

Ecological and environmental effects of urban transformation: An example in Turkey

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Received Mar. 5, 2022

Revised May. 31, 2022

Accepted Jun. 28, 2022

Abstract

Sur district in Diyarbakir city like all historical places in Mesopotamia is a city that has rich historical buildings. The urban transformation has become a necessity as a result of the historical process, unplanned construction, change of tools and equipment in transportation, environmental and ecological problems, and social activities. For this reason, urban transformation applications have been started in Sur. As a result of the transformation; the formerly irregular constructions and environment have become regular. Accordingly, many environmental problems have been reduced. In addition to this, due to the exchange in the originality of historical architecture, some negative have been experienced too.

In this study, positive and negative perspective effects of urban transformations on public living and the environment were examined. Situations before and after their transformations were compared and evaluated. The results show that urban transformations have a positive effect majority of environmental effects.

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Published by ARDA.

Keywords: Urban Transformation, Diyarbakir Province, Suriçi Urban Transformation project, Environmental effects, Urban ecology.

1. Introduction

Cities are complex systems. Especially many historical cities have preserved their existence for centuries and have changed in the process. City areas have gone through many phases of natural and man-made problems. Along with resistance to the problem and natural disasters, risks and difficulties have been experienced [1, 2,3,4]. System risks and failures increase in parallel with the design and construction of infrastructure and superstructure such as water supply networks, sewerage systems, transportation, subways, highways and railways, energy supply networks, telecommunications systems, parks, and green areas in urban areas [5]. For example, the complex growth and transformation in the historical places of Diyarbakir have produced a change in these traditional areas. The roads and streets have penetrated and changed the traditional urban characteristic and form of Diyarbakir.

Historical Sur City like most Mesopotamian cities grew on the Tigris River which is abundant in water, that is the source of prosperity to civilizations. Tigris river gave wealth and prosperity to our city such as other cities above it. The city has been developed during history on the bank of the Tigris River as result of the transportation of goods, trade, culture, and massive agricultural activity. This development was made unplanned for the last two hundred years. Cities are built to develop and can be destroyed as time goes on. They can be re-shaped by a specific plan according to today's conditions.



Cities are like living organisms. Just as living organisms are born, develop, grow and age, in the same way, cities are established, developed and their structure can deteriorate over time. The reason for this deterioration can be expressed as population growth, natural disasters, disasters, unplanned construction, war, and physical wear [3,6]. All of these issues of urban regeneration have been brought up to support regeneration. In such a case, transformation becomes necessary

Urban transformation is the process of restoring a region that has become obsolete, collapsed, deteriorated for various reasons. The process includes the historical sites of the city, abandoned industrial and residential areas, and unused port areas. Urban transformation is not only a problem of dysfunctional land social activities but also includes issues affecting the city in general [3,7]. Urban transformation is known as "the period in which structural-functional change is present as a result of the negative economic, environmental, ecological, social and physical characteristics of the city in general or a part of it [8]. In another definition, urban transformation is a community-oriented change that aims to improve the conditions of people living in neighborhoods with low financial income and to protect the natural environment and historical environment, to improve the environmental characteristics of cities, by reducing the negative effects of construction with certain criteria, and to predict the competition of the city and its surrounding districts. It is a process that the plan and the integrated public sector continue [9]. The transformation project is determined as a holistic plan that aims to minimize the problems in the city and to find a permanent solution to the socio-economic and environmental conditions of the changing spaces [10].

European cities had a dense population in the 1850s. The reason for this is the migration from rural areas to urban centers. This situation caused disruptions in health, infrastructure, education. The distributions brought to the collapse of the cities. After two world wars, deurbanization came to obligation. The restoration and revitalization of the places destroyed during the war completely revealed the need for urban transformation in the countries [11]. On the other hand, the functioning of urban transformation has made continuous progress In Turkey. The first steps with a plan for urban transformation have taken place in the first half of the 20th century due to the problem of squatting. During the Ottoman period, important changes were made in the city centers. The population increased after the war. This situation has led to the expansion of new transportation routes and city streets. After World War II, similar to European cities, destructions occurred in Turkey, too. With the beginning of the migration from rural areas to cities between 1955-1980, an unhealthy process occurred. There has been a rapid increase in population in cities in Turkey. As a result of this increase, the process of squatting started and needed urban transformation [12]. Upon this, new projects have targeted urban transformation Sur district located in Diyarbakir as happened in a few cities in Turkey [13].

This study aims to examine the ecological and environmental effects. Our study focuses on the Sur district of Diyarbakir City, located in the southeast region of Turkey. Like all world, Diyarbakir has experienced significant ecosystem and environmental changes during the unplanned urbanization process. However, comprehensive studies on ecological and environmental effects associated with urban transformation are scarce. This application thus serves as a good case to study the ecological and environmental effects in urbanization transformation, which could also provide references for other cities in the World.

2. Study area, data and method

The study area is Sur district within the central urban area of Diyarbakir city, which is located southeast of Turkey (see Fig. 1). Sur district, located in the middle part of the Southeastern Anatolia Region, was founded on the lava of Karadag, at an altitude of 660 meters from the sea, on the edge of the Dicle River. Historical traces and many historical artifacts left by the great civilizations that dominated the district can be found.

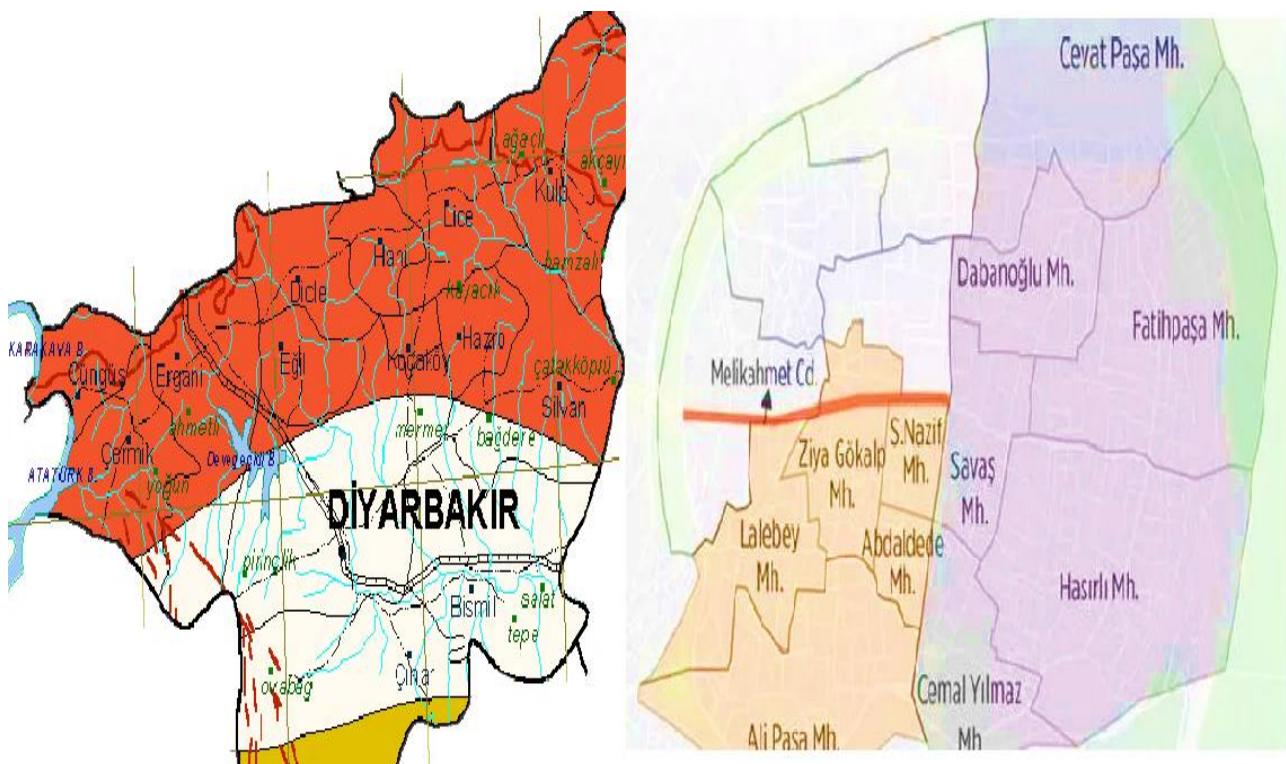


Figure 1. Location of study area (2018)

In this study, a fortification action plan was prepared for the transformation works in the Suriçi region, as seen in Figure 2. Data before and after the transformation were obtained from institutions, supported by tables and graphs, and necessary comparisons were made.

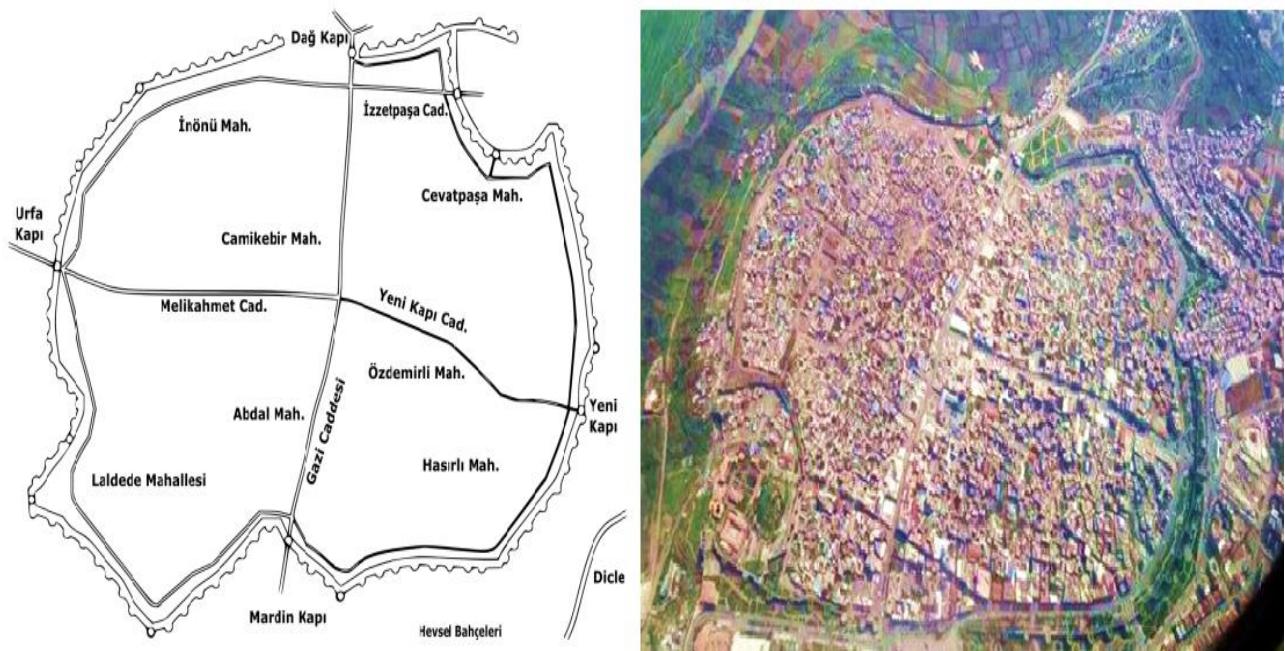


Figure 2. Action plan map and risky area satellite image in Suriçi [14]

The data used in this study were obtained from relevant public institutions between 2012-2020. These public institutions were the Turkey Ministry of Environment and Urbanization and the metropolitan municipality of Diyarbakır. The urban transformation has made in 2015. The data before and after the transformation were evaluated in terms of environmental and ecological change. Thus, the change in a process was evaluated and interpreted.

3. Results and discussion

The urban structure in Sur District of Diyarbakir Province has been destroyed for years, infrastructure problems have been experienced, squatting has increased, which distorts the silhouette of the district, and fire brigades and garbage collection vehicles had become unable to function due to narrow streets. In addition to old and abandoned houses, dilapidated buildings, urban transformation has been become necessary due to terrorist incidents in recent years. In this study, data related to environmental exchanging to the before and after urban transformation were obtained and for each sub-title mentioned below, the environmental effects of urban transformation were evaluated and compared.

3.1. Air pollution

To determine the impact on air pollution of urban transformation in Sur District, Diyarbakir, evaluation was made by comparing data before the transformation and after the transformation (Table 1).

Table 1. Sur District SO₂ and PM10 values by years

Years	SO ₂ ($\mu\text{g}/\text{m}^3$)	PM10($\mu\text{g}/\text{m}^3$)
2012	7	69
2013	18	67
2014	10	62
2015	9	65
2016	7	53
2017	8	49
2018	7	40
2019	8	36
2020	6	38

As seen in Figure 3, while the amount of SO₂ have exchanged in the range of 7 $\mu\text{g}/\text{m}^3$ in 2012, 18 $\mu\text{g}/\text{m}^3$ in 2013, 10 $\mu\text{g}/\text{m}^3$ in 2014, 9 $\mu\text{g}/\text{m}^3$ in 2015 before urban transformation, after the urban transformation have exchanged in the range of 7 $\mu\text{g}/\text{m}^3$ in 2016, 8 $\mu\text{g}/\text{m}^3$ in 2017, 7 $\mu\text{g}/\text{m}^3$ in 2018, 8 $\mu\text{g}/\text{m}^3$ in 2019, 6 $\mu\text{g}/\text{m}^3$ in 2020. It is seen that the amount of SO₂ in years before urban transformation is higher than in years after urban transformation

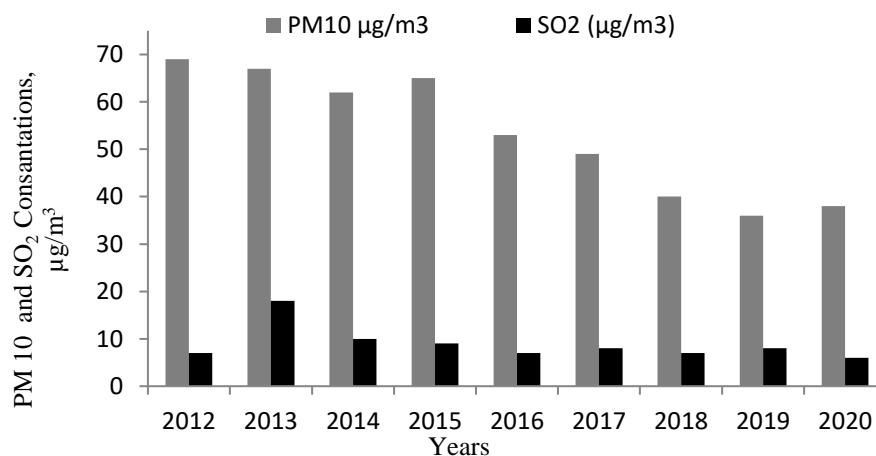


Figure 3. Change of SO₂ and PM10 in Sur District by years [15]

The reasons for this were the poor-quality coal used before the urban transformation, the lack of natural gas and air pollution caused by unhealthy buildings and constrictions. Since the buildings were fixed to suit for using natural gas after the urban transformation, natural gas was provided and thus, using of the wood, coal and waste has minimized. Ruined, scattered and irregular structures which causes dust have been reduced. Also, green areas have been increased. Therefore, a reduction in SO₂ data has been achieved after urban transformation. It can be said that the decrease in the amount of SO₂ in 2016 and later is the result of the positive effects of urban transformation on environment.

Similarly, before urban transformation, while the amount of pm have exchanged in the range of 69 $\mu\text{g}/\text{m}^3$ in 2012, 67 $\mu\text{g}/\text{m}^3$ in 2013, 62 $\mu\text{g}/\text{m}^3$ in 2014, 65 $\mu\text{g}/\text{m}^3$ in 2015, after urban transformation have exchanged in the range of 53 $\mu\text{g}/\text{m}^3$ in 2016, 49 $\mu\text{g}/\text{m}^3$ in 2017, 40 $\mu\text{g}/\text{m}^3$ in 2018, 36 $\mu\text{g}/\text{m}^3$ in 2019, and 38 $\mu\text{g}/\text{m}^3$ in 2020. Since

the region was an irregular and slum area, some citizens were engaged in livestock breeding. There was high rate spread of dust emission from the hay storages using for the animals into the atmosphere. However, after the urban transformation, this situation disappeared. In addition to increase to green areas, dust, smoke, etc. Pollutions which cause to increase of PM such as hay, waste on street and avenues have decreased. In addition, PM originating from bread ovens was minimized after urban transformation.

3.2. Infrastructure status

Since there was unplanned urbanization in the Suriçi region, there was the narrow streets. These streets were an obstacle for municipal vehicles to enter the area. Thus, the garbage could not collect sufficiently. Especially as seen in Figure 4A, and Figure 4C before and during urban transformation, rubbles, medical wastes, waste batteries, construction material wastes were discarded randomly. Since there was unplanned urbanization in the Suriçi region, there was the narrow streets. These streets were an obstacle for municipal vehicles to enter the area. Thus, the garbage could not collect sufficiently. Especially as seen in Figure 4A, and Figure 4C before and during urban transformation, rubbles, medical wastes, waste batteries, construction material wastes were discarded randomly. These were not creating an aesthetically pleasing image. After the completion of the urban transformation, as seen in Figure 4B, with the widening of the roads, the garbage was collected more easily and the ugly excavation and waste images in the environment could be removed. Urban transformation has had a positive effect both in terms of health and aesthetics appearance.



Figure 4. Before urban transformation and after urban transformation Suriçi (2018) [14]

In urban transformation, protection of water quality it is essential, to prevent water pollution and safely transmit clean drinking water from its source to the user. As seen in Figure 4A, during the 2015 terrorist incidents in the Sur region, the drinking water pipes in the city were damaged as a result of the ditch digging incidents in the region and the water in the city. Damaged water pipes brought many negativities. The waters were heavily polluted and many diseases (typhoid, nausea, etc.) have emerged. As can be seen in Figure 5, 25.686 meters of drinking water line has been laid in the region with the urban renewal works and the drinking water problem has been solved.



Figure 5. Images from the drinking water line laying Suriçi after urban transformation (2018) [14]

It was determined that various diseases did not occur as before, since the tap waters flowed clearly. It has been concluded that the transformation has positive effects in terms of public health.

3.3. Solid waste

The amount of garbage collected in the Sur district according per year is shown in Table 2.

Table 2. Amount of garbage collected by years in Sur District

Years	Waste (Ton/year)
2012	55.878
2013	54.347
2014	53.659
2015	51.873
2016	51.503
2017	50.000
2018	40.000
2019	38.000
2020	36.000

When Figure 6 is examined, the waste distributions were obtained to as 55.878 tons in 2012, 54.347 tons in 2013, 53.659 tons in 2014, 51.873 tons in 2015, 51.503 tons in 2016, 50.000 tons in 2017, 40,000 tons in 2018, 38,000 tons in 2019, 36,000 tons in 2020.

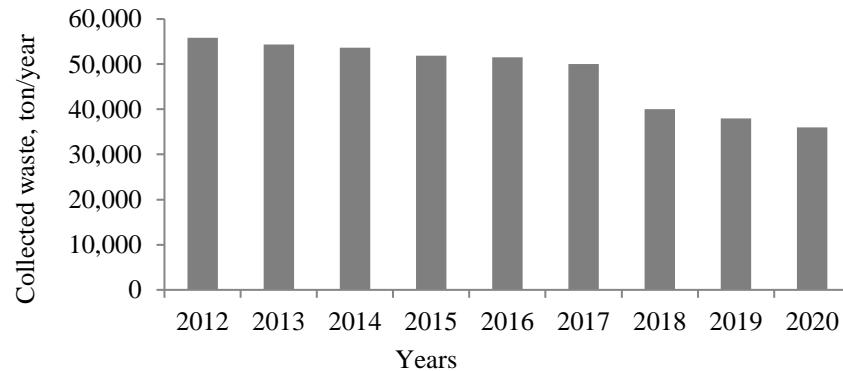


Figure 6. The amount of garbage collected by years in sur district [16]

It is seen that the amount of garbage in 2013, 2014, and 2015, especially in 2012, is higher than in 2016, 2017, 2018, 2019, and 2020. Before the urban transformation, the population was high and the amount of solid waste was relatively high, however it was not collected efficiently. Because the streets were narrow, vehicles could not enter. After the urban transformation, the waste was slightly decreased. This decrease was due to the decrease in population. Normally, the number of solids per population has varied a lot. But the ugly images have disappeared. Wider and regular streets and avenues ensured a more regular collection of solid waste.

3.4. Architectural and historical building

Suriçi traditional houses have been shaped as a reflection of the historical texture. However, during the historical process, squatting and changes in historical buildings have occurred and the architectural structure has deteriorated.

Numerous buildings in Sur district were damaged. Damaged buildings were renovated with urban transformation. Care has been taken not to lose the historical and cultural texture of the buildings reconstructed here. However, the originality of the historical missions and architectural forms of these structures has also been lost. The houses built covered an area of 13.000 square meters. Reconstructed houses were kept small in square meters. The reason for this situation is, while crowded families lived in the past, there are small families now. Bathroom, kitchen, and living room on the ground floor of the two-story houses, bedrooms, and bathrooms are built on the first floor. Basement floors are planned to be used as warehouses.



Figure 7. A view of the newly built houses before and after the urban transformation (2018) [14]

As seen in Figure 7. A, there was a historical texture in old traditional houses. But the structures had a complex and overlapping appearance. There was almost no green space around traditional houses. As can be seen in Figure 7. B, although the new buildings do not exactly reflect the old historical texture, the renovation works have brought a new breath to the city. People's quality of life has risen to higher levels. Traditional architectural structures predicted a healthier and more economical life in houses. Natural a situation had reflected. However, newly made buildings are designed to take into account more current needs. In general, when the renewing evaluation, especially in terms of environment and health, the architectural structure of the houses is considered more favorable. The evaluated data showed that in terms of architecture and history is a negative effect; in terms of general supplies and current need, reception is positive effects.

3.5. Urban transportation and traffic

Before the urban transformation, ambulances in case of any illness and waste collection vehicles could not reach effectively the people due to the narrow streets in Sur. People could not leave their cars parked on the streets of

their houses. Since the Sur region was the heart and busiest place of Diyarbakir, people met all their shopping needs from here. As can be seen in Figure 8. People could not walk comfortably because the streets were narrow and walking areas were difficult. After the urban transformation, as seen in Figure 8. B, the streets have been widened compared to the past and vehicle passages have become easier. It was concluded that urban transformation made a positive effect on traffic and transportation.



Figure 8. A view from Gazi Street in Sur District before and after urban transformation (2018) [14]

3.6. Aesthetic image

The garbage could not be collected regularly because of the narrow streets in the Sur region. There were old and dirty buildings images and unregular workplace signs. These caused the formation of undesirable odor and images in the environment. The sign and shape of the shops in the bazaar had been spoiled the aesthetic image. As can be seen in Figure 9. The shop signs of the bazaar have become quite complex and customers could not identify that they belong to any name. Along with the urban transformation, as seen in Figure 9. B, the signboards of the shops in the district were renewed with a wooden appearance.

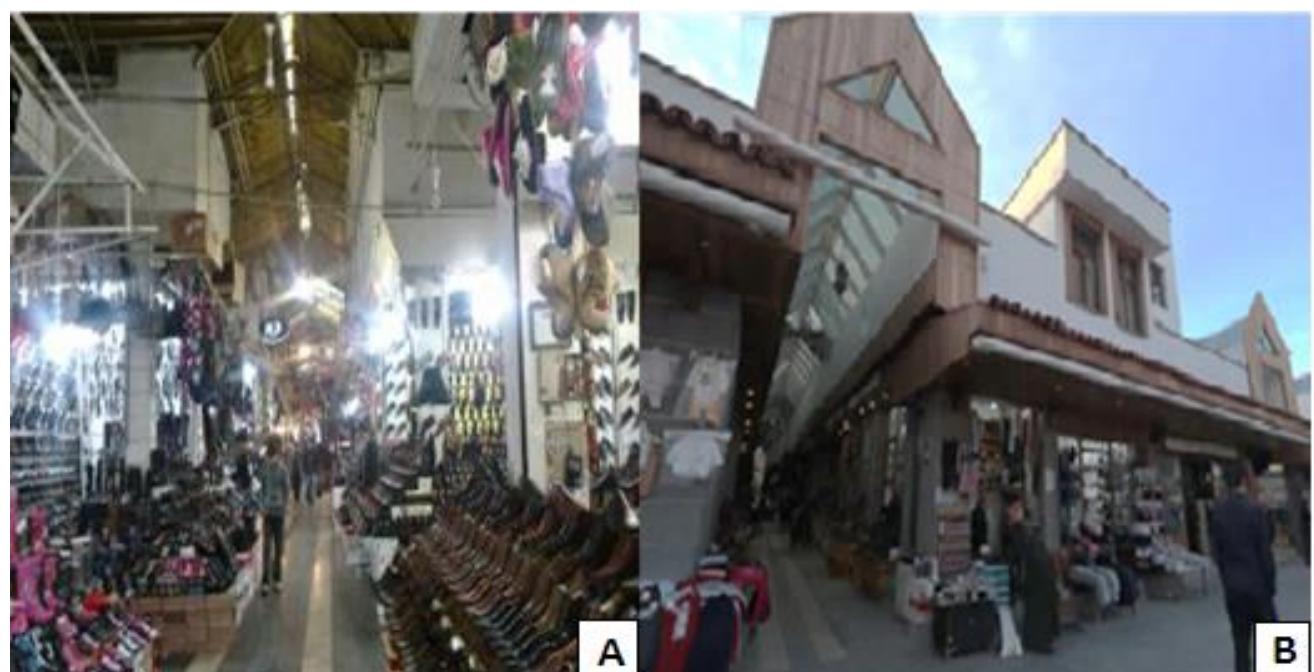


Figure 9. A view from the burned bazaar facade cladding works before and after the urban transformation [14]

In this case, the signboards of the shops were changed with the urban renewal works, wooden signboards were made that appeal to the eye and make the shops attractive. At the same time, garbage collection problems have been removed. Old and dirty buildings were renewed. So, the urban transformation was determined to made positive effect on aesthetic pollution removing and image

4. Conclusions

In the study conducted to determine the environmental effects of urban transformation, the data were evaluated and the following results were obtained:

- SO₂ values decreased in the years after the urban transformation compared to the years before the transformation. Similarly, the amount of PM10 decreased in the post-urban transformation years compared to the years before the transformation. The factors such as the decrease in the use of coal with the urban transformation, the construction of new streets and roads, and the increase in green areas have been effective in this.
- Worn-out infrastructure and sewerage were renewed and built to 28,5 km of new sewerage with urban renewal work in Sur District. Thus, water leaks and problems in wastewater sewage were eliminated.
- There has not been much change in the amount of solid waste after urban transformation. However, the widening of narrow streets has made garbage collection and transportation easier. As a result of this situation, the bad smell and ugly images of the city have disappeared. The earthwork has increased during the urban transformation process. However, it decreased at the end of the process
- The streets have been widened compared to the past and vehicle passages have become easier. So, urban transportation and traffic have been relieved.
- The signboards of the shops in the district were renewed with a wooden appearance. At the same time, garbage collection problems have been removed. Old and dirty buildings were renewed. So, the urban transformation was determined to made positive effect on aesthetic pollution removing and image. The evaluated data showed that in terms of architecture and history is a negative effect; in terms of general supplies and current need, reception is positive effects.

Declarations of competing interest

The authors declare that they have no any known financial or non-financial competing interests in any material discussed in this paper.

Funding information

No funding was received from any financial organization to conduct this research.

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