SPATIAL ANALYSIS OF PONDS AND STONE SPOUTS OF KATHMANDU VALLEY

Suraj Sthapit[1]

Abstract

People have settled in Kathmandu Valley for more than 3000 years. Through the course of time, people living in the valley have developed and advanced several types of water infrastructures for the collection, distribution and delivery of water to the settlements. Among these traditional water infrastructures, an inventory of these stone spouts and ponds has recently been prepared. In the inventory, details of the location, measurement, state of existence, use cases, and many other headings have been presented, although individually and in isolation from the collective context. Studying all of them in a collective context has the potential to yield new information on the choice of site for construction on the basis of various requirements, accumulation in one particular area, hints of historical settlement, and so on. Both qualitative and quantitative methods will be used for the study. Inventory of the water infrastructures are invaluable data sources. Data from this inventory is mapped and analyzed on the basis of the location in particular terrain and space as well as the concentration of ponds and stone spouts in any particular area. The results from this analysis are interpreted in their historical context using utilitarian, religious, and ethnological perspectives. From this research, it is found that most of the stone spouts and ponds are located at the slope/bottom of the bluff/hill because of the ease of access of water. And the majority of stone spouts are located in agricultural fields/new settlements whereas most ponds are located in historical areas. The outcome from this study will be useful for understanding the overall traditional water infrastructure of Kathmandu valley.

Keywords : Water infrastructure, ponds, stone-spouts, Kathmandu valley, history

1. Introduction

The valley of Kathmandu lies in the Mahabharata Range of the lesser Himalayas. It is surrounded by hills towering up to 2780 m above sea level on all sides. The valley is a single independent isolated unit with some smaller valleys connected to it forming its own isolated entity apart from other hills and mountain chains and valleys of the region. Thus, it has no snow-fed rivers entering it but is a separate basin of its own with multiple streams, rivulets, and tributaries that ultimately culminates into the Bagmati River and flows out of the valley through the Chovar Gorge.

This valley has attracted humans from as early as 5000 years ago while the evidence of establishment of proper settlement took place more than 3000 years ago as per the chronicles and more than 2000 years ago according to the archaeological sources. Due to the lack of any snow-fed big rivers and its channelization to the settlements for drinking and agriculture, people of Kathmandu Valley had to rely solely on the rain to serve their water related needs. So, the people of the valley created a system of collection, distribution, delivery and drainage of water.

The catchment area in the form of green and blue landscape (forests and ponds) located above the settlement, accumulation from underground aquifers form the collection system of water, while canals act as the distribution channels, delivery is done through the stone spout and wells, and finally drainage of the excess water from stone spouts, is either recollected in a pond located at the base of the settlement or is released in the river. In this regard, this research paper aims to utilize the available inventory to identify the location of all those catchment and delivery infrastructures in ponds and stone spouts and analyze the reason behind their location of establishment.

1. Lecturer , Tribhuvan University, Central Department of Nepalese History, Culture and Archaeology, Kirtipur, Email: surajsthapit03@gmail.com

2. Review of Previous Literature

The traditional water infrastructures of Kathmandu Valley have not only been the source to satisfy thirst but have also fascinated many scholars about its various aspects. Previous scholars have explored various aspects of the traditional water infrastructures of Kathmandu Valley. These aspects can be divided into various themes: myths and legends; art and architecture; system of operation; traditional management practices; modern management challenges; activism in order to preserve the system;future of traditional water infrastructures; inventory and status; relationship of water infrastructures with nature; culture and society; case studies of selected surrounding hills as catchment area; stone spouts; ponds and water conduits. These themes do not generally occur in isolated instances but very often overlap one another in scholarly writings. A table categorizing various literature according to their corresponding themes is presented below.

Table 1: Previous literature categorized according to theme.

Themes	Scholars
Myths, legends and history	(Amatya, 2003); (Pradhan, 1990); (Pradhananga, 2017); (Ritterspach, 1990)
Art and architecture	(Amatya, 2003); (Parajuli, 2016); (Pradhan, 1990); (Ritterspach, 1990)
System of operation	(Joshi, 2022); (Parajuli, 2016); (Spodek, 2002); (UN-HABITAT, 2007)
Traditional management practices	(Joshi, 2018); (Joshi, 2022); (UN-HABITAT, 2007)
Modern management challenges	(Joshi, 2018); (Joshi, 2022); (Molden et. al, 2016); (Snyder, 2014); (Spodek, 2002); (Tripathi, 2016); (UN-HABITAT, 2007); (Upadhyay et. al, 2019)
Activism for preservation	(Joshi, 2022); (UN-HABITAT, 2007)
Inventory and Status	(Rana et.al, 2024)
Relationship with nature, culture and society	(Amatya, 2003); (Molden et. al, 2016); (Pradhan, 1990); (Shrestha, 2014)
Case Studies	(Joshi, 2022); (Khaniya, 2005); (Ritterspach, 1990); (Snyder, 2014)

Settlements in Kathmandu valley have existed for more than 3000 years. The account of early millennia of existence is obscure but has been passed down from generation to generation as oral tradition. Even though the archaeological evidence and epigraphic sources shed brighter light on the history of settlement of Kathmandu Valley, the historical storytelling through oral tradition remembers many important events of the past, and some even relating to the water infrastructures as well. Amatya (2003) accounts those myths and legends, history of some popular ponds, stone spouts, and springs connecting them to their importance in everyday life for the people of Kathmandu Valley and whole Nepal from the religious, natural and utilitarian line of thought. Whereas Pradhan (1990) includes historical context for the mystical explanation to the creation of stonespouts of Kathmandu valley. She also skimmed the cultural, architectural and artistic importance of stonespouts. Pradhananga (2017) on the other hand analyzed the Lichchhavi inscriptions and provided the historicity, construction, sources of water, the prevalence of stone spouts in the Lichchhavi period, construction materials and administrative institutions relating to stone spouts in Lichchhavi period. Furthermore, Ritterspach (1990) was one of the first to explore the water conduits system of Kathmandu Valley as a whole. He started with mythological aspects followed by water related architectural design, its blend in historical urban milieu, utilitarian concerns, their condition, ritual aspects, system of operation and evolution and development through various historical phases of Kathmandu Valley along with case studies of water sanctuaries of the hills surrounding the valley and case studies of water system of Sankhu, water conduits of Dhobi caste groups and stone spouts such as: Manga Hiti of Patan; Bhindyo hiti, Thanthu Hiti and Lyaku Hiti of Bhaktapur; Sundhara of Kathmandu and Nau Dhara of Godavari.

The work of Parajuli (2017) dives deeper into the nuances of artistic design and architectural integrity of stone spouts and all of their components. Joshi (2022) enlists and explains each component of water infrastructure along with the basic working principles of individual components and the system as a whole along with the traditional management practices, modern challenges, activism to protect the traditional water infrastructures in Lalitpur and the future of that system. The account of UN-HABITAT (2007) is an earlier version of Joshi (2022).

Many scholars such as Molden et al. (2016), Snyder (2014), Spodek (2002), Tripathi (2016), Upadhyay et al. (2019) warn the readers in unison about the modern challenges in order to protect and preserve the traditional water infrastructures of Kathmandu Valley. They report challenges such as fast and haphazard urbanization disturbing the subterranean hydrology, dismantling of traditional institutions that protect traditional water infrastructures, loss of awareness, and connection to the traditional infrastructures, as well as legal and policy-level road blocks to preserve and protect the infrastructures.

Furthermore, Rana et al. (2024) provide the status of 812 stone spouts, of which 110 are already lost. Only 52 of the lost stonespouts have been mapped and the others could not even be located. Similarly, among the 280 ponds inside the Kathmandu Valley, 45 ponds have been lost but are mapped for the record.

Shrestha (2014) provides a lens of deep beauty that traces

the human longing for being in the calming presence of naturally flowing water that excites all the senses of human beings, confirming our love for nature. He also identifies the sacredness, aesthetic utilitarianism, and sustainable features of water conduits of Kathmandu Valley.

Finally, Joshi (2022), Khaniya (2005), Ritterspach (1990), and Snyder (2014) all provide case studies of: The Tikabhairab water system, ponds and stone spouts of Bhaktapur city, various stone spouts across Kathmandu valley and stone spouts of Lalitpur respectively.

Departure

Many scholars have already endeavored to understand in detail about the water infrastructures of Kathmandu Valley. They have identified the system and network of operation. The rainwater is collected in two ways: naturally in the forested area or open space and artificially in the ponds. The collected water is channelized via a canal to the stone spouts in some cases but generally would be accumulated in a pond located on higher ground than the settlements. The water of the pond then seeps underground serving the shallow aquifer where an underground chamber is made to collect the water. That water is then channeled to the stone spouts. The replenishment of underground aquifers also seeps to the wells throughout the settlement. Apart from this fundamental principle, the historicity, myths and legends of water infrastructures; art and architecture, traditional management practice, modern management challenges, activism in favour of the traditional system and the relation with nature, culture and society have also been well scrutinized. Recently even the inventory of all the ponds and stone spouts located inside Kathmandu valley has also been prepared.The new comprehensive inventory on stone spouts and ponds provides the opportunity to explore new ways to analyze them.

In this regard, this research paper aims to tap into the treasure trove of data in the form of inventory and analyze the exact location of all ponds and stone spouts inside the valley and the reason behind their construction in those locations.

3. Methodology

This research views the reality from the post-positivist paradigm, which means the reality exists in objective form but can only be probabilistically apprehensible. Here the reality is the geographical setting, its terrain and contours. And within this geographical setting the stone spouts and ponds exist. The locations of the ponds and stone spouts are recorded in the inventory but the commonality and difference of geographical setting among all the ponds and stone spouts is yet to be analyzed. And thus, this research aims to comprehend the spatial location and the reason behind their existence in the given geographical setting.

Kathmandu valley is surrounded by hills on all sides whereas the valley floor can be divided into three types. They are plateaus: top of the bluffs shaped and carved by the rivers flowing around them; Slope/Bottom of the Bluff/Hill: the sloping part of the plateaus and hills whether declining gradually or abruptly and the bottom of the bluff just after it has completed declining; after declining has completed, the terrain generally flattens and is a lowland i.e. Base. These three types of terrain are universal throughout the valley floor. Furthermore, within these types of terrain, common types of land use are: Historical Area, Religious Area, Jungle Area and finally Agricultural Area/New settlements. These two types of classifications are used in this research to perform spatial analysis of ponds and stone spouts. The following table provides the sample for sorting of the data.

Table 2: *Sample table for data sorting and presentation*

Municipality	Plateau				Slope/Bottom of the Hill/Bluff				Base Area			
	HA	RA	JA	A/N	HA	RA	JA	A/N	HA	RA	JA	A/N

In this table,

HA = Heritage Area

RA = Religious Area

JA = Jungle Area

A/N = Agricultural Area/ New Settlement

Note: Each of the universal terrain typespossess four common land use types.

Here, detailed description for the title of the variables, reason for ponds and stone spouts to fall under the given title and justification for the construction of the titles should be provided.

Universal terrain types in the valley floor

Plateau: It is a land that is located atop the bluff/high ground. If a stone spout or pond is located at the highland of a bluff where water cannot climb naturally from the surrounding, then it is a plateau. Furthermore, ponds and stone spouts that reside at the top of an independent bluff and collect water from its upper portion can also be termed to be located in a plateau. Example of such terrain is north-eastern section of historical Bhaktapur city and the localities of Kwathandau and western high ground area of Bhaktapur where Ta Pukhu, Na Pukhu and Rani Pikhu are located at the top of Bhaktapur bluff and is generally flat. This title is chosen because there are many bluffs inside the Kathmandu valley and generally these bluffs are the place for historical settlements and it is in these top parts of the bluffs many large ponds are constructed. Furthermore, this research also understands that there are no perfectly flat terrains in this valley so, it should be understood that plateau generally means land

atop the bluff.

Slope/Bottom of Bluff/Hill: It is a terrain sloping abruptly or gradually from top of the bluff or a hill surrounding the valley and the place located just below the bluff or hill. If a pond or stone spout is located in a sloping terrain then it will fall under this title. In general, stone spouts and ponds are constructed more commonly in the terrain that is sloping. A perpendicular cut will yield the discharge of water in a terrain that slopes abruptly whereas a quadrilateral steep dig of two or more flights of plinths is required at the terrain sloping gradually. Furthermore, there are many natural instances of water discharge from the slope areas in Kathmandu and in all hilly areas. Some examples are the bottom of the hills surrounding the valley, western slopes of the old settlement of Kathmandu.

Base: Abrupt and even gradual sloping has ended and the terrain seems like a lowland base, although stone spouts and ponds located at a slightly sloping or declining area within the lowland are placed under this category. Examples of base are: Chamati area of Kathmandu, flood plains of the rivers and rivulets, Balambu area of Chandragiri Municipality.

Common types of Land-use in Kathmandu valley

Historical Area (HA): It is a typical old settlement that existed well before hundred years ago. For example: Bode, Thimi, Bhaktapur, Bungamati, historical Kathmandu and so on.

Religious Area (RA): It is a temple/monastic area which may exist within the historical, forest, agricultural area and new settlements. For example: Machhegaon, Matatirtha, Ichangu and so on.

Jungle Area (JA): It is a forested area within the valley floor and the surrounding hills as well. The forest can be as small as Mhepi, UN park, slope of northern Kirtipur, Bhandarkhal of Pashupati, Ranibari, jungle of Tribhuwan University and as large as Nagarjun or Phulchowki forest.

Agricultural Area/ New Settlement (A/N): This is an area devoid of historical, religious and jungle area which is and has been used for agricultural purposes and now is overrun by new urban sprawl. For example: Chamati and Kausaltar. New kinds of land-uses such as industrial sites, playground, commercial sites will also be included within this heading.

All the data required for this research is acquired from a secondary source precisely, the inventory of "Stonespouts and Ponds of Kathmandu Valley" published by "Kathmandu Valley Water Supply Management Board". The inventory has categorized the stonespouts and ponds according to the local administrative body of the municipality and metropolitan city. The altitude feature of Google Earth is utilized in order to identify and measure the plateau, slope and lowland. The method espoused by this research is both quantitative and qualitative. Collective analysis of all the stone spouts and ponds is performed corresponding to their spatial existence. Furthermore, comparative analysis is also performed between multiple historical settlements, new settlements and among each of them. The results will be interpreted using utilitarian, religio-cultural and ethnographic perspectives.

No research is complete and devoid of any flaws. Similarly, the limitation of this research is that the researcher used an online tool called Google Earth in order to map all the stone spouts and ponds but did not personally travel to every location to collect observation data on stone spouts, ponds and canals.

4. Results

Ponds, stone spouts, and canals have objective existence. They are real and tangible and are spread throughout the valley in all its municipalities. Their inventory and status have already been prepared. And the secondary source has been utilized for the purpose of this research. The inventory identifies the exact location of their existence but does not analyse the whereabouts in the spatial and geographical setting. Neither does it analyse all the ponds and stone spouts collectively, nor does it compare their existence to one another.

In this regard, this section attempts to first list out the number of stone spouts, ponds, and canals located in each of the municipalities. Then, all the stone spouts, and ponds will be categorized for spatial analysis using the parameters of terrain type analysis under the heading of: plateau, slope/bottom of the bluff/hill and base; and then common land-use types analysis under the sub-headings of: historical area, religious area, jungle area and lastly agricultural area/new settlement. Furthermore, the number of stone spouts and ponds corresponding to the bluff/hill, concentration in any specific area and any other patterns are stated in this section.

The number of stone spouts are listed below corresponding to their respective municipality.

Table 3: *Status of stone spouts in Kathmandu valley (Rana et al., 2024)*

Municipality	No. of flowing stone spouts	No. of dry stone spouts	No. of lost stone spouts	Total
Bhaktapur Municipality	18	73	0	91
Budhanilkantha Municipality	8	9	2	19
Chandragiri Municipality	17	28	2	47
Changunarayan Municipality	44	18	3	65

Dakshinkali Municipality	19	9	2	30
Godawari Municipality	22	3	0	25
Gokarneshwor Municipality	12	7	1	20
Kageshwori Manohara Municipality	25	4	2	21
Kathmandu Metropolitan City	48	79	52	179
Kirtipur Municipality	6	4	2	12
Lalitpur Municipality	31	41	8	80
Thimi Municipality	43	16	26	85
Mahalaxmi Municipality	8	2	0	10
Nagarjun Municipality	13	6	3	22
Shankharapur Municipality	21	7	2	30
Suryabinayak Municipality	19	9	2	30
Tarkeshwor Municipality	18	3	1	22
Tokha Municipality	10	2	2	14
Grand Total	382	320	110	812

There are in total 812 identified stone spouts in Kathmandu valley. Among them 382 stone spouts are flowing, 320 are dry and 110 are lost.

Similarly, the number of ponds are listed below corresponding to their respective municipality.

Table 4: Status of ponds in Kathmandu valley (Rana et al., 2024)

Municipality	No. of existing Ponds	No. of lost Ponds	Total
Bhaktapur Municipality	33	5	38
Budhanilkantha Municipality	5	0	5
Chandragiri Municipality	18	2	20
Changunarayan Municipality	7	1	8
Dakshinkali Municipality	6	2	8
Godawari Municipality	26	2	28
Gokarneshwor Municipality	0	1	1
Kageshwori Manohara Municipality	9	1	10
Kathmandu Metropolitan City	14	1	15
Kirtipur Municipality	9	1	10
Lalitpur Municipality	49	16	65
Madhyapur Thimi Municipality	17	3	20
Mahalaxmi Municipality	14	6	20
Nagarjun Municipality	1	0	1
Shankharapur Municipality	7	3	10
Suryabinayak Municipality	8	0	8
Tarkeshwor Municipality	6	0	6
Tokha Municipality	6	1	7
Grand Total	235	45	280

There are in total 280 identified ponds in Kathmandu valley. Among them, 235 ponds are existing and 45 are lost.

The stone spouts are spatially categorized under the headings of plateau, slope/bottom of the hill, base; and under the subheadings under each headings as historical area, religious area, jungle area, agricultural area/new settlement. The following table presents the data of spatially categorized number of stone spouts.

Table 5: Spatial categorization of stone spouts

Municipality	Plateau				Slope/Bottom of the Hill/Bluff				Base Area			
	HA	RA	JA	A/N	HA	RA	JA	A/N	HA	RA	JA	A/N
Bhaktapur	18	7	0	2	31	7	1	9	0	0	0	6
Budhanilkantha	0	0	0	0	0	2	4	13	0	0	0	0
Chandragiri	0	0	0	0	8	6	7	24	0	0	0	2
Changunarayan	1	0	0	6	1	4	5	46	0	0	0	2
Dakshinkali	0	0	0	0	6	4	5	13	0	1	0	1
Godawari	0	0	0	0	2	1	9	12	0	0	0	1
Gokarneswor	0	0	0	0	0	0	2	12	0	0	0	6
Kageshwori-Manohara	0	0	0	0	0	2	1	26	0	0	0	2
Kirtipur	1	0	0	0	3	0	3	5	0	0	0	0
Kathmandu	0	1	0	0	38	2	3	89	0	1	0	4
Lalitpur	0	0	0	1	44	9	2	27	0	0	0	5
Mahalaxmi	0	0	0	0	4	0	2	4	0	0	0	0

Nagarjun	0	0	0	0	0	2	2	17	0	1	0	0
Snakharapur	0	0	0	0	9	5	3	13	0	0	0	0
Suryabinayak	0	0	0	1	0	5	1	20	0	0	0	1
Tarkeshwor	0	0	0	0	0	4	1	17	0	0	0	0
Thimi	0	0	0	1	15	3	0	46	0	0	0	1
Tokha	3	0	0	0	4	3	0	4	0	0	0	0
Total	23	8	0	11	165	59	51	397	0	3	0	31

Similar to the stone spouts, ponds are also categorized under the headings of plateau, slope/bottom of the bluff/hill, base; and then under the sub headings of historical area, religious area, jungle area and agricultural area/ new settlement. The following table presents the data on spatially categorized number of ponds

Table 6: Spatial categorization of ponds

Municipality	Plateau				Slope/Bottom of the Hill/Bluff				Base Area			
	HA	RA	JA	A/N	HA	RA	JA	A/N	HA	RA	JA	A/N
Bhaktapur	8	0	0	5	23	1	0	6	0	1	0	1
Budhanilkantha	2	0	0	0	1	2	0	0	0	0	0	0
Chandragiri	0	1	0	0	6	4	3	5	0	0	0	0
Changunarayan	1	0	0	1	1	1	1	3	0	0	0	0
Dakshinkali	0	0	0	0	3	1	0	3	0	1	0	0
Godawari	1	0	0	1	18	3	0	13	0	0	0	0
Gokarneswor	0	0	0	0	0	0	0	0	0	0	0	1
Kageshwori-Manohara	0	0	0	2	0	1	0	6	0	0	0	1
Kirtipur	1	0	0	0	9	0	0	8	0	0	0	1
Kathmandu	0	0	0	0	6	3	1	1	1	0	0	3
Lalitpur	0	0	0	0	51	5	0	9	0	0	0	0
Mahalaxmi	0	0	0	0	13	1	0	6	0	0	0	0
Nagarjun	0	0	0	0	0	0	0	1	0	0	0	0
Snakharapur	0	0	0	0	5	0	0	5	0	0	0	0
Suryabinayak	0	0	0	0	1	3	1	3	0	0	0	0
Tarkeshwor	0	0	0	1	1	0	0	4	0	0	0	0
Thimi	5	0	0	0	12	0	0	5	0	0	0	0
Tokha	4	0	0	0	0	2	0	0	0	0	0	0
Total	22	1	0	10	150	27	6	78	1	2	0	7

Bhaktapur Municipality: This municipality is located in the south-eastern part of the Kathmandu Valley. Bhaktapur municipality is roughly the size of 6.88 sq km. (Bhaktapur Municipality, 2025). To the north and east of Bhaktapur municipality lies Changunarayan municipality, to the west lies Thimi, and to the south lies Suryabinayak municipality. The municipality lies between two rivers Kasan River in the north and Hanumante River to the south. The independent bluff of Bhaktapur is at its highest in the north-east around the army camp, declines in the middle, and rises again at the western edge. These two edges are the plateaus where the largest of the ponds of Bhaktapur are located. Yatu Bahara Pukhu/Kamal Pokhari is the largest and is in a perfect location to collect rain water from further north-eastern highlands. The bluff descends rapidly from the bluff in the north and then the descend is gradual to form a lowland base area till it reaches Kasan River. To the south as well, the descend is rapid from the bluff and has a short base area till Hanumante river. However, in the east the descend is gradual.

In total 81 stone spouts and 44 ponds were categorized but regarding the others, their location could not be traced. Close to ponds of western plateau of Bhaktapur stone spouts are conspicuously absent. Majority of ponds encircle from outside the Bhaktapur bluff that are either located at two plateaus or the slopes of the bluff.

Budhanilkantha Municipality: Located at the north of Kathmandu Valley, Shivapuri hill is the imposing sanctuary from where one of the tributaries of Bishnumati River originates from the west and the Dhobi Khola originates from the east. Two arms of Shivapuri hill, one ending at Green Valley Resort in the west, and another arm ending at the Pullahari Monastery in the east, embrace the floor of Budhanilkantha that extends till the Sukedhara section of the ring road. The terrain of Budhanilkantha Municipality generally slopes towards the south with some small hill protruding from the floor. It has an area of 34.80 sq km (Budhanilkantha Municipality, 2025). This municipality is bordered by Gorkaneshwor municipality to the east, Tokha municipality to the west, Nuwakot district to the north and Kathmandu Metropolitan city to the south. All of its stone spouts and all except two ponds are located at the slope of the bluff/hill. Lichchhavi inscriptions have been found from Dharampur, Chapali and Bishnupaduka which also mentions the name of villages and even towns from the Lichchhavi period but their existence in modern time cannot be ascertained.

In total, 19 stone spouts and 5 ponds are categorized in this municipality. Among them,all stone spouts are located at the slope/bottom while two ponds are located at plateau and the rest at the slope/bottom.

Chandragiri Municipality: This municipality lies at the western edge of the valley located between Chandragiri hill chain in the south, Bad Bhanjyang/Nagdhunga hill pass in the western edge, Dahachowk hill chain to its north and the open valley floor connects this municipality to Kirtipur municipality to its east. Chandragiri is bordered by Nagarjun Municipality to the north, Dhading district to the west and Makwanpur district to the south. The area of this municipality is 43.9 sq km (Chandragiri Municipality, 2025). The floor of Chandragiri gradually declines from hills of three directions: south, west, and

north. The lowest area or base is located in Balambu from which streams emerging from three sides flow to become the Balkhu Khola. Each of its tributaries forms bluffs sloping towards the Balkhu river. At the slopes in the valley floor below Chandragiri and Bhasmasur hills lie the sites of historical settlements. At the foot of these two hills lies major religious areas as well, like Matatirtha and Matsyanarayan temples. While both these temples are water sanctuaries and also are jungle areas, they are listed only as religious areas in the table. The historical settlements of this municipality are (from west towards east): Thankot, Kisipide, Gurjudhara, Balambu, Satungal, Boshigaun, Matsyanarayan and Naikap (north of Thankot road).

In total, 47 stone spouts and 19 ponds are categorized. All the stone spouts are located on the slope/bottom of the bluff/hill except two are located in the base area. Similarly, all ponds except one are located at the slope/bottom of the bluff/hill. The Thankot area has stone spouts surrounding the settlement and also has two ponds just outside. Kisipide has two ponds, one in the middle and another at the edge of the settlement. Balambu has only one pond at a higher slope that seems modern and has no stone spouts. Satungal too has one pond at the southern edge and no spouts. Boshigaun has one pond that is not recorded in the inventory nor included in the table and lastly Naikap has one spout below the settlement. The rarity of water infrastructures in these traditional settlements is perplexing.

Changunarayan Municipality: Changunarayan Temple provides the name to this municipality. Changunarayan Hill, Trishul Dada dominates the northern section while Nagarkot hill chain and Nalagadhi Hill dominate the eastern section of this municipality. Then the terrain gradually slopes towards the valley with few smaller foothills and sloping plateaus, from the west: Saraswati khel, Duwakot, Jhaukhel, Chwasal, Naagthali; turning south: Sudal and Tathali. Between these places lies the base area or lowland from where the tributaries meander ultimately meeting with Hanumante river. Changunarayan municipality has the total area of 62.98 sq km (Changunarayan Municipality, 2016) and is bordered to the east by Kavre, Kageshwori-Manohara Municipality and Madhyapur Thimi Municipality to the west, Shankharapur Municipality to the north and Bhaktapur and Suryabinayak Municipality to the south. The historical settlement of antiquity in Changunarayan is only in the hill with the same name.

In Changunarayan municipality, 65 stone spouts and eight ponds are categorized. Majority of the stone spouts in this municipality are located at Nagarkot, Nalagadhi, Trishul dada, Changunarayan hill slopes; Saraswatikhel, Duwakot and Jhaukhel areas; and near Bhaktapur municipality. The historical settlement of Changunarayan has only two spouts at its western and eastern lower edge whereas the ponds are located even lower.

Dakshinkali Municipality: It is located at the southern edge of Kathmandu Valley bordered by Chandragiri and Kirtipur municipality to the north, Lalitpur Metropolitan city and Godawari Municipality to the east, and Makwanpur District to the west and south. Geographically, the municipality has four major ridges of Champadevi and Bhasmasur hills extending towards the center, where Pharping, the only relatively flat area, is located in a small valley. This valley extends east inclining again to form a small hill till it declines again further to the east up to the Bagmati River. Settlements are also gradually increasing in the lowlands formed between the four ridges.

There are 30 spouts and eight ponds located in this municipality. Half of the stone spouts and all but one pond are located in the valley of Pharping. The other half of the stone spouts are located either at the slope or at bottom of the hill. Dakshinkali and Shesh Narayan stone spouts are located both in religious areas and water sanctuaries below the jungle.

Godawari Municipality: It is located at the southern part of the valley and has a total area of 96.11 sq km (Godawari Municipality, 2025). To the west lies Dakshinkali municipality, to the south are Bagmati and Kongyosom rural municipality (Gaupalika), Kavre district to the east and lastly Mahalaxmi and Lalitpur districts to the north form the boundary of Godawari. Geographically, Dalchoki hill sits at the southern most point and the foothills of Dalchoki extend till Bagmati River located to the west of the municipality and water from these ridges does not enter the valley. Furthermore, Phulchowki hill and its ridges form the south eastern border. Between these ridges lies a secluded valley of Lele from where the Nakkhu Khola starts. East of this river rises a plateau inclining gradually from the foothills of Phulchowki. A royal canal (Rajkulo) originates from Lele and continues its northward journey via: Tikabhairab Temple, Charghar, Tahakhel, Pyanggaon, Vade (Chapagaon), Thecho and moves north to reach Patan and ultimately empties in to Bagmati replenishing all the ponds and rejuvenating all the spouts on the way. The ridge slopes again to the east and forms several lowland areas and rises again but with thin settlement till Godawari. It is at the foot of Phulchowki two water sanctuaries are located: Naudhara and Panchdhara. From these water sanctuaries the terrain slopes gradually till Patan. Within the Godawari municipality, along the slopes lies Badegaon and Thaiba. This ridge declines again further east and then rises at Godamchaur.

In total 25 stone spouts and 36 ponds are categorized in this research. The majority of spouts and ponds are located along the route of royal canals connecting historical settlements.

Gorkarneshwor Municipality: This municipality lies east of Budhanilkantha municipality. To further east are the Kageshwori-Manohara, Sankharapur municipalities and to north-east and north are districts of Sindhupalchowk and Nuwakot respectively. Kathmandu metropolitan city is at its south. It has a total area of 58.50 sq km. (Gokarneshwor Municipality, 2025). Geographically, the eastern section of Shivapuri hill forms the northern boundary from where the Bagmati sprouts and forms the eastern boundary. The valley floor gradually slopes from the foot of Shivapuri hill till it reaches Bagmati River. Then the terrain rises again to form a bluff where Gokarna forest is located. Bagmati river gushes out of gorge between Gokarna bluff and Jagdol foothill. Gokarneshwor Temple is located at the gorge. The terrain gradually slopes further south and creates a lowland base area at the banks of Bagmati river.

Altogether, 20 stone spouts and only one pond is found from this municipality. The majority of stone spouts are located in the slope/bottom of the bluff/hill, while some are also located in the base area.

Kageshwori-Manohara Municipality: The Bagmati River forms a boundary to the west only to be taken over by Gokarna forest in the middle, and the Manohara River to the east. In the north Manichuda hill dominates. The terrain of slopes from the hill forming two bluffs of Aalapot and Bhimsentar in the north. Between these two bluffs flows the tributary of Manohara River. Further south are the bluffs of Bhadrabas, Dachhi and Thali. From here the terrain generally flattens and slopes towards the Manohara River and also gradually declines from the plateau of Gaucharan where the international airport is located. This municipality is bordered by protruding narrow strips of Sankharapur and Gokarneshwor municipality in the north, Shankharapur, Changunarayan and Thimi municipality to the east, Kathmandu metropolitan city to the south and Gokarneshwor municipality to the west. It has the total area of 27.6 sq km (KageshworiManohara Municipality, 2025)

Altogether, 31 stone spouts and 10 ponds are categorized within this municipality. Again the majority of them were located on the slope/bottom in agricultural fields/new settlements.

Kirtipur Municipality: The municipality gets its name from the historical town of Kirtipur located at the north-western edge atop a hill. The terrain of this municipality generally slopes from the foot of the southern hill chain of Champadevi with minor bluffs and shallow base areas apart from the small western portion of the municipality which drains in Balkhu Khola, the whole municipality drains towards Bagmati flowing to the east. The Taudaha lake sits at the south-eastern lowlands just above Bagmati River and collects water from the elevated areas to the west. This municipality is bordered by Lalitpur metropolitan city to the east, Kathmandu metropolitan city to the north along with a strip of Nagarjun municipality, Chandragiri municipality to the west and Dakshinkali municipality to the south. Its total area is 14.76 sq km (Kirtipur Municipality, 2025)

A total of 12 stone spouts and 19 ponds were found and categorized. All the spouts except one are found at Kirtipur, the other one is located near Bagmati river. One spout in Kirtipur is at the top of the plateau while all the others are either at sloping areas or at the bottom of the hill. Regarding the ponds, majority of them are in Kirtipur, one at the plateau and all other at either sloping area or the bottom. Two large ponds are located at the northern bottom and three at the southern bottom of the Kirtipur hill. Two ponds are in Panga and others are at the slope leading up to and around Taudaha.

Kathmandu Metropolitan City: It is the capital of Nepal. It shares its boundary with Tarkeshwor, Tokha, Budhanilkantha and Gokarneshwor municipalities in the north, Kageshwori-Manohara to the north-east, Thimi to the east, Lalitpur metropolitan city, Kirtipur and Mahalaxmi municipality to the south and Nagarjun municipality to the west. It has four major independent bluffs. They are (from the east to west): Gaucharan bluff, Baneshwor-Baudha bluff, Dillibazar-Dhumbarahi bluff and Kantipur-Lazimpat-Maharajgunj-Bansbari bluff carved by Manohara, Dhobikhola, Tukucha and Bishnumati rivers respectively. Further west the sloping terrain from Nagarjun municipality continues till Bishnumati. Swayambhu hill is the eastern extension of Nagarjun foothill. A large and prominent base area is formed by flood plains of Bishnumati River in Chaumati, Khusibun and Kalimati area. All the four bluffs decline from north to south towards the Bagmati River. It has a total area of 50.67 sq km (Kathmandu Metropolitan City, 2021).

In total, 137 stone spouts and 15 ponds are categorized. Among them, the majority of the spouts and ponds are located at the slope/bottom of the bluff. For the Kantipur to Bansbari bluff almost all of the spouts are located at the western slope/bottom and only three were located inside the historical city of Kantipur but others concentrated either at the western slopes/bottom or immediately outside of the city limits. Furthermore, the water required for the Kantipur city was collected first in Lazimpat pond, Lainchaur pond, Kamalpokhari pond (now Chhaya center), Ikha Pokhari of Chhetrapati, Ranipokhari, Civil Mall (Pokhari) and Bagh Durbar pokhari. All have been lost but two remain in Ranipokhari and Ikhapokhari. Two other ponds, Narayanhiti pond and Kamaladi Ganesh pond lie in religious areas at the sloping ground. In Dillibazar-Dhumbarahi bluff, ponds and spouts lie at the sloping area either from north to south or east-west slopes with exceptions of few. The same scenario is repeated in

Gaucharan and Baneshwor-Bauddha bluffs. Stone spouts and one pond are found below the Swayambhu hill and as well as the sloping areas leading towards Banasthali and Dallu.

Lalitpur Metropolitan City: It is bordered by Kathmandu Metropolitan City to the north, Kirtipur and Dakshinkali municipality to the west, Godawari municipality to the south and Mahalaxmi municipality to the east. The slope that starts from the foot of Phulchowki hills and forms a bluff between Nakkhu and Kodku Khola continues towards the historical city of Patan. The slope has eased up and is gradual. It has a total area of 36.12 sq km (Ward1lmc, 2025).

Altogether, 88 stone spouts and 65 ponds were categorized. Majority of the stone spouts are located in historical settlements of Bungumati, Khokana, Harisiddhi, Sunakothi and Patan. In Patan, the spouts are concentrated towards the edges of the city with a few exceptions. This phenomenon is repeated in Harisiddhi and Sunakothi. However stone spouts are also available in city centers of Bungamati and Khokana but the rest are along the edges. Regarding ponds, they also show a clear pattern i.e. their location along the route of the canal that starts from Lele and Godawari. In Patan and Harisiddhi larger ponds are at the top of the settlement whereas in Bungumati and Khokana larger ponds are both at top and bottom of the settlement. Although in case of Sunakothi, large ponds are inside the settlement which show the path of canals through the historical settlement.

Mahalaxmi Municipality: The dominant hill of this municipality is Lakuri Bhanjyang, which itself is a foothill of Phulchowki. The slope that starts from the foot of Lakuri Bhanjyang continues till it is dissected by the Godawari river that meets the Hanumante River further north. The terrain rises again in Siddhipur village in the south-west and Tikathali further north only to gradually slope again through Imadol towards Hanumante and Kodku river. It has a total area of 26.5 sq. km (Mahalaxmi Municipality, 2020).

In total, there are 10 stone spouts and 20 ponds categorized for this municipality. The majority of the spouts are either located at the foot of Lakuri Bhanjyang and Lubhu. In Lubhu, all except one spout are located at the outer rim of settlement. There are no spouts in the historical settlement of Siddhipur. Whereas, there are many ponds in Siddhipur, the largest ones at the top and bottom of the settlement. In Lubhu all the ponds are at the outer rim. The rest of the ponds of this municipality are either at the foot of the hill or out in the open fields.

Nagarjun Municipality: This municipality is flanked by Nagarjun, Dahachowk, Bhimdhunga hills in north, south and west respectively. There are two foothills protruding up from the valley floor. They are Ramkot where the White Gumba is located and Tergar Osel Ling Monastery Hill. The Manamati River is at the bottom of the bluffs on either side that begins from the surrounding hills. These bluffs as well gradually slope towards Kathmandu. A tributary of Bhacha Khusi emerges from the southern section of the Nagarjun Hill near the Ichangunarayan Temple which passes through the middle of foothills and again meanders at the north of the Swayambhu Hill ultimately meeting with another tributary coming from eastern slope of Nagarjun Hill, at Chaumati area in Kathmandu. The municipality is bordered by Tarkeshwor Municipality in the north, Dhading district to the west, Chandragiri and Kirtipur municipality to the south and Kathmandu Metropolitan city to the east. Its total area is 29.8 sq. km (Nagarjun Municipality, 2025).

Twenty two stone spouts and one pond have been categorized from this municipality. The majority of them are located at the slope/bottom of bluff/hill in agricultural fields/new settlements while one is located at the base area. Two spouts, Ichangunarayan Dhara and Santaneshwor Dhara are located below the jungle area and religious area as well.

Sankharapur Municipality: In this municipality the Manichud Hill slopes towards the Sankhu Town and Lapsifedi Hill slopes both towards Sankhu and Melamchi River located outside the Kathmandu Valley. Its southern border is marked by Manohara River and through the valley floor meanders its two tributaries: Sali Nadi and Manamatta River. The Manamatta River and its flood plains/ base area cuts two bluffs of Sanagaon and Sankhu, both sloping from the foot of Manichuda Hill towards Manohara River. Sankharapur is bordered by Sindhupalchowk district in the north, Kavrepalanchowk district in east, Changunarayan Municipality in the south, Gokerneshwor and Kageshwori-Manohara municipalities to its west. It has a total area of 60.21 sq. km (Shankharapur Municipality, 2025).

Among the 30 stone spouts and 10 ponds categorized within this municipality most of the spouts are located in the bluff of Sankhu, on the way to Vajrayogini and foot of Lapsiphedi. Whereas all of the ponds are located in either of the bluffs of Sanogaon and Sankhu. In Sankhu, the ponds encircle the settlement from outside where the biggest ones are either at the top or bottom of the settlement.

Suryabinayak Municipality: This municipality is bordered by Kavrepalanchowk district to the east and south, Mahalaxmi municipality to the west and Changunarayan, Bhaktapur and Thimi municipality to its north. The valley floor starts from the foot of Ranikot and Bukacho Gadhi hill and all the tributaries drain to Hanumante River. It has a total area of 42.45 sq. km (Suryabinayak Municipality, 2025)

26 out of the 28 stone spouts and all of the ponds are located at the slope/bottom of the bluff/hill. In total,

twenty eight stone spouts and eight ponds are categorized.

Tarkeshwor Municipality: In the north of this municipality lies the Nuwakot district, Dhading district in the west, Nagarjun Municipality and Kathmandu Metropolitan city to the south and Tokha municipality to the east. The chain of Shivapuri Hill extends through the north of this municipality to connect with Nagarjun Forest which continues through the southern boundary. Tributaries of Mahadev Khola flow towards the south to meet with Bishnumati River. The tributaries and Mahadev Khola with its flood plains create several bluff areas that starts from the foot of the northern Tarkeshwor Hill and gradually slopes towards the south. Bishnumati River coming from Jhor Mahankal is the eastern boundary of the municipality. It has a total area of 34.95 sq. km (Tarkeshwor Municipality, 2025).

Among 22 stone spouts all are located in the slope/bottom of the bluff/hill of which majority lies in agricultural fields/new settlement. All but one pond are also located on the slope/bottom of the bluff/hill. Tarkeshwor spouts and ponds are both located in jungle and religious areas but only categorized under religious area in the table.

Thimi Municipality: This municipality lies in the middle of the valley and has one independent bluff extending and sloping from the Nil Barahi temple through Bode and Thimi. The other areas generally slope to the either sides reaching till Manohara river in the west and towards Saraswotikhel and Duwakot. The municipality shares its border with Bhaktapur and Changunarayan municipality to the east, Kageshwori-Manohara to the north, Kathmandu metropolitan city to the west, Mahalaxmi and Suryabinayak municipality to the south. It has a total area of 11.47 sq. km (Madhyapur Thimi Municipality, 2025).

Sixty-six stone spouts and 22 ponds were categorized. Majority of stone spouts are located at the slope/bottom of the bluff of Nil Barahi-Bode-Thimi. A few are located on land sloping towards Manohara flood plains in Lokanthali and Sano Thimi. All of the ponds are in the historical settlement of Bode, Nagadesh and Thimi. Bode lies at higher altitude from Nagadesh and Thimi so, some ponds are categorized as located in plateau and all others even though located within the settlement are categorized as located in slope/bottom of the bluff/hill.

Tokha Municipality: Jhor Mahankal is at the highest altitude located to the north. From here the valley floor declines till the Gongabun and Samakhusi region. Just below the Green valley resort lies the Chandeswori Temple, from there the terrain declines and rises again to form an independent plateau of Tokha where the traditional settlement is located. It has a total area of 17.11 sq. km (Tokha Municipality, 2025).

All except three stone spouts lie in either the slope/bottom of Tokha bluff or on its plateau. Two spouts lie at Chandeswori Temple just below the forest but are categorized as religious areas in the table. Regarding the ponds, all except two lie atop the plateau of Tokha. There are altogether 14 stone spouts and six ponds in Tokha municipality.

Among all the stone spouts in Kathmandu valley, 42 are located at plateau, 672 are located at slope/bottom of the bluff/hill and only 34 are located at base area. Also, 188 of stone spouts are in historical area, 70 are in religious area although some also overlap in jungle area but counted as located in religious only, 51 are located in jungle areas, and only 439 are located in agricultural fields/new settlements.

Similarly, among all the ponds in Kathmandu valley, 33 are located in plateau, 261 are located in the slope/bottom of the bluff/hill, nine are located in base area. Also, 173 are located in historical area, 30 are in religious area although some overlap with jungle area but only counted as religious area, six are located only in jungle area and 95 are located in agricultural area/new settlements.

5. Discussion

Since this research has already dealt with the question of 'where' the stone spouts and ponds are located, now this section will scrutinize the 'why' part of the objective of this research. As per the categorization of ponds and stone spouts according to the terrain type of their location, most are located on the slope/bottom of the bluff/hill. It is the case because water maintains a certain level beneath the ground. This level increases in the rainy season sometimes even surpassing the ground level and accumulating above the ground but in the dry season the water level diminishes gradually as the dry season elongates. So, most of the stone spouts are built in the slope for the ease of capturing the underground water and so that they can capture the ground water for as long as possible. Regarding the ponds, most of them are on the slope/bottom of the bluff/hill. This is because it is easier to capture the surface runoff from the upper sections of the ground and accumulate them in a pit. While saying this, there are some stone spouts and ponds located at the plateaus as noted above. This should not mean that these traditional water infrastructures are located at the topmost location. In the parameter itself, it is well informed that to be a categorized in plateau they need to be generally at the top in an independent bluffs where water cannot naturally climb from below via a canal or somehow but can be some of the the firsts among the ponds and spouts that are generally at the pinnacle of a bluff. For example, the ponds located at the north eastern and western points of the bluff of Bhaktapur, the pond at the top of Kirtipur and so on. The most interesting and important among all is the Yatu Bahara pond or Kamal Pokhari of Bhaktapur which is located at the top of the traditional settlement. It too collects water from the slope above it.

The number of ponds and stone spouts are very less in the base area because they lack settlement although the absence of stone spouts in the historical settlement of Balambu is confusing. It may be because water in their wells is always plenty due to their positioning at the base.

Categorizing the stone spouts according to spatial location, most of them are found to be in agricultural fields/new settlements. But they are so because even though an agricultural field is near historical areas they fall under this category. Some are relatively new which were only constructed after the influx of people from outside the valley and settled in places apart from the historical settlements and those settlements needed water so they decided to tap in the natural flow of water located at the slope/bottom. Although, more light could be shed on this only after the study of date of installation and their design type. Some stone spouts were built en-route of the canal as in the case of Godawari and Lalitpur Metropolitan City. Whereas they are built on the walking trail/path/road to the temple or in general. For example: stone spouts built en-route to Swayambhu from historical Kathmandu city. And lastly, in some cases stone spouts are built in some historical settlements that have been forgotten now as in the case of Hadigaon, Maligaon and so on.

Regarding the ponds, most of them are found to be in and around historical settlements such as, Bhaktapur, Patan, Bungamati, Harisiddhi, Bode, Thimi, Siddhipur, Lubhu and so on because the settlements needed water and ponds were their water reserves that would ensure the perennial flow of water through the spouts. These ponds were either served by canals or rainwater. Larger ponds were located at the top of the settlement and at the bottom of the settlement.

The second largest number of stone spouts are located in historical areas, especially in Lalitpur and Bhaktapur. Kathmandu has most of its stone spouts in the western and eastern edges of the historical city proper but not inside or at the midsection of the settlement itself. Furthermore, for the historical city of Kathmandu, there are only two stone spouts inside the settlement which is not the case in Bhaktapur where there are many inside the settlement. Thimi also possesses most of its stone spouts to the immediate boundary of the settlement where the terrain is sloping. Same is the case for Bode, Nagadesh, Chabahil, Hadigaon, Harisiddhi, Lubhu, Changunarayan and Siddhipur. Lalitpur is a case a bit different where there are some stone spouts located inside the settlement but most of them are located at the edges. Bungamati has three spouts inside and four at edges, Khokana has two inside and two at the edge, Sankhu has six inside and eight are at the edge, Tokha has two inside and seven at the edge, Thankot has two inside and six at the edge. Furthermore, Balambu, Kisipide, Boshigaun, Satungal and Naikap have none either out or in. The reason for this may be the use of wells which may seem more convenient or may have been lost. But further study is required on this.

The reason for the existence of the second largest number of ponds at the agricultural field/ new settlement are: being en-route to canal, for irrigation purposes, natural accumulation and above/below the settlement.

The third most common place to find a stone spout and ponds are in the religious place. Religious places require pure water for ritual activities. So, it is common to build them near a religious place. Also, it should be noted that religious places located at the bottom of the jungle are there because of the existence of water sanctuaries as already noted by Ritterspach in 1994. These religious places ensure the proper preservation, management and protection of those perennial and important water sanctuaries.

Lastly, the least common place to find a pond and stone spout is in the jungle because of their non-utilitarian value for people and settlement that prevents people from building water infrastructures that will not be used.

In conclusion, most of the stone spouts and ponds are built at the slope/bottom of the bluff/hill because of the ease to access underground aquifers from these places. They are easy, perennial and have less chance of drying out if they are built in the slopes that have greater degree of angle to them than the gradual slopes. Ponds are generally built in naturally water accumulating areas or areas with comparative ease for accumulation whether above, inside or below the settlement.

References

Amatya, S. (2003). Water & Culture. Jalasrot Vikas Sanstha.

Bhaktapur Municipality. (2025). Brief Introduction. Bhaktapurmun. https://bhaktapurmun.gov.np/en/node/4

Budhanilkantha Municipality. (2025). Budhanilkantha Nagarpalika Ko Sanchhipta Bibaran. Budhanilkanthamun. https://budhanilkanthamun.gov.np/en/about

Chandragiri Municipality. (2025). Sanchhipta Parichaya. Chandragirimun. https://www.chandragirimun.gov.np/en/node/3

Changunarayan Municipality. (2016). Changunarayan Municipality Information and Communication Roadmap Development Plan. Changunarayan Municipality

Godawari Municipality. (2025). Godawari Nagarpalika ko Parichaya. Godawarimunlalitpur. https://godawarimunlalitpur.gov.np

Gokarneshwor Municipality. (2025). Sanchhipta Parichaya. Gokarneshwormun. https://www.gokarneshwormun.gov.np/en/node/3

Joshi, P. (2022). Hiti Pranali. Publication Nepalaya

Kageshwori Manohara Municipality. (2025). Sanchhipta Parichaya. Kageshworimanoharamun. https://kageshworimanoharamun.gov.np/en/node

Kathmandu Metropolitan City. (2021). Introduction. Kathmandu. https://kathmandu.gov.np/archives/1046?lang=en

Khaniya, G. (2005). Traditional Water Management Practices: A Case Study of Bhaktapur City. Jalsrot Vikas Sanstha.

Kirtipur Municipality. (2025). Sanchhipta Parichaya. Kirtipurmun. https://kirtipurmun.gov.np/ne/node/3

Madhyapur Thimi Municipality. (2025). Brief Introduction. Madhyapurthimimun. https://www.madhyapurthimimun.gov.np/

Mahalaxmi Municipality. (2020). Brief Introduction. Mahalaxmimun. https://mahalaxmimun.gov.np/

Molden, O., Griffin, N., & Meehan, K. (2016). The Cultural Dimensions of Household Water Security: The case Study of Kathmandu's Stone Spout Systems. Water International, 1-16.

Nagarjun Municipality. (2025). Sanchhipta Parichaya. Nagarjunmun. https://nagarjunmun.gov.np/en/content

Parajuli, S. K. (2016). Kathmandu Upatyaka Ka Dhungedhara Haru Ka Aadhyan. Tribhuwan University.

Pradhan, R. (1990). Dhunge Dhara: A Case Study of the three Cities of Kathmandu Valley. Ancient Nepal, 10-16.

Pradhananga, S. (2017). Lichhavi Avilekh Ma Dhara Pranali. Rastriya Abhilekhalaya. Abhilekh, 90-101.

Rana S. B., Tiwari N., Khatiwada B., (Eds.) (2024). Stone Spouts and Ponds of Kathmandu Valley: Status Mapping (Second Edition). Kathmandu Valley Water Supply Management Board (KVWSMB), Nepal

Ritterspach, B. (1990). Dhunge-Dharas in Kathmandu Valley - An Outline of their Architectural Development. Ancient Nepal, 1-9.

Ritterspach, B. (1994). Water Conduits in the Kathmandu Valley. Munshiram Manoharlal Publishers Pvt. Ltd

Shankharapur Municipality. (2025). Brief Introduction. Shankharapurmun. https://shankharapurmun.gov.np/en/node/4

Shrestha, S. K., (2014). Understanding Sustainability of the Traditional Water Conduits of the Kathmandu valley through the lens of Deep Beauty. Kansas State University.

Snyder, A. (2014). Water Shortage in the Mountains of Plenty: Water throughout the Hindu-Kush Himalayan Region. Iowa.

Spodek, J. C. (2002). Ancient Newari Water-Supply System in Nepal's Kathmandu Valley. APT Bulletin, 65-69.

Suryabinayak Municipality. (2025). Brief Introduction. Suryabinayakmun. https://www.suryabinayakmun.gov.np/en/node/4

Tarkeshwor Municipality. (2025). Sanchhipta Parichaya. Tarkeshwormun. https://tarakeshwormun.gov.np/ne/node/3

Tokha Municipality. (2025). Brief Introduction. Tokhamun. https://www.tokhamun.gov.np/en/node/4

Tripathi, M. (2016). A Comparative Evaluation of Stone Spout Management Systems in Heritage and non-Heritage Areas of Kathmandu Valley, Nepal. Lincoln University.

UN-HABITAT. (2007). Water Movement in Patan. Water for Asian Cities Programme Nepal.

Upadhyay, S., Thapa, A. B., & Prajapati, R. (2019). The Status of Traditional Stone Spouts in the Kathmandu Valley, Nepal. KEC Conference. Kantipur Engineering College.

Ward1lmc. (2025). About Us. Ward1lmc. https://ward1lmc.com/page/about-us