

Cost-benefit Analyses of Improved Sanitation Options

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Summary

- Project objectives
- Project present state
- Designing improved sanitation options with the EAWAG compendium
- Excel spreadsheet for costing improved WS&S options



Project objectives

- Started in 2004 with the support of GIAN a joint WHO/UNICEF team developed two practical manuals for costing improved WS&S projects.
- The manual for costing improved WS projects has been tested in 2008, in six countries of South-East Asia and Western Pacific. Recommendations formulated within these inter-regional capacity building activities were included in the project objectives. They include:
 - improvements of costing guidance documents and Excel spreadsheets for practical applications;
 - development of these tools in a more comprehensive SCBA framework.



Project present state

- Development of a user-friendly Excel spreadsheet for practical applications, integrating tools for simulating the life-cycle production of a WS&S project and a glossary of technical terms.
- Adoption of the EAWAG methodology for designing Sanitation technological options corresponding to the WHO/UNICEF-JMP definitions of improved sanitation facilities.
- Identification of beneficiaries and type of market and non-market benefits withdrawn from the improved WS&S options.
- Evaluation of benefits based on experimental or quasi-experimental data using the treatment effect methodology.



Designing improved sanitation options with the EAWAG compendium

WHO/UNICEF JMP Improved Sanitation Options

- Flush or pour-flush toilet/latrine to:
 - Piped sewer system
 - Septic tank
 - Pit latrine
- Ventilated improved pit latrine
- Pit latrine with slab
- Composting toilet

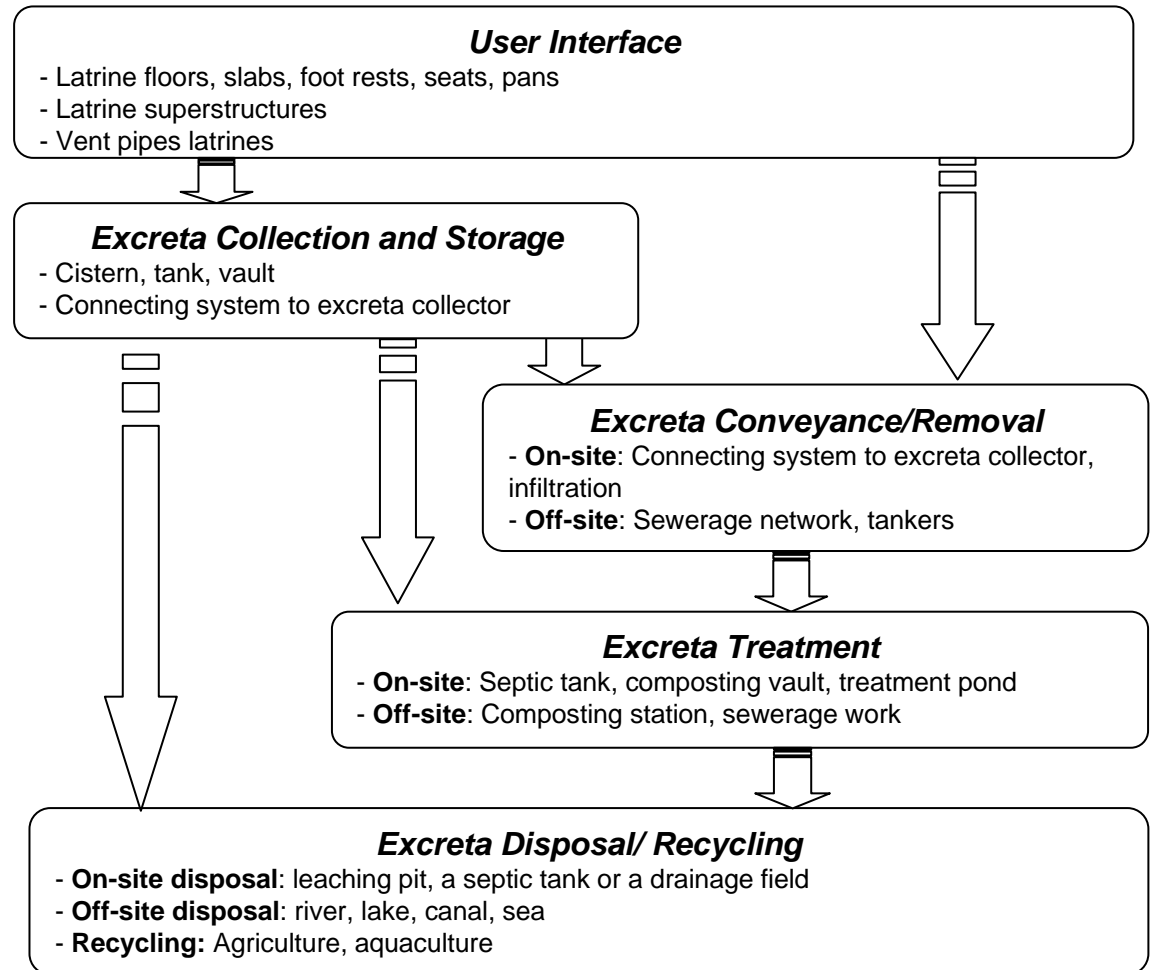
EAWAG System Templates

- ST1: Single Pit System
- ST2: Waterless System with Alternating Pits
- ST3: Pour-Flush System with Twin Pits
- ST4: Waterless System with Urine Diversion
- ST5: Blackwater Treatment System with Infiltration
- ST6: Blackwater Treatment System with Sewerage
- ST7: (Semi-) Centralized Treatment System
- ST8: Sewerage System with Urine Diversion

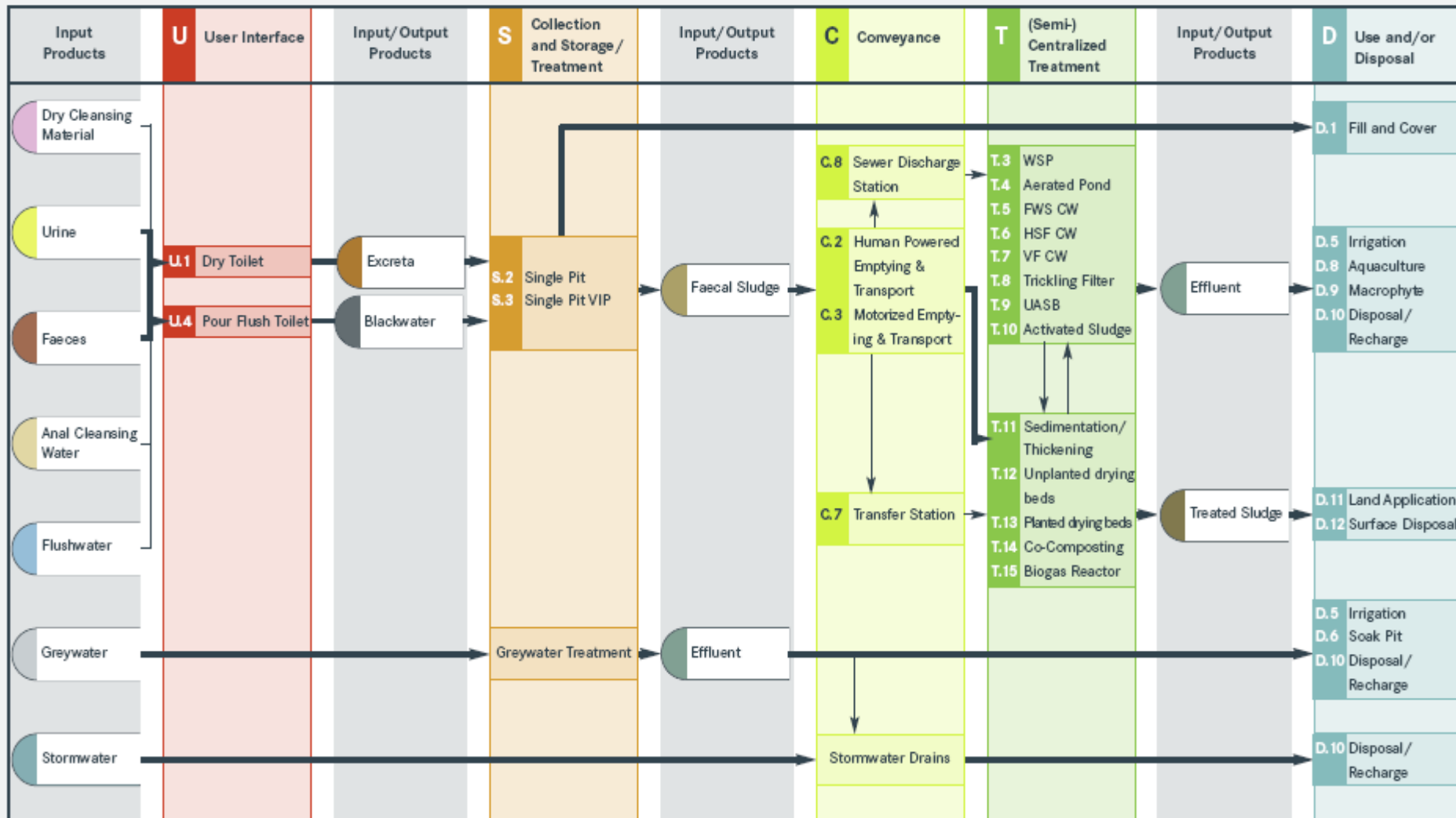


Designing improved sanitation options with the EAWAG compendium

Flow chart of sanitation process



Sanitation System 1: Single Pit System



Cost-benefit Analyses of Improved Sanitation Options

WHO/UNICEF Improved Sanitation Options		EAWAG/WSSCC methodology									
		System Template	Input Products	User interface	Output/ Input Products	Collection and Storage/ Treatment	Output/ Input Products	Conveyance	(Semi-) Centralized Treatment	Output/ Input Products	Use and/or Disposal
Dry pit latrine with slab	ST1	F+U+ DCM+ACW	U1	Ex	S2, S3	FS	n.a.	n.a.	FS	D1	
		F+D+ DCM+ACW	U1	Ex	S2, S3	FS	C2, C3	T1-T15	Ef TS	D5, D8-D10 D11, D12	
		F+D+ DCM+ACW	U1	Ex	S2, S3	FS	(C2, C3)+ C7	T1-T15	Ef TS	D5, D8-D10 D11, D12	
		F+D+ DCM+ACW	U1	Ex	S2, S3	FS	(C2, C3)+C8	T1-T15	Ef TS	D5, D8-D10 D11, D12	
Composting toilet	ST2	F+U+D+ACW +DCM	U1	Ex	S4, S5, S8 n.a.	CEH	C2 n.a.	n.a. n.a.	CEH DCM	D4 D12	
	ST4	F+U+(ash, lime, dry earth) +ACW	U2+U3	F U ACW	S7 S1 n.a.	DF SU	C2 C1, C2 n.a.	n.a. n.a. n.a.	DF SU ACW	D3, D12 D2, D5, D6 D6	
		DCM	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	DCM	D12	
Flush or pour flush toilet	to pit latrine	ST1	F+U+FW+ ACW+DCM	U4	BW	S2	EF+FS	n.a.	n.a.	EF+FS	D1
			F+D+FW+ ACW+DCM	U4	BW	S2	FS	C2, C3	T1-T15	Ef TS	D5, D8-D10 D11, D12
		F+D+FW+ ACW+DCM	U4	BW	S2	FS	(C2, C3)+ C7	T1-T15	Ef TS	D5, D8-D10 D11, D12	
		F+D+FW+ ACW+DCM	U4	BW	S2	FS	(C2, C3)+ C8	T1-T15	Ef TS	D5, D8-D10 D11, D12	
		ST3	F+U+FW+ ACW	(U4, U5)+ U3	BW	S6	TS Ef	C2 n.a.	n.a. n.a.	TS Ef	D11, D12 D10
	to piped sewer system	ST7	F+U+FW+ ACW +DCM	U4, U5	BW	n.a.	BW	C4, C6	T1-T15	Ef TS	D5, D8-D10 D11, D12
			DCM	n.a.	n.a.	n.a.	n.a.	n.a.	DCM	D12	
		ST8	F+U+FW+ DCM+ACW	U6+U3	BW	n.a.	BW	C4, C6	T1-T15	Ef TS	D5, D8-D10 D11, D12
			U	S1	SU	C1, C3	n.a.	SU	D2		
			U6+U3	BW	n.a.	BW	C4, C6	T1-T15	Ef TS	D5, D8-D10 D11, D12	

Cost-benefit Analyses of Improved Sanitation Options

WHO/UNICEF Improved Sanitation Options		EAWAG/WSSCC methodology																	
		System Template	Input Products	User interface	Output/ Input Products	Collection and Storage/ Treatment	Output/ Input Products	Conveyance	(Semi-) Centralized Treatment	Output/ Input Products	Use and/or Disposal								
Flush or pour flush toilet	to septic tank	ST5	F+U+F ₀₀ + ACW	U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)	n.a. T1-T15	Ef Ef TS DCM	D6, D7, D10 D5, D8-D10 D11, D12 D12								
			+DCM									n.a.	n.a.	n.a.	n.a.	n.a.			
			F+U+F ₀₀ + ACW									U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)+ C7+C3	n.a. T1-T15	Ef Ef TS DCM	D6, D7, D10 D5, D8-D10 D11, D12 D12
			+DCM																
		F+U+F ₀₀ + ACW	U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)+C8	n.a. T1-T15	Ef Ef TS DCM	D6, D7, D10 D5, D8-D10 D11, D12 D12									
		+DCM									n.a.	n.a.	n.a.	n.a.					
		ST6	F+U+F ₀₀ + ACW	U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)	n.a. T1-T15	Ef Ef TS DCM	D10 D5, D8-D10 D11, D12 D12								
			+DCM									n.a.	n.a.	n.a.	n.a.				
			F+U+F ₀₀ + ACW									U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)+ C7+C3	n.a. T1-T15	Ef Ef TS DCM	D10 D5, D8-D10 D11, D12 D12
			+DCM																
			F+U+F ₀₀ + ACW									U4, U5	B00	S9, S10, S11	Ef FS	n.a. (C2, C3)+C8	n.a. T1-T15	Ef Ef TS DCM	D10 D5, D8-D10 D11, D12 D12
			+DCM																
			F+U+F ₀₀ + ACW									U4, U5	B00	S9, S10, S11	Ef FS	C4, C5 (C2, C3)	T1-T15 T1-T15	Ef Ef TS DCM	D5, D8-D10 D5, D8-D10 D11, D12 D12
			+DCM																
F+U+F ₀₀ + ACW	U4, U5	B00	S9, S10, S11	Ef FS	C4, C5 (C2, C3)+ C7	T1-T15 T1-T15	Ef Ef TS DCM	D5, D8-D10 D5, D8-D10 D11, D12 D12											
+DCM									n.a.	n.a.	n.a.	n.a.							
F+U+F ₀₀ + ACW	U4, U5	B00	S9, S10, S11	Ef FS	C4, C5 (C2, C3)+C8	T1-T15 T1-T15	Ef Ef TS DCM	D5, D8-D10 D5, D8-D10 D11, D12 D12											
+DCM									n.a.	n.a.	n.a.	n.a.							

Excel
spreadsheet
for costing
WS&S options

Data collection questionnaires

- 1) Project design data**
- 2) Economic costing data** (shadow prices, CPI, etc.)
- 3) Project cost components by activities**
 - **Investment** (physical capital)
 - **Maintenance**
 - **Operation**
 - **Other relevant costs** (administration, training, promotion, education)



Excel
spreadsheet for
costing WS&S
options

Computation of unit costs for least-cost comparisons

Average Incremental Cost (AIC)

$$\text{AIC} = \frac{\text{Full Cost Present Value (FCPV)}}{\text{Life-Cycle Production (LCP)}}$$

$$\text{FCPV} = \sum_{t=1}^T \frac{I_t + M_t + O_t + \text{ORC}_t}{(1+i)^{t-1}}$$

$$\text{LCP} = \sum_{t=1}^T \frac{Q_t}{(1+i)^{t-1}}$$

Q_t series of annual production in physical units (inhabitants, household size, l/inh.)

i annual social discount rate



Cost-benefit Analyses of Improved Sanitation Options

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100% Arial 10 G I S

Répondre en incluant des modifications... Terminer la révision... Sécurité...

C13 Linear

Costing Questionnaire
Water Supply

Improved WS Technology

TYPE OF TECHNOLOGY PROTECTED SPRING & PUBLIC TAP/STANDPIPE

DESIGN LIFETIME [YEARS] 35

Population Growth

POPULATION TREND Linear

Population growth period [years] 30

Households

Design household size [inhab.] 198

Initial household size [inhab.] 159

Inhabitants

Design population [inhab.] 1'363

Initial population [inhab.] 1'094

Water Consumption Growth

WATER CONSUMPTION TREND Constant

Water Consumption growth [years] 35

Water Consumption

Design per capita consumption [l/inhab.] 25

Initial per capita consumption [l/inhab.] 25

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C13 Linear

Costing Questionnaire
Water Supply

Improved WS Technology

TYPE OF TECHNOLOGY PROTECTED SPRING & PUBLIC TAP/STANDPIPE

DESIGN LIFETIME [YEARS] 35

Population Growth

POPULATION TREND Linear

Population growth period [years] Linear

Households

Design household size [inhab.] Exponential

Initial household size [inhab.] 159

Inhabitants

Design population [inhab.] 1363

Initial population [inhab.] 1094

Water Consumption Growth

WATER CONSUMPTION TREND Constant

Water Consumption growth [years] 35

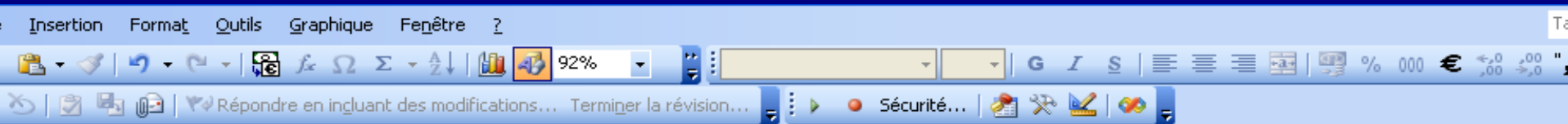
Water Consumption

Design per capita consumption [l/inhab.] 25

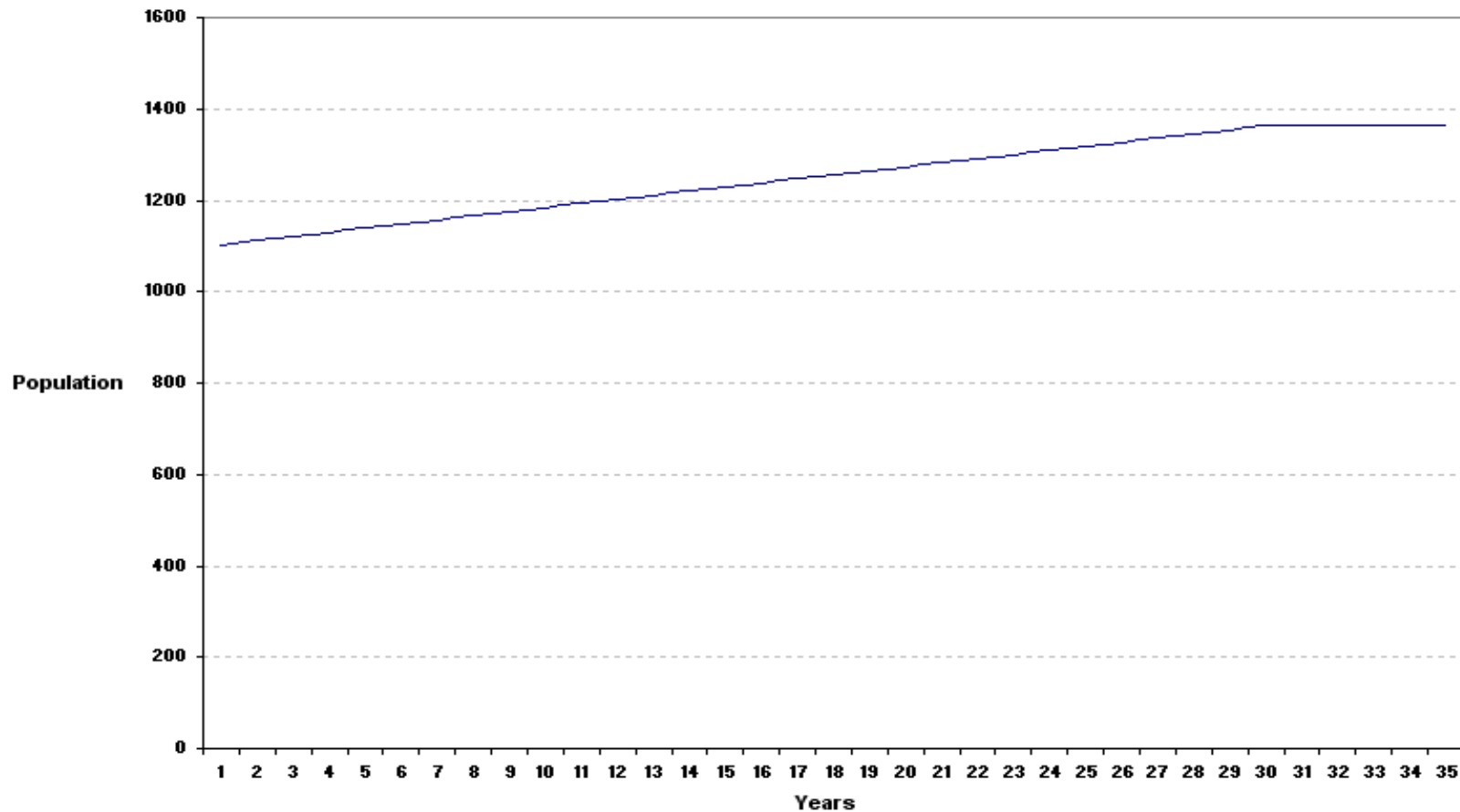
Initial per capita consumption [l/inhab.] 25

Project Data Data comp.&shadow factors Scenario GraphScenario_inh GraphScenario_h GraphScenario_l\inh Summary Summary Collect

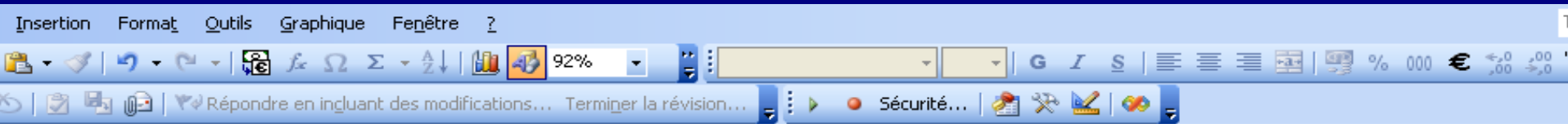
Cost-benefit Analyses of Improved Sanitation Options



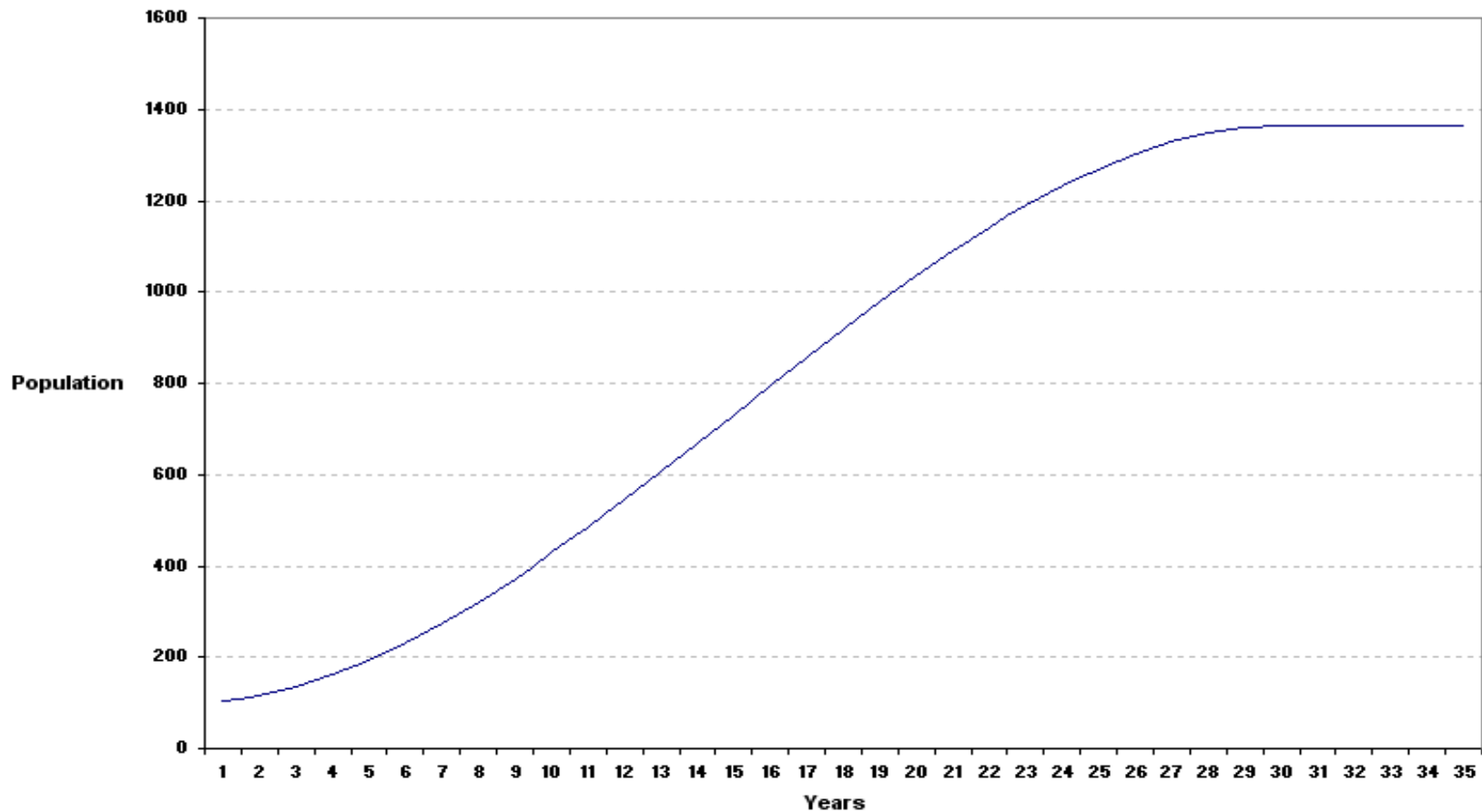
Linear



Cost-benefit Analyses of Improved Sanitation Options



Logistic



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Costing Questionnaire
Water Supply

Data Computation	
Month/Year of actualization (dd.mm.yyyy)	01.01.2008
Currency	PHP
Consumer Price Index (01-08)	100
Present value of households	1'116
Present value of inhabitants	7'676
Present value of per cap. consump.	165

Shadow Factors	
Unskilled labor wage	0.6
Foreing exchange	1.2
Opportunity cost of capital	15%
Annual Social discount rate	15%
Water	
Land	
Other direct inputs _____	

Consumer Price Index	
Date	Index
01.12.2001	100.0
01.01.2002	100.0
01.02.2002	100.0
01.03.2002	100.0
01.04.2002	100.0
01.05.2002	100.0
01.06.2002	100.0
01.07.2002	100.0
01.08.2002	100.0
01.09.2002	100.0
01.10.2002	100.0
01.11.2002	100.0
01.12.2002	100.0
01.01.2003	100.0
01.02.2003	100.0
01.03.2003	100.0
01.04.2003	100.0
01.05.2003	100.0
01.06.2003	100.0
01.07.2003	100.0

base index

Project Data Data comp.&shadow factors Scenario GraphScenario_inh GraphScenario_h GraphScenario_I\inh Summary Summary Collect

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Costing Questionnaire
Water Supply

Data Computation		Shadow Factors		Consumer Price Index	
Month/Year of actualization (dd.mm.yyyy)	01.01.2008	Unskilled labor wage	0.6	Date	Index
Currency	PHP	Foreing exchange	1.2	01.12.2001	100.0
Consumer Price Index (01-08)	100	Opportunity cost of capital			100.0
Present value of households	1'116	Annual Social discount rate			100.0
Present value of inhabitants	7'676	Water			100.0
Present value of per cap. consump.	165	Land			100.0
		Other direct inputs _____			100.0
				01.06.2002	100.0
				01.07.2002	100.0
				01.08.2002	100.0
				01.09.2002	100.0
				01.10.2002	100.0
				01.11.2002	100.0
				01.12.2002	100.0
				01.01.2003	100.0
				01.02.2003	100.0
				01.03.2003	100.0
				01.04.2003	100.0
				01.05.2003	100.0
				01.06.2003	100.0
				01.07.2003	100.0
				01.08.2003	100.0
				01.09.2003	100.0

base index

It reflects the foreign exchange correction factor when price of imports and exports are not in equilibrium due to government regulations. This correction factor is greater than 1.

Project Data | Data comp.&shadow factors | Scenario | GraphScenario_inh | GraphScenario_h | GraphScenario_l_inh | Summary | Summary Collect

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1 2 A B C D E F G H I J

1 **I. Collecting Investment Costs (in local currency unit, LCU)**

2

3 IN ACCORDANCE WITH THE ANSWER OF QUESTION 16 OF SECTION I, COMPLETE THE FOLLOWING TABLES.

4

5 Fill out the following table. Consider all **Local Materials used in Construction**. The table contains pre-classified items, which may be changed if exist others items or sub items.

6 Please, conserve the same schematic form of the table when you will include new items.

7

8 **INVESTMENT COSTS**

Item	Sub item	Inputs	Acquisition Cost in LCU	Month/year of	User life	Qty	Size	Actual Acquisition Costs in LCU (01/2008)	Annual Equivalent Cost in LCU (01/2008)
Materials			184'694					193'531	30'694
Water Collecting			3'568					3'568	639
Catchments			3'568					3'568	639
	Storage dams							-	-
								-	-
	Protected spring	80x40x120cm ferrocement spring box	3'568	janv/2008	13	1	small	3'568	639.07
	Other _____							-	-
								-	-
								-	-
								-	-
Intakes			-					-	-
	Protected side intake							-	-
								-	-
	Bottom river							-	-
								-	-
Water Transporting			143'543					143'543	21'862
	Manual Transporting							-	-
								-	-
	Pipes Transporting	1900m mostly 50mm dia plastic line	143'543	janv/2008	30		see acquisition cost link	143'543	21'862
								-	-
	Other _____							-	-
								-	-
								-	-
Water Storing			7'448					7'448	1'118
Storing Tank			7'448					7'448	1'118
	Concrete-lined earthen reservoir							-	-
								-	-
	Reinforced concrete reservoir	13m3 ferrocement reservoir	7'448	janv/2008	50	1	13m3	7'448	1'118
								-	-
	Elevated steel reservoir (tower)							-	-
								-	-
	Ferrocement tank							-	-

Invest Costs-Local Materials / Invest Costs-Imported Materials / Investment Costs-Equipments / Investment Costs-ImpoEquipments / Investment Costs-L

Cost-benefit Analyses of Improved Sanitation Options

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I. Collecting Investment Costs (in local currency unit, LCU)

IN ACCORDANCE WITH THE ANSWER OF QUESTION 16 OF SECTION I, COMPLETE THE FOLLOWING TABLES.

Fill out the following table. Consider all **Local Materials used in Construction**. The table contains pre-classified items, which may be changed if exist others items or sub items. Please, conserve the same schematic form of the table when you will include new items.

[← Back to Summary](#)

INVESTMENT COSTS									
Item	Sub item	Inputs	Acquisition Cost in LCU	Month/year of	User/ life	Qty	Size	Actual Acquisition Costs in LCU (01/2008)	Annual Equivalent Cost in LCU (01/2008)
Materials			184'694					193'531	30'694
Water Collecting			3'568					3'568	639
Catchments			3'568					3'568	639
	Storage dams							-	-
	Protected spring	80x40x120cm ferrocement spring box	3'568	janv/2008	13	1	small	3'568	639.07
		Protective structure	-				m ³	-	-
		Pipes drain	-				m	-	-
		Seal (puddle clay)	-				m ³	-	-
		PVC	-				m	-	-
		Valve	-				Unit	-	-
		Other_____	-					-	-
	Other_____							-	-
								-	-
								-	-
								-	-
								-	-
								-	-
Intakes			-					-	-
	Protected side intake							-	-
	Bottom river							-	-
								-	-
								-	-
								-	-
Water Transporting			143'543					143'543	21'862
	Manual Transporting							-	-
	Pipes Transporting	1900m mostly 50mm dia plastic line	143'543	janv/2008	30		see acquisition cost link	143'543	21'862
	Other_____							-	-
								-	-
								-	-
Water Storing			7'448					7'448	1'118
Storing Tank			7'448					7'448	1'118

Invest Costs-Local Materials / Invest Costs-Imported Materials / Investment Costs-Equipments / Investment Costs-ImpoEquipments / Investment Costs-L

Cost-benefit Analyses of Improved Sanitation Options

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1 2 A B C D E F G H I J

1 **II. Collecting Maintenance Costs**

2

3 IN ACCORDANCE WITH THE ANSWER OF QUESTION 16 OF SECTION I, COMPLETE THE FOLLOWING TABLES.

4

5 Fill out the following table. Consider all types of **Local Materials used in Maintenance** refer to the present year of operation. The table contains pre-classified items, which may be changed if exist others items or sub items. Please, conserve the same schematic form of the table when you will include new items.

6

7 **MAINTENANCE COSTS**

Item	Sub item	Inputs	Current Annual Cost (in LCU)	Annual Quantity	Size
Materials			2'124		
Water Collecting			41		
Catchments			41		
	Storage dams				
	Protected spring	80x40x120cm ferrocement spring bo	41		
	Other				
Well Lining			-		
	Dug Well				
	Drilled well lining				
	Other				
Water Transporting			1'113		
	Manual Transporting				
	Pipes Transporting	1900m of mostly 50mm dia plastic pip	1'113		
	Other				
Water Storing			60		
Tanks			60		
	Concrete-lined earthen reservoir				
	Reinforced concrete re	13m3 ferrocement ground reservoir	60		

83

84

88

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162

167

168

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Contingency Costs-Incidentals / Other Investment Costs / Mainten Costs-Local Materials / Mainten Costs-Imported Material / Maintenance

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K45 fx A B C D E F G H I J K

Costing Questionnaire Water Supply

by disaggregated level
(Input)

by aggregated level
(Sub-item)

Selected improved technology: PROTECTED SPRING & PUBLIC TAPISTANDPIPE

Currency and day of actualization: Costs in PHP of 01.01.2008

	FCPV in PHP	%	AEC in PHP year	AIC per Household AIC in PHP	UAEC per Household AEC in PHP year	AIC per Inhabitants AIC in PHP	UAEC per Inhabitants AEC in PHP year	AIC per l/inh. AIC in PHP	UAEC per l/inh. AEC in PHP year
TOTAL INVESTMENT COSTS	360'354.71	50%	54'462.16	323.03	275.06	46.94	39.96	1.60	1.60
Local Materials	203'089.40	28%	30'693.89	182.06	155.02	26.46	22.52	0.90	0.90
Imported Materials	-	0%	-	-	-	-	-	-	-
Local Equipments	-	0%	-	-	-	-	-	-	-
Imported Equipments	-	0%	-	-	-	-	-	-	-
Labour	112'625.31	16%	17'021.61	100.96	85.97	14.67	12.49	0.50	0.50
Other investment costs	44'640.00	6%	6'746.66	40.02	34.07	5.82	4.95	0.20	0.20
TOTAL CONTINGENCIES COSTS	130'839.00	18%	19'774.33	117.29	99.87	17.04	14.51	0.58	0.58
Incidental costs	130'839.00	18%	19'774.33	117.29	99.87	17.04	14.51	0.58	0.58
TOTAL MAINTENANCE COSTS	47'972.63	7%	7'250.34	43.00	36.62	6.25	5.32	0.21	0.21
Local Materials	14'054.72	2%	2'124.16	12.60	10.73	1.83	1.56	0.06	0.06
Imported Materials	-	0%	-	-	-	-	-	-	-
Local Equipments	-	0%	-	-	-	-	-	-	-
Imported Equipments	-	0%	-	-	-	-	-	-	-
Labour	33'917.91	5%	5'126.18	30.41	25.89	4.42	3.76	0.15	0.15
TOTAL OPERATION COSTS	14'300.14	2%	2'161.25	12.82	10.92	1.86	1.59	0.06	0.06
Local Materials	-	0%	-	-	-	-	-	-	-
Imported Materials	-	0%	-	-	-	-	-	-	-
Local Power Services	-	0%	-	-	-	-	-	-	-
Imported Power Services	-	0%	-	-	-	-	-	-	-
Labour	14'300.14	2%	2'161.25	12.82	10.92	1.86	1.59	0.06	0.06
TOTAL OTHER RELEVANT COSTS	172'768.30	24%	26'111.31	154.88	131.88	22.51	19.16	0.77	0.77
Administration	172'768.30	24%	26'111.31	154.88	131.88	22.51	19.16	0.77	0.77
Training	-	0%	-	-	-	-	-	-	-
Promotion & Education	-	0%	-	-	-	-	-	-	-
Total	726'235	100%	109'759	651	554	95	81	3.22	3.22

Project Data / Data comp.&shadow factors / Scenario / GraphScenario_inh / GraphScenario_h / GraphScenario_l/inh / Summary / Summary Collect

Thanks for your attention

