – 7/W9. *The International Archives of the Photogrammetry, Remote Sensing and Satellite Information Sciences.*

Elvidge, C. D., Sutton, P. C., Wagner, T. W., et al. (2004). Urbanization. In G. Gutman, A. Janetos, Justice C., et al., (Eds.), *Land change science: Observing, monitoring, and understanding trajectories of change on the earth's surface* (pp. 315– 328). Dordrecht, Netherlands' Kluwer Academic Publishers.

Pauleit. S., Ennos, R., Golding, Y. (2005). Modeling the environmental impacts of urban land use and land cover change—a study in Merseyside, UK, *Landscape and Urban Planning 71*, 295–310.

Pauleit, S., Slinn, P., Handley, J., Lindley, S. (2003). Promoting the natural green structure in towns and cities: the accessible natural green space standards model (ANGSt). *Built Environ.29* (2), 157–171.

Peiser, K. (2001). The decomposing urban sprawl, *Town planning review*, Liverpool University Prees. vol 43,NO1.

Swenson, J.J., Franklin, J. (2000). The effects of future urban development on habitat fragmentation in the Santa Monica Mountains. *Landscape Ecol. 15*, 713–730.

U.S. Geological Survey. (1999). High-Resolution Land Use and Land Cover Mapping. Fact Sheet, FS 0189-99.

Yuan. F, Kali E. Sawaya, Brian C. Loeffelholz, Marvin E. B. (2005). Land covers classification and change analysis of the Twin Cities (Minnesota) Metropolitan Area by multitemporal Landsat remote sensing, Remote Sensing of Environment 98, and 317 – 328.

Zhang, W., Zhang, X.,Li, L., Zhang, Z. (2007). Urban forest in Jinan City: Distribution, classification and ecological significance, Catena 69, 44 – 50

ISBN: 978-605-64453-1-6