Population Displacements 
Associated with Environmentally Significant Infrastructure Projects 

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Outline 

1. Introduction 
   – Overview & World Bank regulations 
   – Environmental impacts of major infrastructure projects 
2. Population displacements associated with large infrastructure 
   – Typology of displacements 
   – Case Studies 
     • Mali 
     • Brazil 
     • South America 
     • Pakistan 
3. Future potential migration owing to large scale migration/adaptation projects 
   – Mitigation Projects 
   – Adaptation Projects 
4. Conclusions: What does the past tell us about the future?
Overview & Environmental Impacts of Major Infrastructure

SECTION 1

Overview

• Thesis: We can learn from major infrastructure projects in the past to understand what may happen through large-scale climate change adaptation projects in the future
  – Voluntary resettlement in response to climate pressures
  – Involuntary resettlement from major adaptation projects

• World Bank regulations (OP 4.12 and OD 4.30)
  – Limit displacement / resettlement, where possible
  – Where unavoidable, resettlement should extend overarching development objectives and benefits
Econ & Social Risks of Displacement

1-3. Loss of Land, Employment, Shelter
4. Marginalization (*reduced economic mobility*)
5. Increased morbidity and mortality
6. Greater food insecurity
7. Loss of access to common property/services
8. Social disarticulation (*break-up of community organizations and other groups*)


Environmental Impacts of Major Infrastructure Projects

- Potentially countervailing objectives
  - Infrastructure in response to changing climate (drought, flood, disasters) to limit climate-induced population displacement
  - Efforts to mitigate climate change or promote adaptation resulting in other infrastructure induced displacement

- Dimensions of environmental impacts

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Proximate     Spatial     Distant
Near-term     Temporal    Long-term
Direct        Scalar      Indirect
```
Example: Climate-Induced Migration

<table>
<thead>
<tr>
<th>climate change</th>
<th>flood causes</th>
<th>floods</th>
<th>direct effects</th>
<th>indirect effects</th>
<th>adaptation options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>intense precipitation events</td>
<td>floods</td>
<td>damage to crops &amp; livestock</td>
<td>loss of land</td>
<td>modification of vulnerability</td>
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<td></td>
<td>tropical cyclones</td>
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<td></td>
<td>deforestation, agricultural use and drainage</td>
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<td>surface sealing from urbanization</td>
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Dam Infrastructure Induced Displacement

<table>
<thead>
<tr>
<th>Climate Impact(s)</th>
<th>Mitigation / adaptation infrastructure</th>
<th>Infrastructure development objectives</th>
<th>Enviro Impacts</th>
<th>Socio-economic Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>Dam</td>
<td>Power generation</td>
<td>Water table rise</td>
<td>Benefits</td>
</tr>
<tr>
<td>Drought</td>
<td></td>
<td>Irrigation</td>
<td>Water logging</td>
<td>Displacement and Resettlement</td>
</tr>
<tr>
<td>Fresh H2O Salinization</td>
<td></td>
<td>Drainage</td>
<td>Alkalinization</td>
<td></td>
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<tr>
<td>Sea-level rise</td>
<td>Transport</td>
<td>Navigation</td>
<td>Forest impacts</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Water table rise</td>
<td>Disease vectors</td>
<td></td>
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<td></td>
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<td>Emissions</td>
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Climate Change

Displacement and Resettlement
Sea Wall (Adaptation) Induced Displacement

Typology of Displacements and Case Studies

SECTION 2
Typology of Displacements

• Displaced to planned resettlement areas
  – Adaptation of those that have been displaced:
    • Changing economic activity, cultural practices, neighborhood perception
    • Full integration
  – Adaptation of host communities (receiving displaced):
    • Out-migration X Integration

• Displaced without planned resettlement
  – No EIA/HIA or lack of accountability
    • Rupture of social, cultural, and community ties
    • Unclear future prospects
    • Multiple resettlements may be necessary

Typology of Displacements

• Infrastructure projects also create in-migration:
  – Temporary jobs related to project’s construction
    • Unskilled/semi-skilled/skilled/professional labor
      – Expectations often exceed demand for labor, putting more pressure on the environment and on local services (e.g., health care and housing)
  – Attraction to new infrastructure (e.g. roads, water, electricity)
    • Corporations
    • Land speculators
    • Small businesses
    • Migrants attracted by the expectation of economic payoffs

• Projects may cause out-migration of local population not directly displaced by the project, but unable to cope with negative consequences
Case Studies

Mali
- Office du Niger - Inland Delta
- Manantali Dam

Brazil
- Tucurui Dam, Pará (Amazon)
- Balbina Dam, Amazonas (Amazon)

South America
- IIRSA: 360+ regional infrastructure projects

Pakistan
- Indus River Valley barrages

Mali: Office du Niger, Inland Delta

- Example of an infrastructure scheme that displaced few and attracted new settlers.
- **Purpose:** In 1930s Office du Niger (ON) created with plans for 1m hectares of long-staple cotton with 1.5m new inhabitants. Forced labor and resettlement provided the labor. Rice replaced cotton in 1960s.
- **Environmental impacts:** Water table rise, water logging, alkalization require improved drainage.
- **Population impacts:**
  - **1961:** 45,000 ha were developed with 37,000 people residing there, but by 1964 the pop declined to 33,000.1
  - **Late 1970s:** 53,000 settlers.
  - **1992:** 47,000 ha of improved lands, and 132,235 people resided there.2
  - Yields and incomes have risen in recent years owing to reforms.

Footnotes:
Mali: Manantali Dam

- Located on the Senegal River, construction completed in 1987, displacing 10-12,000 people.
- **Purpose**: hydroelectric power generation, increased dry season flows for irrigated agriculture, and navigation.
- **Environmental Impacts**: Has had major impacts on flood-recession farming, fisheries, pastoralism, ground water resources, riverine forests, and water-borne diseases. The conversion from flood-recession farming to irrigated agriculture has been much slower and costlier than expected. Irrigated agriculture has actually been less productive than flood-recession farming, and contributes to water-borne diseases via irrigation canals and water-storage areas.¹
- **Population impacts**: A land grab by Moors in 1989, intent on resting valuable river lands from traditional Hal Pulaar communities, led to the forced expulsion of ~70,000 black Mauritanians.² In 2007, 20,000 still remained in camps in Senegal.³

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Brazil: Tucuruí Dam, Pará (Amazon)

- **Purpose**: Electricity generation (subsidized energy provided to the aluminum industry)
- **EIA**: Construction predates Brazil’s 1986 requirement of an Environmental Impact Assessment.
- **Environmental impacts**: Only 30% of the area was cleared before flooding (part of the submerged timber was later logged with a special underwater chainsaw). Over time turbines suffer corrosion as a result of water acidity due to the decomposition of flooded vegetation. The area of the reservoir’s water surface at a water level of 72 m officially 2430 km². The loss of forest caused by Tucuruí was not limited to the area flooded. There was a major reduction in fish species.
- **Population impacts**: >32,000 people displaced; several remained without a home one year after the reservoir was filled; others were moved twice, since the initial relocation site ended up flooded; those without land title were denied assistance. More than 1/3 of the flooded area belonged to an indigenous group that was relocated 5 times within a period of 6 years.
Brazil: Balbina Dam, Amazonas (Amazon)

- One the greatest mistakes and ecological disasters that the Amazon has witnessed – has a reservoir of 2,360 km² and generates only 250 MW – or 9.4 km²/MW.
- **Purpose**: Supply electricity to Manaus, Amazonas’ capital.
- **EIA**: Construction predates Brazil’s 1986 requirement of an Environmental Impact Assessment.
- **Population displacement**: Mitigation programs to assist the population came in short, and were reduced over time. Additionally, one indigenous group was so severely impacted by the dam that accusations of genocide were set forth at the 4th Bertrand Russel Tribunal in Rotterdam in 1980.
- **Environmental Impacts**: Only 2% of the reservoir area cleared before flooding; decomposing trees generate CO2 and CH4 (methane) - in 1990 the emission levels were 22.6 times more than would have been emitted by fossil fuel generating the same amount of energy.

South America: IIRSA

- Initiative for the Integration of Regional Infrastructure in South America (IIRSA)
- **Purpose**: Regional integration; launched in 2000
- **EIA**: More than 360 infrastructure projects, mainly transportation (roads, ports, airports, waterways, bridges, and railroads) and energy (hydropowers, gas pipelines, and transmission lines). Each project will require a separate assessment.
- **Estimated Impacts**: Will directly impact ~ 2.5 million km² in South America, including, just in Brazil, 137 conservation units, 107 indigenous areas, and 484 areas considered of high priority for conservation due to biodiversity.
Pakistan: Indus River Valley

- The first irrigation canals were built by the peoples of the Indus Valley Civilization. Today, dams and barrages along the Indus support 90% of the country’s agriculture, and provide water to Karachi, a city of 18m.
- **Purpose**: Water for agriculture and urban industrial and domestic use.
- **Environmental impacts**: A total drying of the Indus delta, including die off of mangroves and fisheries.
- **Population impacts**: Without the barrages, a large percentage of Pakistan’s population could not be supported.

Future Displacements Owing to Mitigation & Adaptation Projects

**SECTION 3**
Climate change events

- Sea level rise:
  - Rising average sea level
  - Salt water intrusion in aquifers

- Water availability
  - Increasing
  - Decreasing

- Extreme weather events
  - Droughts
  - Heat waves
  - Violent Storms
  - Floods

Speed of Event | Variability
--- | ---
Slow Onset | Low
Fast Onset | High

About 600m people currently live in regions below 10m elevation

Water Availability


About 500m people currently live in regions where runoff is projected to decline by more than 20% by 2080.

The Mekong

Legend
Low Elevation Coastal Zone (km)

Urban Extent

EACH FOR Study Area

Population Density, Persons per km²

Population Density, Persons per km²

Extreme Climate (Hot)
Glacier Dependent Rivers in Asia

Hazard risk represents a cumulative score based on risk of cyclones, flooding, landslides and drought.

### Climate Change Mitigation Projects

<table>
<thead>
<tr>
<th>Objective</th>
<th>Potential Mitigation Response</th>
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<tbody>
<tr>
<td>Reduce GHG emissions</td>
<td>Hydroelectric facilities, large-scale wind farms</td>
</tr>
<tr>
<td>Develop biofuels</td>
<td>Biofuel plantations (jatropha, sugar cane, corn)</td>
</tr>
<tr>
<td>Increase “sinks” for GHGs</td>
<td>Forest plantations</td>
</tr>
<tr>
<td>Geoengineering</td>
<td>Injecting H₂S or SO₂ high in the stratosphere, tampering with ocean albedo, and possibly terrestrial</td>
</tr>
</tbody>
</table>

### Likely Impacts of Climate Change Requiring Adaptation Infrastructure

<table>
<thead>
<tr>
<th>Impact</th>
<th>Potential Adaptation Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level rise, salt-water intrusion</td>
<td>Sea walls, dykes, freshwater injection facilities</td>
</tr>
<tr>
<td>Decreasing water availability, increasing droughts</td>
<td>Dams, irrigation works, water transfer schemes, desalination plants</td>
</tr>
<tr>
<td>Increasing water availability, increasing floods</td>
<td>Dams, dykes, levees, flood control infrastructure</td>
</tr>
</tbody>
</table>
Levels of Displacement

- **Primary**
  - Climate Change Induces Displacement
  - Impact (e.g. flood, sea level rise) resulting in migration

- **Secondary**
  - Infrastructure Induces Displacement
  - Response to impact creates displacement
  - e.g. Dam flood plain

- **Tertiary**
  - Environmental Impacts of Infrastructure Cause Displacement
  - Changing water table across wider region
  - Impacts on disease vectors

Conclusions & Further Research

- Not all adaptation will be the result of grass roots efforts to build climate resilience
- Large scale infrastructure will be a part of the mix
- Likely that some resettlement will be inevitable part of both proactive and reactive adaptation projects
  - Minimize climate and resettlement risks to displaced groups
  - Maximize capacity building within larger adaptation processes
- Migration, even when “forced”, may be a viable adaptation option
- “Resettlement is apt to generate opportunities to improve lives, not only disrupt them.” — M. Cernea, 1999
http://www.populationenvironmentresearch.org

PERN CYBERSEMINAR TO ADDRESS THIS TOPIC IN 2010