Tri-Level Optimization of Regional Water Supply System

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Regional Water Supply System Planning and Management

The graph illustrates the projected supply vs. demand for water over the years 2010 to 2060. The graph shows three supply capacities labeled as Capacity 1, Capacity 2, and Capacity 3, each represented by a different color. The demand line is also shown, indicating the rising demand over time. The supply capacities are projected to meet the demand, with Capacity 3 being the most robust option. The graph highlights the importance of planning and management in ensuring a sustainable water supply.
What is Tri-Level Optimization?

This study is focused on:

Comparing the results of the tri-level optimization model to bi-level optimization model.
Optimal Flow Allocation Model

- Optimizes system design (storage tank construction timings, locations, and sizes) and operation

- 41 years period (2010 ~ 2050) on a daily time step

- Mixed integer linear programming

- Consists of 120 arcs and 66 nodes (204 decision variables per time step)

- 4% discount rate was applied to the unit costs on each arc to compute the present worth of the operation costs
Regional Water Supply System

Pipe C Failure: 1 June 2020, 2030, and 2040
Failure duration = 1 day

RESIN Area
(Approx. 267 square miles)
Comparison between Bi- and Tri-Level Optimization

Total Cost Comparison

<table>
<thead>
<tr>
<th>Pressure Zone</th>
<th>Tank Size (MG)</th>
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<tbody>
<tr>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
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<tr>
<td>E</td>
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<tr>
<td>FS</td>
<td>5</td>
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<tr>
<td>HS</td>
<td>10</td>
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</tbody>
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Functionality over Time

1 June 2020
1 June 2030
1 June 2040
Key Findings / Outcomes

- Development of tri-level optimization model
- Identification of tank construction timings, sizes, and locations to withstand Pipe C failure
- Tri-level optimization model provides more robust regional water supply system than bi-level optimization model
References


