Panama Canal Case Study

Hyunju Jeong

MESSNER Meeting

Dec 16, 2009
SEB122
The Panama Canal created a shortcut from the Atlantic Ocean to the Pacific\(^{(1)}\).
Outline

- Comprehensive Analysis in terms of infrastructure, physical environment, and socio-economic environment
- Initial Panama Canal Development (1914)
- Panama Canal Expansion (2014)
Canal development for transportation and its positive and negative impacts on physical and socio-economic environment
Background of Panama Canal

Economic reason

Ex. just in time to make a fortune carrying gold-seekers on their way to California

→ To shorten the traveling distance

Cost

Construction + Implicit interest cost + Canal defense

= $921.7 million

The project’s scale in 2006 scale = $119.4 billion

SOURCE:
## Economic Savings

### Basic Global Social Savings Estimates

(by route, in millions of 1925 dollars)

<table>
<thead>
<tr>
<th>Route</th>
<th>1921</th>
<th>1922</th>
<th>1923</th>
<th>1924</th>
<th>1925</th>
<th>1926</th>
<th>1927</th>
<th>1928</th>
<th>1929</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Intercontinental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US East - SouthAm West</td>
<td>$3.78</td>
<td>$1.57</td>
<td>$3.73</td>
<td>$4.70</td>
<td>$5.70</td>
<td>$6.37</td>
<td>$5.72</td>
<td>$5.35</td>
<td>$4.73</td>
</tr>
<tr>
<td>US East - Asia</td>
<td>$5.73</td>
<td>$7.09</td>
<td>$6.10</td>
<td>$5.51</td>
<td>$4.95</td>
<td>$6.07</td>
<td>$6.81</td>
<td>$6.04</td>
<td>$6.23</td>
</tr>
<tr>
<td>US East - Australasia</td>
<td>$1.11</td>
<td>$0.48</td>
<td>$0.71</td>
<td>$0.81</td>
<td>$0.95</td>
<td>$1.09</td>
<td>$1.18</td>
<td>$0.78</td>
<td>$0.67</td>
</tr>
<tr>
<td>US West - Europe</td>
<td>$5.17</td>
<td>$5.92</td>
<td>$5.09</td>
<td>$5.79</td>
<td>$5.62</td>
<td>$6.53</td>
<td>$7.92</td>
<td>$7.82</td>
<td>$7.93</td>
</tr>
<tr>
<td>Non-US intercontinental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe-Canada West</td>
<td>$0.00</td>
<td>$1.75</td>
<td>$3.14</td>
<td>$3.92</td>
<td>$5.15</td>
<td>$6.28</td>
<td>$7.45</td>
<td>$9.46</td>
<td>$6.75</td>
</tr>
<tr>
<td>Europe to SouthAm West</td>
<td>$3.75</td>
<td>$2.91</td>
<td>$4.93</td>
<td>$5.41</td>
<td>$7.23</td>
<td>$7.30</td>
<td>$5.90</td>
<td>$7.49</td>
<td>$7.03</td>
</tr>
<tr>
<td>Mexico East to SouthAm West</td>
<td>$1.86</td>
<td>$0.73</td>
<td>$0.67</td>
<td>$0.65</td>
<td>$0.32</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Transcontinental</td>
<td>$10.80</td>
<td>$23.76</td>
<td>$78.27</td>
<td>$128.42</td>
<td>$84.57</td>
<td>$96.16</td>
<td>$99.49</td>
<td>$96.89</td>
<td>$106.26</td>
</tr>
<tr>
<td>Minus tolls</td>
<td>(6.22)</td>
<td>(11.56)</td>
<td>(17.60)</td>
<td>(24.72)</td>
<td>(21.37)</td>
<td>(22.82)</td>
<td>(24.69)</td>
<td>(27.27)</td>
<td>(27.36)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$25.99</td>
<td>$32.66</td>
<td>$85.05</td>
<td>$130.49</td>
<td>$93.10</td>
<td>$106.98</td>
<td>$109.79</td>
<td>$106.56</td>
<td>$112.24</td>
</tr>
</tbody>
</table>

**Social rate of return**

2.8%  3.5%  9.2%  14.2%  10.1%  11.6%  11.9%  11.6%  12.2%
Big watershed for a small country

Water for transportation, hydropower, and human and industrial use

Soil Erosion

Microclimatic Change

Water saving for navigation → Low Evapotranspiration land use

Ex. Forest, Water conserving crops
Environment Vs. Economy\(^{(3)}\)

- Microclimate change of east side
  Farmland in arid area $\rightarrow$ Industry in cities

- Water scarcity:
  - Irrigation of expensive tropical products $\rightarrow$ Cattle ranching and commercial agriculture
  - Deficient water amount does not support the canal functions well $\rightarrow$ economic benefits decrease
Impacts on physical, biological, and socio-economic environments
Roles and Construction

- **Economic Role**
  
  Nearly 7% of the Gross Domestic Product (GDP) in the Panamanian economy
  
  120,000 direct and indirect jobs

- **Efficient Construction Option**
  
  - Construction of two lock complexes—one on the Atlantic side and another on the Pacific side—each with three chambers, which include three water-saving basins
  
  - Excavation of new access channels to the new locks and the widening of existing navigational channels
  
  - Deepening of the navigation channels and the elevation of Gatun Lake’s maximum operating level.

*SOURCE: Panama Canal Authority (2006) Environmental Impact Report*
Goal

- To maintain the competitiveness and value of the Canal route by generating higher revenues and benefits for the Republic of Panama over the long range in a sustainable manner.
- To increase the capacity to meet the growing demand for transits with adequate levels for each segment.
- To allow the transit of ships larger than Panama, in order to increase Canal productivity.
- To add room in the operating capacity to perform maintenance work that requires prolonged lane outages in the current Canal.

Impacts on Physical Environment

- **Microclimate change**
  due to changes in land use: loss of vegetative cover and biomass

- **Loss of Potential Carbon Capture**
  due to changes in land use: forest, brush, shrubs, grassland and pasture → paved surfaces, water surfaces (navigation channels, locks, and water saving basins), rock or exposed soil surfaces (slopes)

- **Deterioration of Air Quality**
  construction activity and increased ship traffic

- **Undermining (Cave-ins)**
  potential alterations of the local geological and/or hydrogeological features of the area due to excavation and backfilling → landslides and/or soil settlement

- Increase in Landslides Risk and soil
Impacts on Biological Environment

- Loss of Vegetative Cover
- Loss of Forestry Potential
- Loss of Land Fauna Habitat
- Direct Impact on Fauna
- Disturbance to Wildlife
- Increased Wildlife Road Kill Risk
- Increased Poaching
- Alteration of Aquatic Resources in Rivers and Creeks
- Alteration of Aquatic Resources of Gatun Lake
- Alteration of Aquatic Resources in Miraflores Lake
- Alteration of Marine Coastal Ecosystems
- Impact on Protected Area

Impacts on Socio-Economic Environment

- **Stimulus to the National Economy**
  - Investment (US 2007, $5.25 billion) → Construction supply sector, Salary expense, Demand for household goods, Service to the staff
  - Panama total export: 9.5% more
  - Fiscal Revenues: 31.8% higher

- **Increase in Panama National Treasury Revenues**
  - During the first 11 yrs: US (2007) $8.5 billion more

- **Job Generation**
  - 6,500 ~ 7,000 new direct jobs
  - 28,500 ~ 33,000 indirect jobs
  - Additional requirement for the operation of new locks and routine maintenance activities

**SOURCE:** Panama Canal Authority (2006) Environmental Impact Report
Impacts on Socio-Economic Environment

- Increase of population and migration flows
  - Due to the Project and the growth of the economy

- Change in land use
  - Due to the Project and the demand for new space in the Metropolitan region

- Impact on public infrastructure
  - Utility infrastructure including potable water distribution pipes and sewer collection and treatment system
  - High voltage transmission towers and lines from power plants
  - Vehicle traffic due to an increased demand for transportation
Impacts on Socio-Economic Environment

- Property Revaluation
  - Mobility and utility provided by the infrastructure and the landscape changes with views of the new locks and transit activities

- Work-related illness or accidents
- Crime rates : employment rate and quality of life
- Waste generation : more construction wastes
  - more people, more wastes
- Tourism flows

SOURCE:
Management Plan for Sustainable Development

- Mitigation plan - air, water, soil, biological, waste
- Monitoring and Follow-up Plan
- Citizen Participation Plan
- Risk Prevention Plan - risks, responsibilities, regulation
- Environmental Education Plan
- Contractor Contingency Plan
  - emergency response measures (fire, flood, earthquake, accidents)
- Post-operations Environment
  - after the completion of all activities and closure of the sites → the reestablishment of natural biological communities
Economic Analysis
for Sustainable Development

- **Monetary valuation** of environmental impact and social externalities
- **Net Present Value (NPV)** of the project investment
- Compare the above values

The project is considered **socially and environmentally feasible**, provided that the prevention, mitigation, monitoring, and compensation measures are performed.

*SOURCE: Panama Canal Authority (2006) Environmental Impact Report*
Conclusion

- For sustainable development for any sector, the comprehensive interrelations should be understood.

- For sustainable development for any sector, the conflicts with environment should be considered.

- e.g., Green landscaping is a comprehensive alternative satisfying infrastructure requirement, positive socio-economic impacts and less environmental impact
Bibliography


(2) Mauer et al. (2006) What Roosevelt Took: The Economic Impact of the Panama Canal, 1903 ~ 1937

(3) Carlos Vargas, Integrated management of Panama Canal Watershed, Summer Institute 2001 Research Mini-Project

(4) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 3 Project description

(5) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 4 Description of the physical environment

(6) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 5 Description of the biological environment

(7) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 6 Description of the socioeconomic environment

(8) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 8 Environmental management plan

(9) Panama Canal Authority (2007) Canal Expansion Program, Environmental impact study (EIS), Chap 9 Final cost-benefit analysis