SAVi Sustainable Asset Valuation

Applying the Sustainable Asset Valuation (SAVi) to Lake Dal, in Srinagar, State of Jammu & Kashmir, India

Analysis of Grey and Natural Infrastructure for Lake Conservation

Client:

Special Advisor on Infrastructure Development to the State Government of Jammu & Kashmir, the Department of Tourism of Jammu & Kashmir, and the Jammu & Kashmir Lakes and Waterways Development Authority.

The complete technical report is posted at bit.ly/savi-dal-lake

IISD International Institute for Sustainable Development

MAVA FONDATION POUR LA NATURE

EMS EMERGING MARKET SUSTAINABILITY DIALOGUES

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

The Scope

Why Use SAVi?

SAVi calculates the environmental, social and economic risks and externalities that impact the financial performance of infrastructure projects. These variables are typically ignored in traditional financial analyses.

SAVi is a simulation tool that is customized to individual infrastructure projects. It is built on project finance and systems dynamics simulation.

Visit the SAVi webpage: https://www.iisd.org/project/SAVi-sustainable-asset-valuation-tool

IISD was invited by the state government of Jammu & Kashmir to use SAVi to develop the business case for the long-term conservation of Lake Dal. The lake has long suffered from anthropogenic pressures including encroachment, water extraction, discharge of untreated domestic sewage and fertilizer runoff from the surrounding agriculture areas. This has led to a sharp decrease in water quality, increased eutrophication and further cascading effects such as declining fish stocks and reduced recreational attractiveness.

The SAVi simulation and analysis considered Lake Dal as a "system." We applied SAVi to assess the impacts of competing users and associated sources of pollution on the lake's water quality. We also used SAVi to simulate how a clean and productive lake would increase revenues for associated industries such as tourism, fisheries and real estate. We also sought the value of the lake as a natural infrastructure asset, providing for water storage, irrigation and flood protection.

The report presents the interim results of the SAVi analysis. The analysis and project was unfortunately halted in June 2018 when Governor's Rule was imposed in Jammu & Kashmir.

About Lake Dal

Lake Dal, in Srinagar, Jammu Kashmir, is one the major natural assets of India. Often referred to as the "jewel in the crown of Kashmir," Lake Dal spans approximately 18 km^2 with a shoreline of around 15.5 km. The lake is also a part of a natural wetland of around 21 km^2.

The SAVi analysis is organized under five scenarios, presented in the table on page 3.

We identified these scenarios in collaboration with the many public stakeholders in Srinagar. They include the Department of Tourism of Jammu & Kashmir, the Urban Environmental Engineering Department, the Jammu & Kashmir Lakes and Waterways Development Authority, and the Scientific Advisory Committee for the conservation of Lake Dal.

The scenarios were also designed to address the most material concerns tabled by these stakeholders in March 2018. These concerns are:

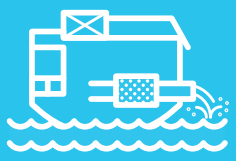
- Sewage treatment plants in and around Srinagar need urgent upgrades. They also overflow during heavy rainfall.
- Sewage treatment plants and pumping stations shut down during electricity blackouts. Some plants continue to operate on diesel generators.
- Sewage from houseboats, that serve as accommodation for tourists, is perceived as the most significant source of untreated sewage.
- Encroachment by informal lake dwellers living at the periphery of and on the lake is increasing the inflow of untreated sewage. These lake dwellers are also destroying the adjoining wetlands. Despite the provision of compensation payments for relocation and social housing in other parts of Srinagar, these communities continue to fill in parts of the wetland, build informal housing and live in the lake periphery.
- Plans to construct the 20 km Western Foreshore Road along Lake Dal.

The Simulation Scenarios

Scenario 0: Business-as-usual (BAU)

The status quo of 2018 prevails:

- 75% of the lake's periphery are connected to the sewage network.
- Sewage from lake dwellers and houseboats not connected to the sewage network flows into the lake untreated.
- Sewage treatment plants overflow during heavy rainfalls and electricity blackouts.

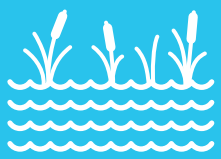


Scenario 1: Sewage treatment for houseboats only

- On-site sewage treatment installed for houseboats.
- Other BAU assumptions remain.

Scenario 2: Grey infrastructure upgrade

- 100% of lake periphery is connected to upgraded sewage treatment plants.
- Sewage treatment plants and pumping stations are powered by solar PV with battery storage. Plants will therefore operate irrespective of blackouts. Sewage outflows will continue to occur during heavy rainfall.
- On-site sewage treatment for all lake dwellers and houseboats.



Scenario 3: Hybrid infrastructure upgrade

- Construction of 500 ha artificial wetland to complement the upgraded sewage treatment solutions in Scenario 2.

Scenario 4: Constructing the Western Foreshore Road and hybrid infrastructure

- Building of the 20 km Western Foreshore Road along Lake Dal.
- All conservation measures of Scenario 3 remain.

SAVi Results: Integrated Cost–Benefit Analysis

SAVi's Integrated Cost–Benefit Analysis (in INR million)

Scenario	1) Sewage treatment for houseboats only	2) Grey infrastructure upgrade	3) Hybrid infrastructure upgrade	4) Western Foreshore Road and hybrid infrastructure
EXPENDITURES				
Upgrade sewage treatment network	**0**	**10,301**	**10,321**	**10,382**
Investment in STPs	0	6,750	6,750	6,750
O&M costs STPs	0	3,551	3,571	3,633
Solar energy capacity for sewage network	**0**	**391**	**393**	**423**
Sewage treatment for houseboats and lake dwellers	**768**	**4,933**	**4,933**	**4,933**
Artificial wetland construction	**0**	**0**	**1,321**	**1,321**
Investment in artificial wetland	0	0	336	336
O&M cost artificial wetland	0	0	985	985
Road construction	**0**	**0**	**0**	**16,032**
Investment for road construction	0	0	0	15,658
O&M cost road	0	0	0	374
Total costs	**768**	**15,625**	**16,968**	**33,092**
BENEFITS				
Revenues for sectors that benefit from a cleaner lake				
Revenues from tourism	73	234,743	373,863	301,478
Revenues from fisheries	1	2,975	3,077	3,027
AVOIDED COSTS				
Social costs of carbon	0	75	75	75
Total added benefits	74	237,793	377,015	304,580
Net results	-694	222,168	360,047	271,489

The SAVi integrated cost–benefit analysis compares:

- The total additional costs and benefits that accrue between 2019 and 2060 as result of implementing the respective scenarios.
- Expenditures: The cumulative public investment required for capital and operational expenditures to execute each respective scenario.
- Benefits: The increase in cumulative revenues each scenario will yield for two key industrial sectors in Srinagar—tourism and fisheries.
- Avoided costs: The economic value from avoided emissions that occur from implementing the respective scenario. The social cost of carbon is the total costs of emitting one additional tonne of carbon dioxide. It is measured in monetary terms and discounted to the value of money today. The social cost of carbon calculation assumes USD 31 per tonne of carbon emitted and an exchange rate of INR 67 to USD 1.

Positive net results in the cost–benefit table (left) indicate that the total added benefits outweigh the total expenditure required for implementing the respective scenario.

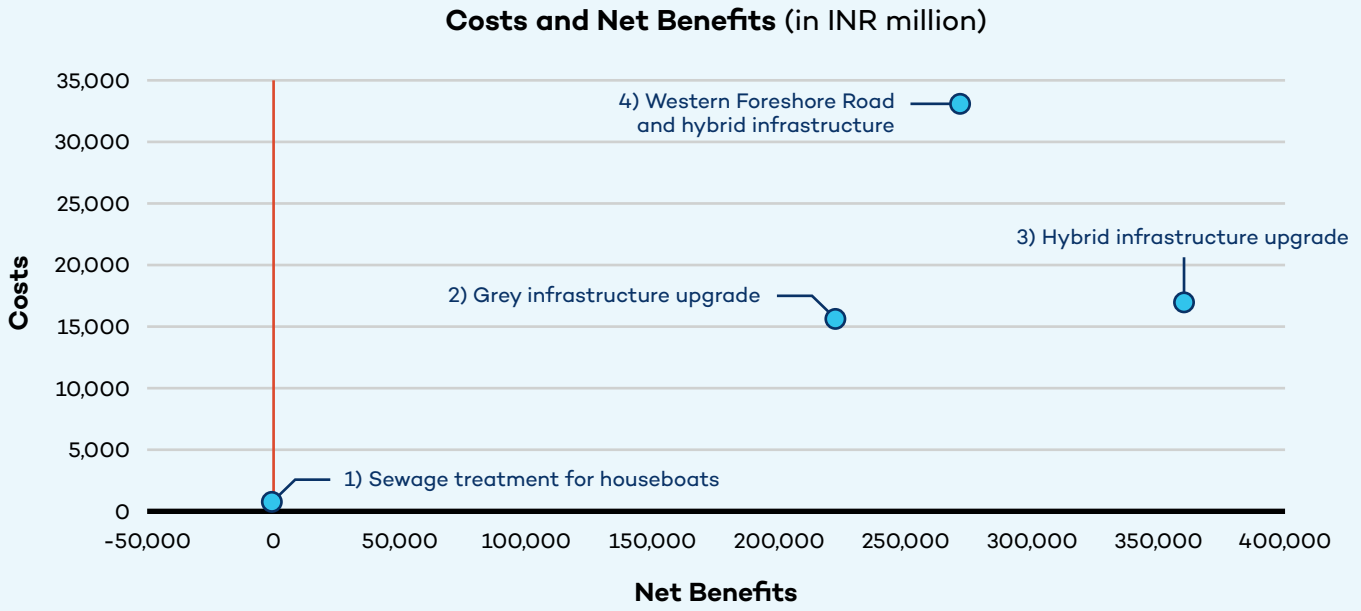
In Scenario 0, we note a continuous downward spiral of the water quality in Lake Dal. In fact, the integrity of the lake will continue to deteriorate, causing severe revenue shrinkages for the tourism industry in Srinagar and threatening the existence of the local fishery industry by 2060.

Scenario 1 examines the costs and benefits related to only treating sewage released by the houseboats. The benefits are extremely negligible and the required investment of INR 768 million will not be worthwhile. This is confirmed by negative net results.

In Scenario 2, the grey infrastructure upgrade presents an intermediate solution. The benefits of INR 237 billion significantly outweigh the associated investment of INR 15.6 billion.

Scenario 3, the hybrid infrastructure upgrade, brings the highest net benefits for Srinagar at INR 360 billion. It pays to invest in the construction of an artificial wetland as the net benefits are 62% higher compared to Scenario 2 while the investments only increase by 8.6%.

Scenario 4 has **lower net benefits than the hybrid infrastructure** upgrade because of expenditures for the construction and maintenance of the Western Foreshore Road. Benefits are also lowered due to the **large-scale damage the sealed road surface and new encroachment will bring to water quality and integrity of the lake**. Compared to the hybrid intervention scenario, the road will reduce revenues to the tourism and fishery industries by more than INR 72 billion until 2060.



Results: SAVi projections on the water quality of Lake Dal

The SAVi cost–benefit analysis draws from the associated simulation how each scenario affects the volume of nitrogen loadings that reaches the lake and the resulting water quality. The table below demonstrates how a range of water quality indicators change over each scenario and across time.

Water Quality Indicators

Nitrogen Concentration

Amount of organic and anorganic nitrogen per litre. If a critical threshold is exceeded, it can contribute to eutrophication.

2016 level: 0.91 mg N/litre	Unit	2030	2060	Average % vs BAU 2030–2060
0) BAU	mg N/litre	1.18	1.53	—
1) Sewage treatment for houseboats only	mg N/litre	1.18	1.53	-0.02%
2) Grey infrastructure upgrade	mg N/litre	0.49	0.69	-54.7%
3) Hybrid infrastructure upgrade	mg N/litre	0.37	0.51	**-65.5%**
4) Western Foreshore Road and hybrid infrastructure	mg N/litre	0.43	0.58	-60.7%

Water Clarity

measured in Secchi depths

2016 level: 1.28 metre	Unit	2030	2060	Average % vs BAU 2030–2060
0) BAU	metre	1.07	0.75	—
1) Sewage treatment for houseboats only	metre	1.07	0.75	+0.03%
2) Grey infrastructure upgrade	metre	2.32	1.67	+108.8%
3) Hybrid infrastructure upgrade	metre	3.00	2.19	**+174.2%**
4) Western Foreshore Road and hybrid infrastructure	metre	2.65	1.94	+140.4%

As with the integrated cost–benefit analysis, the hybrid infrastructure scenario performs the best across all water quality indicators. Throughout the period between 2030 and 2060, this scenario reduces the nitrogen concentration on average by 65.5%, improves the water clarity on average by 174% and reduces the chlorophyll-a concentration on average by almost 90% compared to the BAU Scenario. Water quality improvements lead to the recovery of fish stocks and improve the recreational attractiveness of the lake. The resulting economic opportunities will attract more people to Srinagar. Higher population numbers, especially at the periphery, will create additional pressures on Lake Dal. Such causal links explain why the 2060 values for water quality indicators of all scenarios demonstrate poorer performance compared to the 2030 values.

Chlorophyll-*a* concentration

Concentration of planktonic algal chlorophyll per litre. Often used as a proxy for eutrophication.

2016 level: 26.22 ug / litre	Unit	2030	2060	Average % vs BAU 2030–2060
0) BAU	ug /litre	40.47	71.10	—
1) Sewage treatment for houseboats only	ug /litre	40.43	71.08	-0.05%
2) Grey infrastructure upgrade	ug /litre	6.81	13.66	-81.4%
3) Hybrid infrastructure upgrade	ug /litre	3.89	7.66	**-89.5%**
4) Western Foreshore Road and hybrid infrastructure	ug /litre	5.20	9.85	-86.2%

The Next Steps

This project and analysis was halted in June 2018 when Governor's Rule was imposed in the State of Jammu & Kashmir.

Should the project have continued, IISD would have proceeded to complete valuations on:

1. Real estate and land value capture and associated contributions to the tax revenues for the local and state government.
2. Additional infrastructure services provided by Lake Dal, in terms of irrigation, water storage and water supply. We would have also compared these values to the capital and operating costs of built infrastructure.

Thereafter, we would have used these valuations to determine if public private partnerships could be used to finance and execute the lake conservation measures discussed in this report.

IISD looks forward to continuing work on SAVi and sustainable infrastructure with stakeholders in India.

About SAVi

SAVi is a simulation service that helps governments and investors value the many risks and externalities that affect the performance of infrastructure projects.

The distinctive features of SAVi are:

- Valuation: SAVi puts a financial value on the material environmental, social and economic risks and externalities of infrastructure projects. These variables are ignored in traditional financial analyses.
- Simulation: SAVi combines the results of systems thinking and system dynamics simulation with project finance modelling. We engage with asset owners to identify the risks material to their infrastructure projects and then design appropriate simulation scenarios.
- Customization: SAVi is customized to individual infrastructure projects.

https://www.iisd.org/project/SAVi-sustainable-asset-valuation-tool

SAVi Sustainable Asset Valuation