Inequalities in power sector: A case of mini hydropower project in Sri Lanka

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Objectives of the talk

- Economic valuation of a minihydro project in Sri Lanka
- Inequality issues related to the project
- Integration of inequalities of externalities into decision making

Sri Lanka…

Population - 19 million

urban (21.5%), rural (72.2%) and estate (6.3%)

Population growth rate 0.79%

Economy

Main production sectors

- agriculture, forestry and fishing (19.1%),
- industry (26.2%)
- services (54.7%)

Average per capita income US$850 per annum

Welfare indicators

Percentage of poor households – 20%

Life expectancy - Men 70; women 74

Literacy rate - 92%

…..and its power sector

Energy composition

- Biomass – 48%
- Petroleum – 43%
- Hydro – 9%

Present generation facilities

- Installed Capacity - 2172 MW
  - Large Hydro 1185 MW
  - Thermal 909 MW (oil fired)
  - Wind 3 MW
  - Small-hydro 74 MW
  - Biomass fired 1MW
- Off-grid Systems (2003)- 10 GWh
  - small-hydro 4MW (160 systems)
  - Solar PV 2.2MW (53,000 SHS)
  - Wind 25 systems
- Maximum Demand - 1580 MW
- Total Generation - 8430 GWh

Grid and off-grid renewable resources

Facility	Capacity
Grid	
Major hydro	1187 (MW)
Small hydro	60 (MW)
Wind	3 (MW)
Biomass	1 (MW)
Subtotal grid	1151 (MW)
Off grid	
Small Hydro, Industrial	3226 (kW)
Small Hydro, Household	868 (kW)
Solar Photovoltaic, Household	2207 (kW)
Wind Energy, Household	8 (kW)
Subtotal Off-Grid	6301 (kW)
Total	1157 MW

Inequalities in the power sector

- Inequalities due to Electricity Board's policy on electrification,
- market failures of the power sector which lead to inequalities and
- inequalities due to externalities of power sector projects.

Inequalities due to Electricity Board's policy on electrification

- About 45% of households are not connected to the grid at present
- Extension of the main electricity grid will never be feasible for 20% of the households
- Off grid power plants will be the only option for such rural areas
- However, off grid renewable power generation is not a priority of the CEB

Market failures of the power sector which lead to inequalities

- power producers make no payment for the resource extraction
- Positive externality – when upland land owners conserve the watersheds
- Negative externality – when upland land owners degrade the land creating siltation of reservoirs, water quality deterioration in multi purpose reservoirs

RESULT – non optimal levels of upland conservation

- Most upland land owners are poor farmers

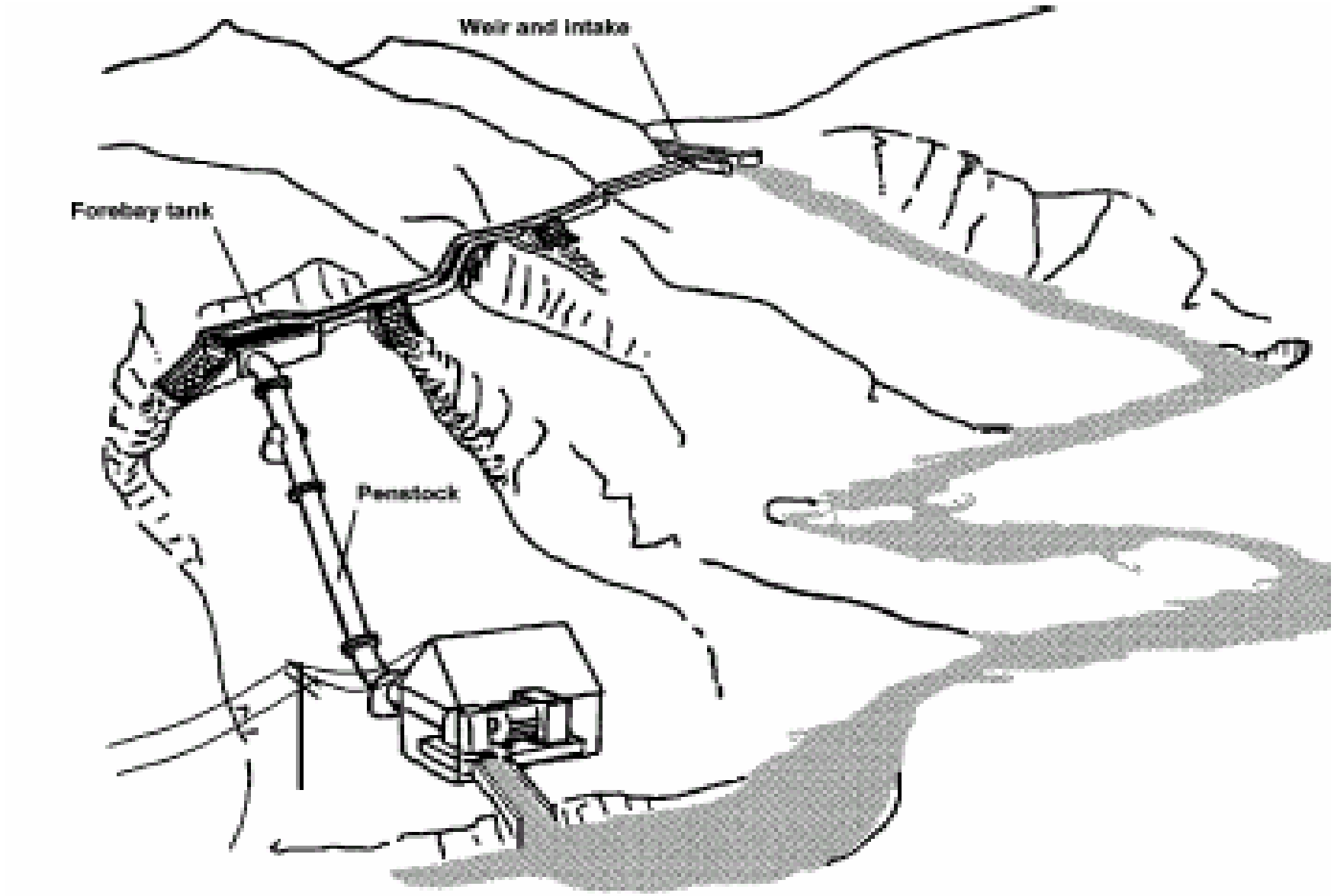
Inequalities due to externalities of power sector projects

- Large hydro projects – involuntary resettlement
- Hydrological regime changes
- Most affected people are low income people

Decision making frameworks and their inability to incorporate externality and equality concerns

- Economic frameworks - ECBA under EIA
- neglect of environmental values
- When valued, estimation and methodological issues
- Lack of compensation for losers
- Negligence of distributional issues
- Lack of applications of distributional weight system

Minihydro project



Study site

- 40 MW Broadlands hydropower scheme in Kitulgala area of Sri Lanka along the Kelani river
- popular tourist destination with historic attractions and recreational activities (white-water rafting)
- main location for the 1957 Oscar-winning film, The Bridge on the River Kwai
- proposed powerhouse site and a part of the access road to the powerhouse will require clearance of about 25ha of forested area and 16 ha homesteads
- cost of water pollution from oil, toxic pollutants and other waste during the construction phase

Valuation of environmental impacts of the project

Component 1 – Lost tourist site 'Bridge on the River Kwai' film site

- Contingent valuation survey
- 100 respondents
- Open ended question format
- The WTP value for preventing the loss of river flow for perpetuity - Rs 425.00.
- Affected population - foreign visitors to the site
- The aggregated value of the cost of lost scenic value - Rs 3, 187,500

Component 2 - Cost of lost recreational activities/ water sports

- Proposed bridge at powerhouse site is situated on the river stretch used for whitewater rafting adventure sport activity.
- This activity will be completely abandoned
- Market price method

Company	Average visitation (per month)	Rates (Rs) Local	foreign	Total value
1	150	1300	1800	3,150,000
2	100	2000	1500	2, 340,000
				Total 5,490,000

Component 3 - cost of lost scrubland/ forest

- the proposed powerhouse site and a part of the access road are to be located within the boundary of the forest reserve

- clearance of 25ha of forested area; 10 ha restored.

Global damage cost approach

- A ha of closed secondary forest contain 152-237 tons of carbon

- Average Global damage cost of a ton of carbon released to the atmosphere - $10

- Total cost - Rs 136,800 per year per ha when the lower bound carbon value is used. (exchange rate is $1 = Rs 90).
- Total cost (Rs) 2,052,000

Component 4 - cost of lost home garden productivity

- The construction of access road will permanently change the homesteads land use along a stretch of about 700m.

Benefit transfer approach

- Extent of home gardens (ha) 15.87
- Per unit economic value (Rs) 535,929.00
- **Total cost (Rs) 8,506,265.00**

Component 5 - cost of water pollution from oil, toxic pollutants and other waste during the construction phase

- Will affect all the activities related water including bathing, swimming and rafting in the downstream

Methodology - costs of mitigatory measures.

- Per unit cost of the most appropriate mitigatory measure 1,017,000.00
- Quantity of the mitigatory measure 36 months
- **Total cost (Rs) 36,612,000.00**

Component 6 - cost due to the loss of forest product collection

- The construction and operation of the powerhouse facilities will terminate community interaction with the forest.
- Methodology - household survey of 229 households and market prices

Forest product	**Annual economic value**
Fuel wood	938,500
Timber	6000
Kitul products	16,000
Medicinal plants	300
Total	**960,800**

- assumption - the collection of forest products would not be compensated by any other area.

Component 7 - cost due to the loss of scenic view of the river

Scenic views that capture natural forest in its background will be lost.

Contingent valuation method

- Valuation of the impact on the loss of river flow for the local people
- The affected population - 60 households
- The survey involved 20 households.
- The WTP value for preventing the loss of river flow for perpetuity is Rs 890.
- Annual aggregated value - Rs 16020.

Component 8 - Benefits of avoided coal power generation

The operation of the present hydropower project will avoid the need of other alternative means of power generation especially thermal power generation.

- Avoided global damage cost approach

Emissions of pollutants from electric power generation: the total fuel cycle

Energy source	CO_2(tons per giga watt hour)
Conventional coal	1, 058.2
Fluidized bed coal	1,057.1
Hydropower	6.6

- Avoided amount of carbon - 1,051.6 tons
- Global damage cost of a ton of carbon $5 - $20
- Annual power generation - 145 GWhrs
- Total benefit - Rs 137,233,800 per year (using $10)

Impact	Value	Main social group affected	Availability of compensation mechanisms
COSTS			
Lost recreation monuments	318,750	Remote affluent	Alternative sites
Lost recreation water sports	5,490,000	Remote affluent	Alternative sites
Lost forest land	2,052,000	Local poor	Alternative sites
Lost home garden productivity	8,506,265	Local poor	Compensation or alternative sites
Water pollution*	36,612,000	Regional	Implementation of mitigatory measures
Lost forest produce collection	960,800	Local poor	Alternative sites
Loss of scenic view of the river	16020	Local poor	None

BENEFITS			
Avoided coal power generation	137,233,800	Remote	
Electricity to the grid		Grid connected	
Total environmental cost			53,955,835
Total environmental benefit			137,233,800
Total cost to remote affluent groups			5,808,750
Total cost to local poor			11,535,085

Implications

- For environmental valuation
- Power sector decision making
- Integration of inequality issues into power sector decision making

Valuation issues

- Unrecognised and unvalued short term and long term benefits and costs
- Under and over estimates
- Adequacy of economic values in making decisions
- Inherent problems of economic values, discounting, hypothetical compensation

Decision making in power sector

- No mechanism to ensure environmental economic values are integrated to power sector decision making

- Less possibility for Environmental concerns incorporation
  - due to the ‘electrical engineer bias’
  - Large projects will bring financial benefits to the CEB staff

Integration of inequality issues into decision making

- The existing frameworks are not flexible for even internalisation mechanisms
- Use of distributional weights or concern on distribution is rarely done for individual projects
- Only possible compensation is through other policy interventions – social welfare etc.
- However, such weak sustainability approaches (compensation of loss of environmental capital with man made capital) may not be always socially acceptable

Conclusions

Minihydro projects could have significant environmental impacts when located in inappropriate sites

Such impacts lead to significant environmental injustices

Internalisation of externalities and correction of inequalities is necessary for true sustainability

Thank you