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Comparative Studies of the Traditional Water structures between Cities of Jhunjhunu and Narnaul in India

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Abstract - *This paper is one of the research outcomes of the "Study of the Impact of Water Management Systems on Evolution and Structuring of Urban Settlements in India". Cities that have been targeted as case example are 'Narnaul' (Haryana) and 'Jhunjhunu' (Rajasthan). Despite the fact that both these cities have similar geographical and climatic conditions, the typology of traditional water here have regional differences based on social structure and resource optimization etc. Narnaul has more vivid typologies with five different categories of water structures namely- Stepwells, Kunds, Talabs, Johads and wells. On the contrary, Jhunjhunu only consists of three typologies- Stepwells, Johads and wells. Hence, this paper explains the conventional wisdom of water structures describing typology, material and usage based on background of both the cities, and finally presenting the current state of these structures. Before losing built heritage of water structures, we must find out value and re-assessment for tuning into the sustainable component of the city. This paper reviews possibility to revive documented water structures and propose sustainable approach in future by acknowledging cultural and spiritual values of abandoned water structures.*

Key Words: Water Structure, Urban Settlement, Sustainable, Documentation, Stepwells, Built heritage

1. INTRODUCTION

The research paper is to clarify and understand variations and actual status of water structures in present through a comparative study between cities of Narnaul and Jhunjhunu.

1.1 Study area

Narnaul and Jhunjhunu are quiet, picturesque towns in the neighboring states, Haryana and Rajasthan respectively in India (see figure 1). The former extends between north latitude 28.04 and east longitude 76.11 whereas the latter extends between north latitude 28.12 and east longitude 75.39. Where Narnaul covers around 286 sq.Km geographical area, Jhunjhunu is believed to be one of the prosperous districts of Rajasthan and is spread in larger area covering almost 5928 sq.Km (see figure 2&3).

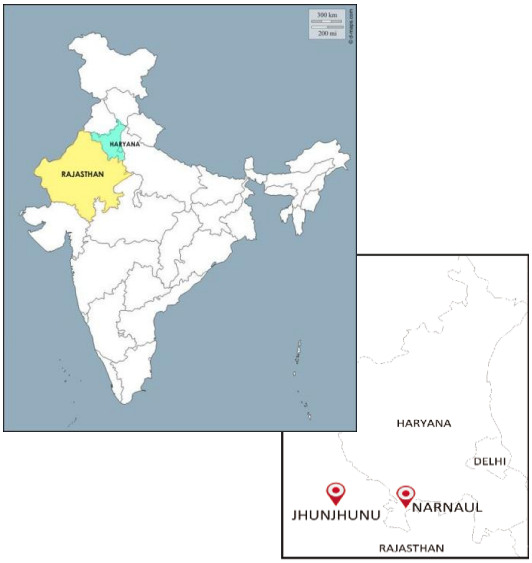


Fig -1: Location of Narnaul and Jhunjhunu in Haryana and Rajasthan respectively. (Source: Author)

Climate of the both the regions can be classified as sub-tropical and comes under the classification of semi-arid region, characterized by very hot summer and very cold winter. Most of the rainfall occurs during South-west monsoon period of about 513mm & 405.1 mm (Census of India, 2011). Since these areas receive scanty rainfall so numerous water structures were used to harvest rainwater collected during monsoon period by accumulating the water in low lying areas of various depths, having a catchment and slope.

1.2 Review of previous studies

At first, it was examined what has already been done in the research area of water structures. The published data thus obtained which included various research papers and books was further scrutinized carefully. The following works are listed as recently published exertions (see table 1).

On careful examination it was noticed that the published data is only limited to the pictorial documentation of some of the existing traditional water

structures in India right from 4th century to late 1990's narrating the history associated with them along with their architectural attributes or depicts the famous stepwells within well known cities. Since time, India prospers because of its efficient water management systems which included essential rain harvesting, groundwater recharging and storage systems. But it was noticed that the already published data focuses on only one typology majorly stepwells.

Hence the research focus was established on targeting all the typologies of traditional water structures. To maintain precision the research was further carried out on regional level which ensured covering all the systems and structures present in a particular area. To understand the mechanisms in depth detailed documentation was done which involved understanding the area of study through primary field studies, observation, Grounded Theory (Data Collection, Coding and Memoing), Ethnographic Approach and finally making on scale drawings of plans and sections of water structures through triangulation methods etc.

Table -1: Books published on water structures (Source: Reference[1],[4],[5],[6],[7],[8],[10])

Title	Author	Date
The Stepwells of Gujarat: In Art-Historical Perspective	Jutta Jain-Neubauer	1981
Steps to water	Morna Livingston	2002
Water Architecture in South Asia	Julia Hegewald	2002
Baolis of Bundi	INTACH	2015
Her Story: Exploring the Stepwells of Gujarat	Purnima Mehta Bhatt	2015
The Vanishing Stepwells of India	Victoria Lautman	2017
Delhi Heritage: Top 10 Baolis	Vikramjit Rooprai	2019

The originality of this paper is not only limited to understand unknown water structures located in particular regions of Narnaul and Jhunjhunu but also to understand in depth the architecture features and diversity of the water structures scattered throughout the town/district comprehensively.

1.3 Objectives

a) To draw comparative analysis of the vivid typologies of water structures present in both the regions to manifest how even after having regional similarities still there is so much alteration in the shape and size of every structure. Moreover, even in same structures of one region there is a presence of diversity as per the background of the city.

b) To make it conspicuous through detailed documentation that how these 250-500 old but scintillating structures are so structurally sound that they can still be used to garner rain water for dry seasons.

c) To spread awareness about these priceless inheritance in people by creating ownership and civic sense.

2. METHODOLOGY OF RESEARCH SURVEY

This paper is based on two field surveys that have been conducted by authors and collaborators in Narnaul from 12th to 18th February 2018 as primary survey and in Jhunjhunu from 2nd to 8th March 2019 as secondary survey. The field survey has been conducted with the following methodology: -

a) The research methodology was adopted on module which begins with identification of the action area within historic core boundary of the districts of Narnaul and Jhunjhunu which is shown with red dotted lines (Figure 2 & 3).

Fig -2: Historic core boundary of Narnaul with existing water structures (Source: Author)

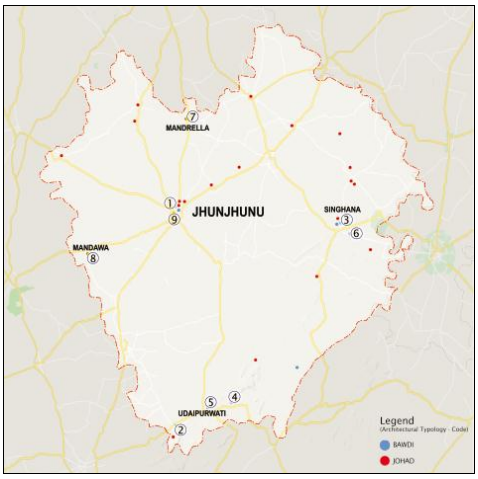


Fig -3: Boundary of Jhunjhunu district with existing water structures (Source: Author)

b) Primary and secondary survey then mainly attributes to the database of the research of water structures that comprehends the traditional wisdom. Main source of information is based on the questionnaires and personal interviews of local people by the author. In addition to it, the research is based on the data collected from the local officials and NGOs.

b) The collected information has thus been perspicuously examined, anatomized and explicated in inventory forms.

d) The final and the most crucial step then adopted was documenting the water structures identified in the marked boundary.

In addition to this, major criteria for selection of water structures for detailed documentation were varied typology, structural stability and mean of access to the particular water structure.

3. DESCRIPTION OF TYPOLOGIES OF WATER STRUCTURES IN NARNAUL AND JHUNJHUNU

The water resources available within the physical boundary of the village Narnaul are marked with blue dots within red dotted line of historic core boundary (see figure 2). There are five varied typologies of water structures present in Narnaul and in local dialect they are regarded as:-

a) Baoli
b) Johad
c) Kund
d) Talab/Sagar
e) Well

Unlike Narnaul, Jhunjhunu has only three typologies of water structures which are shown with red and blue dots (see figure 3), namely -

a) Bawdi
b) Johad
c) Well

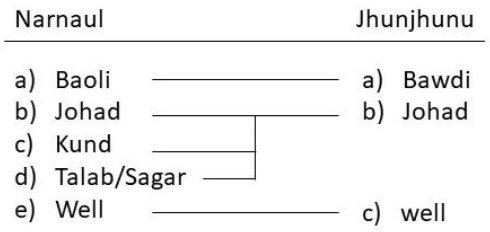


Fig -4: Difference of dialect of water structure in each area and classification of each structures (Source: Author)

According to the survey, typologies of water structure in Narnaul and Jhunjhunu can be classified as figure 4. Although each name in dialect of typologies varies, water structures in Narnaul can be divided into 5 typologies on the basis of difference of structure and usage.

Fig -5: Mukundpura Baoli, Narnaul (Source: Author)

Fig -6: Johad, Narnaul (Source: Author)

All five typologies can be briefly explained as below.

Baoli (see figure 5):

It is called Bawdi in Jhunjhunu but "Stepwell" in general. It has two main components- 'well' and 'enclosed underground corridors along with steps' to approach the well (Michell & Davies, 1990).

As in addition to meet water demands of local inhabitants in specific cases they performed various other necessary societal functions like social, gatherings, religious ceremonies and leisure purposes (Shekhawat, 2015).

Johad (see figure 6&7):

Fig -7: Mandawa Johad, Jhunjhunu (Source: Author)

Fig -8: Gopal Sagar, Narnaul (Source: Author)

Fig -9: Kukkad Kund, Narnaul (Spurce: Author)

Pre-eminent traditional rain water harvesting structures built in natural depressions. In the course of heavy rains these structures avert irrepressible flooding (Bhattacharya, 2015)

Talab/Sagar (see figure 8):

These are basic stone and mud catchments erected across counter's slope to harvest rain water (Bhattacharya, 2015). Principally, these are maintained by community.

Kund (see figure 9):

Autochthonous water harvesting structures constructed by local materials. According to the survey, it is relevant with religious site which locates temples and shrines etc.

Well:

Traditional water management system having cylindrical underground pit to access groundwater.

4. COMPARATIVE ANALYSIS OF WATER STRUCTURES IN NARNAUL AND JHUNJHUNU

Table 2 describes water structures which were documented in primary and secondary survey i.e. Narnaul and Jhunjhunu (see table 2).

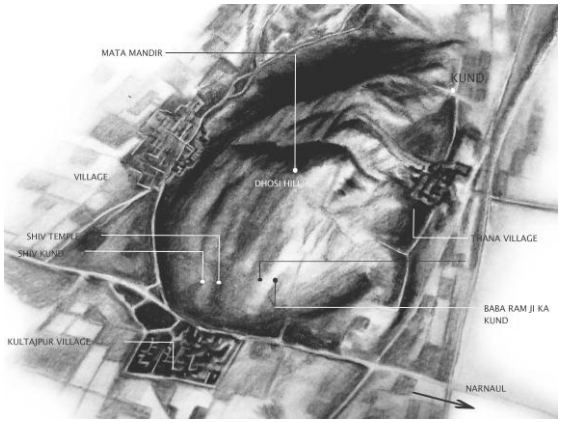


Fig -10: Bird view of Dhosi hill (Source: Author)

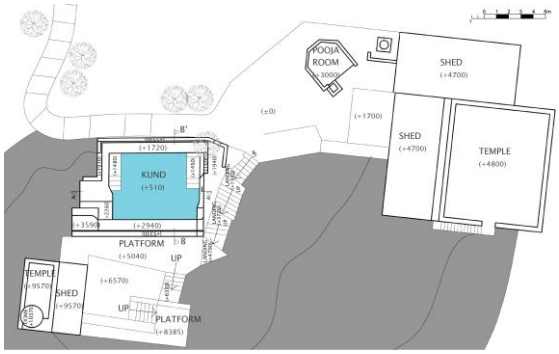


Fig -11: Complex plan of Baba ram Ji Kund in the middle of Dhosi hill (Source: Author)

Table -2: Description of water structures of Narnaul and Jhunjhunu (Source: Author)

	S. no	Typology/ Name	Co-ordinates	Capacity (in metres)	Structural stability	Present condition of structure
Narnaul	1	Johad/ Unknown	28°01'19"N 76°05'36"E	100 x 90m	--	Abandoned
	2	Kund/ Baba Ram Ji Kund	28°03'16"N 76°01'51"E	8.0 x 8.0m	Excellent	The water is covered with the layer of algae.
	3	Talab;Sagar/ Gopal Sagar	28°02'50"N 76°05'52"E	40 x 45m	Good	Adaptive reuse of leisure purpose.
	4	Talab;Sagar/ Tilu Ali ka Talab	28°02'20"N 76°05'49"E	49 x 48m	Good	Abandoned. Vegetation growth at walls and the ground area.
	5	Stepwell/ Nangal Chaudhary Ki Baoli	28°11'34"N 76°07'29"E	21 x 15m	Excellent	Abandoned. Well has filled up with soil due to erosion.
	6	Stepwell/ Mukundpura Baoli	27°59'11"N 76°04'42"E	37 x 13m	Good	Abandoned. Plaster worn off with blemished carvings.
	7	Stepwell/ Mirza Ali Jan Ki Baoli	28°02'48"N 76°05'56"E	30.6 x 13.4m	Good	Abandoned
	8	Stepwell/ Nagpuria Ki Baoli	28°02'50"N 76°06'01"E	7 x 30m	Good	Abandoned. A layer of algae has formed over the water
	9	Stepwell/ Sher Shah Suri Baoli	28°01'51"N 76°05'59"E	15.6m in diameter (Hexagonal)	Good	Abandoned. Vegetation growth can be seen.
	10	Stepwell/ Raja ki Baoli	30°15'08"N 76°52'35"E	20 x 4.6m	Poor	Abandoned.
Jhunjhunu	1	Bawdi/ Mertaniji ki Bawdi	28°08'01"N 75°23'42"E	46.7 x 14.9m	Excellent	Abandoned
	2	Bawdi/ Chetan Das Ji ki Bawdi	27°41'30"N 75°23'35"E	57.8 x 16.3m	Excellent	Abandoned
	3	Bawdi/ Ganga Mandir Kund	28°05'49"N 75°50'20"E	19.3 x 16.8m	Good	Maintenance under supervision of private trust.
	4	Bawdi/ Chapoli ki Bawdi	27°44'20"N 75°33'00."E	43.9 x 11.7m	Good	Abandoned.
	5	Bawdi/ Udaipurwati ki Bawdi	27°43'52"N 75°28'28"E	34.6 X 11.4m	Excellent	Maintenance under supervision of private trust.
	6	Bawdi/ Dhana ki Bawdi	28°05'27"N 75°51'11"E	18.7 x 8m	Poor	Abandoned. Vegetation growth.
	7	Johad/ Mandrella Johad	28°19'10"N 75°25'35"E	34.1 x 34.7m	Good	Abandoned
	8	Johad/ Mandawa Johad	28°02'31"N 75°09'09"E	42.7 x 45m	Excellent	Abandoned.
	9	Johad/ Samas Talab	28°07'43"N 75°23'24"E	41.5 x 40.7m	Excellent	Abandoned.

Note: Structural stability has been categorized into 3 categories.
Excellent- When the structure is intact and there is no risk accessing it.
Good- When the structure is not in dilapidated condition but requires maintenance and repair.
Poor- When the structure is in ruins.

a) Variation based on Typology: -

As already discussed, the first and foremost difference that is present in the water structures of both the regions is the variety of typologies present. Narnaul has more diversity with five typologies of water structures, Jhunjhunu has only three typologies - Stepwells, Johads and wells.

Analyzing the difference in typology, in case of Narnaul the typology is subdivided into Kund, Talab/ Sagar due to ruler's influence or possessing sacred values like `Dhosi hill`. For instance, Baba ram Ji Kund located in middle of hill holds religious value as is located with temple and pooja room etc. together (figure 10&11). Further, Johad is not only catchment but it also possesses additional function and role.

b) Variation based on Social Structure: -

Typologies present in Jhunjhunu purely represents social structure to be based on whole community involvement, the water structures present in Narnaul reflects both community as well as private ownership. For an instance, there are more than 100 traditional wells present in the historic core boundary of Narnaul which are believed to be built by then king's order on local people's plead for water.

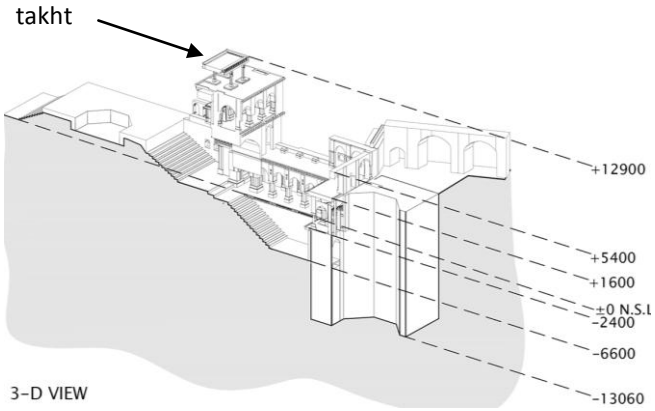


Fig -12: 3D view of section and photograph of Mirza Ali Jan Ki Baoli (Source: Author)

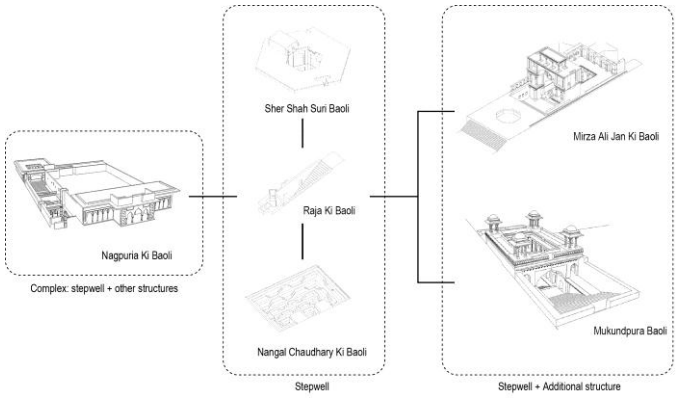


Fig -13: 3 Categories of stepwells in Narnaul (Source: Author)

Table -4: Comparative analysis of Stepwells in Narnaul and Jhunjhunu (Source: Author)

	Narnaul	Jhunjhunu
	Stepwells	
Diversity in Shapes	Diverse variety of shapes are present- a) Linear b) Rectangular c) Hexagonal	All the stepwells are rectangular in shape.
Values	Stepwells in Narnaul have these values associated with them. a) Sacred b) Associative c) Narrative	Except Mertaniji ki Bawdi which holds associative value all the stepwells of Jhunjhunu holds Sacred value.
Level of awarenes s	Low to negligible as mostly structures are left abandoned with no maintenance.	Good. Majorly stepwells are being looked after by private trusts of associated temples.

c) Variation based on Landform: -

Dhosi hills lie in the close vicinity to the Narnaul. Hence presence of diverse landform in form of both plain and hills gives the area diversity of both Kunds as well as Talabs/ Sagars. On the contrary, due to presence of only plain landform, Jhunjhunu lacks these mechanisms.

d) Variation based on ruler/ people's belief: -

Due to close proximity to Delhi, Narnaul was the main centre of kings/ invaders and their gems/ sub-rulers. Therefore, Narnaul's stepwells mark royalty and ruler's symbols of possession whereas stepwells in Jhunjhunu represents totally different scenario with having no ruler's influence but built on spiritual or associative aspect.

As shown in Mirza Ali Jan Ki Baoli the gateway of the structure is crowned by a flat-roofed pillared pavilion above, known as 'Takht'. The takht was used by ruler and symbolizes royalty (see figure 12).

e) Variation in Stepwells of both the regions:-

Stepwells in Narnaul can be classified into 3 categories (see figure 13)-

a) Complex: stepwell + other structures

b) Stepwell

c) Stepwell + additional structure

Unlike Narnaul, Stepwells in Jhunjhunu can be classified into only two categories-

a) Complex: stepwell + other structures

b) Stepwell

This variation can be seen in shape and approaches of stepwell(see table 4).

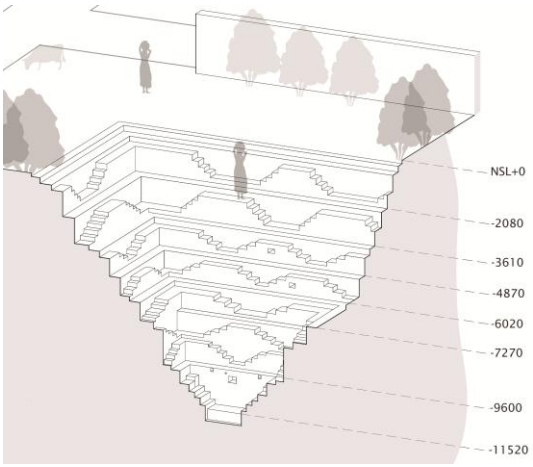
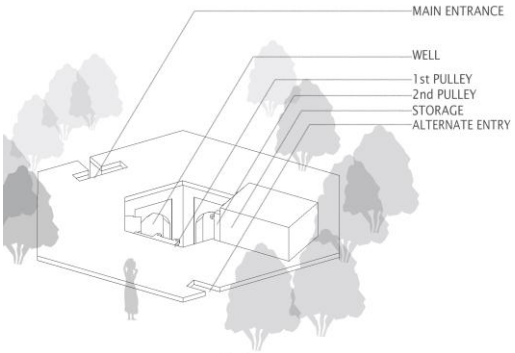


Fig -14: 3D view of Sher Shah Suri Baoli
(Source: Author)



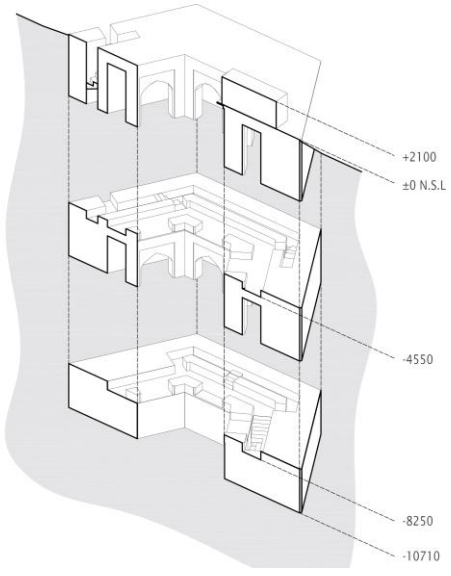


Fig -15: 3D view of Nangal Chaudhary Baoli
(Source: Author)

For example, in Sher Shah Suri Baoli and Nangal Chaudhary Baoli, there is variation of the shape and approaches (see figure 14&15). Former is an octagonal shape having approach along the arc, latter is almost square with approach from three sides. In contrast, the biggest and most complex structure in Jhunjhunu, Mertani Ji Ki Bawdi is rectangular having long length and narrower width. It can be approached from only one way (see figure 16). Almost all stepwells are recognized as similar type.

f) Variation in Johads of both regions:-

Johads in Narnaul are catchment areas with only 'Kacha' construction whereas in Jhunjhunu both Kacha as well as 'Pakka' Johads are there (see table 5). As mentioned in Table 5, Johads in Jhunjunu are especially associated withsacred value through temples in order to be used to perform rituals. Johad in Jhunjhunu, therefore, broadly includes Sagar and Kund in Narnaul. 'Pakka' Johads are the one which are constructed with a strong and durable construction material like brick whereas 'Kacha' Johads are the one which are made up of mud or are formed through the natural depression and does not involve any specific construction material.

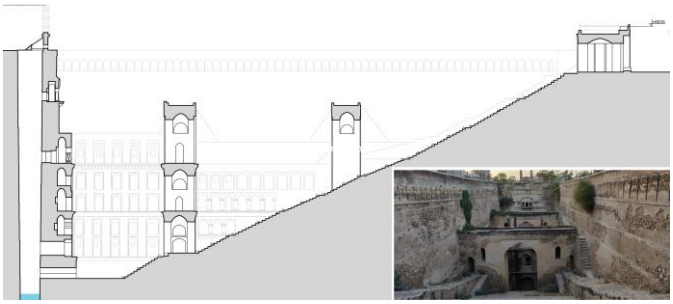


Fig -16: section and photograph of Mertani Ji Ki Bawdi
(Source: Author)

Table -5: Comparative analysis of Johads in Narnaul and Jhunjhunu (Source: Author)

	Narnaul	Jhunjhunu
	Johads	
Construction type	Kacha	Pakka
Values	No values associated	Johads are majorly accompanied with temples, hence water in Johads was used to perform rituals therefore, Sacred Values are associated.
Architectural feature	No such feature present as it was just the natural depression to collect excess water.	Various architectural elements are present like chhatris, minarets, ramps, arches etc.

Fig -17: Present condition of Bawdi in Jhunjhunu (Source: Author)

6. CONCLUSION

This paper clarified the followings through comparative study on neighboring districts- Narnaul and Jhunjhunu.

1. Based on social structure and land form, Johad is not only reservoir and was subdivided into Kund talab/Sagar with additional functions and roles.

2. Shape and approach of stepwells in Narnaul can be seen in variety in comparison to the common type of shape and approach in Jhunjhunu. Because Narnaul's stepwells mark royalty and ruler's symbols of possession whereas stepwells in Jhunjhunu represents totally different scenario with having no ruler's influence but built on spiritual or associative aspect.

Above all, even if water structures are located nearby with similar geographical and cultural conditions, huge differences are observed based on social background of respective areas.

Conventionally, in addition to conclusion, we must notify the present situation of water structure between Narnaul and Jhunjhunu. It is found that unlike Narnaul, various stepwells have become dumping yard gradually in Jhunjhunu (See figure 17).

Water structures including stepwells must be recognized as crucial heritage of water culture in India. To enhance the cultural value the findings of the research should widely disseminated.

ACKNOWLEDGEMENT

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DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

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