Social Cost Benefit Analysis of Water and Sanitation Improvement in a Poor Urban Slum

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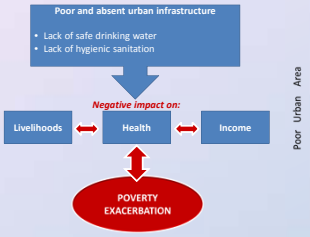
Background



Study Area

The Tebbaneh Slum in Tripoli, Lebanon

Study Area Characteristics

- 0.4 Km^2 area
- Highest population density in the country (~69,000/Km2)
- Poor community
- Average monthly income < 200 USD per month
- Inadequate infrastructure

Illegal water pumps in building basement

Corroded water tanks in attics

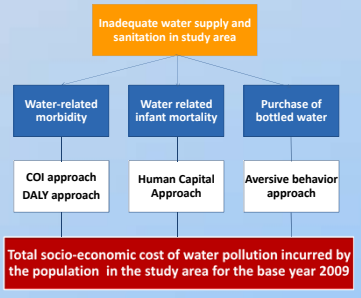
Solid waste littering and poor hygiene

METHODOLOGY

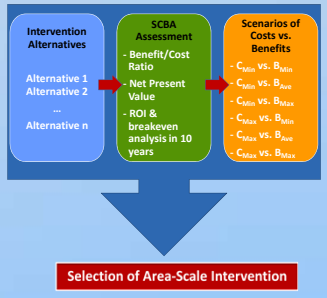
Field surveys

- **Standardized close-ended field questionnaire in 325 households**
  - Socio-demographic
  - Health status
  - Water and wastewater infrastructure
- **Water quality assessment**
  - Water distribution network
  - Household storage tanks
  - Vended bottled water
- **Survey of dispensaries, hospitals and pharmacies**
  - Incidence of cases
  - Cost of treatment of water-related diseases

Health-Based Socio-economic Assessment



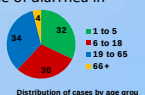
Social Cost-Benefit Analysis



FIELD SURVEY RESULTS

Diarrhea Incidence

- Assumptions
  - **88%** of reported diarrheal cases attributed to unsafe water supply, inadequate sanitation and hygiene
  - Cases are **distributed uniformly** throughout the year
- Annual incidence of diarrhea in Tebbaneh (2009)
  - **33.1 percent**
  - **9,200 cases**



Distribution of cases by age grou

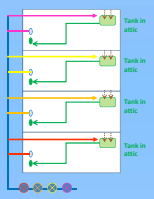
Water Quality Results

- Supplied water is of acceptable quality with more pollution within buildings

Parameter	Range	Standard (EPA/ EU/ WHO)*	Standard Exceedance			
			Drinking Network		Storage Tanks	
			N	(%)	N	(%)
Fecal coliform (CFU/100 ml)	0-3	0	3	(4)	6	(10)
Total coliform (CFU/100 ml)	0-500	0	18	(24)	26	(41)
Residual chlorine (mg/L Cl_2)	0.01-0.3	> 0.5	76	(100)	-	-

Field Observations

- Water pollution problems occur at the building/household level due
  - deteriorated water distribution networks
  - old, corroded uncovered water storage tanks located in the attic



INTERVENTION SELECTION AND SOCIO-ECONOMIC ASSESSMENT RESULTS

Selection of Alternative Interventions & Cost Definition

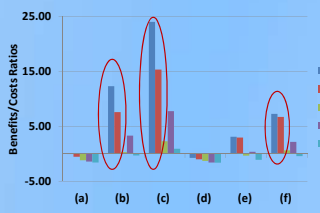
Alternatives	Description	Percent of households	Unit Capital Cost (USD/ Household)	Annual recurrent cost (million USD)
Alternative 1	The installation of a new plastic roof top water storage tanks	50-80	500 – 1,000	0.005 – 0.02
Alternative 2	The installation of a new water piping system to eliminate the risk of wastewater infiltration into the water pipes and to protect the supplied water from recontamination.	80	500 – 1,000	0.008 – 0.02
Alternative 3	The installation of a new wastewater plumbing system to eliminate the problems of leakages, clogging, and broken pipes and the associated risk of wastewater infiltration into the water piping system or accumulation in basements.	80	2,000 – 4,000	0.03 – 0.06
Alternative 4	The implementation of both Alternatives 1 and 2	50-80	1,000 – 2,000	0.01 – 0.03
Alternative 5	The implementation of Alternatives 1, 2 and 3	50-80	3,000 – 6,000	0.04 – 0.09

Estimated Health Benefits or Averted Damage Costs

Impact	Damage cost of water pollution and inadequate sanitation		Economic benefit from improved water supply and sanitation		
	Cost (million USD)	Percent of the area annual income (%)	Percent reduction in cases (%)	Benefit (million USD)	Percent of the area annual income (%)
Mortality					
Human Capital Approach	0.12-0.30	0.52-1.3	17-100	0.06 - 0.3	0.26-1.3
Morbidity	0.66-3.62	2.90-15.80	6-100		
Cost of Illness	0.42-1.50	1.85-6.5 %		0.02- 1.5	0.11-6.5
Cost of DALYs lost	0.018	0.08 %		0.001 - 0.02	0.005-0.08
Aversive behavior	0.22-2.10	0.96-9.14 %	50-100	0.1-2.1	0.48-9.14
Total	0.78-3.90	3.4-17.71	-	0.2 - 3.90	0.85 – 17.7

SCBA RESULTS

Benefits to Costs Ratio



Return on Investment

Alternative	Scenarios for Return on investment (years)					
	(a) C_{Min} B_{Min}	(b) C_{Min} B_{Avg}	(c) C_{Min} B_{Max}	(d) C_{Max} B_{Min}	(e) C_{Max} B_{Avg}	(f) C_{Max} B_{Max}
1. New roof top water tanks	2	1	1	2	2	2
2. New water piping	2	2	1	2	2	2
3. New wastewater plumbing	>25	3	3	>25	3	3
4. Alternatives 1 and 2	>25	2	1	>25	3	3
5. Alternatives 1, 2 and 3	>25	4	4	>25	>25	4

Conclusion

- **Installing rooftop tanks and replacing water piping at the household were the most economically viable interventions**
  - Benefit to Cost ratio ranged between 4.6 and 16.8 USD for every 1 USD invested
  - A positive return on investment within a maximum of 10 years from implementation

Simple low cost interventions are expected to result in positive health impacts which translate into a significant positive socio-economic impact in a poor urban slum.