NATURE-BASED SOLUTIONS FOR WATER IN THE PERI-URBAN

CASE STUDY BRIEF: INDIA, UDAIPUR

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ABSTRACT

This case study concerns a unique lake system situated in the semi-arid, western state of Rajasthan, in and around the heritage city of Udaipur. This lake system, connecting the urban and peri-urban spaces, represents an integrated nature-based solution (NBS) rooted in rainwater harvesting. The stage of NBS can be described as monitoring and evaluation, since it has been in place for more than 400 years and needs action for protection and improvement. The Udai-pur Lake system ensures water sustainability in an otherwise water-scarce area where the groundwater has quality problems and there is lack of perennial water source, and also helps in flood cushioning. The network functions at a catchment scale and comprises more than 100 big and small, public and private, artificial (man-made) lakes, dependent on a number of ephemeral hill streams. In recent times, the lake system is becoming increasingly degraded in terms of both quality and quantity, with a large number of lakes encroached, colonized and polluted, in turn creating significant water cycle gaps. In this changing context, there is need to strengthen the NBS through rejuvenation and restoration of the lake system. This needs to be based upon an action plan which integrates local knowledge, resolves conflicts between different stakeholder interests, and actively engages local citizens.

PURPOSE OF THE CASE STUDY

This case study was performed with two main aims in mind: 1) to analyse the historical factors underlying the sustainability of the Udaipur Lake system – considered along the three dimensions of sustainability (environmental, social and economic); and 2) to identify the challenges that are increasingly threatening its sustainability in recent times. The ultimate purpose was to propose alternative polices and action-plans to remedy the situation and promote water sustainability in this semi-arid region. For this purpose, all the three parts of the NATWiP Framework (context, process and results) were used to assess the NBS. Data were collected through document analysis, observation, and interviews and group discussions with key stakeholders and other local actors.

AREA CHARACTERISATION

Country	India
Province	Rajasthan
Municipality	Udaipur
Town	Udaipur
GPS coordinates	24.5854° N, 73.7125° E
Area	64 sq. km. (this is roughly the area of the city incl the peri-urban areas to be studied, further specification is not possible)

Badi Madar - one of the Upper lakes in peri-urban Udaipur. With a depth of 24 feet, it is fed by two rivers that bring water from the Aravalli Hills. This lake serves as the main source of river Ayad that feeds the City lakes in the lake system. It also provides irrigation water in the neighboring peri-urban areas.

PHYSICAL CONTEXT

Local geography/ topography	The city covers an area of about 64 sq.km. and lies at an altitude of 598 m (1,962 ft) above sea level. It basically lies in a valley (Girwa Valley) on the southern slope of the Aravalli Range - which is the oldest range of fold mountains in India that are highly eroded. Towards the north-west of the region where the city is located lies the Great Indian Desert. The elevation of the city is about 500 m above sea level. Udaipur city has a hot semi-arid climate. There are three main seasons: summer, monsoon and winter. The summer season runs from mid-March to June and touches temperature ranging from 26°C to about 42 °C in the months of March to June. Monsoons (rainy season) arrive in the month of July while winter season prevails from the month of October till the month of March. the The coldest month is January, when the days are bright, sunny and warm with maximum temperature around 28°C, and the minimum dipping to around 2°C.
Main water courses	Ayad or Ahar - originates from the Aravalli hills near Udaipur and flows through the city of Udaipur before it joins the Berach river, which in turn joins Chambal, a tributary in the Ganges river system. This is a monsoon river connected to almost every lake of Udaipur including Pichola, Bada Madar, Chhota Madar, Govardhan Sagar, Roopsagar, Fateh Sagar and Swaroop Sagar. Unfortunately, this river is at present functioning as the drainage canal of Udaipur city filled with sewage and garbage.
Main soil types	Major soil types are: gravelly soil (35-60% gravels) on the hills, sandy clay loams to clay loam soils on the base of the hill slopes, and very deep, well drained, sandy loam to loam in the plains, especially along the banks of water streams.
Precipitation (monthly averages as well as climate change projections)	Monthly average precipitation (mm): January-3,5, February-2,0, March-1,2, April-6,6, May-18,2, June-92,7, July-188,8, August-205,1, September-96,2, October-19,1, November-17,2, December-3,6; Annual average precipitation-654,3mm; Climate model projections for mean annual rainfall in the state of Rajasthan in general indicate an increase in frequency and intensity. Maximum 1-day rainfall is expected to increase by 20 mm, and maximum 5-day rainfall by 30 mm in the period 2071–2100. Regarding water supply, it is projected that by 2045 the entire state of Rajasthan may experience water shortage of 9.4 billion cubic meters, which obviously will affect urban water supply.
Temperature	Max 42 °C (is summer) to min 2 °C (in winter)
Critical infrastructure	Connected by national highway to major cities of India, also located on the primary railway network of the country, 81% households have access to tap water (from treated source) within premises, 99% households have access to electricity, 98% households with wastewater outlet connected to drainage - this figure includes the urban and the peri-urban areas of Udaipur.

SOCIO-ECONOMIC CONTEXT

Other relevant physical factors	Udaipur is a city of Lakes, the major ones are: Fatehsagar, Pichola, Swaroop Sagar, Badi, Madar, Udaisagar
Population	451100
Population density	7048
GPD/capita	GDP data about the city is not available. For the state of Rajasthan, the GDP per capita is US$1800.
Economic status (i.e. low income, high income)	Comparatively low income city, including the peri-urban areas where dependence on agriculture is high.
Other relevant socio-economic factors:	Tourism is a core economic activity in the city, besides, mining and particularly marble industry, all of which have substantial impact on the local water resources

OBJECTIVE OF THE NBS

This case study concerns a NBS – in the form of an integrated lake system spread across urban and peri-urban spaces. It mainly addressed water quantity (excess and shortage) challenge in the past, additionally facilitating access to good quality water. The lake system simultaneously serves a dual purpose:1) as the most important water source for the city and its peri-urban areas through supply of surface water and groundwater recharge; and 2) flood cushioning as the Ayad river swells significantly during the monsoon season, occasionally threatening the city and its outskirts with flood. It also helps address quality challenge as the groundwater tends to be saline, and in some pockets also threatened by high fluoride concentration. The lake water reduces dependence on the contaminated groundwater directly as well as through creation of an artificial shallow aquifer.

POLICY AND GOVERNANCE CONTEXT

Historically, the governance of the lake system was split between royal patronage and community management. The larger lakes were mainly created and maintained under royal patronage. Today they are governed by the Rajasthan State government and the local municipality. The smaller lakes were mainly managed by local communities.
Post-independence, India is a federal polity; hence 3 levels of governance are presently relevant in this case: national, regional (State) and local (urban and rural local bodies). Constitutionally, water is a State subject and hence, water-related policy and action is primarily the responsibility of the (State) Government of Rajasthan. The Public Health Engineering Department (PHED) is the key player, besides the Urban Improvement Trust (UIT), Udaipur which is a government-initiated trust committed to systematic urban development in the city. The latter is more engaged with maintenance of the urban surface water bodies, and hence should have the greater responsibility for implementing the NBS measures for water. In the peri-urban areas that are rural, the lowest-level village level local government (Gram Panchayat) are responsible for planning as well as implementing NBS. At the informal level, the local lake protection forums also take the privilege of initiating and/or engaging in lake protection and res-

Govardhan Sagar –the southernmost City lake in Udaipur. This lake is fed by local runoff as well as stores excess water received from Pichhola Lake, thus helping in flood cushioning. Pichhola is a central City lake that serves as the source of drinking water supply in Udaipur.

toration activities. Important local citizens' forums include the Jheel Sanrakshan Samiti (Lake Conservation Society), Chandpol Nagrik Samiti (Chandpol Citizens' Committee), and Jheel Mitra Sansthan (Lake Friends Institute).

A previous lake conservation plan that focused on 2 major lakes in the core of Udaipur city was funded 70% by the national government and co-funded 30% by the state government of Rajasthan and implemented by UIT. Any future NBSs could have similar financial resource allocation, or else even the ULB or the rural local bodies could participate financially.

ACTIONS

This case study concerns a unique lake system which holds an important heritage value, in the form of an integrated NBS for water sustainability in and around the city of Udaipur. The lake system was created over 400 years ago and connects the city's urban and peri-urban spaces through water.

The network comprises more than 100 big and small, public and private, artificial (man-made) lakes. Of these, 10 are large and critical for the system to function. The latter are categorised as follows: Upper lakes (3), City Lakes (6) and Downstream Lake (1). The lake network functions at a catchment scale, namely the Berach River Basin. The lake system is dependent on a number of ephemeral hill streams, most important being Ayad or Ahar which bring runoff from the hills into the valley which is then tapped and stored in a series of lakes and ponds in and around Udaipur. The overflow drains into river Berach downstream. The lakes were created by generally raising embankments on one side of streams bringing runoff from the hills or spillover from a preceding lake. This

complex NBS was created to support and sustain water availability in Udaipur, a city situated in a valley in the Aravalli Ranges that does not have access to any perennial river.

This NBS was the key to water sustainability in Udaipur city and its hinterlands until some decades ago. However, the lake system is becoming increasingly degraded in terms of both quality and quantity, with a large number of lakes encroached, colonized and polluted. This is creating significant water cycle gaps. In this changing context, there is need to strengthen the NBS through rejuvenation and restoration of the lake system and expansion of rainwater harvesting practices in the city as well as the peri-urban areas.

In response, restoration activities have been undertaken by the national government, state government, and UIT the jointly prepared and implemented a lake conservation plan. In addition, the local lake protection groups have been actively engaged in implementing small scale activities for cleaning and restoring the lakes, besides raising public awareness on the issue and acting as advocacy forums.

POTENTIAL (OR ACHIEVED) IMPACTS AND BENEFITS

It is evident that the NBS in the form of the lake system in and around Udaipur, which is based on the principle of rainwater harvesting, has been delivering multiple benefits for centuries. It enabled a rich civilization in a valley which lacked a perennial water source. Creation of the lakes provided permanent surface water resources in the area. This in turn enabled groundwater recharge which led to water storage in an artificial shallow aquifer. This aquifer supplied good quality drinking water to the city and its fringes through centuries while the lakes provided water for other domestic uses. The NBS also generated a river called Ayad which is the lifeline of the area, providing irrigation water as well as draining out excess rainfall, thus preventing floods. In fact, the entire lake network helps in flood cushioning. The spillover from the interconnected lake system finally leads to creation of the Berach river which is a tributary of Banas River – belonging to the Ganga River system. Finally, the lake network has supported a range of cultural services through the ages. These include tourism

Phoota Talab - one of the several City lakes that helped in flood cushioning but have been encroached in recent decades. This lake disappeared when a colony was built in its bed about two decades back. Now the area gets flooded whenever the monsoon showers are heavy.

for outsiders and naturescape for local residents. Economically, it has supported livelihoods by providing water for agriculture, tourism, and miscellaneous small trades.

It is unfortunate that a number of these benefits are being threatened with the degradation of the Udaipur lake system. The current and any future efforts at rejuvenating this wonderful NBS will help restore a number of the vanishing benefits, including environmental, social and economic.

SUSTAINABLE DEVELOPMENT GOALS AND/OR ANY OTHER WATER-RELATED DEVELOPMENT GOALS ADDRESSED

The unique NBS of Udaipur importantly addresses SDGs 6 (clean water and sanitation), mainly addressed targets, in order of priority, are: Target 6.1 (by facilitating equitable access to safe drinking water); Target 6.5 (strengthening integrated water resources management through restoring and rejuvenating the integrated lake system); and Target 6.4 (by contributing to sustainable withdrawals of freshwater to address water scarcity). Also addressed is SDG 11 (sustainable cities and communities), particularly Target 11.4 (by strengthening efforts to protect and safeguard the historical Udaipur Lake system - an important cultural heritage of India; and Target 11.7 (by supporting access to green and public spaces in the vicinity of the various lakes). Besides, also addressed are SDG 3 (good health and wellbeing) by promoting healthier lives and well-being for local residents; and SDG 16 (peace, justice and strong institutions) by promoting inclusive societies for sustainable development through local participation in lake protection and rejuvenation.

LESSONS LEARNT

This case study shows that sustainability of the integrated Udaipur Lake system depends upon three key factors, as highlighted below:

1. The NBS in question has been rooted in the local environmental context and simple community-friendly technologies, which has enabled its upkeep and maintenance through centuries.
2. On the social side, involvement of the local community and their knowledge about NBS has helped making the Udaipur Lake system survive and flourish throughout history.
3. Economic sustainability of the NBS has been primarily a result of its basis in local resources and simple technology.

The most important lessons emerging from the study are as follows. First, NBS has a long history in urban and peri-urban India, and a rich local knowledge base exists in society regarding relevant context-specific technologies and their upkeep and management. Second, NBS based on rainwater harvesting and collection of local runoff has immense potential to fulfil the water needs of urban centres, as well as peri-urban spaces around. Third, NBS has the potential to also fulfil economic as well as cultural needs of urban and peri-urban communities – irrigation and tourism being most important examples. Fourth, integration of local knowledge for protection, upkeep and maintenance of NBS systems is essential to ensure that it continues to deliver the benefits. Fifth, in present times, NBS operation and maintenance involves conflicts between different stakeholder interests – hence there is need to resolve such conflicts and engage local citizens for keeping the lake system alive.

TRANSFERABILITY OF RESULTS

The above findings can be applied by concerned local practitioners in designing appropriate policy and action plan.

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WHAT IS NATWIP?

NATWiP is an acronym for a project entitled: Nature-Based Solutions for Water Management in the Peri-Urban: Linking Ecological, Social and Economic Dimensions.

This is an EU-Cooperation project funded under the Water Joint Programming Initiative (JPI) Call 2018 and is led by an international consortium of scientists. The NATWiP team works towards promoting sustainable implementation of nature-based solutions to address water challenges in peri-urban areas.

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