Smart and Sustainable Urban Water Management in Quetta City, Pakistan

Ahsan Ali*, Ali Jamshed, Nikhil Agarwal*, Mayank Ostwal***

*Infrastructure Planning, University of Stuttgart, Stuttgart, Germany

**Institute of Spatial and Regional Planning (IREUS), University of Stuttgart, Stuttgart, Germany

INTRODUCTION

According to a United Nations press release, an estimated 1.1 billion people lack access to safe drinking water. Rapid urbanization, lack of proper management, financial constraint, expanding sealed surfaces, coupled with increasing threat of climate change aggravates this problem in developing countries like Pakistan, which faces a severe water shortage with its per capita availability reduced by 78% over the period 1950-2011. In the arid city of Quetta, ground water – while remaining the major source of drinking water – is under stress both in quantity and quality. While the groundwater depth is increasing by 3.5 m every year, samples also show high concentrations of nitrate, sulfate, arsenic, selenium, chromium and nickel. A residential area in Quetta is selected as a case study, which is supplied by drinking water from a local tube well without a filtration plant. The close proximity between sewer and water supply lines further contaminates the unfiltered water and spreads various diseases. Moreover, the conversion of residential green spaces reduces the ground water infiltration. Resultantly, local water demand is fulfilled by private water tankers at a higher cost. This study aims to investigate various social, economic and water related infrastructure characteristics as well as the future plans of the government of the case study area and proposes a model for smart water supply system by employing Information Communication Technology methods like Supervisory Control and Data Acquisition (SCADA), simple & sustainable solutions to recharge the ground water, raising awareness regarding proper water usage and disseminate information concerning the water supply through neighborhood religious institutions (e-g mosques).

METHODOLOGY

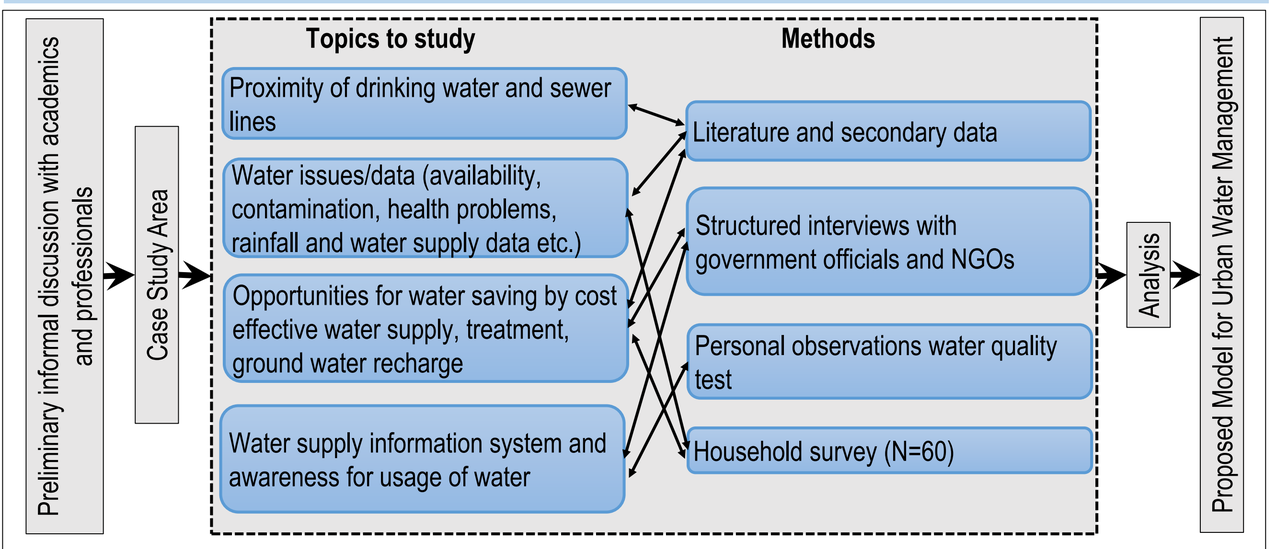
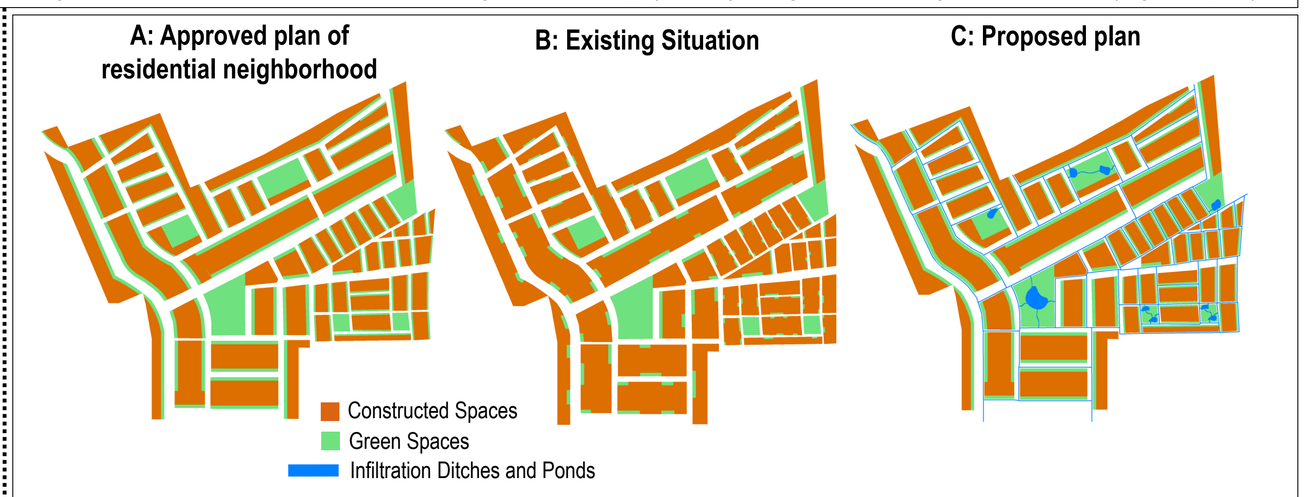


Figure 1: Research methodology



More than 50% of houses converted the residential green spaces into sealed parking lots and habitable rooms

Figure 5: A shows plan approved by spatial planning authorities, B indicates the present situation with conversion of green spaces of residential lots in seal surface, C shows the proposed plan for revival of green spaces with network of infiltration ditches and ponds.

RESULTS

Table 1: Comparison of water quality from source and consumer end

Water Quality Parameter	Permissible Limits	Source (Tube Well)	Consumer End (House)
Color (TCU)	Colorless	Unobjectionable	**Objectionable**
Odor	Odorless	Unobjectionable	**Objectionable**
pH	6.5-8.5 (WHO)	7.82	7.5
Microbiological Contamination	0/-VE	Negative	**Positive**
Turbidity (NTU)	5 (WHO)	5.2	**11.3**
TDS(mg/l)	1000 (WHO)	980	**1130**

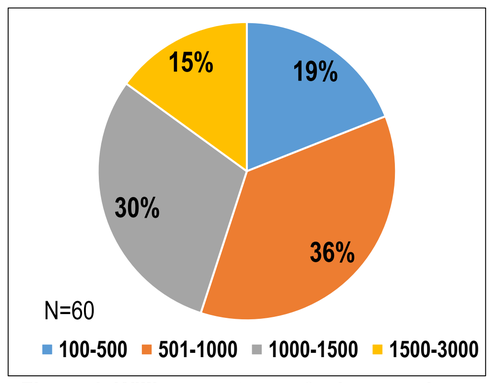


Figure 4: Willingness to pay for improved water supply (in PKR)

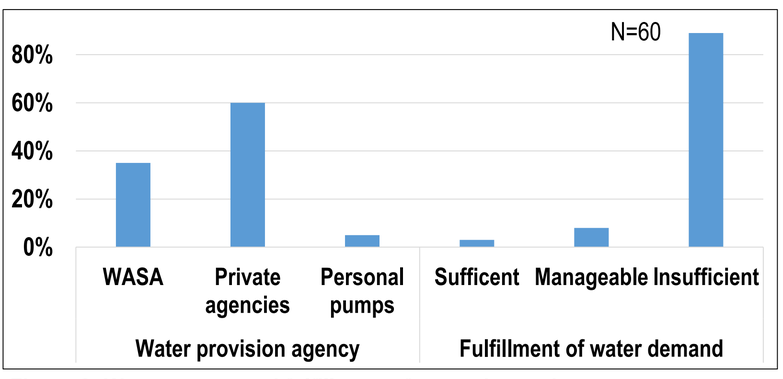


Figure 2: Water source and fulfillment of water demand

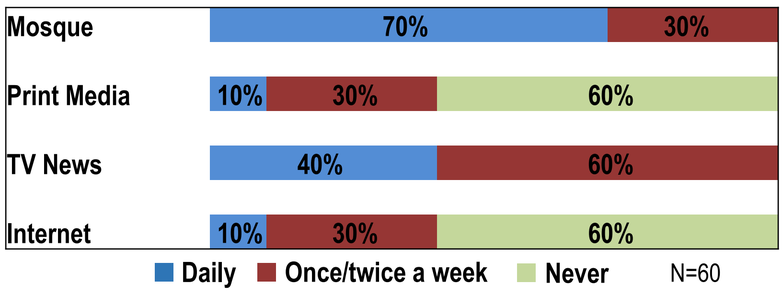


Figure 3: Possible medium of information with respect to accessibility to these medium/institutions by local community.

- Average cost of water by public source is 400 PKR ($ 4) per month and by private sources 3500 PKR ($35) per month.
- Water supplied by WASA has significant impurities (Table 1) because sewer pipes are laid over water pipes causing various diseases (Diarrhea and Hepatitis) leading to substantial expenses.
- Despite being expensive, water supplied by private tankers is preferred over public water supply with respect to quality.
- Water demand is 185 liters per capita per day however supply is less than is 95 liters per capita per day.

PROPOSED MODEL

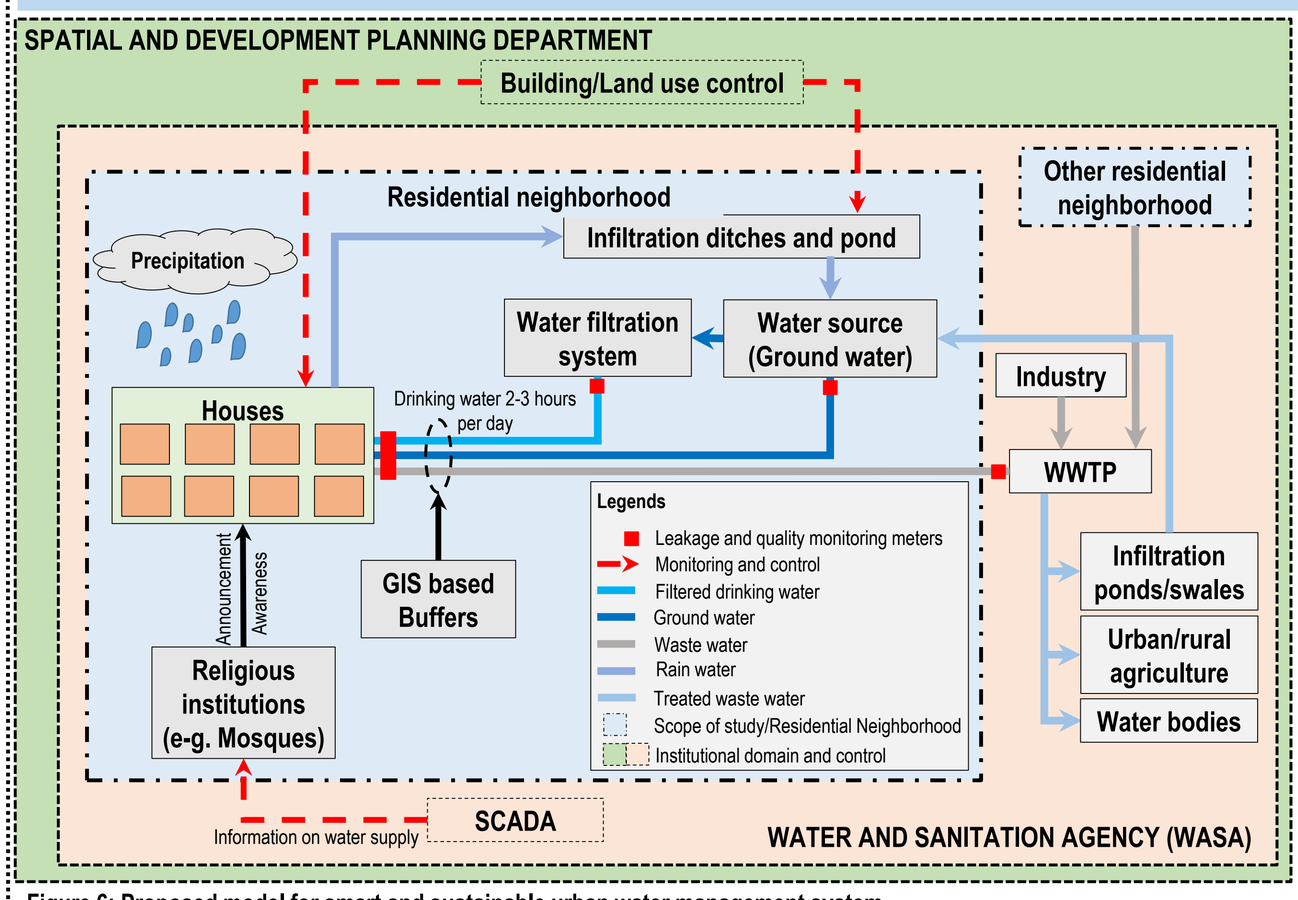


Figure 6: Proposed model for smart and sustainable urban water management system.

- Discontinuous drinking water supply through separate pipelines after filtration from source (2-3 hour per day).
- Contaminations will be reduced by providing a proper buffer between sewer and water pipes and leakages will be monitored with the help of SCADA by WASA.
- Increased water infiltration through revival of green spaces, infiltration ditches and ponds regulated by spatial planning authorities as shown in Figure 5C.
- Information on water availability and awareness on sustainable water use through mosques, thereby, saving the cost of print and electronic communication.

CONCLUSION

Decentralized water supply system in Quetta – as in other cities of Pakistan – is faced with various challenges. The analysis of water situation in one of residential neighborhoods suggests that the water supplied from the groundwater source becomes unsafe for human consumption by the time it reaches the consumer. Leakages results in the failure to meet the water demand. Land use changes have reduced the infiltration of rainwater. The government does not have any integrated system to tackle this problem. Higher willingness to pay for improved water supply indicates the utmost need for a better system. The proposed model provides the opportunity to utilize and integrate local institutions, green spaces, low-cost technology & future plans of the government for the sustainable water management and fulfills the required water demand. Additionally, spatial planning department can play an effective role in water management. Since water system is decentralized in the city, the model is easy to implement. However, further study is recommended to evaluate the feasibility of the model, simulating the impact of infiltration ponds on groundwater level, and assess the importance of local planning and religious institutions in water management.

Contacts:

Ahsan Ali
Infrastructure Planning, Faculty-2
Pfaffenwaldring 7, 70569, Stuttgart
Germany.
Email: ahsan.ali078@gmail.com

Ali Jamshed
Institute of Spatial and Regional Planning (IREUS)
Pfaffenwaldring 7 (3rd Floor), 70569, Stuttgart
Germany.
Email: ali_jam89@hotmail.com

Nikhil Agarwal
Infrastructure Planning, Faculty-2
Pfaffenwaldring 7, 70569, Stuttgart
Germany.
Email: nikhil2319@gmail.com

Mayank Ostwal
Infrastructure Planning, Faculty-2
Pfaffenwaldring 7, 70569, Stuttgart
Germany.
Email: mayankostwal07@gmail.com

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