

SIMUS

EXAMPLE ANALYSIS FOR GHANA

TITLE : COMMUNITY INFRASTRUCTURE UPGRADING FOR GHANA

BACKGROUND INFORMATION

SIMUS (Sequential Interactive Model for Urban Sustainability) is applied here to determine which urban settlement should be upgraded considering a series of restrictions.

Essentially, the model makes a selection of urban areas with the objective of providing the benefits of water and sewage to the maximum number of people and at the lowest costs

- * It is analyzed here the provision of basic infrastructure, i.e. drinking water and sanitation, as well as electricity, to African communities which do not have these services
- * Conditions vary from one urban area to another. For instance the cost of providing these services per hectare can show a large variation.
- * Priorities have also been established based on certain activities in some areas. As an example there is an urban center which is an important hub to automotive and agriculture machinery repairs.
- * Financing comes from the World Bank. Population willingness and capacity to pay are specially considered in this example, as well as limits for hectare investment for upgrading, and limits for per capita payments.
- * Five urban centers with different sizes are assumed.
- * Some data has been taken from the World Bank publication:
" Toward a National Community Infrastructure Upgrading Program for Ghana "

OBJECTIVE:

Maximize number of people taking advantage of infrastructure upgrading

Decision variables

Annual interest rate:	0.04
Period of repayment in years:	5
Density in persons per hectare:	470
Maximum total payment per capita:	51

DATA

AREA 1: Accra

Cost of upgrading (\$/ha)	16,400					
Maximum cost for upgrading (\$/ha)	18,860					
Min. number of hectares to be developed	26					
Max. number of hectares to be developed	35					
Density (persons/hectare)	427					
Total population in the area	14,945					
Maximum total investment (US\$)	574,000					
Ability to pay (US\$/month-person)	0.72					
Annual interest rate:	0.04					
Cost per capita (\$)	43					
Annual payment per hectare (\$/hectare)	3,684					
	Years:	1	2	3	4	5
Cashflow (investment, annual payments), per hectare	-16,400	3,684	3,684	3,684	3,684	3,684
	NPV	0				

AREA 2: Sekondi-Takoradi

Cost of upgrading (\$/ha)	20,500					
<i>Maximum cost for upgrading (\$/ha)</i>						
Min. number of hectares to be developed	54					
Max. number of hectares to be developed	72					
Density (persons/hectare)	450					
Total population in the area	32,400					
Maximum total investment (US\$)	1,476,000					
Ability to pay (US\$/month-person)	0.85					
Annual interest rate:	0.04					
Cost per capita (\$)	51					
Annual payment per hectare (\$/hectare)	4,605					
	Years:	1	2	3	4	5
Cashflow (investment, annual payments), per hectare	-20,500	4,605	4,605	4,605	4,605	4,605
	NPV	0				

AREA 3: Kumasi

Cost of upgrading (\$/ha)	17,800					
<i>Maximum cost for upgrading (\$/ha)</i>	20,470					
Min. number of hectares to be developed	71					
Max. number of hectares to be developed	94					
Density (persons/hectare)	396					
Total population in the area	37,224					
Maximum total investment (US\$)	1,673,200					
Ability to pay (US\$/month-person)	0.84					
Annual interest rate:	0.04					
Cost per capita (\$)	50					
Annual payment per hectare (\$/hectare)	3,998					
	Years:	1	2	3	4	5
Cashflow (investment, annual payments), per hectare	-17,800	3,998	3,998	3,998	3,998	3,998
	NPV	0				

AREA 4: Tema

Cost of upgrading (\$/ha)	21,000	21,000	21,000	21,000	21,000	
<i>Maximum cost for upgrading (\$/ha)</i>						
Min. number of hectares to be developed	32					
Max. number of hectares to be developed	42					
Density (persons/hectare)	517					
Total population in the area	21,714					
Maximum total investment (US\$)	882,000					
Ability to pay (US\$/month-person)	0.76					
Annual interest rate:	0.04					
Cost per capita (\$)	46					
Annual payment per hectare (\$/hectare)	4,717					
	Years:	1	2	3	4	5
Cashflow (investment, annual payments), per hectare	-21,000	4,717	4,717	4,717	4,717	4,717
	NPV	0				

AREA 5: Tamale

Cost of upgrading (\$/ha)	22,500	22,500	22,500	22,500	22,500	
<i>Maximum cost for upgrading (\$/ha)</i>						
Min. number of hectares to be developed	53					
Max. number of hectares to be developed	70					
Density (persons/hectare)	512					
Total population in the area	35,840					
Maximum total investment (US\$)	1,575,000					
Ability to pay (US\$/month-person)	0.82					
Annual interest rate:	0.04					
Cost per capita (\$)	49					
Annual payment per hectare (\$/hectare)	5,054					
	Years:	1	2	3	4	5
Cashflow (investment, annual payments), per hectare	-22,500	5,054	5,054	5,054	5,054	5,054
NPV	0					

SOLVING USING SIMUS

	Urban areas:	Accra	Sekondi - Takoradi	Kumasi	Tema	Tamale		Restrictions & Availabilities	
Density:		427	450	396	517	512			
Ability to pay (annuity):		3,684	4,605	3,998	4,717	5,054			
Weight according to infrastructure efficiency:		5,000	5,000	9,000	6,000	7,000			
Attributes:	Units:								
Max hectares in Accra	Hectares	1					35	< 35	
Min hectares in Accra		1					35	> 26	
Max hec in Sekondi-Takoradi	Hectares		1				72	< 72	
Min hec in Sekondi-Takoradi			1				72	> 54	
Max hectares in Kumasi	Hectares			1			94	< 94	
Min hectares in Kumasi				1			94	> 71	
Max hectares in Tema	Hectares				1		38	< 42	
Min hectares in Tema					1		38	> 32	
Max hectares in Tamale	Hectares					1	64	< 70	
Min hectares in Tamale						1	64	> 53	
Total cost in Accra	US\$	1					##	< 574,000	
Total cost in Sekondi-Takoradi	US\$		1				##	< 1,476,000	
Total cost in Kumasi	US\$			1			##	< 1,673,200	
Total cost in Tema	US\$				1		##	< 882,000	
Total cost in Tamale	US\$					1	##	< 1,575,000	
Percapita cost in Accra	US\$/hect.	1					43	< 51	
Percap. cost in Sekondi-Takoradi	US\$/hect.		1				51	< 51	
Percapita cost in Kumasi	US\$/hect.			1			50	< 51	
Percapita cost in Tema	US\$/hect.				1		41	< 51	
Percapita cost in Tamale	US\$/hect.					1	45	< 51	
Population density in Accra	People/hect.	427					##	< 16,450	
Pop. dens. in Sekondi-Takoradi	People/hect.		450				##	< 33,840	
Population density in Kumasi	People/hect.			396			##	< 44,180	
Population density in Tema	People/hect.				517		##	< 19,740	
Population density in Tamale	People/hect.					512	##	< 32,900	
Total funds available this period	US\$	1	1	1	1	1	##	< 6,180,200	

RESULTS

Urban areas:	Accra	Sekondi - Takoradi	Kumasi	Tema	Tamale	Total:
Hectares to be developed:	35	72	94	38	64	303
Total number of people :	14,945	32,295	37,224	19,740	32,900	137,104
Total cost:	574,000	1,471,238	1,673,200	801,818	1,445,801	5,966,057
Number of hectares available:						313
Number of hectares assigned:						303
Land use efficiency:						0.97

OBJECTIVES: Choose one
and replace
in

objective cell:
Max. # of people 137,104
Maximize
ability-to-pay: 6,700,691