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Cost-Benefit Analysis of Constructing a Filtration Plant for the National Water Carrier in Israel

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Outline:

- economic cost-benefit analysis (CBA) of the construction of a filtration plant for the Israeli National Water Carrier
- cost analysis of two alternative engineering systems: central filtration and localized filtration
- a two stage method for valuating the benefits of the filtration plant

benefits of the filtration plant

- First, we valuate the damages caused by consumption of unfiltered water.
- then we estimate consumers' willingness to pay for high water quality

main result

- that total willingness to pay significantly outweighs the costs of constructing and operating the plant.
- thus, construction of the plant is economically worthwhile.

Background

- NWC conveys today about 330 m3 of water annually to the different parts of the country.
- 35% of all potable water in Israel; 90% of water consumers in Israel receive at least part of their water supply through the NWC.
- coliform levels are now between 150-500 per 100ml

Cost Analysis- result

Net present value of expected expenditures

- **Central filtration- $245 million.**
- **Localized filtration-$850 million.**

Even taking into account - that 30% of the water filtered by the plant is supplied to the agricultural sector

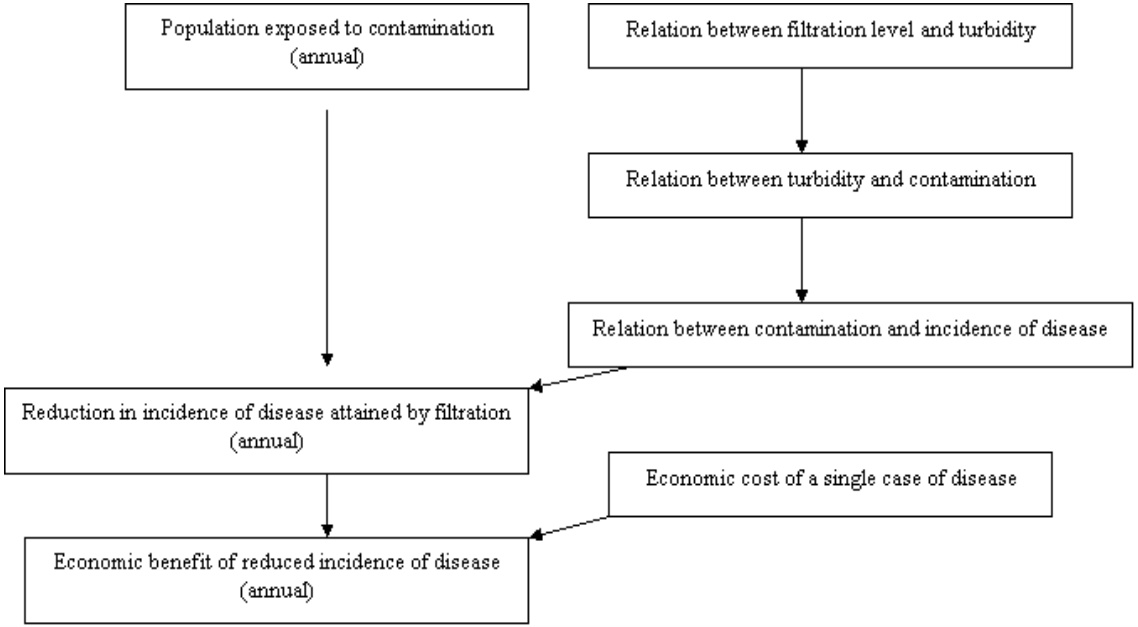
the cost ratio between the two alternatives is still 2.4.

Benefit Analysis

Direct savings: savings in cleaning costs of storage tanks and savings in chemicals used as disinfectants - $1 million.

Indirect benefits - savings to consumers health expenditure and savings due to less sick days.

Valuation of damages 1



Valuation of damages 2

- **The relation between filtration and turbidity- benefits of filtration in terms of reduced turbidity from 1 NTU to 0.2 NTU.**
- **The relation between turbidity and contamination -contamination level will decrease by at least 99.9% (3 log).**
- **The relation between contamination level and incidence of disease- the decrease in incidence of diseases was 10%.**

The economic cost of disease

Table 2: Valuation of the economic cost of a case of Giardiasis

Item	Cost ($)	Notes
Doctor visits	27	3 visits, at $9 per visit
Hospitalization days	97	0.5 hospitalization days, at $194 per day
Prescription drugs per patient (four types)	30	Price of prescription drugs provided for patients of the disease in Israel
Emergency room visits and laboratory tests	87	0.75 visits per patient, at $116 per visit
Direct loss of workdays	411	By average lost workdays (includes loss of workdays due to child's illness)
Reduced productivity	270	Applies to employed persons, on the basis of average wages
Time spent on way to get treatment	12	3 hours multiplied by the average cost of an hour of leisure ($4)
Loss of leisure hours	128	Applies to all persons, on the basis of occupational status distribution
Total	**$1,062**	

Decrease in incidence of disease following filtration of drinking water

Type of disease	Decrease in number of cases (thousands)	Decrease in cases of death (units)
Viruses	202	10.5
Cryptosporidium	13	4
Giardiasis	8.2	Negligible
Bacterial	18.7	24
Overall	**242**	**38.5**

Economic value of decrease in incidence of disease following filtration of drinking water

Type of disease	Decrease in number of cases (thousands)	Economic value of decrease in incidence of disease (million $)	Decrease in cases of death (units)	Economic value of decrease in cases of death (million $)
Viruses	202	14.25	10.5	4.2
Cryptosporidium	13	3.5	4	1.6
Giardiasis	8.2	8.7	Negligible	-
Bacterial	18.7	20	24	9.6
Overall	**242**	**46.5**	**38.5**	**15.4**

Overall benefits reach $62 million annually

Willingness to pay 1

(1) $$EU = qU(W-L) + (1-q)U(W)$$

(2) $$pU(W-L-r) + (1-p)U(W-r) = qU(W-L) + (1-q)U(W)$$

We assume a risk-averse utility function of the form:

(3) $$U(x) = \alpha X^{\beta}$$

Inserting this utility function into Equation (2), we get:

(4) $$p\alpha(W-L-r)^{\beta} + (1-p)\alpha(W-r)^{\beta} = q\alpha(W-L)^{\beta} + (1-q)\alpha(W)^{\beta}$$

As α appears before all expressions, we can drop it from the equation to obtain:

$$p(W-L-r)^{\beta} + (1-p)(W-r)^{\beta} = q(W-L)^{\beta} + (1-q)(W)^{\beta} \qquad (5)$$

Willingness to pay 2

Table 5: Estimates of WTP for water safety, per person

Authors	Valuation	Valuation Method	Estimated WTP
Luzar and Cosse	Δ in water quality	CV open-ended	$77.00
Kwak, Lee and Russel	Δ in drinking water	CV open-ended	$39.36
Laughland et al.	Δ in water safety	averting expenditure	$46.00-$275.00
Abdalla, Roach, and Epp	Δ in water safety	averting expenditure	$14.25
Abrahams, Hubbell and Jordan	Δ in water safety	averting expenditure	$47

Conclusion:

- The costs of filtration are estimated at $0.065 per m3
- WTP of $0.1875 per m3.
- valuation of damages estimate is $0.27 per m3

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Thank you for your time!

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