

eastern dome of Islam”.

5. In this map all the Hauzes and cemeteries which were located in various places such as Bāb Banī Asad, Houibari quarter, Rigistan quarter, Chashmeh Ayub and other scattered cemeteries in north, that mentioned in Arabic documents, were relocated and according to the structure of the city routs presented in the map of Parfenov Fenin, also considering the name of the sites and buildings in the legend of this map, the possible structure and direction of the water system in the 10 century were proposed. in this map all the elements which shaped the water system in those days, were located related to the Rabad, inner city, city wall, city gates and so-called public ensembles.

6. Between water system in the 19th century (in this map) and the map in Fig 2 (presented water system in the 10th century), there is a considerable difference. That is, the Nukhanda Canal, which had an important role in the water system in the 10th centuries, just vanished from the map of Bukhara in the 19th century. this article does not aim to relocate the canals way between the city, although according to the attempts of the Russian and westerns researches seems impossible. Therefore this article use the map of kouchadamov as a reference despite its Lack of strict compliance with other historic documents from Bukhara.

7. In the “History of Bukhara” by al-Narshakhi we read about the Sām khāsh wetland in the Beikand: “... and Arsalan khan Muhammad Ibn Soleyman built Beikand... and the water of Harām Kām lead to that place, and there are all just vast Canebrakes grand ponds, they called this place Pāragin and also Karakul. and I heard people were saying that it is around 125 km \* 125 km ( 20 Farsang) ... and you could not find such amount of birds and fishes in all Khurasan(al Narshakhi: 1951: 26).

8. “... the most pleasant places in the city, is the place called above vault (sār-i-Tāq) where the sub canal flowed beneath... at the end of the city in the bank of brook we found the tomb of the molana Badr-al-Din ... the tomb of the molana Shams al Din Mahbubi, son of the Molana Jamal al Din situated in the east of the Cheshmah-i- Ayyūb (The Fountain of Job)... near the Hauze where situated the tomb ...” (Moeen-al-Foghara, 1960: 2,34).

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## Conclusion

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Although the water system of Bukhara in 10th century, as describe in those days's documents, and the water system in 19th are not congruent and there were important differences, but we could follow the same dominant principles through centuries in the Bukhara's water system. This study showed that there were 9 strong principles lead the formation and development of the water system as same system during 10 centuries. there were strong link between different aspects of the water system and the physical structure and also the cultural and social structure of the city. This multiple relation raised the Bukhara's water network from the mere natural and functional network in the multifaceted system with the infrastructural position. In this case the water system above its initial role as a water distributor in the city, lead the more important role in the cultural, social and in the same time physical and functional structure of the city. In other hand, the process of degradation of the water system in Bukhara from the early 20th

century has shown that despite the functional needs of the water distributed by the system, neglecting the looking after the water system's elements among the citizens beside the disappearance of the respect and scarcity of the water and the water system led to the water system's collapse.

Reciprocal comparison of the dominant principles of the water system in its heyday and its downfall resulted that, at the time of shaping the water system the physical- functional aspects were preceded and the social- cultural aspects and events were invented to power up the sustainability and formidability of the system during the centuries. The degradation of the water system was started with the decadence in the subjective lien between the water system and the citizens of Bukhara, and in the next step the water system completely ruined by the disappearance the functional dependence to the water system in modern days of 21th century.

## Endnote

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\*. This paper rewriting an author's article entitled "Boukhara water network as the landscape infrastructure of the city The rise and fall of an urban landscape infrastructure" which have been published in the Journal of Bagh-e Nazar (Vol.8, No31, Winter 2015).

1. Landscape infrastructure is the green infrastructure in the city witch integrated into the urban structures in different aspects from objective (physical or functional) to subjective (social, cultural,...), and raise from mere urban utility to the more effective infrastructure in various facets of citizens. In fact, the most important part of the urban landscape depends to the presence of this infrastructure within the city.

2. Bukhara, situated on the lower reaches of the Zarafshān River: This spot land called Bukhara was the wetland (al-Narshakhi, 1972: 8). the Zarafshān River, was given the Bukhara as sufficient water as it needed, distributed via the network of the canals to the farm land in the city's wall (Fray, 1987:55).

3. Mollahzādeh (Moeen-al-Foghara) in "The Cemeteries of Bukhara" pointed out the location of some water reservoirs (Hauzes), in relation with the cemeteries and other famous places: Moghdām Hauze ( in front of Tal-e- khājeh (Khojā) Chārshanbeh near Bāb al-Maydān), Kākā Mazār Lulihazā Hauze in north of Khājeh Pārehduz, Darvazeh Kalabād Hauze, one Hauze near Chashmeh Ayub (Moeen al-Fogharā, 1960: 34,39,69). Also Narshakhi in "The History of Bukhara" pointed som Hauzes whiten the city: "... in the other side, from Rigistān to Dashtak, there are all adorable houses and guest houses with considerable ornaments and delicate chāhār bāghes, and fragrant hauzes, and huge trees, in a way there is no particle of sunlight achieve seat places near hauzes..." (al-Narshakhi, 1972: 38).

4. One of the most valuable topographical document on pre-soviet Bukhara is the map of Parfenov Fenin. it is the base of all waorks, which deal with the topography of the city in the pre- soviet period. the first draft of the map goes back to the year 1872. around 1910 the present form of the map had been finished, and in 1911 the most valuable legend to the map with not less than 530 sites and buildings was added (Sukhareva, 1976,10 in 2003: 68). The author used the coloured version of this map republished in 2003 in "Boukara: the

shops of copper and blood- letter runs into the stagnant water in small brooks .... the water teems with the eggs and larvae of the rishta and numerous infectious bacilli; it makes one wonder that the town is not oftener afflicted with epidemics, which is comparatively seldom the case...” ( Gangler, Gaube & Petruccioli, 2004: 66; olefson,1911: 537)...

“...most of the drinking water and water for cooking purposes is, on the contrary, fetched here in spite of the stench, which rises from them in summer ...” (Ibid).

Finally, in the early 20th century, when the Bolsheviks contested Bukhara, over hundreds of hauzes were filled in for reasons of public hygiene at the beginning of the Soviet era and vanished from the urban fabric of Bukhara (Chuvin & Degeorge, 2003 :97)(Fig.12).

The important point which reveals here is that in spite of the functional needs of the water distributed in the city by the traditional system in the late 19<sup>th</sup> century, the regard and respect to the water system and its components were distinctly degraded. Therefore, quality of water and also the physical condition of the water system's components abased.

Hence, the first step leads to the water system to the complete destroy were not the lack of functional needs of the system, but loss of subjective lien between the city and water system. After these issues were led to the water pollution and the physical destructions concerning water system in different levels, by piping water to Bukhara, the functional needs of the tradition water system was finished, the water system was completely ruined (Table 2).

Table 2 : The degradation process of Bukhara water system. Source : author.

|   | <b>Statements</b>   | <b>Principles</b>   |
|---|---|---|
| ١ | their washing natives the sees one when lost is idyll the of charm the of some But melons fruits, from refuse of sort all throwing and them, in cloths, or legs and arms [cleansed rarely very are hey etc.]  | <b>of aspect subjective the of Destruction emsyst Water</b>   |
| ٢ | infectious numerous and rishta the of larvae and eggs the with teems water The by covered are canals smaller the manner[ badly a such in open is main the bacilli] presence, their notice not does one generally that so loads, and rice boards, beams, water yellowish muddy into fall and | <b>system water Ignoringmaintenance components system water the of quality law The of life day the among nuisance become and citizens</b> |
| ٣ | piping by city the for water providing by and Bukhara contested Bolsheviks After disappeared system water the to need eternal the water,  | <b>the of needs function the disappearing system water</b>  |
| ٤ | hauzes of hundreds over system, water the to needs functional the disappearing By era Soviet the of beginning the at hygiene public of reasons for in filled were   | <b>system water and destruction Physical vanished</b>   |

in everyday life of the citizens, shapes the irrefragable lien between water systems and cultural, social and commercial life of the city and in more important ways between the water system and the subjective perception of the citizens of their own city. In fact, there are various physical and non physical actions shaped the subjective integration between citizens and the water system.

Analysis and interpretation of what we have seen from historic reviews of the Bukhara water system and its relation with the city in various aspects, lead us to the define the dominant principles in the formation and development of Bukhara’s water system during 10 centuries (Table1).

### Downfall of the Bukhara’s water system

Looking at the life of the Bukhara’s water system at the time of degradation, reveals the role and the importance of each so-called principle involve the time system’s formation and developments. As we have seen, in 5th and 6th centuries the water system was in its heyday. In all documents from those days we faced with the characteristic and in some way romantic Hauzes (ponds) in the

best quality, within the city. Although we also heard from the water which used for the washing in bad condition “... at the side there are wooden shacks with doors where they wash ... the water is filthy and a lot of garbage is thrown into it. (Al-Moqaddasi in Gangler, Gaube & Petruccioli, 2004: 66).

But we face with the dreadfully other side of the water system in 18th and 19th century as reflected in documents and diaries from Bukhara: As Olefson the Danish tourist describes Bukhara in the late of the 19th century we could imagine the condition of the system in its last time of presence: “... but the smaller canals are covered by beams, boards, rice and loads, so that generally one does not notice their presence, if a horse does not step through the rotten cover, or they open the gratings which lead down to the water and are placed there that the inhabitants may be able to fill their leathern bags with the muddy, yellow water.” (Gangler, Gaube, Petruccioli, 2004: 65\ olefson,1911:516).

Or in other places he noted: “But some of the charm of the idyll is lost when Or ione sees the natives washing their arms and legs or cloths, in them, and throwing all sort of refuse from fruits, melons etc. in to them and that blood from the

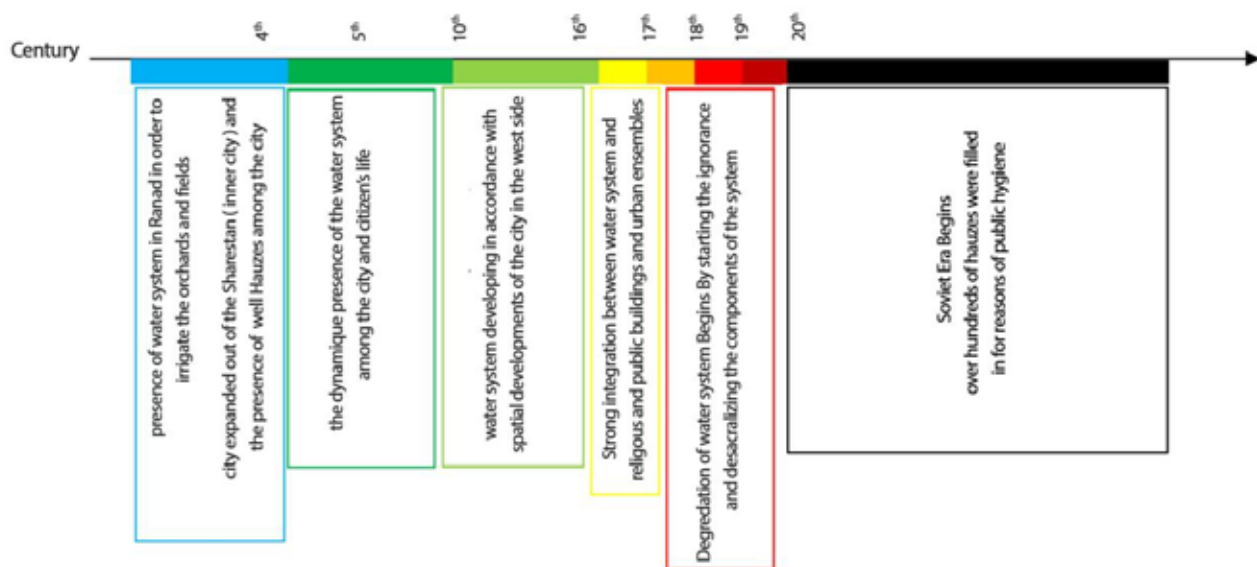


Fig. 12 : The water system of Bukhara’s time line from beginning to the end. Source: author.

when the city developed in south, north and west outside the Shāristān (inner city), the multi faceted relation between water systems and urban structures of the city have developed, in different layers and scales, in the 10th century:

- The way that the city expanded and developed reciprocally related to the water system.
- During city development, water system, consisted of Nahr (main canals), Jouy (subcanals) and Hauze (water reservoirs, ponds), expand in accordance with its old patterns. since new quarters( such as

Jouybāri and jouy-i-moulian) forming, canals and sub canals are developed and new city centres in these new quarters furnished with new ponds with same old pattern.

- The water system elements have a strong link with strategic functions and zones in the city; all Houzes turning to the characteristic centres for quarters and in larger scale the city, sometimes plays the role all alone but mostly in combination with other religious buildings.
- The symbolic presence of water system elements

table 1: Dominant principles of formation and development of Bukhara's water system. Drawn by author.

|   | Statements   | Principles   |
|---|--|--|
| ١ | land and topography the to according Rabaz the through flew city, the inter river Zar ,west the in city exit and , slope   | <b>and system waters between Integration land the of features topographical</b>      |
| ٢ | the at run they streets, the of alignment the follow they canals Tertiary and canals Sub streets of sides  | <b>and system water between Integration structure spatial urban</b>                  |
| ٣ | the to relation in sites private or ensembles public in made Hauzes Traditionally, and Khangah madrassa, mosques, as such buildings public and religious or cemeteries, .Hamams cases some in  | <b>and system water between Integration sites and buildings Religious and Sacred</b> |
| ٤ | activities, commercial hauzes, around occurs mostly were Bukara in life social The for place the was Hauzes around squares Hauzes, near formed markets flea especially citizens the for times spare in gathering and chatting  | <b>and system water between Integration activities social and recreational</b>       |
| ٥ | octagon the : centuries during Hauzes constructing in instruction aesthetic Similar trees apricot and elms by surrounded water, the to down leading steps stone with ponds   | <b>and formal unique and same Following instruction aesthetic</b>                    |
| ٦ | activities and ceremonies special with contribute Hauzes of utilisation and Construction charity a as made Hauzes trees, elm the planted himself Baig Olugh Hauze-I-Lab at : engraved construction of date the and benefactor of name the and activities farewell and .Hauzes in     | <b>and system water between Integration ceremonies state and cultural social,</b>    |
| ٧ | the inter water where place the in Lion of Head of shape of utilization a were There as such places sacred the with integrated mostly Hazes motives. different in Hauze, secreted was Hauzes some of water the that belief a was there   mosques and cemeteries remedy a as used and | <b>and system water between Integration beliefs ritual and religions</b>             |
| ٨ | by or clergy the of states the by viziers, their Emirs, by made were ponds the of Most works public and welfare a as merchants, of circles larger  | <b>Interactive and Participatory management</b>                                      |

planted the elm trees...”(Gangler, Gaube, Petruccioli, 2004: 66). Most of the houzes were made by Emirs, their Viziers (Kushbaigs or Divanbaigs), by the states of the clergy (vakuf) or by a larger circle of merchants as a utility work. There is another intresting point wher Hauzes, like the one near the mosque of Hazreti-Halfa-Kudait is covered by a cupola, built up of burnt bricks... The pond of Hazrati-Halfa-Kudait is [now] considered as holy, and the water drunk as remedy (Gangler, Gaube, Petruccioli, 2004: 66).

**5. Water system of Bukhara and its symbolic aesthetic**

The most remarkable fact about the water system of Bukhara is that the same aesthetical regulation

shaped the houses during 10th centuries. All the large or small hauzes in Bukhara formed in octagonal always provided with stone steps lead down to the water, and shaded by elm or mulberry trees in four sides (Fig. 10).

Often the place where water entered Hauzes, was ornamented like a head of a lion in different models. the poetries graved on the line were noted the one who made the Hauze and the time when it’s done (Fig. 11).

**The dominant principles in formation and development of Bukhara’s water system in its heyday**

As we have seen lately, from 10th century,

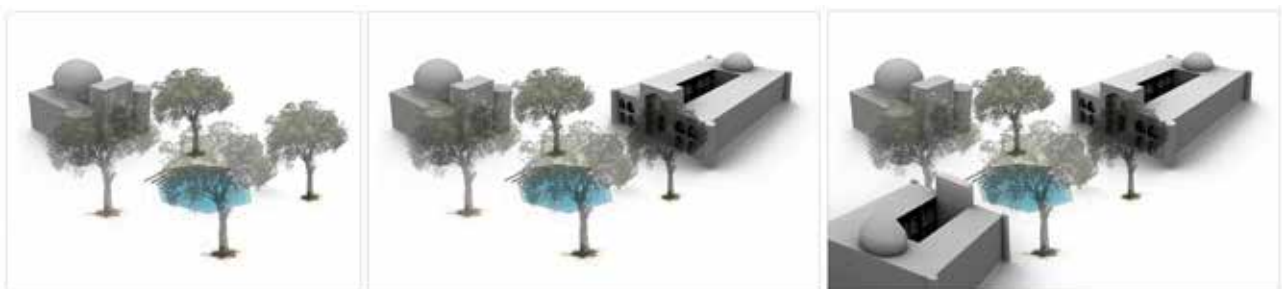


Fig 10 : the dominant aesthetic pattern of Hauzes(ponds) within the urban areas ; the octagon ponds with stone steps leading down to the water, surrounded by elms and apricot trees, mosque or/and one or more religious buildings. Drawn by : Author.



Fig 11 : An example of the places where water entered Hauzes, which was ornamented in a shape of lion’s head in different models. reference : Author-2009 & Timur & Mankovskaja,1991

I-Divanbaigi [lab-I-hauze-I-Diwanbaigi]... It's smaller than rigistan but prettier, the pond being on all parts surrounded by large, shady elms and apricot-trees by which stops and straw-tents are protected from the dreaded summer sun... on the three side it is enclosed by dense mass of chaikhaneh[tea house], fruiteries, and confectioners shops, tables with warm and cold dishes shaded by durra-mats, barbers, coppers and surgeons shops and shops where leather bags are inflated his are sold... Labhavs-i-Diwanbaigi[lab-i-hauze-i-Diwanbaigi] is like Rigistan as lively as a bee-hive. people hustle and push one another, bargaining, crying and scolding steams from samovars and cauldrons, smoke from water pipes stench from the boiling and fired dishes from a cloud over a swarm of white, red and blue turbans, above the pond and the stone terraces which are the favourite play ground for children and the stage for buffoons and jugglers" (Olufsen,1911: 542)(Fig. 9). Or in others about Lab-i-hauze we read: "not so long ago, lab-e havuz - lying in the shade of ancient mulberry trees ..., with old men in turban or wearing the square Uzbek bonnet with its white pattern on a black ground, seated upon large wooden divan (kalawat



Fig. 9. Hauzes and their soundings served as a most favourable places for gather, relax, contemplate, chat, drink, study and recreate. People relax in Lab-I-hauze-i- Diwan baigi. Source: Al-Radi: 1995.

or chor-pol) drinking green tea, clattering their backgammon counters, while the steam rose from the shashliks, and ducks waddled about on the banks" (Chuvin & Degeorge, 2003).

Hauzes also served as recreational places for emirs : "in the hauze in front of Diwanbaigi is filled by the water of jouy-i-moulian, as they said emir alemkhan, magistrate of Bukhara made his turkish slaves to play in water as an amusement" (Baghaiee, 1999: 49).

#### 4. Water system of Bukhara and the beliefs and rituals of Bukharians

The most extensive reasons that brings a kind of respect for water system elements was the deep integration between its elements and the most sacred place and monuments in the city. Including cemeteries, mosques, madrasas and khānahqah among the city, such as Cheshmah-I- Ayyūb (The Fountain of Job) where believed was the tomb of the Biblical Prophet Ayyūb (Job). These respected places were built in front of Hauzes also beside the canals; "they passed FathAbad toward city, there between three canals is the tomb of Mawlānā Jalāl ad-Dīn (Moeen al Foqara, 2000: 78).<sup>8</sup> In some cases hauzes and canals gained their name from these sacred places, such as Cheshmah-i- Ayyūb, or Hauze-i-hayyan: "in the region of Robaat Sarhang at the village called Kakh, there is a Tombe of Hayyan... the Hauze lend its name from this (Ibid: 82). Sometimes they lend their name to the place and ensembles, such as Lab-i-Hauze Divan Baigi.

Moreover, There were constant attempts to encourage public respect to the water system by attaching them to the respected man, khans or amirs. Since al-Narshaki posed in his book, there is common believes that the main canal (ShafriKam canal) was created by the Sassanid prince (al Narshakhi, 1972: 44). In another attempt, Amirs themselves try to link to the elements of the water system, Hauzes mostly constituted by Amirs or their ministers, in some cases Amires themselves presented in the construction or complementation of these elements:"... at Lab-I-Hauze Olugh Baig himself

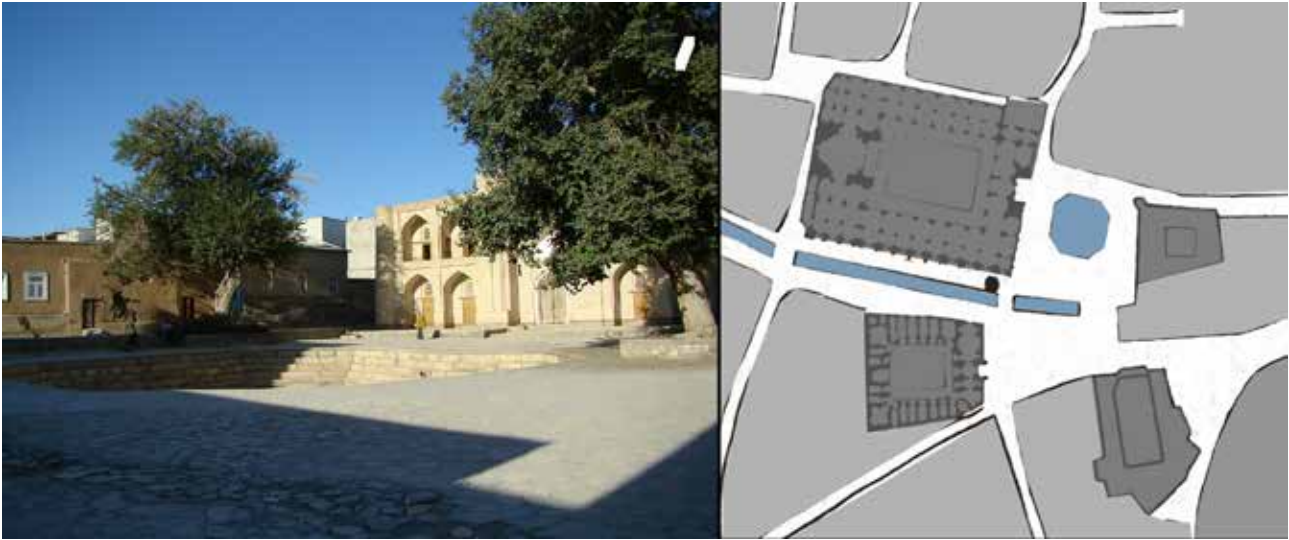


Fig. 7-2. the presence of Hauze as the most cracteristic element in the public places : Gauvkushan urban ensemble, consisted of Hauze, Madresa, Mosque and Bath (Hammam). Photo: Ayda Alehashemi, 2009.

## 2. Water system of Bukhara and public functions and activities

In Bukhara, there were extensive activities and functions in deep relation with Hauzes and canals; first, commercial activities, especially flea markets formed near Hauzes; "... in most of the larger and smaller markets in front of mosques and madaresses or around the ponds under mat tents or dura-straw an overwhelming selection of dried and fresh fruits is sold, on the ponds leather bags, tursuk, for the carrying home of water from canals and ponds to the houses and inflated goats, and wolves, hides, sanaatsh, used at the ferries" (Olufsen, 1911: 533); (Fig. 8). Also activities related to the sanitary were concluded: "in the city, there are large open ponds, beside them there are wooden places for wash and ablution" (Bartold, 1971: 165). These facilities also were referred lately others writings; at the side [of the reservoirs or the canals] are wooden shacks with doors where they wash.... the water is filthy and a lot of garbage is thrown into it" (Gangler, Gaube & Petruccioli, 2004: 51 from Al Moqaddasi, 1919: 51).

## 3. Water system of Bukhara and the social life of the city

The social life in Bukara were mostly occurs around hauzes and these large open ponds shaped the collective memories of citizens. in fact these Hauzes were the focal points for social events, chat and dialogues between peoples and were the centre of public collective memories and perception of the city, as posed by whom visited Bukhara from 10th to 19th centuries: "Labhavs-



Fig. 8. Hauzes as the reservoirs for the consuming water of the citizens, pic refer to the late of 19th century. Source: Timur & Mankovskaja, 1991: 43.



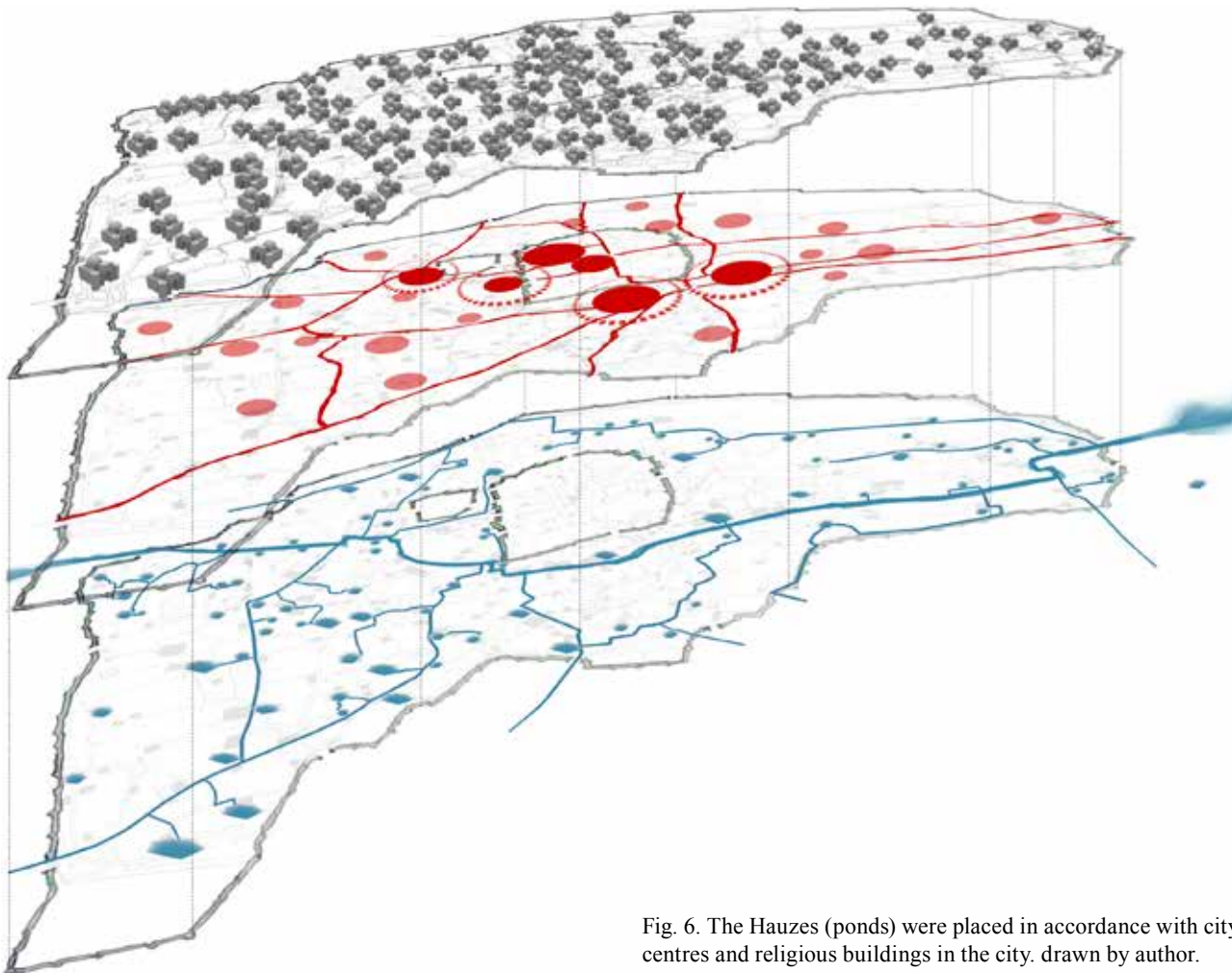


Fig. 6. The Hauzes (ponds) were placed in accordance with city centres and religious buildings in the city. drawn by author.

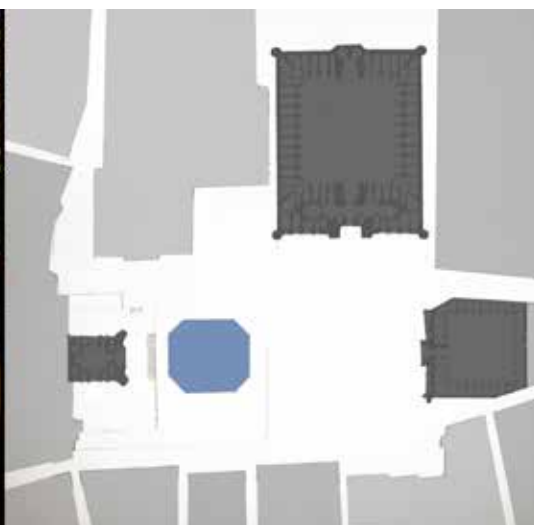


Fig. 7-1. the presence of Hauze as the most cracteristic element in the public places : Labi-Hauze-I urban ensemble, consisted of Hauze, Madresa, Mosque and *khānahqah* Khaneqah. Photo: Ayda Alehashemi, 2009.



Fig. 5. Hauzes as the most characteristic elements in the water system, were built in strong relation to the religious and iconic public or private buildings in the city, from right : Khojah Zein-al-din's Khāngah, Bālā Hauze Mosque, Divan beige's Khāngah, Emir Esmaeil Sāmāni's Tomb and Chor Minar Madrassa. Source: Timur & Mankovskaja: 1991.

existing canals in the Rabad and the houses places in two sides of these canals (Ibid). as we have seen, all the sub and tertiary canals flow along the major and minor streets.

•Second, Hauzes integrated with urban monuments such as mosques, madrasa, Khanahgah, and in some examples baths (Hammām) major and minors urban squares (excepts the centres in the Shāristān). There is Hauzes in almost all of urban squares.

Thus, we could say that Bukhara was made of a set of paths (the roads in which canals flow) and the nodes (the squares which centred by the ponds). Furthermore, Hauzes also linked to the cemeteries, gates (both inner and outer gates) and mostly appear in front of cemeteries and the squares in front of the gates (as Moēn-al Foghara insisted in his book *Mazarat-ē-Bukhara*). Water system of Bukhara and social-cultural structure of the city

### **B) Water system of Bukhara integrated to the social- cultural structure of the city**

in different ways; Firstly, it's linked to the notable social- cultural functions and monuments. Secondly, most of the social and eventual activities were linked to the components of the water system. At the end the water system variously was integrated to the common beliefs,

cultural, social, religious and symbolic rituals of the people of Bukhara<sup>8</sup>.

### **1. Water system of Bukhara in relation with sacred and momentous function of the city**

Al-Narshakhi and Mollah-Zadeh in their distribution of Bukhara in 10th century, both posed different Hauzes in front or near cemeteries and the city gates. Also in the documents from 16th century Hauzes were posed in deep relation to the mosques, madrasa and khanahgah in both public or private ensembles (Fig.5).

According to the map of Parfenov-fenin out of 220 quarters, 205 were furnished or defined by public buildings or public sites, among these two quarters had ponds only and no other public buildings or site. Thirty- eight quarters were furnished by the typical and picturesque combination of a pond and a mosque, whereas 9 quarters were provided with a pond plus mosque and/or other religious buildings (Gangler, Gaube and, Petruccioli, 2004: 80). In fact, the urban ensembles in Bukhara consist of the mosque (or khānahqah), Madras and hauze (Fig. 6), all these elements presented ensemble in urban squares. Two spectacular urban ensemble Labi-Hauz-I Diwanbaigi and Gauvkushan were most considerable examples of these integrations (Ibid: 94-96); (Fig.7).



Fig. 4. The water system through the city of Bukhara in its completed situation. Source: author.

canals (12 canals branch off the main canal called Nahr), Tertiary canals (branch off the sub canals called Jouy and convey the water to the ponds (Hauzes), Ponds (called Hauze, according to Kouchedamov map 113 Hauzes were distributed in Bukhara, all of them were open except one (Halfa-Kaudat hauze) and Baikand Wetland<sup>7</sup> (called Abgir-é-Baikand, where outside the western gate of the city gathered the wastewater).

### Integration between Water system and Urban structure of Bukhara

This article claim that, what made Bukhara's water system more specific from other ordinary water networks and promote it to the landscape infrastructure for Bukhara, is its multi-facade and multi-purpose relation with the city of Bukhara in both subjective and objective aspects. Here we try to distinguish these different types of integrations:

#### A) Water system of Bukhara and Urban spatial structure

As we have seen above, the water system of Bukhara consist of the set of canals (Nahre) (paths; the linear elements as distributors) and ponds (Hauze) (nods: the focal elements as reservoirs). On the other hand the urban spatial structure of Bukhara was based on set of streets and ways (which mostly transfer to bazaar in central part of the city) and various scales of city centres (Maydān). The comparison between the arrangement of the water system and urban spatial structure Bukhara shows that:

- First, the city routes shaped and formed in accordance with main canals and sub canals of the water system and vice versa. al-Muqaddasi (d, after 985) provide considerable image of this integration between streets and canals: “the main canal intern the city from east the subcanals branch off it convey through the streets... flow along the streets, and bring the water to the grand open Hauzes (reservoirs)” (al-Muqaddasi, 1918: 15). About this integration, the historical documents from 5th and 6th centuries proved that in the new residential quarters outside the Shāristān (inner city) the new routes follows

By considering the suggested plan of Bukhara in 10th and 19th centuries by Remple in 1949 and O. G. Bolshakov in 1973 and Bukhara's plan by Parfenov Fenin<sup>4</sup> in 1872, the structure of Bukhara's water system among the city in 10th century presented in Fig 2.<sup>5</sup>

The first point which catches the eye in this map, is that the water has not brought neither to the Shāristān (inner city, in some texts Madina) nor citadel, according to Ibn- Haughal due to their higher elevation (Ashraf, 1999: 71; Ibn-e Hawqal, 1966 ). Therefore the system of Bukhara in its first steps developed in Rabad and its gardens, fields, and villages as the system to reserve and distribute water.

In 1957 Kouchedamov published a map of the main canals and (water reservoirs) Hauzes of the city which was republished by Rempel, (1982,146). The basis of this map was, as in many other cases, the map of Parfenov-Fenin and a survey, conducted by the Samarkand Institute of Tropical Medicine (L. M. Isaev) in the forties

(Gangler, Gaube & Petruccioli, 2004 : 81-82). This map gives a number of 113 water reservoirs. Relying on recent surveys and the principle that the pond must have been provided with water by sub canals, Kouchedamov pointed out the secondary and tertiary canals in his map (Fig3)<sup>6</sup>. As this map shows, in this era, the city wall was replaced in the west, the Shāristān and its residential quarters expanded throughout Rabad and water system followed this development. For instance, two famous city complexes Labihauz-é-Divan Baigi (1620-23) and Gawkushan (1562) as new city centres consist of Madresa, mosque (in Labihauze: Khanqah) and Hauze (pond) (Ibid). Adoption between the map of Kouchedamov with suggested map in Fig 2, gives us the sort of complete view of the Bukhara water system in its advanced situation (Fig 4). According to this map, the water system of Bukhara consist of: River (called Soqd or Zarafshan), Controlling barrage (which reserve and control the water outside the city), Main canal (shahroud or roud-é-Zar), Sub

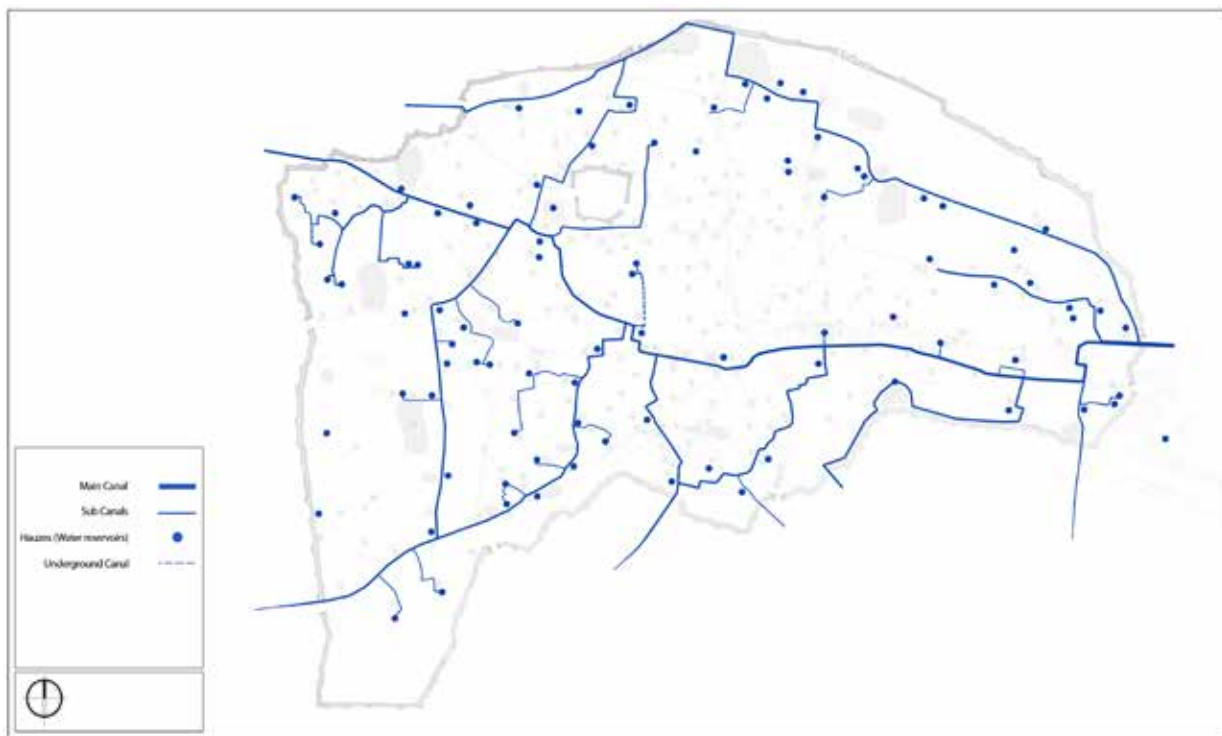


Fig 3. Water system of Bukhara in the late of 19th century, according to the maps presented by Parfenov Fenin and Kouchedamov. Drawn by : author.

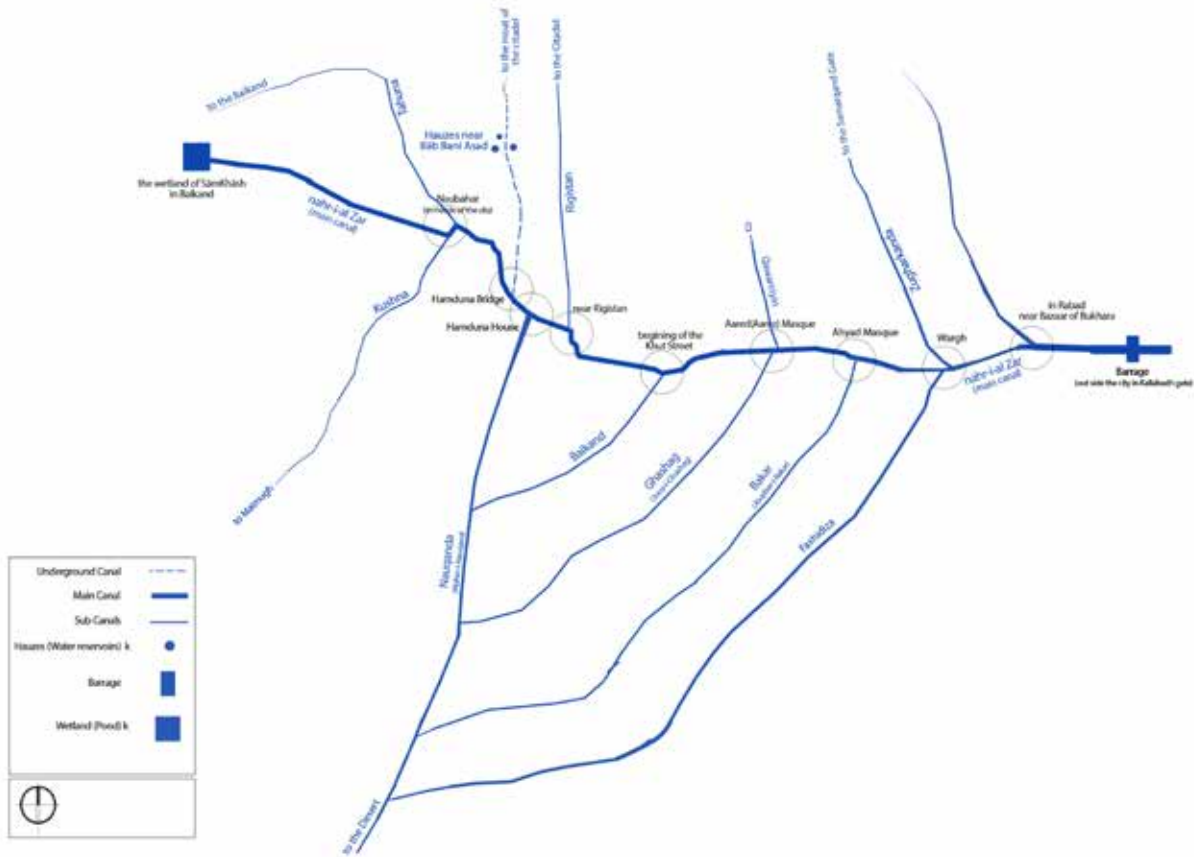


Fig. 1. semi- conceptual plan of the water flows in water system of Bukhara according to the descriptions of al-Istakhri (d.after 951), Ibn Hauqal (d, after 980) and al-Muqaddasi(d,after 985). Source: author.

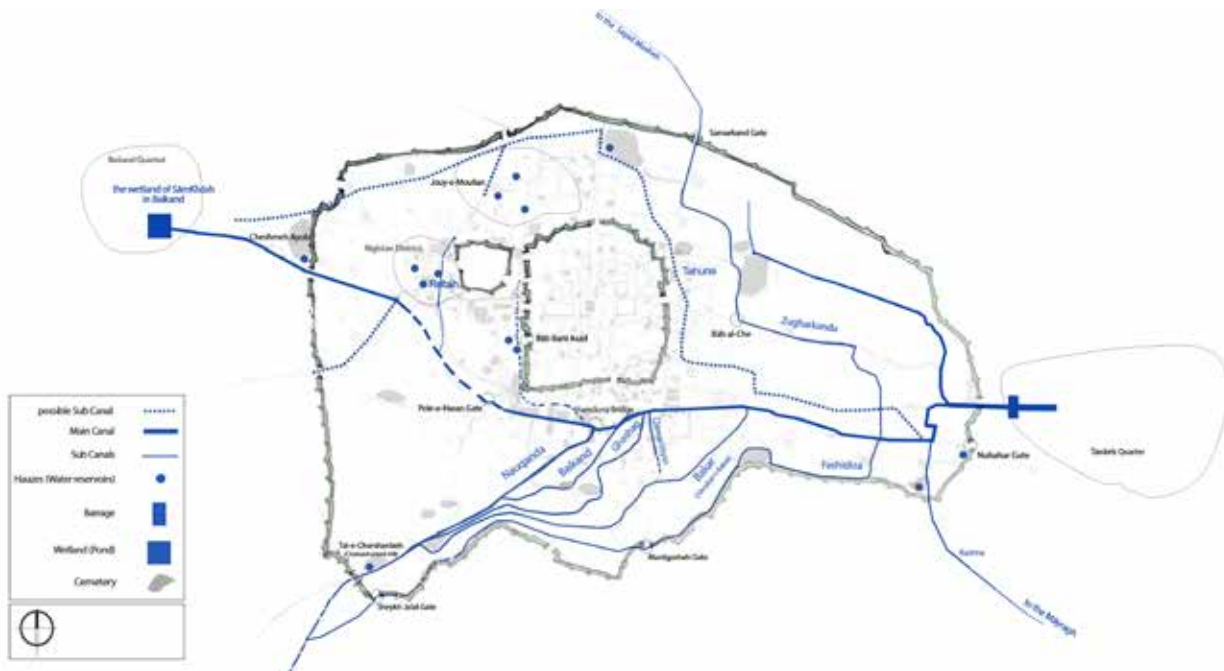


Fig. 2. Accordance between the conceptual map in Fig1 with the urban structure of Bukhara based on documents and informations from 10th, 19th and 20th centuries (about Bukhara in 10th century) and the maps of Bukhara in 1872,1949 and 1973. Source: author.

regulations during the period of formation and the period of expansion and development of the water system?

- Is there a common language and principle continued in the formation and expansion of the Bukhara water system during 10th centuries? Therefore main purpose of the research is to declare the dominant principles in forming and developing the water network of Bukhara and to find the bonds relate this system to the city. Beyond that, identifies the effect of each of these principles in the continues of water system among centuries. For this reason, the research focuses on two different subjective and objective facets the water system integrated into the city.

### Literature review

On the issue of Bukhara, three types of sources and works spend in Bukhara and its water system from 10th to 21st centuries:

First of all, we can find the trace of the Bukhara water system in the works of medieval historians in Arabic (all translated to Persian in last centuries), including Ibn Haughal and al-Istakhri where they spend considerable space of their description of Bukhara on the water system of Bukhara in the 10th century. In the lower level Al Moqadasi, Narshakhi and Mollāhzādeh point out some valuable information about water system within their works.

After that the works and surveys of Russians in the late 19th century and the early of 20th century in Bukhara, including Parvanov-Fenin 1879, Rempel. I. L 1930, Sukhareva. A. O 1954. At the end, the descriptive and analytical works of European and Americans in the late of 20th and the early of 21st which mostly done based on historic evidences and recent archeological surveys in Bukhara.

Among all these, the Arabian resources for middle ages, present a general scenario of primary structure of Bukhara water system, its components and its relations in the 10th century. The Russian and English materials represent the concept and in some references, detailed

description of the water system in the late 19th. In none of these references, the water system was not the centre of the survey, they mostly consider the urban structure or the architectural construction.

### Water system of Bukhara

According to the available references, we can represent the structure of the Bukhara's water system in two eras, the 10th century and the 19th century where there is a remarkable contradiction between these two:

#### Water system in the 10th century

Al Moqadasi gives the general scenario in Bukhara's water system in 10th century: ... the main canal enter the city, the sub canals branch off, they follow the alignment of streets. they run at the sides of streets, pass through the city and bring water to large, open water reservoirs.

In the medieval era, Ibn Haughal and al Istakhri added specific details about this system. According to them: before the Soqd river (in some text this part of Soqd river called Zararshan river) enter the city from east on the Kallabadh side, the water controlled by a barrage (small-scale river diversion dam, in person called Aab-Band), then in the Rabad and the Baazar of Bukhara the river is divided in two and there is the end of the Soqd river... the canal flows through the Rabad... and what remains, is gathered in a pond in front of Baikand, near Farbar, called Sām-Khāsh [out side the city in the west]" (Istakhri, 1995: 329). They both then name and explain 12 canals branch off the Zar canal (the main canal) within Rabad. Among these 12 canals, one flows underground, one named Nauqanda acts as a collector of the water from your other canals (Baiqand (Baigand), Ghashaj, Bakar and Fashidiza); (Istakhri, 1995: 328-330; Ibn-e Hawqal, 1966: 212-215); (Fig. 1).

According to the other authors from this epoch, Narshakhi et Molāhzādeh, we could complete our vision from the integration between the water system and the city in the 10th century<sup>3</sup>.

## Introduction

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Constant struggles with both water scarcity and overflowed in Iranian plateau and civilization, prepared a good context for shaping and developing the most complicated water infrastructures in the world in this area. These considerable systems integrated with the cities in complex processes, promoted from soul natural waterways and played a landscaping and multipurpose role in Iranian cities.

In a general classification, there are three types of water networks in Iranian Plateau: water networks based on groundwater resources (Yazd, Ardestān, Meybod- in the central desert of Iran), water networks based on surface waters- mainly rivers- (Bukhara, Esfahan, Semnān,...), water networks based on seasonal rainwaters (Lār, Qeshm and Evaz in the south of Iran), and of course the mixed water networks based on two types of these water resources (Naeen, Mahallat,...). Studies reveal that despite popular belief, the most considerable examples of the did not belong to the systems relied on Qanats, but the systems based on control, reserve and distribute the water of small-scale rivers and springs. among all, Bukhara had one of the most extensive water system which shaped by containment, distribution and reservation the water of the Zarafshān river in the oasis of Bukhara.<sup>2</sup> A complex and multidimensional system which developed in a same regulation

during 10th centuries from Sassanid epoch to Timurid and Uzbeks. At the end in the early 20th century after the Bolsheviks contested Bukhara, the great parts of the water system were ruined and completely disappeared. Until recent rehabilitation of the historic centre of Bukhara, mainly after dissolution of the Soviet Union, the water system, especially the few remained Hauzes (water open reservoirs) regained their role in the urban landscape of Bukhara once again.

By asking about the formation and development of the water system of Bukhara and surveying on its multifaceted integration with urban structures of the city, this paper aims to find the regulations by them the water systems of Bukhara promote from mere natural waterways to the landscape infrastructure of the city. For this purpose, by focusing on the relations between water networks of Bukhara and urban spatial, social and cultural structures of the city in various scales and layers, this paper extract the dominant circumstances in its efflorescence period. At the end by comparing the system in its decency and degradation, the paper looks for the regulations assured the formation continuance of the water system during the centuries, and by reverse engineering examines the role of each regulation in shaping the sustainable landscape infrastructure during more than 10th centuries.

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## Hypothesis

The Simultaneous subjective and objective integration between Bukhara water system and the urban structures of cities, guaranteed the sustainable resistance of the water system among countries. Inexistence of each of these aspects of integration cause the degradation of the system.

## Research questions and purposes

This research by epistemological approach, by relying on available pictorial and written resources, tries to decode the various facets of the formation and expansion of the water system and its different layers of its relation with the urban structures:

- Is there a difference between the dominant

# The Water System of Bukhara as the Example of Rising the Water Networks to the Landscape Infrastructure<sup>1</sup> for the city\*

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## Abstract

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The water in Iranian plateau and its environs have a main role in urban landscapes; complicate structures which shaped according to the hydraulic situations and played a multi-purpose role in the urban spatial structure. today with the new environmental and social concerns about modern infrastructures, rereading the historic semi-natural infrastructures and their multifaceted integration with urban structures, will contribute to redefine the dominant one-dimensional characteristic of water infrastructures in the modern era. One of the most considerable examples for the multi-dimensional integration between water infrastructure and urban structure was situated in Bukhara in Uzbekistan. A system, developed on current water, with a vital role in the urban landscape of Bukhara, which remains till now, in spite of more than 90 percent of destructions.

The main question that this paper tries to answer is not the formation of the system, although it's important by itself, but the way this system resist through the centuries. How to promote this system from common semi-natural infrastructure to the landscape infrastructure with the most influential effect of the urban structure of Bukhara? For this purpose, the research focuses on the way the water system arises in integration with the urban structure of Bukhara in its started pointing in the 19th century and its expansion till the 20th century, and also it falls in start of the modern era in Bukhara in the early of 20th century.

The survey shows two important and related facts about water system of Bukhara: first, the water system of Bukhara made a tangible relation to the physical and social structure of the city in various scales (from public to private) which made the system as a key player in the urban landscape of Bukhara and promote it from a mere subsistent infrastructure to the landscape infrastructure with a symbolic role in Bukhara. Second, Although the functional role, was the necessity of the existence of the system and its relation to the urban life, but it's not the mere requirement for its continuation through centuries. in fact, the subjective integration between the water system and its components with the city has the equivalent role as the objective integration between system and urban structure in the resistance and continues of system in common language more than ten centuries.

## keywords

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Bukhara, Water infrastructure, Landscape infrastructure, Uban spatial structure, Social-cultural structure.