UNIVERSITI TEKNOLOGI MARA

CONFERENCE PROCEEDING

ICITSBE 2012

1ST INTERNATIONAL CONFERENCE ON INNOVATION AND TECHNOLOGY FOR SUSTAINABLE BUILT ENVIRONMENT

16 -17 April 2012

Organized by:
Office of Research and Industrial
Community And Alumni Networking
Universiti Teknologi MARA (Perak) Malaysia
www.perak.uitm.edu.my

PAPER CODE: UP 09

THE NEED TO USE OF INTENSIFICATION POLICES AND INNER CITY GROWTH CAPACITIES IN TABRIZ

Mojtaba valibeigi[a]and Ali Akbar taghipour[b]
Tabriz, Iran
[a] mojtaba.valibeigi@gmail.com, [b]ali.a.taghipour@gmail.com

Abstract
The optimal use of land is an important subject, due to the fast growth and unplanned urbanization of regions, in order to protect lands in fringe cites. This phenomenon is enumerated of evident characteristics in Iranian metropolitans the same as in other developing countries. Even though urban density in Tabriz is low, but a comparison with City net density or housing density shows a major part of inner city boundary spaces are useless. Many of the city's textures suffer from unfavorable spaces and low housing density. This research investigated sprawl expansion in Tabriz by available statistics and comparative – analysis method. Finding of Research shows that many parts of sprawl growth occur around the outer city because of inaccurate use of available lands. Thus this city do not need urban lands for fringe development until the next 15 years with accurate plans and adoption of a logical densification policy. Also intensification policies should be considered in Tabriz and actions in this field must be continuous and gradual actions.

Keywords: Urban expansion, Intensification, Urban density, Tabriz city.

1. Introduction

Critics of sprawl argue that urban expansion leads to an undesirable sacrifice of farmland along with a loss of amenity benefits from open space on the urban fringe. The longer commutes caused by sprawl are thought to create excessive traffic congestion and air pollution, and sprawl's suburban focus is viewed as depressing the incentive to revitalize decaying downtown areas. Finally, commentators such as Putnam (2000) argue that the low-density suburban lifestyle associated with sprawl reduces social capital, leading to a less-healthy society (Brueckner & Largey, 2007). This research aims to analyze the urban expansion and the inner city growth capacities in Tabriz. Tabriz, as the fourth most populous city in Iran with 1398060 populations, is an interesting case to study urban expansion that faces rapid urban growth over the last four decades.

2. Literature Review

Urban sprawl, a consequence of socioeconomic development under certain circumstances, has increasingly become a major issue facing many metropolitan areas. Although a general consensus regarding the definition and impact of urban sprawl has not been achieved (Jia, 2006: 862, Johnson, 2001), urban sprawl is often referred to as uncontrolled, scattered suburban development that increases traffic problems, depletes local resources, and destroys open space (Jia, 2006, Peiser, 2001). It is critically important to properly characterize urban sprawl in order to develop a comprehensive understanding of the causes and effects of urbanization processes.

Also can urban sprawl as a term that has been used to describe a wide variety of undesirable aspects of urban growth, including excessively large cities, overly long commutes and traffic congestion, loss of open space, and failure to redevelop decayed inner city properties (Miceli, Sirmans, 2007. See also Brueckner, 2000, Nechyba and Walsh, 2004). In response to these concerns, local governments have adopted a wide range of antisprawl measures, including urban growth boundaries (UGBs) and other related zoning policies, public land-purchase programs designed to protect vacant land, and price-based mechanisms such as impact fees that are designed to slow the pace of development (Brueckner & Largey, 2007. see also Brueckner, 2000; Nechyba and Walsh, 2004; Glaeser & Kahn, 2004).

3. Methodology

The data in this research are drawn from available Statistics, the master studies and detail studies compiled over 70 years and the database provides data on urban expansion in Tabriz. Then it is studied by a comparative-analytic method and using the Holdren model to find that what share of urban growth is related to population growth and what share related to urban sprawl. Finally, inner city growth capacities in municipal districts are analyzed by statistical methods.

4. Result and Analysis

In general, the urban growth that causes land use changes is a result of the complex interaction between behavioral and structural factors associated with the demand, technological capacity, and the social relations affecting demand and capacity, ultimately straining the environment. However, there are no universal driving factors of the change. Although similar driving factors have been found in several studies, the degree to which they contribute to landscape change differs (Verburg et al., 2004; Zang & Huang, 2006, Thapa, Murayama, 2010).

The comparative analysis shows that a high increase in physical expansion would reduce the population density and induce the growth of urban scattered. Moreover, an increasing in scattered and gross per capita would result in a greater brown field. Generally, comparison between population trends with urban density and residential density in Tabriz from 1967 to 2007 can be seen higher Physical expansion. As shown in figure 1, whereas urban density in 1967 was About 189 people per hectare, in 2007 reduced to 67. Also whereas in 1996, urban density was 113 people per hectare, population gross density had been 66(Ghorbani, 2005. See Ghorbani & pourmohammadi, 2006). Calculations show in 2007 in respect to the 0.85 annual population growth, Tabriz has 3/4 Annual growth area and with 13/9 growth ratio of population, 41/7 growth ratio of area increased. This information shows the importance of intensification policies in Tabriz.

Table 1: population growth and urban density in Tabriz Between the years 1966 to 2007

year	Area	Population	Growth ratio of area	Growth ratio of population	Population density
1966	2127	403000	---	---	189
1970	2520	471000	7.37	6.74	186
1978	4019	692000	47.58	37.53	172
1986	6440	979000	48.2	33.17	152
1991	7965	1089000	11.84	5.6	136
1996	10500	1191000	15.91	4.68	113
2006	21132	1398060	41.17	13.9	66

Source: Azimi(1998), Sabzineh rah and Zista Consulting Engineers(2002 ,2004), Estimate of authors

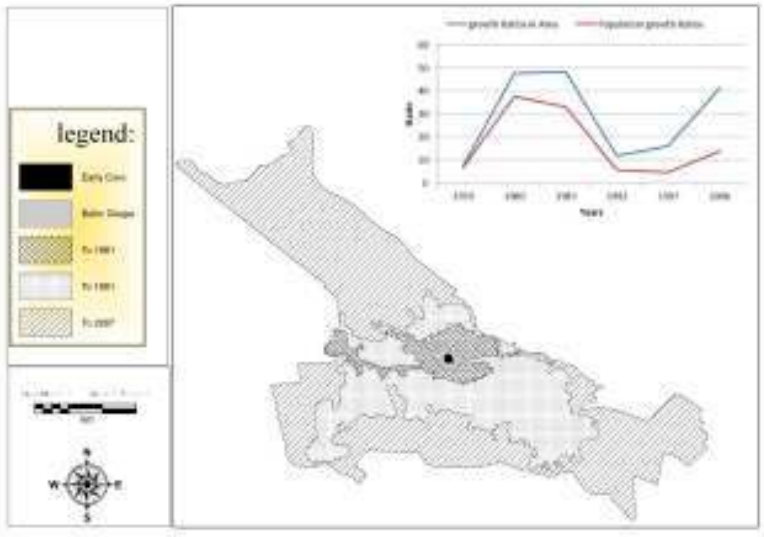

Fig1: urban expansion trends in Tabriz and population and area growth Diagram
Source: Authors

4.1 Determination the rate of urban sprawl

Using of the Holdren model can be determined urban sprawl. The method for quantifying the respective contributions of population growth and changes in consumption per capita of any type of resource consumption was laid out in a landmark 1991 paper by Harvard physicist Prof.John Holdren. Although Dr. Holdren's paper dealt specifically with the role of population growth in rising energy consumption, the method can be applied to many types of population/ resource consumption analyses (Kolankiewicz, Beck, 2001. Beck, 2003. Holdren. 1991). In the case of sprawl, the resource under consideration is rural land, namely the expansion over time of the Urbanized Area into rural areas (Kolankiewicz, Beck, 2001).the total land area occupied by the built-up Urbanized Area can be expressed as:

$$A = P \text{ x } a \qquad (1)$$

Where*:*
A = Area of total urbanized land in a city and its suburbs
a = area of urbanized land used by the average resident (per capita land use)
P = Population of that city and its suburbs
Following the logic in Holdren's paper, if over a period of time t (e.g., a year or decade), the population grows by an increment P and the per capita land use changes by a, the total urbanized land area grows by A which is given by substituting in eqn. (1):

$$A + A = (P + P) \text{ x } (a + a) \qquad (2)$$

Subtracting eqn. (1) from eqn. (2) and dividing through by A to compute the relative change (i.e., A/A) in urbanized land area over time interval t, yields:

$$A/A = P/P + a/a + (P/P) \text{ x } (a/a) \qquad (3)$$

Now eqn. (3) is quite general and makes no assumption about the growth model or time interval. On a year-to-year basis, the percentage increments in P and a are small (i.e., single digit percentages), so the second order term in eqn. (3) can be ignored. Hence following the Holdren paradigm, eqn. (3) states that the percentage growth in urbanized land area (viz., 100% x A/A) is the sum of the percentage growth in the population (100% x P/P) plus the percentage growth in the per capita land use(100% x a/a). Stated in words, eqn. (3) becomes:

Overall percentage land area growth =
Overall percentage population growth + Overall percentage per capita growth (4)

In essence, the Holdren methodology quantifies population growth's share of total land consumption (sprawl) by finding the ratio of the overall percentage change in population over a period of time to the overall percentage change in land area consumed for the same period. This can be expressed as:

$$\textit{Population share of growth} = \frac{(\textit{Overall percentage population growth})}{(\textit{Overall percentage land area growth})} \qquad (5)$$

The same form applies for per capita land use:

$$\textit{Per cap. land use share of growth} = \frac{(\textit{Overall percentage per capita land use growth})}{(\textit{Overall percentage land area growth})} \qquad (6)$$

The above two equations follow the relationship based on Prof. Holdren's eqn. (5) in his 1991 paper. A common growth model follows the form (say for population):

$$P(t) = P_0 (1 + g_P)\, t \qquad (7)$$

Where $P(t)$ is population at time t, P_0 is the initial population and g_P the growth rate over the interval. Solving for g_P the growth rate yields:

$$\ln (1 + g_P) = (1/t) \ln (P(t)/P_0) \qquad (8)$$

Since ln $(1 + x)$ approximately equals x for small values of x, eqn. (8) can be written as:

$$g_P = (1/t) \ln (P(t)/P_0). \qquad (9)$$

The same form of derivation of growth rates can be written for land area (A) and per capita land use (a)

$$gA = (1/t) \ln (A(t)/A_0) \qquad (10)$$
$$ga = (1/t) \ln (a(t)/a_0). \qquad (11)$$

These three equations for the growth rates allow you to restate the Holdren result of eqn. (4) as:

$$gp + ga = gA \qquad (12)$$

Substituting the formulae (eqns. 9 thru 11) for the growth rates and relating the initial and final values of the variables P, a and A over the period of interest into eqn. (12), the actual calculational relationship becomes:

ln (*final population / initial population*) +ln (*final per capita land area / initial per capita land area*) = ln (*final total land area / initial total land area*) (13)

In other words, the natural logarithm (ln) of the ratio of the final to initial population, plus the logarithm of the ratio of the final to initial per capita land area (i.e., land consumption per resident), equals the logarithm of the final to the initial total land area.

In the case of the Tabriz Urbanized Area from 1966 to 2007, this formula would appear as:

$$Ln\left(\frac{1398060}{403000}\right) + Ln\left(\frac{151.15}{52.77}\right) = Ln\left(\frac{21132}{2127}\right)$$

Ln(3.46)+Ln(2.86)=Ln(9.35)

1.24+1.05=2.23

$$\left(\frac{1.24}{2.23}\right) + \left(\frac{1.05}{2.23}\right) = \left(\frac{2.23}{2.23}\right)$$

0.55+0.45=1

Thus, we see that in the case of the Tabriz from 1966 to 2007, the share of sprawl due to population growth was 55%, while declining density (i.e., an increase in land area per capita) was accounted equal to 45%.
Because of these trends, we were interested to examine the inner capacity of city lands.

4.2 Inner city growth capacities in Tabriz

Municipal districts are experiencing different growth whereas the land is scattered in different parts of the city. Meanwhile, population growths and the reception capacity in different districts are not the same.
First population's potential capacities is calculated based on the proposed density in each districts, upon Sabzineh Rah Consulting Engineers studies, and then is compared with the existing population and density.
using the estimated population growth rate of each districts in Traffic studies of Tabriz and Logarithmic growth formula, a year that population's capacity will be completed is determined that shown in 2 table and
Fig. 2 gives a classification of the procedure.

$$t = \frac{\log^{\frac{pt}{p0}}}{\log^{(1+r)}} \qquad t = \frac{\log\left(\frac{1967654}{1399345}\right)}{\log(1+1.59)} = 21$$

Table 2: population potential of municipal districts and prediction the year of capacity completion based on 2005 statistics in Tabriz

Municipal Districts	1	2	3	4	5	6	7	8	Total
Area	2843.68	3931.81	2837.08	2763.79	438.22	436.54	3983.97	2942.44	20222.55
Population	367058	300943	266959	319478	87350	29666	18288	9603	1399345
Potential population	474895	412851	368820	359293	83114	28375	27887	14712	1967654
Capacity of Population reception	107837	111908	99161	39815	-4236	-1291	9599	5109	568309
The gross density	129	76	94	115	180	67	5	3.26	69
The proposed gross density*	167	105	130	130	172	65	7	5	97.3

The gross per capita	77	130	106	86	55	147	2178	3064	144
Prediction of population growth rate**	2.1	2.1	1.5	1.75	2.66	0.5	1.5	0.66	1.59
the remaining years of capacity completion	12	15	21	6	-1	-8	28	64	21
the year of capacity completion	2018	2021	2027	2012	2005	1998	2034	2070	2027

Resource: *zista Consulting Engineers (2005), ** Sabzineh Rah Consulting Engineers (2003) and Author's predictions.

Results show that 6 Districts of 8 Districts still have not completed to their capacity and population growths have a relatively modest. The municipal district number 6 capacity has been completed and has a low population growth. Central tissue and the market of Tabriz city are located in this district. But the municipal district number 5 capacity, that marginal settlements is located in it, not only has been completed; also has the highest rate of population growth with 2/66. It should be noted that district number 9 has not been considered because of any construction. Finally municipal districts in Tabriz regardless of districts number 6(the city center) and number 5(marginal settlements with the high density of 400) have their required Lands to attract the increasing population (At least 6 years up to 64 next years) and in general, Tabriz city has its required lands for the increasing population until 2027.

The matrix that has been given in Figure 3, using GIS, shows the population growth versus the years of capacity completion.

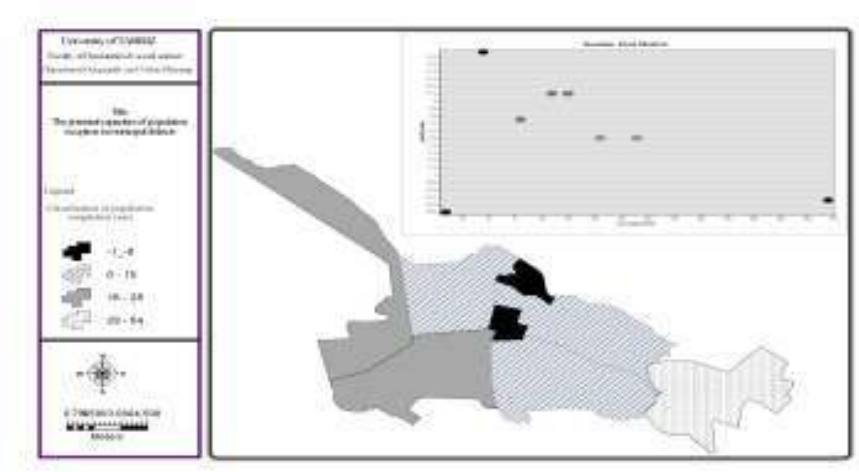

Fig1: potential capacities of population reception municipal districts Tabriz and scattered plot of population growth and completion year in Tabriz
Source: Authors

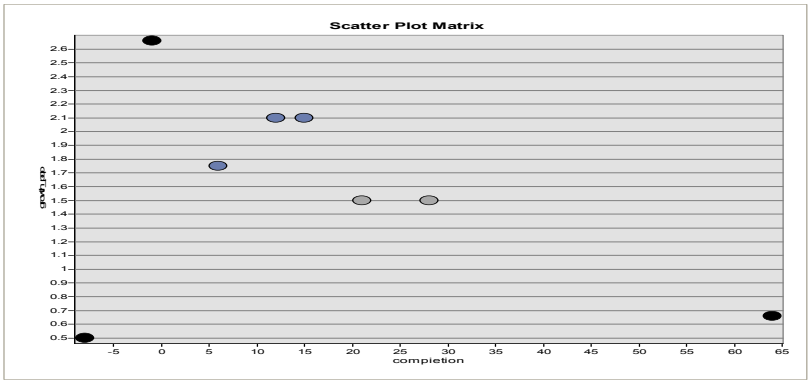

Fig3: the population growth versus the years of capacity completion in Tabriz

5. Conclusion

To conclude, the overall urban areas have grown considerably as the share of area growth has been more than 1.7 population growth and in many cases, particularly residential development, to respond the land demands, have expanded the city. Perhaps it caused by some reasons such as non-land banking, land saving and the rising value of land within boundaries.
The city of Tabriz has the high rate of discontinuous residential areas over the past 50 years. Further, this work shows that the greatest urban sprawl occurs at the edge of city because of inaccurate use of available lands and if are used accurate, Tabriz does not need urban expansion to 2027.

Finally, we analyzed urban expansion to show the kind of polices that should be taken and land potential capacities of city in order to achieve appropriately of urban developments. Of course should be noted that even if it be possible to release all the land capacities to achieve the desired per capita, time should be spend and also needs to improvement, aggregation approaches and Land readjustment. But what is certain, compact city and intensification policies should be considered in Tabriz and in this field, actions must be continuous and gradual.

Acknowledgement

We want to express our respect and thanks to Professor Jamali and Professor pourmohammadi in Urban Planning Department, Tabriz University for their valuable comments on land use planning and A. Gorgij Ph.d student of Tabriz University, comments and suggestions that have helped improving the quality of the paper.

References

Arse Consulting Engineers. (1995). *Tabriz Master plan*; The Organization of Housing and Urban Development.

Azimi, N. (1998). *Recent urban growth and change in the spatial structure of Iranian : the case of tabriz (1991-1996).* Ph.D.Theises university of Ottawa.

Beck, R. Kolankiewicz L. Camarota, S (2003). *Outsmarting Smart Growth, Population Growth, Immigration, and the Problem of Sprawl*, Washington, Center for lmmigration Studies.

Beck, R. Kolankiewicz, Leon. (2001). *Sprawl in Florida Executive Summary*. Copyright ã 2001 by NumbersUSA.com. Second Printing.

Brueckner, 2000 J. Brueckner, Urban sprawl: diagnosis and remedies, International Regional Science Review 23 (2000), pp. 160–171.

Brueckner, J. (2001). *Urban sprawl: Lessons from urban economics*, in: W.G. Gale, J.R. Pack (Eds.), Brookings-Wharton Papers on Urban Affairs, Brookings Institution, Washington, D.C., 2001, pp. 65-89.

Brueckner, J. Largey, A., (2008). Social interaction and urban sprawl, *Journal of Urban Economics*, Elsevier, ‚July.

Ghorbani, R. (2004); *Density and organization of urban spaces in Tabriz*; Ph.D theses Geography and Urban Planning.

Ghorbani, R; Pormohamadi, M (2005). Analysis distribution of population densities of Tabriz using the statistical adjustment; *Geographical Research Quarterly, V 37, Issue 3. from* http://journals.ut.ac.ir/page/article-frame.html?articleId=11241

Glaeser, E. Kahn, M. (2004). *Sprawl and urban growth*, in: J.V. Henderson, J.-F. Thisse (Eds.), Handbook of Urban Economics, Vol. IV, Elsevier, Amsterdam, , pp. 2481-2527.

Holdren, John P. (1991). Population and the Energy Problem. *Population and Environment, Vol. 12, No. 3*, Spring 1991.

Ji Wei Ma, J. Twibell Rima, W. Underhill, K. (2005). Characterizing urban sprawl using multi-stage remote sensing images and landscape metrics. *Computers Environment and Urban Systems 30 (2006) 861–879.*

Johnson, M. (2001). Environmental Impacts of urban sprawl: a survey of the literature and proposed research agenda. *Environment and Planning A, 33(4), 717–735.*

Miceli Thomas, J. Sirmans, C.(2007). The holdout problem, urban sprawl and eminent domain. *Journal of Housing Economics, Vol 16, Issues 3-4, Pages 309-319.*

Nechyba, T.J. Walsh, R. (2004) . Urban sprawl, *Journal of Economic Perspectives 18 (2004), pp. 177–200.*

Peiser, R. (2001). Decomposing urban sprawl. Town Planning Review, 72(3), 275–298.

Sabzine Rah Consulting Engineers. (2001). *public transportation Studies of Tabriz city (Vol 2, Specific and Environmental Studies)*; Tabriz municipality.

Thapa, R, B. Murayama, Y. (2010). Drivers of urban growth in the Kathmandu valley, Nepal: Examining the efficacy of the analytic hierarchy process. *Applied Geography 30 (2010) 70–83.*

Verburg, P. H., Ritsema van Eck, J., de Nijs, T., Schot, P., & Dijst, M. (2004). Determinants of land-use change patterns in the Netherlands. *Environment and Planning B, 31, 125–150.* vol. 64(1), pages 18-34.

Zang, S., & Huang, X. (2006). An aggregated multivariate regression land-use model and its application to land-use change processes in the Daqing region (northeast China). *Ecological Modelling, 193, 503–516.*

Zista Consulting Engineers. (2004). *Tabriz Detailed plan*; The Organization of Housing and Urban Development