The land use change analysis of the walled city in Afghanistan

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ABSTRACT
The ramparted city Ahmad-Shahi Kandahar was established by Ahmad Shah Durrani in about 2 sq km area. It comprised four districts with a high-order planned layout and surrounded by a protective wall within six gates and a moat around it. Authentic literature is investigated to monitor the prior land use and detect the variations. Secondary data and GIS techniques are used for conducting this research. It was found that the circumambient wall, gates, towers, central covered market, freshwater streams network and greenery of the city have vanished, even though the functional status of the gates and the bazaars is still remarkably retained. The total road length is altered from 2.35 km to 16.63 km and streets from 28.12 km to 49.55 km, on the contrary, the reduction of streets width from 9 m to 2.87 m denotes an unfavorable transformation. The 1.01 sq km open space of the city is occupied by congested irregular settlements now. Therefore, applying land reform policy for improving the streets and congestion of dwellings with a special approach is highly recommended along with preserving the valuable monuments standing yet as an important part of the Afghans’ glorious history.

Introduction

Kandahar is the home to one of the world’s oldest human settlements, the stronghold of Alexander, and the birthplace of a major fortified city (Arez, 2015; Allchin, 1995). Searching in Islamic sources, the Gandharians’ settlements on the banks of the Arghistan were from this Kandahar (Helms, 1983). It remained a significant urban center and an important trading hub that connected trade routes between the South Asian subcontinent, Central Asia, Middle East, and the Persian Gulf (Anwar et al., 2016; Neelis, 2011).

The province is located in the south of the country at 31°37’09.8”N 65°42’43.9”E (Google, n.d.). Its total area is 54,844.5 sq km (Independent Directorate of Local Governance, n.d.). Kandahar is situated in the middle of a fertile plain and the rivers around it carry plenty of water (Martin, 1907). Mountains’ height reaches about 1,200 m to 2,800 m above sea level and dominates the northern and the eastern parts of the province (Japan International Cooperation Agency & Ministry of Irrigation, Water Resources and Environment [JICA & MIWRE], Japan International Cooperation
Agency & Ministry of Irrigation, Water Resources and Environment, 2004; Taniwal, 2010). Whilst the southern half of the province is largely occupied by a sandy desert, the Registan just south of the city (Observatory, n.d; Findlay, 2015).

Kandahar is bordered by Zabul province to the northeast, Urozgan province to the north, Helmand province to the west, and Baluchistan to the south and southeast (Independent Directorate of Local Governance, n.d.). It also adds that the province is linked by extensive roads with Lashkar Gah provincial capital of Helmand and Herat province to the west, Ghazni province, and Kabul to the northeast, Tarinkot provincial capital of Urozgan to the north, and Baluchistan to the south. Ahmad Shah Baba International Airport (previously Kandahar International Airport) is located in the southeast of the city which connects Kandahar with national and international destinations (Bosworth, 2007). It lays 20.7 km far from the citadel which remains as the office of the governor (Google, n.d.).

**Study area**

Ahmad-Shahi Kandahar was initially founded by Ahmad Shah Abdali in 1756 (Hotak, 2004). And afterward became famous as the modern Kandahar (Helms, 1983). As shown in [Figure 1](#), it is located at the north side of the province and has occupied about 1.2 sq km area (Hotak, 2004; Murrhee, 2013).

The nature of this study is based on library research and mostly secondary data is used for the accomplishment of the article. However, during the process of digitization site

![Figure 1](#)  
*Figure 1. Maps digitized from Atlas of Afghan City Regions 2016 and James Wyld’s map 1880.*
observation and author’s background knowledge about the study area are also used for better analysis of the maps. Data is collected relatively from many books, articles, reports, and logbooks. Other valuable governmental sources such as the Ministry of Urban Development and Land, Independent Directorate of Local Governance, National Statistics and Information Authority, Kabul Municipality, and Kandahar Municipality are searched to strengthen the validity of this research paper. Moreover, multiple reliable and useful online data sources such as the Library of Congress, British Library, and World Digital Library are explored and used for conducting this research.

The basic purpose of the study is to present an account of the urban morphology of Ahmad-Shahi Kandahar with a special focus on its primary land use and land cover. Another important objective of this research is to find out the land use diversity and land use change within the city throughout history. The investigation of these objectives will surely uncover some significant issues which would be subsequently analyzed, compared and discussed as the major findings of the research.

This paper is comprised of three main sections. Section one is the theoretical part of the research which is considered in two subsections introduction and review of the literature. Section two encompasses the method and materials used for preparing maps to find out the land use diversity and detect the land use change. Section two has three subsections the tool which means ArcGIS 10.3 software, the technique of digitization and the materials such as the historical map and satellite image. Section three is composed of two subsections such as the results and discussion section where the findings of the study are discussed and analyzed as well as the conclusion and recommendations section which summarizes the whole study and recommends the important steps to be taken after the research is conducted.

**Review of literature**

Studying the form or structure of something is called morphology (Merriam-Webster, n.d.). According to Moudon (1997) the utmost essential features of morphology are homes, markets, roads, streets, parks, and monuments (p. 1). Urban forms of cities are represented by buildings, plots, and streets but the difference is in the way they are combined (Oliveira, 2016, p. 182; Ministry of Urban Development and Housing, Independent Directorate of Local Governance, Afghanistan’s Independent Land Authority and Kabul Municipality, 2016).

Ahmad Shah Durrani founded the modern city of Kandahar to the east of the old one and appointed it as the capital of his Kingdom (Bosworth, 2007; Ghobar, 1978). It was an important commercial center with approximately 60 thousand residents (Khan, 1979/1991). Just after completing the wall and towers within it, the ditch, and the dome of the central market, he invited famous personalities and made supplications for the best future of the city (Barakzai, 1919; Katib Hazarah, 1913, p. 26). The newly founded city was supposed to be built on 1.2 sq km area and named Ashraf ul bilad ‘most noble of cities’ (Hotak, 2004). It was also titled Dar-ul-qarar meaning ‘the abode of the quiet’, but among the people, it received the old name just Kandahar (Samizay, 1974). Tribes’ names, religious scholars, industrial groups, and famous locations were the standards for the division of area and naming of the streets (Zalmai, 1972).

Ahmad-Shahi Kandahar was founded in a rectangular shape and some parts of the city still cling to its old traditional design and structure in many respects (Society for the Preservation of Afghanistan’s Cultural Heritage, 2004, p. 5). The fort located in the north of the city which is
known as Arg (royal palace) and the towers of the city were built in Iranian and Indian architecture style (Khan, 1979/1991; Najib, 2009). The mausoleum erected over the grave of the founder of modern Afghanistan is the only building of any architectural merit in the whole city (Ashe, 1881; Bellew, 1879). The city was surrounded by a fortified wall with four main gates at each cardinal point and four large circular towers at each corner (Nariwal, 2006; Wyld, 1812-1887). The main gates Edgah in the north, Shikarpur in the south, Herat in the west, and Kabul in the east were connecting the main roads of the city, besides, there were two minor gates, the Bar Durrani on the eastern face and Tope Khana on the western face (Samizay, 1974, p. 25). Ahmad-Shahi Kandahar is quadrangular in shape consisting of a mud wall without revetment of stones or bricks in it (Trousdale, 2021, p. 85). The confining walls width was 6 m at the bottom and 4 m at the top and their height was 7 to 10 m which was called fort (Resha, 2010; Taniwal, 2010). The city was also protected by a 3-m-deep ditch around it (Ashe, 1881).

Kandahar is a beautiful city with a good location (Zalmai, 1972). The city is not too imperial but it is better than many Asian cities (Elphinstone, 1815/2008, p. 421). On the contrary, Kandahar’s streets are much knit and the built-up area is also poorly characterized comparing to the current era (Kazimee, 2012). The absence of fuel and timbers caused the houses walls and domes of the roofs to be built with unburnt bricks in the city (Masson, 1844, pp. 280–281). Approximately 20,000 houses exist in the city which were built up of sun-dried bricks and had flat roofs (Ashe, 1881). By contrast, the burnt bricks and lime are only used in some mosques and buildings (Martin, 1907). The public marketplace in the middle of the town and four main bazaars gave the city a great regularity (Elphinstone, 1815). Chahar Su is the central covered bazaar of the city where the four roads from the main gates intersect here (Masson, 1844, pp. 279–280). Besides the preexistence of a canal with the name of Pataw Ahmad Shah Abdali ordered to drag another canal from the Arghandab River for the succulence of the city (Hoseyni Jami, 2005). Elphinstone (1815) notes that the freshwater network covers almost all streets within the city which is charged by two large canals drawn from the Arghandab River. The main bazaars are built with wide avenues having trees and canals along either side of the avenues which are better supplied with river water (Masson, 1844, p. 280). On the other hand, Resha (2010) mentions the preplanned wastewater canalization system of the city during the establishment. According to him, it was admirable as he had seen a part of the underground wastewater system.

The industrial revolution as a major transformation has altered the course of human life and caused to stimulate the growth of urban societies (Pacione, 2009). However, Kandahar city did not follow it and for almost two centuries the limits of this planned city remained unchanged and we cannot observe any remarkable urban expansion (Taniwal, 2010).

In the early 20th century, the city was expanded westward along the road to Herat by the name of Shar-e-Naw ‘new city’ (Society for the Preservation of Afghanistan’s Cultural Heritage, 2004, p. 5). Later on, the walls have been replaced by streets and boulevards and a big avenue with a straight road was built in 1947 north of this planned city by the department of urban development (James, 1812–1887; Taniwal, 2010). Society for the Preservation of Afghanistan’s Cultural Heritage (2004, p. 5) report describes that the city was expanded as the walls and gates were torn down for building new governmental structures and the streets were widened at the same time. The report also adds that the Herat Gate intermediates between the new city and the old one as it once stood, in the
center-west of the rectangular city. The dome, which spanned over Chahar Su (main crossroad), was dismantled in the 1930s (Wiebe, 1975).

Almost all business centers, shops, and caravanserais existed in the bazaars and most of the population also lived there (Minoia & Pain, 2015). Artisan activities had gradually invaded the major part of the city’s main streets, starting from the initial central nucleus of the Chahar Su and proceeding particularly north toward the area of Arg, where most of the administrative buildings had been established (Resha, 2010). Work and life activities were inextricably mixed, with most of the shopkeepers and artisans living behind their stores or workshops, but only a few buildings of the Chahar Su did not contain residences (Wiebe, 1975). Activities in the city are organized similar to the Muslim cities’ historical pattern and the center of the city Chahar Su is the area where the concentration of high price products is gathered here (Toepfer, 1971). The multi-story buildings were established in Chahar Su for the first time; therefore, it was known as the high rate, the unique modern class services, and money gaining area (Wiebe, 1975).

A city surrounded by high walls with gates for easy access to all directions is called the walled city and besides that it is bearing all the characteristics of a city and has the amenities needed for the city’s residents survival (Upadhyaya & Jakhanwal, 2015). Multiple functions such as defining a ruler’s territory, distinguishing the boundary of the city, and keeping the security of the city’s residents are played by the walled cities (Bennison & Gascoigne, 2007). Different historical periods could be presented by walled cities around the world (Creighton, 2007). In analyzing cities, walls are the important elements worldwide and they are sometimes the focal points to be studied (Nelson, 1961). Walled cities were more populated in the past and had a high rate of employment than now (Ioannides & Zhang, 2017). Nowadays modernization is forcing pressure on walled cities around the world so they will soon be deteriorated and lose their multi-functional role (Rghei & Nelson, 1994). Many walled cities had played a vital role in nation-building and politics during history (Creighton, 2007). Usually, walled cities were built because of security concerns and regular attacks from enemies so the ruler’s major concern was to consider the safety of their nations’ lives and goods (Upadhyaya & Jakhanwal, 2015). However, Ahmad Shah Durrani founded this walled city to shift and accommodate the residents of the old city here, because of the old city’s harsh and swampy land and unsuitable climate (Hotak, 2004, p. 13). Walled cities were well planned and all of the various elements such as bazaars, religious places, monuments, roads, streets, and residences were surrounded by moats and walls (Upadhyaya & Jakhanwal, 2015, p. 204).

**Method and materials**

**Research design**

The current study mainly relied on comparing a historical map and a satellite image in order to find out the land use diversity and detect the land use change in urban morphology of Ahmad-Shahi Kandahar within the period. ArcGIS 10.3 software was a standard tool and suitable equipment to perform this task with the help of digitization technique and conduct the research. After producing the maps, they were analyzed to elaborate the land use diversity and morphological changes. The study suggested
solutions to the problems in accordance with current city planning policies in Afghanistan.

**Tool and technique**

ArcGIS 10.3 version from GIS software was used to digitize and produce new maps for the research to detect the changes that occurred between 1880 and 2011. Two maps entitled land use/land cover, and roads and streets network were digitized from James Wyld's map drawn in 1880. Besides that, two other maps entitled land use/land cover and roads and streets network were digitized from WorldView-2 satellite image acquired on 28 March 2011.

**Historical map**

A map drawn by James Wyld was downloaded from World Digital Library. The map was geo-referenced for digitizing new maps from it with the help of ArcGIS 10.3 software and then precisely analyzed for investigating the targeted objectives of the study. The foundation stone of the city was laid out on 1756 and James Wyld illustrated the city map after 124 years on 1880 which denotes that the researcher cannot guarantee it is the first form of this city. On the contrary, there would have not been too much difference between the foundation and James Wyld's illustration. The reason behind this claim is the current urban characteristics, its typical morphology, and the status of the features within the city.
**Satellite image**

The satellite image is the best source of spatial analysis to detect and analyze land use and land cover changes of an area. Therefore, the satellite image which is used for conducting the research to detect the changes is obtained from Kandahar city municipality and used for finding the variations of the city during the history.

The land use and dwellings classification presented in this article is largely based on the visual interpretation of a very high-resolution satellite image with 0.56 meter spatial resolution acquired by WorldView-2 on 28 March 2011. To develop land use maps and dwelling counts, the image is able to support as it is used for urban planning and land management strategies and programs. The accuracy of the image is enough sufficient and fair to be used for interpretation. Therefore, I was able to distinguish built environment features, for example, individual compounds, buildings, and structures, as well as roads and streets.

Considering the nature of the city, one point should be clearly mentioned that mixed-use of residential and commercial land is an accepted culture of Ahmad-Shahi Kandahar. For example, a shop in a residential area is classified as residential land use and a house in a commercial area is classified as a commercial area.

**Results and discussion**

Ahmad-Shahi Kandahar was built on 2 sq km flat land area and a ditch around it. It was also surrounded by a 6.35 km long wall, with an 8.22 m height, and an average width of 5.33 m. As it appears from Figure 2, the city was well planned in its primary layout, which was

Figure 2. Maps digitized from James Wyld’s map of 1880 and satellite image of 2011.
similar to a rectangle elongated from north to south. Ahmad-Shahi Kandahar remained within the same area and boundaries for more than two centuries, even the houses and building forms were unchanged. Tribes, religious scholars, industrial groups, and famous locations were the standards for the division of area and naming of the streets at that time. It had one citadel, four bazaars with a covered central market, four main gates, and two minor ones for ingress and egress. It was found that the settlements occupied 0.99 sq km and the remaining 1.01 sq km was open space. Within the city areas were specified for residence, governmental offices, military installations, mosques, commercial groups, and greenery.

**Land use land cover**

Generally, the homes were one-story buildings with having a basement. Nearly all of them were built with timbers and unburnt breaks with flat or dome-shaped roofs. It is remarkable to denote that the urban fabric was not changed completely except for the bazaars where the one-story shops were replaced by multi-story buildings. The open space area which was more than half in the beginning had totally changed to settlements. Due to the division of house land between families’ members, they were too much congested and had no regularity.

Comparing the maps in Figure 3, many variations have taken place during the urban history. There were only two main roads from east to west and north to south intersecting each other at the center of the city called Chahar Su with a total length of just 2.35 km and about 20 m in width. Currently according to the 2011 satellite image, the city was connected with 16.63 km long roads with a mean width of 23.38 m. Two types of streets were connecting all the settlements and residents within the four districts of the city. The primary type of streets was connected with main roads while the second type of streets was the sub-
sections of the primary ones. The primary streets were 18.81 km and secondary streets were 9.31 km long both types of the street had an equal width of about 9 m. However, the streets were increased in number and length which is about 49.55 km, but their mean width was decreased to 2.87 m. Four bazaars were placed along each side of the main roads which are still playing an essential role as a commercial area, in addition, the commercial area is expanded from 0.14 sq km to 0.79 sq km. The citadel was a complex of governmental offices built in 0.08 sq km while 0.11 sq km land was dedicated for the military compound and 0.04 sq km for Ahmad Shah Abdali’s tomb. Four residential districts occupied 1.21 sq km land of the city which makes 60.5% of the whole area.

Roads, streets and freshwater streams network

The ditch was filled up, the wall around the city was destroyed, and the land was added to the city; therefore, the area is changed from 2 sq km to 2.24 sq km. Moreover, from 1.01 sq km open space nearly all of it was covered by settlements. The two main roads were slightly widened, and few of the primary streets had left their places to new and broad roads, however, most of the 9-m-wide streets of the city are narrowed to an average of 2.87 m which is a big and awful alteration.

Two freshwater canals from the Arghandab was irrigating the city, and streams were spread to almost every street and had made a network of irrigation. However, the map drawn by James Wyld shows that two other canals were also supplying water to the city at that time which no citations were found with this regard. Considering the history of the canals it is inferred that these four canals were not supplying water at the same period of the time. For the purpose of the greenery, the city had a garden with the name of Shalimar Bagh at the northeast section of the city, and it was also functioning as a park at that time. Moreover, a stream of freshwater was flowing alongside the main roads irrigating the roadside trees. And almost every home in the city had a stream of freshwater, as a result, the city was flourished with trees and verdure.

Table 1. Ahmad-Shahi Kandahar according to geographer James Wyld 1880.

| No  | Item                           | Area (Square Kilometer) | Length (Kilometer) | Mean Width (Meter) | Height (Meter) |
|-----|--------------------------------|-------------------------|--------------------|--------------------|---------------|
| 1   | Residential Area               | 1.21                    | -                  | -                  | -             |
| 2   | Commercial Area                | 0.14                    | -                  | -                  | -             |
| 3   | Citadel                         | 0.08                    | -                  | -                  | -             |
| 4   | Military Compound              | 0.11                    | -                  | -                  | -             |
| 5   | Green Area                     | 0.03                    | -                  | -                  | -             |
| 6   | Ahmad Shah Abdali Tomb         | 0.04                    | -                  | -                  | -             |
| 7   | Non-residential Area           | 0.03                    | -                  | -                  | -             |
| 8   | Cattle Market                  | 0.02                    | -                  | -                  | -             |
| 9   | Grass Market                   | 0.02                    | -                  | -                  | -             |
| 10  | Roads                          | 0.04                    | 2.35               | 20                 | -             |
| 11  | Primary Streets                | 0.16                    | 18.81              | 9                  | -             |
| 12  | Secondary Streets              | 0.08                    | 9.31               | 9                  | -             |
| 13  | Fresh Water Canals             | 0.01                    | 4.60               | -                  | -             |
| 14  | Fort                           | 0.03                    | 6.35               | 5.33               | 8.22          |
| 15  | Total Area                     | 2                       | -                  | -                  | -             |
Table 2. Ahmad-Shahi Kandahar according to satellite image 2011.

| No | Item                          | Area (Square Kilometer) | Length (Kilometer) | Mean Width (Meter) |
|----|-------------------------------|-------------------------|--------------------|--------------------|
| 1  | Residential Area              | 1.224                   | -                  | -                  |
| 2  | Commercial Area               | 0.41                    | -                  | -                  |
| 3  | Citadel                       | 0.04                    | -                  | -                  |
| 4  | Ahmad Shah Abdali Tomb       | 0.04                    | -                  | -                  |
| 5  | Roads                         | 0.38                    | 16.63              | 23.38              |
| 6  | Streets                       | 0.14                    | 49.55              | 2.87               |
| 7  | Fresh Water Canal             | 0.006                   | 1.36               | 4.57               |
| 8  | Total Area                    | 2.24                    | -                  | -                  |

Land use land cover data comparison

It seems in Table 1 that the land use diversity due to various purposes was considered in the first layout of the city, but to compare with Table 2 the study detected a remarkable land use change. The residential and commercial areas were expanded by adding land from the military compound, green area, and non-residential area. On the contrary, the regular and broad streets mentioned in Table 1 are remarkably changed to irregular and very narrow streets in Table 2. Table 1 tells us that Ahmad-Shahi Kandahar had just two main roads with less than 3 km length intersecting the center of the city and streets with no more than 30 km length. However, the scenario is highly changed in Table 2 because new roads and streets are established. The total roads length reaches to about 17 km and nearly 50 km streets are connecting the city residents.

Looking from different perspectives Ahmad-Shahi Kandahar’s morphology could be explained in various ways. Through this study, it is comprehended that the city was well projected to be enough for the accommodation of its residents for more than a century. The traditional house design is evolved on basis of religion, culture, and climatic considerations. Housing and settlements styles were generally a single story with the basement as the city’s accepted culture. As summers are very hot and winters are cold in Kandahar so the basement is the best way to struggle with hot and cold weather without other expensive methods. Most of the houses are subdivided and this division has remarkably lessened the yards of the dwellings.

The walled city today is known as the congested area of current Kandahar city. All of the open space has already left its place for settlements and the city is characterized as bearing the highest residential density. Moreover, with the occupancy of the open space new, but very narrow streets have come into existence. However, some streets are widened and they are known as main roads, but with the duration of time, most of remaining are straitened. As a result, it seems that the residents living in the narrow streets of this city are suffering from many problems such as car parking, canalization system, congested and small homes, and absence of playgrounds and parks. The increasing commercial activities have changed it to be known as the central business district and many homes are replaced with commercial buildings. This variation is caused the dwellers to suffer from noise and air pollution which is a caution of risk for them.

With conducting this research to detect the variations in urban land use many differences were found, for example, all of the open space has left its place to settlements. Old commercial areas were widened and new ones were added in the form of multi-story
buildings. As well as the road and street lengths were highly changed, but the streets’ widths were dramatically lessened.

As we know, peace and the physical growth of the city are factors that caused to fill up the moat, destroy the wall and extirpate the gates forever. The absence of these elements is the essential part that has culturally and historically declined the value of Ahmad-Shahi Kandahar. Unfortunately, governments have forgotten to pay attention to these valuable monuments and keep them far from destruction.

One of the sorrowing issue is the full absence of the freshwater streams and trees on the lanes. The culture of roadside trees and trees at home is totally forgotten within the gated city now. There is not even the sign of a single freshwater stream they are all dried up except for the canal which is passing through the heart of the city from west to east. It is now functioning as a part of the city’s wastewater and rainwater canalization system. Currently, people are using groundwater for all of their daily needs in the city.

We realize that it is a very complex task for the government and city planning involved administrations to apply Kandahar city master plan here. A special development approach is needed under the jurisdiction of the development authority and Kandahar municipality to apply an appropriate plan for the improvement of this historical city.

Conclusion and recommendations

We will never touch the high walls with towers in it and there are no gates to enter through it and no central covered market to walk in for shopping, besides that, the only remaining freshwater canal is functioning as the city’s sewerage. In addition, the greenery section of Shalimar Bagh, the military compound, and the non-residential areas are not there anymore and the land is changed to residential and commercial areas. On the contrary, Ahmad-Shah’s Tomb, the citadel, the harem and some historical mosques are still standing and some of them are repaired in almost every regime.

Streets have taken the shape similar to a spider’s web, no open space exists in the form of parks and playgrounds and the absence of roadside trees is another disappointing issue. These are the most significant elements of today’s cities so it is recommended that urban development and planning administrations have to understand the importance of the issue.

Moreover, from the touristic view the historical structures could be a better source of gaining money for the government as a result, it is recommended to maintain these monuments and they should be conserved with adequate care and professional maintenance because their preservation tells the story of Afghans’ bright history of that era.

Disclosure of statement

No potential conflict of interest was reported by the author(s).

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