An Investigation Into Urban Development

Patterns With Sprawl and Other Corresponding Changes: A Case Study of Babol City

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Abstract

Urban sprawl is one of the serious problems in developing countries and is known as serious economic, physical, and environmental problems in Iran. This study aims to investigate Babol City development between 1956-2016 and more specifically deals with its spatial changes and variations. Based on secondary data collection from Iran Statistical Center for Holdrem model to the as appropriate method to show sprawl tendency. After that, with the application of descriptive statistic in order to analyze data and corresponding information Application of the Holdren model illustrated that 74% of this increase is associated with population growth and the rest, that is 26 percent related to sprawl. There are two main factors that involve in Babol development first increase in gross population growth as well as the increase in gross urban per capita of lands and its consequent great urban horizontal development. The sprawl is the nature of growth related to Babol has resulted in the formation of residential towns, informal settlements, as well as the annexation of the neighboring rural areas.

Keywords: *Babol City, Iran, Sprawl, Urban Development, Spatial Changes*

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Introduction

Reviewing urban literature indicates that there exist some differences between urban growth concepts, urban development, and urban sprawl development. Urban sprawl always has a negative meaning and refers to the destruction of agriculture and nature (Ewing, 1997). There are some works that show the urban development footprint is huge in suburb and city areas and they shape the social condition and the quality of the environment. Cities do not have enough resources to place the population and suburbs are where the new development can provide them facilities to live. Unplanned and informal urban development causes many social and economic problems for policymakers and planners. While many planners and policymakers are concerned about the new development the biggest problems come years later habitat fragmentation, water and air pollution, increased infrastructure costs, inequality, and social homogeneity (Padmanaban et al, 2017; Squires, 2002). This is where urban growth and growth process changes both levels of income and efficiency of growth. As a result, the market size and production will change the population in urban areas (Black & Henderson, 1997).

The history of urban sprawl dates back to mid of twenty century. As a prime example, the U.S. cities have swallowed a great amount of good agricultural lands such as forest areas due to their outward expansion growth at the end of the 1950s. This, in turn, resulted in many environmental and traffic problems and consequences (Bhatta, 2010). Those days in US sprawl concept were associated with uncontrolled urban growth (Wang, 2017) pertaining to highway development as well as the great degree of private car ownership (Hess, 2001). This trend as a predominant spatial development form applies to many other developed countries as well as developing nations during the last 60 years besides the US cities. The historical trend in the middle of 1950 indicates that the European cities experienced 78 percent expansion rates while their population growth rate amounted to be 33 percent (Tabibian & Asadi, 2008).

The literature about urban sprawl is increasing in Iran due to political economy and national policies. The negative impact of urban sprawl are significant and the last decade's urban sprawl has made the urban economic, social, physical, and environmental system so complicated. Urban sprawl or suburban sprawl is a multifaceted concept centered on the expansion of auto-oriented, low-density development, and without municipal rules and regulations in developing cities. This phenomenon generally leads to negative problems and consequences for cities (Irandoost et al, 2018); decreasing the quality of urban neighborhoods (Mousavi, 2018) changing development policies reduce urban sprawl, such as floor area ratio (Meshkini et al, 2016). Urban sprawl is not a short-term development and it is all about understanding outward development. Where is the boundary between urban and rural areas? In general urbanization and growth in terms of the time and in a geographical context move together and interaction between these two forms the shape and direction to urban development. Therefore, urban growth as a general concept is being considered as an increase in area under urban uses, while urban expansion exemplified itself in rate, direction, whether vertical or horizontal, and form of urban growth. However, urban sprawl as one form of urban expansion

implies some negative dimensions. Even though urban development could be considered as a synonym for all those mentioning types of growth, but it deals with the improvement and betterment of urban life dimensions including growth and expansion (Kamanroodi et al, 2014)

Literature Review

Urban sprawl has been associated with over-consumption of land, non-stopped steady, horizontal expansion, leapfrogging growth and improper use of land (Peiser, 2006). The Vermont Association argued that these phenomena possess an outlying compact urban and rural growth nature along with highways and within rural suburbs (Frumkin et al, 2004). Furthermore, sprawl is being considered as an unplanned and unauthorized growth taken place along major arteries or bordering roads in haphazard and piecemeal fashion (Rabbani et al, 2018). Urban sprawl implies new urban growth over isolated sections separated from other regions by vacant lands (Ottensmann, 1977). This type of urban growth sometimes labeled leapfrogging growth (Pendall, 1999). The identification of three types of growth forms that are infill, expansion and outlying growth. The outlying horizontal expansion has led to isolated, linear and clustered branch (Figure 1) (Bhatta, 2010). Some experts believe that sprawl is comparable with cancerous growth and urban sprawl is also defined as intrusion over rural (Pendall, 1999), low-density urbanization (Robert, 1965), suburban development (Bhatta, 2010), and non-continuous development (Weitz & Moore, 1998).

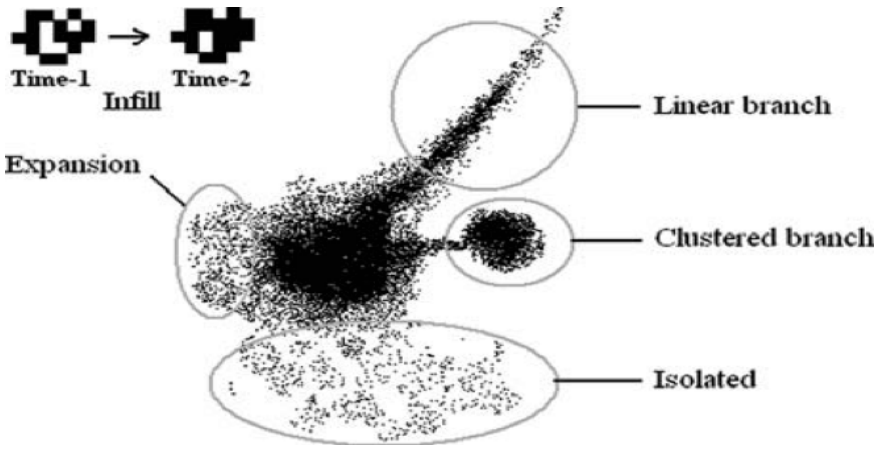

Figure 1. Schematic diagram of urban growth pattern. Source: Bhatta, 2010.

Galster criticized the conceptual ambiguity regarding sprawl definition. They stated that the concept of sprawl could well be parallel to each of those individual definitions as well as all of them, including specific pattern pertains to land use behaviors and its consequences (Galester et al, 2001). He investigates sprawl via eight dimensions, including, density, continuity, clustering, centrality, dependency, mixed-use development and vicinity (Galester & Khan, 2004). Ewing believes that density, mixed uses, centrality, and accessibility are the four prominent factors in this regard (Ewing et al, 2002) In general, there exist three widespread characteristics regarding the definition of sprawl. These include unlimited expansion and

intrusion over undeveloped regions, low density and non-continuous expansion (Burchell et al, 2005). Regardless of its causes and characteristics, this phenomenon could be defined as an outward expansion with low density generated out of dense nuclei by pushing and environmental sustainability properties could be defined as an outward expansion with low density generated out of dense nuclei by pushing and environmental sustainability properties. It may conclude that urban growth must be compatible with the following principles:

1. Discouraging outward growth
2. Under unavoidable circumstances, outward growth should possess high-density nature
3. Urban growth should not override population growth
4. Sustainability considerations would highly appreciate (Bhatta, 2010)

Some experts believe that urban sprawl does not have a solid black or white color. Meshgeeni stated that the urban sprawl pattern has some positive impacts, including economic production, provision of new job opportunities as well as offering some services and a better lifestyle. Williamson believed that one of the advantages of urban sprawl in the USA is to respect citizen's privacy and fulfilling the dream of many U.S. citizens regarding having a decent private house in a desirable and secure neighborhood (Williamson, 2010). Historically speaking, low density as the main characteristic of urban sprawl has been associated with the U.S., European and Mesopotamian cities. This type of growth by no means just pertains to twenty centuries (Bruegmann, 2006). Sprawl is caused by many complex and interwoven factors and forces. These forces could be analyzed at macro, mezzo, and micro scales. Macro-level is associated with general economic and political trends and patterns, including capitalization, globalization of the economy, and political ideology. Mezzo level exemplified itself in discussions and discourses regarding the causes of urban sprawl such as population changes, political and administrative structures, as well as geographic, economic, and social circumstances. Micro-level is associated with different actors and individual decision-makers including households, institutions and organizations dealing with decisions regarding the provision of housing, services and transportation facilities (Leontidou & Chris, 2007).

It is argued that undeveloped and developed countries are experiencing different metropolitan growth consequences. In industrial countries, the spillover population is trying to move away from the overcrowded metropolitan centre to more secure and decent neighborhoods. At the same time, some economic activities due to their spatial and locational limitations are moving toward peripheries. Therefore, within the industrial metropolitans, migration acts in a reverse manner, that is population is moving toward rural peripheries. However, in undeveloped countries, spatial non-continuity and overall centralization have led to balanced metropolitan growth and expansion, which in turn resulted in social, economic, physical, and spatial disorders and irregularities. This would pave the way for rural annexation as well as spatial disorders and metamorphism. Thus, physically speaking, we are dealing with the suburbanization and creation of informal settlements (Saidi & Shafie Sabet, 2018).

The urban ratio in Iran as a developing country which was encountering accelerated urban growth from 28% in 1921 reached 68.5% in 2006 (Saidi & Shafie Sabet, 2018). In this country accelerated urban growth initiated after the increase in revenue pertains to 1961 and 1971. This, in turn, increased rural-urban migration (Ahmadi et al, 2010). The exogenous nature of Iran urban expansion, urban motorization, injection of oil revenue into urban economy, the global economic system and land speculation all have led to the existence of many idle and vacant lands in the city centre as well as suburbanization (Ahmadi et al, 2010; Shahsavarian, 2015). Those mentioning factors were responsible for the increase in both density and housing demands. Many migrants moved to old dwellings, while those fairly rich settlers moved to old dwellings, while those fairly rich settlers who used to reside in the older part of the inner-city house moved to new decent and desirable neighborhoods in order to benefit from well organized and ample urban facilities, amenities, and social services. However, many rural migrants were incapable of providing even lower-quality dwellings. This, in turn, has led to the development of ghettos and uncontrolled and haphazard urban expansion.

Moreover, the increase in economic transactions and interactions has resulted in skyrocketing land prices in the cities. However, with an increase in distance and moving toward peripheries land price decline. Those migrants who are financially incapable would push into the edges of the cities. The intrusion over peripheral regions and edges possesses a non - continuous nature and finally result in the annexation (Saidi & Shafie Sabet, 2018).The idea of urban planning introduced in Iran along with the expansion of urban mechanisms in 1950. This type of planning has been associated with the separation of different land uses as well as the place of residence and work and more specifically great dependency upon private car ownership as opposed to public transit. Changes pertaining to the prevailing economic and social structures of Iran, growth in marginal and peripheral urbanization resulted from rural-urban migration, poor executive and administrative measures and political-social changes due to the Islamic revolution in 1978 all have a great impact upon the urban mechanism.

In addition, one should not ignore Iran-Iraq imposed war bottlenecks and associated problems during eight years, decrease and cutoffs in government financial supports regarding municipalities, proposing new policies to solve urban problems, including new land provision policies between 1980-1988, and municipalities self-sufficiency policies regarding the provision of financial resources from 1978. This resulted in Iran's increase in private car ownership, overselling of density, and expansion of commercial land uses and ribbon development along different roads and transportation taxes by municipalities. Inadequate parking spaces, reluctance regarding public transit more specifically rail system, increase in pollution level and moving toward sustainability are among the major outcomes and consequences of this type of urban development (Majedi, 1999)

Taking into consideration Babol's historical, cultural, and environmental properties, this city follows the country's urban developments and change trends. It is argued that Babol's central part taking into account its great amount of fertile

lands, is capable of affecting ample growth potential. This situation along with the lack of an officiant local, regional management have led to peripheral expansion and intrusion over agricultural lands located in neighboring villages. This study proves that this city experienced spontaneous expansion growth over neighboring communities. Urban sprawl characteristics vary from a place to another place and based on different urban and regional policies (Egidi, 2020).

Data and Research Methods

This study has applied nature and it deals with quantitative data. In fact, methodologically speaking, it possesses a descriptive-analytical approach. Statistical society corresponds to Babol City and covers 1956-2016 time period. Needed information was obtained via field works and documentary procedure. Holdren Quantitative Model was applied for the computation of the degree of sprawl and it is the best model to show how the city changes its normal shape of development (Hekmatnia & Mousavi, 2006). Holdren applied this model in order to determine the urban horizontal expansion rate as well as population growth in 1991. Using this model, one could determine the degree and rate of urban growth due to population growth as opposed to sprawl. Holdren used per capita gross land via 14 equations (Rahnama et al, 2016; Kurd Daronkolaei, 2006). In addition, the Geographical Information System was applied in order to draw maps and to analyze rate, direction, and form of sprawl in Babol. Babol's expansion pattern and its spatial variations were investigated by using social, economic, political and physical criterion as well as the application of 15 indicators.

Deterioration approaches are a broad methodology in ecological-economics, in specific in arrange to recognize the significance of populace development for the alter in natural weakening. Our note appears that deterioration approaches can be used either for the ex-post portrayal or for clarification and figure purposes. The use of this approach as a hypothetical show presupposes that the free advancement of the factors on the proper hand side of Ehrlich and Holdren's identity can be legitimized on the premise of hypothetical or experimental examinations (Hekmatnia & Mousavi, 2006; Gans & Jöst, 2005).

1. Holdren equation follows by: $A = p.a$

2. A (depends on the per capita gross) a (Population) P (urban area) Holdren, if during the t period, the population with equal growth P increase and the end of the earth changes to a, total Urban lands should be prepared for an increase.

3. $A + A = (P+P) + (a+a)$

By placing the equivalents 1 and 2 and dividing by A, the ratio of the change in the range of the range to the city is obtained over time.

4. $A/A = P/P + a/a + (p/p)\ (a/a)$

Equation 3 is now completely general and offers no assumptions about the growth model or time interval. Within a year, the percentage increase of p and a is low, so the second expression in Equation 3 can be omitted. Following the Heldren paradigm, Equation 3 states that the percentage growth rate of a city is the sum of the percentage of population growth and the percentage of per capita land use growth.

5. Total per capita gross % + total urban population growth % = total urban area growth %

Accordingly, Heldren's method (Ezat Panah & Khaliji, 2016) of medicine achieves the share of population growth from the total land use by the ratio of the change in the percentage of the total population in a period to the change in the percentage of total land use in the same period, which is as follows:

6. Total area growth % ÷ total population growth % = population growth per capita landuse

7. Urban expansion growth % ÷ total per capita urban landuse % = urban landuse per capita

The above two equivalents are presented in the 1991 memo based on 5 Heldern paradigms. Based on uncontrolled population growth, a general growth model is presented as follows:

8. $P(t) = P_o(1+g_p)^t$

P(t)is population in time, Po is the first population, gp is population growth between two time spans and by solving gp it shows:

$$Ln(1+g_p) = (\frac{1}{t})Ln(\frac{P_t}{p_o})$$

Since Ln (1 + x) for small values, the approximations are equal to x, the equivalent of 8 can be written as follows:

9. $$g_p = (\frac{1}{t})Ln(\frac{p_t}{p_o})$$

Such a form of inference was also written by Nahro Rashhad, the landlord of the city (A) and the impure head of land use (a).

10. $$g_A = (\frac{1}{t})Ln(\frac{A_t}{A_o})$$

11 $$g_a = (\frac{1}{t})Ln(\frac{a_t}{a_o})$$

12. $g_p + g_a = g_A$

By placing the formula for the growth and relationship between the initial values and the end of the period of variables P, a and A, we will have a time interval of 12:

13.

$$\frac{Population\ at\ the\ end\ of\ study\ period}{Population\ of\ beginning\ of\ study\ period} \div \frac{Gross\ per\ capita\ end\ of\ end\ period}{Growth\ per\ capita\ of\ beginning\ point}$$

$$= \frac{Urban\ situation\ at\ the\ end\ of\ study\ period}{Urban\ \ situation\ at\ beginning\ of\ study\ period}$$

Criterion	Indicator
Social	Population, population growth rate, immigrant population ratio, sex ratio, number of households, household size
Economical	employee ratio
Political	number of villages merged
Physical	area, gross per capita, extent of expansion, direction of expansion, pattern of expansion, shape of expansion, sprawl percentage

Figure 2. Criteria and Indices used in this research.

Results and Discussion

Babol's Sprawl

Babol is located between 36° 32' 39" North, 52° 40' 44" eastern longitude of the meridian of the Grenadines. Its population has been amounted to 250217 in which corresponds with 81572 households. Its area is 3036 acres. It's located toward north eastern of Tehran metropolitan (figure 3) (Iran bureau of census, 2016).

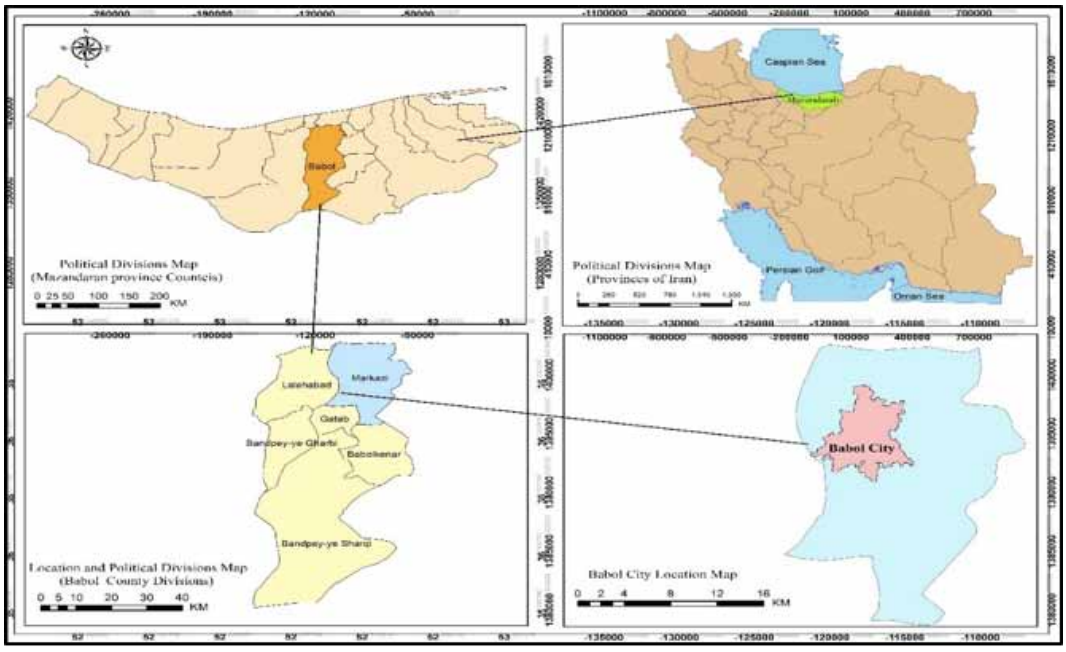

Figure 3. Map of the political situation of the Babol City in Iran.

Population growth rate and the actual number of the population has increased between 1956-1986 (Center for Statistics of Iran, 2013) (figures 4 & 5). However, it got adjusted between 1996-2016 (Center for Statistics of Iran, 2014). Moreover, Babol's area has continuously increased between 1956-2016 (Center for Statistics of Iran, 2014). The share and role of population and sprawl with regard to increasing in Babol's area during this time period was different. In general, based on Holdren model computation, 74% of the increase in the area was associated with population growth as opposed to 26 % resulted from sprawl. This, in turn, resulted in a decrease in gross population density and an increase in gross per capita of urban land use and horizontal expansion and intrusion.

Year	Population	Growth rate	Area (ha)	Gross per capita (square meter)	Growth rate	Expansion percentage related to population growth	Sprawl Percentage
1956	36194		269	74.23			
1966	49973	3.28	656	131.27	2.44	64	36
1976	68059	3.4	692	101.67	1.05	66	34
1986	115320	5.41	1133	98.24	1.63	80.5	19.5
1996	158346	3.22	1574	99.40	1.38	83	17
2006	201335	2.43	2647	131.47	1.45	75	25
2016	250217	2.2	3036	121.33	1.32	74	26

Figure 4. Population, Area, and Sprawl changes of Babol City from 1956-2016. Source: Statistics Center of Iran.

In addition, the population in Babol in 2016 about 6.9 times is bigger than the population in 2016. While the Babol area(ha) in 2016 is 11.28 times more than the Babol area in 1956. It seems city size developed very fast to place these newcomers. However, there is some important points in this development in different decades. In the first decade (1956-1966) and the second decade (1966-1976), there is a very slow population development and urban expansion. After that, there is a logical population development which is faster than decades ago and slower than decades ahead. The third decade (1976-1986) and the fourth decade is (1986-1996). The most important reason for population growth and urban development in Babol City is Land Reform so-called (Eslahat Arazi) in Shah time. The most significant period of time in Babol City is between (1996-2006) and (2006-2016) in these decades, Babol has experienced very fast population development and urban expansion which has never experienced before. Also, Just in the last two decades, Babol has experienced over 1000 ha land development for each decade. Furthermore, population growth plays an important role in urban sprawl in Babol.

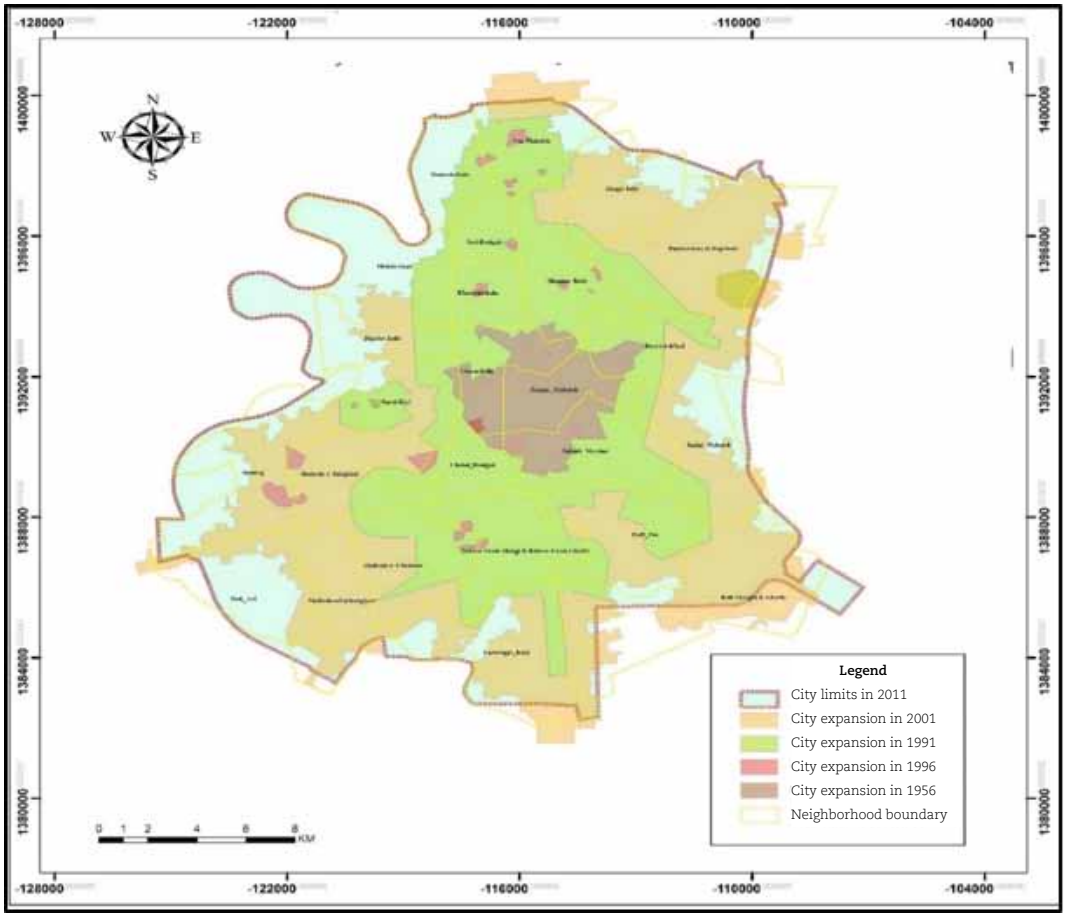

Figure 5. Map of the expansion process of Babol City from 1956-2016.

Social Changes

Application of agricultural land reform (1961), the gradual decrease in investment in the agricultural sector compared with both industrial and service sectors, agricultural modernization associated with the fourth plan (1968-1972), and the occurrence of Islamic revelation (1978) all resulted in the great magnitude of rural-urban migration. As the table in figure 6 suggests most of Babol's population growth was associated with the 1976-1986 time period coinciding almost with the Islamic revolution. As such, 21 percent of total Babol's population were migrants in 1986 (Center for Statistics of Iran (1957-2017; Consultant Engineers of Design and Invented 1987) However, this increase besides natural population growth and migration was associated with rural annexation between 1986-2016 as well.

Babol's sex ratio was 101 which was lower than its Mazandaran's counterpart (104) and Babol's (102). This ratio reached 103 in 1966. The corresponding figures pertain to 1976 and 1986 were higher than the Babol ratio and reached 108 and 106 respectively. However, it started to decrease from 1986 with the exception in

2016. The number of households amounted to be 7162 in 1956. It reaches to 81572 in 2016. The size of the household was estimated to be 5 in 1956. It drastically decreased and it reached 3.06 in 2016. The changes in sex ratio and household size were predominantly associated with both migration and rural annexation (Duany et al, 2001; Gordon & Richardson 1997).

Year	Population changes		
	Population	Growth Rate	Sex Ratio
1956	36194		101
1966	46973	3.28	103
1976	68059	3.4	108
1986	115320	5.41	106
1996	158346	3.22	101
2006	201335	2.43	100
2016	250217	2.2	99

Figure 6. Population changes of Babol City from 1956-2016. Source: Statistics Center of Iran.

Economic Changes

The distribution of labor force regarding the economic sectors was attributed to the different roles of each sector. Along with this, the nature of the economic structure is capable of offering more job opportunities and therefore more resultant employees. Babol showed predominant service function between 1956-2016 (Figures 7 & 8). This city in terms of function mainly geared to commerce in 1976. As such the percentage of the labor force involved in the agriculture sector was nearly 2% in that year. Babol's orientation toward commercial function was associated with the distribution pattern of some of these service functions in neighboring communities (Gutfreund, 2004). The table in figure 6 shows that Babol in between 1956 and 1966 had big agriculture sectors with more 11.30% out of the population and 30% in industry and 69% in service sectors. After that, the agricultural sector due to mechanization, less profit, very high risk rated the lowest percentage of the employees. In terms of economy, the other sectors become more profitable, less risk, and with a better income.

Year	Agriculture	Industry	Services
1956	11.30	27.50	61.20
1966	9.40	30.60	60
1976	2	26	72
1986	6	11	83
1996	7	23	70
2006	6	28	66
2016	7.24	24.14	68.62

Figure 7. Employee ratio changes of Babol City from 1956-2016. Source: Statistics Center of Iran.

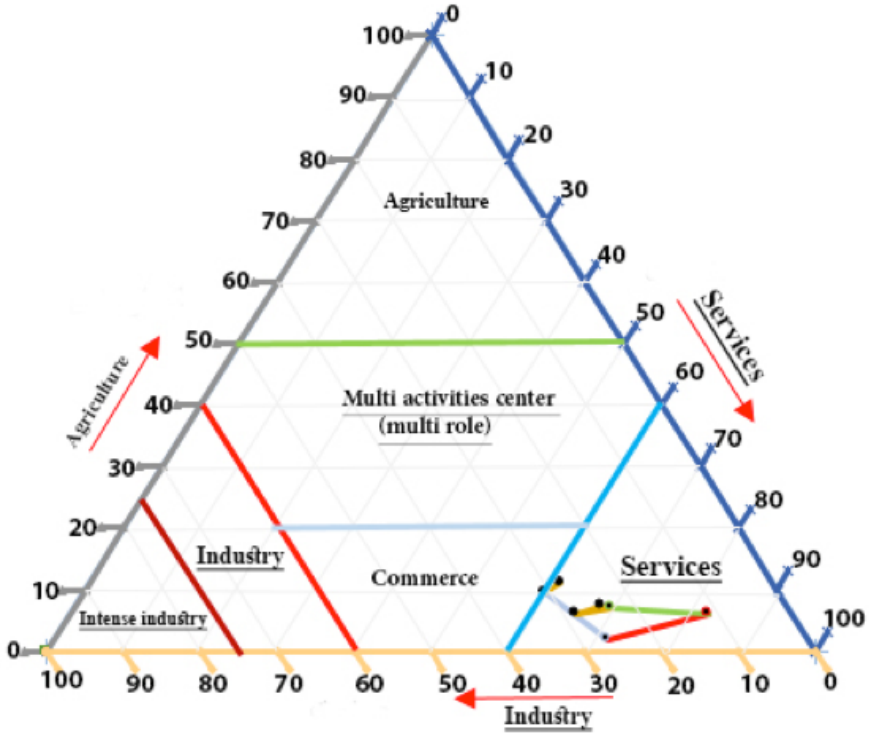

Figure 8. The economic role of the Babol City in 2011.

Political Changes

Rural annexation within the urban area was attributed to both changes in political subdivisions and continuous sprawl development. As the table in figure 9 indicates, 16 villages were annexed into Babol between 1956-2016. Most of this annexation occurred in 1956, 1966, 1976, and 1986. This city experienced the highest population growth (5.41) as well as the highest gross per capita of land (1.63) in the 1980s. This situation lasted one more decade and it resulted in more rural annexation in Babol. The statistics are from different decades in Iran the first decade is after Dr. Mosadeq democratic government thrown out by the British and United States coup which is between 1956 and 1966 with the rational urban and rural development. The second decade is between 1966 and 1976 which is after the land reformism by The Mohammad Reza Shah which rural to urban migration accelerated due to the destruction of the traditional system of land ownership. The third decade was between 1976 and 1986 caused government change and more land freed by the new Islamic government. In the third decade, there is rapid population growth and rapid rural deportation and people moved to the cities. Therefore, at the end of this decade for the first time population in urban and rural areas equaled. The fourth decade between 1986 and 1996 and after the ceasefire between Iran and Iraq the economy started to be more relay on oil and industrial development and cities provided more job opportunities. Liberal economic devel-

opment and influence of liberalism in urban and rural planning made cities very attractive than ever in history and rural areas. After that, the same policy continued in the fifth decade between 1996 and 2006. However, from 2004 and by Ahmadinejad International and national policies the economic situation in Iran become very week, and the housing sector profitable and at the same time with the highest inflation. Therefore, the market has never been as active that is used to be in decades before. While the housing market is very demandable but people do not have money to afford to own or rent a house.

Villages	Time of integration	1956	1966	1976	1986	1996	2006	2016
Darzi-kety		No statistics						
Vag-Mahaleh	1956-1966	133			Merged			
Bendarkola		262						
Hamzehkola		775						
Razikola		144						
Astaneh-sar	1966	No statistics	254					
Haft-tan	1976	26	8			Merged		
Moziraj		905	971					
Kamangarkola	1976	181	314	1839		Merged		
Kety	1986	55	688	2083				
Sadatmahaleh		284	378	466	567			
Heydarkola		253	298	450	576			
Bazgirkola	1986	No statistics	No statistics	290	929		Merged	
Moziraj-e-Sofla	1996	No statistics	194	699	1060			
Molakola		119	220	276	314			
Darvishkheil	1996 2016	355	653	852	1056	1155	Merged	

Figure 9. The number villages merged in Babol City from 1956-2016. Source: Statistics Center of Iran.

Physical Changes

Babol's area continuously experienced some increases between 1956-2016 (figures 4 & 5). Its area showed 11 fold increase. It reaches from 269 acres in 1956 to 3036 acres in 2016. The most integration was in the west and the northwest in Babol. Based on figures 7 & 10, this situation is predominately associated with intrusion over rural areas and rural annexation. Location wise, these are located in the vicinity of the main inter-urban arteries, therefore they are well exposed to annexation process. These villages are considered as part of some neighborhoods while preserving their rural physical characteristics.

Babol's urban expansion is exemplified itself in the linear continuous pattern along the Northern-Southern axis and non-continuous and scatter forms in neighboring communities (figures 5 & 10). This form of development was accelerated with the construction of residential towns and public housing as well. It is influenced by the existence of natural barriers around the town. Most of the expansion was occurred along the northern axis next to Babol-Babolsar road followed by the southern axis along Babol- Babolkenar and Band pay. However, Babol's expansion

toward the eastern-western part is associated with the transit roads located in this part of the town. According to the statistics and figure 10 Babol has the north and the north-westward development.

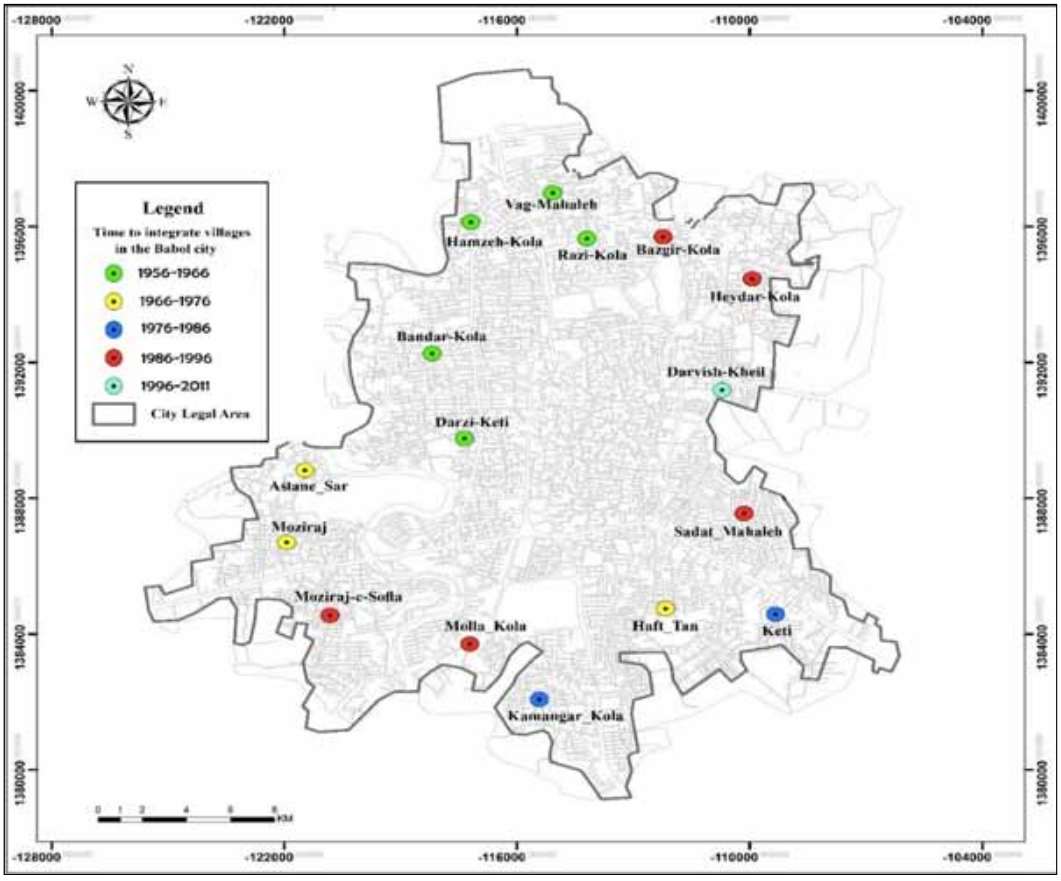

Figure 10. Map of the integrated rural settlements in Babol from 1956-2016.

Conclusion

Babol experienced accelerated population growth and expansion between 1956-2016. Its population with the average growth rate of 3.33 percent reached from 36194 in 1956 to 250217 in 2016. In another word, this city experienced a 214023 increase in number within these 60 years of time span. Furthermore, its area reached from 269 acres in 1956 to 3036 in 2016, which is an 11 fold increase. The computation of sprawl development using the Holdren model indicates that 74 percent of the horizontal expansion is explained by population growth as opposed to 26 percent resulted from sprawl development within the study period. This, in turn, has led to rural annexation. 16 villages were annexed to the legal jurisdiction of this city between 1956-2016. This sprawling development was exemplified itself in linear, continuous form along the north-south axis and non-continuous form with physical changes in neighboring communities.

The construction of the residential towns and public housing around Babol and population movement from central parts into peripheries along with a lack of physical barriers all contributed to sprawl development. In addition, Babol's

sprawl was taken place along the northern and southern axis, including Babol-Babolsar in north and Babol-Babolkenar and Band pay in southern direction. Furthermore, part of the city expansion followed the eastern-western direction. As such, most of the annexed villages were located along those mentioned arteries and roads.

Babol's sprawl development was taken place in peripheral lands, including agricultural lands and pastures. Furthermore, rural annexation, the construction of residential towns as well as public housing, the occurrence of the economic, social, political and physical changes, the existence of informal settlements such as Imam Khomeini towns, the western Cati, the eastern Kamangarcola and Gohardash towns are among the major consequents of this sprawl development pattern.

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