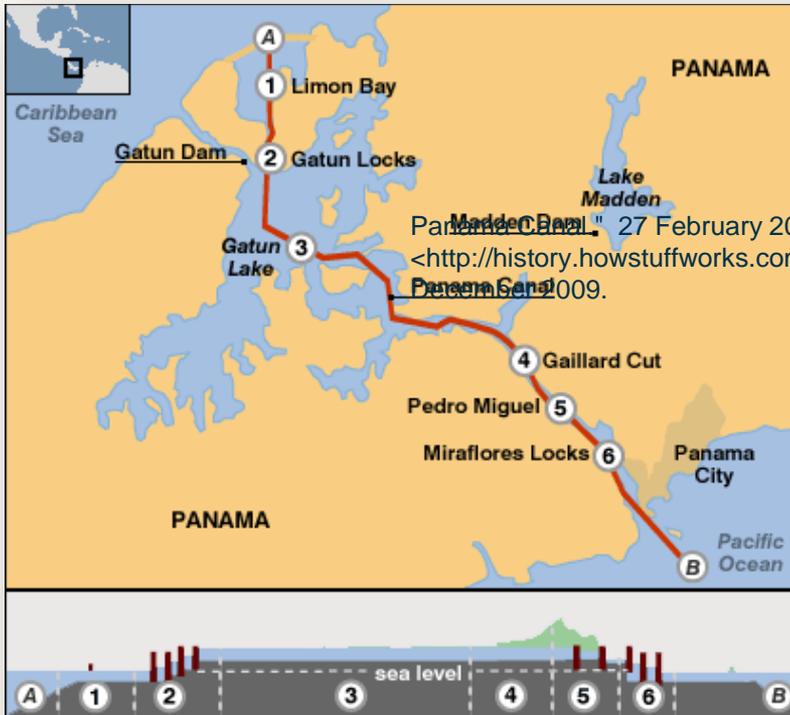


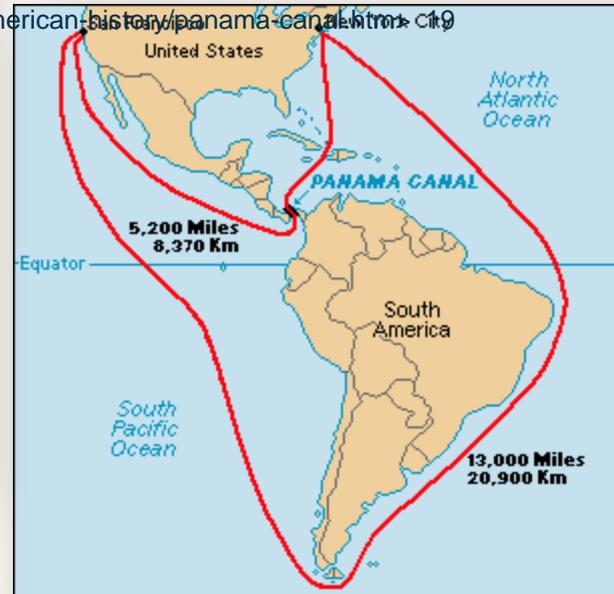


Panama Canal Case Study

Geography



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<<http://history.howstuffworks.com/american-history/panama-canal.htm>> 19
Panama Canal 2009.



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)**



Panama Canal Development

Canal development for transportation and its positive and negative impacts on physical and socio-economic environment

Economy Vs. Transportation⁽²⁾



□ 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



Transportation Vs. Economy⁽²⁾



□ Economic Savings

Basic Global Social Savings Estimates
(by route, in millions of 1925 dollars)

	1921	1922	1923	1924	1925	1926	1927	1928	1929
US Intercontinental									
US East - SouthAm West	\$3.78	\$1.57	\$3.73	\$4.70	\$5.70	\$6.37	\$5.72	\$5.35	\$4.73
US East - Asia	\$5.73	\$7.09	\$6.10	\$5.51	\$4.95	\$6.07	\$6.81	\$6.04	\$6.23
US East - Australasia	\$1.11	\$0.48	\$0.71	\$0.81	\$0.95	\$1.09	\$1.18	\$0.78	\$0.67
US West - Europe	\$5.17	\$5.92	\$5.09	\$5.79	\$5.62	\$6.53	\$7.92	\$7.82	\$7.93
Non-US intercontinental									
Europe-Canada West	\$0.00	\$1.75	\$3.14	\$3.92	\$5.15	\$6.28	\$7.45	\$9.46	\$6.75
Europe to SouthAm West	\$3.75	\$2.91	\$4.93	\$5.41	\$7.23	\$7.30	\$5.90	\$7.49	\$7.03
Mexico East to SouthAm West	\$1.86	\$0.73	\$0.67	\$0.65	\$0.32	\$0.00	\$0.00	\$0.00	\$0.00
Transcontinental	\$10.80	\$23.76	\$78.27	\$128.42	\$84.57	\$96.16	\$99.49	\$96.89	\$106.26
Minus tolls	(6.22)	(11.56)	(17.60)	(24.72)	(21.37)	(22.82)	(24.69)	(27.27)	(27.36)
TOTAL	\$25.99	\$32.66	\$85.05	\$130.49	\$93.10	\$106.98	\$109.79	\$106.56	\$112.24
Social rate of return	2.8%	3.5%	9.2%	14.2%	10.1%	11.6%	11.9%	11.6%	12.2%



Transportation Vs. Environment (3)

- Big **watershed** for a small country
- **Water** for transportation, hydropower, and human and industrial use
- **Soil Erosion**
- **Microclimatic Change**
- Water saving for navigation → Low Evapo-transpiration **land use**
Ex. Forest, Water conserving crops



Environment Vs. Economy⁽³⁾



- Microclimate change of east side
Farmland in arid area → Industry in cities

- Water scarcity :
 - ▣ irrigation of expensive tropical products → Cattle ranching and commercial agriculture
 - ▣ Deficient water amount does not support the canal functions well → economic benefits decrease



Panama Canal Expansion (~ 2014)

Impacts on physical, biological, and socio-economic environments

Roles and Construction⁽⁴⁾



□ 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.



Goal⁽⁴⁾

- 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⁽⁵⁾



- **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⁽⁶⁾



- ❑ 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⁽⁷⁾



- 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



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



Management Plan for Sustainable Development⁽⁸⁾



- 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⁽⁹⁾



- **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.



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



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