PO-CCS-1-307

The Brink of Extinction

Quantifying the Stories of Stone Spouts in the Kathmandu Valley

Saroj Maka [1] sroj551@gmail.com **Pratik Shrestha** [1] pratik@smartphones4water.org **Anusha Pandey** [1] anusha@smartphones4water.org **Jeffrey C. Davids** [2, 3] jeff@smartphones4water.org

Main Point: Based on three seasons of data collected by citizen scientists, we found that roughly three quarters of stone spouts measured (n = 83) are seasonally dry, and nearly half are permanently dry (i.e. extinct).

Introduction

- Traditional water harvesting and management techniques in Nepal (and other developing countries) are in decline, or have been completely abandoned.
- Stone spouts - a traditional water supply system (Figure 2) - were a primary water source in the Kathmandu Valley since 550 C.E.
- Stone spouts (also known as "Dhunge Dhaara") are channelized water spouts which use shallow aquifers, springs, ponds, and canals as their source(s).
- **Objective**: Characterize the spatial and temporal variation of discharge and EC of Stone Spouts in the Kathmandu Valley.

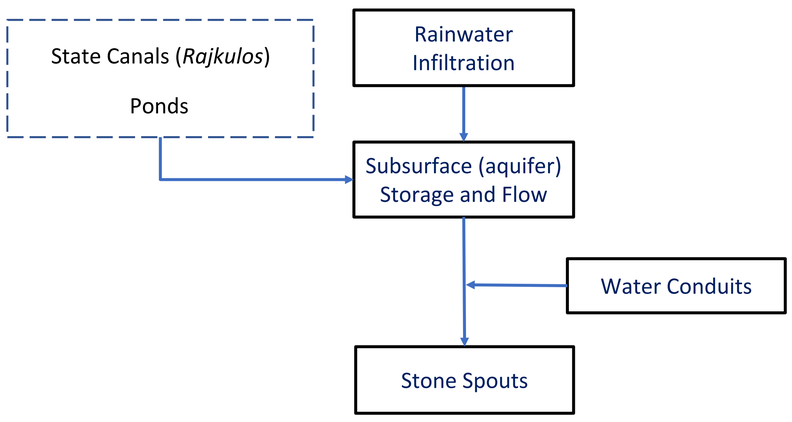


Figure 1. Flow chart showing the operating system of traditional water supply system in Kathmandu valley (modified from Khadge and Tiwari 2014).

Methods and Materials

Study Area: Kathmandu Valley

Data Collection: Dhunge Dhaara Land Use Campaigns (2D-LUC)

Who?: Citizen Scientists (CS) from the Kathmandu Valley

What?: Stone spout discharge and electrical conductivity (EC)

How?: Android Open Data Kit (ODK) application, measuring bucket, and EC Meter

When?: Post Monsoon 2017 and Pre/Post Monsoon 2018

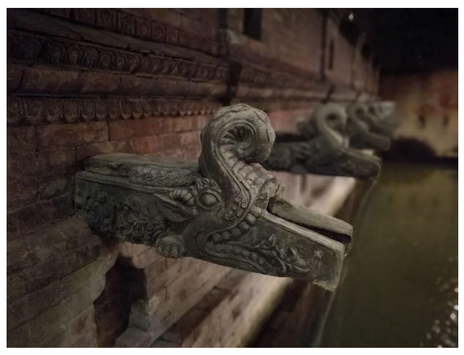


Figure 2. Stone spouts in Kathmandu.

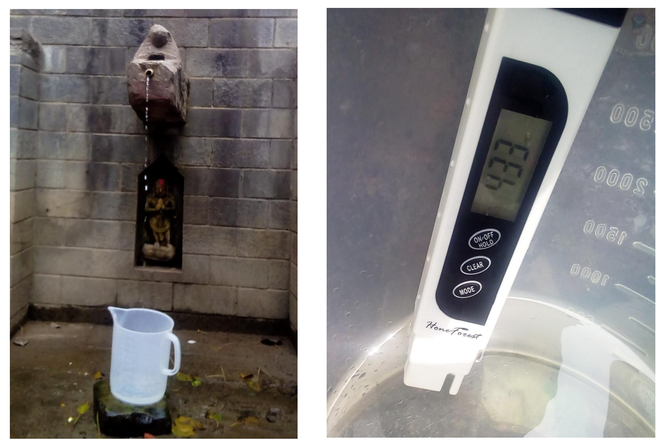


Figure 3. Measurement of stone spout discharge and EC.

Results

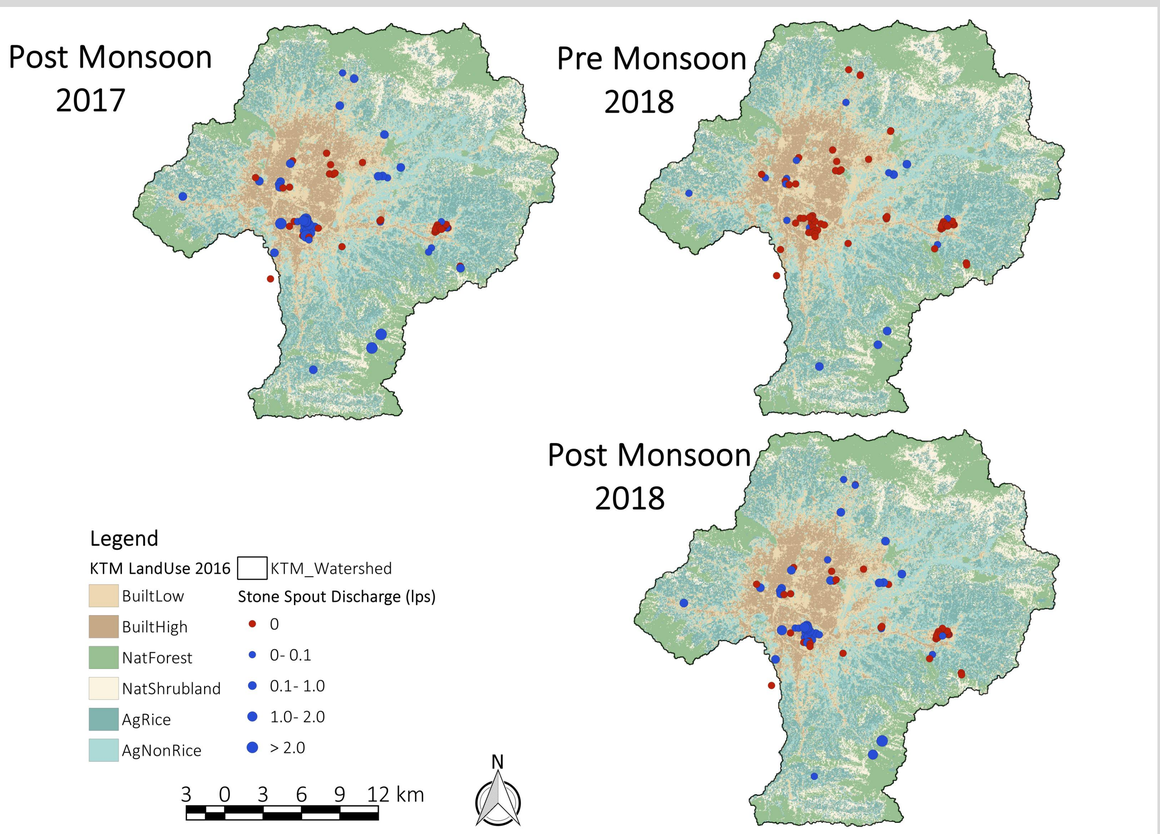
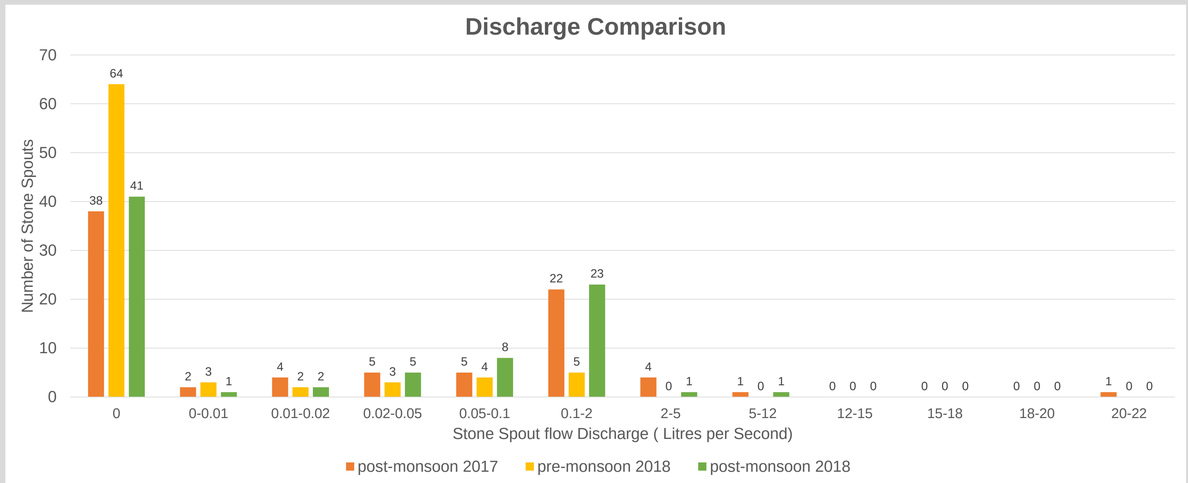


Figure 3. Spatial and temporal variation in stone spout discharge in Kathmandu Valley.



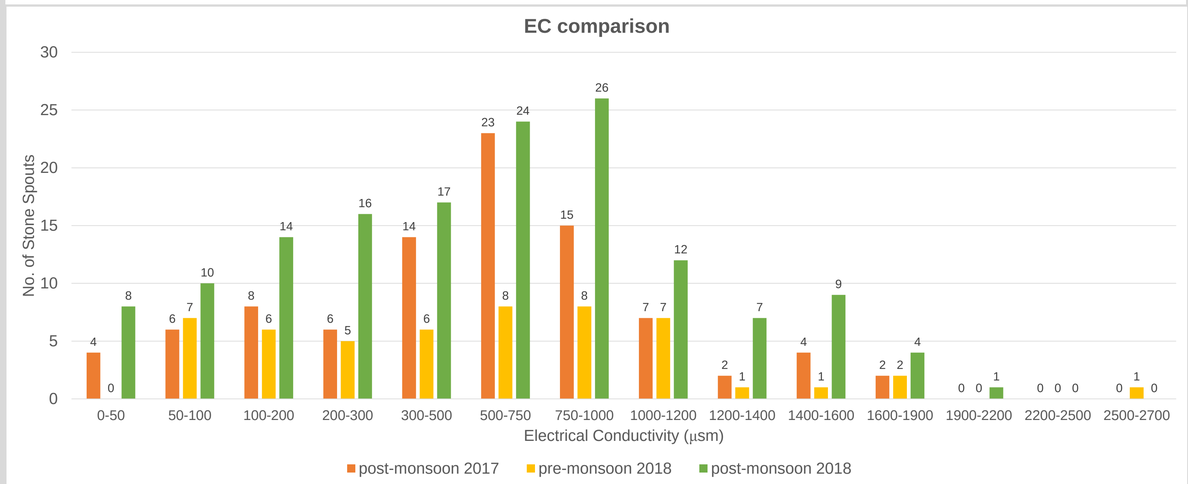


Figure 4. Seasonal variation of stone spout discharge and EC.

Discussion

- Seasonal drying of stone spouts indicates depletion of groundwater aquifers, disruption of supply mechanisms, and/or lowering groundwater tables. This could be due to various factors including: urbanization, over-population, depletion of shallow groundwater aquifers, reduced surface infiltration capacity, destruction of state canals, excessive groundwater extraction, and obstructions to sub-surface flow areas.
- Seasonal drying of stone spouts appears to be focused in urban areas, and maybe due to a combination of the factors listed above.
- Dry stone spouts appear to be increasing (n = 38 in 2017; n = 41 in 2018).

Conclusions and Recommendations

- Large numbers of stone spouts dry seasonally and are no longer capable of meeting water demands of the Valley.
- These ancient heritages should be revived to preserve our historical ambience.
- Future work should explore how aquifer storage and recovery could recharge shallow and deep aquifers, springs and ponds, and thus reviving our historical stone spouts.

Citizen Science - *scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions. [Oxford English Dictionary]*

TU Delft Delft University of Technology [3]

S4W-Nepal [1]

SmartPhones4Water = Citizen Science + Mobile Technology + Young Researchers

SmartPhones 4 Water [2]