

## Articles

### Process of Urban Development and its Environmental Impacts in Southern Caspian Sea Region

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**Abstract:** This paper examines the trend of urban development and its environmental impacts in southern Caspian Sea Region, which constitutes three provinces of Guilan, Mazandaran and Golestan in northern Iran. As a distinct geographical region, Southern Caspian Region in northern Iran is a rich area in terms of natural resources and is heavily occupied by population and activities. While this region covers only 3.5 % of Iranian territory, it includes 10.3% of population and 12.3% of cities in the country, of which the density is three times more than that of the country in average. With 657 km of coastline and suitable climate for most part of the year, this region is the most important recreation area for tourism activities in Iran especially in the summer time. The focus of this paper is to analyze the trend of urban development and population change in three northern provinces in the last 45 years and the major environmental effects which urban development has had in the region. The results of the analysis indicate that the major environmental impacts of urban development in the Southern Caspian Sea Region include: (1) water pollution because of the lack of appropriate sewage system and direct discharge of run off waters from households and industrial units into the rivers. This issue has led to the pollution of waterbodies especially such as in Anzali Lagoon and destruction of natural breeding areas for fish in several places; (2) Soil pollution through inappropriate deposition of urban waste outside the cities and along roadsides; and (3) clearance of the forest and invasion of the agricultural lands because of urban sprawl. At the end, some recommendations are made to alleviate and control the negative environmental impacts

of urban development in order to preserve the fragile environment in the region.

#### Keywords:

Caspian Sea Region, urban development, environmental impacts, water pollution, sewage system, urban waste, soil pollution.

#### Introduction to the Southern Caspian Region and its environmental importance

About 177000 square kilometer (10.78%) of Iranian territory fall in the Caspian Sea basin. This basin receives 18.72% of the total volume of precipitation in the country. Even though 10 out of 28 Iran's provinces completely or partially are located in this basin, only three of them, i.e. Guilan, Mazandaran and Golestan are adjacent to the Caspian shores. With 58061 square km, these three provinces cover one third of the Caspian basin in Iran or 3.5% of the country. The natural environment and urban and regional development in these provinces have mutually affected each other.

With a similar Mediterranean climate and adequate rainfall, Southern Caspian Region is the only area in Iran with dense vegetation. The northern sides of Elburz Mountains and their foothills, are mostly covered with dense forests, while the altitudes comprise rich pastures. Between the mountains and sea (which vary in distance) there exist lowlands with suitable soil which support extensive agricultural activities across the region. In fact, it is because of such productive lands that the area has been densely occupied and that thousands of villages and cities have grown up across the region. This area covers only 3.5% of Iran's territory, while it homes 10.3% of the population of the country. The density of this area is three times more than that of the country in average. Southern Caspian Region



produces most of the agricultural products such as rice, cotton, tobacco, tea, citrus and silk in Iran.

Another characteristic of the natural environment in Southern Caspian Region is a chain of freshwater lakes and marshes, brackish lagoons, irrigation ponds stretching along the shores of Southern Caspian Sea. Two of the most important of these are Anzali lagoon (mordab) in the west and Gorgan Bay/Miankhaleh lagoon in the east (Mansoori, 1984). These lagoons play a buffer zone for flooding of several river systems before they enter Caspian Sea. They have beautiful scenery and diversity in the ecological life. These lagoons are also extremely important as spawning and nursery ground for commercial and bony fishes and as breeding, staging and wintering areas for a wide variety of waterfowl migrating from Siberia and cold regions of the northern latitudes.

The sea itself has been supporting tens of thousands of families from local population who rely upon fishing from the sea. This is, perhaps, the main reason for the establishment of hundreds of towns and villages beside the sea.

### Process of urban development in Southern Caspian Region

The Southern Caspian Region in Iran has faced a dramatic urban population growth over the past four decades. In 1956, the region had only 24 cities with 434,000 urban residents, but during the last 45 years (1956-2001) the number of cities increased to 109 and their population amounted to about 3,203,000. This means an average population growth of 4.54% annually in urban areas, while the natural population growth rate in Iran during this period was 2.78% (Fig.1 and Table 1). This implies considerable migration from rural areas to urban areas (an estimation of approximately two million rural exodus).

Another characteristic of urban development in Southern Caspian Region has been the concentration of population in larger cities. According to Table 2, while in 1956, 25.2% of urban population in the region lived in cities with more than 100,000 inhabitants; in 1996 it increased to 48.5%. However, the share of smaller cities (less than 25,000 residents) decreased from 46.7% to 21.3%. Since the concentration of population is considered one of the main sources for environmental problems (Berry, 1990), the trend of urban

population change in Southern Caspian Region implies an increase of the environmental problems in the region over the past four decades.

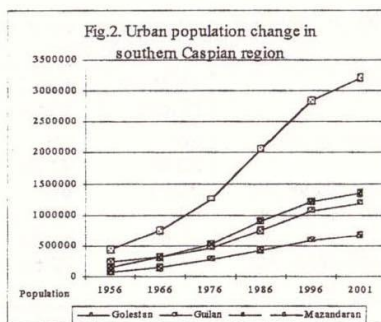
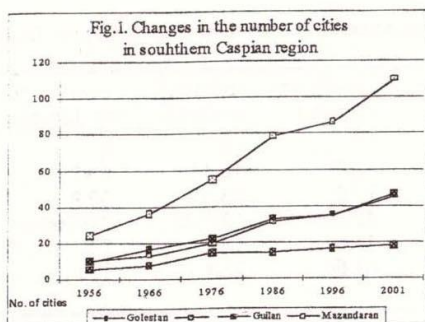
In terms of location, most of the cities accommodating urban populations are located in a 20 km buffer zone from coastline (Table 3). From 86 towns and cities in 1996, 20 cities were located without any distance from the shore, 36 cities were in less than 20 km from the shore, 11 cities were located between 20 and 50 km from the shore, 13 cities were located between 50 and 100 km and finally 6 cities were located between 100 and 140 km from the coastline. In terms of population, based on 1996 census, an aggregate of 72.5% of urban population lived in a buffer zone of 20 km distance from sea, another 15% lived in a buffer zone with 20 to 50 km distance from sea, while the rest (only 12.5 percent) of urban population (mostly in Golestan province) lived in areas with over 50 km distance from sea shore.

The extent of urban development varies within the region. Generally, as we move from east to west, the number of cities and the extent of urban development and the density of industrial activities increase. Based on Table 4, Guilan province has the highest population density among the other provinces.

The largest city of the region, Rasht, is located in Guilan province. Rasht and its surrounding areas in southwest of Caspian Sea is considered one of the densest part in Iran. Table 4 indicates the variation in the density of urban development in Southern Caspian Region.

Based on Table 4, the density of urban population in Guilan province (west) is about three times higher than that of Golestan province (east). Regarding with population density, we can see another difference in this respect and that is the extent of industrial activities in the region. Again, like relative higher population density in Southern Caspian Region compared with the rest of the country, we can identify a higher concentration of industrial activities in the region too. As Table 5 indicates, the three provinces with 3.5% of national share in terms of territory comprise 8.2% of industrial units. At the regional scale, similar to population distribution pattern, we can again see the higher share of industrial establishments in the western part than those in the eastern part.

As a result of the higher density of population and industrial establishment, we are



**Table 1:** Urban population growth rate in Southern Caspian Region (1956-1996)

Censuses						
Province	1956	1966	1976	1986	1996	2001 (est)
Golestan	70034	139268	259396	422193	587482	666603
Guilan	218102	303686	461264	743174	1049980	1189683
Mazandaran	146338	301729	511787	893023	1194233	1347453
Total	434474	744683	1232447	2058390	2831695	3203741
Country	18954704	25788722	33708744	49445010	60055488	65000000
N. urban	5953563	9794246	15854680	26844561	36817789	

**Percentage of population growth**

Province	1956-66	66-76	76-86	86-96	96-2001	1956-2001
Golestan	7.12	6.42	4.99	3.36	2.56	5.13
Guilan	3.37	4.27	4.89	3.52	2.53	3.84
Mazandaran	7.50	5.43	5.72	2.95	2.44	5.06
Total	5.54	5.17	5.26	3.24	2.50	4.54
Country	3.13	2.71	3.91	1.96	1.59	2.78
N. urban	5.10	4.93	5.41	3.21		4.66*

(For 1956-1996)

**Table2:** Classification of cities and change in their shares from urban population in Southern Caspian Region

Censuses					
City class	1956	1966	1976	1986	1996
100000-500000	109491	143557	188957	914197	1374317
50000-100000	0	51181	475387	226624	280353
25000-50000	122201	307703	118452	269076	573374
10000-25000	124543	148753	283096	449239	396120
less than 10000	78239	93489	166555	199254	207531
	434474	744683	1232447	2058390	2831695

**Percentage of each class from urban population of the region**

City class	1956	1966	1976	1986	1996
100000-500000	25.2	19.3	15.3	44.4	48.5
50000-100000	0.0	6.9	38.6	11.0	9.9
25000-50000	28.1	41.3	9.6	13.1	20.2
10000-25000	28.7	20.0	23.0	21.8	14.0
less than 10000	18.0	12.6	13.5	9.7	7.3
	100.0	100.0	100.0	100.0	100.0

Source: Statistical center of Iran, 1956; 1966; 1976; 1986; 1996 Censuses & Annual year book of 2001



**Table 3:** Distribution of cities in terms of distance from sea shore in Southern Caspian Region based on 1996 census

Cities	on shore (0 km)	(0-20 km) distance	(20-50 km) distance	(50-100) distance	over 100 km distance
Number of cities	20	36	11	13	6
(%)	23.25	41.86	12.79	15.11	6.97
Accumulative (%)	23.25	65.11	77.9	93.01	99.9
urban Population	537769	1516103	425501	137070	216755
(%)	18.99	53.54	15.03	4.84	7.6
Accumulative (%)	18.99	72.53	87.56	92.4	100

**Table 4:** Variation in the population density of urban areas in Southern Caspian Region

Province	Area (1000 sq km)	Urban population		Total density of population	
		density 1996	2001 (est.)	1996	2001 (est.)
Gholestān	20891	28.1	31.9	68.3	72.9
Guilan	14106	74.4	84.3	158.9	169.6
Mazandaran	23064	51.8	58.4	112.8	120.4
Total region	58061	48.8	55.2	108.0	115.2

faced with more environmental problems in the west part (Guilan province) compared with those in the middle and eastern parts (Mazandaran and Golestan provinces). We can conclude that, 1) Southern Caspian Region has a higher relative concentration of population and industrial activities at national level; 2) most of this population and activities are concentrated in a 20 km buffer zone from the Sea shore, and 3) there is a higher concentration of population and activities as we move from east to west.

### The environmental impacts of urban development

At present, from five littoral countries of Caspian Sea, Iran is the only country which neither involved in oil and gas extraction, nor established heavy industry on Caspian shores. Since the major international environmental concern on Caspian Sea Region is oil pollution (USEIA, 2002.), we can argue that the southern shores of Caspian Sea is, perhaps, the least polluted part of this region. However, in the past four decades, there has been a rapid population growth particularly a dramatic urban development in northern Iran resulting in a number of environmental problems.

As mentioned above, from 1956 to 2001, urban population in Southern Caspian Region increased by 737%, (more than seven

times) and the number of cities grew up with 454% (more than 4.5 times). Such rapid urban growth, by itself, has been the cause of several environmental problems in the southern part of Caspian Sea. In this section, we examine the main environmental problems related to rapid urban development in Southern Caspian Sea Region.

### Water pollution

The increase in the density of population and activities in urban areas in recent decades, has led to a higher consumption of water, on the one hand, and production of more waste water, on the other hand. Several studies conducted in the region indicate a serious water pollution in a number of rivers and waterbodies in northern provinces of Iran (Sabetraftar, 2001, Zarkami and Sabetraftar, 2001, Layeghi, 2001, Sadjjadi, 2001). Among the rivers in the southwest particularly, Zarjoob and Goharrood (in the basin of Anzali Lagoon) are the most polluted rivers in the region.

**Table 5:** Distribution of industrial units in Southern Caspian Sea Region

Province	population density p/km <sup>2</sup>	Total indust. establishments	with 10-49 workers	with 50-99 workers	with more than 100 workers
Golestan	68.3	198	169	15	14
(1.26)		(1.4)	(1.4)	(1.3)	(1.0)
Guilan	158.9	541	414	51	76
(0.8)		(3.8)	(3.5)	(4.5)	5.4)
Mazandaran	112.8	436	327	53	56
(1.40)		(3.0)	(2.8)	4.7)	(4.0)
Total (region)	108.8	1175	910	119	146
(3.5)		(8.2)	(7.7)	(10.5)	(10.5)
Country	36.0	14263	11739	1131	1393

Because of direct discharge of industrial and household sewage system, these rivers are ecologically dead. Their blurred color with disturbing smell is quite evident. For these reason, it is said that these rivers are the most polluted rivers in the country. These rivers having crossed the City of Rasht join each other and with the Peerbazaar river enters Anzali lagoon.

Because of entering Peerbazaar River in the eastern part of Anzali lagoon, this part of the lagoon is heavily polluted. It is dying as the reed beds and water fern *Azolla* expand because of the higher nutrients in the polluted water. In their studies on 20 rivers entering Anzali lagoon, Zarkami and Sabetrafar (2001) found that rivers passing through the cities are more polluted than those passing through the rural areas. They also noticed a significant relationship between the size of cities and the extent of river pollution, meaning that the rivers passing through the larger cities are more polluted than those passing through the small cities.

Anzali lagoon is extremely important as spawning and nursery grounds for fishes and as breeding, staging and wintering areas for a wide variety of waterfowls (Scott, 1995). However, the recent urban development has affected the ecosystem of this important natural habitat through water pollution and increased illegal hunting and fishing.

Another example is the pollution caused by Chooka pulp and paper factory adjacent to Anzali lagoon (Near Rezvanshahr), with less than 5 km distance from Caspian Sea considered as one of the major pollutant sources in Guilan province. The untreated waste water from this factory directly transferred to Poonel river and later Caspian Sea causing a heavy pollution for this river and coastline. As we move towards east, the extent

of water pollution and disturbances decrease compared with those of the western part. In the middle part of the region, there is river pollution too. Studies of Mehrdadi (2001) and Mirnia (2001) on Babolrud and Siahrud rivers (in Babol and Ghaemshahr) indicate pollution as a result of urban development as well as industrial and agricultural run off waters. Towards the east, with the decrease in the population density (especially in the urban areas), there is less water pollution. For example, in Miankaleh Peninsula and Gorgan Bay disturbances have been related to the increased poaching and increased pressure for settlement and increased farming activities.

### Soil pollution

Dumping urban waste is becoming a main environmental concern worldwide (Seager, 1995). This is the case for the Southern Caspian Sea Region too. Lack of appropriate methods for the disposal of urban waste has caused several problems in the region. While, in larger cities, urban waste is dumped in open spaces with some distance from cities, in small cities it is usually deposited in any place found around the cities or along roadsides (Sabermaash, 2001). Deposition of garbage in open spaces leads to the pollution of soil through sipping water produced by waste and the addition of indisposable materials like metals, plastics, glass, to the soil. Also the displacement of light materials such as plastic and paper causes unpleasant scenes within or outside the urban areas. This problem is also evident in the tourist sites along coastlines. In designated recreation sites such as Gheesuem, Jefrood, Zeebakanar, Tonkapon, Ramsar, the surrounding soil usually becomes polluted because of the scattering of waste produced in these sites by tourists and because of the lack of any collection system



for garbage. Another cause of soil pollution in the region is the heavy use of pesticides and herbicides in farmlands which contributes to the soil pollution and weakens its productivity.

### Forest cut and destruction of natural habitats

As noted before, the southern Caspian Sea Region has been faced with a rapid urban development over the past decades. Because of the higher level of water tables in the region, urban expansion depends on the choice of the horizontal development. As seen in the city of Rasht, the built up area has increased by more than 100% in less than two decades (Azimi, 2001). This is the case in almost all cities in the region. The spatial development of urban areas has resulted in consumption of more agricultural lands as well as forest cut in many cases. This issue is particularly more evident in the urban areas close to the mountains such as Talesh, Fuman, Lahijan, Siahkal, Langrud, Chaloos, Ramsar, Noshahr, Kalardasht and Amol. Inappropriate system of forest exploitation and wood smuggling, and the overuse of pastures in altitudes have caused several devastating floods in recent years among which we can refer to devastating Masoleh flood in the summer of 1998 and Neka flood in the summer of 2000 each with more than 50 casualties and heavy economic loss, and Golestan's vast flooding with over 250 life lost and extraordinary damage in summer of 2001.

Another major environmental issue in the region is the disturbances of natural habitats. Overfishing and over-hunting threaten the main wetlands in Southern Caspian Region such as in Anzali, Bandar Kiashahr and Miankaleh wetlands. For example, in addition to illegal hunting and fishing in Anzali lagoon, the number of licensed hunters has increased from 6000 in 9170s to more than 20000 in mid 1990s (Scott, 1995). At present one of the main tasks of the Department of Environment and Conservation of Guilan Province (DECG) is to control the illegal fishing and hunting in the lagoon. Another impact of recent urban development in the region has been the decrease of the waterfowl coming to the region for wintering. The destruction of natural breeding areas for sturgeon and the great decrease in the number of the wintering waterfowl during the last decades are examples of this problem (Scott, 1995). The causes for these problems have been

attributed to increased activities, building dams, pollution of rivers, vehicle traffic around the lagoons, excess hunting, boating, construction projects around the rivers and lagoons etc., (DECG, 2002). A good example is the newly begun 16 km ring road construction project in the middle of the Anzali wetland which could severally disturb its ecosystem. Even though, after beginning the construction, the DECG has halted the project, most probably; it will be soon resumed following the political pressures.

### Conclusion

The rapid urban development was discussed as one of the underlying factors for the environmental problems in Southern Caspian Region. The concentration of people in cities and rapid urban growth have mainly been attributed to the regional inequality, especially that between urban and rural areas (Seager, 1995). Therefore, at macro scale, removing the disparities between urban and rural areas and enhancing public awareness about the consequence of environmental problems are essential. However, related to the Southern Caspian Sea Region, some practical solutions are recommended as follow:

- 1) Establishing appropriate sewage systems for urban areas especially in larger cities and prohibiting direct discharge of urban sewage into rivers.
- 2) Improving the existing waste collection system in cities and tourist sites; recycling of durable waste and establishment of compost installations for organic and disposable materials.
- 3) Reconsideration of environmental aspects of urban development policies in order to control rapid urban expansion.
- 4) Enactment of effective regulations to control untreated industrial runoff into river system.
- 5) Effective measures to be taken against the illegal fishing, hunting and forest cut.

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